BUDGET JUSTIFICATIONS

The United States
Department of the Interior

and Performance Information
Fiscal Year 2014

U.S. GEOLOGICAL SURVEY

NOTICE: These budget justifications are prepared for the Interior, Environment and Related Agencies Appropriations Subcommittees. Approval for release of the justifications prior to their printing in the public record of the Subcommittee hearings may be obtained through the Office of Budget of the Department of the Interior.

U.S. GEOLOGICAL SURVEY
FY 2014 BUDGET JUSTIFICATION

References to the *2013 Full Yr. CR* signify annualized amounts appropriated in P.L. 112-175, the Continuing Appropriations Act. These amounts are the 2012 enacted numbers annualized through the end of FY 2013 with a 0.612 percent across-the-board increase for discretionary programs. Exceptions to this include Wildland Fire Management, which received an anomaly in the 2013 CR to fund annual operations at $726.5 million. The *2013 Full Yr. CR* does not incorporate reductions associated with the Presidential sequestration order issued in accordance with section 251A of the Balanced Budget and Emergency Deficit Control Act, as amended (BBEDCA), 2 U.S.C. 109a. This column is provided for reference only.

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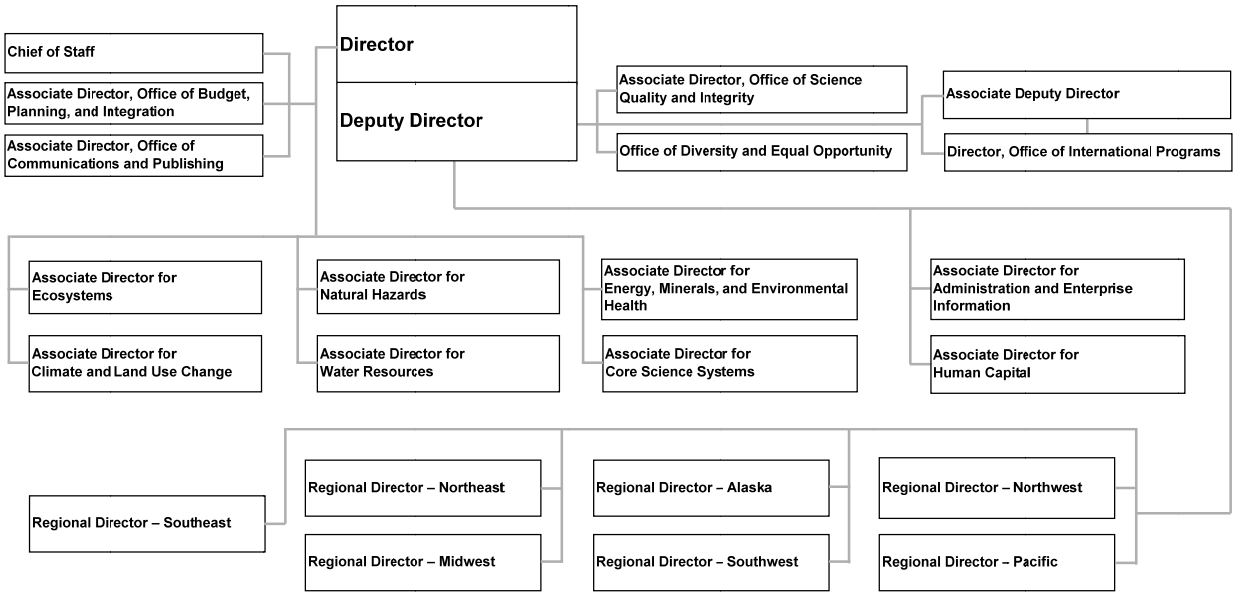
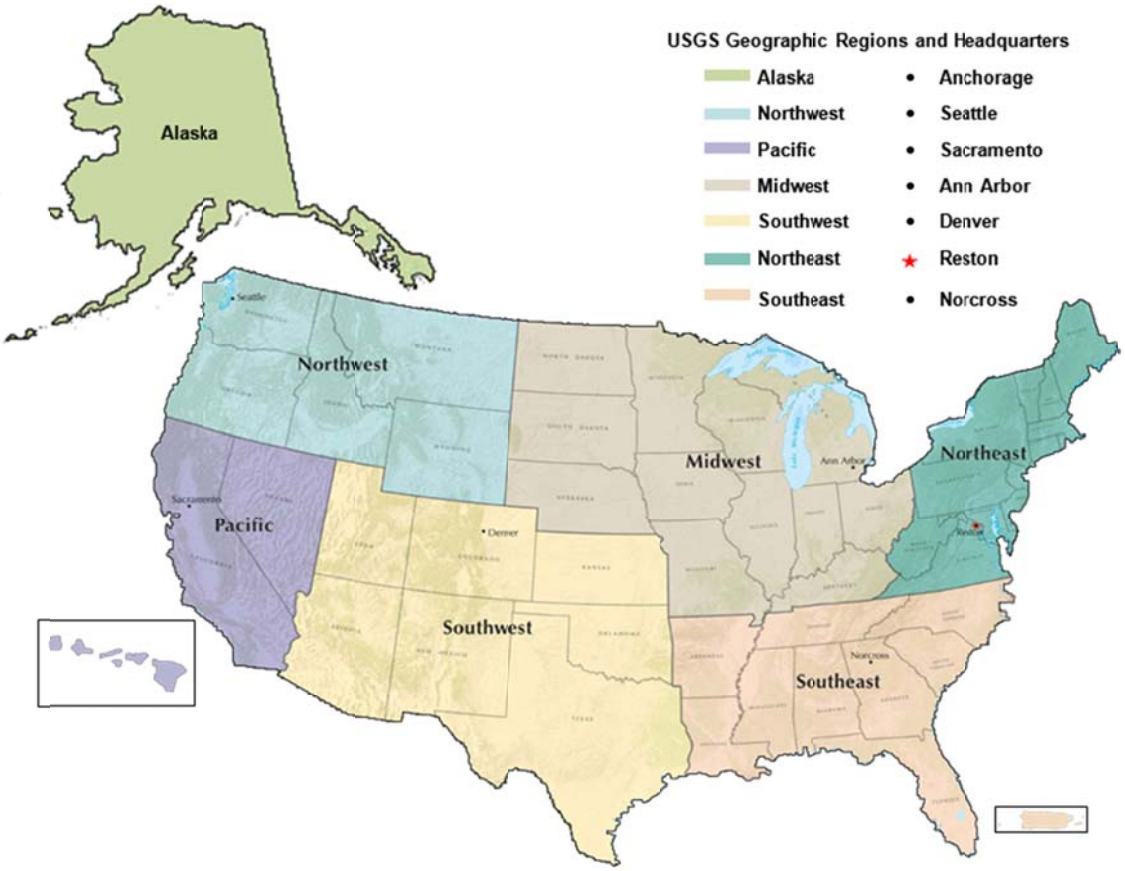
U.S. Geological Survey



USGS Regional Structure



Alphabetical List of Acronyms

AAAS	American Association for the Advancement of Science
AAPG	American Association of Petroleum Geologists
ABC	Activity-Based Costing
ABC/M	Activity-Based Costing/Management
ABP	Asset Business Plan
ACCNRS	Advisory Committee on Climate Change and Natural Resources Science
ACES	Achieving Cost Efficiencies for Science
ACI	American Competitive Initiative
ACP	Arctic Coastal Plain
ACWI	Advisory Committee on Water Information
ADA	Americans with Disabilities Act
AEI	Administration and Enterprise Information
AFS	American Fisheries Society
AFWA	U.S. Air Force Weather Agency
AMD	Aviation Management Directorate
AMP	Asset Management Plan
AMWG	Adaptive Management Work Group
ANS	Alaska North Slope
ANS	Aquatic Nuisance Species (Ecosystems)
ANSS	Advanced National Seismic System
ANWR	Arctic National Wildlife Refuge
APHIS	Department of Agriculture Animal and Plant Health Inspection Service
API	Asset Priority Index
AR	Accounts Receivable
AR5	5th Assessment Report
ARMI	Amphibian Research and Monitoring Initiative
ARRA	American Recovery and Reinvestment Act
ASC	Alaska Science Center
ASIWPCA	Association of State and Interstate Water Pollution Control Administrators
AVHRR	Advanced Very High Resolution Radiometer
AVO	Alaska Volcano Observatory
AWiFS	Advanced Wide Field Sensor
BASIS+	Budget and Science Information System
BBL	Bird Banding Laboratory
BBS	Bird Breeding Survey
BEN	Balkan Endemic Nephropathy
BT	Budget Team
BGN	Board of Geographic Names
BIA	Bureau of Indian Affairs
BIMD	Biological Information Management and Delivery
BIP	Biological Informatics Program (Equivalent to BMID)
BIS	Commerce - Bureau of Industry and Security
BLM	Bureau of Land Management
BLT	Business Leaders Team
BMPs	Best Management Practices
BNP	Biscayne National Park
BOR	Bureau of Reclamation
BPA	Blank Purchase Agreement

BPC	Bureau Program Council
BPI	USGS Office of Budget, Planning, and Integration
BPXA	BP Exploration (Alaska)
BSR	Business Strategy Review
CA	Condition Assessment
CAC	Civil Applications Committee
CALFED	California Federal (Bay-Delta Authority program)
CAP	Cooperative Agreements Program
CARA	Circum-Arctic Resource Appraisal
C&A	Certification and Accreditation
CC	Cost Center
CBERS	China/Brazil Earth Resources Satellite
CBLCM	Chesapeake Bay Land Cover Management
CBM	Coal bed Methane
CBP	Chesapeake Bay Program
CCI	Collaborative Communications Infrastructure
CCOAT	Coast Chesapeake Online Assessment Tool
CCSP	U.S. Climate Change Science Program
CDC	Centers for Disease Control and Prevention
CDR	Critical Design Review (Climate and Land Use)
CDR	Climate Data Record (Climate and Land Use)
CDI	Council for Data Integration
CEN	Climate Effects Network
CENR	Committee on Environment and Natural Resources
CEAP	Conservation Effects Assessment Project
CEGIS	Center of Excellence for Geographic Information Science
CEOS	Committee on Earth Observation Satellites
CEQ/NSTC	Council on Environmental Quality/National Science and Technology Council
CERC	Columbia Environmental Research Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERP	Comprehensive Everglades Restoration Plan
CESU	Cooperative Ecosystems Study Unit
CFO	Chief Financial Officer
CIO	Chief Information Officer
CISN	California Integrated Seismic Network
CITES	Conventional on International Trade in Endangered Species
CLU	Climate and Land Use Change
CMG	Coastal and Marine Geology
CMGP	Coastal and Marine Geology Program
CMSP	Coastal and Marine Spatial Planning
CNS	Central portion of the North Slope
CO_2	Carbon Dioxide
COAST	Chesapeake Online Adaptive Support Toolkit
CoML	U.S. National Committee for the Census of Marine Life
CORE	Committee on Resource Evaluation
CPIC	Capital Planning and Investment Control
CR	Central Region
CRADA	Cooperative Research and Development Agreement
CRSSP	Commercial Remote Sensing Space Policy
CRTF	Coral Reef Task Force

CRU	Cooperative Research Units
CRUISE	Columbia River USGS Integrated Science Explorer
CRV	Current Replacement Value
CRWA	Charles River Watershed Association
CSC	Climate Science Center
CSI	Core Science Informatics
CSIP	Cost Savings and Innovation Plan
CSIRC	Computer Security Incident Response Capability
CSMP	California Seafloor Mapping Program
CSRS	Civil Service Retirement System
CSS	Core Science Systems
CTBTO	Comprehensive Test Ban Treaty Organization
CUES	Comprehensive Urban Ecosystems Studies
CUSEC	Central United States Earthquake Consortium
CVJV	Central Habitat Joint Venture
CVO	Cascades Volcano Observatory
CWD	Chronic Wasting Disease
CWP	Cooperative Water Program
CWS	Canadian Wildlife Service
DCIA	Debt Collection Improvement Act
DEM	Digital Elevation Model
DEP	[State] Department of Environmental Protection
DEQ	[State] Department of Environmental Quality
DFRs	Departmental Functional Reviews
DGH	Indian Directorate General of Hydrocarbons
DHS	Department of Homeland Security
DiGIR	Distributed Generic Information Retrieval
DMC	Data Management Center
DMC	Disaster Monitoring Constellation
DMCI	Deferred Maintenance and Capital Improvements
DNR	Department of Natural Resources
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOGAMI	Oregon Department of Geology and Mineral Industries
DPAS	Data Processing and Archiving
DRAGON	Delta Research and Global Observation Network
DROT	Drift River Oil Terminal
DRTO	Dry Tortugas National Park
DWH	Deepwater Horizon
DSS	Decision Support System
EA	Enterprise Architecture
EAD	Enterprise Active Directory
EAL	Energy Analytical Laboratory
ECMs	Energy Conservation Measures
ECO	Energy Conserving Opportunities
ECS	[U.S.] Extended Continental Shelf
ECV	Essential Climate Variable
EDCs	Endocrine Disrupting Chemicals
EDEN	Everglades Depth Estimation Network
EDMAP	Education Mapping Program (in National Cooperative Geologic Mapping Program)

EDRR	Early Detection, Rapid Assessment and Response
EEOC	Equal Employment Opportunity Commission
EFT	Electronic Funds Transfer
EGIM	Enterprise Geographic Information Management
EGS	Enhanced Geothermal Systems
EHP	Earthquake Hazards Program (Hazards Program)
EHP	Enterprise Hosting Platform (AEI)
EI	Enterprise Information
EIR	Enterprise Information Resources
EISA	Energy Independence and Security Act of 2007
EIS&T	Enterprise Information Security and Technology
ELA	Enterprise License Agreement
ELT	Executive Leadership Team
EMS	Environmental Management System
E.O.	Executive Order
EOL	Encyclopedia of Life
EOP	Executive Office of the President
EOR	Enhanced Oil/Gas Recovery
EPA	U.S. Environmental Protection Agency
EPCA	Energy Policy and Conservation Act of 2000
EPM	Ecosystem Portfolio Model
ER	Eastern Region
ERA	E-Risk Assessment
ERAS	eRemote Access Services
EROS	Earth Resources Observation and Science Center
ERP	Energy Resources Program
ESD	Earth Surface Dynamics
ESI	Environmental Sensitivity Index
ESN	Enterprise Services Network
ESPC	Energy Savings Performance Contract
ESRI	Environmental Systems Research Institute
ET	Evapotranspiration
ETM+	Enhanced Thematic Mapper Plus
EVMS	Earned Value Management System
EWeb	Enterprise Web
FAA	Federal Aviation Administration
FAC	Federal Advisory Committee
FACA	Federal Advisory Committee Act
FAER	Fisheries: Aquatic and Endangered Resources
FASAB	Federal Accounting Standards Advisory Board
FBAT	Facilities Budget Allocation Team
FBMS	Financial Business Management System
FBWT	Fund Balance with Treasury
FCI	Facilities Condition Index
FEA	Federal Enterprise Architecture
FECA	Federal Employee Compensation Act
FEDMAP	Federal Lands Mapping Program (in National Cooperative Geologic Mapping Program)
FEGLI	Federal Employees Group Life Insurance
FEHB	Federal Employees Health Benefit
FEMA	Federal Emergency Management Agency

FERC	Federal Energy Regulatory Commission
FERS	Federal Employees Retirement System
FFMIA	Federal Financial Management Improvement Act of 1996
FFS	Fire and Fire Surrogate
FGDC	Federal Geographic Data Committee
FICA	Federal Insurance Contributions Act
FICMNEW	Federal Interagency Committee for the Management of Noxious and Exotic Weeds
FISC	Florida Integrated Science Center
FISMA	Federal Information Security Management Act
FMT	Field Managers Team
FMFIA	Federal Managers' Financial Integrity Act of 1982
FMMS	Facilities Maintenance Management System
FOS	Flight Operations Segment
FOT	Flight Operations Team
FRAMES	Fire Research and Management Exchange System
FRB	Federal Reserve Board
FRPC	Federal Real Property Council
FRPP	Federal Real Property Profile
FSA	Farm Service Agency
FSAM	Federal Segment Architecture Methodology
FSP	Fundamental Science Practice
FTE	Full-Time Equivalent
FWS	U.S. Fish and Wildlife Service
GAAP	Generally Accepted Accounting Principles
GAM	Geographic Analysis and Monitoring Program
GAP	Gap Analysis Program
GAO	Government Accountability Office
GBIP	Great Basin Information Project
GBIS	Global Biodiversity Information Facility
GCDAMP	Glen Canyon Dam Adaptive Management Program
GC-IMS	Global Change-Information Management System
GCP	Global Change Program
GCMRC	Grand Canyon Monitoring and Research Center
GEO	Group on Earth Observations
GEODE	GEO-Data Explorer
GeoMAC	Geospatial Multi-Agency Coordination Group
GEOMAG	Geomagnetism Program
GEOSS	Global Earth Observation System of Systems
GFDL	Geophysical Fluid Dynamics Laboratory
GFL	Global Fiducials Library
GHG	Greenhouse Gas
GIRT	Geospatial Information Response Team
GIS	Geographic Information System
GLS	Global Land Survey
GLSC	Great Lakes Science Center
GNIS	Geographic Names Information System
GOES	Geostationary Operational Environmental Satellites
GOS	Geospatial One-Stop
GPRA	Government Performance and Results Act
GRB	Green River Basin

GHG	Greenhouse Gas
GPS	Global Positioning System
GPSC	Geospatial Products and Services Contract
GSA	General Services Administration
GS-FLOW	Groundwater and Surface-water flow model
GSN	Global Seismographic Network
GWRP	Ground-Water Resources Program
HAZUS	Federal Emergency Management Agency's Earthquake Loss Estimation Program
HBN	USGS Hydrologic Benchmark Network
HDOA	Hawaii Department of Agriculture
HDR	High-Data Rate Radio
HEDDS	Highly Pathogenic Avian Influenza Early Detection Data System
HDDS	Hazards Data Distribution System
HHS	Department of Health and Human Services
HIF	Hydrologic Instrumentation Facility
HLI	Healthy Lands Initiative
HNA	Hydrologic Networks and Analysis Program
HPO	High Performing Organization
HPPG	High Priority Performance Goal
HR	Human Resources
HR&D	Hydrologic Research and Development Program
HRS	Helibourne electromagnetic Surveys
HSPD -12	Homeland Security Presidential Directive 12
HUB	Historically Underutilized Business
HUD	US Department of Housing and Urban Development
HVO	Hawaii Volcano Observatory
HWATT	Hemlock Woolly Adelgid Action Team
I&M	Inventory and Monitoring – NPS
IAGA	International Association of Geomagnetism and Aeronomy
ICAO	International Civil Authorization Organization
ICL	International Consortium on Landslides
ICRP	Internal Control Review Plan
ICWP	Interstate Council on Water Policy
IDWR	Idaho Department of Water Resources
IEAM	Integrated Environmental Assessment and Management
IGPP	Institute for Geophysics and Planetary Physics
IIE	Integrated Information Environment
ILM	Integrated Landscape Monitoring
IOOS	Integrated Ocean and coastal Observing System
IP	Investment Plan
IPCC	Intergovernmental Panel on Climate Change
IPDS	Information Product Data System
IRB	Investment Review Board
IRIS	Incorporated Research Institutions for Seismology
IRS	Indian Remote Sensing Satellite
InSAR	Interferometric Synthetic Aperture Radar
ISO	International Organization for Standardization
ISSP	Information Security Strategic Plan
IT	Information Technology
ITAP	Invasive Terrestrial Animals and Plants

ITILOB	Information Technology Infrastructure Line of Business
ITIS	Integrated Taxonomic Information System
ITSOT	IT Security Operations Team
ITSSC	IT Security Steering Committee
ITT	Information Technology Transformation
IUCN	International Union for the Conservation of Nature
IUCN	International Union of Conservation Nations
JFA	Joint Funding Agreement
JV	Joint Venture Partnerships
KSF	Thousand Square Feet
LAS	Local Action Strategy
LCAT	Land Cover Analysis Tool
LCC	Landscape Conservation Cooperatives
LCS	Land Change Science Program
LDCM	Landsat Data Continuity Mission
LDGST	Landsat Data GAP Study Team
LEAG	Long-term Estuary Assessment Group
LHP	Landslide Hazards Program
LiDAR	Light Detecting and Ranging
LIFE	NBII Library of Images from the Environment
LIMA	Landsat Image Mosaic of Antarctica
LMV	Lower Mississippi Valley
LMVJV	Lower Mississippi Valley Joint Venture Office
LOA	Level of Authentication
LRS	Land Remote Sensing
LSC	Leetown Science Center
LST	Landsat Science Team
LTRMP	Long-Term Resource Monitoring Program
LTWG	Landsat Technical Working Group
LUPM	Land Use Portfolio Model
MARCO	Mid-Atlantic Research Consortium for Oceanography
MBTU	Million British thermal units
MD	Management Directive
MEO	Most Effective Organization
METRIC	Mapping EvapoTranspiration with high Resolution and Internalized Calibration
MHDP	Multi-Hazards Demonstration Project
MMS	Minerals Management Service
MOA	Memorandum of Agreement
MOC	Mission Operations Center
MODIS	Moderate Resolution Imaging Spectroradiometer
MODFLOW	Modular Ground-Water Flow Model
MOU	Memorandum of Understanding
MRBI	Mississippi River Basin Healthy Watersheds Initiative
MRDS	Mineral Resources Data System
MRERP	Mineral Resources External Research Program
MRLC	Multi-Resolution Land Characteristics Consortium
MRP	Mineral Resources Program
MSCP	Multi-Species Conservation Program
MSH	Mount St. Helens
MSS	Multi Spectral Scanner

MTBE	Methyl Tert-Butyl Ether
MTBS	Monitoring Trends in Burn Severity
MUSIC	MIT-USGS Science Impact Collaborative
MW	Megawatt
MWE	Megawatt electric
NABCI	North American Bird Conservation Initiative
NACO	National Association of Counties
NADP	National Atmospheric Deposition Program
NAGT	National Association of Geoscience Teachers
NANPCA	Non-indigenous Aquatic Nuisance Prevention and Control Act
NARA	National Archives and Records Administration
NAS	National Academy of Sciences (Core Science)
NAS	USGS National Non-indigenous Aquatic Species Database (Ecosystems)
NASA	National Aeronautics and Space Administration
NASQAN	National Stream Quality Accounting Network
NatWeb	National Web Server System
NAWQA	National Water-Quality Assessment
NBC	Department of the Interior – National Business Center
NBII	National Biological Information Infrastructure
NCA	National Climate Assessment
NCAR	National Center for Atmospheric Research
NCAP	National Civil Applications Program
NCCWSC	National Climate Change and Wildlife Science Center
NCDE	Northern Continental Divide Ecosystem
NCEP/NOAA	National Centers for Environmental Prediction
NCGMP	National Cooperative Geologic Mapping Program
NCIA	National Competitiveness Investment Act
NCPP	USGS National Coastal Program Plan
NCRDS	National Coal Resources Data System
NDMC	National Drought Mitigation Center
NDOP	National Digital Orthoimagery Program
NED	National Elevation Dataset
NEHRP	National Earthquake Hazards Reduction Program
NEIC	National Earthquake Information Center
NEON	National Ecological Observatory Network
NEPA	National Environmental Policy Act
NEST	National Environmental Status and Trends
NETL	National Energy Technology Laboratory
NFHAP	National Fish Habitat Action Plan
NGA	National Geospatial-Intelligence Agency
NGAC	National Geospatial Advisory Committee
NGGDPP	National Geological and Geophysical Data Preservation Program
NGIC	National Geomagnetic Information Center
NGMA	National Geologic Mapping Act
NGMDP	National Geologic Map Database Project
NGO	Nongovernmental organization
NGP	National Geospatial Program
NGWMN	National Ground Water Monitoring Network
NHD	National Hydrography Dataset
NHWC	National Hydrologic Warning Council

NIEHS	National Institute of Environmental Health Sciences
NIFC	National Interagency Fire Center
NIH	National Institute of Health
NISC	National Invasive Species Council
NIISS	National Institute for Invasive Species Science
NISMP	National Invasive Species Management Plan
NIST	National Institute of Standards and Technology
NIWR	National Institutes for Water Resources
NLC	National League of Cities
NLCD	National Land Cover Database
NLlC	National Landslide Information Center
NLIP	National Land Imaging Program
NOAA	National Oceanic and Atmospheric Administration
NORAD	North American Aerospace Defense Command
NORTHCOM	U.S. Northern Command
NOSC	National Operations and Security Center
NPN	National Phenology Network
NPRA	National Petroleum Reserve Alaska
NPS	National Park Service
NRDA	Natural Resource Damage Assessment
NRIS	Natural Resource Information System
NRC	National Research Council (United States National Academies)
NRC	Nuclear Regulatory Commission (United States NRC)
NRCS	Natural Resources Conservation Service
NRMP	National Resource Monitoring Partnership
NROC	Northeast Regional Ocean Council
NRP	National Research Program (research organization in USGS Water Resources)
NRPP	National Resource Preservation Program
NSDI	National Spatial Data Infrastructure
NSF	National Science Foundation
NSGIC	National States Geographic Information Council
NSIP	National Streamflow Information Program
NSLRSDA	National Satellite Land Remote Sensing Data Archive
NSMP	National Strong Motion Program
NSPD	National Space Policy
NSTC	National Science and Technology Council
NSVRC	Northern Shenandoah Valley Regional Commission
NTN	National Trends Network
NVCS	National Vegetation Classification Standard
NVEWS	National Volcano Early Warning System
NWAVU	National Water Availability and Use Assessment
NWHC	National Wildlife Health Center
NWIS	National Water Information System
NWQL	National Water Quality Laboratory
NWQMN	National Water Quality Monitoring Network
NWRC	National Wetlands Research Center
NWS	National Weather Service
O&M	Operations and Maintenance
OAEI	Office of Administration and Enterprise Information
OAFM	USGS Office of Accounting and Financial Management

OAG	USGS Office of Acquisition and Grants
OAP	Ocean Action Plan
OBIS	Ocean Biogeographic Information System
OBIS	USGS Office of Business Information Systems, (AEI)
OCAP	USGS Office of Communication and Publications
OED	Office of Employee Development
OEPC	Office of Environmental Policy and Compliance
OES	Office of Emergency Services
OFDA	Office of Foreign Disaster Assistance
OFEE	Office of the Federal Environmental Executive
OFR	Open-File Report
OGC	Open Geospatial Consortium
OHC	USGS Office of Human Capital
OIA	Office of Insular Affairs
OICR	USGS Office of Internal Control and Reporting
OIG	Office of the Inspector General
OGDB	Organic Geochemistry Database
OLI	Operational Land Imager
OMB	Office of Management and Budget
OMS	USGS Office of Management Services
OPA	USGS Office of Policy and Analysis
OPM	Office of Personnel Management
ORPP	Ocean Research Priority Plan
ORPPIS	Ocean Research and Priorities Plan and Implementation Strategy
OSHA	Occupational Safety and Health Administration
OSM	Office of Surface Mining
OSQI	Office of Science Quality and Integrity
OSTP	Office of Science and Technology Policy
OWRS	Office of Western Regional Services
PAGER	Prompt Assessment of Global Earthquakes for Response
PBO	Plate Boundary Observatory
PBX	Private Branch Exchange
PCR	Polymerase Chain Reaction
PDA	Personal Digital Assistant
PDF	Portable Document Format
PDR	Preliminary Design Review
PES	Priority Ecosystem Science
PFM	(Department) Office of Financial Management
PI	Principal Investigator
PII	Personally Identifiable Information
PIP	Performance Improvement Plan
PIP	Program Improvement Plan
PMO	Project Management Office
PNAMP	Pacific Northwest Aquatic Monitoring Partnership
POA&M	Plan of Action and Milestone
PP&E	Property, Plant, and Equipment
PRB	Powder River Basin
PSNER	Puget Sound Near Shore Ecosystem Restoration
PSS	Perimeter Security Standard
PTWC	Pacific Tsunami Warning Center

PWRC	Patuxent Wildlife Research Center
QOL	Quality of Life
R&D	Research and Development
RASA	Regional Aquifer-System Analysis
RCM	Regional Climate Models
RCOOS	Regional Coastal Ocean Observing Systems
REE	Rare Earth Elements
REMS	River Ecosystem and Modeling Science
RFP	Request for Proposal
RGIO	Regional Geospatial Information Office®
RIF	Reduction in Force
RIM	River Input Monitoring Program
RISA	Regional Integrated Science and Assessments – NOAA
RPM	Real Property Management System
RSAC	Remote Sensing Application Center
RSSI	Required Supplementary Stewardship Information
RTS	Reports Tracking System (Water Resources)
R/V	Research Vessel
RWRPC	Regional Water Resources Policy Committee
S&T	USGS Status and Trends Program
SAC	Stakeholder advisory Committee (Climate and Land use)
SAC	USGS Science Advisory Council
SAFOD	San Andreas Fault Observatory at Depth
SAFRR	Science Application for Risk Reduction
SAIN	Southern Appalachian Information Node
SAP	Synthesis and Assessment Product
SAR	Synthetic Aperture Radar
SAUS	Storage Assessment Units
SBFD	San Francisco Bay and freshwater delta
SBSP	South Bay Salt Pond Restoration Project
SCEC	Southern California Earthquake Center
SCR	System Concept Review
SDI	Spatial Data Infrastructures
SDR	Subcommittee for Disaster Reductions
SDRT	Supervisory Development Review Team
SES	Senior Executive Service
SETAC	Society of Environmental Toxicology and Chemistry
SFBD	San Francisco Bay Delta
SFMP	Strategic Facilities Master Plan
SFWMD	South Florida Water Management District
SHC	Strategic Habitat Conservation
SLC	Scan Line Corrector
SGL	Standard General Ledger
SIR	Surveys, Investigations, and Research
SOGW	Subcommittee of Ground Water
SoIVES	Social Values for Ecosystem Services
SOW	Statement of Work
SPARROW	Spatially Referenced Regressions on Watershed Attributes
SPN	Scientific Publishing Network
SPOC	Security Point of Contact

SPOT	Satellite Pour L'Observation de la Terre
SPRESO	South Pole Remote Earth Science Observatory
SRR	Systems Requirement Review
SRTM	Shuttle Radar Topographic Mission
SSRIs	Selective Seronin Reuptake Inhibitors
STATEMAP	State Mapping Program (in Cooperative Geologic Mapping Program)
STEM	Science, Technology, Engineering and Mathematics
STIG	Security Technical Implementation Guides
SWPC	Space Weather Prediction Center
TAA	Technical Assistance Agreements
TANC	Transport of Anthropogenic and Natural Contaminants
TCOM	Tahoe Constrained Optimization Model
TDWG	Biodiversity Information Standards
TIC	Trusted Internet Connection
TIRS	Thermal Infrared Sensor
TM	Thematic Mapper
TMDL	Total Maximum Daily Loads (Clean Water Act requirement)
TRIGRS	Transient Rainfall Infiltration and Grid-Based Regional Slope-Stability Analysis
TRIP	The Road Indicator Project
TROR	Treasury Report on Receivables
TRPA	Tahoe Regional Planning Agency
TSP	Thrift Savings Plan
UAS	Unmanned Aircraft Systems
UHM	University of Hawaii-Manoa
UIC	Underground Injection Control
URISA	Urban and Regional Information System Association
U.S.	United States
USACE	U.S. Army Corps of Engineers
USAID	U.S. Agency for International Development
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USDOE	U.S. Department of Energy
USFS	U.S. Forest Service
USGCRP	U.S. Global Change Research Program
USGEO	U.S. Group on Earth Observations
USGS	U.S. Geological Survey
UMESC	Upper Midwest Environmental Services Center
USNG	United States Nation Grid
VANS	Volcano Activity Notices
VBNS	Very Broadband Network Services
VCP	Vegetation Characterization Program
VDAP	Volcano Disaster Assistance Program
Veg	Vegetation Characterization
VegDRI	Vegetation Drought Response Index
VHP	Volcano Hazards Program
VHSV	Viral Hemorrhagic Septicemia Virus
VOIP	Voice over IP Systems
VONA	Volcano Observatory Notifications for Aviation
VSIP/VERA	Voluntary Separation Incentive Payment/Voluntary Early Retirement Authority
VTC	Video Teleconferencing

WAN	Wide Area Network
WCCI	Wyoming Cooperative Conservation Initiative
WCF	Working Capital Fund
WCMC	UNEP-World Conservation Monitoring Center
WERC	Western Ecological Research Center
WFRC	Western Fisheries Research Center
WLAN	Wide Local Area Network
WLCI	Wyoming Landscape Conservation Initiative
WNS	White-Nose Syndrome
WNV	West Nile Virus
WPA	World Petroleum Assessment 2000
WR	Western Region
WRD	Water Resources discipline (formerly Water Resources Division)
WRIR	Water Resources Investigation Report
WRRA	Water Resources Research Act
WRRIs	[State] Water Resources Research Institutes
WSC	[USGS State] Water Science Center
WSWC	Western States Water Council
WTER	Wildlife: Terrestrial and Endangered Resources
WUI	Wildland-Urban Interface
YMP	Yucca Mountain Program
YVO	Yellowstone Volcano Observatory

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General Statement

Total 2014 Budget Request

(Dollars in Thousands)

Budget Authority	*2013 Full Yr. CR (PL 112-175)*	2012 Enacted	2014 Budget Request	Inc (+)/Dec (-) from 2012
Discretionary	*1,074,568*	1,068,032	1,166,855	98,823
Mandatory	*1,162*	857	1,123	266
Total	***1,075,730***	**1,068,889**	**1,167,978**	**99,089**
FTE	*8,554*	8,546	8,646	100

FTE	*2013 Full Yr. CR (PL 112-175)*	2012 Enacted	2014 Budget Request	Inc (+)/Dec (-) from 2012
Direct	*5,439*	5,431	5,531	100
Reimbursable	*2,838*	2,838	2,838	0
Working Capital Fund	*244*	244	244	0
Allocation Account	*27*	27	27	0
Contributed Funds	*6*	6	6	0
Total	*8,554*	8,546	8,646	100

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Overview

The 2014 U.S. Geological Survey (USGS) budget request is $1.2 billion, which is $98.8 million or 9.3 percent above the 2012 Enacted Budget. Fundamental knowledge of the land and its resources is a basic need for effective government, a productive economy, and sustainable resource management in any nation. In 2014, the USGS celebrates 135 years of providing the Nation with reliable scientific information that can be used in many different ways: to describe and understand the Earth; to minimize

loss of life and property from natural disasters; to manage water, ecosystem, energy, and mineral resources; and to enhance and protect our quality of life.

The 2014 Budget reflects science investments that address critical needs and support a resilient and robust economy, while also protecting the health and environment of the Nation. The 2014 budget builds on the core historical mission of the USGS, increases research and development funding by $87.7 million to advance priorities in science-based resource management and the protection of public health and safety from hazards, focuses existing resources on science priorities identified in the USGS Science Strategy, and makes difficult targeted program decreases.

In the 2014 budget request, the USGS will continue to advance development of water availability research and tools, increase knowledge and information needed to inform the complex energy and environmental issues surrounding hydraulic fracturing, improve the Nation's capacity to quickly and effectively respond to natural hazards, help establish a 21st Century Conservation Service Corps as an outcome of the America's Great Outdoors initiative, and provide information needed to protect priority ecosystems and support Interior's conservation mission. Below are recent USGS achievements that provide the foundation for growth in 2014.

To ensure a balanced domestic energy portfolio, the President emphasizes an "all-of-the-above" strategy for energy development, and the USGS makes important contributions in each component. In 2012, the USGS released maps of the biofuel potential of grasslands in areas of the American Midwest. New software was released that estimates likely bird and bat mortality caused by collision with wind turbines, and this software is critical to properly siting facilities to minimize adverse environmental effects of wind power development. The USGS continued to provide scientific information needed to ensure safe and effective development of natural gas extraction using hydraulic fracturing practices. The USGS released an updated World Oil and Gas Assessment that provides a global context for decisionmakers to understand changes in our understanding of the availability of resources, particularly growth in estimates of natural gas.

The USGS continues to provide the information and tools necessary to prevent the loss of life and property due to natural hazards. Immediately prior to Hurricane Sandy, the USGS deployed sensors from prepositioned staging areas to measure rising storm surge levels, conducted airborne Light Detection And Ranging (LiDAR) to measure pre-storm coastal topography and bathymetry, and forecast probability of coastal impacts to assist preparedness of first responders. During the storm, USGS real-time monitors were reporting coastal river levels and water quality on the Internet. Immediately following the storm, USGS scientists compiled more than 830 high water marks and data from more than 140 storm-surge sensors to map peak storm tide—information used to direct responders and early recovery efforts and to improve storm surge models. The USGS also conducted airborne LiDAR surveys to quantify storm-induced changes before the bulldozers moved in to begin rebuilding. The data collected in the midst of this natural disaster are now being used to develop models and assessments that will inform longer term mitigation strategies to increase the resilience of coastal communities.

USGS Organic Act

43 U.S.C. 31 et seq. Organic Act of March 3, 1879, as amended, establishes the United States Geological Survey. Provides, among other matters, that the USGS is directed to classify the public lands and examine the geologic structure, mineral resources, and products within and outside the national domain. Establishes the Office of the Director of the United States Geological Survey under the Department of the Interior. The Director is appointed by the President with the advice and consent of the Senate.

USGS tools provide the water information and science needed to respond to changing climate and water use patterns. The USGS released a report predicting the effects of climate change on water availability in

14 river basins across the Nation. This groundbreaking study demonstrated that many different strategies will be needed to deal with the various hydrological responses to climate change that occur across river basins. The importance of groundwater as a resource increases when surface water supply cannot meet irrigation needs, such as in the water-challenged Klamath River Basin. The USGS provided the Bureau of Reclamation (BOR) with the results of a groundwater management model study that will be critical to ensuring that groundwater in the Klamath River Basin is wisely managed.

The USGS 2014 Budget Request

The President's 2014 Budget demonstrates the Administration's commitment to advancing science, research and development, Earth observations, and the availability and usability of data—the foundations of scientific discovery, technological innovation, economic well-being, and sound decisionmaking. The USGS is among the leading Federal Earth science agencies and provides information and tools used by Federal, State, tribal, and local entities across the Nation and across the globe. As a world-class Earth science agency and the leading science agency for Interior, the USGS received a significant funding increase for research and development (R&D) in the 2013 President's budget request. USGS accomplishments in 2012 provide a strong track record of success on which to build. Maintaining support for these directions in 2013 and 2014 is critical to national well-being.

A balanced portfolio is essential to a healthy science agency, ensuring that it can maintain diverse expertise to respond to constantly evolving science needs. Accordingly, the budget request was developed with an eye toward balancing investments in monitoring, research, assessments, technical assistance, information delivery, and partner-driven activities.

Funding for Administration Priorities in 2014 Request
($ in Thousands)

	2013 Full Yr. CR (PL 112-175)	2012 Enacted	2014 Request	Changes from 2012 Enacted (+/-)
New Energy Frontier	*33,962*	30,962	48,178	17,216
WaterSMART	*12,010*	7,974	22,469	14,495
Youth in the Great Outdoors	*2,154*	2,112	3,154	1,042
Science for Adapting to a Changing Climate	*51,394*	51,394	67,822	16,428
Ecosystem Priorities	*51,276*	49,276	65,847	16,571
3DEP: Enhanced Elevation for the Nation	*12,701*	12,701	23,701	11,000
Big Data for Earth Science	*0*	0	9,000	9,000
Science for Coastal and Ocean Stewardship	*2,000*	2,000	8,050	6,050
Environmental Impacts of Uranium Mining	*150*	150	3,150	3,000
Improving Rapid Disaster Response	*2,325*	2,325	4,832	2,507

The 2014 request includes targeted increases of $125.0 million and refocuses existing program efforts to advance Administration priorities such as Renewable Energy (New Energy Frontier), WaterSMART (Water Challenges), Earth Scientists for Tomorrow (Youth), Climate, Ecosystem Priorities, 3DEP, Hydraulic Fracturing, Big Earth Data, Environmental Impacts of Uranium Mining, and Rapid Disaster Response at funding levels consistent with the 2012 enacted level or higher. Below is a description of USGS efforts in the priority areas for 2014:

- **New Energy Frontier** – Broadening the energy sources of the United States requires update to assessments of resource potential as well as information to evaluate and minimize the impacts of development on fish and wildlife habitat and water quality. The USGS proposes an increase in funding to further address issues related to hydraulic fracturing, alternative energy permitting on

Federal lands, and assessments of geothermal energy potential. More information can be found in the Program Changes and Energy and Minerals and Environmental Health Sections.

- **WaterSMART** – The USGS contribution to Interior's Water Challenges initiative is the WaterSMART effort, which involves multiple USGS mission areas and is coordinated with the BOR. As competition for water resources grows for crop irrigation, growing cities and communities, energy production, and the environment, the need for information and tools to aid water resource and land managers grows. WaterSMART, through the combined efforts of BOR in the West and the USGS throughout the entire Nation, provides the foundation for a sustainable water strategy. More details about WaterSMART can be found in the Program Changes Section.
- **Youth in the Great Outdoors – 21st Century Conservation Service Corps** – Funds proposed in the 2014 budget will expand USGS youth programs and partnerships to accomplish high priority projects and promote quality participant experiences and pathways to careers. The request includes an increase of $1.0 million for expanded youth programs and partnerships, including the proposed 21st Century Conservation Service Corps. A portion of the increase will be dedicated for USGS youth activities as part of an integrated, Departmentwide effort to leverage youth partnership agreements with partners. The USGS would engage partners to complete significant projects to protect, restore and enhance public and tribal lands and waters, as well as natural, cultural and historical resources and treasures. More information can be found in the Program Changes and Administration and Enterprise Information Sections.
- **Science for Adapting to a Changing Climate** – Effectively responding to impacts of climate change requires science that meets resource managers' needs. In particular, the National Climate Change and Wildlife Science Center (NCCWSC)/Department of the Interior Climate Science Centers (CSC) Program, the Climate Research and Development (R&D) Program, and the biologic carbon sequestration project in the Climate and Land Use Change (CLU) Mission Area all conduct research to inform resource managers' strategies to mitigate and adapt to climate change. Continued research leveraging all of these programs' strengths is needed to better understand climate change impacts on natural resources and the infrastructure, to support a more resilient Nation. For more information see the Program Changes and CLU Sections.
- **Ecosystem Priorities** – To complement the America's Great Outdoors Initiative, the 2014 budget request includes strong support for the USGS to contribute to ecosystem restoration efforts in the Chesapeake Bay, Everglades, California Bay Delta, Great Lakes, Upper Mississippi River, Columbia River, Puget Sound, Klamath River, and Gulf Coast. The USGS is working with Interior bureaus and other agencies to provide scientific tools for strategic decisionmaking in support of restoring clean water, conserving treasured places, restoring habitats for fish and wildlife, and better understanding ecosystem services as outlined in the *Sustaining Environmental Capital* report by the President's Council of Advisors on Science and Technology. More details about ecosystem priorities can be found in the Program Changes Section.
- **3-D Elevation Program (3DEP) –** Accurate, precise, and up-to-date elevation data are the foundational requirement for efforts to quantify current and future coastal vulnerability to storms, flooding, tsunamis, and climate driven change. The 3DEP initiative will systematically collect enhanced elevation data on the United States using LiDAR and other technologies over an 8-year period. More details about 3DEP can be found in the Program Changes Section.
- **Hydraulic Fracturing –** The 2014 budget supports a collaborative interagency research and development effort by the USGS, DOE, and EPA to conduct a national science, research, and development program aimed at understanding and reducing the potential environmental, health, and safety impacts of hydraulically fractured oil and gas resources. The primary objective of this effort is to address the most urgent questions and decision-support needs surrounding hydraulic fracturing. Through this effort, the three agencies will build upon current work and

collaboratively identify and coordinate new priority research and development activities that support sound management and policy decisions by Federal, State, tribal, and local entities. The goal is to produce decision-ready information to ensure the prudent development of energy resources and the protection of human health and the environment. More details about hydraulic fracturing can be found in the Program Changes Section.

- **Big Earth Data** – The Federal government invests several billion dollars annually across numerous Federal agencies to collect information about the Earth from satellite, airborne, terrestrial, and ocean-based systems. This information is used to achieve broad benefits ranging from natural disaster impact mitigation to commercial supply chain management to natural resource management to climate change resilience planning. Access to and use of these data is fundamental to supporting decisionmaking, scientific discovery, and technological innovation. The Big Earth Data Initiative in the President's 2014 Budget invests in standardizing and optimizing the management of data from federal Earth observations systems. Interagency coordination for this effort will be accomplished through the USGEO Subcommittee of the National Science and Technology Council (NSTC), led by the Office of Science and Technology Policy (OSTP). USGS and other DOI data sets are regularly used for science and decisionmaking. Funding for this initiative will enable innovation to dramatically expand the utility of this information and the array of users that can access this resource. The USGS would coordinate with Interior bureaus, other Federal agencies, and States to develop a cohesive strategy that makes the data available via Web services in a compatible format to integrate with other sources. More details about Big Earth Data can be found in the Program Changes Section
- **Science for Coastal and Ocean Stewardship** – Increased population growth, energy development, and resource use in coastal areas requires information to help communities make wise decisions. This initiative invests in the science and information necessary to develop and provide access to integrated assessments of marine and coastal resources and vulnerability and to provide data and model-based assessments of the consequences of changing coastal conditions and alternative management scenarios. More details about Science for Coastal and Ocean Stewardship can be found in the Program Changes Section.
- **Environmental Impacts of Uranium Mining –** In January 2012, the Secretary of the Interior withdrew over 1 million acres of public lands in the Grand Canyon region from mineral entry for 20 years under the Mining Law of 1872. However, even under the withdrawal, some mining will occur on valid existing claims. Recognizing a lack of scientific information on the potential impacts of mining, a key factor in the Secretary's decision, the USGS developed a 15-year science plan in collaboration with the Bureau of Land Management (BLM), National Park Service (NPS), U.S. Fish and Wildlife Service (FWS), and the U.S. Forest Service (USFS). The studies would provide critical information for future decisions on withdrawal of lands and help inform the development, mitigation, reclamation, and ecological restoration of mines on valid existing claims, as applicable. More details about Environmental Impacts of uranium mining can be found in the Program Changes Section.
- **Rapid Disaster Response** – Recent events have increased expectations for the USGS to provide rapid, robust information in response to natural disasters. This initiative will support improvements for early warning and disaster event characterizations and scenario products for earthquakes, eruptions of volcanic ash, debris flows and flood monitoring. The investments proposed in this budget request would leverage substantial investments in earthquake and volcano monitoring made through the American Recovery and Reinvestment Act (ARRA). More details about Rapid Disaster Response can be found in the Program Changes Section.

Budget Change Summary ($ in Thousands)	
2012 Enacted	**1,068,032**
Program Increase	125,021
Program Decrease	-36,636
2013 Fixed Costs	6,629
2014 Fixed Costs	3,809
2014 Request	**1,166,855**

Formulation of the 2014 budget proposal required a significant effort to balance priorities and meet mission needs, the budget request required difficult choices that include program reductions totaling $36.6 million. More details about program reductions can be found in the Program Changes Section.

In addition to decreases, some resources were shifted from lower to higher priorities. Examples include: in the National Water Quality Assessment Program, work shifted from methods development and assessments to WaterSMART and Ecosystem Priorities; in the Hydrologic Networks and Analysis Program, work shifted from lower priority research and data collection to WaterSMART; in the Cooperative Water Program, work shifted from lower priority assessments to WaterSMART.

Technical Changes

The USGS proposes to realign the $2.4 million and 12 FTE from the Science Support for DOI Bureaus activity under the Climate and Land Use Change Mission Area to the Ecosystems Mission Area. This funding provides directed support for other bureaus within the Department. For example, the USGS provides wildlife research related to white-nose syndrome, golden eagles, condors, desert tortoises, and renewable energy. The USGS also provides science support for other Federal, State, tribal, academic, and private eco-regional fish, wildlife, and land conservation efforts by providing integrated ecological and population modeling capacity for national efforts, as well as increased capacity for applying models and other scientific information for resource managers. This proposal aligns the work to support the Ecosystems research goals. More details about the internal transfer can be found in the Program Changes Section.

Information Technology Transformation

The 2014 President's Budget Request includes $477,000 for the USGS's participation in the Department's Information Technology (IT) Transformation efforts as a contribution to the Working Capital Fund. These funds will support IT Transformation project-level planning and coordination and the implementation of enterprise IT services.

Agency Priority Goals

Climate Change Adaptation

The USGS is a primary contributor to the Climate Change Adaptation Agency Priority Goal (APG): By September 30, 2013, for 50 percent of the Nation, the Department of the Interior will identify resources that are particularly vulnerable to climate change and implement coordinated adaptation response actions. In 2014, progress for improved climate change adaptation and collaboration across the Department of the Interior will include pursuing the following significant milestones:

- Establishment of climate change adaptation guidance in all of the Interior land management bureaus, distributed throughout each bureau's regional offices and individual management units;
- Establishment of climate adaptation networks within each bureau and across the Department, with individual performance measures in place;
- New climate change adaptation data and decision tools relating to:
    - predicting and anticipating wildland fire trends,
    - predicting the spread or introduction of invasive species,
    - tracking changes in wildlife abundance and distribution;
- Integrated vegetation surveys representing the entire lower 48 States; and
- Creation of a Web-based searchable database of the vulnerability assessments prepared across all Federal land management agencies.

Bureau Contribution: The CLU Mission Area is the primary contributor to this APG. Along with other USGS mission areas including Ecosystems, Water, and Natural Hazards, CLU conducts climate vulnerability assessments used by Interior land management bureaus to develop adaptation plans. The NCCWSC and the eight CSCs will lead the effort for the USGS to conduct science to support this APG. The USGS funding for climate change in 2012 is $58.2 million, $58.2 million in 2013, and $71.7 million in 2014.

Implementation Strategy: The Climate Change Adaptation APG presents an opportunity to unite climate change research and science that Interior bureaus have been doing. Interior's implementation strategy for the Climate Change Adaptation APG includes:

- Climate Change Impact Science: The CSCs and LCCs work collaboratively to identify research needs, develop science projects, implement monitoring approaches, and develop tools and methods to translate science to improve the understanding of climate change impacts and vulnerabilities. The LCCs are deeply engaged in adaptation planning and identification of strategic approaches, thus serving as a key science-management bridge. This joint effort helps to identify strategic decisions in response to management needs: the CSCs will primarily focus on large scale climate change science associated with broad regions of the country; and LCCs will focus on applied science and management decisionmaking at the landscape level. With operations and staffing in place for all eight CSCs, the initial phase of the CSC startup in 2013 has begun to provide resource management agencies with science and technical support on the impacts of climate change on fish, wildlife, and ecological processes. Specifically, in 2014, the CSCs will work closely with LCCs to develop strategic science approaches and award translational science grants to support adaptation planning with a focus on meeting the needs of specific decisions and planning activities, and on delivering application-ready information.

- Assessing the Vulnerability of Areas and Species Related to Climate Change: The USGS (as well as other Interior bureaus) have been conducting climate change vulnerability assessments across the United States in an effort to determine the resources that are most vulnerable and assess the threats to resources that may be exacerbated by climate change. Of the Interior bureaus, the USGS conducts the most climate change vulnerability science, and thus is the largest contributor to this section of the APG. USGS climate change vulnerability assessments are currently being conducted in the Ecosystems, Climate and Land Use Change, Water Resources, and Natural Hazards mission areas. The USGS is currently tracking 96 climate change vulnerability assessments that will be completed by the end of 2013. In 2014, the NCCWSC/CSC Program would continue to focus on the interagency coordination of climate change science to help eliminate redundancy and improve the use of existing climate change information. This would require the NCCWSC to track climate change adaptation science across multiple Federal agencies, and the CSCs to work with regional partners to identify and develop multi-agency strategies on common priorities. As part of this coordination effort, the NCCWSC would develop a public database and field guide to help Interior and other Federal, State, and local agencies create standards and best practices for vulnerability assessments.

Performance Metrics: The USGS is responsible for reporting the following performance measures related to this APG:

- Number of CSCs formed
  - 2012 Actual: 8
  - 2013 Target: N/A (network is established)
- Number of CSC research priority documents completed
  - 2012 Actual: 7
  - 2013 Target: 8
- Number of climate change vulnerability assessments completed through 2016 (cumulative)
  - 2011 Actual: 11 of 178 (6 percent)
  - 2012 Actual: 38 of 178 (21 percent)
  - 2013 Target: 124 of 178 (70 percent)
  - 2014 Target: 165 of 178 (93 percent)
  - 2015 Target: 176 of 178 (99 percent)
  - 2016 Target: 177 of 178 (99 percent)
  - Ongoing: 1 of 178 (1 percent)

Youth Stewardship

Goal: By September 30, 2013, the Department of the Interior will maintain the increased level of employment of individuals between the ages of 15 to 25 that was achieved in 2010 (35 percent increase in total youth employment over 2009) to support the Department's mission of natural and cultural resource management. For 2014, the Department is expecting to sustain a level of youth engagement similar to that achieved in 2010 (35 percent increase in total youth employment over 2009), based on estimated funding and participation from partners through the 21st Century Conservation Service Corps (CSC).

Bureau Contribution: The USGS contributes to Interior's goal by engaging youth through meaningful hands-on work experience, training, professional mentoring and graduate research in the natural sciences. Increasing the number of youth hired at the USGS is critical to achieving the USGS mission now and in

the future. The USGS budget contribution to Youth in the Great Outdoors in 2012 was $2.1 million, $2.2 million in 2013, and is $3.1 million in the 2014 Budget request. In addition to this funding, base funding is included in several USGS programs that support Youth activities.

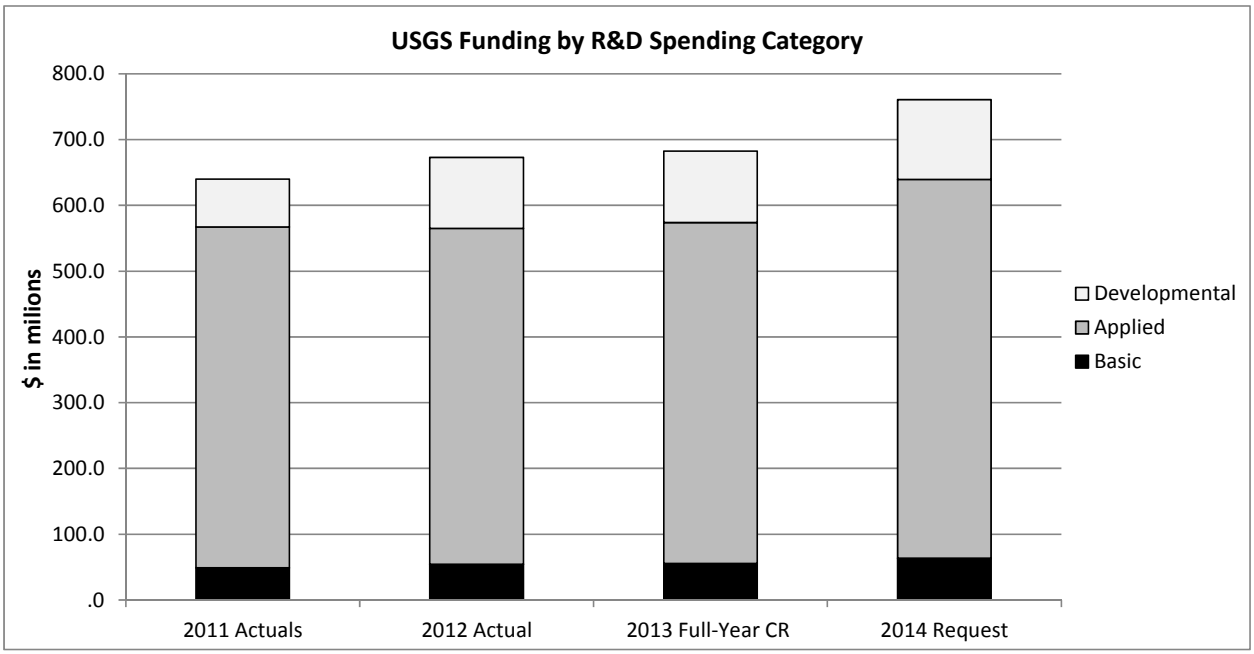
Implementation Strategy: As a bureau of scientists, the USGS has a rich culture of mentoring, engaging, employing, and educating youth in the geosciences. In 2011, the USGS engaged in a wide array of Youth activities nationwide. For example:

- GeoFORCE: The USGS has worked closely for the past 6 years with GeoFORCE, a University of Texas/Austin program, to engage minority high school students in the Earth sciences. The USGS, primarily through the National Cooperative Geologic Mapping Program's EDMAP training component, is realizing a high return on investment by encouraging the "graduates" of this 4-year high school science experience to continue to work with the USGS throughout their college education. This year's GeoFORCE class of 40 includes 25 women and is 80 percent Hispanic.
- Denver Mayor's Office Partnership: The USGS worked closely with the Denver Public Schools and the Denver Mayor's office to hire 11 diverse students, ages 15 to 21 years. The Mayor's office sponsored a 3-week training session to prepare these young people to work with the USGS. The USGS identified a sponsor for each student in the program, with a focus on mentoring, career exploration, and understanding the missions of the USGS and Interior. The students made presentations describing what they had learned and experienced throughout the summer. Eight of the 11 students were extended for employment beyond the summer.

The USGS met the APG measure of increasing youth hires by 35 percent over 2009 figures by the third quarter of 2011. In 2012 and 2013, the USGS will continue to participate in the Youth in the Great Outdoors Initiative. The USGS is implementing a Youth and Education in Science component to leverage resources; is tracking new and current youth hires and youth hired by our partners; is enhancing participation in the sciences by women, Native American, and minority students; is providing training and experiences in the natural sciences outdoors; and is creating science career pathways that reach out to students in grades K-16.

National Science Perspective: Addressing National Science and Technology Priorities

Investments in Research and Development (R&D) promote economic growth and innovation and ensure American competitiveness in a global market. R&D is the core of the USGS mission. Total R&D funding is $760.5 million[1], which is 65.2 percent of the total USGS appropriated budget. This level is a net increase of $87.7 million, or 13.0 percent above the 2012 enacted level.



Of the $760.5 million R&D total, $63.7 million is for basic research, $575.7 million is for applied research, and $121.1 million is for developmental research. All USGS basic, applied, and developmental research ultimately supports the goal of providing the scientific framework for decisionmaking. The increased funding for R&D will continue many of the priority directions that were initiated in the 2013 President's budget request, which included an increase of $51.0 million for R&D for advancing USGS capacity to address emerging societal challenges related to hydraulic fracturing, marine and ocean science, rapid disaster response, water availability, and ecosystem priorities.

To ensure that R&D funding is tracked consistently, each program identifies the percentage of the program that fits into the categories of basic, applied, and developmental research. The percentage is then applied to total funding provided. The percentages are revisited periodically to ensure they accurately reflect the research portfolio. This approach provides a manageable and consistent manner to track R&D costs across science activities and fiscal years.

[1] R&D funding shown for the USGS has been updated from figures shown in the Analytical Perspectives volume of the 2013 Budget.

Ensuring Scientific and Scholarly Integrity

High quality science and scholarship play an important role in advancing Interior's mission. The USGS established the Office of Science Quality and Integrity in 2011, charged with the oversight for implementation of this and other critical policies to ensure the highest quality objective science. In February 2011, Interior released a new Scientific and Scholarly Integrity Policy that sets forth clear expectations for all employees to uphold the principles of scientific integrity and establishes a process for impartial review of alleged breaches of those principles. The policy is based on the principles found in Secretarial Order 3305 and builds on the previous USGS Scientific Integrity Policy. The policy applies to all departmental employees when they engage in, supervise, or manage scientific or scholarly activities; analyze and publicly communicate scientific or scholarly information; or use this information or analyses to make policy, management, or regulatory decisions. Additionally, the policy includes provisions for contractors, partners, grantees, lessees, volunteers and others who conduct these activities on behalf of Interior.

DOI Strategic Plan

The 2011–2016 DOI Strategic Plan, in compliance with the principles of the GPRA Modernization Act of 2010, provides a collection of mission objectives, goals, strategies, and corresponding metrics that enable an integrated and focused approach for tracking performance across a wide range of DOI programs. While the DOI Strategic Plan for 2011–2016 is the foundational structure for the description of program performance measurement and planning for the 2014 President's Budget, further details for achieving the Strategic Plan's goals are presented in the DOI Annual Performance Plan and Report (APP&R). Bureau and program specific plans for 2014 are fully consistent with the goals, outcomes, and measures described in the 2011-2016 version of the DOI Strategic Plan and related implementation information in the APP&R.

USGS Strategic Planning

In 2007, the USGS published a Bureau Science Strategy, "Facing Tomorrow's Challenges—U.S. Geological Survey Science in the Decade 2007–2017." It provided a view of the future, establishing science goals that reflected the USGS's fundamental mission in areas of societal impact such as energy and minerals, climate and land use change, ecosystems, natural hazards, environmental health, and water. Intended to inform long-term program planning, the strategy emphasizes how USGS science can make substantial contributions to the well-being of the Nation and the world.

In 2010, the USGS realigned the management and budget structure, changing it from a structure associated with scientific disciplines—Geography, Geology, Biology and Hydrology—to an issue-based organization along the lines of the Science Strategy.

Additionally, in 2010, seven Science Strategy Planning Teams (SSPTs) were commissioned to draft science strategies for each USGS mission area. Although the existing Bureau Science Strategy was a starting point for this exercise, the SSPTs went well beyond the scope of the existing document. What is of enduring value from the work of the programs that existed under the former science disciplines needed to be reframed and reinterpreted under the new organization of the science mission areas. In addition, new opportunities for research directions have emerged in the five years since the Bureau Science Strategy was drafted, and exciting possibilities for cooperating and collaborating in new ways are enabled by the new mission focus of the organization.

Scientists from across the Bureau were selected for these SSPTs for their experience in strategic planning, broad range of experience and expertise, and knowledge of stakeholder needs and relationships. Each SSPT was charged with developing a long-term (10-year) science strategy that encompasses the portfolio of USGS science in the respective mission area. Each science strategy will reinforce others because scientific knowledge inherently has significance to multiple issues. Leadership of the USGS and Interior will use the science vision and priorities developed in these strategies for program guidance, implementation planning, accountability reporting, and resource allocation. These strategies will guide science and technology investment and workforce and human capital strategies. They will inform partners regarding opportunities for communication, collaboration, and coordination. Final versions of these science strategies will be published in 2013, at which time implementation will be initiated.

Administration's Management Agenda

Enterprise Reforms

The Department of the Interior supports the President's Management Agenda to cut waste and implement a government that is more responsive and open. The USGS budget supports the Department's plan to build upon the Accountable Government Initiative through a set of integrated enterprise reforms designed to support collaborative, evidence-based resource management decisions; efficient IT Transformation; optimized programs, business processes, and facilities; and a network of innovative cost controlling measures that leverage strategic workforce alignment to realize an effective 21st Century Interior organization.

Campaign to Cut Waste

Over the last three years, the Administration has implemented a series of management reforms to curb uncontrolled growth in contract spending, terminate poorly performing information technology projects, deploy state of the art fraud detection tools, focus agency leaders on achieving ambitious improvements in high-priority areas, and open government up to the public to increase accountability and accelerate innovation.

In November 2011, President Obama issued an Executive Order reinforcing these performance and management reforms and the achievement of efficiencies and cost-cutting across the government. This Executive Order identifies specific savings as part of the Administration's Campaign to Cut Waste to achieve a 20 percent reduction in administrative spending from 2010 to 2013 and sustain these savings in 2014. Each agency is directed to establish a plan to reduce the combined costs associated with travel, employee information technology devices, printing, executive fleet services, and extraneous promotional items and other areas.

The Department of the Interior is on target to reduce administrative spending by $217 million from 2010 levels by the end of 2013, and to sustain these savings in 2014. To meet this goal, the Department is leading efforts to reduce waste and create efficiencies by reviewing projected and actual administrative spending to allocate efficiency targets for Bureaus and Departmental Offices to achieve the 20 percent target. Additional details on the Campaign to Cut Waste can be found at *http://www.whitehouse.gov/the-press-office/2011/11/09/executive-order-promoting-efficient-spending."*

The USGS is controlling other administrative expenses by initiating internal controls requiring senior-level preapproval of conference-related spending and then tracking and reporting funds spent on conferences. Further, to reduce printing costs, the USGS is committed to limiting the publication and printing of hard copy documents in support of more efficient spending practices, while continuing to

effectively communicate necessary data for public consumption. Finally, the USGS is actively engaged in reducing funds spent on promotional materials as specified by Departmental policy guidance issued March 29, 2012.

Real Property

In support of the Administration's real property cost savings efforts, the Interior issued a policy restricting the maximum amount of bureau/office-leased and GSA-provided space to 2010 levels and reducing the target utilization rate (square feet per person) for office space by 10 percent. Through actions such as consolidations, collocations, and disposals, the USGS plans to achieve a utilization rate of 281 usable square feet per person by the end of 2014.

Interior has a moratorium on construction of new facilities and required each bureau/office to set aside a minimum of three percent of its construction budget request for disposal activities that support real property cost savings goals.

Data Center Consolidation

As part of the Administration's Management Priorities, the Department has initiated a plan for IT Transformation designed to reduce spending by the consolidation of IT infrastructure and services under a single Chief Information Officer (CIO). The new IT shared services organization will transform the way that IT is delivered to over 70,000 Interior employees, using advances in technology to provide better services for less. The USGS supports Interior's initiative to reduce 95 data centers by 2015 without disruption to mission. As part of this initiative, the USGS is planning to create consolidation activities in 10 data centers during 2014. The USGS anticipates the savings achieved from these consolidations will total approximately $500,000 of which 50 percent will be reinvested in USGS science activities.

Program Changes

Program Changes - USGS Initiatives

Component	Subactivity	2014 Program Change Amount ($000)	FTE Changes
Renewable Energy		**4,000**	**6**
	Energy Resources	[2,000]	[3]
	Wildlife Program	[2,000]	[3]
WaterSMART		**14,495**	**66**
	Fisheries Program	[1,386]	[5]
	Land Change Science	[136]	0
	Contaminant Biology	[1,000]	[3]
	Toxic Substance Hydrology	[1,800]	[4]
	Groundwater Resources	[1,827]	[7]
	National Water Quality Assessment	[3,300]	[24]
	Hydrologic Research & Development	[300]	[2]
	Hydrologic Networks & Analysis	[2.346]	[11]
	Cooperative Water Program	[2,000]	[10]
	National Cooperative Geologic Mapping Program	[200]	[0]
	National Geospatial Program	[200]	[0]
Earth Scientists for Tomorrow		**1,000**	**0**
	Science Support	[1,000]	[0]
Science for Adapting to a Changing Climate		**16,153**	**24**
	Carbon Sequestration	[2,958]	[5]
	Climate Research & Development	[3,172]	[10]
	National Climate Change and Wildlife Science Center /DOI Climate Science Centers (CSC)	[10,023]	[9]
Ecosystem Priorities		**16,571**	**34**
	Fisheries Program	[901]	[4]
	Environments Program	[5,284]	[8]
	Invasive Species	[4,000]	[8]
	Land Change Science	[1,500]	[6]
	Contaminant Biology	[200]	[0]
	Toxic Substance Hydrology	[200]	[1]
	National Water Quality Assessment	[1,700]	[5]
	Hydrologic Research & Development	[1,182]	[2]
	Science Synthesis, Analysis and Research Program	[800]	[0]
	National Geospatial Program	[804]	[0]
3DEP: Enhanced Elevation for the Nation		**11,000**	**2**
	Coastal & Marine Geology	[2,000]	[2]
	National Geospatial Program	[9,000]	[0]
Hydraulic Fracturing		**13,035**	**32**
	Fisheries Program	[2,200]	[10]
	Energy Resources	[1,250]	[6]
	Contaminant Biology	[1,400]	[5]
	Earthquake Hazards	[1,700]	[3]
	Groundwater Resources	[2,100]	[6]
	Hydrologic Research & Development	[2,200]	[2]
	Science Synthesis, Analysis and Research Program	[185]	[0]
	National Cooperative Geologic Mapping Program	[2,000]	[0]
Earth and Environmental Observations Innovation and Applications		**9,000**	**1**
	Science Synthesis, Analysis and Research Program	[9,000]	[1]
Science for Coastal and Ocean Stewardship		**6,050**	**9**
	Coastal & Marine Geology	[5,750]	[9]
	Science Synthesis, Analysis and Research Program	[300]	[0]
Environmental Impacts of Uranium Mining		**3,000**	**12**
	Contaminant Biology	[500]	[3]
	Toxic Substance Hydrology	[2,500]	[9]
Improving Rapid Disaster Response		**2,507**	**8**
	Land Change Science	[757]	[4]
	Earthquake Hazards	[850]	[1]
	Volcano Hazards	[400]	[1]
	Landslide Hazards	[500]	[2]
Total: USGS		**96,811**	**194**

* Estimated changes in FTEs compare against actual 2012 FTE usage, not 2012 enacted formulation estimates.

Program Changes - USGS Increases			
Component	**Subactivity**	**2014 Program Change Amount ($000)**	**FTE Changes**
White Nose Syndrome		**1,505**	**1**
	Wildlife Program	[1,505]	[1]
Coral Reefs		**442**	**1**
	Environments Program	[442]	[1]
Brown Tree Snakes		**500**	**0**
	Invasive Species	[500]	[0]
New and Emerging Invasive of National Concern		**874**	**4**
	Invasive Species	[874]	[4]
Rare Earth Elements Research		**1,000**	**5**
	Mineral Resources	[1,000]	[5]
High Priority Research on Critical Minerals		**1,130**	**7**
	Mineral Resources	[1,130]	[7]
Emerging Contaminants/ Chemical Mixtures		**2,000**	**5**
	Contaminant Biology	[1,000]	[3]
	Toxic Substance Hydrology	[1,000]	[2]
Pathogens and Contaminants		**611**	**2**
	Contaminant Biology	[611]	[2]
Earthquake Products and Improved Monitoring in Eastern U.S.		**1,200**	**0**
	Earthquake Hazards	[1,200]	[0]
Enhance Monitoring		**108**	**0**
	Geomagnetism	[108]	[0]
Enhanced Coastal Storm Response Capability		**850**	**3**
	Coastal & Marine Geology	[850]	[3]
Streamgages		**7,161**	**0**
	National Streamflow Information Program	[7,161]	[0]
Streamgage R&D		**1,000**	**1**
	Hydrologic Research & Development	[1,000]	[1]
Tribes		**1,000**	**7**
	Cooperative Water Program	[1,000]	[7]
NAQWA Related Studies		**1,000**	**7**
	Cooperative Water Program	[1,000]	[7]
Geological and Geophysical Data Preservation		**400**	**0**
	Science Synthesis, Analysis and Research Program	[400]	[0]
Alaska Mapping		**1,044**	**0**
	National Geospatial Program	[1,044]	[0]
Operations and Maintenance Efficiencies-Reduce Facilities Footprint		**6,385**	**0**
	Rental Payments and Operations & Maintenance	[6,385]	[0]
Total: USGS		**28,210**	**43**

* Estimated changes in FTEs compare against actual 2012 FTE usage, not 2012 enacted formulation estimates.

Program Changes - USGS Decreases			
Component	**Subactivity**	**2014 Program Change Amount ($000)**	**FTE Changes**
Geologic Carbon Sequestration		**-532**	**-1**
	Carbon Sequestration	[-532]	[-1]
National Civil Application Program/Civil Applications Committee		**-576**	**-2**
	Land Remote Sensing	[-576]	[-2]
North American Data Buy		**-1,000**	**0**
	Land Remote Sensing	[-1,000]	[0]
Minerals Information		**-1,157**	**-10**
	Mineral Resources	[-1,157]	[-10]
Minerals Resources		**-1,000**	**-8**
	Mineral Resources	[-1,000]	[-8]
Research and Assessment		**-2,803**	**-23**
	Mineral Resources	[-2,803]	[-23]
Eliminate Management-Supporting Habitat and Service Mapping		**-2,150**	**-8**
	Coastal & Marine Geology	[-2,150]	[-8]
Great Lakes Beach Health Study		**-600**	**-1**
	Coastal & Marine Geology	[-600]	[-1]
Methods Development and Assessments		**-5,000**	**-29**
	National Water Quality Assessment	[-5,000]	[-29]
Data Collection and Research		**-867**	**-9**
	Hydrologic Networks & Analysis	[-867]	[-9]
Interpretive Studies/Assessments		**-4,000**	**-25**
	Cooperative Water Program	[-4,000]	[-25]
Water Resources Research Act		**-5,490**	**0**
	Water Resources Research Act Program	[-5,490]	[0]
Federal Geographic Data Committee		**-1,697**	**-3**
	National Geospatial Program	[-1,697]	[-3]
Administrative Services		**-3,135**	**-18**
	Science Support	[-1,906]	[-8]
	Security & Technology	[-1,229]	[-10]
General Program Reductions		**-6,629**	**0**
	Status and trends	[-145]	0
	Fisheries Program	[-172]	0
	Wildlife Program	[-320]	0
	Environments Program	[-283]	0
	Invasive Species	[-59]	0
	Cooperative Research Units	[-132]	0
	National Climate Change and Wildlife Science Center /DOI Climate Science Centers (CSC)	[-89]	0
	Climate Research & Development	[-162]	0
	Carbon Sequestration	[-41]	0
	Science Support for DOI Bureaus	[-8]	0
	Land Remote Sensing	[-153]	0
	Land Change Science	[-83]	0
	Mineral Resources	[-439]	0
	Energy Resources	[-189]	0
	Contaminant Biology	[-67]	0
	Toxic Substance Hydrology	[-57]	0
	Earthquake Hazards	[-312]	0
	Volcano Hazards	[-188]	0
	Landslide Hazards	[-27]	0
	Global Seismographic Network	[-17]	0
	Geomagnetism	[-17]	0
	Coastal & Marine Geology	[-300]	0
	Groundwater Resources	[-69]	0
	National Water Quality Assessment	[-500]	0
	National Streamflow Information Program	[-114]	0
	Hydrologic Research & Development	[-280]	0
	Hydrologic Networks & Analysis	[-219]	0
	Cooperative Water Program	[-403]	0
	Water Resources Research Act Program	[-4]	0
	Science Synthesis, Analysis and Research Program	[-100]	0
	National Cooperative Geologic Mapping Program	[-165]	0
	National Geospatial Program	[-460]	0
	Science Support	[-22]	0
	Security & Technology	[-165]	0
	Rental Payments and Operations & Maintenance	[-868]	0
Total: USGS		**-36,636**	**-137**

* Estimated changes in FTEs compare against actual 2012 FTE usage not 2012 enacted formulation estimates.

Program Changes - USGS Internal Transfers			
Subactivity	**Internal Transfer**	**2014 Program Change Amount ($000)**	**FTE Changes**
Internal Transfer		**2,358**	**12**
Environments	Internal Transfer from Science Support for DOI Bureaus	[2,358]	[12]
Internal Transfer Decrease		**-2,358**	**-12**
Science Support for DOI Bureaus	Internal Transfer to Environments	[-2,358]	[-12]
Internal Transfer Total		**0**	**0**

* Estimated changes in FTEs compare against actual 2012 FTE usage, not 2012 enacted formulation estimates.

Priority Increases

Renewable Energy

Renewable Energy		2013 Full Yr. CR (PL 112-175)	2012 Enacted	Changes	Program Changes (+/-)	2014 Budget Request	Change from 2012 Enacted (+/-)
Wildlife Program		*592*	592	0	2,000	2,592	2,000
	FTE	*3*	3	0	3	6	3
Energy Resources		*1,600*	1,600	0	2,000	3,600	2,000
	FTE	*0*	0	0	3	3	3
Total Requirements ($000)		***2,192***	**2,192**	**0**	**4,000**	**6,192**	**4,000**
	Total FTE	***3***	**3**	**0**	**6**	**9**	**6**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Justification of 2014 Program Changes

The 2014 budget request for Renewable Energy is $6,192,000 and 9 FTE, a program increase of +$4,000,000 and +6 FTE from the 2012 Enacted level.

Overview

The proposed funding increase in 2014 would fund research to support permitting decisions for alternative energies on Federal lands and research to provide information on species, populations, habitats, and energy technology so that impacts of energy development on natural populations can be assessed and modeled as part of decision support tools.

Program Performance

Renewable Energy **+$4,000,000/+6 FTE**

Energy Future and Wildlife Sustainability **(+$2,000,000/+3 FTE)**

Wildlife Program (+$2,000,000/+3 FTE)

Traditional and alternative energy innovation, development, production and delivery will remain a national focus for decades. USGS ecosystems science is a key linkage between energy development and sustainability of our ecosystems, and is at the forefront of providing information for management decisions, particularly for renewable energy. The USGS is a leader in supplying science needed to solve the challenges of making progress in energy availability, while maintaining functioning natural systems. New research would build on the past three years of focused work on impacts to golden eagles, bats, condors, and tortoise from wind and solar energy development. The USGS would collect biological data; focus on strengthening and developing advanced technologies, such as algorithms and advanced computing infrastructure to mine bird and bat information from existing weather data; and thermal imaging and infrared videography to allow observations of birds and bats at night. In the Arctic, the USGS would build on pilot studies using remote data collection methods and multi-agency collaborations to solve unprecedented challenges in marine mammal research, resulting in information about mammals and their environments and address Native peoples' concerns about traditional polar bear research methods (physical capture using immobilizing drugs). Large tracts of the Arctic are now leased for oil and gas development and exploratory drilling, resulting in significant overlap between the leased areas

and those used by the Pacific walrus. Research would add new knowledge on potential impacts of seismic activities and ship traffic for this declining species.

Alternative Energy Permitting on Federal Lands **+$2,000,000/+3 FTE**

Energy Resources Program (+$2,000,000/+3 FTE)

This proposed increase allows the Energy Resources Program (ERP) to provide science support to the agencies responsible for energy resource management on Federal Lands in several ways. There is substantial potential for unconventional geothermal resources (Enhanced Geothermal Systems) on Federal lands, but these resources have not yet been thoroughly evaluated. The U.S. Geological Survey (USGS) would use core capabilities in geothermal research to evaluate the geology and subsurface characteristics to identify likely areas of potential exploration and development of geothermal resources. The Bureau of Land Management (BLM) and other bureaus could use this information for land use planning, lease sales, and potentially a targeted environmental impact statement for high grade areas. The proposed funding increase would allow a focused effort to survey and subsequently track the impacts of geothermal development over time, which have been poorly characterized to date. This effort would focus on key areas where there are, or may be, issues related to ongoing geothermal production. The increase would also allow for additional support for researching induced seismicity related to geothermal development on Federal lands, and help to determine the risks and potential mitigation plans should development be proposed.

Water Challenges: WaterSMART

WaterSMART		2013 Full Yr. CR (PL 112-175)	2012 Enacted	Changes	Program Changes (+/-)	2014 Budget Request	Change from 2012 Enacted (+/-)
Fisheries Program		498	498	0	1,386	1,884	1,386
	FTE	0	0	0	5	5	5
Land Change Science		634	498	136	0	634	136
	FTE	0	0	0	0	0	0
Contaminant Biology		0	0	0	1,000	1,000	1,000
	FTE	0	0	0	3	3	3
Toxic Substance Hydrology		0	0	0	1,800	1,800	1,800
	FTE	0	0	0	4	4	4
Groundwater Resources		2,685	2,685	0	1,827	4,512	1,827
	FTE	0	0	0	7	7	7
National Water Quality Assessment		1,100	0	1,100	2,200	3,300	3,300
	FTE	6	0	6	18	24	24
Hydrologic Research & Development		0	0	0	300	300	300
	FTE	0	0	0	2	2	2
Hydrologic Networks & Analysis		5,393	4,293	1,100	1,246	6,639	2,346
	FTE	5	3	2	9	14	11
Cooperative Water Program		1,500	0	1,500	500	2,000	2,000
	FTE	0	0	0	10	10	10
National Cooperative Geologic Mapping Program		0	0	0	200	200	200
	FTE	0	0	0	0	0	0
National Geospatial Program		200	0	200	0	200	200
	FTE	0	0	0	0	0	0
Total Requirements ($000)		**12,010**	**7,974**	**4,036**	**10,459**	**22,469**	**14,495**
	Total FTE	**11**	**3**	**8**	**58**	**69**	**66**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Justification of 2014 Program Changes

The 2014 budget request for the USGS's WaterSMART Availability and Use Assessment initiative is $22,469,000 and 69 FTE, a program increase of +$14,495,000 and +66 FTE from the 2012 Enacted level.

Overview

As competition for water resources grows for irrigation of crops, for growing cities and communities, for energy production, and for the environment, the need for information and tools to aid water and natural resource managers grows. WaterSMART is a Department of the Interior initiative that leverages and directs existing expertise and resources within the USGS (along with the Bureau of Reclamation) towards addressing complex, national and regional-scale water challenges. Among the primary focuses of the WaterSMART initiative are developing a national water census, better understanding water budgets, supporting ecologically-sound water management, and better understanding the connections between water quality and availability. Leveraging expertise across multiple disciplines enables a broader focus to address these challenging issues in a time of growing competition for water resources. The USGS possesses both the skills and foundational resources to unlock this knowledge and provide water resource, ecosystem, and land use managers the decision support tools to make more informed decisions. The goal of this initiative is to provide a well-integrated and thorough understanding of how water quantity and quality combine to influence water availability for human and ecosystem uses. USGS expertise in understanding the hydrologic cycle, water geochemistry, land use effects on water, human water use, and the ways in which water quality and quantity affect the natural environment make the USGS the premier

science agency to address this issue. WaterSMART, through the combined efforts of Bureau of Reclamation in the West and the USGS throughout the entire Nation, provides the foundation for a sustainable water strategy. The Nation will be well served through this effort, by gaining the ability to balance water resource sustainability through consideration of water quantity, quality, and uses, including ecological uses.

Program Performance

Water Quality Enhancement **(+$5,986,000/+25 FTE)**

National Water Quality Assessment (+$275,000/+2 FTE)

This funding increase within the National Water Quality Assessment subactivity is being implemented in the 2013 Operating Plan.

Fisheries	(+$1,386,000/+5 FTE)
Contaminant Biology	(+$1,000,000/+3 FTE)
Toxic Substances Hydrology	(+$1,800,000/+4 FTE)
National Water Quality Assessment	(+$1,525,000/+11 FTE)

Efforts in this area would produce a national synthesis of knowledge on the degree to which water quality influences the quantity of water suitable for both human and ecosystem uses. In 2014, the USGS would publish the results of synthesis efforts for five of the Nation's principal aquifers. Each report would describe what is known about water quality conditions for principal aquifers, the natural and human factors influencing water quality conditions, and the implications for water availability. The national synthesis would focus on understanding the natural and human-induced variability in quality across the Nation; developing fundamental ways of assessing the degree to which environmental contamination affects water quality, human and ecological exposure, and the associated adverse ecological effects on aquatic organisms; and improving understanding of the cause-and-effect linkages between water quality and availability. This involves the integration of water quality and quantity information in relation to the human and ecological needs for water in priority and representative settings across the Nation. The synthesis effort would add a strong component of water quality to the water availability analysis. Water quality would be examined in the context of suitability of ambient water for environmental needs, as well as potential increased costs for making the raw water suitable for intended human needs.

The USGS would identify the highest priority water resource contamination issues facing the Nation. Contaminants of emerging environmental concern would be identified. Studies would evaluate the overlay chemical occurrence with habitat utilization and land management practices in order to better quantify risk, and evaluate potential tools that resource managers might use to reduce exposure and impacts to terrestrial and aquatic organisms. New methods would be developed to measure these emerging contaminants and their impacts on the environment at levels that enable systematic assessment by monitoring and compliance programs. The information provided would guide decisions related to reducing environmental release of contaminants, protecting natural resources, and safeguarding public health. Models would be developed that use this information to enable evaluation of the regional and national implications of emerging environmental contamination issues

Ecological (or environmental) flows are defined as the quantity, quality, and timing of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems. Ecological flow recommendations are utilized by water management authorities to establish flow criteria, often minimum flow criteria, into allocation decisions for water withdrawals from streams, rivers, or basins. However, rivers, streams, and estuaries also support a wide

range of other ecosystems services with significant monetary and non-monetary benefits to society. With increased demand for consumptive freshwater use for domestic supply, agriculture, manufacturing, and energy production, there is a growing need to incorporate ecosystem service valuation into ecological flow guidelines that allow water managers to quantify trade-offs in monetary and non-monetary costs of water allocation decisions.

The following research in collaboration with Federal, Tribal, State, academic, and private partners would support better incorporation of ecosystem services valuation into current ecological flow recommendations:

- Coordinate data collection and analysis to qualitatively describe and quantitatively value the impact of alternative ecological flows on ecosystem services. Characterize and aggregate ecological and biological data (State, Tribal, and Federal) to support ecological flow criteria development and describe the ecosystem services and their values associated with alternative streamflows;
- Incorporate ecological services modules into existing water availability studies (WaterSMART) and biological components to existing nutrient transport models like Spatially Referenced Regressions on Watershed attributes (SPARROW). Development of information and tools to assist in understanding flow relationships on ecosystem services in the Upper Colorado River, Delaware River, and Apalachicola-Chattahoochee-Flint basins. Evaluate the transferability of science from one study basin to another. Incorporate a biological component into the Chesapeake Bay SPARROW model to help explain divergence of model nutrient loads from measured concentrations;
- Develop web-based tools to support the acquisition of ecological flow data and related ecosystem service information by stakeholders. Develop a cyber-data portal to allow researchers and others access to ecological data from a common database. The portal would be based on common technology standards for exchanging and integrating environmental observations and would enable connections to other large data collections including water-quality data collected by Federal, State, and tribal organizations. Stakeholder access would be through map-based displays and would serve biological and hydrologic information to facilitate studies of ecological flow at regional, state, or basin scales and their impact on ecosystem services; and
- Develop methods for incorporating ecosystem services into adaptive management and structured decision processes. Develop effective methods and practices of transferring information on ecosystem service valuation into ecological flow guidelines and decisions within adaptive management and structured decisionmaking processes.

National Groundwater Monitoring Network **(+$763,000/+3 FTE)**

Land Change Science (+$136,000/+0 FTE)

This funding increase within the Land Change Science Program subactivity is being implemented in the 2013 Operating Plan.

Groundwater Resources (+$627,000/+3 FTE)

The SECURE Water Act Section 9507(b) authorizes a National Groundwater Monitoring Network (NGWMN) to develop a systematic monitoring program for each major aquifer system in the United States, and to complete implementation of the groundwater Climate Response Network (CRN) into each of the Nation's 366 Climate Divisions. The proposed increase would support implementation of these two efforts, but would not fully fund the activities. The CRN would be expanded into additional

Climate Divisions. This effort would provide valuable data during ongoing and future droughts. The first year funding would be made available in 2014 to begin the implementation of the NGWMN as conceptualized by the Advisory Committee on Water Information, Subcommittee on Ground Water in its 2009 report, "A National Framework for Ground Water Monitoring in the United States." This initial funding would allow the NGWMN to move from the current pilot stage and begin initial implementation of the Network. The pilot scale NGWMN data and information portal would be upgraded to production scale, and the USGS would provide technical assistance to partner data providers who volunteer to join the NGWMN.

Regional Estimates of Baseflow and Recharge **(+$1,200,000/+4 FTE)**

Groundwater Resources (+$1,200,000/+4 FTE)

As part of the regional groundwater availability studies being conducted by the Groundwater Resources Program, water budgets are developed for a subset (40 of 62) of the priority principal aquifers mapped in the United Sates. Estimates of baseflow and recharge for the United States are required in a timely manner to generate water budgets for every watershed in United States under WaterSMART. In 2014, the GWRP would use the resources provided to develop regional techniques and further develop methods to extrapolate estimates of these parameters from areas currently being analyzed to areas with similar characteristics that are not scheduled for detailed study.

National/Regional Synopsis and Surveys **(+$500,000/+5 FTE)**

National Water Quality Assessment (+$275,000/+2 FTE)

This funding increase within the National Water Quality Assessment subactivity is being implemented in the 2013 Operating Plan.

National Water Quality Assessment (+$225,000/+3 FTE)

The USGS would conduct regional, multi-disciplinary streamflow and water-quality surveys to: (1) determine contaminant concentrations in relation to land use and chemical use in selected regions; (2) determine links between streamflow, contaminant conditions, and ecological impairment; and (3) evaluate the significance of contaminant distributions and levels to sources of drinking water. The first of these regional assessments is being developed in collaboration with the States and the U.S. Environmental Protection Agency's (EPA) National Rivers and Streams Assessment Program and will focus on stream quality in the agricultural Midwest, a region encompassing parts of 12 states. Other areas that are candidates for Regional studies in 2014 include the humid southeast, arid southwest, the Atlantic Highlands, and the Rocky Mountains. Targeted regional studies would provide resource managers with data and tools to understand and predict ecological conditions in relation to streamflow alteration and concentrations of contaminants, nutrients, and sediment.

Predictive Models **(+$500,000/+3 FTE)**

National Water Quality Assessment (+$275,000/+1 FTE)

This funding increase within the National Water Quality Assessment subactivity is being implemented in the 2013 Operating Plan.

National Water Quality Assessment (+$225,000/+2 FTE)

USGS researchers would develop predictive models, visual displays of scientific information, and other decision-support tools for developing scenario analyses on the water quantity and quality linkage and the effects on vulnerable resources, human uses, ecosystems, and species. These models would incorporate water quality data that have been collected by the USGS systematically across the Nation, and through geochemical studies of water and rock interactions. USGS water quality models**,** such as SPARROW and Watershed Regressions for Pesticides (WARP), which link concentrations and loads of pesticides, nutrients, sediment, or salinity to sources and hydrologic conditions would also be enhanced and improved through this effort. Dynamic SPARROW models that would predict changes in water quality in response to changes in land cover or hydroclimatic conditions would be developed.

Program and Information Management **(+$2,300,000/+7 FTE)**

National Water Quality Assessment	(+$275,000/+1 FTE)
Hydrologic Networks and Analysis	(+$1,100,000/+2 FTE)
National Geospatial Program	(+$200,000/+0 FTE)

These funding increases within the National Water Quality Assessment, the Hydrologic Networks and Analysis, and the National Geospatial Program subactivities are being implemented in the 2013 Operating Plan.

National Water Quality Assessment	(+$225,000/+2 FTE)
Hydrologic Networks and Analysis	(+$300,000/+2 FTE)
National Cooperative Geologic Mapping	(+$200,000/+0 FTE)

Managing the various data streams and integrating this information into a cohesive picture is a major effort under WaterSMART. In 2014, work to store, integrate and serve the data and information about water budget components within a defined watershed would continue. A pilot Web-based system is being developed with the capability to identify a watershed of interest and then access all information on daily streamflows, recharge, precipitation, evapotranspiration, changes in storage and monthly water use characteristics for that watershed and all watersheds above it. The same system would be used to develop the overall water budget and access information on historical trends in water budget components. New national and regional models of potential stressors, such as altered streamflow, nutrient delivery, and contaminant toxicity, would provide managers with critical information on stressors that affect ecological health. Other data and information management efforts would focus on supporting needs for stream ecological science by providing more effective ways to access biological data from multiagency sources and integrate that data with hydrologic information. WaterSMART would enhance USGS capabilities that link concentrations and loads of water quality constituents to the water resources that they influence, so that the consequences of changing water quality can be related to overall water availability. The USGS would integrate existing information with decision-support tools that facilitate exploitation of that information in a manner that is relevant to natural resource management and public use decisionmaking.

WaterSMART efforts would integrate water use location information into the National Hydrography Dataset. Such locations, from the Site-specific Water Use Data System (SWUDS), are places where water is withdrawn, diverted, transferred, or returned to the Nation's hydrographic network. The integration of these data would allow managers to view and model the downstream and interbasin effects of water use. The increase to the National Cooperative Geologic Mapping Program would be used to provide 3D subsurface geologic frameworks of glacially-derived deposits in the northern United States.

Streamflow Estimation and Stressors to Hydrology - Water Use Research (+$2,300,000/+12 FTE)

Hydrologic Research and Development	(+$300,000/+2 FTE)
Cooperative Water Program	(+$2,000,000/+10 FTE)

USGS researchers are developing a system by which water managers and the public would be able to access and use critical water budget information in their water availability analyses. Streamflow is one of the most critical components of a water budget. Water resource managers require this information at temporal and spatial scales which the USGS is unable to deliver through traditional monitoring programs. In order to deliver this information, the USGS must make use of hydrologic models in addition to traditional monitoring networks. These models must deliver daily values of streamflow at spatial scales relative to very small watersheds everywhere in the Nation. In order to support these models and deliver streamflow data that are of acceptable quality, the USGS must undertake various activities that improve the certainty of models for areas of the Nation where measured hydrologic information is sparse. These activities include acquisition of information on the hydrological characteristics of open-channel flows, additional data layers of basin characteristics, and representative streamflow discharges and velocities. The funds from the Hydrologic Research and Development and Cooperative Water Programs would be used to acquire this information and feed it into the models that are used to estimate streamflow data for water budget analysis under the WaterSMART water availability and use assessment. As with all, Cooperative Water Program efforts, appropriated funds could be leveraged by non-Federal partners who are interested in and willing to further these objectives.

Water use information, which delineates the direct hydrologic stresses caused by human water withdrawals and return flows, is also critical information for WaterSMART's water budget analysis. This information, which is mostly collected at State, tribal, regional, and local governmental levels, must be obtained on a geospatially site-specific scale in order to be fully useful in WaterSMART analyses. Directed work is required to develop better methods of sampling, estimating, aggregating, and presenting water use data. Research into new methods that use remote sensing and spatial datasets in water use estimation is needed. The research and networks and analysis functions of the USGS would work together to advance the development of those methods for use within the WaterSMART initiative. In addition, the Cooperative Water Program would work directly with State, tribal, regional, and local cooperators to make maximum use of their water use datasets in the water availability and use assessment. Priority would be placed on irrigation and self-supplied industrial water use. The USGS would integrate this information with decision-support tools that facilitate use of that information in a manner that is relevant to water resource management decisionmaking.

Estimating Water Budget (+$100,000/1 FTE)

Hydrologic Networks and Analysis	(+$100,000/1 FTE)

USGS researchers are developing a system by which water managers and the public will be able to access and use critical water budget information in their water availability analyses. New or improved methods for estimating various components of water use would be developed. Better estimates of the various components of the water budget also would allow the development of better flow and ecological models.

Ecological Flows and Water Use Science **(+$846,000/6 FTE)**

Hydrologic Networks and Analysis (+$846,000/6 FTE)

The USGS is advancing the understanding of the water availability needs of wildlife and habitat through the following major efforts:

- Developing a classification system, for use by stakeholders, of the streams across the Nation based on their hydro-ecological type;
- Systematically assembling and making available to the public biological and hydrological datasets for use in flow alteration–ecological response analysis;
- Developing statistical tools that allow stakeholders to analyze these data for their areas of interest and incorporate ecological water needs into water availability analysis; and
- Supporting ecological water needs work in geographic focus area studies.

In 2014, the USGS would begin the process of developing a statistical modeling approach to make the connection between hydrology and biology within any target watershed. This effort connects with the streamflow estimation and hydro-ecological classification efforts of WaterSMART. The USGS would look at a particular watershed and postulate what could be accomplished with differing levels of data ranging from data-poor to data-rich environments. This effort would be tested in 2014 in a variety of basins where the USGS possesses robust biological and hydrological datasets, for example biological GAP datasets.

Water use information would be made available in databases containing key hydrologic information that addresses precipitation; water in snowpack, ice fields, and large lakes; evapotranspiration; stream and river run-off characteristics; total water withdrawals by source; stream and river baseflow characteristics; interbasin transfers; groundwater level indices; consumptive uses; rates of groundwater recharge; changes in groundwater storage; and return flows.

Youth Stewardship: Earth Scientists for Tomorrow

Earth Scientists for Tomorrow						
	2013 Full Yr. CR (PL 112-175)	2012 Enacted	Changes	Program Changes (+/-)	2014 Budget Request	Change from 2012 Enacted (+/-)
Science Support	*1,602*	1,602	0	1,000	2,602	1,000
FTE	*0*	0	0	0	0	0
Total Requirements ($000)	***1,602***	**1,602**	**0**	**1,000**	**2,602**	**1,000**
Total FTE	***0***	**0**	**0**	**0**	**0**	**0**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Justification of 2014 Program Changes

The 2014 budget request for the USGS's Youth Stewardship initiative is $2,602,000 and 0 FTE, a program increase of +$1,000,000 and 0 FTE from the 2012 Enacted level.

Overview

The USGS has a proud history of mentoring and engaging the youth of the Nation. Prior to Secretary Salazar implementing the Youth Stewardship Agency Priority Goal (APG), the USGS had successful programs in place that provided a broad array of research and learning experiences to young people in the geosciences. Two programs that are excellent examples are the National Association of Geoscience Teachers (NAGT)/ USGS Cooperative Summer Field Training Program and EDMAP, a component of the National Cooperative Geologic Mapping Program. These mentoring opportunities are aimed at engaging and grooming students in pursuit of scientific careers, increasing science literacy, and instilling a sense of stewardship for the Earth. In 2014, the USGS would expand its education and internship programs for underrepresented students in Earth science fields relenvent to the USGS mission and recruitment needs, including tribal colleges and veterans, as well as expanded partnerships in support of the 21st Century Conservation Service Corps.

USGS engagement with youth covers a broad age range. Typically, USGS outreach activities and science camps are aimed at elementary and secondary school students, while internship programs employ students in high school, colleges and universities, and graduate school. The USGS also engages and hires post graduate young scientists that are critical to the development of the USGS science mission. The USGS values and supports youth programs and activities across the Nation.

As the Federal workforce faces the retirement eligibility of 53 percent of permanent full-time employees by 2014 (per OPM estimates), the USGS considers the development of a science workforce of tomorrow a vital tool in succession planning and passing on institutional knowledge.

Program Performance

Science Support **+$1,000,000/0 FTE**

21st Century Conservation and Natural Resources Science Corps **(+$1,000,000/0 FTE)**

Science Support – Office of Science Quality and Integrity (+$1,000,000/0 FTE)

As part of a proposed $10.0 million distribution among the Department of the Interior (Interior) bureaus, the USGS would receive an increase of $1.0 million to establish the science component of the 21st Century Conservation Service Corps , part of the America's Great Outdoors (AGO) initiative. This science component, the 21st Century Conservation and Natural Resources Science Corps (Science Corps), would put young Americans to work for USGS science programs, providing science for decisionmaking in support of protecting, restoring, and enhancing public and tribal lands and waters. The USGS would engage other Interior bureaus, Tribes, learning institutions and governmental and non-governmental organizations, to create partnerships and projects with the goal of developing USGS's next generation of scientists. The USGS provides critical early science experiences through its education programs, resources for teachers, and research oportunities for students to work with USGS scientists.

Career pathways in conservation and natural resources science would be provided to 50 students from underrepresented groups, by coupling Science Corps internships with cooperative training programs at two and four year colleges. This would help build upon and expand current hydrologic, biologic, and physical science technician programs with Gateway (Phoenix, AZ), Vermillion (Ely, MN), South Dakota, and Northern Virginia Community Colleges, and would be expanded to new minority-serving institutions and tribal colleges. The Science Corps would also provide internships, mentoring, and training in life skills, such as how to effectively apply to college, to approximately 50 urban high school youth by working with city governments, city schools, and inner city summer programs. Current pilot programs in Denver, CO, and Albuquerque, NM, would be expanded and new programs in Washington, DC, and other cities would be created. These examples highlight the USGS's unique role of working with a wide array of cooperators to bring world class Earth science to decisionmakers, communities, and schools.

The development of a new general Science Corps program of approximately 100 undergraduate students would work with the Interior bureaus and other partners, such as the National Science Foundation, University of Texas, Student Conservation Association, and GeoCorps America to create recruitment, hiring, and project placement processes that can be readily used by others. The students would work with USGS scientists and others on projects that support USGS mission goals. In addition, an effective, low cost evaluation methodology would be developed and implemented to ensure USGS youth programs are meeting goals, are based on best practices, and provide an evidence-based improvement process.

Science for Adapting to a Changing Climate

Science for Adapting to a Changing Climate							
		2013 Full Yr. CR (PL 112-175)	2012 Enacted	Changes	Program Changes (+/-)	2014 Budget Request	Change from 2012 Enacted (+/-)
National Climate Change and Wildlife Science Center/DOI Climate Science Centers (CSC)		*25,198*	25,198	0	10,094	35,292	10,094
	FTE	*48*	48	0	9	57	9
Climate Research & Development		*21,759*	21,759	0	3,351	25,110	3,351
	FTE	*133*	133	0	10	143	10
Carbon Sequestration		*4,437*	4,437	0	2,958	7,420	2,983
	FTE	*19*	19	0	5	24	5
Total Requirements ($000)		***51,394***	**51,394**	**0**	**16,403**	**67,822**	**16,428**
	Total FTE	***200***	**200**	**0**	**24**	**224**	**24**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Justification of 2014 Program Changes

The 2014 budget request for the U.S. Geological Survey's Science for Adapting to Changing Climate initiative is $67,822,000 and 224 FTE, a program increase of +$16,428,000 and +24 FTE from the 2012 Enacted level.

Overview

Climate change is one of the greatest natural resource challenges the world faces. In both President Barack Obama's January 2013 inaugural speech and his 2013 State of the Union address, President Obama stated "…we must do more to combat climate change." The overwhelming judgment of science is that the climate is changing, and it is important to be prepared for extreme weather events and other impacts. American prosperity, security, resilience, and sustainability require investments in activities designed to improve our understanding and strengthen the Nation's climate preparedness and resilience. The USGS has conducted climate change research for over 100 years in an effort to understand the impact of climate change on humans and wildlife. In particular, the National Climate Change and Wildlife Science Center (NCCWSC)/Department of the Interior Climate Science Centers (CSC) Program, the Climate Research and Development (R&D) Program, and the Carbon Sequestration program in the USGS Climate and Land Use Change Mission Area all conduct research to inform resource managers' strategies to mitigate and adapt to climate change. Continued research leveraging all of these programs' strengths is needed to better understand climate change impacts on natural resources and the infrastructure of the Nation.

Program Performance

Climate and Land Use Change +16,403,000/+24 FTE

National Climate Change and Wildlife Science Center/Department of the Interior Climate Science Centers (+10,023,000/+9 FTE)

Established in 2008, the NCCWSC has created eight regional CSCs to provide resource management agencies with science and technical support on the impacts of climate change on fish, wildlife, and ecological processes. In early 2013, Interior released a policy that requires Interior bureaus and offices to incorporate climate adaptation into policies, programs, planning, and operations. Fundamental to such a policy, and essential for developing priorities for adaptations, is an improved understanding of Interior's

most vulnerable assets. Federal studies are underway that relate to the vulnerability of lands, water, wildlife, cultural resources, and other resource management responsibilities. In 2014 the NCCWSC would use work with an existing interagency coordination group to develop a public cross-agency database and field guide to vulnerability assessments. This would support Interior and other agencies in establishing standards and best practices and tracking progress for such assessments, and in strategically prioritizing management actions.

Interagency coordination would be important during the building and maintaining of the vulnerability assessment database. Interagency coordination would help to eliminate redundancy and make maximum use of existing data and information. In 2014, the NCCWSC would use a portion of the new funding to develop and implement the technical means to track relevant climate change adaptation science across Federal agencies and ensure the availability of this information in a web accessible format at the regional and national scale. Additionally, the CSCs would work with regional partners to identify common priorities and develop multi-agency strategies that ensure coordinated implementation of public science investments to target the most critical management needs. This cross-agency dialogue convened by the CSCs represents a critical component of an effective and efficient Federal response to the climate science needs of managers. Investment in better coordination allows the NCCWSC/CSCs to better leverage the capacity and expertise of existing institutions and better meet the needs of decisionmakers.

The NCCWSC/CSCs would use additional funding in 2014 for translational science grants, particularly in resource management and in coordination with the biologic carbon sequestration project. The CSCs would significantly expand their activities that support adaptation planning, with a focus on meeting the needs of specific decisions and planning activities, and on delivering application-ready information. The CSCs would develop an approach that uses decision-focused methods to identify policy choices that could be informed by research outputs, then develop working groups of scientists, managers and decisionmakers to assure that science projects provide decision ready outcomes. Establishing an ongoing collaboration between research scientists and land managers is essential to the successful application of decision science. The NCCWSC would work with the biologic carbon sequestration project to find common themes and incorporate national assessment results into adaptation planning. The CSCs would pilot this effort through regional projects focused on sea level rise impacts to coastal habitats and on the impacts of extended drought on ecosystems.

The NCCWSC/CSC Program would also use additional funding to better develop tribal climate science partnerships. As Native American communities confront the challenge of a changing climate, their demand for scientific and planning information grows. The CSCs would work with tribes to identify a suite of high priority tribal resource management concerns and build a science portfolio that provides information directly responsive to these needs. In addition, the NCCWSC and CSCs would work to identify best practices for the potential integration of traditional ecological knowledge into science and funding opportunities. These efforts would be guided and supported by participation of tribal interests on CSC stakeholder committees and on the Federal advisory committee established to guide the NCCWSC. These efforts will also be coordinated with the Bureau of Indian Affairs climate programs, tribal governments, consortia, and organizations, and other Federal climate efforts in Indian Country.

Climate Research and Development **(+3,172,000/+10 FTE)**

For more than fifty years, the Climate Research and Development (R&D) Program has supported fundamental multidisciplinary research needed to understand patterns of climate and land use change and their impacts on the Earth system. In 2014, the Climate R&D Program requests an increase of $3.2 million to focus efforts on emerging science needs. This research would increase capabilities of the Climate R&D Program to understand regional responses to climate and land use stressors and to forecast impacts of different climate and land use scenarios.

An important emerging science need is the identification and documentation of long-term patterns of drought, storms, and ocean circulation. Recent drought events and model projections of increased aridity in parts of the world have raised concerns about the ability of society to respond to and mitigate impacts of altered water availability. Because monitoring of climate variables such as temperature and precipitation spans only the last century or so, it is critical to integrate them with fossil and chemical indicators of past climate to understand the magnitude, frequency, spatial impacts, and drivers of droughts and megadroughts (events that lasted decades). In 2014, the Climate R&D Program plans to initiate a coordinated research effort to document baseline levels of variability in water resources across the United States, complemented by research on ocean variability to determine whether changes in ocean circulation are tied to droughts, storms, and other events that affect coasts, urban areas, agriculture, and other sectors in our Nation.

Because of the high concentration of the U.S. population along our Nation's coastline, a rising sea level would have significant impacts on society, infrastructure, and coastal habitats that serve as buffers from storm surges and severe weather events. One emerging science need is to improve our ability to accurately forecast rates and magnitudes of future sea level rise. This can be done by understanding the potential contributions of melting glaciers and ice sheets to sea level. In 2014, The Climate R&D Program would conduct research to develop consistent methods to measure the amount of water contained in alpine glaciers. This research would reduce uncertainties regarding how much fresh water released from melting glaciers that leads to sea level rise. The Climate R&D Program would expand research on geologic records of past high sea levels. This effort would document the amount of sea level rise during past warm events as well as improve the interpretation of the impacts of melting of Antarctic and Greenland ice sheets versus warming of the oceans on sea level rise.

Another emerging science need is the response of coastal habitats to combined effects of sea level rise and changing land use. Both stressors affect the distribution of plant communities and the ecosystem services that they provide. In 2014, the Climate R&D Program would expand efforts to integrate ecological research on existing plant communities with reconstructions of past vegetation and aquatic communities to improve our understanding of how coastal habitats respond to specific changes. By designing projects in consultation with resource managers within national parks and U.S. Fish and Wildlife (FWS) Refuges, the results should facilitate development of sustainable resource management strategies for the Nation's coastlines.

An effective application of climate research to address resource management needs requires ongoing communication between USGS scientists and resource managers as well as an understanding of our scientific capabilities and limitations. This requires Climate R&D Program scientists to work with stakeholders in public lands to identify their most pressing science needs and coordinate with researchers to develop projects to address those needs. In 2014, the Climate R&D Program and the NCCWSC propose cost-sharing of staff with expertise in both natural resource management and research to work with stakeholders and researchers to design research efforts aimed at providing data on ecosystem response to climate and land use changes over appropriate temporal and regional scales that would facilitate development of sustainable management plans.

Biologic Carbon Sequestration **(+2,958,000/+5 FTE)**

In accordance with the Energy Independence and Security Act of 2007, the USGS began in 2009, assessing the potential capacity of carbon sequestration in ecosystems. In 2014, the USGS would complete the first-ever national assessment of carbon stocks and carbon sequestration for all ecosystems and evaluating effects of all major driving processes. This biological national assessment encompasses all 50 states and would provide estimates for both current conditions and for future carbon sequestration capacities. The biological carbon sequestration project is requesting new funding in 2014 to improve

methods and models, so that changes in ecosystem carbon storage can be monitored and reported consistently, future periodic assessments can be made with improved accuracy and confidence, and land managers and policymakers can use the assessment results in land management decisions.

The biological carbon sequestration assessment project would use a portion of the requested funding increase to improve methods and models for accounting and monitoring carbon in ecosystems. Research is needed to better quantify and monitor changes in carbon storage related to land use and climate change, so that such changes can be evaluated and reported consistently and in a timely manner. This new research includes developing methods in remote sensing; land use and land cover change detection; the mapping of fire and other natural disturbances; linking land use/cover change and ecosystem carbon models; and creating statistical methods that analyze and scale data from the USGS streamgage network. Besides the anticipated improvement in methods and models, the biologic carbon sequestration project would focus on the following thematic areas that represent key science and information gaps: the quantification of greenhouse gas emissions in different types of wetlands; the impacts of non-fire disturbances such as insect infestation and diseases; the integration of terrestrial and aquatic processes in selected watersheds; and the development of improved land use carbon models and testing of such models in selected ecosystems. Additional funding would be used to support adapting and enhancing existing ecosystem service portfolio models that would be used to support land management applications. Specific algorithms and calibrations that would be incorporated are tailored to the needs of specific land management applications.

The biological carbon sequestration project would also use a portion of the requested funding increase to link the national biological carbon sequestration assessment results to land management applications particularly in the FWS and the National Park Service (NPS).). The USGS will also reach out to the BIA to identify potential for integrating biological carbon sequestration into Tribal resource managers' decisionmaking. The USGS plans to collaborate with the FWS, the NPS, and academic experts on quantifying and reducing uncertainties in the estimates of the national assessment and developing decision support mechanisms such as models, workshops, and experiments. The goal of quantifying and reducing uncertainties in estimating carbon stocks and sequestration is to increase the accuracy and confidence of the assessment results. This work would quantify the uncertainties of the assessment and develop strategies for reducing these uncertainties by focusing on the scientific gaps identified. The goal of developing decision support tools is to allow land managers to ask “what-if” questions regarding potential land management strategies on carbon stocks and sequestration capacity, as well as on other ecosystem services, such as biodiversity, water quality, etc. These tools are effective only if they can be developed together with land managers and other users who have intimate knowledge of management and community requirements. The requested new funding would help the USGS to: conduct facilitated workshops with land management agencies to identify requirements and possible management actions; develop landscape or watershed-scale data to improve the resolution of the assessment results; test and adapt different ecosystem services management models; develop specific management tradeoff scenarios and related algorithms; and develop visualization tools. This project would be a multi-year collaboration that would continue through 2018.

Ecosystem Priorities

Ecosystem Priorities		2013 Full Yr. CR (PL 112-175)	2012 Enacted	Changes	Program Changes (+/-)	2014 Budget Request	Change from 2012 Enacted (+/-)
California Bay-Delta		*6,002*	6,002	0	2,982	8,984	2,982
	FTE	*12*	12	0	4	16	4
Chesapeake Bay		*7,349*	7,349	0	1,815	9,164	1,815
	FTE	*29*	29	0	5	34	5
Columbia River		*12,537*	12,537	0	854	13,391	854
	FTE	*48*	48	0	2	50	2
Everglades		*6,882*	6,882	0	1,000	7,882	1,000
	FTE	*30*	30	0	2	32	2
Great Lakes		*3,117*	2,617	500	1,500	4,617	2,000
	FTE	*8*	6	2	2	10	4
Puget Sound		*6,396*	6,396	0	1,019	7,415	1,019
	FTE	*26*	26	0	2	28	2
Upper Mississippi River		*5,362*	4,862	500	700	6,062	1,200
	FTE	*24*	23	1	3	27	4
Klamath Basin		*2,631*	2,631	0	901	3,532	901
	FTE	*0*	0	0	4	4	4
Eco Informa		*500*		500	300	800	800
	FTE	*0*		0		0	0
National Ecosystems Services Framework		*0*	0	0	1,000	1,000	1,000
	FTE	*0*	0	0	1	1	1
Land Use Science		*0*	0	0	1,000	1,000	1,000
	FTE	*0*	0	0	4	4	4
Sustaining Environmental Capital		*500*	0	500	1,500	2,000	2,000
	FTE	*1*	0	1	1	2	2
Total Requirements ($000)		***51,276***	**49,276**	**2,000**	**14,571**	**65,847**	**16,571**
Total FTE		***78***	**74**	**4**	**30**	**208**	**34**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Justification of Program Change **(+$16,571,000/+34 FTE)**

The 2014 budget request for Ecosystem Priorities is $65,847,000 and 208 FTE, a program increase of +$16,571,000 and +34 FTE from the 2012 Enacted.

Overview

Knowledge of ecosystems is critical to the well-being of the Nation because ecosystems supply the natural resources and other goods and services that humans require. The scope of science needed to improve conservation and restoration of ecosystems is complex. Regional environmental resource issues in many ecosystems are at critical decisionmaking junctures as they are challenged with balancing human needs with ecosystem health. The multidisciplinary approach applied by the USGS is necessary to develop an understanding both of individual ecosystem processes as well as holistic ecosystem level evaluations of responses to actual and proposed restoration alternatives and plans. Science enables resource managers to make informed decisions, to help resolve and prevent resource management conflicts, and to support the Interior's public trust stewardship responsibilities for the Nation's lands and waters.

Increases in 2014 support research and development efforts focused in the California Bay-Delta, the Chesapeake Bay, the Columbia River, the Everglades, the Klamath Basin, and Puget Sound. They also support critical invasive species research, including research on Asian carp control in the Great Lakes and the Upper Mississippi River Basin. These studies are designed to serve local ecosystem management

needs and provide knowledge and approaches transferable to similar ecosystems across the Nation. Specific research efforts are also focused on invasive brown tree snakes and white-nose syndrome in bats. Actions are being implemented to better understand and support decisionmaking in sustaining environmental capital.

Program Performance

California Bay-Delta **(+$2,982,000/+4 FTE)**

Environments Program	(+$1,000,000/+2 FTE)
National Water Quality Assessment	(+$1,000,000/+1 FTE)
Hydrologic Research and Development	(+$982,000/+1 FTE)

The California Bay-Delta Ecosystem (Delta) is recognized as one of the world's threatened treasures of biodiversity, supporting unique native species and their critical tidal and wetland habitats. Like other urban estuaries, this system has a history of anthropogenic changes involving multiple stressors including altered hydrodynamics, environmental contaminants, and invasive species that have degraded the ecosystem. The native fish fauna has been much reduced and key species are now protected by the Endangered Species Act. Among these species, the threatened Delta smelt most prominently impact human decisions about the movement of water through the system. The recovery of this species requires an improved understanding of habitat and ecosystem functions within the Delta. Policymakers now must plan for systemic changes that influence all stressors and parts of the system, including watersheds, rivers, deltas, bays, and the ocean. To assist policymakers, the USGS has developed a network of real-time flow monitoring stations in the Delta. These stations would be augmented to assist with determining the causes and rates of decreased sediment supply due to various alterations to the system and to monitor turbidity fields in the Delta, which may have implications for Delta smelt survival and movement. The USGS would expand its research efforts to understand how flow conditions, water quality, and fish behavior affect fish survival. In doing so, the USGS would advance fundamental understanding of the interactions among the physical, chemical, biological, and human components and multiple stressors of the Delta system to improve knowledge of system impacts to the Delta smelt and its critical habitat. Using this advanced understanding, USGS scientists would improve and develop advanced models of the Delta system to represent more comprehensively, and predict more realistically, Delta ecosystem component responses to management and restoration, including effects of climate change and potential seismic events. The USGS would advance the capability to collect, store, access, visualize, and share data and information about the Delta system, the vulnerabilities of Delta ecosystem components to change, and the potential responses to these vulnerabilities.

Chesapeake Bay **(+$1,815,000/+5 FTE)**

Environments Program	(+$615,000/+1 FTE)
Land Change Science	(+$500,000/+2 FTE)
Contaminant Biology	(+$100,000/+0 FTE)
Toxic Substances Hydrology	(+$100,000/+0 FTE)
National Water Quality Assessment	(+$500,000/+2 FTE)

The USGS provides science to restore the Nation's largest estuary and carry out the President's Chesapeake Bay Executive Order (EO) strategy and associated action plan. Interior, through the USGS, the FWS, and the NPS, is providing leadership, expertise, and resources to meet the major goals of the Chesapeake Bay Program (CBP) partnership and the associated EO to restore water quality, recover habitat, sustain fish and wildlife, and conserve lands and increase public access. The USGS has lead

responsibility under the EO (in collaboration with the National Oceanic and Atmospheric Administration's (NOAA) to strengthen science to support all of these goals. In 2013, the USGS had $7.3 million among multiple programs to conduct Chesapeake activities. In 2014, the requested $1.815 million increase would enhance activities to (1) restore brook trout and their habitats; (2) help identify contaminants affecting fish health; (3) forecast the effects of land change and sea-level rise on black ducks and their habitats (4) forecast effects of land and climate change on habitat conditions; (5) explain water-quality change, and (6) use remote sensing to assess effectiveness of conservation practices. This effort would be led by the programs listed below:

- Expand science to help restore Brook Trout and their habitats. The USGS worked with the FWS and partners to identify five research priorities to support brook trout conservation and restoration, which is an EO priority. Refining and developing patch-prioritization tools and assessing effects of shale-gas drilling would begin in 2014 (Environments Program in collaboration with Fisheries Program);
- Enhance science on the multiple factors affecting fish health in the Bay watershed and the associated effects and sources of toxic contaminants and endocrine-disrupting compounds. The USGS activities are needed to address recommendations in the recent EO report on the extent and severity of toxic substances and their biologic effects in the bay and its watershed. (Environments, Toxic Substances Hydrology and Contaminant Biology Programs);
- Assess the combined effects of land change and sea-level rise on black duck habitats. Additional funding would be used to improve energetics models for wintering black ducks within the Bay refuge system. A new effort would be started to have the energetics models coupled with new models of sea-level rise and land use change predict future impacts on coastal wetland and help identify the best areas for restoration of black duck habitats (Environments Program);
- Forecast the combined effects of land and climate change on habitat conditions. To support the brook trout, black duck, and water-quality studies, the USGS would enhance efforts to identify potential effects of land use and climate change by: (1) considering the potential effects of hydraulic fracturing and land change on stream quality; and (2) assessing potential changes in land cover on black duck habitats. (Land Change Science Program and Environments Program);
- Further investigate the factors affecting water quality to enhance progress toward the Bay total maximum daily load (TMDL). The USGS would enhance the use of models, land use information, and other data to explain changes in nutrients and sediment at key areas in the Bay watershed. The USGS has been asked by EPA and six States to better assess trends and explain the effects of water quality management practices as the Bay TMDL is implemented. The USGS would also work with the U.S. Department of Agriculture (USDA) to evaluate the effect of agricultural practices to improve water quality. (NAWQA, Environments, and Land Change Science Programs); and
- Increase research on the effectiveness of winter cover crops in reducing both soil erosion and nitrogen runoff from agricultural fields into the Chesapeake Bay. This research would support water-quality studies and is conducted in collaboration with the USDA Agricultural Resource Service, the Maryland Department of Agriculture, and local Soil Conservation Districts. Project scientists would use satellite-based remote sensing data products with site specific, privacy protected conservation program farm data records to measure cover crop success in preventing sediment and nutrients from reaching the Bay. (Land Change Science Program).

Columbia River (Salmon) **(+$854,000/+2 FTE)**

Environments Program	(+$300,000/+1 FTE)
Contaminant Biology	(+$100,000/+0 FTE)
Toxic Substances Hydrology	(+$100,000/+1 FTE)
National Geospatial Program	(+$354,000/+0 FTE)

The Columbia River is the largest river in the Pacific Northwest, and plays an important role in the Region's culture and economy through tribal fisheries, irrigation, power production, and recreation, among other goods and services. This system has been affected by a number of anthropogenic changes, including altered flows, environmental contaminants, and invasive species that have degraded the ecosystem. Managers and policymakers require scientific information to prevent the decline of critical species such as salmon, which are a valued tribal trust species; to manage ecological flows in this engineered river system; and to reduce risks from habitat degradation, changes in species composition, and climate change. With the proposed increase, the USGS would provide critical results to managers and decisionmakers on forage fish, which are a critical part of the Columbia River food web that supports a suite of important fish, bird and mammal species. The USGS would address forage fish life histories, invasive species, related climate impacts, chemical and physical habitat degradation, and effects on economic and trust species. USGS scientists would conduct research on the effect of altered flow regimes due to climate change and dam operations on habitats. A new Columbia River Treaty with Canada, which would take effect in 2025, could potentially affect flow regimes. USGS researchers would characterize ecological tradeoffs related to alternative flow regimes, as they affect physical habitat features, food webs, and ecological interactions influencing the sustainability of salmon, sturgeon and other key species populations. The increase in 2014 would address early detection and risk reduction of aquatic invasives in the Columbia River system. USGS researchers would determine conditions in mainstem, estuarine, and tributary systems that increase the risk of proliferation invasion of invasive species, and identify requirements for reliable early detection and adaptation/restoration actions by resource managers.

Everglades **(+$1,000,000/+2 FTE)**

Invasive Species	(+$1,000,000/+2 FTE)

In support of restoring the south Florida ecosystem and in partnership with the Comprehensive Everglades Restoration Plan and the South Florida Ecosystem Restoration Task Force (SFERTF), the USGS conducts scientific investigations to fill key science information gaps and to assist in the sustainable use, protection, and restoration of the South Florida ecosystem. South Florida is particularly vulnerable to the introduction and spread of invasive plants and animals and is highly colonized by a wide variety of exotic species such as water hyacinth, melaleuca, old world climbing fern, and the Burmese python. The SFERTF recognizes the challenges that invasive species pose to the success of overarching ecosystem restoration efforts. Funding would support high priority research needs identified by the interagency invasive species working group of the SFERTF, including quantifying ecosystem effects of invasive species to assist partnering agencies in deciding where best to allocate management and control efforts; filling key biological and ecological information gaps of invasive species to better inform early detection efforts of partnering agencies; and to improve methods to better detect and control species such as Burmese pythons, for which ecosystem effects have been documented.

Great Lakes **(+$2,000,000/+4 FTE)**

This funding increase within the Invasive Species subactivity is being implemented in the 2013 Operating Plan.

Invasive Species (Asian Carp) [+$500,000/+2 FTE]

Funding would augment current support of the ACRCC's Asian Carp Control Strategy Framework. This research focuses on providing scientific information and methodologies to better prevent, detect, and control Asian carp. Specific research activities include developing methods for the oral delivery of registered fish toxicants; identifying and developing attractant pheromones and food lures to aid in targeted removal of Asian carp from infested waters; and testing seismic technology as a means to affect the distribution of Asian carp and to restrict their passage through lock and dam structures. The proposed increase would enable research to accelerate from "proof of concept" stage to transferring technology to resource managers for field use.

Invasive Species (Asian Carp) (+$1,500,000/+2 FTE)

The ability of Asian carp to grow large, spread quickly, and become abundant has prompted national and regional planning efforts to prevent further introductions and to contain and manage existing populations. In 2009, the Administration established the Asian Carp Regional Coordinating Committee (ACRCC), which consists of Federal, State, and local agencies and other private stakeholder entities, to protect and maintain the integrity and safety of the Great Lakes ecosystem from an Asian carp invasion. The USGS, a charter member of this group, has been conducting research to provide critical information to the ACRCC since 2010.

Klamath Basin Restoration Agreement **(+$901,000/+4 FTE)**

Fisheries Program (+$901,000/+4 FTE)

The Klamath Basin Restoration Agreement was signed on February 18, 2010, and engages Federal, State and local government agencies, Tribes and non-governmental organizations with the intention of restoring natural production and providing for full participation in harvest opportunities of fish species throughout the basin, establishing reliable water and power supplies which sustain agricultural uses and communities and national wildlife refuges, and contributing to the public welfare and the sustainability of all basin communities through these and other measures. With this funding, the USGS would determine relationships between water availability, fish habitats, and water quality on sucker growth, condition, and survival in Upper Klamath and Clear lakes; investigate aquatic productivity with special attention to intensity, magnitude, and composition of plankton blooms; investigate production of blue green algae and transfer of cyanotoxins through food webs to endangered suckers; and assess the biological effects of exposures of cyanotoxins in leading to a possible bottleneck in population recovery. If these agreements are implemented, the application of research results would extend to the possible reintroduction of Chinook salmon in the Upper Klamath Basin and to enhanced understanding of the effects of harmful algal blooms throughout the basin.

Puget Sound **(+$1,019,000/+2 FTE)**

Environments Program	(+$369,000/+1 FTE)
Hydrologic Research and Development	(+$200,000/+1 FTE)
National Geospatial Program	(+$450,000/+0 FTE)

The Puget Sound (Sound), the second largest estuary in the United States, provides diverse benefits to a growing regional human population. It provides a home, recreation and economic opportunity to millions of people. The Sound is a natural resource treasure, supporting hundreds of species of fish, sea birds, and marine mammals, many of which are of enormous economic and cultural importance to the region. Human development and land use changes, as well as climate change, will likely affect the future sustainability of the Sound, particularly watershed and shoreline alterations that are likely to reduce critical habitat for species and reduce water quality. More than 20 Native American Tribes are protected in perpetuity in their uses of salmon. However, salmon are in decline due to reductions in habitat quantity and quality. The USGS is providing critical science to a major ecosystem restoration effort involving tribal, local, State, and Federal entities. The proposed increase would support managers and decisionmakers by developing process based monitoring and models at the ecosystem scale to identify and address risks to salmon. In addition, the USGS would investigate the status of forage fish populations—some of which are in decline—and identify linkages between population dynamics, bioenergetics, predation, habitat alterations, disease, and food availability. In support of the restoration, this work would result in new molecular tools and sampling methods. Finally, the recent removal of two major dams on the Elwha River is one of the largest river restoration projects in history, requiring active management of former submerged reservoir lands; use of hatcheries to supplement wild fish populations; and monitoring of specific aquatic, terrestrial, and near-shore marine responses of the ecosystem. USGS science would provide managers with information on ecosystem responses to specific post-removal restoration actions, to ensure that restoration is effective.

Upper Mississippi River **(+$1,200,000/+4 FTE)**

This funding increase within the Invasive Species subactivity is being implemented in the 2013 Operating Plan.

Invasive Species (Asian Carp) [+$500,000/+1 FTE]

Funding would support new research using priorities identified for the Upper Mississippi River System (UMRS) in the 2007 "Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States," as well as those identified in the newly released "2011 Asian Carp Action Plan" developed by the Minnesota-Wisconsin Asian Carp Task Force. The increase would augment ongoing USGS efforts initiated in 2013 and target specific research gaps identified in these collaborative planning efforts, including improving methods to detect Asian carp at low population levels; identifying habitats and locations most vulnerable to colonization by these invasive fishes; and improving methods for containment and control of Asian carp in UMRS habitats.

Invasive Species (Asian Carp) (+$500,000/+1 FTE)

The ability of Asian carp to grow large, spread quickly, and become abundant has prompted national and regional planning efforts to prevent further introductions and to contain and manage existing populations. The USGS is a charter member of the Minnesota-Wisconsin Asian Carp Task Force, the USGS was instrumental in helping to produce the 2011 Asian Carp Action Plan that assesses the threat to the Upper Mississippi River System posed by Asian carp and actions needed to minimize their impact, and has unique capabilities in the region to provide research critical to its implementation.

National Water Quality Assessment (+$200,000/+2 FTE)

This initiative builds on ongoing USGS activities in the Upper Mississippi River Basin (Basin). The Basin contains a wide diversity of landscape types that include major agricultural operations headwaters with major urban landscapes. Both landscape types can have negative impacts on aquatic ecosystem health of the Mississippi River and connecting rivers downstream resulting in maintaining or expanding hypoxia conditions in the Gulf of Mexico. Existing USGS programs in this region are developing a better understanding of water resources through critical streamflow measurement stations that characterize water quality. The USGS has been collecting samples of contaminants of emerging concern and learning about the potential effects of these contaminants on aquatic organisms living in the streams and rivers. Data collections and interpretive studies addressing water quality concerns are shared with State and local partners in this five State region (Minnesota, Wisconsin, Illinois, Iowa and Missouri).

Sustaining Environmental Capital **(+$2,000,000/+2 FTE)**

Environments Program (+$500,000/+1 FTE)

This funding increase within the Environments subactivity is being implemented in the 2013 Operating Plan.

Environments Program (+$1,500,000/+1 FTE)

The President's Council of Advisors on Science and Technology (PCAST) recommended that the Federal government provide "integrated information on the condition of U.S. ecosystems, including but not limited to their biodiversity, as well as on measures of ecosystem services flowing from them and the contributions of these to human health, economies, and other aspects of well-being." The USGS is contributing to that goal by bringing together data on water and aquatic organisms (from NAWQA, Water SMART and other studies), and ecosystem services. The objective is to provide resource managers access to ecosystem service valuations based on these scientific data, which are integrated within a decision support system. The USGS would build this information and capability into PCAST's online resource for ecosystem services, habitat criteria, and biodiversity information, EcoINFORMA (Ecoinformatics-based Open Resources and Machine Accessibility). The ultimate goal is to develop a national level ecosystem service valuation tool that can be used in conjunction with ongoing streamflow monitoring programs (e.g., NAWQA and WaterSMART) for decisionmaking. The increase request would provide for the development of methodologies in several pilot areas, and gaps in information being identified. These contribute to the Federal PCAST effort by providing a linked package of tools and data to support valuation of ecosystem services information for water based resource decisionmaking, a key element in the overall Federal ecosystem services blueprint.

In addition, the increase would enable the USGS ultimately to build standard methods and a National capability to value water related ecosystem services. By adding an ecosystem services component, the USGS would be able to assess trends in ecosystem services, and provide ecosystem service information to a broad network of resource managers for decisionmaking. The USGS would determine the conditions under which these methods can be used as standard methods, and the applicability of these methods to other geographic areas.

National Ecosystem Services Framework **(+$1,000,000/+1 FTE)**

Environments Program (+$1,000,000/+1 FTE)

The President's Council of Advisors on Science and Technology (PCAST) recommended that the Federal government provide "integrated information on the condition of U.S. ecosystems, including but not limited to their biodiversity, as well as on measures of ecosystem services flowing from them and the contributions of these to human health, economies, and other aspects of well-being." As part of a multi-agency assessment of activities that contribute to the identification, assessment, valuation and use of ecosystem services, the USGS would assess of gaps in valuation of ecosystem services; develop and test alternative methodologies; and develop standards and practices for implementation in natural resource decisionmaking. The USGS would collaborate with the Committee on Environment, Natural Resources and Sustainability's Subcommittee on Ecological Systems and other cross-government efforts to make these methods available and to test them.

EcoINFORMA **(+$800,000 /0 FTE)**

Science Synthesis, Analysis, and Research (+$500,000 /0 FTE)

This funding increase within the Science Synthesis, Analysis, and Research subactivity is being implemented in the 2013 Operating Plan.

Science Synthesis, Analysis, and Research (+$300,000 /0 FTE)

The President's Council on Science and Technology Advisors (PCAST) report, "Sustaining Environmental Capital: Protecting Society and the Economy" recommended a series of Federal actions including the Econinformatics-based Open Resources and Machine Accessibility (EcoINFORMA) initiative to enable integration and use of current knowledge to inform decisions. EcoINFORMA improves and expands Federal and non-Federal biodiversity, ecosystem, and ecosystem service information access, data exploration, availability, and interoperability for decisionmakers. EcoINFORMA facilitates cost savings by providing ready access to data, improved applications and availability, and useful tools to resource managers and decisionmakers.

In 2013, the USGS funded ($0.5 million) activities associated with implementing recommendations in the PCAST report, including the development of the EcoINFORMA Implementation Blueprint. The Blueprint calls for implementation of resource hubs supported by existing communities of practice that improve data standards, interoperability, and ecosystems data reuse. In 2013, two hubs were established and a third hub was proposed: (1) the biodiversity resources hub that leverages the USGS BISON program (Biodiversity Information Serving Our Nation); (2) the ecosystem hub that powers the Environmental Protection Agency's EnviroAtlas; and, (3) the Multi-Resolution Land Characteristics Consortium that support the land cover dynamics resource hub.

In 2014, the USGS requests an additional $0.3 million to continue implementing the PCAST report recommendations. The two established hubs would be expanded by working directly with agencies that provide key data and Ecosystems.data.gov would be initiated as the public presence for EcoINFORMA.

Land Use Science **(+$1,000,000/+4 FTE)**

Land Change Science (+$1,000,000/+4 FTE)

The Land Change Science Program (LCS) conducts research on the land changes occurring in the United States to better assess the causes and consequences of land cover change. The program would assess ecosystem changes due to a variety of external drivers, such as climate change, invasive species and land cover-land use change (including those resulting from resource extraction techniques) and identify their impacts on conservation objectives and local communities. Building from current projects, LCS researchers would analyze how these ecosystem changes impact the services provided by the ecosystems, including water filtration and storage, carbon sequestration, fisheries, and recreation. Research would be conducted in collaboration with other Interior bureaus, the Department of the Interior Climate Science Centers (CSCs), the Department of the Interior Landscape Conservation Cooperatives (LCCs), other Federal agencies, and State and local governments. Research products would include journal articles, geospatial datasets of both current and possible future ecosystem conditions and decision support tools allowing resource managers to assess the impacts of various ecosystem conservation and restoration activities.

3D Elevation Program – Enhanced Elevation for the Nation

3DEP: Enhanced Elevation for the Nation							
		2013 Full Yr. CR (PL 112-175)	2012 Enacted	Changes	Program Changes (+/-)	2014 Budget Request	Change from 2012 Enacted (+/-)
Coastal & Marine Geology		*1,500*	1,500	0	2,000	3,500	2,000
	FTE	*8*	8	0	2	10	2
National Geospatial Program		*11,201*	11,201	0	9,000	20,201	9,000
	FTE	*49*	49	0	0	49	0
Total Requirements ($000)		***12,701***	**12,701**	**0**	**11,000**	**23,701**	**11,000**
	Total FTE	***57***	**57**	**0**	**2**	**59**	**2**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Justification of 2014 Program Changes

The 2014 budget request for the U.S. Geological Survey's 3D Elevation Program – Enhanced Elevation for the Nation (3DEP) initiative is $23,701,000 and 59 FTE, a program increase of +$11,000,000 and +2 FTE from the 2012 Enacted level.

Overview

The 3DEP initiative will systematically collect enhanced elevation data using Light Detection And Ranging (LiDAR) and other technologies over the United States during an eight- year period. In 2012, a study funded by the USGS and partners identified 602 mission-critical activities of 34 Federal agencies; the 50 States; and selected local and tribal government, private, and other organizations that would benefit from enhanced elevation data. The Nation would receive up to $13 billion annually in new benefits from enhanced elevation data. An independent study of 500 remote sensing systems, the National Earth Observations Strategy sponsored by the Office of Science and Technology Policy, identified enhanced elevation data from sensors such as LiDAR among the top ten needs nationally. The National Geospatial Advisory Committee, the National States Geographic Information Council, and the Management Association for Private Photogrammetric Surveyors endorsed the 3DEP plan. Interior, staffed by the NGP, is organizing an interagency 3DEP Executive Forum to identify interagency funding strategies and coordinate Federal activities.

Accurate, precise, and up-to-date elevation data is the foundational requirement for efforts to quantify current and future coastal vulnerability to storms, flooding, tsunamis, and climate driven change. Provision of more accurate elevation data and resulting products that enhance access for varied applications would substantially reduce a major uncertainty in existing decision support tools, facilitate development of improved models, and enable users to access appropriately formatted and merged data streams. As a consequence, users across State, Tribal, and Federal entities and the NGO and academic communities would incur substantially reduced costs and technical burdens related to access and application.

Program Performance

Core Science Systems **+$9,000,000/0 FTE**

National Geospatial Program (+$9,000,000/0 FTE)

The NGP worked with partners to identify an optimal program design to meet needs identified in the 2012 3DEP study. The current approach, in which multiple agencies and States acquire data as needed and as funding partnerships allow, addresses only 10 percent of the needs identified in the study and will not lead to national data coverage. Through the 3DEP initiative, more economical project design and economies of scale would reduce the unit costs of data acquisition by 25 percent. If funded at the proposed level, this initiative would yield national coverage in eight years. The resulting data would meet 58 percent of needs identified in the study. Data would be acquired through contracts with the private sector. In the initial phase, data acquisition will focus on coastal areas.

Natural Hazards **+$2,000,000/+2 FTE**

Coastal and Marine Geology **(+$2,000,000/+2 FTE)**

Collecting Coastal LiDAR Data (+$2,000,000/+2 FTE)

Prioritization of data collection would be coordinated with NOAA and other agencies, through the 3DEP, the Interagency Working Group for Ocean and Coastal Mapping (IWG-OCM), and the Interagency National Digital Elevation Program (existing coordination groups chaired by the USGS with wide agency participation) to ensure application of appropriate technologies; to effectively utilize 3DEP procurement process for private sector data collection; to ensure that all data meet shared standards reflecting application and integration requirements; and to support cooperative development of data collection, processing, and delivery capabilities across the community of practice. Resources provided herein, coordinated with broader 3DEP efforts and thus part of a cooperative National LiDAR program, would focus on addressing priority data gaps and newly arising needs as identified through stakeholder engagement with regional ocean alliances and coastal zone resource and emergency management agencies at the State, Tribal, and Federal levels. The proposed activity would advance 3DEP objectives through collection of bathymetric and topographic “near shoreline” elevation data, and integration of elevation data from other sources, to provide seamless elevation coverage across coastal settings as required for adaptive management of terrestrial and submerged resources and to forecast the coastal change vulnerability of resources and communities.

Hydraulic Fracturing

Hydraulic Fracturing		2013 Full Yr. CR (PL 112-175)	2012 Enacted	Changes	Program Changes (+/-)	2014 Budget Request	Change from 2012 Enacted (+/-)
Fisheries Program		*108*	108	0	2,200	2,308	2,200
	FTE	*1*	1	0	10	11	10
Energy Resources		*5,850*	4,600	1,250	0	5,850	1,250
	FTE	*29*	23	6	0	29	6
Contaminant Biology		*0*	0	0	1,400	1,400	1,400
	FTE	*0*	0	0	5	5	5
Earthquake Hazards		*800*	300	500	1,200	2,000	1,700
	FTE	*2*	1	1	2	4	3
Groundwater Resources		*520*	520	0	2,100	2,620	2,100
	FTE	*1*	1	0	6	7	6
Hydrologic Research & Development		*1,300*	50	1,250	950	2,250	2,200
	FTE	*1*	0	1	1	2	2
Science Synthesis, Analysis and Research Program		*0*	0	0	185	185	185
	FTE	*0*	0	0	0	0	0
National Cooperative Geologic Mapping Program		*0*	0	0	2,000	2,000	2,000
	FTE	*0*	0	0	0	0	0
Total Requirements ($000)		***8,578***	**5,578**	**3,000**	**10,035**	**18,613**	**13,035**
	Total FTE	***34***	**26**	**8**	**24**	**58**	**32**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Justification of 2014 Program Changes

The 2014 budget request for hydraulic fracturing research is $18,613,000 and 58 FTE, a program increase of +$13,035,000 and +32 FTE from the 2012 Enacted level.

Overview

In 2012, the President issued an Executive Order (EO), "Supporting Safe and Responsible Development of Unconventional Domestic Natural Gas Resources," as a component of the energy strategy. The goal of the EO is to ensure coordination among Federal agencies regarding natural gas development activities. In support of this effort, the Interior, Department of Energy (DOE), and the EPA signed a Memorandum of Agreement (MOA) formalizing a Multi-Agency Collaboration on Unconventional Oil and Gas Research. This collaboration is aimed at improving our ability to understand and address potential environmental, human health, and safety impacts of hydraulic fracturing and associated operational activities. The three agencies are working together to engage other organizations involved in research on hydraulic fracturing in the pursuit of collaborative research opportunities. Through the MOA, the USGS is applying and building its research strengths with focused studies on resource characterization and assessments, water quality and availability, ecological effects, effects on people and their communities, and induced seismicity. The interagency collaboration is intended to build on the core capabilities of each agency in synergistic ways that lead to complementary and non-duplicative work. To accomplish this, Interior, the DOE, and the EPA are developing a multi-year National Research Framework designed to address the highest priority research questions, new and innovative technological opportunities, and community concerns associated with safely and prudently developing resources through hydraulic fracturing.

The development of oil and gas resources through hydraulic fracturing is playing an important and rapidly growing role in the domestic energy portfolio of the United States. Shale and other unconventional oil and gas formations are found throughout the United States beneath Federal, State, tribal and private lands.

The development and extraction of unconventional oil and gas resources are accomplished through hydraulic fracturing, a technique that entails horizontal drilling, perforation of steel casing and cement grout using explosive charges, and expansion of fractures using fluids and propellants under high pressure.

While there are economic benefits associated with oil and gas production and industry has developed best management practices for well site activities, concerns remain about potential environmental, health, and safety impacts of hydraulic fracturing. A comprehensive understanding of these potential impacts will require a significant research effort, including baseline data collection, across the various geologies involved. Potential effects of hydraulic fracturing may include impacts to water resources, including the contamination of aquifers and surface waters from drilling and hydraulic fracturing chemicals; the cross-contamination of aquifers through faulty well construction and casing installation; the release of methane and other greenhouse gases into aquifers and the atmosphere; contamination from radioactive elements and other toxic chemicals in waters recovered during gas production; and the reduced availability of water, particularly in water-scarce areas; landscape changes including soil erosion and habitat fragmentation; generation of airborne pollutants; and unintended seismic events from the subsurface injection disposal of recovered hydraulic fracturing and rock formation fluids. Singly or in combination, these potential effects might result in harmful impacts on human health or on terrestrial and aquatic wildlife and ecosystems. Oil and gas development can also cause socio-economic impacts to communities.

Program Performance

Hydraulic Fracturing **(+$13,035,000/+32 FTE)**

The 2014 budget supports a collaborative interagency research and development effort by the USGS, DOE, and EPA to conduct a national science, research, and development program aimed at understanding and reducing the potential environmental, health, and safety impacts of hydraulically fractured oil and gas resources and to address the most urgent questions and decision-support needs surrounding hydraulic fracturing. Through this effort, the three agencies are building upon current work and collaboratively identifying and coordinating new priority research and development activities that support sound management and policy decisions by Federal, State, tribal, and local entities. The goal is to produce decision-ready information to ensure the prudent development of energy resources and the protection of human health and the environment.

In 2013, USGS research efforts are focused on a number of activities including resource characterization and assessments, water quality and availability, ecological impacts, effects on people and their communities, and induced seismicity. The USGS conducted research and assessments of undiscovered, technically recoverable unconventional oil and gas resources for high-priority shale and tight gas basins. It is important to understand where these resources are located, their potential volumes, and their character so as to understand where production might occur, and to understand potential environmental impacts should development commence.

Also in 2013, the USGS continued to, or initiated, selected monitoring and research efforts directed toward understanding potential effects of unconventional oil and gas production on water resources. Baseline monitoring of groundwater was conducted in a number of States, notably in Arkansas, where hydraulic fracturing is underway, and in North Carolina, where hydraulic fracturing was not allowed prior to the time of sampling. Surface water monitoring was conducted in Pennsylvania and New York, among other areas. The USGS conducted studies of produced waters to investigate the occurrence of naturally occurring radioactive materials contained within the waters, as well as research on proper disposal methods. The USGS worked collaboratively with EPA and others to develop appropriate groundwater

sampling protocols in regions subject to hydraulic fracturing. New laboratory methods for analysis of flowback and produced waters are being developed collaboratively with EPA. A USGS-wide effort to compile water quality data extending back more than 60 years continued, potentially leading to a better understanding of water quality trends in relation to unconventional oil and gas development. A compilation of national water quality databases associated with unconventional oil and gas production is being done in 2013. In addition, the USGS published studies on the occurrence of, and potential for, earthquakes triggered by the injection disposal of hydraulic fracturing flowback fluids and produced formation fluids into deep rock formations, and studies on the impact of shale gas development activities on land use change. The USGS continued to monitor and model the effects of shale gas development on wildlife and aquatic species and ecosystem integrity.

The budget increase in 2014 would expand the collaborative, interagency research and development effort to address the highest priority challenges and to answer critical research questions. The USGS would focus on research that builds upon and enhances ongoing studies, as well as new and innovative investigations, assessments, technique development, modeling, and monitoring to address urgent research questions identified for the following subject areas: resource assessments and characterization; water quality; water availability; ecological impacts; effects on people and their communities; and induced seismicity. The USGS research would be designed in collaboration with the DOE and EPA, and where appropriate and beneficial to the achievement of program goals, would include input from State, tribal, academic, and non-governmental organization partners. A detailed research and development plan is currently under development by DOI, EPA, and DOE. In this plan, the highest priority science and information needs of decisionmakers will be identified as a basis for prioritizing the specific research that will be undertaken in 2014. Below is a discussion of potential projects that could be undertaken. Resource assessments provide critical evaluations of where future energy development might take place, or equally important, where it is unlikely to take place. The USGS is the sole provider of publicly available estimates of undiscovered, technically recoverable unconventional oil and gas resources of onshore lands and offshore state waters. In 2014, a portion of the requested new funding would allow the USGS to begin an assessment of the size and location of hydraulically fractured oil and gas resources in a new basin such as assessments underway in the Barnett Shale, Permian Basin, and Bakken Formation. Geologic mapping conducted by the USGS would support research on the geological parameters of unconventional oil and gas basins under current or near-term development.

The development and extraction of shale gas and other unconventional oil and gas resources require large quantities of water for hydraulic fracturing and produce large volumes of fluids during flowback and production. In 2014, a portion of the requested funding increase would be used for water availability studies to: 1) assess the water needs associated with unconventional oil and gas development; 2) evaluate and estimate the volumes and spatial distributions of non-potable (brackish) water resources for use in hydraulic fracturing; and 3) characterize flowback fluids and brines from hydraulically fractured wells, which would be important to identify and track potential contamination. The USGS would also conduct studies that address the identification of alternative sources of water used for hydraulic fracturing to replace the use of scarce fresh water sources. In addition, the USGS would address water availability through the development of groundwater flow and transport models in selected case study areas. These models would be used to understand the effects of withdrawals whether water would be used for hydraulic fracturing operations or produced waters, on basin-wide water availability.

In 2014, the USGS would use a portion of the requested funding to expand baseline surface water and groundwater quality monitoring. In order to support the monitoring activities, the USGS would support the continued development of analytical methods for the detection of contaminants associated with produced and flowback waters in the environment, including an enhancement of methods for sampling and measuring methane. This would include enhanced methods for monitoring and characterization of "stray gas". The USGS would support research on the development of geochemical methods and

groundwater flow models used to determine if hydrofracture fluids and other drilling materials are contaminating water supplies. These tools and monitoring data would enable assessments and prioritization of key human and ecological exposure pathways associated with natural or anthropogenic contaminants created and mobilized throughout the life cycle of hydraulic fracturing activities.

Additionally, the USGS would develop new methods to detect and understand the mobilization and occurrence of naturally-occurring contaminants resulting from hydraulic fracturing. The USGS would be working with EPA and other partners at prospective sites as part of the EPA hydraulic fracturing drinking water program to assess potential groundwater and surface water contaminants associated with hydraulic fracturing operations.

In 2014, the USGS would support research that assesses potential ecological impacts associated with unconventional oil and gas development. This research includes how changes in land use, water quality, and water availability from hydraulically fractured oil and gas operations affect biological communities and specific species of management concern. The USGS would conduct studies to identify those practices that minimize risks or mitigate impacts to ecological resources, as well as identify potential socioeconomic impacts from hydraulically fractured oil and gas resource development on nearby communities. These studies would examine how this development would affect the production of critical ecosystem services and would explore the potential for estimating the value of these services. In addition, an ecosystem services analytical framework would be developed for evaluating the environmental and social consequences of developing unconventional oil and gas resources.

The USGS would assess the risk of earthquakes associated with oil and gas production in 2014 with the requested increase in funding. The risks are primarily associated with wastewater disposal using deep well injection. The USGS plans to analyze earthquake sources that are induced by injection activities along with related geologic data to determine those factors that affect induced seismicity from subsurface disposal of waste fluids. This information could be used to guide changes to disposal operations, such as adding new wells or changing injection parameters. Cataloging the presence or absence of earthquakes induced by injection activities would yield critical information on the regions and conditions that are favorable for induced seismicity. This would be combined with probabilistic seismic hazard analysis to assess the hazard and risk of damaging earthquakes.

The USGS would emphasize products that contain decision-ready information. Deliverables would include new assessments of undiscovered technically recoverable unconventional oil and gas resources to inform the public about the magnitude and location of potential future production and its associated impacts. These and other assessments would form a foundation for planning where and what kind of additional studies are needed, such as those involving water quality and quantity, potential ecological impacts, and induced seismicity. Three-dimensional geologic models and a better understanding of rock structures form the basis to characterize the hydro-geologic framework used to understand impacts. Results of water budget analyses and water requirements for unconventional oil and gas development would help water managers better utilize existing water resources and protect scarce potable resources. Maps and databases showing the occurrence and distribution of naturally occurring radioactive elements would be used to inform water disposal management in a way that reduces or eliminates the potential for buildup of radiation to dangerous levels. Data and reports that characterize baseline surface water and groundwater quantity and quality of selected sites would be produced. These assessments would provide the information needed to determine pathways of human and ecological exposures to natural and anthropogenic contaminants associated with hydraulic fracturing activities.

The USGS plans to release reports describing the factors controlling the occurrence of earthquakes due to fluid injection activities to inform both Federal and state agencies that permit the injections and the industry operators who wish to minimize the risk of damaging earthquakes. The USGS would produce

updated probabilistic seismic hazard maps that incorporate the contribution from injection induced seismicity, so that building codes (which reflect long-term hazard) can appropriately account for the local or regional effects of induced earthquakes. Finally, the USGS would plan to release reports and other publications that outline effects of hydraulic fracturing and associated activities on terrestrial and aquatic species and create decision support systems that would help avoid or minimize ecological impacts associated with hydraulic fracturing.

Earth and Environmental Observations Innovation and Applications (Big Earth Data Initiative)

Earth and Environmental Observations Innovation and Applications							
		2013 Full Yr. CR (PL 112-175)	2012 Enacted	Changes	Program Changes (+/-)	2014 Budget Request	Change from 2012 Enacted (+/-)
Science Synthesis, Analysis and Research Program		*0*	0	0	9,000	9,000	9,000
	FTE	*0*	0	0	1	1	1
Total Requirements ($000)		***0***	**0**	**0**	**9,000**	**9,000**	**9,000**
	Total FTE	***0***	**0**	**0**	**1**	**1**	**1**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Justification of 2013 Program Changes

The 2014 budget request for the Earth and Environmental Observations Innovation and Applications (Big Earth Data Initiative) is $9,000,000 and 1 FTE, a program increase of +$9,000,000 and 1 FTE from the 2012 Enacted level.

Overview

The Federal government invests several billion dollars annually across numerous Federal agencies to collect information about the Earth from satellite, airborne, terrestrial, and ocean-based systems. This information can be used to achieve broad benefits ranging from climate change resilience planning to natural disaster impact mitigation to commercial supply chain management to natural resource management. Access to and use of these data is fundamental to supporting decisionmaking, scientific discovery, and technological innovation. The Earth and Environmental Observations Innovation and Applications is USGS and DOIs contribution to the Big Earth Data Initiative. The President's 2014 Budget invests in standardizing and optimizing the management of data from Federal Earth observations systems. Interagency coordination for this effort will be accomplished through the U.S. Group on Earth Observation (USGEO) Subcommittee of the National Science and Technology Council (NSTC), led by the Office of Science and Technology Policy (OSTP). The USGS budget request includes $9.0 million to support these efforts.

Program Performance

Science Synthesis, Analysis, and Research +$9,000,000/ +1 FTE

The USGS is home to high value Earth observations, both satellite and in-situ, that are critical to providing reliable scientific information to the Nation to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life. USGS data sets are regularly recognized as a high priority from a Federal science perspective. These data are regularly used for science and decisionmaking, and this additional funding to enable innovation would dramatically expand the utility of this information and the array of users that can tap into the resource.

As part of the Big Earth Data Initiative, efforts would be initiated to implement an agency-wide framework for the Department of the Interior for managing and curating Earth system data that would: (1) maximize the availability and timeliness of Earth system observations; (2) broaden the potential uses of observations and data through the use of open, machine readable formats and Application Programming Interfaces (APIs); and (3) encourage the development and use of uniform tools and practices across Federal agencies for the handling of Earth system data and information to increase interoperability. Funding would be focused on high-value data sets, particularly those data sets derived from the high-impact observing systems and surveys by Interior stakeholders. For example, development of a seamless map database and web service for the Nation's coastal areas that is easy to access and apply has been a critical goal of the Earth science community. Funding for this initiative would dramatically advance this work and provide society with critical information needed to respond to coastal storms and sea level rise.

In coordination with the NSTC/USGEO led by OSTP, the USGS would coordinate with Interior bureaus, other Federal agencies, Tribes, and States to develop a cohesive strategy that contributes to and follows guidelines for governmentwide interoperability improvements that focus on web service access layer development to deliver underlying Earth observations. For example, investments under this initiative would enable access and integration of data from State Wildlife Management Plans, the U.S. Fish and Wildlife Service Wetland Inventory and USGS habitat and water quality databases to inform management strategies needed to restore the Gulf Coast Ecosystem.

Within the USGS, efforts would be focused on providing expanded scientific discoverability, access, and integration of critical Earth observations. Working across the Mission Areas, high-value data sets would be identified, prioritized, and made available using web services and standards. Resources would focus on ensuring the data are documented, discoverable and useable. Results would include expanded, sustainable delivery of high-value scientific monitoring. For example, the USGS initiated an effort to increase standardization of water use databases that are critical to ensuring the Nation has information available to manage an increasingly scarce resource. For example, water use information is managed by many entities across the country. Funding from this initiative could provide the infusion of resources necessary to rapidly advance this effort.

Resource Management Tools

Societal challenges such as the availability of water resources for agriculture are often better understood and addressed through analysis of many large and complex data sets The USGS is addressing this challenge, in part, with a tool called the *Geo Data Portal*. Based on open standards, this tool allows many databases to be queried for a particular area and time period of interest. Water resource managers use the results to answer specific questions such as how a particular section of the country or urban area might be affected by changes in water availability through time.

Science for Coastal and Ocean Stewardship

Science for Coastal and Ocean Stewardship							
		2013 Full Yr. CR (PL 112-175)	2012 Enacted	Changes	Program Changes (+/-)	2014 Budget Request	Change from 2012 Enacted (+/-)
Coastal & Marine Geology		*2,000*	2,000	0	5,750	7,750	5,750
	FTE	*5*	5	0	9	14	9
Science Synthesis, Analysis and Research Program		*0*	0	0	300	300	300
	FTE	*0*	0	0	0	0	0
Total Requirements ($000)		***2,000***	**2,000**	**0**	**6,050**	**8,050**	**6,050**
	Total FTE	***5***	**5**	**0**	**9**	**14**	**9**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Justification of 2014 Program Changes

The 2014 budget request for Science for Coastal and Ocean Stewardship is $8,050,000 and 14 FTE, a program increase of +$6,050,000 and +9 FTE from the 2012 Enacted level.

Overview

Federal, State, local and tribal entities are challenged to better coordinate their efforts to reduce vulnerabilities of both human and ecological communities from land-based and marine-based changes to habitats, resource and water availability, and natural hazards. Current mandates to sustain economic growth, without compromising national security or ecosystem protection, require providing scientific information to better inform decisions and improve understanding for diverse audiences ranging from the general public to policymakers. The USGS is recognized as a critical source of assessments of resources and their vulnerability; data and models to assess the consequences of changing conditions and alternative management scenarios; and monitoring and interpretive tools to advance integrated systems for observations, mapping, and infrastructure.

Program Performance

Enhancing Coastal Communities **+$6,050,000/+9 FTE**

Coastal and Marine Geology (+$5,750,000/+9 FTE)
Science Synthesis, Analysis, and Research (+$300,000/0 FTE)

The proposed increase would fund regionally-focused science efforts in the Arctic and Pacific Islands. While these efforts would address objectives specific to those regions, the effort would also provide models for application to national issues arising in other regions.

<u>Integrated Resource and Coastal Vulnerability Assessments – Arctic</u> (+$2,500,000/ +4 FTE)

The proposed increase would improve the integrated science needed to inform sustainable development of resources and would balance with mandates to conserve the Nation's unique coastal and marine Arctic ecosystems under Interior's stewardship. A significant portion of the Nation's undiscovered oil and gas potential and a vast proportion of the Nation's endowment of wildlife, biodiversity, and wild places can be found in the U.S. Arctic. It is a place where Native peoples must also thrive through sustainable economies, infrastructures, and culturally important subsistence foods. The Arctic is not static; its changing climate is increasing access to exploitable resources, bringing the world to the Arctic through

polar navigation routes, and shifting fish, wildlife, and plant habitats in ways that are not fully understood. The increase would support new understanding in several major areas important to current and future energy and natural resource decisions in the Arctic.

Specifically, the USGS would produce:

- Improved geological and geophysical data to refine understanding of oil and gas resources (through acquisition and interpretation of seismic data pertaining to both the fundamental geology and petroleum potential of Chukchi shelf, the northwest Beaufort shelf, and the marine slope of the deep Canada Basin), which would improve understanding of the petroleum potential across Exclusive Economic Zone (EEZ) and Extended Continental Shelf (ECS). USGS resource assessments differ significantly from industry assessments in several ways: USGS assessments are: (1) transparent, from methodology to assumptions to results; (2) publicly available to all parties; (3) consistent so the results are comparable. For these reasons, and because the methodology is externally peer reviewed, USGS assessments are considered robust and objective. The USGS has a unique Federal role to provide the geologic characterization of public lands required to assess resource potential. Very little is known about the geology or the oil and gas resources on the Arctic extended continental shelf (this area is beyond any BOEM analysis or resource assessment or current industry activity), and thus there is a need to understand what potential may exist. The analysis and resource evaluation need to be made publicly available, in a manner that is comparable to other areas, so resource managers, Arctic policy analysts, and national security agencies may understand the resource potential of this area. This is the only source of information to inform U.S. Government decisions regarding ECS claims.
- Sea floor and habitat maps and analyses to inform resource management and development using bathymetric sonar and sea floor video surveys resulting in a comprehensive sea floor map for some 100 square kilometers of priority habitat. These maps would be designed in consultation with key partners and management agencies to support existing environmental and energy development programs in the Arctic Outer Continental Shelf and statistical analyses of habitats;
- Geochemical surveys to map vulnerability of priority marine species to ocean acidification by completing and disseminating seawater analyses of archived ocean acidification samples and develop predictive models to link benthic habitat change to ice cover change and increased atmospheric carbon dioxide; and acquiring additional baseline data in sensitive areas;
- Shoreline vulnerability assessments and coastline projections from high resolution digital coastal maps which inform forecasts of likely erosion patterns under current and future climate scenarios and inundation vulnerability assessments under recurring and extreme storm events; and
- Enhanced data access and community involvement through metadata produced according to Federal and Alaska Data Integration Working Group standards; delivery of new and existing data to science portals such as the Alaska Ocean Observing System, Alaska Emergency Response Management Application, and the CMSP National Information Management System; and engagement of Native communities by training youth in USGS project efforts, designing community protocols for information sharing, and piloting approaches to incorporate local knowledge into project efforts.

<u>Integrated Resource and Coastal Vulnerability Assessments – Pacific Island Communities</u>

(+$2,000,000/ +3 FTE)

Accelerated sea level rise in low lying Pacific Islands threatens coastal communities by impacting groundwater supplies and agro-forestry production and exposes coastal ecosystems and communities to erosion, storm inundation, and groundwater salinization. Recent storm events, combined with extreme

high tides, have highlighted the vulnerability of these communities, resulting in widespread coastal flooding, erosion, and groundwater contamination in the Republic of the Marshall Islands and the Federated States of Micronesia, in which Federal Government has trust responsibilities. The extreme vulnerability of these communities to changing sea level and ocean conditions represents a serious potential threat through impacts to public safety, environmental health, and food and water security. The USGS would focus on selected vulnerable population centers in the Pacific Islands to develop assessments, forecasts, and decision support tools to anticipate consequences of more frequent, persistent, and extreme wave run-up, overwash, and coastal inundation on communities and the resources on which they depend. Areas of ongoing collaborative development, and likely enhancement of efforts through this activity, include Kwajalein Atoll and Palau (Freely Associated States of the Republics of the Marshall Islands and Palau), the Northern Marianas, and the Federated States of Micronesia. Final decisions on initial focus of activities will respond to stakeholder input and engagement with other Federal programs, primarily within DOD and DOI.

Products developed would include assessments of resource status and vulnerability, including coral reef ecosystems, groundwater, and agricultural resources; forecasts of changing ecosystem and community vulnerability as a consequence of future scenarios including sea level rise, changes in storm climatology, and alteration of natural features (corals, coastal landscapes and vegetation) that mitigate impacts; and integrated models that augment forecasts to understand consequences in terms of community and ecosystem vulnerability and facilitate the development and evaluation of alternative approaches to resource management and adaptation to climate change.

Comprehensive Mapping and Resource Assessments (+$1,250,000/ +2 FTE)

In priority regions, the USGS would engage with Federal, State, tribal, and other regional partners to provide access to comprehensive maps and assessments of seabed and coastal conditions and vulnerability. These efforts would support the Interior priorities by focusing on areas proposed for advancing renewable energy development (e.g., the Interior's Smart from the Start initiative for offshore wind energy development off the Atlantic coast). Activities supported would include development of comprehensive seabed and geologic characterization; multi-resolution and multi-temporal elevation models; indices of seabed disturbance potential and resilience; assessments and forecasts of the vulnerability and response of indicator species; and integrated coastal vulnerability assessments.

The USGS has a unique Federal role to provide the geologic characterization of public lands required to assess hazard and resource potential. Marine assessments of hazard sources and the location and potential of energy and mineral resources are the foundation for policy and management decisionmaking across the vast EEZ and the ECS. Assessments in these poorly surveyed and remote regions require marine field programs utilizing large research vessels and specialized technologies. Access to these assets and effective utilization of USGS resources demands collaborative marine field programs with other USGS programs, Federal agencies, and academic partners. Increased funding would provide opportunities to leverage ongoing USGS activities, such as the ECS study, and broader federally supported programs to ensure that expensive marine field programs are cost effective and meet the compelling need for marine geologic surveys and the resulting resource and hazards assessments.

Science Synthesis, Analysis, and Research **(+$300,000/ 0 FTE)**

The proposed increase would provide quality assured data in standard formats to enable users easy and integrated access to comparisons of environmental responses across regions to facilitate better planning decisions. New data and products would result from efforts that would include creation of Web maps or feature services for Web enabled datasets; updating Web services to current and appropriate technology;

enhancement of metadata creation tools; improved mechanisms for storage and delivery of data and products; and development of tools that facilitate integration and analysis of data into models.

Environmental Impacts of Uranium Mining

Environmental Impacts of Uranium Mining							
		2013 Full Yr. CR (PL 112-175)	2012 Enacted	Changes	Program Changes (+/-)	2014 Budget Request	Change from 2012 Enacted (+/-)
Contaminant Biology		*50*	50	0	500	550	500
	FTE	*0*	0	0	3	3	3
Toxic Substance Hydrology		*100*	100	0	2,500	2,600	2,500
	FTE	*0*	0	0	9	9	9
Total Requirements ($000)		***150***	**150**	**0**	**3,000**	**3,150**	**3,000**
	Total FTE	***0***	**0**	**0**	**12**	**12**	**12**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Justification of 2013 Program Changes

The 2014 budget request for the Environmental Impacts of Uranium Mining is $ 3,150,000 and 12 FTE, a program increase of +$3,000,000 and +12 FTE from the 2012 Enacted level.

Overview

In January 2012, the Secretary of the Interior withdrew over 1 million acres of public lands in the Grand Canyon region from mineral entry for 20 years under the Mining Law of 1872. However, even under the withdrawal, some mining will occur on valid existing claims. For example, the Canyon Mine (on U.S. Forest Service (USFS) lands south of the Grand Canyon) and the EZ Mine (on Bureau of Land Management (BLM) property north of the Grand Canyon) are expected to begin ore extraction in 2014 and 2016, respectively. Recognizing a lack of scientific information on the potential impacts of mining, a key factor in the Secretary's decision, the USGS developed a 15-year science plan in collaboration with the BLM, National Park Service, U.S. Fish and Wildlife Service, and the USFS. The studies would provide critical information for future decisions on withdrawal of lands and help inform the development, mitigation, reclamation, and ecological restoration of mines on valid existing claims, as applicable.

Program Performance

Northern Arizona Uranium Mining Science **+$3,000,000/+12 FTE**

Toxic Substances Hydrology Program (+$2,500,000/+9 FTE)

The proposed increase would begin the implementation of the integrated 15-year science plan by collecting new baseline data, expanding smaller scale studies begun in previous years, and lay the foundation for future modeling and monitoring efforts. Work in 2014 would characterize the baseline conditions of soil, groundwater, and surface water at the Canyon and EZ Mine sites before ore extraction begins. This would be done in cooperation with agency partners and the private mining companies, and would complement USGS work on Trust resources (animal and plant species) started at Canyon Mine in 2013. This baseline work is crucial for comparison after extraction occurs and enables understandings of the extent of naturally occurring versus mine related uranium and associated contaminants in soil, water, and biota.

In addition, work would begin to determine potential pathways of uranium exposure, such as movement through groundwater-flow paths, surface water, and wind dispersion. This includes continued and expanded monitoring of water quality and uranium levels in the Colorado River in the Grand Canyon, Kanab and Havasu creeks, and other regional rivers, streams, intermittent washes, and springs. USGS researchers would analyze data continually in preparation for presenting an interim report at the end of the third year of the study that describes spatial and temporal patterns of uranium in soil and water samples, and includes regional exposure models that would shape subsequent research and monitoring components.

Contaminant Biology Program (+$500,000/+3 FTE)

The proposed increase would support characterization of baseline radiation and chemical concentrations in sentinel species (e.g., burrowing mammals and reptiles, waterfowl) at targeted new mine sites (including the Canyon Mine) before ore extraction begins. Before reclamation is scheduled to begin in 2014, biological surveys and samples would also be collected at the Kanab North Uranium Mine, Arizona Strip. This site is considered to be representative of legacy contaminated abandoned mines. These activities would be conducted in collaboration with agency partners and the private mining companies. Establishment of baseline data, along with determining priority toxicological pathways of exposure and biological effects of exposure, are crucial to evaluate if chemical and radiation contamination are increased due to mining activities and pose unacceptable risk to biota in and around uranium mine sites. Interior and other key stakeholders would be kept apprised of progress on the project.

Improving USGS Rapid Disaster Response through Preparedness and Robust Monitoring

Improving USGS Rapid Disaster Response through Preparedness and Robust Monitoring							
		2013 Full Yr. CR (PL 112-175)	2012 Enacted	Changes	Program Changes (+/-)	2014 Budget Request	Change from 2012 Enacted (+/-)
Land Change Science		*550*	550	0	757	1,307	757
	FTE	*1*	1	0	4	5	4
Earthquake Hazards		*715*	715	0	850	1,565	850
	FTE	*0*	0	0	1	1	1
Volcano Hazards		*800*	800	0	400	1,200	400
	FTE	*0*	0	0	1	1	1
Landslide Hazards		*200*	200	0	500	700	500
	FTE	*3*	3	0	2	5	2
		60	60	0	0	60	0
National Streamflow Information Program	FTE	*0*	0	0	0	0	0
Total Requirements ($000)		***2,325***	**2,325**	**0**	**2,507**	**4,832**	**2,507**
	Total FTE	***4***	**4**	**0**	**8**	**12**	**8**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Justification of 2014 Program Changes

The 2014 budget request for Improving USGS Rapid Disaster Response through Preparedness and Robust Monitoring is $4,832,000 and 12 FTE, a program increase of +$2,507,000 and +8 FTE from the 2012 Enacted level.

Overview

Every year the United States faces natural and human disasters that threaten the Nation through loss of life and property, degradation of human health and the environment, and threats to national security and economic vitality. In domestic and global events, the Nation's emergency managers and public officials look to USGS science to inform them of the risks that hazards pose to human and natural systems, and how to reduce losses and improve response capabilities.

Events like the 2011 magnitude-9.0 earthquake and accompanying tsunami which struck the eastern coast of Japan are solemn reminders of the challenge that even the most developed nations face. As tragic as the disaster was, early warning systems for both the earthquake and tsunami combined with public preparedness and strong building codes saved many lives that otherwise would have been lost. Even much smaller events like the magnitude-5.8 earthquake that struck central Virginia caused significant disruption and damage in the Nation's Capital some 80 miles away. This earthquake was felt by at least 30 million people and caused disruption and concern throughout the Eastern third of the United States. More than 160 USGS scientists, technicians, and specialists responded to Hurricane Sandy, providing critical information on inundation levels and issuing predictions of coastal impacts to help guide response.

These events, each in their own way, demonstrate the seriousness and pervasiveness of natural hazards with threats that are unavoidable but with consequences that are not. This is where USGS science can make a difference and faced with rising expectations for rapid, robust information in response to these events, the 2014 budget request would allow the USGS to strengthen its capabilities both before and after disasters strike.

Program Performance

Robust Monitoring Networks for Effective Warning **+$1,750,000/+4 FTE**

Earthquake Early Warning and Rapid Event Characterization (+$850,000/+1 FTE)

Earthquake Hazards Program (+$850,000/+1 FTE)

USGS and its partners in California and Washington State have made substantial progress toward the development of a prototype earthquake early warning system along the U.S. West Coast with a goal of delivering public alerts before strong shaking arrives at population centers. This progress has been accomplished by leveraging small amounts of research funding with a combination of economic stimulus funding and private research funds. The economic stimulus funding from the American Recovery and Reinvestment Act was used to upgrade seismic and Global Positioning System (GPS) networks in California, Oregon and Washington. This funding has enabled earthquake detection and evaluation within seconds, a basic requirement of early warning. A test system is operating now in California. The private funding, from the Gordon and Betty Moore Foundation, is being used by USGS and its university partners to continue research and development efforts.

To complete a fully functional, robust prototype system, further improvements to hardware, software and communications are needed. The USGS would extend earthquake early warning development to include a partnership with social scientists to better understand how the technical information can be most effectively communicated. The proposed funding would be used for these tasks. The result would be a system better suited to support emergency managers and other decisionmakers as they respond to earthquake activity.

In the state of California, legislation has been introduced to supplement the Federal investment in early warning. The USGS is specifically included in the proposed law, which calls for the California Emergency Management Agency to collaborate with the USGS, the California Institute of Technology (Caltech), the California Geological Survey, the University of California Berkeley, and others, to develop a comprehensive statewide earthquake early warning system in California.

Improve Rapid Response to Eruptions of Volcanic Ash (+$400,000/+1 FTE)

Volcano Hazards Program (+$400,000/+1 FTE)

The Icelandic volcanic ash eruptions of April 2010 and May 2011, and the Chilean ash eruption of June 2011, provide examples of the importance of volcano monitoring, early warning, and pre-crisis planning. Improved early warning of impending ash eruptions, followed by rapidly updated forecasts of ash impacts as an eruption progresses, maximizes the time and information available for undertaking mitigating actions. Tasks would be undertaken to mitigate risk from volcanic activity to aviation, airports, communities, and infrastructure, to improve resiliency, and to enhance monitoring of ash producing volcanoes. These steps comprise continued gradual implementation of the National Volcano Early Warning System (NVEWS) and recognize the emerging urgency of the ash issue.

Volcanic ash is a major threat to both national and international aviation. In-flight encounters with ash clouds result in engine and avionic failures, with potential for catastrophic losses. Explosive eruptions of volcanoes in California, Oregon, Washington, and Hawaii could have major regional impacts on the ground as well. Volcanic ash can disrupt power generation and distribution, transportation systems, water supplies, business operations, and agriculture, and poses a direct threat to public health and safety. The USGS proposes to implement a real-time, ashfall modeling capability to provide emergency managers,

decisionmakers, and the public with the best possible information on expected time of onset and amount of ashfall. Working together with the NOAA National Weather Service (NWS), and the Air Force Weather Agency, the USGS would engage users to design and provide useful text and graphic products derived from model runs and real-time observations. This would be complemented by field work to construct a more comprehensive database of ashfall deposits in the western United States to better inform and guide preparedness. Upgrades would commence to the monitoring network at Mount Hood, a very high threat ash-producing volcano adjacent to Portland, OR, designated as a high priority for NVEWS. The USGS Volcano Hazards Program in partnership with the U.S. Army Corps of Engineers and Southern Methodist University would install seismic and infrasound sensors on Pagan, a high threat volcano in the Commonwealth of the Northern Mariana Islands.

Expanded Debris Flow Warning System (+$500,000/+2 FTE)

Landslide Hazards Program (+$500,000/+2 FTE)

The prototype debris flow early warning system developed by the USGS and the NWS is assisting in the protection of lives, important infrastructure, and lifelines in southern California. This initiative would expand the successful partnership to northern California and the southern part of Oregon. It would support the development of predictive tools (rainfall intensity and duration thresholds and susceptibility models) in fire related and non-fire related areas, as well as expanding monitoring efforts in intensely burned areas. Partners include NOAA, local and State governments, and the private sector. The products are rainfall thresholds and real-time warnings of debris flows, particularly in burned areas.

Disaster Scenarios and Strategic Science Crisis Response **+$757,000/+4 FTE**

Land Change Science (+$757,000/+4 FTE)

To prepare for the impacts of hazards before they strike, the USGS would develop fully realized scenarios of disaster events in collaboration with Federal, State, tribal, local, and university partners, by simulating a real hazard event. By understanding the potential impacts of these hazards before they occur, the USGS would strengthen capabilities in warning, responding and recovering from such events. These scenarios would improve the Nation's resilience to natural hazards, biological epidemics (e.g., epidemic avian influenza), and human-triggered disasters (e.g., industrial accidents). These scenarios apply integrated science across multiple mission areas, including modeling of the hazard process (e.g., ground motion modeling for earthquakes or wave modeling for tsunamis), environmental health and economic consequences to inform community decisionmaking on hazard mitigation and emergency response. In 2014, efforts would facilitate development of a standing Interior capacity for rapidly implementing strategic science working groups, similar to what was done during the Deepwater Horizon Oil Spill disaster, to allow crisis responders to quickly evaluate the impacts of alternative response strategies. The working groups would engage with other Interior bureaus, the Landscape Conservation Cooperatives (LCC), and the Department of the Interior Climate Science Centers (CSC).

Other Program Changes

Program Increases

Ecosystems

White Nose Syndrome **(+$1,505,000/+1 FTE)**

Wildlife Program (+$1,000,000/+1 FTE)

This funding increase within the Wildlife Program subactivity is being implemented in the 2013 Operating Plan.

Wildlife Program (+$505,000/+0 FTE)

White-nose syndrome (WNS) is an emergent disease of hibernating bats. Since first described among bats in New York during the winter of 2007, the disease is estimated to have killed over five million bats, and declines greater than 95 percent have been documented for some affected populations. The disease is caused by a fungus, *Geomyces destructans*. Bats are the primary predators of night-flying insects and the natural pest-control services they provide are valued at $22.9 billion each year for agriculture in the continental United States. The USGS is working closely with the FWS, State natural resource agencies, academic institutions, and non-governmental organizations to implement a collaboratively developed National Plan for managing WNS, and the USGS continues to lead disease investigations, research, and development of strategies to mitigate the effects of the WNS. Ongoing USGS research and monitoring activities are geared toward providing enhanced disease surveillance, improving diagnostic tools, and providing a better understanding of WNS disease ecology with the ultimate goal of developing practical management solutions to reduce the impacts of this devastating disease. The proposed increase would enhance surveillance and diagnostic capacity to detect the continued spread of WNS, develop an oral vaccine for WNS; and provide for the development of non-bat models for studying virulence of *G. destructans*.

Coral Reef Ecosystem Research **(+$442,000/+1 FTE)**

Environments Program (+$442,000/+1 FTE)

Coral reefs are among the most diverse and biologically complex ecosystems on Earth. They support more species per unit area than any other marine environment; provide important fishery habitat, economic and environmental services to millions of people for recreation, sources of food, jobs, chemicals, pharmaceuticals; and offer unparalleled shoreline protection. Under threat from multiple stressors that are overwhelming their natural resilience, an estimated 27 percent of reefs globally have already been lost and 60 percent are threatened by ocean warming, disease and anthropogenic activities including coastal development, polluted runoff from unsustainable land use practices, over-harvesting, destructive fishing, and global climate change.

In 2014, the increase in the Environments Program would enable the USGS to increase research to support the U.S. Coral Reef Task Force (CRTF) in collaboration with the Office of Insular Affairs. The USGS would provide the science to better understand how corals respond to natural and anthropogenic changes in the environment by increasing understanding of how stressors affect the physiologic processes of coral reef organisms and reef structure; provide state-of-the-art science to support development of effective, science-based methodologies for quantifying lost ecosystem services from degraded coral reefs

as well as the potential environmental benefits associated with coral reef restoration; and support a rapid response team to assess extreme coral events (e.g., heating or cooling events, disease outbreak).

Expected products include developing, with interagency collaboration through the CRTF, a reef manager's resource guide to coral reef impacts; contributing to the scientific basis for developing a functional assessment methodology for quantifying reef ecosystem services; and assessing coral reefs undergoing extreme events. This information would provide insight into how corals are actively responding to stressors and enable reef managers to make better decisions for managing in and around the watershed where the reef is located.

Brown Tree Snakes – Detection and Control **(+$500,000/0 FTE)**

Invasive Species Program (+$500,000/0 FTE)

Shortly after World War II, the brown tree snake (BTS) was accidentally transported from its native range in the South Pacific to Guam. As a result of abnormally abundant prey on Guam and the absence of natural predators and other population controls, BTS populations reached extraordinarily high numbers. Snakes have caused the extinction of most of the native forest vertebrate species; thousands of power outages affecting private, commercial, and military activities; and widespread loss of domestic birds and pets. The highest priority needs for control and management of BTS are the development of landscape scale methods to suppress or eradicate snakes on Guam and to detect and eradicate incipient populations of snakes accidentally transported to other islands such as Hawaii and the Northern Mariana Islands. The military expansion on Guam will raise the profile of these issues because military construction will result in mitigation actions that include snake suppression in areas of high ecological value, and because increased military cargo transport and off-Guam training exercises will increase the odds of transporting snakes to other islands, such as Hawaii. With the increase, the USGS would focus on high-priority research to validate the population-level efficacy of aerially-delivered toxicants for snake control at landscape scales; predict the results of snake suppression on Guam in terms of recovery rates of snake populations as well as recovery of potentially problematic species (such as non-native rats) that would benefit from snake suppression; develop novel methods for detection and control of juvenile snakes, which are not susceptible to the attractant used to deliver toxicants; and revive the USGS "Dogs in the Woods" program, to assess the utility of detector dogs for detecting snakes on recipient islands; and, for eliminating snakes that escaped poisoning in areas that have received toxicant applications.

New and Emerging Invasive Species of National Concern **(+$874,000/+4 FTE)**

Invasive Species Program (+$874,000/+4 FTE)

The introduction, establishment, and spread of invasive species will be important drivers of biodiversity loss over the next century and will pose substantial risks to native species, valued ecosystem services, and human and wildlife health. Ongoing global changes such as more frequent transcontinental and transoceanic trade and tourism, land and water use changes, and climate change are facilitating ever-faster rates of establishment and spread of harmful, invasive plant and animal species around the world. The challenge for scientists will be to determine which newly established nonnative species may cause significant impacts and become high priority invaders. While many invaders come without noticeable impact, causing little or no observed change in the invaded ecosystem, a small percentage of species that become established alter ecosystem structure and function in detectible and deleterious ways. The USGS has gained an understanding of the qualities and characteristics to help identify the next generation of invaders – hopefully in time to take action to prevent large-scale landscape changes like those caused by invasive cheatgrass which have changed fire dynamics in ecosystems in the Western United States. USGS research on current high priority invasive species, tamarisk in the Southwest, nutria in the Gulf of

Mexico, Burmese pythons in the Everglades, and Asian carps in the Mississippi River Basin, provides information to identify the next generation of invaders and to forecast their impacts. Assessing the factors influencing such known invasions improves the National ability to predict invasions and to take preventative measures early enough to better address new invasive species.

This proposed increase would allow researchers to investigate the relationship between landscape scale alterations such as hydrologic alterations, drought, climate change and hurricanes and invasive species, and enhance our ability to improve our predictive tools. The USGS would develop models, decision tools and other approaches to predict geographic distribution of invasive species based on parameters such as temperature, precipitation, elevation, and vegetation. These models would provide screening tools to focus early detection efforts by predicting potential range and resulting distribution. The USGS would also enhance existing efforts focused on the development, evaluation, and improvement of early detection and control methods for high profile invasive species such as Asian carp and Burmese pythons. The USGS would utilize eDNA or similar methods, as well as other advanced next-generation molecular methods to detect invasive species at very low densities in the field. These USGS research endeavors would provide information for assessments of risk and predictions; determine effects of invasive species; develop tools and innovative methods for control and management; and deliver information management tools to more effectively integrate and utilize available data on invasive species. The end result is a greatly enhanced capability for early detection and control of the next, as yet unknown, generation of invasive species.

Energy Minerals and Environmental Health

Rare Earth Elements Research **(+$1,000,000/+5 FTE)**

Mineral Resources Program (+$1,000,000/+5 FTE)

This funding increase within the Mineral Resources Program (MRP) is being implemented in the 2013 Operating Plan to support Rare Earth Elements Research activities.

High Priority Research on Critical Minerals **(+$1,130,000/+7 FTE)**

Mineral Resources Program (+$1,130,000/+7 FTE)

The USGS Mineral Resources Program (MRP) will continue to conduct research on rare earth element (REE) resources as described above for 2013. In addition, in 2014, this research will be expanded to cover a broader range of critical materials such as the platinum group elements, tellurium, and lithium.

Advancing Environmental Health

The Contaminant Biology and Toxics Substances Hydrology Programs conduct research on the environmental impacts of chemical and pathogenic contaminants that enter the environment through natural and anthropogenic mechanisms, and threaten human, animal (fish and wildlife), and ecological health. In 2013, the USGS published the Environmental Health Science Strategy which summarizes national environmental health priorities that USGS is best suited to address, and will serve as a strategic framework for USGS environmental health science goals, coordination of research efforts, partnerships, and outcomes for the next decade. This strategy delineates the connection between USGS scientific research and its ability to support decision making to safeguard environmental health. The following three program increases are efforts to bring together science and decision making to further the USGS environmental health mission.

Emerging Contaminants and Endocrine Disrupting Chemicals **(+$1,000,000/+3 FTE)**

Contaminant Biology Program (+$1,000,000/+3 FTE)

One of the most important groups of emerging contaminants is endocrine disrupting chemicals (EDCs). Exposure to EDCs can cause reductions in reproduction, deformities, behavioral abnormalities, and immune dysfunction. The proposed increase would support laboratory research and field investigations focused on the effects of EDCs on terrestrial and aquatic wildlife species. Research topics would include: 1) assessing sources and effects of agricultural-related EDCs on the health of birds, fish and amphibians; 2) understanding how EDCs impact the immune function and disease resistance; 3) identifying both trans-generational genetic effects and behavioral effects; and 4) investigating the movement of EDCs through ecosystems to characterize risk across species.

Research would assess how differences in animal agriculture practices and intensity can affect reproductive output (e.g., mating behavior, egg production and hatchability, early life stage development, and sexual differentiation). Studies would evaluate the overlay of wildlife habitat utilization, EDC exposure, and land management practices to better quantify risk, and evaluate potential tools that resource managers might use to reduce wildlife EDC exposure and impacts. Much of the research done on EDCs to date has focused on assessing effects on reproduction; relatively little has been done to assess the effects on immune function and disease resistance. Funding would expand pilot studies designed to assess the biochemical changes that occur when organisms exposed to an EDC are subsequently exposed to a bacterial or viral agent. This work would enhance understanding of the effect EDCs have on disease susceptibility in native fish, such as largemouth bass, and facilitate development of a diagnostic field test to rapidly detect EDC exposure in wild fish.

Epigenetic effects of EDCs (e.g., alteration of the expression of genes in offspring), have been demonstrated in mice and humans. Proposed studies would be the first to investigate epigenetic effects in fish and wildlife. Fish exposed to a model EDC would be evaluated for genetic alterations and subsequent effects on reproduction, immune function and behavior. Behavioral changes associated with sub-lethal exposure to EDCs can impair long-term survival and reproduction. These studies would evaluate how EDCs affect different behaviors; how changes in those behaviors relate to the physiologic health of the organism and whether those changes can be used for predicting the sustainability of natural populations.

Within ecosystems, EDCs likely exert impacts differentially among fish and wildlife species, which can result in ecosystem-level impacts. Thus, it is important to characterize how exposure to pathways partition through food webs will improve predictions of which species are likely subjected to the greatest risk. Studies would examine predator-prey pathways of EDC exposure to key representatives of fish and wildlife guilds across a range of different habitat types, and provide risk profiles based on both exposure probability and EDC sensitivity. This work would facilitate a broad characterization of EDC dynamics in wild populations to more efficiently target mitigation such as exposure reduction efforts.

Emerging Contaminants **(+$1,000,000/+2 FTE)**

Toxics Substances Hydrology Program (+$1,000,000/+2 FTE)

The proposed increase would support a National assessment of contaminant mixtures at stream locations affected by combinations of contaminant sources, including wastewater treatment plant discharges, industrial discharges, landfill leachate, crop agriculture, and animal agriculture. Samples of stream waters and sediments would be analyzed using USGS analytical capabilities for approximately 800 common and emerging chemical contaminants. In addition, extensive forensic analyses would be employed to identify

unknown contaminants in these environmental samples. This project would be coordinated with the EPA and their capability to conduct *in vitro* bioassays of the same environmental samples. The information produced by these activities would provide a basis for toxicity testing for chemical mixtures and low-level exposures; would help improve understanding groups of contaminant effects on organism health; and would identify unidentified contaminants of emerging concern based their actual presence and their levels in the environment. A pilot project currently ongoing in 2013 is testing chemical mixtures and forensic methods in stream waters at a limited number of stream sites; scientists from the EPA National Exposure Research Lab, National Risk Management Research Lab, and National Health and Environmental Effects Research Laboratory are testing the same water samples for biological activity using bioassays. The expanded effort would enable testing at additional sites for other contaminant source types and combinations, and would enable contaminants to be tested in both stream water and sediments providing a better estimate of total contaminant mass and exposure potential.

Pathogens and Contaminants **(+$611,000/+2 FTE)**

Contaminant Biology Program (+$611,000/+2 FTE)

Historically, researchers studied effects of pathogens (infectious disease) and contaminants (toxicological disease) in isolation; yet animals and people are often exposed to these agents simultaneously in the environmental. Concurrent exposure to these disease agents can produce significant, and sometimes unexpected, interactions which affect the health and well- being of fish, wildlife and people. For example, exposure to contaminants can impact the immune systems of organisms, making them vulnerable to pathogens. USGS research has demonstrated that immunosuppression, caused at least in part by exposures to chemical contaminants in the environment, is a potential contributing cause of massive fish die-offs in the Potomac River.

The proposed increase would integrate expertise that is not traditionally brought together in environmental studies. The studies would focus on enhancing the understanding of the effects of exposure to complex combinations of disease agents, identifying the mechanisms of interactions, and helping to more accurately quantify the individual impacts of different disease agents on the health of aquatic and terrestrial organisms. Resource managers would use this knowledge to identify vulnerable populations and to better diagnose and respond to disease outbreaks that cannot be fully explained by our understanding of the effects of single classes of disease agents. Human health researchers can utilize this information to better understand the potential effects of these combined interactions on public health.

Natural Hazards

Earthquake Products and Improved Monitoring in Eastern U.S. **(+$1,200,000/0 FTE)**

Earthquake Hazards Program (+$1,200,000/0 FTE)

Following every significant earthquake, the USGS quickly distributes several “situational awareness” products, including *ShakeMap*, *ShakeCast*, *Prompt Assessment of Global Earthquakes for Response* (*PAGER)* and *DidYouFeelIt?,* which governments and emergency response organizations use to gauge the earthquake’s impact and to plan response activities. These products have wide use but have technical limitations because the seismic network coverage is too sparse in many areas of the country, especially in the Central and Eastern United States, and other input data is too sparse and results in high uncertainties in shaking and loss estimates.

To address these technical limitations, the USGS is proposing to:

- Release Version 2 of the *ShakeMap Atlas*, with nearly 10,000 global earthquake ShakeMaps for years since 1973. This database, to be released online, would be used for PAGER, Global Earthquake Model (GEM), the United Nations, and dozens of loss modelers and researchers. The USGS would supplement the *ShakeMap Atlas* with older and smaller events for New England, the Central and Eastern United States, and for landslide and liquefaction case history events;
- Implement a new scientific and technical strategy to address the challenges of geospatial site amplification. This would move beyond employing only shallow velocity profiling to estimate site amplification (still the current standard). This work will address a long-term goal of being able to improve ShakeMap with any available method for refined site amplification;
- Develop ShakeCast, Version 3.0 applications, under contract to Caltrans and the U.S. Nuclear Regulatory Commission. These would include customizable settings for vulnerability, landslide probability, and liquefaction potential. External user coordination would continue to be supported by reimbursable contracts to the Fort Collins Science Center, and via workshops and visits to critical users around the country;
- Develop effective relocation procedures for mainshock/aftershock sequences. Such procedures have been used to assess the magnitude 8.8 earthquake in Maule, Chile, and the magnitude 7.2 earthquake in Van, Turkey, and are being used to improve constraints on earthquake source parameters in the magnitude 7.2 Virginia earthquake sequence; and
- The USGS would extend PAGER by enhancing the ShakeMap hazard layer to assess the likelihood and spatial distribution of secondary hazards. Estimating both liquefaction and landslide probabilities are not yet applicable on a global scale in practice. On-going calibrations are being performed with the greatly improved subset of recent landslide and liquefaction case-history events provided by the ShakeMap Atlas 2.0.

In addition, the USGS has been working for the past 18 months with the Office of Science and Technology Policy, the Office of Management and Budget, the National Science Foundation (NSF), the Department of Energy and the Nuclear Regulatory Commission (NRC) to develop a plan to make 150-200 seismic stations in the Central and Eastern United States permanent. These seismic stations are currently part of the "USArray" transportable array, funded by the NSF. A comprehensive and detailed plan for widespread conversions to make these stations permanent has been completed and the NSF is taking the first steps toward implementation of this plan in 2013 with funding in its budget. This proposed funding would complement the NSF's continuing investment in the station conversion project

Enhancing Monitoring **(+$108,000/ 0 FTE)**

Geomagnetism Program (+$108,000/0 FTE)

The proposed increase would help maintain and modestly expand USGS work on geomagnetically-induced currents (GICs). GICs are produced when space weather impacts the Earth, causing damaged electric power grids and other electricity conducting infrastructure, affecting the availability of power to millions of Americans and impacting regional economies. The USGS, in collaboration with the NOAA Space Weather Prediction Center and NASA-Goddard GIC, are building monitoring tools that include a nationwide conductivity model, a local magnetic field model and regional electric field estimates.

Enhanced Coastal Storm Response Capability: Improved Assessments of Coastal Storm and Climate Impacts and Vulnerability **($850,000/+3 FTE)**

Coastal and Marine Geology Program ($850,000/+3 FTE)

The USGS, in anticipation of Hurricane Sandy and through the subsequent response and recovery, provided pre-storm forecasts of Sandy impacts, surveys to assess coastal and community impacts, and assessments of coastal conditions and vulnerability reflecting the altered post-storm landscape. The USGS Sandy response continues an investment in developing capabilities to anticipate and document the impact of hurricanes, other major storms, and the long-term consequences of coastal erosion and sea-level rise. The resulting data and tools have high-visibility and have established expectations for USGS products with wide applicability, as well as products targeted to the requirements of specific coastal resource and emergency managers at both the state and Federal level.

Demands for USGS data and products subsequent to Hurricane Sandy exceeded USGS capacity. In response, the USGS is implementing changes to ensure that data and products are more readily available (through, for example, the *ocean.data.gov* portal), that standard products meet broad needs, and that USGS information systems facilitate the ability of users to access and integrate information to meet their specific requirements. The proposed funding increase would support evaluation of the accuracy and effectiveness of current forecast products; development of improved models for storm impacts at regional and national scales (including cumulative impacts over management relevant time scales and reflecting climate change scenarios); and development of products for application to specific management needs such as public safety, infrastructure vulnerability, and cultural and natural resource management. Project execution would include collaborative efforts with diverse users, particularly other Interior bureaus and State resource managers, to ensure products and delivery mechanisms are accessible, reflect management processes and technical capacities, and are applied in a manner consistent with product uncertainties.

Water Resources

Streamgages and Streamgage R&D **(+$8,161,000/+1 FTE)**

The USGS streamgage network provides streamflow information and understanding for National, State, Tribal, and local economic well-being, the protection of life and property, and efficient and effective water resource management. Research and development into complimentary methods of stream flow data collection is important to measure areas in which it is not practical or feasible to place a gage.

National Streamflow Information Program (+$7,161,000/+0 FTE)

The increase proposed for the National Streamflow Information Program (NSIP) would enhance its stability by retaining streamgages that would otherwise be discontinued. It is expected that the NSIP would be able to fully fund at least another 100 NSIP streamgages and partially fund over 200 other streamgages. However, there would be more streamgages at risk due to anticipated partner (other Federal, State, Tribal and local agencies) reduction in funding because of economic conditions. The proposed 2014 increase would provide for a full-time Flood Coordinator and a half-time Drought Coordinator who would help plan and oversee the USGS response to ongoing floods and droughts and documentation for nationally consistent data acquisition and analyses. With the proposed increase, the program can help support a highly reliable system for real-time and historic streamflow information delivery to customers that includes data processing, quality assurance, storage, and easy data access. These funds would help ensure that the National Water Information System (NWIS) database, critical to the success of NSIP, is operated and maintained at peak efficiency and effectiveness. Additional efforts are needed to provide real-time data users information on the range

of uncertainty of the streamflow information they use to make decisions on a regular basis. Proposed funding would support software upgrades for time series information.

Hydrologic Research and Development (+$1,000,000/+1 FTE)

The USGS would expand research and development on the next generation of streamflow and bathymetric measurement techniques, which would incorporate remote sensing to achieve cost efficiencies and improve capabilities for measuring discharge and depth profiles at ungaged sites. High-speed infrared video and particle image velocimetry have demonstrated potential for generating accurate, spatially detailed measurements of water-surface velocities and channel bathymetry. Laboratory experiments and field tests of these techniques use data collected by aircraft and unmanned aerial vehicles (UAV's) to enhance current capabilities for measuring discharge in ungaged streams. The resulting methods would eventually be applied to remote sensing data from satellite platforms currently in development and scheduled to become operational in a few years. This capability has applications that could potentially reduce loss of life and property damage during floods; other applications include hydrographic charting for navigation, ecological monitoring and restoration, water resource management, and contaminant transport.

Water Science and Technical Support for Tribes (+$1,000,000/+7 FTE)

Cooperative Water Program (+$1,000,000/+7 FTE)

The CWP monitoring and assessments will continue and expand work related to water availability issues on Tribal lands in order to address such topics as water rights, water use, hydrologic conditions, and water-quality issues. The CWP would continue development of quantitative models of water budgets, including groundwater and surface-water interactions, that provide information on how human and natural factors, such as groundwater pumping and climate change, affect stream flows so that Tribal river managers can develop effective strategies to maintain and restore critical habitats and healthy ecosystems. Funding for tribal cooperators, including an increase in the 2014 budget will be allocated in coordination with the DOI Secretary's Indian Water Rights Office and other Bureaus (including Indian Affairs and Reclamation) that support the Federal trust responsibility for water in Indian Country.

NAWQA Related Studies (+$1,000,000/+7 FTE)

Cooperative Water Program (+$1,000,000/+7 FTE)

The Cooperative Water Program (CWP) monitoring and assessments would continue to provide watershed insights to meet national objectives of the National Water-Quality Assessment (NAWQA) program, including on the transport and fate of nutrients and sediment through watersheds to receiving waters; enhancement of real-time continuous monitoring at streams and rivers; natural and man-made contaminants in deep groundwater used for drinking; ecological modeling of ecosystems; and forecasting of water quality resulting from land-use and climate change.

Core Science Systems

Geological and Geophysical Data Preservation **(+$400,000/0 FTE)**

Science Synthesis, Analysis and Research Program (+$400,000/0 FTE)

The National Geological and Geophysical Data Preservation Program (NGGDPP) is dedicated to preserving physical and analog geoscience data including rock and ice cores, fossils, fluid samples of oil, gas, and water, and geochemical samples that represent potentially beneficial or harmful chemical compounds in the rocks. To accomplish this work, the NGGDPP cooperates with state geological surveys and other Interior bureaus. The USGS Libraries Program identifies, acquires, manages, and provides access to a broad collection of scientific information for a wide range of internal and external customers. It maintains physical and digital collections and provides tools for accessing them onsite and remotely. The increase would: 1) provide more states with funds to inventory and preserve physical collections, such as core samples, fossil and fluid samples, and derived and indirect data, such as geochemical and seismic data, maps, or field notebooks; 2) improve the National Digital Catalog, which makes it possible to find, get, and use preserved geoscience data from over 750 collections on nearly 3 million geoscience data points provided by 44 states and USGS collections; and, 3) expand digitization, description, and accessibility of scientific research products in the possession of the USGS and its partners for the broader content availability for integration and discovery.

Alaska Mapping **(+$1,044,000/0 FTE)**

National Geospatial Program (+$1,044,000/0 FTE)

The National Geospatial Program (NGP) is working with the State of Alaska and Federal partners to replace more than half-century-old topographic maps and to provide current geospatial data for Alaska. New and accurate geospatial data are needed to improve aviation safety; understand and mitigate the effects of coastal erosion and storm surge; plan infrastructure for Arctic shipping and resource extraction; and protect biodiversity and habitats. The NGP and its partners are working on a five-year effort (2013-2018) to acquire geospatial data to remap the State. The topographic maps generated from the data would be completed in 2019.

The Alaska Mapping Executive Committee, an interagency group chaired by Interior and staffed by the NGP, is identifying and pooling funds to acquire elevation and hydrography data. The State works with the Federal Committee members and its Technical Subcommittee. The highest priority need identified by the Committee is for elevation data. Approximately 35 percent of the elevation coverage for the State has been updated. The proposed increase would bolster funding for elevation data acquisition contracts, and reduce the estimated $37.8 million shortfall needed to complete the State. Some funding would be used to improve techniques to increase the efficiency of acquiring hydrography data, which is the second highest priority.

Facilities

Operations and Maintenance Efficiencies--Reduce Facilities Footprint **(+$6,385,000/0 FTE)**

Rental Payments and Operations and Maintenance (+$6,385,000/0 FTE)

With the proposed increase, Facilities, Rental Payments and Operations and Maintenance would have the ability to invest in Cost Savings and Innovation Plan (CSIP) projects, that allow the USGS to consolidate

space, reduce the occupancy footprint, improve utilization and create real property cost savings and other efficiencies. Funding would enhance the ability to meet requirements of statutory energy goals; increase efforts for energy reduction, water conservation, and waste reduction; and enhance the USGS's ability to meet specified environmental requirements, as well as enable more efficient and economical maintenance of its real property assets.

Program Decreases

Climate and Land Use Change

Geologic Carbon **(-$532,000/-1 FTE)**

Carbon Sequestration (-$532,000/-1 FTE)

The geological storage of carbon dioxide (CO_2) in porous and permeable rocks involves injecting high pressure CO_2 into a subsurface rock unit and displacing the fluid that initially occupied the pore space. The proposed funding reduction in 2014 would delay assessment and research activities planned by the geologic carbon sequestration project. For example, the completion of a three-year assessment of the recoverable oil and gas resources resulting from carbon dioxide sequestration associated with enhanced oil and gas recovery would be delayed by one year. Another example is that the program would delay the development of economic assessment methodologies to evaluate the results of the national geologic carbon sequestration assessment until 2015. A third example is that the program would scale back the scope of ongoing investigations into the potential for induced seismicity related to carbon dioxide injection and subsurface storage; this would affect the number of sites studied and the amount of data collected. Finally, the geologic carbon sequestration program would curtail on-going collaboration on geological storage of CO_2 with universities and State and Federal agencies.

National Civil Applications Program/Civil Applications Committee **(-$576,000/-2 FTE)**

Land Remote Sensing (-$576,000/-2 FTE)

The National Civil Application Program (NCAP) serves USGS science programs and other Federal civil agencies by providing for the acquisition, dissemination, archive, and exploitation of classified remote sensing systems and data to address land and resource management, environmental, socioeconomic, hazards, disasters, and other geospatial scientific analysis and policy issues. In addition, NCAP provides support for the Civil Applications Committee (CAC), an interagency committee that provides coordination and oversight of Federal civil use of classified collections. The LRS Program would reduce the NCAP/CAC funding by $0.6 million in 2014. The program would reduce it through cost savings associated with two activities: 1) a migration of secure communications capabilities to a less expensive but sufficiently capable communications provider, and 2) reduced office space footprint at the LRS Program's secure facilities. These activities are expected to reduce costs without compromising core program capabilities.

North American Data Buy **(-$1,000,000/0 FTE)**

Land Remote Sensing (-$1,000,000/0 FTE)

In 2014, the Land Remote Sensing (LRS) Program would reduce its data acquisition expenditures by $1.0 million through the cancellation of the North American Data Buy (NADB) program. The NADB first started in 2009. This program was particularly necessary in 2012 during the suspension of operations for Landsat 5 and in 2013 to address gaps in Landsat coverage during the decommissioning of Landsat 5. Landsat 8 operational data collection is expected to begin by June 2013. Should Landsat 8 data collection be delayed, reducing the NADB incurs some additional risk of a gap in data provided to all users. However, its continuation is not deemed critical to address core program requirements.

Energy Minerals and Environmental Health

Minerals Information **(-$1,157,000/-10 FTE)**

Mineral Resources Program (-$1,157,000/-10 FTE)

This proposed reduction would reduce the support for the collection, analysis, and dissemination of minerals information. There is increasing need for this information due to emerging technologies and supply risk, as seen most recently for rare earth elements. This reduction would diminish the ability to collect and analyze both domestic and international data, and to provide this information to Congress and Federal agencies that count on USGS minerals information for mineral policy decisionmaking. Partners impacted would be the Federal agencies and departments that require an understanding of domestic mineral resource production and consumption in the context of global mineral resource availability and supply (e.g., Commerce, Defense, State, intelligence community).The proposed reductions to MRP would result in diminished workforce expertise to address important mineral resource issues for the Nation. Once lost, this expertise would take many years to reestablish. As the minerals program is realigning its structure and science with the Mission Area strategic science plan, the program is evaluating options for right-sizing various components of the program to meet the changing science and minerals information needs of the Nation.

Mineral Resources – Research **(-$1,000,000/-8 FTE)**

Mineral Resources Program (-$1,000,000/-8 FTE)

This funding reduction to research and assessment activities within the Mineral Resources Program (MRP) is being implemented in the 2013 Operating Plan. As the minerals program is realigning its structure and science with the Mission Area strategic science plan, the program is evaluating options for right-sizing various components of the program to meet the changing science and minerals information needs of the Nation.

Research and Assessment **(-$2,803,000/-23 FTE)**

Mineral Resources Program (-$2,803,000/-23 FTE)

This proposed reduction would eliminate research on mineral environmental health. As a result of this reduction, the USGS and the Federal government would lose the capability to understand the interactions of mineral resources with the environment, both natural and as a result of resource extraction, and the capability to predict the impact that resource development may have on human and ecosystem health. Partners impacted by the reduction would include regulating agencies such as the EPA, the BLM, the USFS, and State and local governments. This proposed funding scenario would reduce mineral resources field and research studies in Alaska, which represents one of this Nation's final frontier regions for geologic and mineral resource research. The world's largest zinc producer and one of the world's largest undeveloped gold-copper resources are in Alaska. This reduction would diminish the Federal Government's ability to investigate Alaska's mineral resources and fully understand the region's potential as a major supplier of mineral resources that are important to the Nation's economic and national security. Partners impacted would be the State of Alaska, industry, and Federal land management agencies.

The MRP would delay domestic mineral and environmental assessments until adequate resources are available. The MRP conducts mineral resource and mineral environmental assessments at local, regional, and national scales to estimate the quality and quantity of undiscovered mineral resources and potential

impacts of mineral resource development on environmental health. This unbiased objective geologic-based information is used in land planning and mineral policy decisionmaking. Currently, no other private, State, or Federal entity is capable of doing this work. Loss of this capability would severely impact the Federal government's ability to provide science-based decisionmaking on mineral related issues. Partners impacted would be the Federal land management agencies (e.g., BLM and the USFS) and Federal organizations that require an understanding of the national mineral resource endowment (e.g., Commerce, Defense, and the intelligence community).

These proposed reductions would result in further diminished workforce expertise to address important mineral resource and mineral environmental issues for the Nation. Once lost, this expertise would take many years to reestablish. As the minerals program is realigning its structure and science with the Mission Area strategic science plan, the program is evaluating options for right-sizing various components of the program to meet the changing science and minerals information needs of the Nation.

Natural Hazards

Eliminate Management-Supporting Habitat and Service Mapping **(-$2,150,000/-8 FTE)**

Coastal and Marine Geology Program (-$2,150,000/-8 FTE)

CMGP supports field and interpretive activities to provide environmental mapping to meet management needs within Marine Sanctuaries, National Parks, Fish and Wildlife Refuges, Marine Monuments, and for management of fisheries and other living marine resources in State and Federal Waters. Those benthic habitat and other mapping programs that exclusively respond to the needs of management agencies would be eliminated. Continuing service mapping would only be supported where it enables scientific studies addressing CMGP research priorities and where substantial cost-sharing from partnering agencies is available. As a consequence of this reduction, the USGS would no longer apply expertise in physical characterization of the sea-floor and coastal systems to the development of interpretive maps for use by resource managers. Mapping will remain a foundational CMGP activity, but mapping activities will be less available in response to site-specific and single-user requests for data-only products. Elimination of field mapping activities supporting this objective will reduce the availability of data for interpretive mapping by other State and Federal agencies.

Great Lake Beach Health Study **(-$600,000/-1 FTE)**

Coastal and Marine Geology Program (-$600,000/-1 FTE)

This funding reduction within the Coastal and Marine Geology Program is being implemented in the 2013 Operating Plan. The Great Lakes Beach Health study has been completed. USGS worked collaboratively with NOAA, EPA, and State and local public health agencies to expand the use of beach health predictive models to over 40 recreational beaches in five Great Lake States; develop new rapid field technology to determine bacteria concentrations at beaches; and increase understanding of the occurrence of true, rather than indicator, pathogens and viruses. This work provides beach managers the ability to issue warnings and closures, which have substantial public health and economic consequences, with greater certainty of risk.

Water Resources

Methods Development and Assessments **(-$5,000,000/-29 FTE)**

National Water Quality Assessment (NAWQA) Program (-$5,000,000/-29 FTE)

Within NAWQA, resources are being redirected from projects that are nearing completion as well as projects that are lower in priority, to WaterSMART, Ecosystems Priorities, and other higher priority projects. This will, however, impact the program's ability to meet some stakeholder needs for timelier reporting of water quality information and development of decision support tools. In particular, the program's ability to provide: (1) annual Web-based reporting of the concentrations, loads, and trends of nutrients, sediment and other contaminants in rivers flowing into important estuaries such as the Gulf of Mexico, Chesapeake Bay, San Francisco Bay; and (2) development, installation and calibration of real time water-quality sensors, training of field staff in the installation and operation of these sensors and the development of new laboratory analytical methods for new pesticides, high production volume chemicals and pharmaceuticals.

These decisions reflect a redirection of funds to protect, sustain and enhance USGS operational data networks and data management and delivery systems. Consistent, high quality, reliable, and uninterrupted hydrologic data are critical for the protection of life and property and to support the myriad of resource management decisions by public and private sectors as the Nation continues to strive for a robust economy and safe environment in the face of continued population growth, land and habitat changes, and climate variability. The primary implication of the 2014 decisions means that USGS assessments and research activities, other than those activities that advance cost-effective and innovative monitoring and data management technology, are reduced significantly. Applications developed to deliver USGS data in accessible, user-friendly, graphical and tabular formats, also are diminished.

Data Collection and Research **(-$867,000/-9 FTE)**

Hydrologic Networks and Analysis (HNA) Program (-$867,000/-9 FTE)

HNA support for the Priority Ecosystem Science (PES) would be reduced, which would affect data collection, assessments, and research conducted at the sites supported by the Priority Ecosystem Science program. Sites include Chesapeake Bay, San Francisco, Everglades, Mojave Desert, Yellowstone, and Platte River. These reductions would affect the efforts to develop new integrated science approaches that can be developed to address the needs of decisionmakers and to meet the Interior's responsibilities to manage the Nation's lands.

These reductions were made as a decision by the Program Council to preserve data networks over general assessment. It is felt that currently, networks are a higher priority than assessments. HNA provides general support to the Ecosystems Mission Area in the affected PES', this support will be reduced as a result of this reduction.

Interpretative Studies/Assessments **(-$4,000,000/-25 FTE)**

Cooperative Water Program (-$4,000,000/-25 FTE)

The proposed redirection of funds and FTE within the Cooperative Water Program (CWP) would reduce available science funding that supports assessments and research on selected issues; emerging topics first identified at local and State levels; and quality assurance that ensures that information collected across State boundaries are consistent and comparable. The funds would be used to support NAWQA and

WaterSMART studies and prioritizes CWP science to assess occurrence and transport of nutrients and other contaminants in streams and groundwater; to estimate streamflow at ungaged sites for more accurate water budgets; track site specific public-supply water use and consumptive uses; and increase understanding of streamflow and water availability for future needs on Tribal lands. The number of monitoring sites would remain stable, but may shift in location with the possible shift in assessment priorities.

The shift in Cooperative Water funding allows the USGS to use scarce resources to more strategically address USGS and nationally oriented priority issues. Decisions reflect a redirection of funds to protect, sustain and enhance USGS operational data networks and data management and delivery systems.

Water Resources Research Act Reduction **(-$5,490,000/0 FTE)**

Water Resource Research Act Program (-$5,490,000/0 FTE)

In 2012, the Water Resource Research Institutes (WRRI) program provided about $5.5 million of funding to the Institutes as annual base grants and an additional $1.0 million to 6 Institutes for successful national competitive grants. The proposed reduction would eliminate the annual base grants, but would continue to provide funding for the national competitive grant. The National Institutes for Water Resources (NIWR)-USGS National Competitive Grant Program supports research on water problems and issues that are of a regional or interstate nature beyond those of concern only to a single state. These grants prefer substantial collaboration between the USGS and university scientists. Collaboration ranges from the use of USGS data and information in the research to mutual involvement of USGS and University scientists on projects.

More than 250 applied research and information transfer projects funded through the annual base grants would be discontinued as would education and research opportunities offered by the Institutes to students. Many Institutes depend on the annual base grants to keep the Institute operating and would not be able to function. NIWR and the USGS have had good working relations over the years and are looking to better develop collaborative opportunities through development of an Internal Committee. The research priorities of the National Competitive Grant Program will better align with the USGS Strategic Plans (especially Water and Ecosystems) that were recently developed for the Mission Areas. The USGS will work with the Institutes to develop more rigorous oversight and performance measures to ensure that Federal investments effectively and consistently maximize national science goals and leverage all available resources, particularly in the areas of water availability, quality, and climate change.

Core Science Systems

Federal Geographic Data Committee (FGDC) Legacy Activities **($1,697,000 /-3 FTE)**

National Geospatial Program ($1,697,000 /-3 FTE)

In 2014, the USGS proposes to reduce funding for the FGDC. The FGDC would be funded at approximately $3.8 million. At this funding level, the FGDC Office of the Secretariat (OS) would provide support for the Steering Committee, Executive Committee, Coordination Group, and the National Geospatial Advisory Committee and support the Geospatial Line of Business/Federal Geospatial Platform. Support for key initiatives and Office of Management and Budget Circular A-16 components including architecture, the USGS National Spatial Data Clearinghouse network, geospatial standards development, National Spatial Data Infrastructure (NSDI) development and training, metadata program, and some of implementation of the A-16 Supplemental Guidance would continue. The reduction to the

FGDC OS would result in a reduced level of staff and capacity to address the balance of the implementation of the A-16 Supplemental Guidance, interagency policy, program, and coordination functions and requirements that would impact the Federal and national geospatial communities. The proposed reduction would eliminate the NSDI Cooperative Agreements Program and cloud computing initiative and significantly reduce International activities. The FGDC is funded through an interagency line of business. As the interagency steward of the program USGS funds the Office of the Secretariat. This reduction will eliminate funding for lower priority activities that have been historically provided by the Office.

Administration and Enterprise Information

Reduction to Administrative Services **(-$3,135,000/-18 FTE)**

Science Support (-$1,906,000/-8 FTE)

The Administration and Enterprise Information program funds the bureau and region leadership and management that provide guidance, direction and oversight of all USGS science activities and resource management and business and information systems, which provide the framework for science activities. The proposed reduction would result in the loss of core administrative and information technology services impacting the ability to deliver critical resources and business services to science centers, and reducing the availability of USGS science data used by emergency planners, natural resource planners and managers, and the general public.

The Science Support subactivity includes science quality and integrity, communications, and bureau management activities, such as leadership and budget formulation and analysis. Administrative support would be severely impacted, resulting in decreased support services in acquisitions, policy analysis and accounting and financial management oversight, including internal controls. Acquisition and Grant services necessary for conducting science projects would be delayed and would result in reducing the number of awards that can be made in a fiscal year. A reduction in Human Capital services would severely impact responsiveness, service, and the expectations of the Interior, the Office of Personnel Management, and USGS customers. A reduction in communication services could limit key proactive outreach activities directed at the public, policy makers and stakeholders about USGS science and capabilities. Timely and accurate responses to inquiries and data calls would also be negatively affected resulting in incomplete information being provided in a less-than-timely manner.

The proposed budget reduction would leave organizations without the employees needed to maintain fiscal accountability and internal controls; procure essential goods and services for science; maintain and operate facilities; manage equipment and property; and provide USGS maps and science products to the public. There would be an increased risk of material weakness in financial controls, property management and acquisition actions, which could lead to undetected fraud, waste, abuse or mismanagement.

Essential services including purchasing science equipment and field supplies; executing science agreements with partners; contracting for support scientists and researchers; vehicle management; funds accounting; oversight of cost savings and innovation projects, safety training; and hazardous waste management would be reduced and delivery of services delayed. Results of scientific studies and updates to datasets would lag or possibly would not be available to the public or other research agencies due to lack of resources for accomplishing reviews for scientific rigor and integrity and editing and preparing documents for publication.

Mandated goals to improve contract processes and eliminate sole source contracts would not be met. Insufficient numbers of acquisition employees could result in lack of quality control and risks increased liability to the government for improper contract actions.

The availability of authoritative USGS scientific data and products, used by emergency responders and the public would be limited and the timeliness of updates on social media sites reduced.

Prior year gains in building future scientific capacity through youth hiring and youth outreach activities would be lost through required cuts to these programs. Further, cooperative science projects and training with Native American tribes would be reduced, resulting in less science conducted by students on tribal lands and the elimination of important natural resources management training for hundreds of tribal members.

USGS activities with tribes would be negatively affected due to the reduced ability to hire interns for the Students In Support of Native American Relations (SISNAR) program, which brings interns to work on USGS research studies on tribal lands. Budget cutbacks would impact the ability to provide capacity-building tribal trainings and support for Tribal Colleges and Universities (TCUs).

At the proposed funding level:

- Bureauwide research support tools such as scientific journal subscriptions would be reduced or eliminated, making it more difficult for USGS researchers to conduct comprehensive literature reviews.
- Staffing, classification, labor relations advice and assistance to science managers would be reduced, negatively impacting the ability to effectively manage the workforce and accomplish strategic workforce planning.
- Science facility leasing contracting officers and construction project managers would increase the number of projects managed by employees, increasing the risk of accepting construction work or space contracts that do not achieve maximum benefit for funds expended or would require additional work to correct substandard construction.
- Environmental specialists would perform fewer NEPA site visits to assist science center staff with the complex process of properly managing and disposing of hazardous materials.

Security and Technology (-$1,229,000/-10 FTE)

Security and Technology facilitates science through technologies that enable collaboration and knowledge and information sharing between scientists across the landscape in addition to providing the communications and data management backbone. The proposed level of funding would require reductions to the Enterprise Geospatial Information Services (EGIS) support effort that works with mission programs to leverage GIS software and services to visually communicate natural science information to improve scientific understanding. Maintenance and technology refresh for telecommunications, computing infrastructure hardware and system software contracts and services would be deferred, increasing risk of a hardware failure. Additionally, software licenses, software database and information services management and maintenance contracts that have been centrally funded would be reduced or eliminated. This includes eliminating the bureauwide Oracle license, and security and maintenance support contracts for routers, security devices, portable personal communications devices, Norton antivirus, firewalls, and backup software. Failure to renew these services reduces core capability, increasing the likelihood of a critical systems failure, jeopardizing compliance and internal controls, and delaying and reducing distribution of USGS information.

Service contracts that sustain the underpinning of science computing infrastructure for mission data systems, administrative and security systems would be significantly downgraded and response times would decrease by ten percent, this would require a workforce reduction equivalent of 27 full time employees.

General Program Reductions (-$6,629,000/0 FTE)

These funding reductions are being implemented in the 2013 Operating Plan in part to offset increased costs to USGS programs due to fixed costs, to attain greater cost efficiencies, and support higher priorities.

Ecosystems	**(-$1,111,000/0 FTE)**
Status and Trends	(-$145,000/0 FTE)
Fisheries Program	(-$172,000/0 FTE)
Wildlife Program	(-$320,000/0 FTE)
Environments Program	(-$283,000/0 FTE)
Invasive Species	(-$59,000/0 FTE)
Cooperative Research Units	(-$132,000/0 FTE)
Climate and Land Use Change	**(-$536,000/0 FTE)**
National Climate Change and Wildlife Science Center/DOI Climate Science Centers (CSC)	(-$89,000/0 FTE)
Climate Research and Development	(-$162,000/0 FTE)
Carbon Sequestration	(-$41,000/0 FTE)
Science Support for DOI Bureaus	(-$8,000/0 FTE)
Land Remote Sensing	(-$153,000/0 FTE)
Land Use Change	(-$83,000/0 FTE)
Energy, Minerals, and Environmental Health	**(-$752,000/0 FTE)**
Mineral Resources Program	(-$439,000/0 FTE)
Energy Resources Program	(-$189,000/0 FTE)
Contaminant Biology	(-$67,000/0 FTE)
Toxic Substances Hydrology	(-$57,000/0 FTE)
Natural Hazards	**(-$861,000/0 FTE)**
Earthquake Hazards	(-$312,000/0 FTE)
Volcano Hazards	(-$188,000/0 FTE)
Landslide Hazards	(-$27,000/0 FTE)
Global Seismographic Network	(-$17,000/0 FTE)
Geomagnetism	(-$17,000/0 FTE)
Coastal and Marine Geology Program	(-$300,000/0 FTE)

Water Resources	**(-$1,589,000/0 FTE)**
Groundwater Resources	(-$69,000/0 FTE)
National Water Quality Assessment	(-$500,000/0 FTE)
National Streamflow Information Program	(-$114,000/0 FTE)
Hydrologic Research and Development	(-$280,000/0 FTE)
Hydrologic Networks and Analysis	(-$219,000/0 FTE)
Cooperative Water Program	(-$403,000/0 FTE)
Water Resources Research Act Program	(-$4,000/0 FTE)
Core Science Systems	**(-$725,000/0 FTE)**
Science Synthesis, Analysis, and Research	(-$100,000/0 FTE)
National Cooperative Geologic Mapping Program	(-$165,000/0 FTE)
National Geospatial Program	(-$460,000/0 FTE)
Administration and Enterprise Information	**(-$187,000/0 FTE)**
Science Support	(-$22,000/0 FTE)
Security and Technology	(-$165,000/0 FTE)
Facilities	**(-$868,000/0 FTE)**
Rental Payments and Operations and Maintenance	(-$868,000/0 FTE)

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Internal Transfers

Ecosystems

Environments **(+$2,358,000/+12 FTE)**

The Science Support for DOI program provides science support for other bureaus within Interior. For example, the USGS provides priority wildlife research related to White-nose Syndrome, golden eagles, bats, condors, desert tortoises and renewable energy. The USGS also provides science support for other Federal, State, tribal, academic, and private eco-regional fish, wildlife and land conservation efforts by providing integrated ecological and population modeling capacity for national efforts, as well as increased capacity for applying models and other scientific information for resource managers.

Climate and Land Use Change

Science Support for DOI Bureaus **(-$2,358,000/-12 FTE)**

In order to more closely align work in the Mission Areas, Ecosystems would receive $2.4 million and 12 FTE from the Climate and Land Use Change Mission Area for Science Support for DOI Bureaus to support Ecosystems research goals.

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Budget at a Glance
(Dollars in Thousands)

	2013 Full Yr. CR (PL. 112-175)	2012 Enacted	Fixed Costs	Internal Transfers	Program Changes	2014 President's Budget
Appropriation: Surveys, Investigations, and Research						
Ecosystems						
Status and Trends	***21,733***	**21,733**	**283**	**-**	**(145)**	**21,871**
Fixed Costs	-	-	283	-	-	-
General Program Reduction	-	-	-	-	(145)	-
Fisheries Program	***22,172***	**22,172**	**340**	**-**	**4,315**	**26,827**
Fixed Costs	-	-	340	-	-	-
Ecosystem Priority: Klamath Basin Agreement	-	-	-	-	901	-
Hydraulic Fracturing	-	-	-	-	2,200	-
WaterSMART: Water Quality Enhancement	-	-	-	-	1,386	-
General Program Reduction	-	-	-	-	(172)	-
Wildlife Program	***47,978***	**46,978**	**622**	**-**	**3,185**	**50,785**
Fixed Costs	-		622	-	-	-
Energy Future and Wildlife Sustainability	-		-	-	2,000	-
White Nose Syndrome	-		-	-	1,505	-
General Program Reduction	-		-	-	(320)	-
Environments Program	***36,620***	**36,120**	**552**	**2,358**	**5,443**	**44,473**
Fixed Costs			552	-	-	-
Coral Reefs			-	-	442	-
Ecosystem Priority: California Bay Delta			-	-	1,000	-
Ecosystem Priority: Chesapeake Bay			-	-	615	-
Ecosystem Priority: Columbia River			-	-	300	-
Ecosystem Priority: Puget Sound			-	-	369	-
Ecosystem Priority: Sustaining Environmental Capital			-	-	2,000	-
Ecosystem Priority: National Ecosystems Services Framework			-	-	1,000	-
Science Support for DOI Bureaus (Internal Transfer From CLU)			-	2,358	-	-
General Program Reduction			-	-	(283)	-
Invasive Species	***13,824***	**12,824**	**111**	**-**	**5,315**	**18,250**
Fixed Costs			111	-	-	-
Brown Tree Snakes			-	-	500	-
Ecosystem Priority: Everglades			-	-	1,000	-
Ecosystem Priority: Great Lakes Asian Carp Control Framework			-	-	2,000	-
Ecosystem Priority: Upper Mississippi River Asian Carp Control			-	-	1,000	-
New and Emerging Invasive of National Concern			-	-	874	-
General Program Reduction			-	-	(59)	-
Cooperative Research Units	***18,441***	**18,441**	**257**	**-**	**(132)**	**18,566**
Fixed Costs			257	-	-	-
General Program Reduction			-	-	(132)	-
Activity Total, Ecosystems	***160,768***	**158,268**	**2,165**	**2,358**	**17,981**	**180,772**

Budget at a Glance
(Dollars in Thousands)

	2013 Full Yr. CR (PL. 112-175)	2012 Enacted	Fixed Costs	Internal Transfers	Program Changes	2014 President's Budget
Climate and Land Use Change						
Climate Variability						
National Climate Change and Wildlife Science Center /DOI Climate Science Centers (CSC)	***25,198***	**25,198**	**160**	**-**	**9,934**	**35,292**
Fixed Costs			160	-	-	
Translational Science Grants			-	-	3,500	
Climate Adaptation and Resiliency - Vulnerability Assessment Database & Field Guide			-	-	800	
Interagency Coordination			-	-	3,223	
Tribal Climate Science Partnerships			-	-	2,500	
General Program Reduction			-	-	(89)	
Climate Research & Development	***21,759***	**21,759**	**341**	**-**	**3,010**	**25,110**
Fixed Costs			341	-	-	
Emerging Science needs			-	-	3,172	
General Program Reduction			-	-	(162)	
Carbon Sequestration	***8,874***	**8,874**	**80**	**-**	**2,385**	**11,339**
Fixed Costs			80	-	-	
Biological Carbon Sequestration			-	-	2,958	
Geologic Carbon Sequestration			-	-	(532)	
General Program Reduction			-	-	(41)	
Science Support for DOI Bureaus	***2,358***	**2,358**	**8**	**(2,358)**	**(8)**	**-**
Fixed Costs			8	-	-	
General Program Reduction			-	-	(8)	
Science support for DOI Bureaus (Internal Transfer to ECO)			-	(2,358)	-	
Subtotal: Climate Variability	*58,189*	58,189	589	(2,358)	15,321	71,741
Land Use Change						
Land Remote Sensing	***72,077***	**72,077**	**296**	**-**	**(1,729)**	**70,644**
Fixed Costs			296	-	-	
National Civil Applications Program/Civil Applications Committee			-	-	(576)	
North American Data Buy			-	-	(1,000)	
General Program Reduction			-	-	(153)	
Land Change Science	***11,273***	**11,137**	**160**	**-**	**2,310**	**13,607**
Fixed Costs			160	-	-	
Ecosystem Priority: Chesapeake Bay			-	-	500	
Ecosystem Priority: Land Use Science			-	-	1,000	
Rapid Disaster Response: Scenarios and Crisis Response			-	-	757	
WaterSMART			-	-	136	
General Program Reduction			-	-	(83)	
Subtotal: Land Use Change	*83,350*	83,214	456	-	581	84,251
Activity Total, Climate and Land Use Change	***141,539***	**141,403**	**1,045**	**(2,358)**	**15,902**	**155,992**

Budget at a Glance
(Dollars in Thousands)

	2013 Full Yr. CR (PL. 112-175)	2012 Enacted	Fixed Costs	Internal Transfers	Program Changes	2014 President's Budget
Energy, Minerals, and Environmental Health						
Mineral and Energy Resources						
Mineral Resources	***48,760***	**48,760**	**866**	**-**	**(3,269)**	**46,357**
Fixed Costs			866	-	-	
Minerals Information			-	-	(1,157)	
Minerals Resources			-	-	(1,000)	
Rare Earth Elements Research			-	-	1,000	
Research and Assessment			-	-	(2,803)	
High Priority Research on Critical Minerals			-	-	1,130	
General Program Reduction			-	-	(439)	
Energy Resources	***28,820***	**27,570**	**370**	**-**	**3,061**	**31,001**
Fixed Costs			370	-	-	
Alternative Energy Permitting on Federal Lands			-	-	2,000	
Hydraulic Fracturing			-	-	1,250	
General Program Reduction			-	-	(189)	
Subtotal: Resources	*77,580*	*76,330*	*1,236*	-	*(208)*	*77,358*
Environmental Health						
Contaminant Biology	***9,180***	**9,180**	**131**	**-**	**4,644**	**13,955**
Fixed Costs			131	-	-	
Ecosystem Priority: Chesapeake Bay			-	-	100	
Ecosystem Priority: Columbia River			-	-	100	
Emerging Contaminants/Chemical Mixtures			-	-	1,000	
Hydraulic Fracturing			-	-	1,400	
Pathogens and Contaminants			-	-	611	
WaterSMART: Water Quality Enhancement			-	-	1,000	
Environmental Impacts of Uranium Mining			-	-	500	
General Program Reduction			-	-	(67)	
Toxic Substance Hydrology	***10,580***	**10,580**	**111**	**-**	**5,443**	**16,134**
Fixed Costs			111	-	-	
Ecosystem Priority: Chesapeake Bay			-	-	100	
Ecosystem Priority: Columbia River			-	-	100	
Emerging Contaminants/ Chemical Mixtures			-	-	1,000	
WaterSMART: Water Quality Enhancement			-	-	1,800	
Environmental Impacts of Uranium Mining			-	-	2,500	
General Program Reduction			-	-	(57)	
Subtotal: Environmental Health	*19,760*	*19,760*	*242*	-	*10,087*	*30,089*
Activity Total, Energy, Minerals, and Environmental Health	***97,340***	**96,090**	**1,478**	**-**	**9,879**	**107,447**

Budget at a Glance
(Dollars in Thousands)

	2013 Full Yr. CR (PL. 112-175)	2012 Enacted	Fixed Costs	Internal Transfers	Program Changes	2014 President's Budget
Natural Hazards						
Earthquake Hazards	***54,379***	**53,879**	**607**	**-**	**3,438**	**57,924**
Fixed Costs			607	-	-	
Hydraulic Fracturing			-	-	1,700	
Rapid Disaster Response: Robust Monitoring Networks			-	-	850	
Earthquake Products and Improved Monitoring in Eastern U.S.			-	-	1,200	
General Program Reduction			-	-	(312)	
Volcano Hazards	***24,122***	**24,122**	**364**	**-**	**212**	**24,698**
Fixed Costs			364	-	-	
Rapid Disaster Response: Early Warning Networks			-	-	400	
General Program Reduction			-	-	(188)	
Landslide Hazards	***3,168***	**3,168**	**52**	**-**	**473**	**3,693**
Fixed Costs			52	-	-	
Rapid Disaster Response: Early Warning Networks			-	-	500	
General Program Reduction			-	-	(27)	
Global Seismographic Network	***5,151***	**5,151**	**32**	**-**	**(17)**	**5,166**
Fixed Costs			32	-	-	
General Program Reduction			-	-	(17)	
Geomagnetism	***2,004***	**2,004**	**32**	**-**	**91**	**2,127**
Fixed Costs			32	-	-	
Enhance Monitoring			-	-	108	
General Program Reduction			-	-	(17)	
Coastal & Marine Geology	***42,221***	**42,821**	**583**	**-**	**5,550**	**48,954**
Fixed Costs			583	-	-	
Coastal Lidar			-	-	2,000	
Eliminate Management-Supporting Habitat and Service Mapping			-	-	(2,150)	
Enhanced Coastal Storm Response Capability			-	-	850	
Great Lakes Beach Health Study			-	-	(600)	
Science for Coastal and Ocean Stewardship			-	-	5,750	
General Program Reduction			-	-	(300)	
Activity Total, Natural Hazards	***131,045***	**131,145**	**1,670**	**-**	**9,747**	**142,562**

Budget at a Glance
(Dollars in Thousands)

	2013 Full Yr. CR (PL. 112-175)	2012 Enacted	Fixed Costs	Internal Transfers	Program Changes	2014 President's Budget
Water Resources						
Groundwater Resources	*8,731*	**8,731**	**133**	**-**	**3,858**	**12,722**
Fixed Costs			133	-	-	
Hydraulic Fracturing			-	-	2,100	
WaterSMART: Groundwater Network			-	-	627	
WaterSMART: Baseflow and Recharge and Regional GW Availability			-	-	1,200	
General Program Reduction			-	-	(69)	
National Water Quality Assessment	*61,570*	**61,570**	**973**	**-**	**(500)**	**62,043**
Fixed Costs			973	-	-	
Ecosystem Priority: California Bay Delta			-	-	1,000	
Ecosystem Priority: Chesapeake Bay			-	-	500	
Ecosystem Priority: Upper Mississippi River			-	-	200	
Methods Development and Assessments			-	-	(5,000)	
WaterSMART: National/Regional Synopsis and Surveys			-	-	500	
WaterSMART: Predictive Models			-	-	500	
WaterSMART: Program and Information Management			-	-	500	
WaterSMART: Water Quality Enhancement			-	-	1,800	
General Program Reduction			-	-	(500)	
National Streamflow Information Program	*28,977*	**28,977**	**221**	**-**	**7,047**	**36,245**
Fixed Costs			221	-	-	
Streamgages			-	-	7,161	
General Program Reduction			-	-	(114)	
Hydrologic Research & Development	*12,667*	**11,417**	**546**	**-**	**4,402**	**16,365**
Fixed Costs			546	-	-	
Ecosystem Priority: California Bay Delta			-	-	982	
Ecosystem Priority: Puget Sound			-	-	200	
Hydraulic Fracturing			-	-	2,200	
Streamgage R&D			-	-	1,000	
WaterSMART: Streamflow and Stresses to Hydrology			-	-	300	
General Program Reduction			-	-	(280)	
Hydrologic Networks & Analysis	*30,597*	**29,797**	**423**	**-**	**1,260**	**31,480**
Fixed Costs			423	-	-	
WaterSMART: Ecological Flows and Water Use Science			-	-	846	
WaterSMART: Estimating Water Budget			-	-	100	
WaterSMART: Program and Information Management			-	-	1,400	
Data Collection and Research			-	-	(867)	
General Program Reduction			-	-	(219)	
Cooperative Water Program	*62,632*	**62,632**	**785**	**-**	**(403)**	**63,014**
Fixed Costs			785	-	-	
NAQWA Related Studies			-	-	1,000	
Tribes			-	-	1,000	
WaterSMART: Streamflow Estimation and Water Use Research			-	-	2,000	
Interpretive Studies/Assessments			-	-	(4,000)	
General Program Reduction			-	-	(403)	
Water Resources Research Act Program	*6,490*	**6,490**	**4**	**-**	**(5,494)**	**1,000**
Fixed Costs			4	-	-	
Water Resources Research Act Reduction			-	-	(5,490)	
General Program Reduction			-	-	(4)	
Activity Total, Water Resources	*211,664*	**209,614**	**3,085**	**-**	**10,170**	**222,869**

Budget at a Glance (Dollars in Thousands)	2013 Full Yr. CR (PL. 112-175)	2012 Enacted	Fixed Costs	Internal Transfers	Program Changes	2014 President's Budget
Core Science Systems						
Science Synthesis, Analysis and Research Program	***25,888***	**25,388**	**170**	**-**	**10,585**	**36,143**
Fixed Costs			170	-	-	
Hydraulic Fracturing			-	-	185	
Science for Coastal and Ocean Stewardship			-	-	300	
Geological and Geophysical Data Preservation			-	-	400	
Ecosystem Priority: Eco Informa			-	-	800	
Earth and Environmental Observations Innovation and Applications			-	-	9,000	
General Program Reduction			-	-	(100)	
National Cooperative Geologic Mapping Program	***25,901***	**25,901**	**323**	**-**	**2,035**	**28,259**
Fixed Costs			323	-	-	
Hydraulic Fracturing			-	-	2,000	
WaterSMART: Information Management			-	-	200	
General Program Reduction			-	-	(165)	
National Geospatial Program	***63,188***	**62,988**	**893**	**-**	**8,891**	**72,772**
Fixed Costs			893	-	-	
Alaska Mapping			-	-	1,044	
Ecosystem Priority: Columbia River			-	-	354	
Ecosystem Priority: Puget Sound			-	-	450	
Federal Geographic Data Committee			-	-	(1,697)	
WaterSMART: Information Management			-	-	200	
3D Elevation Program - Enhanced Elevation for the Nation			-	-	9,000	
General Program Reduction			-	-	(460)	
Activity Total, Core Science Systems	***114,977***	**114,277**	**1,386**	**-**	**21,511**	**137,174**

Budget at a Glance
(Dollars in Thousands)

	2013 Full Yr. CR (PL. 112-175)	2012 Enacted	Fixed Costs	Internal Transfers	Program Changes	2014 President's Budget
Administration and Enterprise Information						
Science Support	***91,786***	**91,786**	**152**	**-**	**(928)**	**91,010**
Fixed Costs			769	-	-	
Reductions to Administrative Services			-	-	(1,906)	
Fixed Costs: Other			(617)	-	-	
Earth Scientists for Tomorrow			-	-	1,000	
General Program Reduction			-	-	(22)	
Security & Technology	***25,028***	**25,028**	**914**	**-**	**(1,394)**	**24,548**
Fixed Costs			205	-	-	
Reductions to Administrative Services			-	-	(1,229)	
Fixed Costs: IT Transformation Cost			477	-	-	
Fixed Costs: Other			232	-	-	
General Program Reduction			-	-	(165)	
Activity Total, Administration and Enterprise Information	***116,814***	**116,814**	**1,066**	**-**	**(2,322)**	**115,558**
Facilities						
Rental Payments and Operations & Maintenance	***93,141***	**93,141**	**(1,457)**	**-**	**5,517**	**97,201**
Fixed Costs			117	-	-	
Operations and Maintenance Efficiencies-Reduce Facilities Footprint			-	-	6,385	
Fixed Costs: Rent			(1,574)	-	-	
General Program Reduction			-	-	(868)	
Deferred Maintenance and Capital Improvement	*7,280*	7,280				7,280
Activity Total, Facilities	***100,421***	**100,421**	**(1,457)**	**-**	**5,517**	**104,481**
Total, SIR	***1,074,568***	**1,068,032**	**10,438**	**-**	**88,385**	**1,166,855**

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Analysis By Account and Activity
(Dollars in Thousands)

Activity/Subactivity/Program Element	*2013 Full Yr. CR (PL 112-175)*		2012 Enacted		Fixed Costs & Related Changes (+/-)		Program Changes (+/-)		Internal Transfers		2014 Budget Request		Inc. (+) Dec (-) From 2012	
	FTE	*Amount*	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount
Appropriation: Surveys, Investigations, and Research														
Ecosystems	*1,045*	*160,768*	1,040	158,268	0	2,165	44	17,981	12	2,358	1,096	180,772	56	22,504
Climate and Land Use Change	*462*	*141,539*	462	141,403	0	1,045	31	15,902	-12	-2,358	481	155,992	19	14,589
Energy, Minerals, and Environmental Health	*602*	*97,340*	599	96,090	0	1,478	12	9,879	0	0	611	107,447	12	11,357
Natural Hazards	*682*	*131,045*	682	131,145	0	1,670	12	9,747	0	0	694	142,562	12	11,417
Water Resources	*1,481*	*211,664*	1,481	209,614	0	3,085	21	10,170	0	0	1,502	222,869	21	13,255
Core Science Systems	*560*	*114,977*	560	114,277	0	1,386	-2	21,511	0	0	558	137,174	-2	22,897
Administration and Enterprise Information	*552*	*116,814*	552	116,814	0	1,066	-18	-2,322	0	0	534	115,558	-18	-1,256
Facilities	*55*	*100,421*	55	100,421	0	-1,457	0	5,517	0	0	55	104,481	0	4,060
Total, USGS	*5,439*	*1,074,568*	5,431	1,068,032	0	10,438	100	88,385	0	0	5,531	1,166,855	100	98,823

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

United States Geological Survey

Federal Funds

General and special funds:

SURVEYS, INVESTIGATIONS, AND RESEARCH

For expenses necessary for the United States Geological Survey to perform surveys, investigations, and research covering topography, geology, hydrology, biology, and the mineral and water resources of the United States, its territories and possessions, and other areas as authorized by 43 U.S.C. 31, 1332, and 1340; classify lands as to their mineral and water resources; give engineering supervision to power permittees and Federal Energy Regulatory Commission licensees; administer the minerals exploration program (30 U.S.C. 641); conduct inquiries into the economic conditions affecting mining and materials processing industries (30 U.S.C. 3, 21a, and 1603; 50 U.S.C. 98g(1)) and related purposes as authorized by law; and to publish and disseminate data relative to the foregoing activities; [$1,102,492,000] $1,166,855,000, to remain available until September 30, [2014] 2015; of which [$53,337,189] $53,337,189 shall remain available until expended for satellite operations; and of which [$7,280,000] $7,280,000 shall be available until expended for deferred maintenance and capital improvement projects that exceed $100,000 in cost: Provided, That none of the funds provided for the ecosystem research activity shall be used to conduct new surveys on private property, unless specifically authorized in writing by the property owner: Provided further, That no part of this appropriation shall be used to pay more than one-half the cost of topographic mapping or water resources data collection and investigations carried on in cooperation with States and municipalities.

Note.--A full-year 2013 appropriation for this account was not enacted at the time the budget was prepared; therefore, this account is operating under a continuing resolution (P.L. 112-175). The amounts included for 2013 reflect the annualized level provided by the continuing resolution.

Appropriation Language and Citations

For expenses necessary for the United States Geological Survey to perform surveys, investigations, and research covering topography, geology, hydrology, biology, and the mineral and water resources of the United States,

- **43 U.S.C. 31(a)** provides for establishment of the Office of the Director of the Geological Survey, under the Interior Department, and that this officer shall have direction of the Geological Survey, and the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain.

A full listing of USGS appropriation language and citations is available at the USGS Office of Budget, Planning, and Integration Web site, under Resources and Tools.

Web site: *http://www.usgs.gov/budget/resources_tools.asp*

Expiring Authorizations

Program Name	Citation	Title of Legislation	Last Year of Authorization	Amount Authorized ($000s)	Appropriation in Last Year of Funding	2014 Budget Request in $000s	Explanation of Authorization Requirement for 2014	Description of Authority/Program Description
Science Synthesis, Analysis, and Research - Data Preservation	42 U.S.C. 15908 sec 351 P.L. 109-58	National Geologic and Geophysical Data Preservation Program Act of 2005	2010	$30,000	$1,000	$2,000	No individual programmatic authorization is necessary for the USGS to continue his effort	SEC. 351. PRESERVATION OF GEOLOGICAL AND GEOPHYSICAL DATA. PROGRAM.—The Secretary (Interior) shall carry out a National Geological and Geophysical Data Preservation Program in accordance with this section—(1) ESTABLISHMENT.—The Secretary shall establish, as a component of the Program, a data archive system to provide for the storage, preservation, and archiving of subsurface, surface, geological, geophysical, and engineering data and samples. The Secretary, in consultation with the Advisory Committee, shall develop guidelines relating to the data archive system, including the types of data and samples to be preserved.
Water Resources Research Act Program	42 U.S.C. 10301 - 10303 P.L. 109-471	Water Resources Research Act Amendments of 2006	2011	$12,000	$6,486	$1,000	No individual programmatic authorization is necessary for the USGS to continue his effort	Sec. 2 (a) Scope of Research; Other Activities; Cooperation and Coordination. –Section 104(b)(1) of the Water Resources Research Act of 1984 (42 U.S.C. 10303(b)(1) is amended to read as follows: “plan, conduct, or otherwise arrange for competent applied and peer reviewed research that fosters: improvements in water supply reliability; the exploration of new ideas that address water problems, or expand understanding of water and water related phenomena; the entry of new research scientists, engineers, and technicians into water resources fields; and the dissemination of research results to water managers and the public.
Carbon Sequestration Program (Biologic)	42 U.S.C. 17286 P.L. 110-140	Energy Independence and Security Act of 2007	2012	$20,000	$4,400	$7,400	National assessments of biologic carbon sequestration	Subtitle B-Carbon Capture and Sequestration Assessment and Framework. Sec 711-712: The Secretary (Interior) through the Director of the USGS should consult with the Secretary of DOE, EPA Administrator, and State Surveys to complete national assessment of capacity for carbon dioxide in accordance with the methodology created.
Carbon Sequestration Program (Geologic)	42 U.S.C. 17286 P.L. 110-140	Energy Independence and Security Act of 2007	2012	$30,000	$4,400	$3,900	National assessments of geologic carbon sequestration	Subtitle B-Carbon Capture and Sequestration Assessment and Framework. Sec 711-712: The Secretary (Interior) through the Director of the USGS should consult with the Secretary of DOE, EPA Administrator, and State Surveys to complete national assessment of capacity for carbon dioxide in accordance with the methodology created.

Expiring Authorization Citation	
Bureau/Office Name	USGS/Core Science Systems
Program Name	Science Synthesis, Analysis, and Research - Data Preservation
Citation	42 U.S.C. 15908 sec 351, P.L. 109-58
Title of Legislation	National Geologic and Geophysical Data Preservation Program Act of 2005
Last Year of Authorization	2010
BY Budget Request ($000)	$1,000
Explanation of Authorization Requirement for BY	No individual programmatic authorization is necessary for the USGS to continue this effort
Program Description	SEC. 351. Preservation of Geological and Geophysical Data Program.—The Secretary (Interior) shall carry out a National Geological and Geophysical Data Preservation Program in accordance with this section—(1) Establishment.—The Secretary shall establish, as a component of the Program, a data archive system to provide for the storage, preservation, and archiving of subsurface, surface, geological, geophysical, and engineering data and samples. The Secretary, in consultation with the Advisory Committee, shall develop guidelines relating to the data archive system, including the types of data and samples to be preserved.

Expiring Authorization Citation	
Bureau/Office Name	USGS/Water Resources Program
Program Name	Water Resources Research Act Program
Citation	42 U.S.C. 10301 - 10303, P.L. 109-471
Title of Legislation	Water Resources Research Act Amendments of 2006
Last Year of Authorization	2011
BY Budget Request ($000)	$1,000
Explanation of Authorization Requirement for BY	No individual programmatic authorization is necessary for the USGS to continue this effort
Program Description	Sec. 2 (a) Scope of Research; Other Activities; Cooperation and Coordination. –Section 104(b)(1) of the Water Resources Research Act of 1984 (42 U.S.C. 10303(b)(1) is amended to read as follows: “plan, conduct, or otherwise arrange for competent applied and peer reviewed research that fosters: improvements in water supply reliability; the exploration of new ideas that address water problems, or expand understanding of water and water related phenomena; the entry of new research scientists, engineers, and technicians into water resources fields; and the dissemination of research results to water managers and the public.

Expiring Authorization Citation	
Bureau/Office Name	USGS/Climate and Land Use Change/Climate Variability
Program Name	Carbon Sequestration Program (Biologic)
Citation	42 U.S.C. 17286, P.L. 110-140
Title of Legislation	Energy Independence and Security Act of 2007
Last Year of Authorization	2012
BY Budget Request ($000)	$7,400
Explanation of Authorization Requirement for BY	National assessments of biologic carbon sequestration
Program Description	Subtitle B-Carbon Capture and Sequestration Assessment and Framework. Sec 711-712: The Secretary (Interior) through the Director of the USGS should consult with the Secretary of DOE, EPA Administrator, and State Surveys to complete national assessment of capacity for carbon dioxide in accordance with the methodology created.

Expiring Authorization Citation	
Bureau/Office Name	USGS/Climate and Land Use Change/Climate Variability
Program Name	Carbon Sequestration Program (Geologic)
Citation	42 U.S.C. 17286, P.L. 110-140
Title of Legislation	Energy Independence and Security Act of 2007
Last Year of Authorization	2012
BY Budget Request ($000)	$3,900
Explanation of Authorization Requirement for BY	National assessments of geologic carbon sequestration
Program Description	Subtitle B-Carbon Capture and Sequestration Assessment and Framework. Sec 711-712: The Secretary (Interior) through the Director of the USGS should consult with the Secretary of DOE, EPA Administrator, and State Surveys to complete national assessment of capacity for carbon dioxide in accordance with the methodology created.

Administrative Provisions

From within the amount appropriated for activities of the United States Geological Survey such sums as are necessary shall be available for [reimbursement to the General Services Administration for security guard services;] contracting for the furnishing of topographic maps and for the making of geophysical or other specialized surveys when it is administratively determined that such procedures are in the public interest; construction and maintenance of necessary buildings and appurtenant facilities; acquisition of lands for gauging stations and observation wells; expenses of the United States National Committee [on Geology] *for Geological Sciences*; and payment of compensation and expenses of persons [on the rolls of] *employed by* the Survey duly appointed to represent the United States in the negotiation and administration of interstate compacts: Provided, That activities funded by appropriations herein made may be accomplished through the use of contracts, grants, or cooperative agreements as defined in section 6302 of title 31, United States Code: Provided further, That the United States Geological Survey may enter into contracts or cooperative agreements directly with individuals or indirectly with institutions or nonprofit organizations, without regard to 41 U.S.C. [5] *6101*, for the temporary or intermittent services of students or recent graduates, who shall be considered employees for the purpose of chapters 57 and 81 of title 5, United States Code, relating to compensation for travel and work injuries, and chapter 171 of title 28, United States Code, relating to tort claims, but shall not be considered to be Federal employees for any other purposes.

Justification of Language Changes in USGS Administrative Provisions

The USGS requests the technical changes outlined below. A justification of the changes is provided below, along with the edits necessary to implement the changes.

Technical Updates

The USGS requests a small number of technical changes in our administrative provisions to keep pace with changes in laws, organizations, and policies.

- **Delete language regarding reimbursement of the General Services Administration (GSA).** The USGS has not reimbursed GSA for security guard services since this responsibility was transferred from GSA to the Department of Homeland Security, more specifically the Federal Protective Service (FPS), in 2003. Further payment for FPS through GSA leases does not require additional authorities, since this is a condition of GSA leases.
- **Update the name of the United States National Committee on Geology.** This committee has updated its name to the United States National Committee for Geological Sciences; the Administrative Provisions language should be consistent with this change.
- **Replace the term "on the rolls of" with "employed by."** The current Administrative Provisions use the term "on the rolls of," a dated and technically incorrect term that should be replaced with "employed by."
- **Update the statutory reference to a procurement law provision that is cited in the Administrative Provisions.** The current Administrative Provisions contain an outdated reference to statutory procurement citations that were recently changed.

Administrative Provisions Language and Citations

A full listing of USGS appropriation language and citations is available at the USGS Office of Budget, Planning, and Integration Web site, under Resources and Tools.

Web site: *http://www.usgs.gov/budget/resources_tools.asp*

Summary Of Requirements
($ in Thousands)

Activity/Subactivity/Program Element	2013 Full Yr. CR (PL 112-175)		2012 Enacted		Fixed Costs & Related Changes		Program Changes		Internal Transfers		2014 President's Budget		Change from 2012 Enacted	
	Total FTE	*Amount*	Total FTE	Amount	FTE Changes	Amount	FTE Changes	Amount	FTE	Amount	FTE	Amount	FTE Changes	Amount
Appropriation: Surveys, Investigations, and Research														
Ecosystems														
Status and Trends	*131*	*21,733*	131	21,733	0	283	0	-145	0	0	131	21,871	0	138
Fisheries Program	*157*	*22,172*	157	22,172	0	340	19	4,315	0	0	176	26,827	19	4,655
Wildlife Program	*342*	*47,978*	341	46,978	0	622	4	3,185	0	0	345	50,785	4	3,807
Environments Program	*203*	*36,620*	202	36,120	0	552	9	5,443	12	2,358	223	44,473	21	8,353
Invasive Species	*61*	*13,824*	58	12,824	0	111	12	5,315	0	0	70	18,250	12	5,426
Cooperative Research Units	*151*	*18,441*	151	18,441	0	257	0	-132	0	0	151	18,566	0	125
Ecosystems Total	*1,045*	*160,768*	1,040	158,268	0	2,165	44	17,981	12	2,358	1,096	180,772	56	22,504
Climate and Land Use Change														
Climate Variability														
National Climate Change and Wildlife Science Center /DOI Climate Science Centers (CSC)	*48*	*25,198*	48	25,198	0	160	9	9,934	0	0	57	35,292	9	10,094
Climate Research & Development	*133*	*21,759*	133	21,759	0	341	10	3,010	0	0	143	25,110	10	3,351
Carbon Sequestration	*39*	*8,874*	39	8,874	0	80	4	2,385	0	0	43	11,339	4	2,465
Science Support for DOI Bureaus	*12*	*2,358*	12	2,358	0	8	0	-8	-12	-2,358	0	0	-12	-2,358
Subtotal	*232*	*58,189*	*232*	*58,189*	*0*	*589*	*23*	*15,321*	*-12*	*-2,358*	*243*	*71,741*	*11*	*13,552*
Land Use Change														
Land Remote Sensing	*163*	*72,077*	163	72,077	0	296	-2	-1,729	0	0	161	70,644	-2	-1,433
Land Change Science	*67*	*11,273*	67	11,137	0	160	10	2,310	0	0	77	13,607	10	2,470
Subtotal	*230*	*83,350*	*230*	*83,214*	*0*	*456*	*8*	*581*	*0*	*0*	*238*	*84,251*	*8*	*1,037*
Climate and Land Use Change Total	*462*	*141,539*	462	141,403	0	1,045	31	15,902	-12	-2,358	481	155,992	19	14,589
Energy, Minerals, and Environmental Health														
Mineral and Energy Resources														
Mineral Resources	*324*	*48,760*	327	48,760	0	866	-29	-3,269	0	0	298	46,357	-29	-2,403
Energy Resources	*152*	*28,820*	146	27,570	0	370	9	3,061	0	0	155	31,001	9	3,431
Subtotal	*476*	*77,580*	*473*	*76,330*	*0*	*1,236*	*-20*	*-208*	*0*	*0*	*453*	*77,358*	*-20*	*1,028*
Environmental Health														
Contaminant Biology	*65*	*9,180*	65	9,180	0	131	16	4,644	0	0	81	13,955	16	4,775
Toxic Substance Hydrology	*61*	*10,580*	61	10,580	0	111	16	5,443	0	0	77	16,134	16	5,554
Subtotal	*126*	*19,760*	*126*	*19,760*	*0*	*242*	*32*	*10,087*	*0*	*0*	*158*	*30,089*	*32*	*10,329*
Energy, Minerals, and Environmental Health Total	*602*	*97,340*	599	96,090	0	1,478	12	9,879	0	0	611	107,447	12	11,357
Natural Hazards														
Earthquake Hazards	*243*	*54,379*	242	53,879	0	607	4	3,438	0	0	246	57,924	4	4,045
Volcano Hazards	*151*	*24,122*	151	24,122	0	364	1	212	0	0	152	24,698	1	576
Landslide Hazards	*21*	*3,168*	21	3,168	0	52	2	473	0	0	23	3,693	2	525
Global Seismographic Network	*13*	*5,151*	13	5,151	0	32	0	-17	0	0	13	5,166	0	15
Geomagnetism	*18*	*2,004*	18	2,004	0	32	0	91	0	0	18	2,127	0	123
Coastal & Marine Geology	*236*	*42,221*	237	42,821	0	583	5	5,550	0	0	242	48,954	5	6,133
Natural Hazards Total	*682*	*131,045*	682	131,145	0	1,670	12	9,747	0	0	694	142,562	12	11,417
Water Resources														
Groundwater Resources	*74*	*8,731*	74	8,731	0	133	13	3,858	0	0	87	12,722	13	3,991
National Water Quality Assessment	*521*	*61,570*	521	61,570	0	973	0	-500	0	0	521	62,043	0	473
National Streamflow Information Program	*139*	*28,977*	139	28,977	0	221	0	7,047	0	0	139	36,245	0	7,268
Hydrologic Research & Development	*100*	*12,667*	99	11,417	0	546	7	4,402	0	0	106	16,365	7	4,948
Hydrologic Networks & Analysis	*259*	*30,597*	259	29,797	0	423	2	1,260	0	0	261	31,480	2	1,683
Cooperative Water Program	*386*	*62,632*	387	62,632	0	785	-1	-403	0	0	386	63,014	-1	382
Water Resources Research Act Program	*2*	*6,490*	2	6,490	0	4	0	-5,494	0	0	2	1,000	0	-5,490
Water Resources Total	*1,481*	*211,664*	1,481	209,614	0	3,085	21	10,170	0	0	1,502	222,869	21	13,255
Core Science Systems														
Science Synthesis, Analysis and Research Program	*111*	*25,888*	111	25,388	0	170	1	10,585	0	0	112	36,143	1	10,755
National Cooperative Geologic Mapping Program	*116*	*25,901*	116	25,901	0	323	0	2,035	0	0	116	28,259	0	2,358
National Geospatial Program	*333*	*63,188*	333	62,988	0	893	-3	8,891	0	0	330	72,772	-3	9,784
Core Science Systems Total	*560*	*114,977*	560	114,277	0	1,386	-2	21,511	0	0	558	137,174	-2	22,897

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Summary Of Requirements
($ in Thousands)

Activity/Subactivity/Program Element	*2013 Full Yr. CR (PL 112-175)*		2012 Enacted		Fixed Costs & Related Changes		Program Changes		Internal Transfers		2014 President's Budget		Change from 2012 Enacted	
	Total FTE	*Amount*	Total FTE	Amount	FTE Changes	Amount	FTE Changes	Amount	FTE	Amount	FTE	Amount	FTE Changes	Amount
Administration and Enterprise Information														
Science Support	*467*	*91,786*	467	91,786	0	152	-8	-928	0	0	459	91,010	-8	-776
Security & Technology	*85*	*25,028*	85	25,028	0	914	-10	-1,394	0	0	75	24,548	-10	-480
Administration and Enterprise Information Total	*552*	*116,814*	552	116,814	0	1,066	-18	-2,322	0	0	534	115,558	-18	-1,256
Facilities														
Rental Payments and Operations & Maintenance	*55*	*93,141*	55	93,141	0	-1457	0	5,517	0	0	55	97,201	0	4,060
Deferred Maintenance and Capital Improvement	*0*	*7,280*	0	7,280	0	0	0	0	0	0	0	7,280	0	0
Facilities Total	*55*	*100,421*	55	100,421	0	-1,457	0	5,517	0	0	55	104,481	0	4,060
Total, USGS	*5,439*	*1,074,568*	5,431	1,068,032	0	10,438	100	88,385	0	0	5,531	1,166,855	100	98,823

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

USGS

Justification of Fixed Costs and Internal Realignments

(Dollars In Thousands)

Other Fixed Cost Changes and Projections	2012 Total	2012 to 2014 Change
Change in Number of Paid Days	0	+2,209
The combined fixed cost estimate includes an adjustment for one additional paid day between FY2012 and FY2013. The number of paid days do not change between FY2013 and FY2014.		
Pay Raise	0	+6,739
The PY column reflects the total pay raise changes as reflected in the the PY President's Budget. The BY Change column reflects the total pay raise changes between FY2012-FY2014.		
Employer Share of Federal Health Benefit Plans	7,098	+2,972
The change reflects expected increases in employer's share of Federal Health Benefit Plans.		
Departmental Working Capital Fund	15,267	+709
The change reflects expected changes in the charges for centrally billed Department services and other services through the Working Capital Fund. These charges are displayed in the Budget Justification for Department Management.		
Worker's Compensation Payments	3,242	-445
The adjustment is for changes in the costs of compensating injured employees and dependents of employees who suffer accidental deaths while on duty. Costs for the BY will reimburse the Department of Labor, Federal Employees Compensation Fund, pursuant to 5 U.S.C. 8147(b) as amended by Public Law 94-273.		
Unemployment Compensation Payments	720	-172
The adjustment is for projected changes in the costs of unemployment compensation claims to be paid to the Department of Labor, Federal Employees Compensation Account, in the Unemployment Trust Fund, pursuant to Public Law 96-499.		
Rental Payments *	72,894	-1,574
The adjustment is for changes in the costs payable to General Services Administration (GSA) and others resulting from changes in rates for office and non-office space as estimated by GSA, as well as the rental costs of other currently occupied space. These costs include building security; in the case of GSA space, these are paid to Department of Homeland Security (DHS). Costs of mandatory office relocations, i.e. relocations in cases where due to external events there is no alternative but to vacate the currently occupied space, are also included.		
Non-Foreign Area COLA Adjustment to Locality Pay	549	+0
This adjustment is for items identified in the Fixed Cost Table as "Other Uncontrollable Costs Included." Please indicate the appropriate supporting justification for the cost identified.		
Internal Realignments and Non-Policy/Program Changes (Net-Zero)		**BY (+/-)**

* 2014 Change in Rental Payments was calculated using initial 2013 Rental amounts in the June 2011 Exhibit 54. This number is continually updated; above figures may not reflect the most up-to-date estimates, and may be understated.

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Activity: Ecosystems

		2013 Full Yr. CR (PL 112-175)	2012 Enacted	2014 Fixed Costs and Related Changes (+/-)	2014 Program Changes	2014 Internal Transfer	2014 Budget Request	Change from 2012 Enacted (+/-)
Status and Trends ($000)		*21,733*	21,733	283	-145	0	21,871	138
	FTE	*131*	131	0	0	0	131	0
Fisheries Program (($000)		*22,172*	22,172	340	4,315	0	26,827	4,655
	FTE	*157*	157	0	19	0	176	19
Wildlife Program ($000)		*47,978*	46,978	622	3,185	0	50,785	3,807
	FTE	*342*	341	0	4	0	345	4
Environments Program ($000)		*36,620*	36,120	552	5,443	2,358	44,473	8,353
	FTE	*203*	202	0	9	12	223	21
Invasive Species ($000)		*13,824*	12,824	111	5,315	0	18,250	5,426
	FTE	*61*	58	0	12	0	70	12
Cooperative Research Units ($000)		*18,441*	18,441	257	-132	0	18,566	125
	FTE	*151*	151	0	0	0	151	0
Total Requirements ($000)		***160,768***	**158,268**	**2,165**	**17,981**	**2,358**	**180,772**	**22,504**
	Total FTE	***1,045***	**1,040**	**0**	**44**	**12**	**1,096**	**56**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Summary of Program Changes

Request Component	($000)	FTE	Page
Status and Trends	**-145**		
General Program Reduction	-145	0	B-64
Fisheries Program	**4,315**	**19**	
Ecosystem Priority: Klamath Basin Agreement	901	4	B-20
Hydraulic Fracturing	2,200	10	B-31
WaterSMART: Water Quality Enhancement	1,386	5	B-7
General Program Reduction	-172	0	B-64
Wildlife Program	**3,185**	**4**	
Energy Future and Wildlife Sustainability	2,000	3	B-5
White Nose Syndrome	1,505	1	B-47
General Program Reduction	-320	0	B-63
Environments Program	**7,801**	**21**	
Coral Reefs	442	1	B-47
Ecosystem Priority: California Bay Delta	1,000	2	B-20
Internal Transfer from Climate and Land Use Change	2,358	12	B-67
Ecosystem Priority: Chesapeake Bay	615	1	B-20
Ecosystem Priority: Columbia River	300	1	B-20
Ecosystem Priority: National Ecosystems Services Framework	1,000	1	B-20
Ecosystem Priority: Puget Sound	369	1	B-20
Ecosystem Priority: Sustaining Environmental Capital	2,000	2	B-20
General Program Reduction	-283	0	B-64
Invasive Species	**5,315**	**12**	
Brown Tree Snakes	500	0	B-48
Ecosystem Priority: Everglades	1,000	2	B-20
Ecosystem Priority: Great Lakes Asian Carp Control Framework	2,000	4	B-20
Ecosystem Priority: Upper Mississippi River Asian Carp Control	1,000	2	B-20
New and Emerging Invasive of National Concern	874	4	B-48
General Program Reduction	-59	0	B-64
Cooperative Research Units	**-132**	**0**	
General Program Reduction	-132	0	
Total Program Change	**20,339**	**56**	**B-63**

** Estimated changes in FTEs compare against actual 2012 FTE usage, not 2012 enacted formulation estimates.

Justification of Program Changes

The 2014 Budget Request for Ecosystems is $180,772,000 and 1,096 FTE, a net program change of +$22,504,000 and +56 FTE from the 2012 Enacted Budget. For more information on the Ecosystems Mission Area changes, please see Section B, Program Changes as indicated in the table.

Activity Summary

The Ecosystems activity is comprised of six subactivities:

- Status and Trends (*http://biology.usgs.gov/status_trends)*
- Fisheries Program (*http://biology.usgs.gov/faer*)
- Wildlife Program *(http://biology.usgs.gov/wter)*
- Environments Program (*http://biology.usgs.gov/ecosystems)*
- Invasive Species (*http://biology.usgs.gov/invasive)*
- Cooperative Research Units *(http://www.coopunits.org/cooptor/coopunits.html*)

Ecosystems Mission Area programs provide science support to Department of the Interior (Interior) bureaus and other partners through research focused on answering management questions and real-world problems. This requires a combination of short- and long-term biological research, survey and monitoring, data analysis and applications, development of new tools and techniques, and decision support and adaptive management. Partnerships with other Federal, State, and private research organizations leverage millions of dollars that result in ecosystem restoration and conservation efforts vital to community economies, safety, and well-being by delivering key services to society such as commercially valuable fish and wildlife, water filtration and pollution control, healthy soils, crop pollination, and reduction of risk of severe weather events and other natural disasters. Ongoing efforts are focused on critical issues such as ecosystem restoration, energy development, coastal resiliency, and fire ecology in places such as Chesapeake Bay, California Bay-Delta, Puget Sound, Gulf Coast, Sagebrush Biome, Everglades and the Outer Continental Shelf.

> "*Louisiana is losing a football field of wetlands an hour, new U.S. Geological Survey study says."* [Since Hurricane Katrina, the USGS maps have quickly become the standard against which many protection and restoration activities are evaluated.]
>
> Times-Piscayne
> June 2, 2011

Mission Area 4: Provide a Scientific Foundation for Decisionmaking
Goal #2: Provide Science for Sustainable Resource Use, Protection, and Adaptive Management
Strategy #1: Identify and Predict Ecosystem Change

Strategic Plan Performance Measures	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Target	2012 Actual	2013 Target	2014 Target	2008 - 2014 Trend
Strategy #1: Identify and Predict Ecosystem Change										
Percent of targeted species for which monitoring and decision support information on their status and trends are available (Status & Trends)	USGS	27.2%	27.2%	27.2%	28.2%	28.5%	28.5%	28.5%	28.5%	
		178	178	178	185	187	187	187	187	
		655	655	655	655	655	655	655	655	
Percent of targeted fish and aquatic populations and their habitats for which information is available regarding limiting factors such as migratory barriers, habitat, and effects of disturbance (fire, flood, nutrient enhancement) (Fisheries)	USGS	41.2%	41.2%	41.2%	42.0%	42.9%	42.9%	42.9%	42.9%	
		49	49	49	50	51	51	51	51	
		119	119	119	119	119	119	119	119	
Percent of targeted wildlife populations for which science information is provided for management decisionmaking to inform and improve conservation (Wildlife)	USGS	47.0%	51.6%	54.4%	57.8%	61.2%	61.2%	61.2%	61.2%	
		166	182	192	204	216	216	216	216	
		353	353	353	353	353	353	353	353	
Percent of targeted ecosystems with information products forecasting ecosystem change (Environments)	USGS	11%	11%	22%	22%	33%	33%	33%	44%	
		1	1	2	2	3	3	3	4	
		9	9	9	9	9	9	9	9	
Percent of targeted science information products available for successful control and management of priority groups of invasive species (Invasives)	USGS	45%	45%	45%	45%	45%	45%	45%	45%	
		27	27	27	27	27	27	27	27	
		60	60	60	60	60	60	60	60	

Supporting Performance Measures

Outputs, Supporting Performance Measures, and/or Milestones	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Plan	2012 Actual	2013 Plan	2014 Plan
Number of students complete degree requirements for MS, PhD, and post-doctoral program under the direction and mentorship of Unit Scientists (Cooperative Research Units)	USGS	83	110	89	84	85	83	83	83
Number of systematic analyses and investigations completed (Ecosystems)	USGS	1,211	1,267	1,169	1,273	1,011	1,444	1,031	1,052
Number of formal workshops or training provided to customers (Ecosystems)	USGS	154	112	113	142	85	129	95	118

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Activity: Ecosystems
Subactivity: Status and Trends

2012 Enacted: $21.7 million (131 FTE)
2013 CR: $21.7 million (131 FTE)
2014 Request: $21.9 million (131 FTE)

Overview

The living resources of the United States and the habitats on which they depend are undergoing constant change due to human and natural influences. The Status and Trends Program monitors, evaluates, forecasts, and reports the status of the Nation's biological resources to advance science, inform policy makers, and facilitate resource management. Specific goals of the Program are to (1) describe and track the abundance, distribution productivity and health of the Nation's plants, animals and ecosystems, (2) develop and evaluate inventory and monitoring methods, designs, tools, models and technologies to measure and track biological status and trends, (3) collaborate with partners to collect, manage, and share data and information to determine and understand biological status and trends, and (4) describe and deliver information and synthesis products to meet the needs of stakeholders including natural resource managers, policy- and decisionmakers, researchers and the public.

Over the last several years, and particularly in 2012, the United States has experienced unprecedented drought and heat. These disturbances have caused profound impacts on landscapes that support wildlife, fisheries, and plant communities. Both short and longer-term monitoring, assessment and research activities supported by the Program are critical to understanding potential impacts of these and other disturbances on ecosystems and the services they provide. For example, in 2012 the USGS evaluated 100 years of vegetation and climate data across the Sonoran Desert in the Southwest and forecasted significant changes in these fragile landscapes under forecasted warmer and drier conditions. This and other monitoring and assessment activities supported by the Program will serve as a critical baseline to evaluate impacts of disturbances on the production of goods and services for the U.S. public (e.g., clean water and air, pollination services, and flood control).

The Status and Trends Program supports two key activities, one focused on Interior lands and species, and the other on conservation, management and decisionmaking for a diversity of U.S. landscapes and jurisdictions.

Program Performance

Monitoring and Research in Support of Interior Bureaus, Lands and Species

The USGS is the principal science agency for Interior, providing unbiased, independent data and information to DOI resource management bureaus such as the National Park Service (NPS) and the Fish and Wildlife Service (FWS) on the current and future status of biological resources. This information is used to improve the effectiveness and efficiency of management and policy decisions through early detection and action that prevents costly efforts later. To address these issues in an integrated manner, the USGS works with other Interior bureaus and external partners to provide scientific information critical to adaptive natural resource management. The following two examples highlight support to other Interior bureaus:

National Park Monitoring – The USGS assists national parks with inventory and monitoring protocol development and other monitoring-related research needs such as monitoring planning and design,

statistical data analysis, and review or revision of existing protocols. Priority issues identified by the NPS typically benefit several parks and require multi-year efforts. The USGS and the NPS are also jointly supporting projects in 2013 that provide exploratory research and technical assistance to national parks to support new research on emerging issues that may become significant to the parks.

Approximately 4,000 native bee species, which are critical for pollinating wild plants and agricultural crops, are found in the United States. Significant declines in honeybee populations and frequent extirpations of native bumblebees indicate that some species and their associated functions are in jeopardy of decline or loss. The USGS is investigating whether and how these declines may be related to various environmental drivers such as habitat loss, climate change, contaminants, and disease. In 2012, the USGS completed sampling of native bees at 65 national parks that the NPS identified as being of special concern, and is using these data to understand how bee abundance and community composition changes along environmental gradients such as elevation or level of disturbance. Goals for 2013-2014 are to improve the ability to predict native bee distribution and diversity, understand habitat specificity of native bees, and evaluate climate sensitivity of native bee species.

A leaf cutter bee (*Trachusa zebrata*) collected at Indiana Dunes National Lakeshore.

Refuge Cooperative Research Project – The USGS partners with the National Wildlife Refuge System (NWRS) to improve science-based management on Refuges by providing expertise in modeling, decisions analysis, and monitoring. Incorporation of science helps refuges to make transparent, defensible decisions in the face of uncertainty, with the ultimate aim of improving decisionmaking and resource delivery over time. For example, in 2012, the USGS identified optimal management strategies that could be used to adapt to climate-driven changes predicted at four refuges in North and South Dakota. The study provided alternatives for water management under different precipitation and temperature scenarios. The USGS continues to work with refugees to tackle difficult resource management issues and will have several new frameworks ready in 2013 and 2014.

Visitor Experience on National Wildlife Refuges –The National Wildlife Refuge System mission is "to foster understanding and instill appreciation of fish, wildlife, and plants, and their conservation, by providing the public with safe, high-quality, and compatible wildlife-dependent public use." Understanding visitors and characterizing their experiences on refuges are critical elements of managing these lands and meeting goals of the Refuge System. In 2012, USGS social scientists conducted an objective, consistent, nationally coordinated survey of more than 10,000 refuge visitors at 53 national wildlife refuges to better understand visitor needs and experiences, and summarized visitors' concerns about refuge activities and attitudes. This national-level information provided by USGS will help the FWS understand and manage visitation to the refuges, and help design programs and facilities that respond to visitor needs. Moreover, this national-level review is important in helping the refuge system tackle challenges while undertaking its vision for "Conserving the Future."

Survey recruiter at Wertheim NWR, contacting refuge visitors.

Integrated Research, Monitoring and Assessments for Conservation, Management and Decisionmaking

The Program targets research, monitoring and assessment activities to support diverse resource management and policy decisions for a variety of stakeholders. For example, Program-supported research and monitoring activities are used to develop optimal policy and management activities for migrating waterfowl in the upper mid-west. Long-term monitoring of fish populations, stock, and distributions enable managers to determine the extent, rate of spread, and impact of invasive fish species. Information about historical fire regimes in mountain forests help wildfire managers balance fire suppression and management in mixed-conifer forests in the northern Rocky Mountains. The following paragraphs highlight two important long-term monitoring and assessment programs:

Bird Banding Laboratory (BBL) – Banding birds with unique leg bands is a universal technique for studying the movement, survival, and behavior of birds. The USGS BBL manages all marking and recovery information for migratory birds in the United States, Canada, and Mexico. Bands spotted on or recovered from birds are reported to the BBL, which provides data to Federal, State, and tribal agencies for use in developing bird conservation and management strategies. BBL data is a critical information source used in the annual regulation-setting process for migratory bird hunting. In 2012, the BBL implemented a new website to improve reporting of encountered banded birds by the public. A data management system is being developed in 2013 to maintain re-sighting data collected by banders, which provides demographic information for the management of migratory bird populations.

USGS scientists place leg-bands on a Red-eyed Vireo at the Patuxent bird banding station.

Wyoming Landscape Conservation Initiative (WLCI) – The WLCI is a long-term, science-based program of assessing, conserving, and enhancing fish and wildlife habitats while facilitating responsible energy and other development in Wyoming. The success of the WLCI is based on cooperation, local involvement, and partnerships. Formal partners with the USGS include the Bureau of Land Management (BLM), FWS, Wyoming Game and Fish Commission, Wyoming Department of Agriculture, the U.S. Department of Agriculture (USDA), six county commissions, and nine conservation districts. The USGS provides practical scientific and technical assistance to WLCI partners to support management decisions and advance understanding of ecosystems in southwestern Wyoming. In 2012, the USGS and WLCI partners developed new maps and spatial data on energy and mineral resources, completed 152 vertebrate species range maps and identified areas where species ranges overlap with energy development, and completed a multi-resource Integrated Assessment for the WLCI area. The Integrated Assessment compiles best-available information on energy, wildlife, habitats, and WLCI partner priority areas to inform planning and decisionmaking. The assessment evaluates the context for energy development and other land uses, and is being used to identify areas with high potential for conservation, restoration, and development. In 2013, the USGS is developing new tools for evaluating potential tradeoffs among different land use scenarios and assessing the effectiveness of on-the-ground conservation actions.

Screen capture of the Web application for the WLCI Integrated Assessment. The application allows users to view and explore results and download data used in the assessment.

North American Breeding Bird Survey (BBS) – Established in 1966, in response to widespread synthetic chemical pesticide use and their deleterious effects on birds, the BBS program collects scientifically credible population data on more than 400 bird species in support of the Interior's regulatory responsibility to monitor and assess migratory nongame bird populations and determine the effects of environmental changes and human activity on these populations as prescribed by the Fish and Wildlife Conservation Act, the Migratory Bird Treaty Act, and the Migratory Bird Conservation Act. Managed by the USGS, approximately 2,200 skilled volunteers sample more than 3,000 BBS routes across the United States and southern Canada annually, providing two million individual bird detections to inform conservation and management planning efforts. In addition, the USGS is working to improve BBS data depth, breadth, and usefulness through a variety of initiatives. In 2012, the USGS digitized 31 years of legacy BBS data and began the process of data rectification which, once complete by 2014, will extend the data set available to evaluate the influence of historic climate and land use change on birds. The USGS partnered with the FWS and the Mexican National Commission for the Knowledge and Use of Biodiversity to expand the BBS program into northern Mexico to provide needed management information on more than 60 bird species whose breeding populations span the U.S. and Mexican border. Over a dozen training workshops were conducted in 2012 and more than 30 Mexican routes sampled, with plans in place to double the number of routes sampled within two seasons. Additionally, the USGS continues to strengthen the integration of BBS data into management planning through development and evaluation of analytical models to identify impacts of climate change, land use (e.g., Marcellus Shale natural gas extraction), and other potential threats to migratory birds.

National Phenology Network – The USA National Phenology Network, established in 2007 by the USGS in collaboration with other governmental and non-governmental organizations, is a national-scale science and monitoring initiative focused on phenology, which is the study of seasonal life-cycle events such as leafing, flowering, reproduction and migration as a tool to understanding how plants, animals and landscapes respond to environmental variation and change. Stakeholders include resource managers, educators, communication specialists, non-profit organizations, human health organizations, science networks, and the public who make decisions about resource management and adaptation to variable and changing climates and environments. Timely and widely-distributed phenological information is critical for the management of wildlife, invasive species, and agricultural pests, understanding drought wildfire risk, and managing risks to human health and welfare, including allergies, asthma, and vector-borne diseases. For example, the Network conducted a campaign from Missouri to Maine to track the response of forests to the anomalously warm spring of 2012. Also in 2012, the Network established a coordinated phenology monitoring program for all 19 NPS units in California, and supported the new Inventory and Monitoring Program of FWS Refuge System. Activities in 2013 and 2014 will be focused on the development of data products to support decisionmaking by resource management agencies, particularly the NPS and the FWS, and on engaging groups of people typically underrepresented in science (e.g., minorities, urban youth, and tribes) in support of the America's Great Outdoors initiative.

A rancher in central Texas observes and reports phenology of juniper trees (*Juniperus pinchotii*) as part of a joint project between NASA and the USA National Phenology Network to understand and forecast production of juniper pollen for human health applications.

Activity: Ecosystems
Subactivity: Fisheries Program

2012 Enacted: $22.2 million (157 FTE)
2013 CR: $22.2 million (157 FTE)
2014 Request: $26.8 million (176 FTE)

Overview

Healthy watersheds and thriving fish populations are vital to the wellbeing of American society, providing clean water, food, and recreation. Unfortunately, in many places around the United States, fish and the habitats on which they depend on are in decline. According to the National Fish Habitat Action Plan, almost 40 percent of the Nation's freshwater fish species are considered at risk or vulnerable to extinction. Many saltwater fish are also in decline due to habitat degradation and overfishing. Revenue from recreational (over 46 of the Nation's 60 million anglers fish in a given year) and commercial fisheries added more than $115.0 billion to our Nation's economy, but this economic engine is at risk as fisheries and habitats decline.

> Each American eats about six pounds of fish and shellfish per year, and 40 million of us are anglers who generate about $45 billion in related retail sales.
>
> *The National Fish Habitat Action Plan*

The USGS Fisheries Program employs world-class scientists to work on cutting-edge research to protect, restore, and enhance our Nation's fisheries and their habitats. The quality, quantity, and breadth of USGS capacity, expertise and geographic coverage are conducive to addressing local, regional and national questions on aquatic species, communities, and habitats. The Fisheries Program brings the following expertise and capacity to accomplish Ecosystem Mission Area goals and conduct crosscutting research with other USGS Mission Areas, Interior bureaus, and other internal and external partners.

Fish and Aquatic Organism Health
The USGS investigates pathogens and other environmental factors that affect aquatic organism health to support the management, conservation, and restoration of aquatic species. In 2013, fish disease research includes both basic and applied science focused on understanding the factors that control the distribution and severity of infectious diseases affecting aquatic organisms and wild fish populations. (*http://www.usgs.gov/ecosystems/fisheries/health.html)*

Genetics, Genomics, and Molecular Biology
Research on genetics and genomics of fish and other aquatic organisms examines and characterizes variation, diversity, taxonomy, and response of individuals, stocks, strains, and populations to environmental change. Molecular tools include the construction of genomic libraries, cloning, sequencing, phylogenetic analysis, recombinant DNA expression systems, standard and quantitative polymerase chain reaction assays, random-amplified polymorphic DNA fingerprinting, DNA probes, and DNA microarray. This capacity provides aquatic resource managers with a more accurate method to identify and discriminate among native, cultured, introduced, and invasive aquatic species, as well as develop science-based conservation and restoration strategies. In 2013, USGS research is focusing on developing new technologies to monitor and evaluate wild fish populations such a brook trout. (*http://www.usgs.gov/ecosystems/fisheries/genetics.html)*

Imperiled Aquatic Species
USGS scientists conduct studies on biology, life history, population ecology, and conservation strategies for at-risk species, and the impacts of environmental stressors on and habitat requirements of those species. These investigations lead to more effective and viable conservation actions that reduce the need for formal listing of aquatic species as threatened or endangered and support the goal of downlisting or delisting species. In 2013, USGS research will focus on American eel in the eastern United States and native salmonids in the western United States. (*http://www.usgs.gov/ecosystems/fisheries/imperiled.html)*

Restoration Science and Technology
USGS research and technology provides the scientific basis for the adaptive management of aquatic species and aquatic habitats in the United States. The USGS examines the physiology, life history, reproduction, and habitat needs of specific life stages of fish and other aquatic organisms to assist fishery managers to develop techniques to understand, conserve, and restore fish communities. In 2013, the USGS will focus on restoration research before and after dam removal at Elwha and Glines Canyon Dams. (*http://www.usgs.gov/ecosystems/fisheries/restoration.html)*

Species Diversity and Life History
USGS scientists study the diversity of aquatic species and their varied life histories and species interactions that represent complex aquatic communities in unique aquatic habitats. They provide scientific syntheses and modeling to develop decision-support and adaptive management models that incorporate diversity, life history, and species interactions of fish and other aquatic organisms. Scientists forecast causes of change based on scientific information about diversity, life history, and species interactions that affect the condition and dynamics of aquatic communities. In 2013, USGS research will focus on mussels and threatened native fish species.
(*http://www.usgs.gov/ecosystems/fisheries/diversity.html)*

Aquatic Community Ecology
USGS scientists quantify and describe functional relationships among aquatic species and habitats to describe aquatic community structure, function, adaptation, and sustainability. By conducting basic research this science links biology, population genetic diversity, and organism health for fish, native mussels, and other aquatic organisms in relation to their habitat requirements. This science contributes to understanding ecological processes and patterns of diversity through coordination, development, and standardization of geospatial classification models and maps of national ecosystems. In 2013, USGS research will focus on nutrient and sediment reduction provided by aquatic ecosystems.
(*http://www.usgs.gov/ecosystems/fisheries/ecology.html)*

Fish Passage and Dams
USGS research assesses and evaluates management efforts to improve fish passage for anadromous and other migratory fish. Research focuses on fish physiological and behavioral characteristics as well as hydrological conditions that affect successful navigation around barriers by fish and other at-risk aquatic species. In 2013, research will focus on improving the efficiency and effectiveness of artificial passage structures to improve passage of American eel, shad species, and Pacific salmon.
(*http://www.usgs.gov/ecosystems/fisheries/fish_passage.html)*

River Science
The USGS conducts research on structure and function of large river systems with the goal of sustaining and enhancing fisheries resources in concert with other human uses such as navigation, transportation, energy production, irrigation, and human water supply. The USGS studies the ecology and biodiversity of large rivers and gathers data on the effects of impoundment, urbanization, and changing land and water use on fish, other aquatic species, and their riverine habitats. In 2013, USGS research will provide

modeling expertise, including aquatic habitat mapping and development of decision-support systems, to investigate population dynamics and biological requirements of at-risk species such as native fish, amphibians, and riparian vegetation. (*http://www.usgs.gov/ecosystems/fisheries/river_science.html)*

Program Performance

Dam Removal – Elwha and Glines Canyon Dams – There are over 75,000 large dams in the United States and over 2 million smaller dams and water diversions. Many of these are near the end of their life expectancy and are being considered for removal for ecological, economic, and safety reasons. Improved science on where, when and how to remove these dams is needed by natural resource managers and decisionmakers.

View of the Elwha dam removal project

For nearly 100 years, the Elwha and Glines Canyon dams in Washington have disrupted natural processes, trapped sediment in the reservoirs, and blocked fish migrations, all of which changed the ecology of the river downstream of the dams. All five Pacific salmon species and steelhead trout, historically present in large numbers in the river, are locally extirpated or persist in critically low numbers. Upstream of the dams, more than 145 kilometers of pristine habitat, protected inside the Olympic National Park awaits the return of salmon populations. As the dams are removed during this two to three year project, some of the 19.0 million cubic meters of entrapped sediment will be carried downstream by the river in the largest controlled release of sediment into a river and marine waters in history. In 2012, the Elwha and Glines Canyon dams were removed and the USGS began intensive monitoring of the downstream sediment delivery. In addition, benchmark data on fish populations was collected in order to monitor post-dam removal population trends. Critical monitoring information was shared with a variety of stakeholders. Research in 2013 and beyond will focus on population response, interaction with resident fishes, sediment redistribution, ecosystem stabilization, and ecosystem effects of sediment release. Understanding the changes to the river and coastal habitats, the fate of sediments, and the salmon recolonization of the Elwha River wilderness will provide useful information for society as future dam removals are considered.

Understanding Potential Ecological Impacts of Hydraulically Fractured Oil and Gas Resource Exploration and Development – The quality, quantity and delivery time of water are critical drivers influencing ecosystem change. The rapid expansion of gas exploration utilizing hydraulic fracturing has left management and regulatory agencies in desperate need of scientific information concerning potential effects on water quality, quantity, and timing of water delivery. In addition, the cumulative impacts of infrastructure development (road systems, pipelines, pad construction) are poorly known on this important ecosystem driver. USGS research is providing important baseline information for evaluating the risks of hydraulic fracturing. In 2012, baseline data was collected on several pilot sites including Marcellus shale deposit areas in Pennsylvania. Future proposed work in 2013 and beyond focuses on both short and long term impacts on water quality, quantity, and delivery as they affect aquatic biota. Science and information needs on this topic are critical to FWS, BLM and other Federal, State, and tribal partners making decisions on future water needs.

Ecological Flows (WaterSMART) – Ecological flows are defined as the quantity, quality, and timing of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems. It has been said that "water is life", and water is arguably the most important ecosystem service provided by healthy, well-managed watersheds. The delivery of water at the correct time, quantity, and quality is critical to society both economically and ecologically. With increased demand for consumptive freshwater use for domestic supply, agriculture, manufacturing, and energy production, there is a growing need to understand and quantify ecological flows. Ecological flow recommendations are utilized by water management authorities to establish flow criteria, often-minimum flow criteria, into allocation decisions for water withdrawals from streams, rivers, and basins. In 2012, ecological flow work was continued in three pilot areas establishing baseline data needs to identify the quantity, quality, and timing of water flows required to sustain freshwater and estuarine ecosystems in support of WaterSMART. In 2013 and beyond, additional sites will be added to the network identifying water needs to sustain freshwater ecosystems addressing critical science needs for all Interior bureaus and external partners.

Fish Health – Viral Hemorrhagic Septicemia Virus – There is an increased understanding that disease is a natural component of aquatic ecosystems and that many environmental factors can modulate the impacts of disease in such systems. The fish health research program will address pathways at individual, population, community, ecosystem or other levels of biological organization and will continue the development of novel methods for prevention, mitigation, and control of diseases affecting aquatic species. Viral Hemorrhagic Septicemia Virus (VHSV) is considered to be one of the most important viral pathogen of fish worldwide with recent outbreaks resulting in massive fish kills throughout North America.

In 2012, work continued on the predictive factors and viral genetic diversity of VHSV and the susceptibility of the virus in freshwater fishes in the Great Lakes ecosystem. In 2013, VHSV research continues in the analysis of emerging strains from outbreaks in the Great Lakes; improvement of diagnostic tools for detection; virulence trials in marine and freshwater fish; and comparison of West Coast, Great Lakes and European strains.

Great Lakes Fisheries Science – Great Lakes commercial and recreational fisheries are valued at over $7.0 billion. The USGS supports Great Lakes fisheries management by providing resource agencies, including the Great Lakes Fisheries Commission, States, tribes, Canadian provinces, and FWS cutting edge science for the management, conservation and restoration of this ecosystem. The USGS provides long-term, consistent, lakewide assessment of forage fish stocks, emphasizing deepwater fishes. In 2012, the USGS conducted lake-wide assessment of forage fish stocks. In 2013 and 2014, funding from the Status and Trends and Fisheries Programs will continue the long-term assessment work on forage fish stocks, which are critical to the scientific management of this world-class fishery.

USGS Great Lakes Science Center operates five research vessels, one on each of the Great Lakes. This one of a kind research fleet collects fish population, limnology and habitat assessment data for partners and is critical to managing the commercial and recreational fisheries in the Great Lakes.

Activity: Ecosystems
Subactivity: Wildlife Program

2012 Enacted: $47.0 million (341 FTE)
2013 CR: $48.0 million (342 FTE)
2014 Request: $50.8 million (345 FTE)

Overview

Wildlife and the habitats upon which they depend are an enduring part of the United States' rich natural heritage. They boost the economy directly through hunting, birdwatching and other recreational opportunities. They contribute to food security, medical research, genetic diversity, and productive ecosystems that provide healthy soils, pollutant filtering, carbon storage and storm mitigation. The Interior has responsibility for the conservation and management of a number of wildlife species through the Endangered Species Act, the Migratory Bird Treaty Act, the Marine Mammal Protection Act and other statutory responsibilities. The USGS conducts research on migratory birds, terrestrial and marine mammals, threatened and endangered species, wildlife disease, terrestrial plants, renewable energy, and amphibians. This research helps Federal, tribal, and state managers and policymakers make informed, cost-effective, and balanced decisions that have economic, social, ecological, and cultural importance. The Wildlife Program supports four key activities:

Conservation and Management of Wildlife and their Habitats

The USGS conducts basic and applied research on factors influencing the distribution, abundance, and condition of wildlife populations and their associated ecosystems. Many activities focus on the development of new information and tools for the management of wildlife on federally managed lands such as national parks, national wildlife refuges, and BLM areas.

Tools and Techniques for Effective, Science-Based Management

The USGS develops tools and methods for wildlife management including modeling alternative scenarios for resource management, incorporation of new and specialized statistical formulas and programs, analysis of large scale genomic datasets, and identification and prediction of disease outbreaks and spread.

Factors Affecting Conservation of Species of Concern

The USGS provides scientific information in support of management decisions related to species protected under the ESA, Marine Mammal Protection Act (MMPA), similar state laws and regulations, and other species in decline such as amphibians. This information is used by resource managers in listing decisions and other management actions for wildlife species.

Emerging Wildlife Issues

Wildlife resources are being affected in unanticipated ways by multiple stressors such as fragmented habitat, invasive species, disease, and climate change. The USGS provides interdisciplinary science to help managers, policymakers, and industry make decisions using landscape or regional approaches to evaluate potential impacts to species or habitats.

Program Performance

Conservation and Management of Wildlife and their Habitats

Priority Research for DOI Bureaus – USGS researchers work directly with FWS and NPS resource managers to develop joint studies which address critical science needs identified by the management agencies through programs such as the Science Support Partnership (FWS) and the Natural Resources Preservation Program (NPS), supporting more than 100 studies each year. One study completed in 2012 provided insight into how carbon sequestration rates can be influenced by impoundment management on National Refuges. A new study initiated in 2013 at the request of the FWS will assess the outcomes of the largest estuarine restoration project in the Pacific Northwest. The Nisqually Wildlife Refuge has worked with the Nisqually Indian Tribe to restore more than 900 acres of estuarine habitat, an effort that is expected to benefit populations of fish and migratory birds, including the threatened Nisqually Fall Chinook salmon stock, the Nisqually winter chum salmon, and many of the 275 migratory bird species that use the refuge. The study will assess how effective the restoration has been in providing food for fish and wildlife populations, allowing wildlife managers to learn from their actions and make improvements as needed.

Migratory Birds – The USGS works with the FWS, state and tribal wildlife agencies, private organizations, and Canadian and Mexican Federal wildlife agencies to provide science needed for protection of over 1,000 birds under the Migratory Bird Treaty Act. Activities include the ecology and movements of migrating birds to identify habitats required for successful migration, geospatial, telemetry, and molecular tools to better describe long-distance movements, population distribution, and survival during different life stages. In 2012, the USGS initiated studies to determine the efficacy of using unmanned aerial vehicles (UAVs) as a cost effective alternative to radio and satellite telemetry techniques to conduct surveys for sandhill cranes migrating through Colorado's San Luis Valley. Further studies planned for 2013 will assess the ability of UAVs to reduce risk for both birds and low-flying pilots and determine cost-effectiveness for migratory bird population assessments.

Tools and Techniques for Effective, Science-Based Management

Emerging Wildlife Disease – The USGS provides information, technical assistance, and research on State, national, and international wildlife health and disease issues such as White-Nose Syndrome (WNS) in bats, highly pathogenic avian influenza, plague, and chronic wasting disease. Like the Centers for Disease Control (CDC), USGS infrastructure and interagency partnerships provide a critical foundation and template for emergency disease response to future zoonotic diseases of wildlife. The USGS uses the latest tools of molecular biology and genetics to address the ecology of infectious diseases affecting both fish and wildlife. In 2012, the USGS worked with the National Oceanic and Atmospheric Administration (NOAA) to isolate a novel avian influenza virus from stranded and dead harbor seals in New England. The USGS also worked with collaborators to characterize a coral cyanobacterial outbreak in Hawaii. In 2012, the USGS National Wildlife Health Center was designated as a Collaborating Center of the World Organization for Animal Health (OIE).

Genetics and Genomics – The USGS conducts research using genetics and genomics to answer questions on wildlife population structure, movement, distribution, disease, and response to environmental stresses. Genomics research capability is being enhanced with the addition of next generation sequencing and bioinformatics capacity. In 2012, the USGS used genetics and landscape data to develop a range-wide connectivity map and clarify taxonomic boundaries and status of greater sage grouse, which was petitioned for listing under the Endangered Species Act (ESA). The USGS also used genetic markers to clarify relationships between Puerto Rican and Florida populations of West Indian manatee to help design restoration programs for the dwindling Puerto Rico manatee population. While whole genome

sequencing is rapidly advancing and changing the way we view molecular science, the production of vast amounts of raw genetic data can be overwhelming. To gain the maximum benefit from these large data sets, in 2013, the USGS will unveil a newly developed data management and analysis server that will provide access to the bioinformatics tools in an easy to use format to facilitate sharing and secure storage of sequencing data.

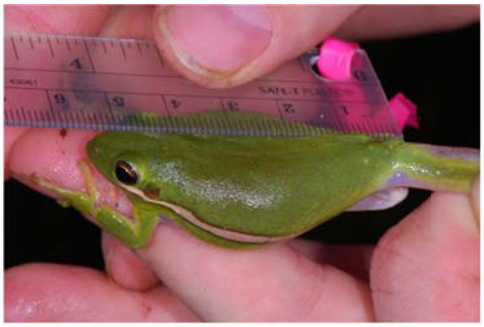
Factors Affecting Conservation of Species of Concern

Threatened, Endangered, and At-Risk Wildlife – The USGS investigates factors that contribute to the conservation and recovery of at-risk species. USGS science is designed to understand the status of declining, threatened, and endangered species, and assist managers in their recovery. In 2012, the USGS determined that barred owls in the central Coast Range of western Oregon are out-competing the federally threatened Northern spotted owl for critical resources such as space, habitat, and food. This research finding will be used by Federal land managers in owl management decisions.

A 2012 report by the USGS and academic researchers revealed that bats are estimated to save between $3.7 to $53.0 billion a year in agriculture products because of the pest-control (insect eating) services these animals provide. The federally endangered Indiana Bat is susceptible to population declines as White-nose syndrome spreads rapidly through east and central North America. Wildlife managers need to understand the potential impacts of the disease to inform their management and recovery actions. In 2012, the USGS completed an Indiana Bat population model which forecasts future population levels, discovered and identified the fungus responsible for this significant disease and has pioneered laboratory techniques for studying impacts of the fungus on hibernating bats, and helped develop the WNS National Plan and supports the field actions of the management agencies. In 2013, the USGS will initiate research to study fungal ecology to determine the role of bat hibernacula environmental conditions in disease progression and to evaluate potential vaccine vectors.

Better protection of prairie dogs against plague would minimize the risk of disease transfer to endangered black-footed ferrets and aid in prairie dog conservation. In 2012, the USGS developed and laboratory-tested an oral plague vaccine for prairie dogs as a pre-emptive method of combating plague. The USGS is working in collaboration with numerous state and Federal agencies and tribes to obtain approval for field trials in 2013 with vaccine-laden, peanut-butter flavored baits and evaluate the safety and effectiveness of the vaccine in grasslands.

Amphibian Research and Monitoring Initiative (ARMI) – Worldwide declines of amphibians prompted the development of the ARMI to monitor the status of amphibians on Interior lands, determine causes for their decline, and work with partners to develop management options to reverse declines. Since its initiation in 2000, ARMI has established the only set of large-scale quantitative information on amphibian declines in the United States. ARMI's research has included pioneering work on the effects of habitat loss, climate change, diseases, invasive species, fire, and contaminants on individual amphibians and populations. Research completed in 2012 at the Chesapeake and Ohio National Historical Park in Maryland used models to predict species occurrences in wetlands of four amphibian species. This information is being used by the NPS to implement conservation management actions in light of future climate change and observed declines in occurrence for some species.



Measuring length of a green treefrog, *Hyla cinerea*, captured at Big Thicket National Preserve near Beaumont, Texas

In 2012, ARMI scientists at the USGS produced the first analysis of the rate of change for amphibian populations across Interior lands. While there was some variation across the country, ARMI found that on average, amphibians declined 3.7 percent annually across the United States from 2002 to 2011. This analysis suggests that amphibian declines are continuing and are more severe than previously realized. Further, the declines are occurring for species for which there has been little concern in the past. This information will be used to develop and test models to explain what factors are contributing to and driving this national decline. Model development is expected to be completed in 2013, with analysis and testing scheduled for 2014. The analyses and models will be used to focus research questions and management alternatives developed in collaboration with the Department of the Interior, tribal, and state partners on an ongoing basis.

Emerging Wildlife Issues

Energy and Wildlife – Recent focus and incentives for renewable energy and advances in technology for extracting fossil fuels have increased energy production footprints on the U.S. landscape, resulting in greater interactions between energy production and wildlife. The USGS is on the forefront of science to support good management decisions that provide options for siting and operating energy development to meet wildlife and ecosystem sustainability goals. The USGS conducts innovative survey design and monitoring strategies and full life cycle biological research with focus on why, how, and at what magnitude mortality, injury, or habitat loss or modification can occur and what that means for the species. Products provided to managers include tools and techniques, software, mapping, and modeling tools. In 2012, the USGS delivered mortality estimation software tool for windfarms to Interior managers, and is now conducting training sessions around the country. Testing of an infrared video monitoring system was completed and the system is now being deployed in full scale research project in cooperation with industry facility managers in 2013.

Determining how bats interact with wind turbines has been a scientific challenge. Bats are long-lived, slow-growing, and slow- reproducing mammals, making them extremely vulnerable to population failure. Their small size compared to industrial wind turbines also makes it difficult to observe bat-turbine interactions high above the ground in the dark. USGS research is focusing on developing new methods to automatically record and analyze imagery of bat interactions with turbines. In 2012, projects in Indiana and Hawaii provided new information about the way bats behave around turbines. Bats were captured with an infrared video camera capable of "seeing" bats in the dark, imaged approaching and interacting with turbine blades and towers which has led to discoveries about how and why bats interact with wind turbines, as well as factors associated with species susceptibility. In 2013 and beyond, this tool and other proposed research will assist managers in predicting potential fatality prior to facility construction, developing techniques to reduce fatalities once facilities are in place, and assessing cumulative effects on wildlife populations.

View of a wind farm.

Changing Arctic Ecosystems – Changes to the physical environment in the Arctic include warming temperatures, diminishing sea ice, increasing coastal erosion, deteriorating permafrost, and changing water regimes. The USGS conducts research to understand the potential suite of wildlife population responses in order to inform key resource management decisions, such as those related to the Endangered Species Act, and provide unique insights into how Arctic ecosystems are responding under new stressors. The USGS is examining how and why changes in the ice-dominated ecosystems of the Arctic are affecting wildlife and will provide a better foundation for understanding the degree and manner in which wildlife species respond and adapt to rapid environmental changes. In 2013, USGS

work in the Arctic will continue to produce information useful to decisionmakers managing oil and gas exploration and development in the Chukchi and Beaufort Seas, and for addressing challenges posed by increased shipping and other economic opportunities in a more accessible Arctic. This includes the effects of changing sea ice and increased commerce in Arctic waters on walrus, polar bears, sea otters, seabirds and their habitats.

Pacific Walrus – Pacific walruses spend the majority of their time in water and are extremely difficult to study using standard methods involving animal captures. A mix of complementary approaches and creative techniques are required to understand how sea-ice change is affecting walruses. Transmitters deployed on walruses in the Chukchi Sea over the past several years have provided data to identify important seasonal movements and foraging areas. In 2012, the walruses arrived earlier and stayed later than in the past. The lack of sea ice over the continental shelf in September and October caused walruses to seek food near shore rather than offshore areas as they have done have in the past. Bioenergetic models developed by the USGS are used to evaluate the walruses behavioral changes and if they are likely to compromise reproductive and juvenile survival rates. This real-time data is critical to the Bureau of Ocean Energy Management (BOEM) for managing oil and gas drilling operations in the Chukchi Sea. The walrus use areas are key data for BOEM's decisions on operational constraints for drilling and related support activities. In 2013, research will be conducted to develop methods to estimate the age structure of walrus groups that seek food on shore and on the ice to determine how population dynamics may be shifting.

Adult female walruses with young in Alaska.

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Activity: Ecosystems
Subactivity: Environments Program

2012 Enacted: $36.1 million (202 FTE)
2013 CR: $36.6 million (203 FTE)
2014 Request: $44.5 million (223 FTE)

Overview

Interior is responsible for the stewardship of approximately 20 percent of our Nation's lands, the largest supplier of water in the 17 Western States, the Nation's second largest producer of hydroelectric power, oversees 27 percent of oil and 15 percent of natural gas produced domestically, and manages conventional and renewable energy development on 41 million acres within the Outer Continental Shelf. In addition, Interior upholds Federal trust responsibilities to Indian Tribes and Alaska Natives, is responsible for migratory wildlife and endangered species conservation, and works in partnership for conservation activities on non-Federal lands and priority ecosystems across the United States.

> *"The scientific research performed by the USGS in the Detroit River International Wildlife Refuge is essential to understanding ecosystem processes, setting priorities, and selecting restoration and conservation actions within an adaptive management context."*
>
> John H. Hartig
> Refuge Manager, Detroit River
> September 23, 2011

The USGS Environments Program assists in Interior land stewardship responsibilities by providing the science required to make informed decisions on sustainable resource use, protection, and adaptive management. The USGS conducts research to assess, understand, model, and forecast the impacts of both natural and human-induced changes to our ecosystems, natural resources, and communities. Informed forecasting of landscape structure, function, composition, and condition requires a fundamental understanding of the factors that control, constrain, and regulate ecosystem dynamics. USGS science is focused on understanding these driving factors using historical ecological studies, controlled long-term field studies, remote sensing, geospatial technologies, and empirical and mechanistic ecosystem modeling. In addition, the USGS evaluates trade-offs of varying strategies for land management, land use, conservation, and restoration for the benefit to landscapes, infrastructure, and economies.

Responsiveness, integration, and application are important characteristics of the research and science delivery conducted by the Environments Program. The USGS integrates ecological science with research from other USGS mission areas and universities, government agencies, and non-governmental organizations. The products of integrated USGS research represent science-based solutions that reconcile and accommodate both the conservation and use of natural resources to problems faced by decision-and policy makers, local land and resource managers, and community planners that involve land-use, natural resource, and ecosystem services for the benefit of the citizens of the United States. Primary program components include:

Ecosystem Restoration

Most natural ecological systems provide critical goods and services important to society that are estimated to be worth trillions of dollars annually. These natural goods and services include production of food and timber, purification of air and water, detoxification and decomposition of wastes, regulation of climate, regeneration of soil fertility, and pollination of crops. The expansion of human population centers near and within nationally important ecological systems has resulted in a degradation of natural processes and has impaired the ability of these systems to provide goods and services. Restoration ecology research

supported by the Program focuses on the practice of renewing and restoring degraded, damaged, or destroyed ecosystems and habitats in the environment by active human intervention and action. Research focuses on understanding how ecological systems have changed in the past and how they may change in the future, how different resource management alternatives may affect the rate and direction of ecosystem recover, and how to best establish baselines and processes for restoring degraded ecosystems.

Energy Development

DOI is responsible for managing millions of acres of Federal lands for multiple purposes, including sustainable development of conventional and alternate energy important to the U.S. economy and for national security. These lands also contain a treasure trove of fish, wildlife, and landscapes that are equally important to the American public's health and well-being. The USGS conducts research on the potential impacts of alternative and fossil fuel energy development, including hydraulic fracturing, on wildlife and wildlife habitats through adaptive management and structured decisionmaking approaches to address short and long term decisionmaking needs. Requests to the USGS for science support related to wildlife and energy development continues to grow; close coordination between the FWS, BLM, BOEM and USGS is underway.

Coastal Resiliency

Coastal environments, the shores of the Pacific Ocean, Atlantic Ocean, Gulf of Mexico, and Great Lakes, are critically important habitats for people and other organisms. Already densely populated, the American coast is expected to be home to nearly 75 percent of the population by 2025, focusing biological, social, and economic issues into narrow bands along the Nation's margins. Unfortunately, much of the Nation's coastal habitats are degraded or, in the case of the Gulf Coast, the San Francisco Bay and other important habitats, being lost because of coastal erosion, reductions in sediment deposition, and changes in sea-level elevations. They also turn to the USGS for reporting on coasts regarding descriptions of biophysical processes, the status and trends of the plant and animal populations that occur there, many of which have legal status as protected, threatened, or endangered. The Environments Program provides detailed descriptions and maps of the state of the Nation's coasts, and uses scientific knowledge of processes to build quantitative models in support of conservation decisionmaking for these important habitats.

Fire Ecology

The 2012 fire season was challenging in severity and fire condition, with about 9 million acres of U.S. lands burned by wildfire. However, 2012 was not an anomaly; over the last decade, with few exceptions, fire seasons have tended to be more active – with larger acreages burned and more severe conditions – than in any other decade since accurate records were first kept starting in 1960. The Environments Program conducts fire ecology research to understand effects of wildland fire on the structure and the function of ecological systems, and on other ecological attributes such as wildlife habitat. Research is also directed at understanding fire history and fire regimes; interactions of fire with invasive species such as cheatgrass; the role of climate variability in size and intensity of fires; fire relations with vegetation structure and effectiveness of fuels treatments; and the development of guidelines for restoring and rehabilitating fire-impacted ecosystems and watersheds. For example, fire is a major factor controlling

> *"Useful and timely geospatial data provided by the USGS are critical in helping DOI make decisions that support wildland fire management across the Nation. Having access to this scientifically valid information is key to helping us successfully respond to fires that threaten the public's well-being and practicing adaptive management during fires to protect resources and enhance landscape resilience."*
>
> Kirk Rowdabaugh, Director
> DOI Office of Wildland Fire Coordination
> November 11, 2011

the Everglades ecosystem; for thousands of years, lightning-strike fires from summer thunderstorms maintained a dynamic landscape suited both to withstand fire and to recover quickly in the wake of frequent fires. Today, managers in the Everglades National Park are implementing controlled burns to promote healthy, sustainable vegetation patterns and ecosystem functions based on USGS data and models

Ecosystem Services

Modern landscape science not only recognizes the individual components and connectivity of natural systems, but also that these systems provide valuable, quantifiable benefits to humans. Termed ecosystem services, these benefits range from water purification and storm surge reduction to recreation. The USGS is working to provide an understanding of the economic and non-economic valuations of various ecosystem processes and components. Current multi-disciplinary projects include studies of changes to Gulf of Mexico coastal islands and wetlands (for storm surge protection), water quality monitoring in Chesapeake Bay (for water sources and wildlife production), and monitoring of habitats in Puget Sound (important to fisheries production and recreation).

Dust Ecology and Ecohydrology

Atmospheric dust caused by wind erosion has far-reaching effects on dryland ecosystems of the western United States. Ecological impacts, which are affected by – and interact with – drought, livestock grazing, and changes in precipitation and soil moisture regimes, include redistribution of nutrients and decreases in snowpack, resulting in earlier and faster snowmelt and river runoff. Socioeconomic impacts include property damage, changes to agricultural productivity, changes in recreation, and increased respiratory ailments. For these reasons, the USGS is working in collaborative research teams to understand the factors that contribute to dust emission, the sources and deposition of dust, the physical and chemical properties of dust, and the prospects for future dust emission. The goal of this research is to develop simple tools that scientists and managers can use to assess wind erosion vulnerability at a particular site under current conditions and under future climate and land use change scenarios. This is particularly important in areas where road networks are expanding through arid regions because of energy development and off-highway recreation.

Program Performance

Chesapeake Bay – The USGS provides science to help restore the Nation's largest estuary and carry out the Presidents' Chesapeake Bay Executive Order (EO). The USGS has lead responsibility to provide watershed science to the Chesapeake Bay Program (CBP) Federal and State partners. Research goals include restoration of water quality, recovery of habitat, sustaining fish and wildlife, and conserving lands and increasing public access. In 2012, the USGS completed research on reservoirs in the lower Susquehanna River, indicating that sediment storage capacity has been reached, resulting in a 55 percent increase in phosphorus and a 97 percent increase in sediment loads to the Bay since 1996. This information is being used by the US Army Corps of Engineers (USACE), and the Environmental Protection Agency (EPA), and Maryland to develop management options to reduce pollution load into the bay. The USGS reported on the extent and severity of toxic contaminants in the Chesapeake Bay and its watershed; the findings will be used by EPA and the CBP partners to consider goals for reducing the impact of toxic contaminants. The USGS also collaborated with the NPS and NatureServe to develop Chesapeake Landscope, a decision-support tool to help identify priority areas for land conservation by Interior and other partners. The system will be updated in 2013 to include new information on land-use changes due to population growth in the watershed.

California Bay-Delta – The California Bay and associated delta is recognized as one of the world's threatened treasures of biodiversity, supporting unique native species and their tidal and wetland habitats. Like other urban estuaries, this system has a history of anthropogenic changes involving multiple stressors, including altered hydrodynamics, environmental contaminants, and invasive species. The USGS is providing science to partners charged with restoring over 13,000 acres of wetlands in South San Francisco Bay. The bay system is constantly changing, and because of decreased sediment delivery and expected changes in hydrodynamics and sediment dynamics, the past may not be a good predictor for the future. The combination of historical data, contemporary monitoring, and development of models will improve understanding of likely responses to future accelerated sea level rise and improve the chances for successful restoration.

Puget Sound – The Puget Sound is the second largest estuary in the United States, providing recreation and economic opportunity to millions of people, including over 20 American Indian Tribes with perpetual rights to use of salmon protected under law. However, salmon are in decline due to reductions in habitat quantity and quality. The USGS is providing science for ecosystem restoration by developing monitoring programs and developing models at the ecosystem scale to identify and address risks to salmon. In 2012, The USGS initiated investigations into the status of forage fish populations to identify linkages between population dynamics, bioenergetics, predation, habitat alterations, disease, and food availability. This work will continue into 2014 with development of new molecular tools and sampling methods to better understand the effectiveness of restoration efforts.

Gulf Coast – Coastal parks and refuge managers of DOI require better understanding of climate change impacts, and need relevant decision-support tools to aid conservation planning and ecosystem management. In 2012, the USGS took a lead role in landscape-scale ecological modeling of climate change in the northern Gulf Coast region, conducting over 30 sea-level rise modeling discussions with the NPS and FWS on mangrove expansion, coastal forest retreat, climate change, and sea-level rise. The USGS also contributed to the recently published National Climate Change Assessment and joint partnership in regionally based Landscape Conservation Cooperatives of the Southeastern United States. The USGS collaborates closely with other government agencies and NGOs on coastal and climate change issues, including NOAA, EPA, DOE, DOD, USACE, DOS, TNC, NGI, and GCBO. In 2013 and 2014, the USGS will develop new landscape-scale field and modeling studies with interagency cooperation to improve forecasting applications at the park, refuge, regional, and national level. For example, the USGS will collaborate with DOE on coastal watershed modeling to assess potential impacts of sea-level rise and hurricanes on energy services and infrastructure, and will continue to contribute science to inform assessment and restoration of ecosystems affected by recent or potential future oil spills.

Collecting marsh grass samples for greenhouse studies in coastal Louisiana.

Sagebrush Biome – Greater sage-grouse, a sagebrush inhabitant and a candidate for listing under the Endangered Species Act, currently occupy only half of their historic range (in what is termed the sagebrush biome) due to habitat loss. In 2012, the USGS worked with State, academic, and Federal partners to identify sage-grouse populations at risk of extinction due to isolation from other populations and habitat changes. Because the broad, multi-State distribution of greater sage-grouse encompasses diverse habitats, the USGS and university collaborators are mapping habitats based on a

The greater sage-grouse (*Centrocercus urophasianus*).

novel statistical approach that identifies regions with the minimum environmental features required by sage-grouse. This approach enabled scientists to map habitat availability across large areas and facilitated mapping corridors that enable connections among populations. This research is being coupled with range-wide gene flow research that provides information on population connectivity through dispersal. Analysis of genetic data collected from more than 400 breeding locations in 2012 is being used to prioritize sampling efforts planned for 2013 and 2014. Maps of current and future habitats, coupled with range-wide genetics information will provide managers with powerful tools to focus conservation actions in areas having the highest likelihood of sustaining sage-grouse into the future.

Greater Everglades – The USGS provides information for conservation and management of complex ecological systems that make up the Greater Everglades ecosystem. In 2012, USGS and FWS scientists estimated that without human alterations to Everglades hydrology, average water levels would be 0.3 m higher and flow volumes three to six times greater than under present conditions. A comparison of this flow deficit to the volume of freshwater channeled from the Everglades to the Atlantic and Gulf Coasts each year indicates there is enough water to restore more natural flow to the Park and sustain both the natural and societal needs in south Florida. This information can inform decision- and policy makers concerned with sustainability of the good and services provided by the Everglades system, and resource managers working to maintain and restore degraded portions of the Greater Everglades ecosystem.

Reef-building corals found among the mangroves of the Virgin Islands Coral Reef National Monument provide an opportunity to examine resilience of coral reefs to environmental change.

Outer Continental Shelf – USGS research provides information to BOEM on long-term ecological effects of offshore oil and gas exploration, production, and platform decommissioning on fish and deep sea corals, and potential impacts of offshore wind energy development on marine communities and avian and sea bird migration. In 2012, the USGS studied coral reef condition and resilience in the U.S. Virgin Islands, the Florida Keys, and the Hawaiian Islands, as well as deep water corals proximal to the Deepwater Horizon release. This research enabled Virgin Islands National Park to better understand the relationships among high seawater temperature, bleaching, and disease to facilitate management and recovery of elkhorn coral and other coral species. Research in 2013 and 2014 will continue to focus on changes in coral reef condition, coastal habitats for fish and wildlife, and the production of goods and services important to local economies and national and cultural identities.

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Activity: Ecosystems
Subactivity: Invasive Species

Over 6,500 different types of harmful non-native species estimated to cause more than $137 billion in damages each year to the U.S. economy (farmers, ranchers, businesses and government).

2012 Enacted: $12.8 million (58 FTE)
2013 CR: $13.8 million (61 FTE)
2014 Request: $18.3 million (70 FTE)

Overview

Nonindigenous invasive plants and animals cause significant economic losses and diminishing opportunities for beneficial uses of forests, croplands, rangelands, and aquatic resources. Costly effects include clogging of water facilities (quagga and zebra mussels) and waterways (hydrilla, giant salvinia), wildlife and human disease transmission (West Nile virus, monkeypox), threats to commercial, native, and farmed fisheries (Asian carps, snakehead fish, whirling disease, hemorrhagic septicemia), and increased fire vulnerability and adverse effects for ranchers and farmers (leafy spurge, cheatgrass, brome, buffelgrass).

"USGS researchers are pioneering the battle against Asian carp by informing monitoring efforts and developing innovative detection and control tools that will protect the Great Lakes and other waterways across the Nation."

David Ulrich
Chair, U.S. Section
Great Lakes Fishery Commission

Many species introduced decades ago have spread rapidly in U.S. ecosystems and pose increasing threats to lands and waters. They harm native ecosystems and are contributing factors in the listing of 40 percent of all threatened and endangered species. It is estimated over 6,500 non-native species cause more than $137.0 billion in damages annually to the U.S. economy as the country battles to control the economic, ecological, and health threats these invaders pose. Increased global travel and trade are providing more pathways for both intentional and unintentional introductions of invasive species.

The USGS works on each of the species mentioned above, working collaboratively on all significant groups of invasive organisms in terrestrial and aquatic ecosystems in all regions of the United States. Across the Nation, the USGS partners with States, tribes, other Federal agencies, businesses, agriculture, natural resource managers, and the private sector to help solve problems posed by these invaders. The USGS joins Federal efforts to combat invasive species in natural and semi-natural areas by providing information on early detection and assessment of newly established invaders; monitoring invading populations; improving understanding of the ecology of invaders and factors in resistance of habitats to invasion; and developing and testing prevention and alternative management and control approaches.

USGS science is also key to implementing the National Invasive Species Management Plan, developed by the National Invasive Species Council, as called for in the Presidential Executive Order 13112 on invasive species. The Interior bureaus work in partnership with other Federal agencies; State, local, and tribal governments; and private sources to conduct activities related to prevention, early detection and rapid response, control and management, restoration, and organizational collaboration.

Program Performance

Prevention, Early Detection, and Rapid Assessment

USGS research focuses on developing and enhancing capabilities to forecast and predict invasive species establishment and spread. Early detection helps resource managers identify and report new invasive species and assess risks to natural areas.

- *Modeling and Forecasting* – The USGS develops and tests spatial models and data management and decision support tools. These efforts directly assist land managers and other decisionmakers in their efforts to detect and predict potential ranges and effects of harmful invasive species by documenting, mapping, and predicting their spread. In 2012, the USGS brought together land managers and scientists to develop distribution models and synthesize data to better understand where species of concern are likely to thrive under current and future climate and land-use scenarios. In 2013, the USGS will create "Software for Assisted Habitat Modeling (SAHM)" to expedite habitat modeling and help maintain a record of the various input data, processing steps and modeling options incorporated in the construction of a species distribution model. This tool will help researchers and managers explore and maintain records of multiple parameters and different iterations in the habitat modeling process to develop a meaningful interpretation of results.
- *Early Detection of Invasive Species* – Tracking the establishment and spread of existing and new invasive species is a critical component in the effort to manage invasive species. In addition to the standard means of monitoring, the USGS is developing new tools and techniques to assist in the early detection of invasive species. In 2012, the USGS worked with partners to develop a rapid and quantitative genetic-based (eDNA) method to detect Asian carp. In 2013, the USGS in collaboration with other scientists, will document the establishment of boa constrictors on the island of Puerto Rico. Genetic studies show that boas on the island are highly related and likely come from a small number of boas stemming from the pet trade, even though private ownership of boas and most other snakes is prohibited on the island. In the last year alone, more than 150 boas have been found in the wild on the island.
- *Nonindigenous Aquatic Species Database* – The USGS hosts the Nonindigenous Aquatic Species (NAS) database which provides the latest information on distribution of introduced aquatic species across the United States. The online database (*http://nas.er.usgs.gov*) contains locality information for more than 1,100 species of vertebrates and invertebrates introduced as early as 1850. It is a primary source of invasive species information and early alert system for State and Federal resource managers and the public with over 95,000 visits daily. Species of recent concern include Asian carp, zebra mussels, quagga mussels, and lionfish. The USGS has been tracking and documenting reports of Asian tiger shrimp since they first came to the attention of marine scientists and resource managers in 1988, when nearly 300 of them were collected within a 3 month period off the coasts of South Carolina, Georgia and Florida. Increasing numbers were collected in 2006, and expanded 10-fold by 2012 to the coasts of Georgia, Mississippi and Texas. The presence and maintenance of a comprehensive aquatic invasive species database made this information easily available to managers attempting to address this issue.

Effects and Risks Posed by Invasive Species

The USGS provides methods and information to assess risks posed by invasive species to native species and their habitats. Understanding both the potential and realized effects of invasive species helps managers allocate resources for control and management.

Invasive Species and Habitat Interactions – The interactions between living things and their environments -- fire, atmospheric and climate stresses, land use changes, disease -- strongly influence invasions of non-native species. Many factors influence species invasiveness and its ability to persist in the environment. In semi-arid western North American riparian ecosystems, for example, increased drought and lower streamflows under climate change may reduce native plant growth and favor drought-tolerant exotic species. In 2013, the USGS will examine the effects of CO_2 and water availability on native and non-native riparian species to determine if elevated CO_2 might ameliorate the effects of increased drought and lower streamflows. While there is some moderate positive effect, it is unlikely to counteract the large negative effect of increased aridity which will favor drought tolerant exotic plant species.

Biology, Ecology and Population Dynamics of Invasive Species – Understanding life history and the environmental requirements, tolerances and thresholds of targeted invasive species is critical to developing effective control and management options. The USGS conducts research on numerous aquatic and terrestrial fish, wildlife, and plants, including Burmese pythons, nutria, Asian carp, buffelgrass, brome, cheatgrass, tamarisk, leafy spurge, snakehead fish, brown tree snakes, zebra/quagqa mussels, and feral pigs, to provide the information needed by management agencies.

Understanding salinity tolerance is critical to evaluating the likelihood of giant constrictors spreading beyond the Everglades and is valuable information to State and Federal resource managers as they make decisions about allocating resources. A study published in 2012 by the USGS provides initial evidence that Burmese pythons may be able to withstand exposure to salt water long enough to expand their range through ocean and estuarine environments. In another study completed in 2012, USGS and academic scientists found that small mammals in the southern part of the Everglades National Park have declined dramatically since the establishment of Burmese pythons. The scientists suggest that one reason for such dramatic declines in such a short time is that these prey species may be "naïve" (previously unexposed and therefore unadapted) to large constrictor snakes since such large snakes have not existed in the eastern United States for millions of years. In addition to being prey for pythons, some of the declining species may also be competing with pythons for food. Additional studies related to monitoring and control of large constrictor snakes will continue in 2013 and 2014.

> *"Most alarming are the decimating changes in the delicate Everglades that have accompanied the explosion in invasive snake populations. Biologists and researchers including those at USGS and University of Florida are working to not only limit the snakes' takeover but determine whether or not the pythons are responsible for the near-total disappearance of native mammals including raccoons, opossums, and bobcats."*
>
> Janie Campbell
> The Huffington Post
> 8/14/12

Control and Management of Invasive Species – USGS research improves existing invasive species control methods and develops and tests new chemical, physical, molecular, and biological methods of control. This permits managers to understand and minimize environmental impacts at landscape, regional, and local scales.

The spread of Asian carp is one of the most acute threats facing the Great Lakes and its multi-billion dollar fishery. Since 2010, there has been an aggressive focus by the Administration on pushing the Asian carp population invasion back from rivers that feed into the Great Lakes. The USGS is a member of the Asian Carp Regional Coordinating Committee (RCC), which coordinates Federal response to the threat of Asian carps becoming established in the Great Lakes. The USGS is developing options to control populations of Asian carp and other invasive species utilizing chemical, physical and biological methods. In 2012, the USGS worked with partners to develop selective control methods and technologies for Asian carps based on increased selectivity of the piscicide rotenone. The goal is to deliver a chemical

that kills Asian carp with no impact on other aquatic species. The USGS also conducted research to better understand spawning requirements for Asian carps to identify risk of potential spread, tested selective control approaches including pressurized air cannons, and improved the accuracy of environmental DNA (eDNA) tests including fecal microbes for early species detection. Previous work has shown that the presence of a species could be confirmed using the microbial composition of their feces. In 2012, scientists identified bacterial species in the feces of silver, bighead and grass carps that could be used for diagnostic purposes. The USGS also developed initial markers for these bacteria. Research will continue into 2013 to isolate bacteria species and develop markers for native and additional non-native fishes.

Invasive Species in Hawaii – USGS research focuses on the ecology and control of highly invasive plants (e.g., miconia, faya tree, strawberry guava, Kahili ginger); animals (e.g., Argentine ant, mouflon, brown tree snake on Guam); wildlife disease organisms; and methods for reducing impacts of invasive species on the region's unique native flora and fauna.

Restoration of Invaded Habitats

The USGS develops strategies and techniques to understand and facilitate restoration of native species and habitats affected by invasive species. This is critical because control without restoration can leave the ecosystem vulnerable to subsequent costly species invasions.

Weeds in the West – The USGS conducts multi-scale, integrated assessments to: map infestations and accurately monitor the spread of invasive plants, particularly weeds, in western forests and arid rangelands; predict areas most vulnerable to invasive species; assess the effects of management practices and natural disturbances on invasive species; evaluate how invasive grasses alter the frequency and intensity of wild fires; and improve methods to restore public rangelands affected by weed invasions. In 2012, the USGS developed a simple method for predicting responses of plants to fire in western arid lands to help land managers prescribe appropriate fire conditions or develop more effective alternative treatments or follow-up procedures. The USGS is conducting evaluating techniques to control populations of harmful weeds (Sahara mustard, buffelgrass, brome, etc.) while maintaining or increasing the abundance and diversity of native annual plants.

Tamarisk Control and Restoration – Researchers debate the extent to which tamarisk and other riparian invasive species have had negative effects on managed waterways in the arid Southwest, but it is clear that they can alter habitat quality for some wildlife, water use by floodplain vegetation, and the frequency and intensity of wildfires. The USGS is addressing some of the most compelling research questions related to these and other non-native plant species that occur in riparian ecosystems in the western United States. USGS research on post-control strategies and techniques to restore native species and habitats is critical to the success of land managers seeking to revegetate and restore function to riparian habitats. In 2012, the USGS evaluated the impact of a biological control of invasive tamarisk on native wildlife and plant species along the Virgin River in Utah. Research indicates that some wildlife species such as the Southwest Willow Flycatcher use tamarisk as breeding habitat. Other work by the USGS examines the ecosystem response to defoliation by a beetle used for biological control of Tamarisk. This project looks at the effectiveness of the biological control agent and its impacts to other biota and the overall restoration effort.

Activity: Ecosystems
Subactivity: Cooperative Research Units

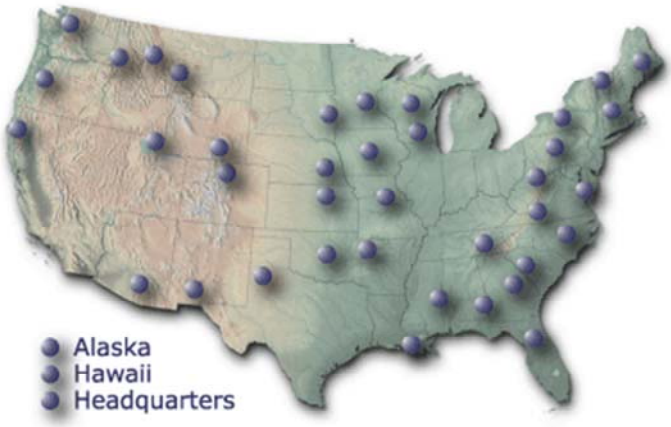
2012 Enacted: $18.4 million (151 FTE)
2013 CR: $18.4 million (151 FTE)
2014 Request: $18.6 million (151 FTE)

Overview

The Cooperative Research Unit (CRU) program is a unique cooperative relationship among the USGS, the U.S. Fish and Wildlife Service (FWS), State fish and wildlife agencies, host universities, and the Wildlife Management Institute. Since 1935, this cooperative relationship has provided a strong connection between the USGS, State and Federal management agencies, and the national university community and has greatly enhanced research capabilities in fish, wildlife, ecology and natural resources. 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 with a legislated mission (PL 86-686) of research, education, and technical assistance focused on fish, wildlife, ecology, and natural resources;
- Science capabilities responsive to resource management needs of States, Interior Bureaus, and other Federal resource agencies; and
- A premiere program for graduate education and training of future natural resources professionals having skills to successfully serve the broad natural resources management community.

The CRU program is comprised of 40 CRUs located at universities in 38 States, with a headquarters office in Reston, VA. 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 positions 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 of university graduate students; and provide Federal and other natural resource managers' access to university expertise and facilities.



Locations of the Cooperative Research Units

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. Through university affiliations, CRU scientists train future resource professionals and provide opportunities through graduate education to diversify the Federal workforce.

CRU scientists teaching graduate level courses.

University and State agency contributions to the program remain strong, as does Federal, State, and local government reimbursable funding for research and technical assistance. Regular cooperator-focused satisfaction surveys continue to indicate a high satisfaction rate of 95 percent or greater with CRU program execution of the education and science mission at local units. The program's appropriated dollars continue to be matched by State, university, and Federal partners, at a ratio of approximately three matching dollars to each appropriated dollar.

Program Performance

To meet future natural resource management challenges, the program is investigating new approaches to more effectively help State, tribal, and Federal cooperators implement science-based decisionmaking. These approaches will further provide a framework for cooperators to work together across State and regional boundaries and address large-scale, trans-boundary issues. The CRU program is recognized by Interior as the primary source of technical expertise on structured decisionmaking and adaptive management, and is actively working with DOI bureaus to bring science to bear on regulatory and management decisions. More closely knitting science with management is critical for Interior bureaus faced with significant resource decisions and complexities in the face of unpredictable effects of climate change. Currently, expert knowledge and application of structured decisionmaking and adaptive management is limited and does not meet the demand for this expertise.

To meet this need, CRU partnered with Oregon State University in 2012 to develop and deliver an online, graduate level course in structured decisionmaking and adaptive management. This new program will greatly expand the opportunity of graduate students to learn systematic and innovative approaches to science-based natural resources management. As these graduates populate the workforce of our State and Federal partners, an increased capacity will be realized across all agencies which will foster collaboration and more rapid adoption of the overall approach. Because many of our graduates find employment within the Department of the Interior, these efforts will ensure the Department is better positioned to achieve its strategic goal of enhancing science-based natural resource decisionmaking.

Plans to develop new ways of working across State and regional boundaries are a key goal of the decision support initiative. CRU cooperators fully support broad-scale research projects aimed at understanding mechanisms affecting species and habitats at unprecedented scales. For example, CRU Units in Wyoming, Utah, and Montana are working with multiple western States to identify options for managing elk herds in ways not possible from a single-State perspective. This type of trans-boundary approach to wildlife research is an important precursor to the multitude of landscape-level wildlife management research issues that will arise as climate and land use changes. CRUs extensive work in climate change research directly supports and aligns with Interior's strategic science vision that requires landscape level solutions.

The CRU program has more than 800 active projects at the start of 2013. Many of these projects exemplify how CRU scientists are delivering tools to Interior agencies to make management decisions on our Nation's important natural resources. Many of the projects use structured decisionmaking or adaptive management to address landscape level issues associated with climate change and energy development. CRU scientists currently have 43 research projects (41 are in support of Interior) to better understand and predict the potential effects of climate change on the future availability of habitat and resulting

distribution of species in the future. Similarly, CRU has nine projects related to the impact of energy development projects on the distribution and life history of ecologically or economically important species. These studies are critical for understanding biological and environmental processes to inform decisions that integrate underlying biology with societal needs and values.

Examples of ongoing research projects that highlight how CRU scientists are helping State and Federal partners make science-based management decisions include:

Decision support tool for American alligator harvest regulations in Florida, Georgia, and South Carolina – This four-year project is developing decision tools for annually regulating public harvest of alligators in Florida, Georgia, and South Carolina. The research is developing population models for harvest decisionmaking that enable a robust way to interpret and act upon monitoring observations, and includes innovative ways to incorporate urbanization and climate change into alligator harvest models.

American alligator

Multi-species adaptive management in Delaware Bay – This project develops predictive models that help managers understand linkages between changes in horseshoe crab populations and shorebird dynamics used in setting crab harvest regulations in the Delaware Bay. Horseshoe crab management is a high priority in the National Shorebird Plan and State Wildlife Action Plans of Delaware and New Jersey. This project supports conservation priorities of the FWS Strategic Habitat Conservation Initiative, DOI Adaptive Management Initiative, and is an example of proactive species conservation to preclude listing under the ESA.

Wyoming Assessment of Wildlife Vulnerability to Energy Development (AWVED) –The goal of AWVED is to prioritize Wyoming's 200 wildlife species relative to potential sensitivity to future energy development. This research identifies each species' range, and then predicts potential exposure to energy development within that range, and sensitivity of each species to that exposure level. Combining these two features enables State and Federal managers to identify landscape-level conservation measures that reduce environmental risk of energy development and avoid regulatory solutions.

2012 in Review – Achieving the Unit Mission

In 2012, Unit scientists continued their productivity with 862 active projects with Federal and State partners, and with their students, remained engaged in service to professional societies delivering 840 presentations. In addition, Unit scientists gave 69 invited seminars, indicating their research activities and findings are held in high regard by the scientific and management communities. CRU's service to their host universities continued to be strong with 74 academic classes taught and 33 additional workshops and short courses delivered to partners in 2012.

Productivity Summary	**2011**	**2012**
Peer reviewed publications	349	358
Invited Seminars	56	69
Workshops and Short Courses	25	33
Total Projects (State + Fed + other)	793	862
Papers Presented	684	840
Academic Courses Taught	75	74
Total number of students	550	555
Master's degrees awarded	61	60
Doctoral degrees awarded	23	23

Each year, over 500 students engage in graduate education and training in natural resources conservation through the CRU program. About 15 percent of these students matriculate each year and enter the natural resources management workforce as employees of State and Federal agencies, non-governmental organizations, and universities. The number of advanced degrees awarded to Unit students in 2012 was 83, which is consistent with long-term trends.

In 2012, CRU continued to provide strong leadership in research to support Interior trust species and habitats, such as migratory birds and threatened and endangered fish and wildlife. CRU is developing new collaborations in science-based decisionmaking, and continues to support technical assistance and outreach to State cooperators to solve natural resource problems using structured decisionmaking and adaptive management. CRU provided science and research support to State fish and wildlife agencies faced with the emerging and complex challenge of climate change and the predicted effects on State wildlife resources.

The CRU advanced plans to restore science capacity through 2012 by rehiring research scientists with an increase in 2010. CRU has consistently invested over 90 percent of program funding in scientists salaries, with all funding for research projects supplied by program partners. Therefore, improvements in program performance in the form of increased publications, presentations, courses taught, and other product-oriented elements of scientific outreach will occur over the subsequent years after science staff are hired and initiate their research programs. Reinvesting in science capacity to staff vacant Unit positions has a direct and near immediate benefit in improving the number of students the program can support, with an attendant 15–20 percent increase in numbers of M.S. and PhD students graduated within 5–7 years.

Activity: Climate and Land Use Change

		2013 Full Yr. CR (PL 112-175)	2012 Enacted	2014 Fixed Costs and Related Changes (+/-)	2014 Program Changes	2014 Internal Transfer	2014 Budget Request	Change from 2012 Enacted (+/-)
Climate Variability								
National Climate Change & Wildlife Science Center/DOI		*25,198*	25,198	160	9,934	0	35,292	10,094
Climate Science Centers ($000)	FTE	*48*	48	0	9	0	57	9
Climate Research and Development ($000)		*21,759*	21,759	341	3,010	0	25,110	3,351
	FTE	*133*	133	0	10	0	143	10
Carbon Sequestration ($000)		*8,874*	8,874	80	2,385	0	11,339	2,465
	FTE	*39*	39	0	4	0	43	4
Science Support for DOI Bureaus		*2,358*	2,358	8	-8	-2,358	0	-2,358
	FTE	*12*	12	0	0	-12	0	-12
Subtotal: Climate Variability ($000)		***58,189***	**58,189**	**589**	**15,321**	**-2,358**	**71,741**	**13,552**
	FTE	***232***	**232**	**0**	**23**	**-12**	**243**	**11**
Land Use Change								
Land Remote Sensing ($000)		*72,077*	72,077	296	-1,729	0	70,644	-1,433
	FTE	*163*	163	0	-2	0	161	-2
Land Change Science ($000)		*11,273*	11,137	160	2,310	0	13,607	2,470
	FTE	*67*	67	0	10	0	77	10
Subtotal: Land Use Change ($000)		***83,350***	**83,214**	**456**	**581**	**0**	**84,251**	**1,037**
	FTE	***230***	**230**	**0**	**8**	**0**	**238**	**8**
Total Requirements ($000)		***141,539***	**141,403**	**1,045**	**15,902**	**-2,358**	**155,992**	**14,589**
	Total FTE	***462***	**462**	**0**	**31**	**-12**	**481**	**19**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Summary of Program Changes

Request Component	($000)	FTE	Page
Subtotal: Climate Variability	**12,963**	**11**	
National Climate Change and Wildlife Science Center/DOI Climate Science Centers (CSC)	**9,934**	**9**	
Climate Adaptation and Resiliency - Vulnerability Assessment Database & Field Guide	800	0	B-16
Interagency Coordination	3,223	6	B-16
Translational Science Grants	3,500	3	B-16
Tribal Climate Science Partnerships	2,500	0	B-16
General Program Reduction	-89		B-64
Climate Research & Development	**3,010**	**10**	
Emerging Science needs	3,172	10	B-16
General Program Reduction	-162		B-64
Carbon Sequestration	**2,385**	**4**	
Biological Carbon Sequestration	2,958	5	B-16
Geologic Carbon Sequestration	-532	-1	B-57
General Program Reduction	-41		B-64
Science Support for DOI Bureaus	**-2,366**	**-12**	
Internal Transfer to Environments Program	-2,358	-12	B-67
General Program Reduction	-8		B-64
Subtotal: Land Use Change	**581**	**8**	
Land Remote Sensing	**-1,729**	**-2**	
National Civil Applications Program/Civil Applications Committee	-576	-2	B-57
North American Data Buy	-1,000	0	B-57
General Program Reduction	-153		B-64
Land Change Science	**2,310**	**10**	
Ecosystem Priority: Chesapeake Bay	500	2	B-20
Ecosystem Priority: Land Use Science	1,000	4	B-20
Rapid Disaster Response: Scenarios and Crisis Response	757	4	B-44
WaterSMART	136	0	B-7
General Program Reduction	-83	0	B-64
Total Program Change	**13,544**	**19**	

** Estimated changes in FTEs compare against actual 2012 FTE usage, not 2012 enacted formulation estimates.

Justification of Program Changes

The 2014 Budget Request for Climate and Land Use Change (CLU) is $155,992,000 and 481 FTE, a net program change of +$14,589,000 and +19 FTE from the 2012 Enacted Budget. For more information on the CLU Mission Area changes, please see Section B, Program Changes as indicated in the table.

Activity Summary

The U.S. Geological Survey (USGS) holds a leadership role in providing critical science needed to inform resource managers' strategies for mitigating and adapting to climate change. In particular, the CLU Mission Area is uniquely positioned to serve the Nation's needs in understanding and responding to climate change, including its impacts on fish, wildlife, and ecological processes, changes in sea level rise, and land use and land cover change. The CLU Mission Area works with science partners, decisionmakers, resource managers, and Native American tribes at local to national scales. The CLU Mission Area's core mission is to improve the understanding of past and present change and to identify those lands, natural resources, and communities most vulnerable to climate change processes.

The science needed for improved understanding of, adaptation to, and mitigation of climate change is a top priority for the Administration and the Department of the Interior (Interior). The CLU Mission Area has responsibility for:

- National Climate Change and Wildlife Science Center (NCCWSC)/Department of the Interior Climate Science Centers (CSCs) (*http://nccwsc.usgs.gov/*);
- Climate Research and Development (R&D, *http://gcp.usgs.gov/rd/*);
- Carbon Sequestration (Biological: *http://www.usgs.gov/climate_landuse/land_carbon/;* Geologic: *http://energy.usgs.gov/HealthEnvironment/EnergyProductionUse/GeologicCO2Sequestration.aspx);*
- Land Remote Sensing (LRS, *http://remotesensing.usgs.gov/*); and
- Land Change Science (LCS, formerly Geographic Analysis and Monitoring) *http://gam.usgs.gov/*).

The CLU Mission Area supports the following Interior 2011 – 2016 Strategic Plan goals: (1) Identify and model causes and impacts of changes to the Earth and ocean systems, and (2) Assess and forecast climate change and its effects. The goal of CLU programs is to be a primary provider of science needed for adaptation to and mitigation of the impacts of climate and land use change on Earth and human systems. Policymakers, land, and other resource managers use this information for decisionmaking.

CLU Mission Area projects also support the goals of the U.S. Global Change Research Program (USGCRP) to:

- Advance scientific knowledge of the integrated natural and human components of the Earth system;
- Provide the scientific basis to inform and enable timely decisions on adaptation and mitigation;
- Build sustained assessment capacity that improves the Nation's ability to understand, anticipate, and respond to global change impacts and vulnerabilities; and
- Advance communications and education to broaden public understanding of global change, and empower the workforce of the future.

The *USGS Climate and Land Use Change Science Strategy: A Framework of Understanding and Responding to Global Change* will be released in 2013. The plan outlines seven broad goals for USGS climate change science for the coming decade:

1. Rates, causes, and impacts of past global changes;
2. The global carbon cycle;
3. Biogeochemical cycles and their coupled interactions;
4. Land use and land cover change rates, causes and consequences;
5. Droughts, floods, and water availability under changing land use and climatic conditions;
6. Coastal response to sea-level rise, climatic change and human development; and
7. Biological responses to global change.

Federal law requires the USGCRP to submit an assessment of climate change and its impacts (the U.S. National Climate Assessment, NCA) to the President and Congress once every four years. In 2012 and 2013, several CLU scientists led or co-led teams that wrote reports, articles, and books that underpin chapters of the third NCA. The CLU-led reports focused on coastal impacts, adaption, and vulnerabilities; global sea level rise; biodiversity, ecosystems, and ecosystem services; and land use/land cover change. An NCA synthesis report will be published in 2014. In addition to the NCA, several CLU scientists served as lead authors of the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). All of the IPCC AR5 products are scheduled for completion in 2014.

In 2012, the NCCWSC/CSC Program completed the establishment of the network of eight CSCs (Alaska, Northwest, Southeast, South Central, North Central, Northeast, Southwest, and Pacific Islands). The CSCs provide scientific information and tools to regional natural and cultural resources managers as they plan for climate change and increased climate variability. Each CSC is a joint Federal-university collaboration, guided by science priorities identified by regional resource managers.

Also in 2012, the geologic carbon sequestration project completed a review of U.S. sedimentary basins and geologic characterization of more than 200 potential storage formations for carbon dioxide sequestration. Data made available from cooperative agreements with 33 State geological surveys and universities were incorporated into the geologic models developed for the potential storage formations. The biological carbon sequestration project issued a study of carbon storage and sequestration in the Western U.S. in December 2012, the second in a series of studies mandated by Congress comprising a national assessment of carbon storage and sequestration capacities by ecosystems. The Western U.S. sequestration study confirms the important role that the Nation's natural landscapes have in absorbing carbon and helping to counter-balance the Nation's carbon emissions.

Finally, the USGS and the National Aeronautics and Space Administration (NASA) celebrated the 40th Anniversary of Landsat on July 23, 2012. The USGS-managed Landsat archive is the largest archive of remotely sensed land data in the world, supplying free and open access to current and historical images. USGS Landsat activity is led and funded through the LRS Program.

Mission Area 4: Provide a Scientific Foundation for Decisionmaking
Goal #2: Provide Science for Sustainable Resource Use, Protection, and Adaptive Management
Strategy #2: Identify and Model Causes and Impacts of Changes to the Earth and Ocean Systems

Strategic Plan Performance Measures	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Target	2012 Actual	2013 Target	2014 Target	2008 - 2014 Trend
Strategy #2: Identify and Model Causes and Impacts of Changes to the Earth and Ocean Systems										
Percent of U.S. surface area with contemporary land cover data needed for major environmental monitoring and assessment programs (Land Change Science Program)	USGS	99%	46%	95%	100%	15%	15%	59.9%	98.0%	
		298	213	440	463	69	70	272	445	
		300	463	463	463	463	454	454	454	

Supporting Performance Measures

Outputs, Supporting Performance Measures, and/or Milestones	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Plan	2012 Actual	2013 Plan	2014 Plan
Number of terabytes managed cumulatively (Land Remote Sensing)	USGS	3,840.60	3,010.90	2,873.40	3,723.00	4,734.00	5,073.20	6,655.10	8,510.60
# of remote sensing products distributed (LRS)	USGS	417,029	3,127,040	5,600,000	4,710,757	4,852,080	5,923,825	6,101,540	6,284,568
Percent of critical milestones successfully reached to support the Landsat 8 (LDCM) launch schedule (LRS)	USGS	35% 8/23	52% 12/23	70% 16/23	67% 16/24	83% 19/23	83% 19/23	100% 23/23	NA
NASA successfully lauched Landsat 8 on February 11, 2013. The USGS will not assume ownership of Landsat 8 until a post-launch review is finished by NASA; estimated to be spring 2013.									
Number of systematic analyses and investigations completed (Land Use Change)	USGS	93	90	79	92	85	84	82	82

Mission Area 4: Provide a Scientific Foundation for Decisionmaking
Goal #2: Provide Science for Sustainable Resource Use, Protection, and Adaptive Management
Strategy #3: Assess and Forecast Climate Change and Its Effects

Strategic Plan Performance Measures	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Target	2012 Actual	2013 Target	2014 Target	2008 - 2014 Trend
Strategy #3: Assess and Forecast Climate Change and Its Effects										
Number of fish and wildlife climate based habitat and population models developed by scientists and in cooperation with land managers (Climate)	USGS	Baseline Not Established	1	3	6	10	16	18	20	

Supporting Performance Measures

Outputs, Supporting Performance Measures, and/or Milestones	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Plan	2012 Actual	2013 Plan	2014 Plan
Number of DOI Climate Science Centers formed (Priority Goal)	USGS	NA	NA	3	5	8	8	NA	NA
In 2012, the NCCWSC/CSC Program completed the establishment of the network of eight CSCs (Alaska, Northwest, Southeast, South Central, North Central, Northeast, Southwest, and Pacific Islands). This performance measure will be phased out after the 2014 Greenbook.									
Number of DOI Climate Science Center research priority documents completed (Priority Goal)	USGS	NA	NA	NA	3	8	7	8	NA
The delay in completing this performance measure is due to a delay in hiring CSC Directors.									
Percent of climate research and development studies of which interpretive and synthesis products are cited by partners and users within three years of study completion (R&D)	USGS	NA	NA	NA	80%	80%	92.2%	90%	90%
Percent of targeted land cover trends national assessment syntheses, research plans, or science strategies that are published (R&D)	USGS	NA	20% 1/5	40% 2/5	60% 3/5	100% 5/5	100% 5/5	NA	NA
This performance measure will be phased out after the 2014 Greenbook.									
Percent of the baseline, reference projection, and mitigation evaluation units completed for a national biological carbon sequestration assessment (Bio Carbon)	USGS	NA	NA	NA	14% 45/330	64% 210/330	40% 120/300	75% 225/300	100% 300/300
In 2013, the biological carbon sequestration project will complete and publish the quantitative, probabilistic assessments of the national potential for the conterminous U.S. In 2014, the project would complete the Alaska and Hawaii assessments.									
Number of systematic analyses and investigations completed (Climate Variability)	USGS	7	93	121	130	100	177	137	148
Number of masters' and doctoral level students supported at CSC consortium universities (NCCWSC/CSC)	USGS	NA	NA	NA	NA	NA	NA	Baseline is 20 for 2013	30

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Activity: Climate and Land Use Change
Subactivity: Climate Variability
Program Element: National Climate Change and Wildlife Science Center/ Department of the Interior Climate Science Centers

2012 Actual: $25.2 million (48 FTE)
2013 CR: $25.2 million (48 FTE)
2014 Request: $35.3 million (57 FTE)

Overview

Natural and cultural resource managers require scientific information about the potential effects of changing climate, and approaches to adapting to those effects. The NCCWSC and the network of eight CSCs work with these natural and cultural resource managers to identify and deliver high quality, integrated and efficiently-implemented science that meets their needs. Having completed a crucial development phase, the NCCWSC and the CSCs are now taking steps to increase the efficiency, integration, and effectiveness of operations.

The NCCWSC/CSC Program is closely linked to the USGS and other Federal science capabilities and initiatives, and consists of Federal-university research centers, with strong input from stakeholders regarding their high priority science needs. The initial phase of CSC startup will be completed in 2013, with basic operations and staffing in place for all eight CSCs. Each CSC has established mechanisms for identifying priority science needs and for initiating and overseeing research and other scientific activities to respond to those needs.

Each CSC is creating a five-year strategic plan that outlines science priorities. By the end of 2013, all eight CSCs will have completed an initial five-year strategic plan, with input provided by the Department of the Interior Landscape Conservation Cooperatives (LCC), CSC Stakeholder Advisory Committees (SAC), and other partners. The CSCs will increase their focus on high priority climate science that identifies potential impacts to fish, wildlife, and their habitats. In addition, a draft national-scale science plan has been developed by the NCCWSC, based on the eight CSCs plans. This national-scale plan will be the subject of additional development upon review by the Advisory Committee on Climate Change and Natural Resource Science (ACCCNRS), a new Federal Advisory Committee established by Interior to provide input to the NCCWSC and the CSCs.

Work in the CSCs builds upon and provides information for other key components in the CLU Mission Area. The development of long term historical paleoclimate records, funded by the Climate R&D Program, provides the key underpinnings for much of the actionable science supports that projects in the CSCs will provide. Results from geological records produced by the Climate R&D Program are used to understand and build models that produce forecasts of possible impacts of future climate change. Additionally, integrated modeling projects (such as the Integrated Ecosystem Model being produced in Alaska) provide a basis for understanding carbon storage potential (now under development by the USGS biological carbon sequestration assessment project). Further, the integrated models created that will be used to predict impacts of drought and wildfire on vegetation patterns can also be used to forecast potential changes in carbon storage.

The NCCWSC/CSC Program is a new approach for the way science is planned, conducted, and delivered to decisionmakers. Upon the completion of the initial phase of the CSC startup in 2013, with operations and staffing in place for all eight CSCs, the program has begun to provide resource management agencies with science and technical support on the impacts of climate change on fish, wildlife, and ecological

processes. Overall, the CSCs' main goal is to provide actionable science that can be used for adaptation planning. For example, the CSCs fund science like the Alaska Integrated Ecosystem Model, which is developing approaches to forecast climate impacts on changes in wildfire, habitat, hydrology and permafrost. The Alaska Integrated Ecosystem Model is a science partnership between investigators at the USGS and in the University of Alaska-Fairbanks. The Alaska CSC works with partners to provide outputs of these forecasts for use in adaptation planning for species and ecosystems in Alaska. With the addition of new funding in 2014, the program would expand tribal climate science partnerships, provide dedicated grant and technical assistance funding to address tribal adaptation and climate-resource management concerns, and integrate traditional ecological knowledge systems into science and funding opportunities. This work will be conducted in partnership with tribes, tribal consortia and organizations, the Bureau of Indian Affairs climate programs, as well as other Interior and Federal climate efforts in Indian Country. The program would continue to focus on the interagency coordination of climate change science to help eliminate redundancy and improve the use of existing climate change information. This would require the NCCWSC to track climate change adaptation science across multiple Federal agencies, and the CSCs to work with regional partners to identify and develop multi-agency strategies on common priorities. As part of this coordination effort, the NCCWSC would develop a public database and field guide to help Interior and other Federal, tribal, State, and local agencies create standards and best practices for vulnerability assessments. The CSCs would also provide increased funding for translational science grants to support adaptation planning and pilots, with a focus on meeting the needs of specific decisions and planning activities, and on delivering application-ready information.

Program Performance

Post Developmental Stage: Focusing on Funding Science: Even though the initial development phase of the CSCs was completed in 2013, the NCCWSC began funding meaningful science in 2009, and these early investments are generating useful and important results. Work completed in 2012 and 2013 included data on how sea level rise affects habitats for federally protected species in the San Francisco Bay complex and in islands in the recently-created Papahānaumokuākea Marine National Monument in the Pacific. These studies will help identify management strategies for use in the adaptation of sea level rise. A second example is research that projected how climate-related drought, wildfire and other factors will affect native trout and other salmonid fish in the Rocky Mountains. This project information will help others to manage these rare and declining populations. Another science project is the development of a scientific infrastructure and GeoData portal to enable researchers to easily share and combine their data. The GeoData portal facilitates access to very large datasets and can directly translate datasets prepared in very different formats and content structures. The GeoData portal is used to coordinate and provide access to many types of climate data. Based on a growing record of consultation with regional management partners, the CSCs plan to expand their scientific activities to meet high priority research and information needs in 2014. The CSCs would develop broad multi-CSC initiatives to address wide-ranging topics such as sea level rise impacts and the effects of extended drought on ecosystems. These activities would help to ensure that CSC science is tightly linked with specific decisions and management needs.

Strategic Science Goals: As the NCCWSC and the CSCs continue to mature, the development of a series of strategic scientific goals and associated products will be important. These strategic science goals, or endpoints, are based on the long-term strategic science plans developed for each of the CSCs as well as input from Interior and other partners engaged in the SACs. In 2014, the NCCWSC and the CSCs would expand upon work begun in 2013 with the Climate R&D program to assess the vulnerability of coastal fish, wildlife, and habitats to the impacts of sea level rise; identify climate impacts on fish and wildlife species (building upon the work completed by the NCCWSC on climate impacts to biodiversity, ecosystems and ecosystem services); and develop improved approaches for using downscaled climate model output to determine the impacts to natural resources. Much of this work would build upon the

series of projects initially funded by the NCCWSC from 2009-2012 and would add value to new strategic research approaches. Each of these projects is designed to feed directly into decision and policy discussions, allowing managers to weigh possible impacts to resources when developing adaptation plans.

Integrated model to understand effects across ecosystems: One of the critical components of the CSCs is the linkages to other USGS programs as well as an extensive research network available in the partner universities. Given the breadth of scientific expertise now available, the CSCs are working across broad geographic scales to understand climate impacts across multiple parts of the ecosystems (including effects on fish, wildlife, and their habitats). These efforts build upon both the Alaska Integrated Modeling, which examines potential impacts of climate change on wildfire regimes, water cycles, and permafrost in Alaska, and the Southeast Regional Assessment, which examined impacts to both terrestrial and aquatic systems (and the species within). In 2012, the Northwest CSC started a project to coordinate and bring together integrated scenarios of potential climate impacts to various components of Northwest ecosystems. Once completed in 2014, managers would have access to a variety of tools that allow them to understand potential impacts and develop "what if" scenarios, which would improve long term adaptation planning.

National and Regional Focus on "Ecological Drought": In 2014, the NCCWSC and the CSCs would undertake a strategic science initiative to address the issue of ecological drought, including national, cross-regional, and individual CSC-scale activities. An "ecological drought" refers to effects on ecosystems and their components as a consequence of long term drought. Understanding the effects and mechanisms of long term drought on ecosystems is crucial, as there are strong indications that in the future, 'megadroughts' may occur more frequently in the United States. Because previous drought research focused largely on human and agricultural impacts, there is a dearth of basic and applied understanding of questions such as what causes trees to die in prolonged drought. This activity would also demonstrate the NCCWSC/CSC network's ability to integrate research and science delivery across multiple spatial scales (i.e. individual CSC region, across multiple CSCs, and nationally).

Training for the Future: The next generation of fish and wildlife managers must possess the skill to work with professionals from other scientific disciplines. The CSCs continue their baseline work of educating the next generation of multi-disciplinary scientist-managers, with approximately 64 graduate students and post-doctoral researchers who work on CSC science priorities. In 2014, the NCCWSC/CSC Program would continue to provide training in climate science and impacts across the CSC network and provide a source of talented, trained students to become the next generation of Interior resource managers.

National Climate Change and Wildlife Science Center
(Estimates for 2012, $4.5 million; 2013, $4.5 million; 2014, $7.6 million)

The NCCWSC manages the operations of the eight CSCs, and leads additional research and assessment activities related to climate impacts on fish, wildlife and their habitats. For example, in 2012, NCCWSC scientists completed a national assessment of the impacts of climate change on ecosystems, biodiversity, and ecosystem services, as a component of the NAC.

Department of the Interior Climate Science Centers
(Estimates for 2012, $20.7 million; 2013, $20.7 million; 2014, $27.7 million)

The eight CSCs were established between 2010 and 2012 to provide information needed by natural and cultural resource managers to identify and adapt to a changing climate. Each is a Federal-university collaboration, and develops a science portfolio in consultation with regional resource managers and science partners. The locations and host institutions of each of the eight CSCs are listed below.

DOI CSC (date established)	**Host Institution**
Alaska (2010)	University of Alaska
Northwest (2010)	Multi-institution consortium headed by Oregon State University
Southeast (2010)	North Carolina State University
Southwest (2011)	Multi-institution consortium headed by University of Arizona
North Central (2011)	Multi-institution consortium headed by Colorado State University
South Central (2012)	Multi-institution consortium headed by University of Oklahoma
Northeast (2012)	Multi-institution consortium headed by University of Massachusetts, Amherst
Pacific Islands (2012)	Multi-institution consortium headed by University of Hawaii, Manoa

Activity: Climate and Land Use Change
Subactivity: Climate Variability
Program Element: Climate Research and Development Program

2012 Actual: $21.8 million (133 FTE)
2013 CR: $21.8 million (133 FTE)
2014 Request: $25.1 million (143 FTE)

Overview

Climate R&D Program research is designed to advance the understanding of the physical, chemical, and biological components of the Earth system, the causes and consequences of climate and land use change, and the vulnerability and resilience of the Earth system to such changes. Climate R&D Program researchers draw on expertise in past climate, geology, hydrology, geography, and biology to document patterns of climate and land use change on daily to millennial timescales and assess and model the impacts of changes on local, regional, and national spatial scales. This research provides the basic data needed to understand the rates and patterns of Earth system response to a range of climate and land use changes. Integration of these data with modeling efforts provides a means to improve the understanding of the impacts of change and feedbacks between the Earth and climate systems. Climate R&D Program data contributions improve model performance and our ability to forecast likely changes under a range of climate and land use scenarios.

Climate R&D Program activities are planned and conducted over five year increments to address specific research questions. This strategy provides sufficient time and stability for projects to accomplish their stated goals and produce products and outcomes. It also provides the Climate R&D Program with the flexibility to address emerging critical issues (such as hydrologic extremes of drought and flooding) by coordinating among existing areas of expertise to establish appropriate research teams. Climate R&D Program activities are routinely reviewed by a program council of subject matter experts to ensure adequate progress is being made to achieve the stated goals and allows for modification of objectives as appropriate. Climate R&D Program research supports national and international efforts to understand climate change, such as the U.S. NAC, the USGCRP Strategic Plan process, and the IPCC.

The Climate R&D Program continues to fund climate change research needed to understand patterns of climate and land use change and their impacts on the Earth system. In 2013, the program will focus on multidisciplinary research and modeling efforts in key habitats, including wetlands, mountains, and coastal areas that will increase the understanding of the impacts of climate and land use change. In 2014, the Climate R&D Program would focus efforts on emerging science needs that would improve understanding of regional responses to climate and land use change as well as provide estimates of future climate and land use changes. These emerging science needs include: the identification of long term patterns of drought, including interactions with ocean circulation; using geologic records to improve estimates of potential magnitudes and ranges of sea level rise; coastal ecosystem response to changing sea level; and application of process-based research to resource management issues.

Program Performance

Documenting Historical Levels of Climate Variability on Regional to National Scales: The USGS has a long history of paleoclimate research. In 2011, the Climate R&D Program began a new initiative to establish historical North American climate baselines based on paleoclimate and instrumental records. In 2013 and 2014, the Climate R&D Program plans to expand these efforts by creating a nationwide network of paleoclimate research sites with sufficient temporal resolution to understand long term patterns of variability in temperature and moisture availability. These records would provide critical evidence to understand regional to continental climate patterns on multidecadal to millennial timescales and improve the USGS's capability to model climate changes and impacts on the Earth system. These long-term baselines provide a context to evaluate impacts of human-induced change to the system and can inform resource managers how specific systems respond to climate and environmental stressors. Such studies would contribute to planned efforts to improve our understanding of long-term patterns of drought, storms, sea level rise, and ocean circulation. Regional syntheses of natural climate variability would improve our understanding of the influences of atmospheric and ocean processes on the Nation. Such data are critical to improve our capabilities to forecast impacts of different climate and land use scenarios across North America. Climate R&D Program scientists are collaborating with researchers in other Federal, State, local, international, and academic institutions to expand the coverage of the network starting in 2014.

Improve the understanding of how climate and land use change influences the processes that control fluxes of carbon and greenhouse gases: New research is needed to improve the understanding of the processes that influence fluxes of carbon and greenhouse gases (GHGs). The Climate R&D Program began coordination meetings among carbon researchers in 2013 with the goal of developing multidisciplinary projects to better understand how natural and anthropogenic processes influence the storage and stabilization of carbon in soils and sediments. New projects in 2014 would leverage USGS expertise in soil science, biogeochemistry, surficial geology, paleoclimate, ecology, microbiology, and hydrology to understand biogeochemical cycling in critical habitats, including coastal wetlands that are susceptible to sea level rise.

Increase the understanding of the impacts of climate and land use change on our Nation's ecosystems: Climate R&D Program research uses a combination of process-based research and monitoring to document past ecosystem variability and model potential ecosystem response to different climate and environmental stressors. In 2013 and 2014, Climate R&D Program researchers plan to focus on multidisciplinary research and modeling efforts in key habitats that include wetlands, mountains, and coastal areas. The new projects would focus on energy and nutrient flow through ecosystems over long timescales and would record the impacts of both natural climate variability and land cover change. This research would provide evidence on how processes critical to the health of the Nation – such as carbon sequestration, water table recharge, and nutrient filtration – respond to different climate and environmental changes. Collaborative planning between Climate R&D Program researchers, the CSCs, resource managers, and policymakers will help managers develop sustainable management policies for key habitats across the Nation.

Climate R&D Program research is broken out into eight focus areas: abrupt climate change; carbon cycle; climate data and model integration; documenting patterns and magnitudes of natural climate variability; hydrologic extremes (patterns, causes, and impacts); impacts of climate and land use change on terrestrial and marine systems; rates, causes, and consequences of land use and land cover change; and sea level rise and coastal regions. Descriptions of each focus area can be found below.

Abrupt Climate Change: Abrupt climate changes are defined as large-scale changes in the climate system that occur over a few decades or less, persist (or are expected to persist) for at least a few decades,

and cause substantial disruptions in human and natural systems. The study of past abrupt changes, preserved in fossil records of past climate, provides important evidence on impacts of events that were so rapid and large that recurrence would pose significant risks for society. For example, Climate R&D Program research on ice core records from the West Antarctic Ice Sheet documents the consequences of a warmer climate on ice sheets and improves our understanding of the potential magnitude, rate, and timing of sea level rise in a global warming scenario.

Carbon Cycle: An important question in climate research involves how the carbon cycle is affected by natural climate variability and human changes to the environment. Changes to the carbon cycle are important drivers of climate and land use change, and also a primary source of uncertainty in projecting future climate and land use trends. Climate R&D Program research focuses on understanding the processes that impact carbon flux, including studying the very large soil carbon stocks in the northern latitudes to assess the vulnerability of stocks to climate fluctuations such as rapid warming.

Climate Data and Model Integration: Climate models based on physical data are continually improving their ability to simulate current and past climates, which in turn improves their prediction of future climate changes. Because climate changes during the last few decades of instrumental modeling are modest compared to those of the geologic past, it is important to determine whether the models can simulate climate conditions much different from today. Climate R&D Program research tests climate model simulations with geologic data to evaluate the ability of models to reproduce known past changes and to improve model projections of the future.

Documenting Patterns and Magnitudes of Natural Climate Variability: An important question in climate change research is whether we can distinguish the human fingerprint on climate from natural climate variability. Climate R&D Program research uses paleoclimate records from North America and adjacent oceans to develop long-term records of variability due to natural climate processes as a context to examine observed trends of the last century. For example, Climate R&D Program researchers conducted an analysis of past sea ice extent using paleoclimate data from Arctic Ocean sediments. This effort is improving the USGS's understanding of patterns and causes of Arctic climate variability and shedding light on possible impacts of future climate change. Such records provide resource managers and decisionmakers with results of natural climate experiments, their impacts on ecosystems and species, and their implications for policies on energy, transportation, and other societal issues.

Hydrologic Extremes: Patterns, Causes, and Impacts: Water can pose significant hazards through droughts, flooding, and landslides. Water and hydrologic processes also have strong and complex interactions with the carbon cycle, sediment and nutrient transport, and the structure and function of terrestrial, estuarine, and marine ecosystems. Climate R&D Program research integrates observational records of precipitation and streamflow with paleo-reconstructions of past hydrology and modeling of the hydrologic system to assess patterns of hydrologic variability and its impacts on local to continental scales. One aspect of this research combines real-time measurements of stream flow and water quality with historic records to understand the processes that influence water and biogeochemical cycling in key watersheds. This research dovetails with geologic studies that examine the physical evidence of past regional droughts, providing a better understanding of the historical magnitude and duration of such events in North America.

Impacts of Climate and Land Use Change on Terrestrial and Marine Systems: Climate and land use changes affect ecosystems on timescales ranging from days to centuries. The Climate R&D Program research examines the processes that cause shifts in ecosystem structure and persistence using biological, geological, and hydrological evidence to improve understanding of ecosystem response and modeling capabilities. For example, Climate R&D Program research includes the examination of the response of coastal marshes and forests to sea level rise over annual to centennial timescales. Results of this research

provide data on the consequences of such changes for carbon and nutrient cycling, and the vulnerability of coastal wetlands to change over annual to centennial timescales.

Rates, Causes, and Consequences of Land Use and Land Cover Change: Changes in land cover have substantial impacts on hydrology, biogeochemical cycling, and water quality, and resulting changes in biophysical parameters also influence local and regional climate. Climate R&D Program research uses remote sensing evidence to document patterns and consequences of land cover change on ecosystem health, climate variability, biogeochemical cycles, and hydrology. This research also seeks to understand how land surface changes affect regional climate through feedback mechanisms.

Sea Level Rise and Coastal Regions: Because a large percentage of the world's population lives along a coastline at or near sea level, even small increases in sea level can have significant societal and economic impacts through increased coastal erosion, susceptibility to storm surges, saltwater intrusion into groundwater, loss of coastal wetlands, and stresses on ecosystems and community infrastructure. Uncertainties on potential contributions of melting ice sheets to sea level limit our capacity to accurately model future sea level. The Climate R&D Program addresses these uncertainties by using geologic records of sea level to document how large ice sheets responded to past warm periods. It also uses studies of the amount of water contained in alpine glaciers to evaluate their potential contribution to sea level rise. These efforts are complemented by ecological research that quantifies the response of coastal vegetation and habitats to sea level rise. These studies provide resource managers with evidence on potential rates and magnitudes of sea level rise that are needed to develop sustainable restoration and mitigation strategies for coastal regions.

Activity: Climate and Land Use Change
Subactivity: Climate Variability
Program Element: Carbon Sequestration

2012 Actual: $8.9 million (39 FTE)
2013 CR: $8.9 million (39 FTE)
2014 Request: $11.3 million (43 FTE)

Overview

Carbon sequestration is a method of securing carbon dioxide (CO_2) to prevent its release to the atmosphere and its contribution to global warming as a GHG. Geologic storage of CO_2 in porous and permeable rocks involves injecting high pressure CO_2 into a subsurface rock unit and displacing the fluid that initially occupied the pore space. Biological carbon sequestration refers to both natural and deliberate processes by which CO_2 is removed from the atmosphere and stored as carbon in vegetation, soils and sediments. The Energy Independence and Security Act (EISA) of 2007 (P.L. 110-140) called for the USGS to develop a methodology for and then complete a national assessment of geologic storage capacity for CO_2. The legislation also required the Secretary of Interior to complete a quantitative national assessment of the carbon stored in and released from ecosystems.

In 2013, the Carbon Sequestration Program will complete and publish the quantitative, probabilistic assessments of the national potential for geologic carbon sequestration and of the conterminous United States for biological carbon sequestration. In 2014, the biological carbon sequestration project would complete the Alaska and Hawaii assessments. In addition, the biological carbon sequestration project would use new funding for research needed to improve methods and models for accounting and monitoring carbon in ecosystems, quantifying interactions between carbon storage, land use, and climate change. The biological carbon sequestration project would also link the national biological carbon sequestration assessment results to land management applications in the U.S. Fish and Wildlife Service (FWS) and the National Park Service (NPS). This work would be accomplished through the development of decision support tools based on models, workshops and experiments. This ultimately will enable land and resource managers to effectively assess utilize management options to achieve net reductions in atmospheric carbon.

Geologic Carbon Sequestration
(Estimates for 2012, $4.4 million; 2013, $4.4 million; 2014, $3.9 million)

In 2010, the USGS published the assessment methodology to estimate carbon sequestration storage potential suitable for uniform application to geologic formations throughout the United States. The USGS methodology, a unique, robust approach to assessing the CO_2 storage potential of individual storage assessment units in the sedimentary basins of the United States, is a geology-based, probabilistic methodology. The USGS methodology will serve as a base international standard for global geologic carbon sequestration potential.

In 2013, activities focused on the completion and publication of the geologic national assessment results (currently scheduled for publication in 2013). Additional scientific reports that describe the geologic models that form the basis of the national assessment were finalized. In order to understand the impacts of the processes involved in geologic carbon sequestration as well as to improve future assessments, research continued on the controls of carbon sequestration. In addition, research activities continued on the identification of the controls on storage capacity, factors associated with enhanced oil and gas recovery and CO_2 storage potential, issues related to storage of CO_2 in unconventional reservoirs

(primarily coal), and the potential impacts of induced seismicity on storage of CO_2. Collaborative efforts were continued with State Geological Surveys, universities, and the U.S. Department of Energy (DOE) National Energy Technology Laboratories Regional Carbon Sequestration Partnerships.

In 2014, the geologic carbon sequestration project plans to continue research on carbon sequestration and collaborate with universities and State, Federal, and tribal agencies. For example, the EISA authorized the USGS to estimate the "potential volumes of oil and gas recoverable by injection and sequestration of industrial carbon dioxide in potential sequestration formations." There are significant gaps in the understanding about which oil and gas reservoirs are suitable for enhanced oil recovery operations. The USGS plans to finalize the assessment methodology for assessing the technically recoverable hydrocarbons resulting from carbon sequestration associated with enhanced oil/gas recovery (EOR) in 2014. Once the methodology is complete, the USGS would start a three-year national assessment of technically recoverable hydrocarbons resulting from CO_2-EOR. The USGS would also use the existing USGS natural gas assessment methodology to assess the availability of recoverable natural CO_2 for use in enhanced oil recovery. The national resources of recoverable natural CO_2 are unknown and would be used along with anthropogenic CO_2 for enhanced hydrocarbon recovery. The USGS plans to develop economic assessment methodologies to evaluate the results of the 2013 national geologic carbon sequestration assessment, and the national assessment of technically recoverable hydrocarbons resulting from carbon sequestration associated with EOR.

The EISA instructs the USGS, DOE, and other agencies to coordinate efforts to conduct research related to geologic carbon sequestration. The USGS has unique and specific expertise to understanding the injection of CO_2 into saline formations, as well as provide baseline information in order to understand potential seismicity induced by sequestration activities. A U.S. National Research Council (2012) report recommended that the USGS work with other government and private agencies to collect new data to better understand the risks associated with injection of CO_2 into deep brine aquifers. The USGS is currently investigating the possible causes of induced seismicity that are related to the subsurface injection of fluid CO_2 and plan to continue this work in 2014. The research team is coordinating with ongoing CO_2 injection projects funded by the DOE, to monitor and study the potential for induced seismicity related to CO_2 injection.

Finally, the USGS in 2014 would continue to conduct focused detailed geologic studies of reservoirs and seals in selected basins with high potential for carbon sequestration or that have demonstrated capacity to trap naturally occurring CO_2. Significant additional information is needed on these geological parameters to ensure safe and long-term storage of CO_2. Research would also include characterizing variations in reservoir temperature and pressures related to CO_2 injectivity and storage. The USGS would also investigate the effects of subsurface CO_2 injection on water and rock chemistry for enhanced oil and gas recovery, geologic carbon sequestration, and naturally occurring CO_2 reservoirs. Very little is known about the effects of injecting high pressure, liquid CO_2 into the subsurface and the changes it will cause there.

Biological Carbon Sequestration

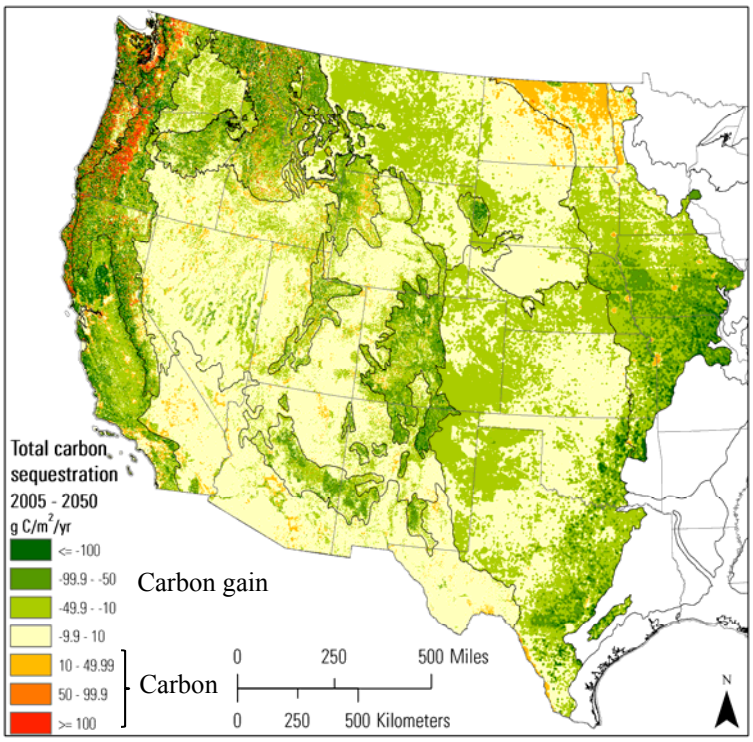
(Estimates for 2012, $4.4 million; 2013, $4.4 million; 2014, $7.4 million)

The USGS released the biological carbon sequestration assessment methodology in 2010. A wide range of stakeholders view this assessment as a major scientific effort to advance knowledge on relationships between ecosystem capacities to store carbon (or ecosystem vulnerability to release carbon into the atmosphere) and natural and anthropogenic processes, particularly land use change, ecosystem disturbances, management practices and climate change. All major ecosystems are included in the assessment, including forests, agricultural lands, grasslands, wetlands, rivers, lakes, and estuaries. By

design, the biological assessment is conducted on a regional basis: Great Plains, Western United States, Eastern United States, Alaska, and Hawaii.

The USGS has completed and delivered two regional assessments: those of the Great Plains in December 2011 and the Western United States in November 2012. The regional assessment results were published in two comprehensive USGS reports (USGS Professional Papers 1787 and 1797, available at *http://pubs.usgs.gov/pp/1787/* and *http://pubs.usgs.gov/pp/1797/*, respectively). In addition, data products (including carbon stock and sequestration estimates, emissions and fluxes in and out of ecosystems, land use change, and wildland fire) covering 4.8 million square kilometers extending from just the west of Mississippi to the Pacific Coast, will be made available to the public in 2013. In addition, the USGS plans to deliver assessment results for the Eastern United States in 2013, thus completing the conterminous United States assessment for biological carbon sequestration.

The Great Plains and Western United States assessments confirmed that both the Great Plains and Western United States are overall "carbon sinks," meaning the ecosystems take up more carbon than they emit. While the Western ecosystems are a greater carbon sink than that of the Great Plains, estimates of carbon sinks and sources, as well as their strengths, are variable across the large geography (see Figure 1 below). On a national scale, the amount of carbon that is currently stored per year in ecosystems of the Great Plains and the Western United States combined is about 8.5 percent of total fossil fuel emissions nationwide.



Total carbon gained or lost, on a per-unit-of-area basis, between 2005 and 2050 for all terrestrial ecosystems. The map shows estimated magnitudes of carbon sinks (gains) and sources (losses) by the ecosystems.

In 2014, to meet the requirements of the EISA and to assess ecosystem carbon sequestration for all 50 States in relation to changes in land use and climate, the USGS would complete an assessment of carbon storage and sequestration, as well as GHG emissions in all ecosystems for Alaska and Hawaii. Specifically, assessment reports as well as journal papers for the conterminous United States, Alaska, and Hawaii would be completed. The publications would quantify carbon stored in the various ecosystems of

the regions studied, GHG emissions from these ecosystems, changes in carbon stocks and GHG emissions, and how land use and climate change drive the changes in carbon stocks and GHG emissions. The ecosystems in which carbon is stored include forests, grasslands and shrublands, agricultural lands, wetlands, rivers, lakes, estuaries, and coastal areas. The assessment reports would also include estimates on the current and projected future potential land use changes, and current and projected future potential wildland fires and their emissions. The USGS would assist users to use data products produced from the assessment by delivering, distributing, and visualizing major data products in digital map format over Internet. Federal, State, tribal, and local agencies, as well as private users, would be able to use the digital map data in combination with their own spatially explicit information for resource management decision making. The USGS plans to continue to develop methods to better measure and monitor carbon stored in ecosystems and changes in carbon storage related to land use change and climate change, including developing methods in areas of remote sensing, land use and land cover change detection, mapping of fire and other natural disturbances, and statistical methods to analyze and scale data from the USGS streamgage network.

Finally, the USGS would add a new focus on bringing the assessment results into the decisionmaking process for use by resource managers, private land owners, and policymakers in 2014. The management of carbon stored in biological reservoirs is important for both the mitigation of climate change and for adaptation to such changes, with decisions about one resource objective affecting other outcomes. While the USGS has developed methods for evaluating biological carbon storage at a regional scale, these methods need refinement to be applicable to a specific site or decision. Natural resource management activities have implications for carbon management, but are hampered by the lack of tools for understanding or incorporating science into decisions about carbon management. The development of an approach that identifies the science basis for carbon management decisions and a process to incorporate science results directly into management planning is essential for effective use of scientific results. The USGS would collaborate with Interior bureaus and other agencies and user communities in using assessment results for land use planning, developing of land management decisions, and other scientific or land-use applications. One example of such an application is a planned collaborative pilot study in which the FWS and the USGS would use the assessment results to understand carbon storage and sequestration as related to refuge management.

Activity: Climate and Land Use Change
Subactivity: Land Use Change
Program Element: Land Remote Sensing Program

2012 Enacted: **$72.1 million (163 FTE)**
2013 CR: **$72.1 million (163 FTE)**
2014 Request: **$70.6 million (161 FTE)**

Overview

The LRS Program collects, interprets, and provides the Nation with information from satellite and airborne instruments. This remote sensing information supports improved water resource management, agriculture, forest monitoring, urban planning, and disaster recovery throughout the world. These data also contribute to the scientific community's understanding of the impacts of, and feedbacks between, land use change and climate change.

The LRS Program provides a comprehensive, permanent, and impartial record of the planet's land surface through the National Satellite Land Remote Sensing Data Archive. The LRS Program supports research on the uses of remotely-sensed data to assess ongoing changes to the Earth's land, land cover, and inland surface waters. The program also provides Federal civil agencies with access to commercial and classified Earth observing assets and supports the development of unclassified, derived information products from these assets.

Since 1972, Landsat satellites have provided the authoritative record of changes to the Earth's land surfaces, at a scale allowing the differentiation between natural and human-induced change. Under the Land Remote Sensing Policy Act of 1992 and Presidential Decision Directive National Science and Technology Council (NSTC)-3, Interior and the USGS shares responsibility for Landsat program management with NASA. Under this successful partnership, NASA develops and launches the Landsat satellites while the USGS develops the associated ground systems. Following launch and on-orbit checkout, the USGS assumes ownership and operation of the satellite.

The LRS Program continues to provide moderate-resolution land remote sensing data free of charge to the public. With the addition of Landsat 8, the USGS will once again be able to provide data for the same location every eight days. In 2014, the USGS will work with NASA to analyze user requirements and develop a successor mission to Landsat 8, formerly the Landsat Data Continuity Mission. Funding to begin work on the successor mission is provided in the 2014 budget for NASA, which will be responsible for development of Landsat-class land imaging satellites going forward. In addition, the LRS Program would support the remote sensing science needed to increase the usability of Landsat data for natural resource management. The LRS Program plans to work with intramural and extramural scientists to develop the science and make the resultant value-added data products available in consistent, centralized, readily usable formats and interfaces.

Program Performance

Landsat Satellite Missions – A big year for Landsat: At the continental and global scales, satellites are the most efficient and reliable means of collecting data necessary to observe land surface changes and assess their impacts to society. The USGS operates the Landsat series of satellites to provide long-term, impartial information for improved public and private sector decisionmaking. In 2012, the USGS and

NASA celebrated Landsat's 40th anniversary; Landsat is the world's longest-running Earth-observing satellite program.

As of April 2013, the USGS currently operates only the Landsats 5 and 7 missions. In January 2013, the USGS began decommissioning Landsat 5, following the loss of one of its stabilizing gyroscopes after a record-setting 28 years of reliable performance. Launched in 1984, Landsat 5 orbited the planet over 150,000 times and transmitted more than 3.7 million images of the Earth to domestic and international ground receiving stations. Landsat 7 was launched in 1999 and continues to collect useful imagery, though with significant data gaps in each scene due to a 2003 on-board equipment failure. Landsat 7 is well past its design life but has enough fuel to fly through early 2017. In 2012, the USGS completed the ground system for Landsat 8 (known until on-orbit checkout as the Landsat Data Continuity Mission) at the Earth Resources Observation and Science (EROS) Center in Sioux Falls, South Dakota. Landsat 8 was successfully launched by NASA on February 11, 2013. Landsat 8 has an estimated five-year design life for visible and infrared imagery, and a three-year design life for thermal infrared imagery. The USGS will assume ownership of Landsat 8 when a post-launch review is finished by NASA, estimated to be spring 2013. During Landsat 7's remaining life, it will be operated in tandem with Landsat 8 to provide eight-day repeat coverage of the Earth's land surfaces. In 2014, the USGS will work with NASA to analyze user requirements and develop a successor mission to Landsat 8, formerly the Landsat Data Continuity Mission. In addition, the USGS will continue to manage the existing Landsat ground system and satellite operations, process and distribute historical and current Landsat data, and develop foreign satellite partnerships to complement Landsat operations.

Mission Accomplished for Landsat 5

"This is the end of an era for a remarkable satellite, and the fact that it flew for almost three decades is a testament to the NASA engineers and the USGS team who launched it and kept it flying well beyond its expected lifetime. The Landsat program is the 'gold standard' of satellite observation, providing an invaluable public record of our planet that helps us tackle critical land, water, and environmental issues."

Anne Castle
Assistant Secretary for Water & Science
Department of the Interior
2012

In 2013, the USGS, in cooperation with NASA, reconvened the Landsat Science Team (LST). The LST is comprised of leading United States and foreign experts in land remote sensing engineering, science, and applications. The LST provides technical input to the USGS and NASA on issues critical to the success of the Landsat program. The group also plays a key role in ensuring that Landsat 8 will be successfully integrated with past, present, and future applications that involve observing and monitoring national and global environmental trends. The LST will also be important advisors to the USGS and NASA during the requirements phase for the Landsat 8 successor mission. The LST's output will include long-term land cover change analyses, drought and water use assessments, and agricultural research. These activities are supported by the LRS Program's development of globally-consistent scientific measurements and data products, as described below.

Data Management Operations: Land remote sensing data acquired by the USGS and its government, commercial, and foreign partners is managed and archived at the EROS Center. The EROS archive has the ongoing challenge of efficiently managing and distributing its stored data, all the while ingesting increasing volumes of new data. In addition to more than 3.5 million Landsat images, the archive holds current and historical image data from several other satellite systems, and millions of aerial photos of the United States and its territories. More recently, the USGS is incorporating tens of thousands of high-resolution aerial photos of 133 U.S. cities obtained repetitively by the National Geospatial-Intelligence Agency, and coast to coast aerial photo coverage acquired routinely by the U.S. Department of Agriculture. During 2012, the magnitude of data archived and managed at the EROS Center reached approximately 7,000 terabytes, a 42 percent increase since 2009. (One terabyte of data is equivalent to

over 4.5 million printed 200-page books; thus, the archive's total current holdings are equivalent to approximately 31.5 billion books.) The LRS Program will continue to support more than six million downloads annually of land remote sensing data, at no cost to the end user. The USGS continues its role as a leader in remote sensing science and technology in the international arena by providing remote sensing support for disaster response, as well as playing a lead role in international Earth observation efforts. The USGS serves as the lead U.S. agency to the International Charter (Charter) for "Space and Major Disasters." The Charter provides a unified system of emergency data acquisition by many international satellite systems and delivery to those affected by natural or anthropogenic disasters.

Science Support to Decisionmakers: The LRS Program supports science to advance applications of land remote sensing data and to improve the understanding of landscape dynamics and global change processes. These activities contribute to improved land use management decisions by both the public and private sector. In 2013 and 2014, the LRS Program plans to focus on supporting the remote sensing science needed to increase the usability of Landsat data for natural resource management. The LRS Program would work with internal and external researchers to develop the science and make the resultant value-added data products available in consistent, centralized, readily usable formats and interfaces.

Consistent global measurements are necessary to advance the USGS's understanding of the Earth's changing land surface and climate. The LRS Program has identified a set of Landsat-based data products that will improve applications used by natural resource managers and will also contribute to the international and interagency climate monitoring community's initiative to develop consistent Essential Climate Variables (ECVs) and related Climate Data Records (CDRs). The CDRs are long-term time-series measurements that support the development of the ECVs such as snow cover; glaciers and ice caps; permafrost; land surface albedo; land cover; absorbed photosynthetically active radiation; leaf area index; biomass; and fire disturbance. The CDRs and ECVs can provide an authoritative basis for regional to continental scale identification of historical change, monitoring of current conditions, and predicting future scenarios. Satellite observations are often the most efficient and cost-effective means to address these information needs. In 2013 and 2014, the LRS Program plans to work with external partners to generate an initial set of high-priority CDRs to capitalize on the unique capabilities and long-term continuity of Landsat observations. Also in 2013 and 2014, the USGS would continue to advance algorithm development, characterization studies, and stakeholder consultations for variables including initial burned area, surface water extent, and snow covered area.

The LRS Program is also supporting researchers from the USGS, University of Maryland, State University of New York, and other collaborators in developing the first global Landsat-derived land cover and land cover change data product at 30-meter spatial resolution. This product will detect land change at the scale of most human activity, offer increased flexibility for environmental modeling, and provide more detailed information than existing global land cover datasets in demand by resource managers and the climate research community. In 2012, the USGS compiled a prototype database of continuous tree coverage of the world and validated a database of South American land cover change. In 2013 and 2014, the LRS Program plans to create a prototype database showing tree gain and loss from 2000 to 2012 and validate the latest global database of 100 sites depicting updated land cover change. The LRS Program also supports an Unmanned Aircraft Systems (UAS) project enabling the USGS and its partners to monitor Earth surface processes in areas that, in the past, have been physically difficult, dangerous or cost-prohibitive to observe. The UAS's low costs and flexible operations enhance the USGS's ability to track earthquake fault zones, landslides, shoreline erosion, and enhance habitat mapping and wildlife monitoring.

Civil Applications Projects: The National Civil Applications Program (NCAP) provides for the acquisition, archive, dissemination, and exploitation of classified remotely sensed data to support the science programs of the USGS, Interior, and more than a dozen other Federal civil agencies. Data from

classified systems are used to address land and resource management, hazards, disasters, and other issues. In addition, the NCAP provides support for the USGS-chaired Civil Applications Committee (CAC), an interagency committee that provides coordination and oversight of Federal civil use of classified collections. The CAC's Global Fiducials Program makes declassified versions of imagery products available to cooperating scientists and the general public.

Activity: Climate and Land Use Change
Subactivity: Land Use Change
Program Element: Land Change Science

2012 Enacted: $11.1 million (67 FTE)
2013 CR: $11.3 million (67 FTE)
2014 Request: $13.6 million (77 FTE)

Overview

The goal of the LCS Program (formerly Geographic Analysis and Monitoring) is to understand the Nation's urgent environmental, natural resource, and economic challenges by providing the information and tools necessary for identifying possible solutions to these challenges. The LCS Program accomplishes this by conducting research on land cover, which provides a historical record of resource use and indicates the availability and quality of natural resources; assessing the impacts of land cover change; and by developing tools for decisionmakers to use for resource allocation. Comprehensive land cover information is essential in a wide variety of investigations, such as assessing the impacts of climate change, evaluating ecosystem status and health, understanding spatial patterns of biodiversity, and informing land use planning. The LCS Program's research activities include understanding of:

- environmental consequences of land change and its impacts on people, environment, economy, and resources;
- ecosystem functioning and the services delivered by these functions; and
- improving the scientific basis for vulnerability and risk assessments, as well as disaster mitigation, response, and recovery.

The LCS Program manages the creation, updates, and distribution of the National Land Cover Database (NLCD), which is the standard land cover map of the Nation. The NLCD provides valuable information on the types of land cover, changes that are occurring, their distribution, and patterns, and the potential consequences of these changes. Land cover information is critical for identifying and assessing climatic changes since surface energy fluxes between the land and the atmosphere have a major impact on climate. This information is also essential in assessing: water quality and quantity; biodiversity conservation efforts; and the risks from natural hazards.

The LCS Program's activities utilize land cover information, remote sensing data, land change models, sensitivity analyses, and the probabilities of specific landscape disturbances, to develop tools so that land and community managers can make knowledgeable resource allocation decisions and assess the impacts of natural hazard events. These projects include developing case studies, interpretative assessments, and workshops involving stakeholders, and other partners in collaborative decision making processes. The LCS program also supports the research objectives of the USGCRP and is an active participant in international global science initiatives through promotion of the use of USGS science results and assets around the globe.

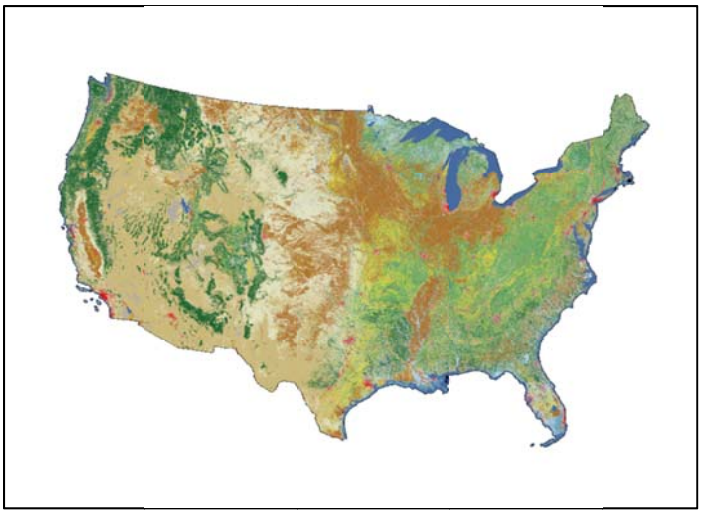
The LCS Program collaborates with other USGS programs, and contributes to bureau initiatives, including the Science Application for Risk Reduction (SAFRR), LANDFIRE, WaterSMART, and the Chesapeake Bay restoration effort, improving USGS Rapid Disaster Response through Preparedness and Robust Monitoring, and the New Energy Frontier. With new funding in 2014, the LCS Program would provide land use/land cover change analysis of hazard events through the simulation of disaster scenarios. By understanding the potential impacts of these hazards before they occur, the USGS would strengthen

capabilities in warning, responding, and recovering from such events. The LCS Program would also focus research on land changes to better understand ecosystem changes due to climate change. This research would provide decision support tools to Federal agencies and State and local governments for use in assessment of impacts of ecosystem conservation and restoration activities. Finally, the LCS Program would use new funding to expand research efforts in the Chesapeake Bay watershed, using satellite-based remote sensing data products to evaluate winter cover crops to assess soil erosion and nitrogen runoff from agriculture fields.

Program Performance

Land Cover Monitoring and Assessments – Continuing to Improve the NLCD: The LCS Program monitors land use and land cover change at multiple scales, documenting the geographic variability of change and defining the environmental, social, technological, and political drivers of change, as well as assessing the impacts of these changes. Current land cover monitoring activities include the NLCD and regional activities in areas such as the Great Plains, Rocky Mountains and the Chesapeake Bay watershed. Regional assessments involve analyzing the impacts of land cover change on water quality, biodiversity and community risk and vulnerability, as well as conducting land cover change modeling, used to assess impacts of future resource use and climate change.

The 2006 iteration of the NLCD was completed in 2012; providing consistent public domain information on the Nation's land cover characteristics. The work was accomplished through USGS partnerships with Federal, State and local government agencies, private industry, and nongovernmental organizations. In 2013, the mapping of NLCD 2011 will continue, utilizing Landsat images acquired in 2011. The five-year production cycle provides the Nation with current and accurate land cover information, while allowing for technological advances to be incorporated and accuracy assessments to be conducted.



NLCD 2006 Land Cover map

Assessing Water Resources and Food Security: As part of the WaterSMART initiative, in 2012, LCS researchers analyzed the importance of remote sensing in assessing cropland productivity and water use. This research assesses classification algorithms in conducting routine, rapid, and accurate mapping of croplands and their characteristics. Such assessments require data fusion and combination techniques from multiple satellite sensors, secondary data sources, and a large and systematic collection of *in-situ* information, including temporal phenologies and hyperspectral signatures. In 2013 and 2014, LCS research would assess systematic and integrated approaches to cropland assessments that support a wide

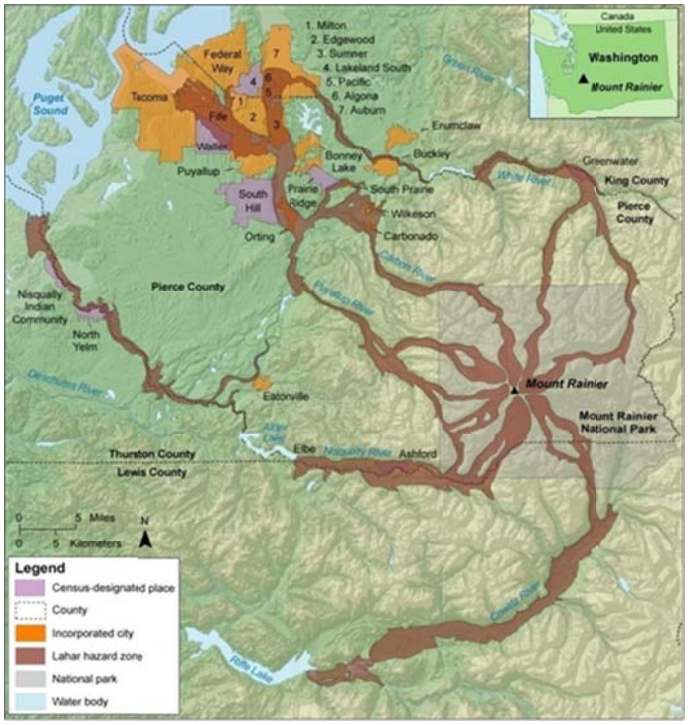
range of applications, including monitoring crop productivity, identifying food security "hotspots" of vulnerability and assessing the risk of crop failure due to climate change and water scarcity.

Ecosystem Functioning and Services – Conducting Ecosystem Services Assessment and Valuation: The LCS Program develops spatially-explicit models of ecosystem functioning and analyzes the services provided by these ecosystems, including carbon sequestration, water availability and biodiversity conservation. Projects include monetizing the value of ecosystem services and developing tools such as the Ecosystem Portfolio Model (EPM) and the Chesapeake Land Conservation Priority System (CLCPS). These tools support sound conservation planning and decision making by resource managers and foster strategic coordination by incorporating multiple land conservation values.

Species that migrate through protected and wilderness areas and utilize their resources, deliver ecosystem services to people located great distances from these areas. The mismatch between areas that support a species and those areas where the species provide most benefits to society can lead to underestimation of the true value of protected areas such as wilderness. In 2012, LCS researchers developed a method to assess the comprehensive value of wilderness and protected areas. In 2013 and 2014, LCS researchers would apply this method to a variety of species and geographic locations, in order to conduct a complete accounting of the benefits of wilderness protection.

Assessing Societal Vulnerability to Natural Hazards: This science research utilizes models, sensitivity analyses, geographic distributions of people and infrastructure along with the probability of specific disturbance factors, to evaluate a community's vulnerability and risk. The LCS Program helps local and State governments assess their vulnerability by augmenting the USGS's traditional expertise in natural hazards with the ability to assess the exposure, sensitivity, and resilience of a community. These projects include case studies, interpretative assessments, and science impact studies involving stakeholders and other partners in collaborative processes. Specific projects include assessing multiple hazards in southern California, as well as volcanoes and tsunamis in the Pacific Northwest.

As part of the SAFRR initiative, LCS scientists are demonstrating how integrative hazards science can be used to improve community resiliency to natural hazards. The LCS research helps States and localities reduce their risk from natural hazards by directing research toward community needs, improving the monitoring technology, producing innovative vulnerability and risk products, and improving dissemination of the results. In 2013 and 2014, LCS scientists are assessing the economic and social impacts of major wildfires, winter storms, volcanoes and tsunamis, and will use this information to support risk reduction efforts as part of planned disaster scenario exercises.



Lahar hazard zones associated with a Mount Rainier major eruption.

Activity: Energy, Minerals, and Environmental Health

		2013 Full Yr. CR (PL 112-175)	2012 Enacted	2014 Fixed Costs and Related Changes (+/-)	2014 Program Changes	2014 Internal Transfer	2014 Budget Request	Change from 2012 Enacted (+/-)
Mineral and Energy Resources								
Mineral Resources ($000)		*48,760*	48,760	866	-3,269	0	46,357	-2,403
	FTE	*324*	327	0	-29	0	298	-29
Energy Resources ($000)		*28,820*	27,570	370	3,061	0	31,001	3,431
	FTE	*152*	146	0	9	0	155	9
Subtotal: Resources		***77,580***	***76,330***	***1,236***	***-208***	***0***	***77,358***	***1,028***
	FTE	***476***	***473***	***0***	***-20***	***0***	***453***	***-20***
Environmental Health								
Contaminant Biology ($000)		*9,180*	9,180	131	4,644	0	13,955	4,775
	FTE	*65*	65	0	16	0	81	16
Toxic Substances Hydrology ($000)		*10,580*	10,580	111	5,443	0	16,134	5,554
	FTE	*61*	61	0	16	0	77	16
Subtotal: Environmental Health		***19,760***	***19,760***	***242***	***10,087***	***0***	***30,089***	***10,329***
	FTE	***126***	***126***	***0***	***32***	***0***	***158***	***32***
Total Requirements ($000)		***97,340***	***96,090***	***1,478***	***9,879***	***0***	***107,447***	***11,357***
	Total FTE	***602***	***599***	***0***	***12***	***0***	***611***	***12***

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Summary of Program Changes

Request Component	($000)	FTE	Page
Subtotal: Mineral and Energy Resources	***-208***	***-20***	
Mineral Resources	**-3,269**	**-29**	
High Priority Research on Critical Minerals	1,130	7	B-49
Minerals Information	-1,157	-10	B-58
Minerals Resources	-1,000	-8	B-58
Rare Earth Elements Research	1,000	5	B-49
Research and Assessment	-2,803	-23	B-58
General Program Reduction	-439	0	B-64
Energy Resources	**3,061**	**9**	
Alternative Energy Permitting on Federal Lands	2,000	3	B-6
Hydraulic Fracturing	1,250	6	B-31
General Program Reduction	-189	0	B-64
Subtotal: Environmental Health	***10,087***	***32***	
Contaminant Biology	**4,644**	**16**	
Ecosystem Priority: Chesapeake Bay	100	0	B-20
Ecosystem Priority: Columbia River	100	0	B-20
Emerging Contaminants/ Chemical Mixtures	1,000	3	B-50
Environmental Impacts of Uranium Mining	500	3	B-42
Hydraulic Fracturing	1,400	5	B-31
Pathogens and Contaminants	611	2	B-51
WaterSMART: Water Quality Enhancement	1,000	3	B-7
General Program Reduction	-67	0	B-64
Toxic Substance Hydrology	**5,443**	**16**	
Ecosystem Priority: Chesapeake Bay	100	0	B-20
Ecosystem Priority: Columbia River	100	1	B-20
Emerging Contaminants/ Chemical Mixtures	1,000	2	B-50
Environmental Impacts of Uranium Mining	2,500	9	B-42
WaterSMART: Water Quality Enhancement	1,800	4	B-7
General Program Reduction	-57	0	B-64
Total Program Change	**9,879**	**12**	

** Estimated changes in FTEs compare against actual 2012 FTE usage, not 2012 enacted formulation estimates.

Justification of Program Changes

The 2014 Budget Request for Energy, Minerals, and Environmental Health (EMEH) is $107,447,000 and 611 FTE, a net program change of +$11,357,000 and +12 FTE from the 2012 Enacted Budget. For more information on the EMEH Mission Area changes, please see Section B, Program Changes as referenced in the table.

Activity Summary

The EMEH Activity includes programs that conduct research and assessments on the location, quantity, and quality of the Nation's and world's mineral and energy resources, including economic and environmental effects of resource extraction and use, and programs that conduct research on environmental impacts of human activities that introduce chemical and pathogenic contaminants into the environment and threaten human, animal (fish and wildlife), and ecological health.

The EMEH Activity is comprised of four subactivities:

Mineral and Energy Resources

- Mineral Resources Program (*http://minerals.usgs.gov*)
- Energy Resources Program (*http://energy.usgs.gov*)

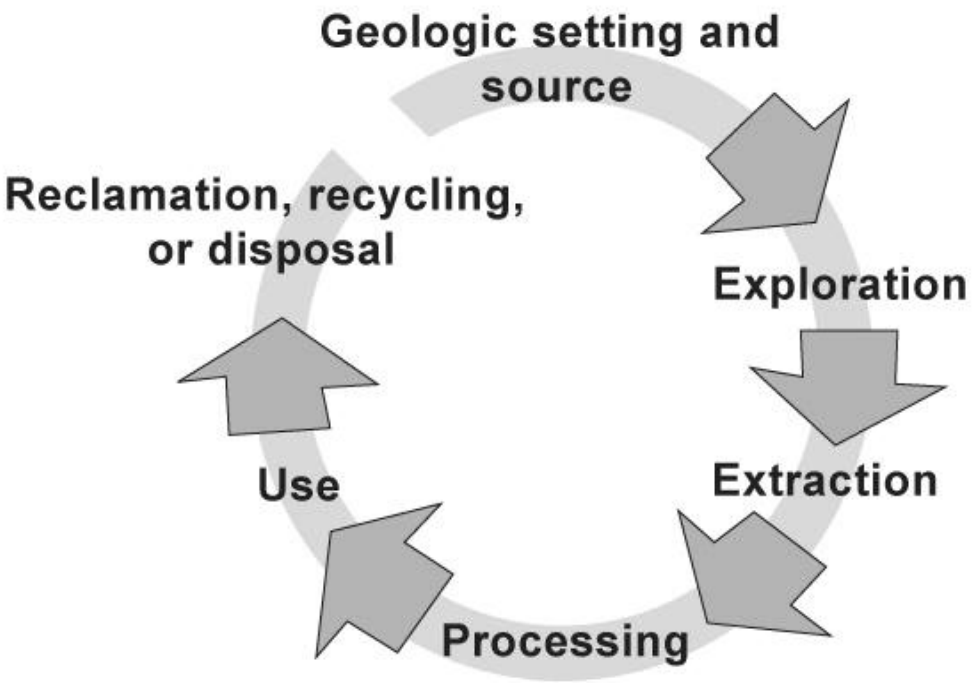
Environmental Health

- Contaminant Biology Program (*http://www.usgs.gov/envirohealth*)
- Toxics Hydrology Program (*http://toxics.usgs.gov*)

Mineral and Energy Resources

The Energy Resources and Mineral Resources Programs conduct research on the location, quantity, and quality of the Nation's and world's energy and mineral resources, including economic parameters and environmental effects of resource occurrence, extraction, and use. Together these two programs provide information to resource managers, policymakers, and the public to support science-based policy development, land and resource management, and decisionmaking on a range of critical resource issues. These include energy and mineral development and use, informing a variety of energy-mix scenarios, developing energy policy, determining mineral resource needs, understanding domestic resources and production in the context of global resource supply chains, and evaluating trade-offs including environmental risks. The Mission Area provides impartial, trusted science and information for understanding both the occurrence and distribution of national and global energy and mineral resources.

In 2013, the USGS published an Energy and Minerals Science Strategy which summarizes national science priorities that the USGS is best suited to address, and will serve as a strategic framework for USGS Energy and Mineral science goals, actions, and outcomes for the next decade. This plan describes the USGS role and important partnership opportunities, and outlines steps that can be taken in the next 10 years to continue to provide the Nation with energy and minerals science and information on both current and emerging issues. This plan provides a framework of complete life cycle analysis (see Figure) within which to build upon and expand current work for understanding trade-offs and informing decisionmaking with respect to such issues as economic vitality, environmental health, national security, and responsible resource management and protection on U.S. Department of the Interior (DOI) and other lands.

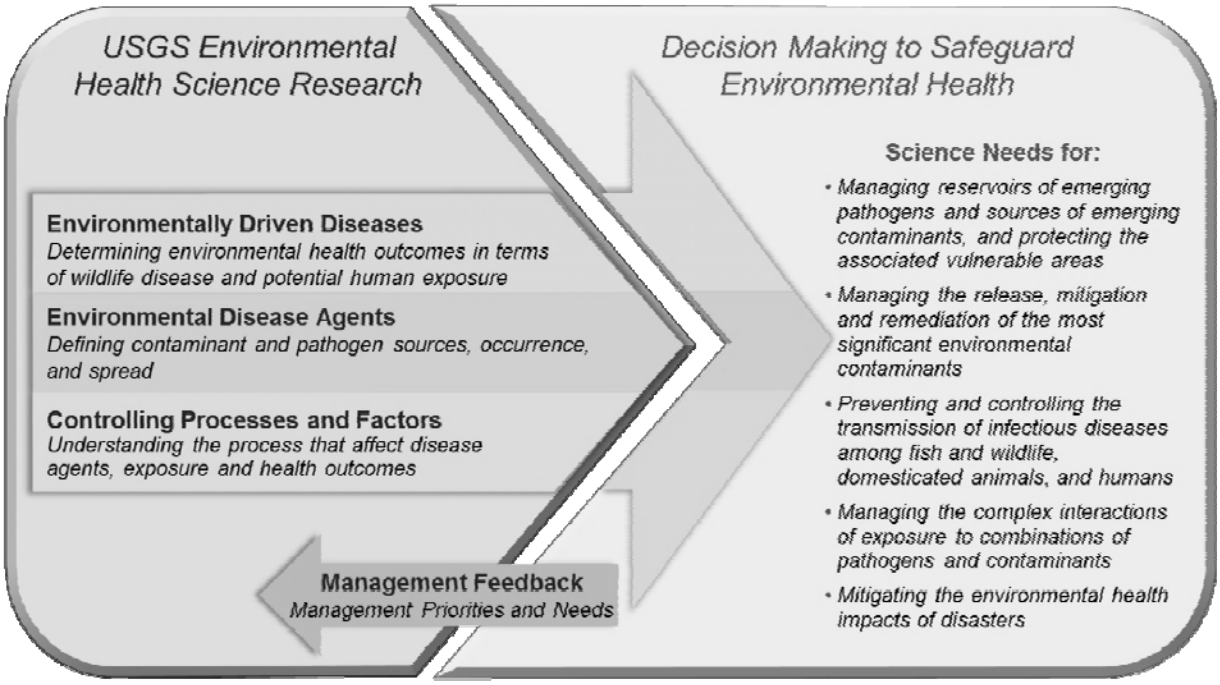


Conceptual diagram that depicts a resource lifecycle for energy and minerals. Society faces key decisions within each stage of the resource lifecycle. Scientific understanding is essential to providing information for these decisions

Environmental Health

The Contaminant Biology and Toxics Substances Hydrology Programs conduct research on the environmental impacts of chemical and pathogenic contaminants that enter the environment through natural and anthropogenic mechanisms, and threaten human, animal (fish and wildlife), and ecological health. In 2013, the USGS published its first Environmental Health Science Strategy which summarizes national environmental health priorities that the USGS is best suited to address, and will serve as a strategic framework for USGS environmental health science goals, coordination of research efforts, partnerships, and outcomes for the next decade. This strategy delineates the connection between USGS scientific research and its ability to support decisionmaking to safeguard environmental health.

The USGS is a lead Federal agency in providing information and tools to address occurrence, behavior, and effects of environmental contaminants, including impacts on susceptible ecosystems and implications for human, wildlife, and fish health. This information includes identifying chemical and pathogenic environmental contaminants (pesticides, surfactants, human and veterinary pharmaceuticals, and other industrial and naturally occurring contaminants); developing methods to identify sources of environmental contamination and measuring those contaminants in habitats and biota; assessing toxicological significance of contaminant exposure to vulnerable organisms; characterizing effects on organisms exposed in susceptible environmental settings, including potential human exposure; and providing information on performance of best management practices and treatment alternatives. This information informs decisionmaking by the public and industry and helps resource managers and policymakers to assess environmental risks; prevent contamination; license and approve chemicals; and manage, protect, and restore natural resources, contaminated lands, and important natural ecosystems, including trust resources of the Department of the Interior. These efforts complement other USGS programs by focusing on new and currently understudied issues and contaminants, and by developing and improving methods to detect and characterize toxic substances in the environment.



The USGS role in environmental health science is providing scientific information and tools to environmental, natural resource, agricultural, and wildlife, and public health management agencies for management and policy decision making.

The EMEH Mission Area continues to increase focus on integrating its core capabilities more broadly. Mission Area Programs are jointly developing approaches to natural resource assessments that incorporate energy and mineral resource information, as well as environmental and economic information. Several pilot projects, including a uranium study, are being developed or are in the early stages of implementation. These projects will help decisionmakers consider a more comprehensive set of trade-offs for the increasingly complex set of conflicting and competing resource needs the Nation faces.

Portions of the Energy Resources Program were reviewed by external technical committees in 2011. Each time a new assessment methodology is developed in Energy Resources, an external panel of technical experts formally reviews the methodology and approach. Energy Resources revises the methodology based on the review and does not consider a methodology final until it has received expert review. In 2010 and 2011, Energy Resources had the following methodologies reviewed by external experts:

- Methodology to estimate carbon sequestration potential for uniform application to geologic formations across the Unites States;
- Methodology to assess reserve growth in oil and gas fields (assessment of both undiscovered resources and additions to reserves from discovered fields and reservoirs requires estimation of reserve growth); and
- Methodology to determine economically recoverable resources of unconventional petroleum resources (coalbed methane, tight gas sands, shale gas, shale oil).

Review of the methodology to assess economically recoverable resources for conventional petroleum in the Arctic occurred in 2012. Other methodologies, as they are developed, such as that for a national uranium assessment and the water budget associated with unconventional oil production, will be reviewed in 2013 and 2014.

Using guidance developed by the National Academy of Sciences Committee on Critical Minerals published in 2008, Mineral Resources identified 16 mineral commodities as the focus of the next National Mineral Resource Assessment. These commodities include metals and Rare Earth Elements needed for new energy and "green" technology development and industrial minerals important to agriculture. The USGS conducted a Mineral Resource Assessment Forum in 2012 to examine methodologies for producing mineral assessments and to determine the science needed to produce the most relevant and useful assessments in anticipation of starting the next National Assessment. New mineral deposit and mineral environmental model development for critical commodities continued in 2012. Deposit models were completed in 2013; research on and development of mineral environmental models will be significantly diminished in 2014.

Mission Area 4: Provide a Scientific Foundation for Decisionmaking
Goal #2: Provide Science for Sustainable Resource Use, Protection, and Adaptive Management
Strategy #5: Assess National and International Energy and Mineral Resources

Strategic Plan Performance Measures	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Target	2012 Actual	2013 Target	2014 Target	2008 - 2014 Trend
Strategy #5: Assess National and International Energy and Mineral Resources										
Percent of targeted non-fuel mineral commodities for which up-to-date deposit models are available to support decision making (Mineral Resource Program)	USGS	7.0%	20.0%	53.0%	73.0%	80.0%	80.0%	93.0%	93.0%	
		7	20	53	73	80	80	93	93	
		100	100	100	100	100	100	100	100	
Number of USGS energy products accessed online (Energy Resource Program) (# in millions)	USGS	5.08	8.24	6.89	5.02	4.50	5.00	5.00	4.80	

Supporting Performance Measures

Outputs, Supporting Performance Measures and/or Milestones	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Plan	2012 Actual	2013 Plan	2014 Plan
Number of systematic analyses and investigations delivered to customers (MRP)	USGS	3	3	4	3	3	3	2013 is the year of baselining	TBD
The MRP is redefining (expanding) what it counts as systematic analysis and investigations. 2013 is a year of baselining, so targets for outyears are still being developed.									
Number of formal workshops or training provided to customers (MRP)	USGS	6	6	8	6	5	5	Discontinued	Discontinued
The MRP is redefining (expanding) this measure and changing this language to "Number of outreach activities provided to customers". 2013 is a year of baselining, so targets for outyears are still being developed.									
Number of outreach activities provided to customers (MRP)	USGS	NA	NA	NA	NA	NA	NA	2013 is the year of baselining	TBD
Number of mineral commodity reports available for decisions (MRP)	USGS	649	707	748	705	680	729	730	680
Number of megabytes collected annually (ERP)	USGS	1,201	18,07	1,707	2,323	1,126	2,147	1,500	1,425
Number of systematic analyses and investigations delivered to customers (ERP)	USGS	5	6	5	205	150	149	150	143
Number of outreach activities provided to customers (ERP)	USGS	8	8	9	1,570	1,500	2,482	2,000	2,100

Mission Area 4: Provide a Scientific Foundation for Decisionmaking
Goal #3: Provide Scientific Data to Protect and Inform Communities
Strategy #2: Identify the connection between the natural environment and wildlife and human health

Strategic Plan Performance Measures	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Target	2012 Actual	2013 Target	2014 Target	2008 - 2014 Trend
Strategy #2: Identify the connection between the natural environment and wildlife and human health										
Number of emerging disease outbreak (contaminants and pathogens) investigations (Contaminants)	USGS	672	669	673	581	503	593	550	550	

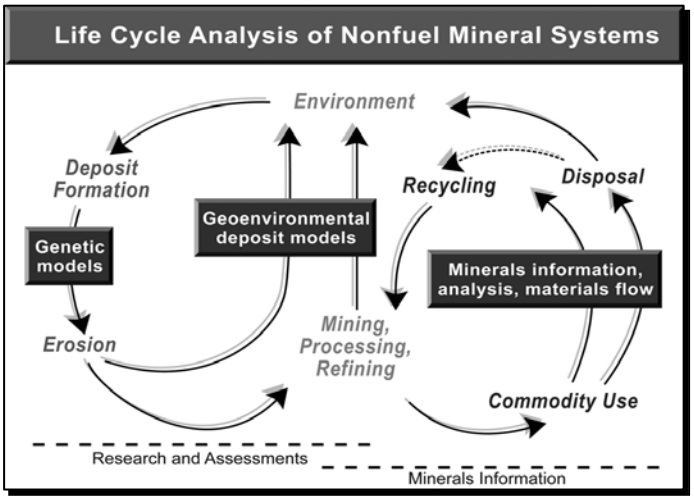
Supporting Performance Measures

Outputs, Supporting Performance Measures and/or Milestones	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Plan	2012 Actual	2013 Plan	2014 Plan
Number of knowledge products on environmental contamination provided to support management decisions (Toxics)	USGS	149	128	115	146	115	139	120	130

Activity: Energy, Minerals, and Environmental Health
Subactivity: Mineral Resources

2012 Enacted: $48.8 million (327 FTE)
2013 CR: $48.8 million (324 FTE)
2014 Request: $46.4 million (298 FTE)

Overview



The Mineral Resources Program (MRP) supports data collection and research on a wide variety of nonfuel mineral resources that are important to the Nation's economic and national security. The MRP's Research and Assessment function helps to understand the geologic processes that concentrate known mineral resources at specific localities in the Earth's crust and to assess quantities, qualities, and distribution of undiscovered mineral resources for potential future supply. The program also conducts research on the interactions of mineral resources with the environment, both natural and as a result of resource extraction, to develop geochemical baselines and better predict the impact that resource development may have on human and ecosystem health. The MRP's Minerals Information function supports collection, analysis, and dissemination of data that document production and consumption for about 100 mineral commodities, both domestically and internationally for 180 countries. This full spectrum of mineral resource science allows for a comprehensive understanding of the complete life cycle of nonfuel mineral resources and materials—resource formation, discovery, production, consumption, use, recycling, and reuse—and allows for an understanding of environmental issues of concern throughout the life cycle.

Program Performance

Research and Assessment
(Estimates for 2012 Enacted, $34.2 million; 2013 CR, $34.2 million; 2014, $32.5 million)

In 2012, the MRP completed a 10-year cooperative project providing the first-ever global assessment of undiscovered resources of copper and potash, commodities essential to infrastructure, food security, and environmental health. Never before have decisionmakers and scientists had access to a publicly available, globally consistent assessment of this type. This USGS-led international cooperative effort was conducted on a regional, multi-national basis with the participation of dozens of interested national and internal geologic, mineral resource, and other governmental and nongovernmental institutions. The final products of this international collaboration include maps and text describing the distribution of areas permissive for undiscovered deposits of copper and potash for specific regions of the world and the estimated quantity of metals contained in each permissive area. This body of work will form the basis for decisions about land use and mineral supply in the United States and around the world.

Also in 2012, the MRP completed three large projects in support of assessment activities: (1) Updated National Mineral Resource Assessment—Planning Phase (uNMRAP) , (2) Assessment Techniques for Concealed Mineral Resources (Concealed), and (3) Development of Mineral Environmental Assessment Methodologies (MEA). The uNMRAP delivered updated national-scale mineral occurrence, geology, geophysics and geochemical data as well as updated mineral deposit models for use in future assessments and other research activities. The Concealed project produced a series of products on concealed mineral resources research in the Southwest and the upper Midwest part of the United States, and in Alaska, where geochemical and geophysical studies were conducted over the Pebble copper-gold deposit. The MEA project produced mineral environmental characterization studies and assessment tools that will be used to integrate mineral environmental and mineral resource assessments in the future.

In 2012, MRP also continued with its long-standing effort in Afghanistan and completed a hyperspectral survey of the country to help identify mineral resources that could be targeted for economic development projects and build toward post-conflict stabilization. This was a highly successful effort that drew the attention of many and initiated conversation about similar hyperspectral surveys in the United States should funding become available.

Beginning in 2013 the MRP is refocusing activities in several geographic and topical areas including (1) Geologic and Mineral Resourcre Studies in Alaska, (2) Characterization and Identification of Critical Mineral Resources, (3) Characterization of the Midcontinent Rift and related Mineral Resources, (4) Assessment of Undiscovered Resources, (5) Mineral Resource Research and Information, (6) Minerals and the Environment, and (7) Laboratory and Analytical Research and Development and Support.

Geologic and Mineral Resource Studies in Alaska – The MRP is expanding its activities in Alaska to provide an up-to-date geologic foundation for mineral resource assessment activities. This work includes research to understand geologic controls of mineral resources in the Western Alaska Range (a five-year effort to be completed in 2014), investigations at the Bokan Mountain rare earth element deposit, acquisition of new and interpretation of exisiting regional airborne geophysical survey data, as well as acqusition of airborne hyperspectral data over selected mineral districts and regions. In addition, the MRP and the State of Alaska have initiated a three-year effort, known as the Alaska Critical Minerals Cooperative. MRP and Alaska State scientists will work jointly to evaluate critical and strategic mineral commodities, such as rare earth and platinum group elements that are vital to defense, renewable-energy and electronics technology development. The MRP will analyze information from its extensive statewide databases, and use its expertise in regional and economic geology to outline areas of Alaska with the highest potential for critical minerals. Follow-up investigations of specific geologic belts and regions will be carried out by both agencies.

Characterization and Identification of Critical Mineral Resources – Global demand for critical mineral commodities is on the rise with increasing applications in consumer products, computers, automobiles, aircraft, and other advanced technology products. Much of this demand growth is driven by new technologies that increase energy efficiency and decrease reliance on fossil fuels. The MRP is expanding its research and assessment activities to address the need for more up-to-date information on the Nation's and the world's critical mineral resources. In 2013, the MRP will complete an updated critical mineral resource summary, modeled after the highly successful 1973 Professional Paper 820, "United States Mineral Resources," which was the last summary of many of these critical mineral resources. In 2013 and 2014, the MRP will be conducting geologic, geochemical, geophysical, and remote sensing surveys to comprehensively characterize the unconventional rare earth element potential of the Appalachian front and coastal plain regions of the southeastern United States. These include resources concentrated from the weathering of older rare-earth-bearing rocks, rare-earth-bearing placer deposits on the coastal plain associated with heavy-mineral titanium resources, and rare-earth-bearing phosphate deposits. The MRP has established working agreements with industry partners to better

characterize significant domestic rare earth element (REE) resources, at Mountain Pass, CA, Bear Lodge, WY, Bokan Mountain, AK, and Elk Creek, NE. This USGS-Industry collaboration includes geophysical data acquisition and processing that will provide a better understanding of the extent of REE resources in the subsurface and help delineate geologic controls on resource distribution. What is learned from these studies will be applied in future assessments of undiscovered REE resources. Finally, the MRP is conducting a national survey of previously mined ores and tailings as potential resources of critical and strategic elements. The survey is employing a novel rapid analytical method developed by USGS scientists. Historically, ores from mining operations were not analyzed for metals now considered critical and strategic. A USGS pilot study has documented that ores from past mining operations can contain highly elevated concentrations of critical elements such as indium, tellurium, gallium, germanium, and rare earths.

Characterization of the Midcontinent Rift and related Mineral Resources – The MRP is refocusing efforts in data acquisition and multidisciplinary research to image and characterize the Midcontinent rift and related mineral resources, to document mineral resource potential, and to evaluate mineral environmental impact of past and future mineral resource development in the region. The midcontinent rift is a 1.1 billion-year-old structural feature that is exposed in the Lake Superior region, but is covered by younger rocks as it extends to the south through Iowa, Nebraska, Kansas, and Missouri. Rocks that formed in response to development of the rift, such as the Duluth layered igneous complex in northern Minnesota contain significant known resources of copper, nickel, and platinum group metals. The MRP conducted airborne geophysical surveys (completed in 2013) over northeast Iowa and southeast Minnesota to investigate whether a buried igneous intrusion, known as the Northeast Iowa Igneous Intrusive complex, has the potential to host metallic resources similar to the copper-nickel-platinum-rich Duluth complex in the Lake Superior region. A serendipitous finding during these geophysical surveys was confirmation that a 470 million-year-old meteorite impact structure underlies the town of Decorah, Iowa. Other midcontinent rift studies in progress during 2013 and 2014 include environmental geochemistry research to evaluate Impacts of past and future mining in the Lake Superior region, and an assessment of the platinum-group element resources in mafic-ultramafic igneous intrusions of the Duluth complex and vicinity of the Lake Superior region.

A**ssessment of Undiscovered Resources –** The results of topical and geographic-based research conducted by the MRP is applied to evaluate the potential of undiscovered mineral resourses and to decrease the uncertainty in probabilistic assessments. These assessments are used to inform decisions regarding potential domestic and global resource supply and decisions regarding land management of future resource development. In 2013, the MRP will be combining all of the regional copper assessments of the global mineral resource assessment into a seamless global synthesis product showing analysis and applications of the global copper assessment. In 2013 and 2014, the MRP will continue a collaborative effort with the Energy Resources Program (ERP) to prepare for and initiate a national uranium assessment. This project, "Uranium Resources and the Environment," is drawing on ERP and MRP funded expertise to update uranium deposit models with environmental components, develop and vet an assessment methodology, and conduct a national assessment for undiscovered uranium resources. The MRP is continuing with research and development on assessment methodology and protocol to ensure of the efficient use of all available knowledge and data in the assessment process

Mineral Resource Research and Information – The MRP continues to collect and analyze mineral resource data and conduct research on the genesis of and regional geologic controls for a wide variety of types of mineral resources. In 2013 and 2014, this includes a nationwide compilation of non-metallic mineral resources used in the industrial, construction, and agricultural industries. Work will also continue on updating mineral deposit models for phosphate, rare earth elements, and gold, as such deposit models are the keystone to conducting mineral resource assessments. The MRP will support research to better understand the genesis and regional controls on significant precious-metal resources in the Walker Lane

region of the Great Basin and research to document the basement tectonic framework of the United States as a foundation for understanding large-scale events and structural features and their role in localizing domestic mineral resources.

Minerals and the Environment – The MRP conducts research on the interactions of mineral resources with the environment, both natural and as a result of resource extraction, to develop geochemical baseline parameters and better predict the degree of impact that resource development may have on human and ecosystem health. In 2013, these activities include efforts to better understand emerging environmental geochemical challenges for future mining and the uses, characteristics, and environmental/health implications of metal and mineral commodities in the built environment. In addition, in 2013, products from MRP's Soil Landscape Geochemistry project will be released. This is a 10-year effort that has resulted in unprecedented coverage of the composition of soils in the conterminous United States. More than 4,800 sample sites and more than 15,000 analyses are portrayed on a series of national maps for three different soil horizons. This information will be extremely valuable in defining baseline parameters of soil composition for a variety of applications and at a variety of scales. Furthermore, all samples are archived in Denver for future research opportunities.

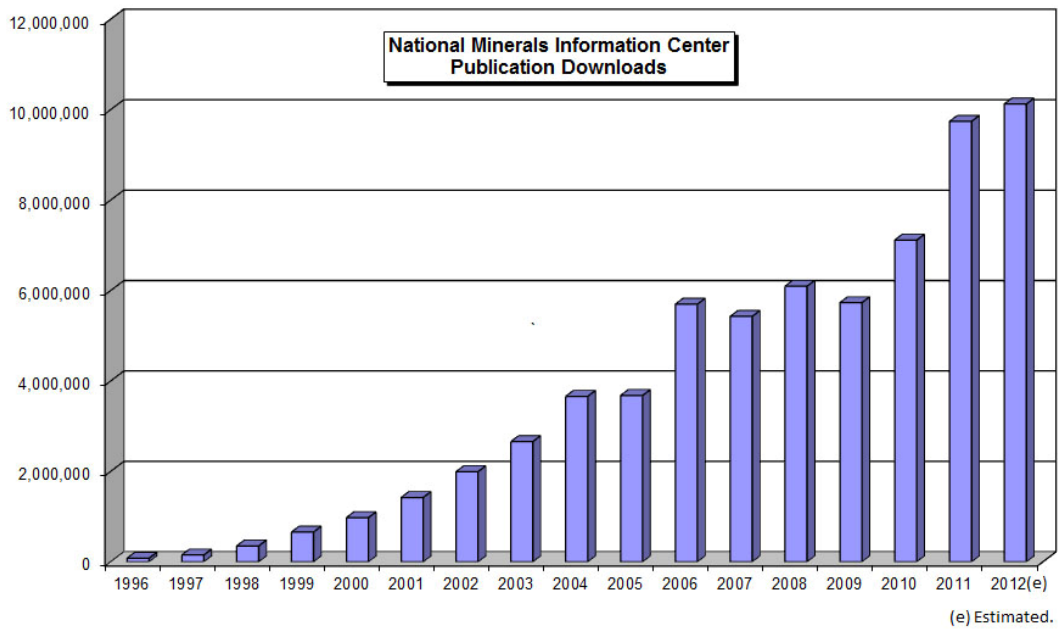
Laboratory and Analytical Research and and Development and Support – The MRP supports research on analytical techniques and methods development to help characterize mineral resource genesis and mineral environmental interactions and provide analytical support to understand the nature and distribution mineral resources. It is important to understand that these capabilities support science and research in many other parts of the USGS as well. Analytical chemistry, isotope, and geochronology labs supported by the MRP provide high-caliber data to projects and programs in all USGS Mission Areas. Geophysical capabilities developed by MRP-funded scientists to better understand mineral resource potential are now being applied to study a variety of USGS earthquake and volcanic hazard issues, groundwater aquifer characterization, and the extent of permafrost. These capabilities have been curtailed as a result of past budget reductions and will be further curtailed as a result of the proposed 2014 budget reduction.

In 2013 and potentially 2014, the MRP will continue with international studies to better understand the mineral resource potential of Afghanistan and Central Asia, to assist with economic development and stabilization for both regions, emphasizing the important role the USGS and the MRP play in the area of science diplomacy.

Minerals Information

(Estimates for 2012 Enacted, $14.6 million; 2013 CR, $14.6 million; 2014, $13.9 million)

In 2012, the use of the USGS minerals information continued to increase. Every year, more than 700 reports are prepared by the MRP's National Minerals Information Center and are added to the minerals information Web pages (http://minerals.usgs.gov/minerals). Downloads from the MRP website continued its upward trend in 2012 attesting to the increasing demand for USGS minerals information. In providing information on materials flow, the MRP released three reports in 2012 related to critical mineral materials flow; "Lithium use in batteries," "Materials Flow of Indium in the United States in 2008 and 2009," and "Byproduct metals and rare-earth elements used in the production of light-emitting diodes—Overview of principal sources of supply and material requirements for selected markets."



For 2013, the MRP is releasing a study of "Metal Prices in the United States through 2010," a product released approximately once every ten years. The previous study analyzed metal prices through 1998. Another study, released in the first quarter of 2013, looked at the effect of recent strikes in South Africa on the global supply of platinum group metals. For 2013 and 2014, the MRP will continue to produce monthly, quarterly, and annual mineral information products such as the Nonmetallic Mineral Products Industry Indexes, the Metal Industry Indicators, the Mineral Industry Survey, the Minerals Yearbook, and the Mineral Commodity Summaries. Materials flow studies in progress and due for release in 2013 and 2014 include analyses of amount of rare earths, indium, and other critical mineral commodities in consumer goods as well as what can be recovered through recycling.

In 2014 and on a continuing basis, MRP mineral economists and minerals information specialists provide minerals information on a regular basis to other Federal agencies, including the U.S. Census Bureau, the Department of Defense, and the Federal Reserve Board (FRB). MRP specialists also chair and contribute to several Office of Science and Technology Policy (OSTP)-convened working groups that will inform Federal critical minerals policy related to supply chain sustainability, research and development, and information collection and dissemination.

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Activity: Energy, Minerals, and Environmental Health
Subactivity: Energy Resources

2012 Actual: $27.6 million (146 FTE)
2013 CR: $28.8 million (152 FTE)
2014 Request: $31.0 million (155 FTE)

Overview

The USGS is the sole provider of unbiased, publicly available estimates of energy resources for the United States, exclusive of the U.S. Outer Continental Shelf, as well as being the sole provider of a variety of publicly available products related to global oil and gas resources. The USGS also performs research to advance the science of energy resources and assessments and understand key impacts and issues. Major consumers of the Energy Resources Program (ERP) products are the Department of the Interior's land and resource management bureaus, other land management and environmental agencies, national security agencies, policymakers and Congressional offices, State geological surveys and other State agencies, energy industry, environmental groups, international energy community, nongovernmental organizations, academia, and the public. Providing information that is utilized to make decisions supporting energy security, energy policy, and environmentally sound production and utilization, ERP activities directly contribute to the DOI strategic plan goal to provide science for sustainable resource use, resource protection, and adaptive management.

Because of our reputation of conducting unique, robust, geologically based research and assessments, the ERP was directed by the Energy Policy Act of 2005, and the Energy Independence and Security Act of 2007, to study and assess energy resources including geothermal, alternative energy sources such as gas hydrates and oil shale, unconventional gas resources, conventional oil and gas resources, and to conduct a national geologic carbon sequestration assessment (found under the Climate and Land Use (CLU) Change section).

Program Performance

Energy Policy Act of 2005 Implementations – The Energy Policy Act of 2005 called for actions for which USGS science is a critical component. The Act addresses a range of energy sources, with emphasis on assessment of geothermal resources, alternative energy sources such as gas hydrates and oil shale, and research on unconventional gas resources. The act also reauthorized the Energy Policy and Conservation Act Amendments of 2000 (EPCA), in which the USGS was directed to assess oil and gas resources underlying Federal lands in the United States.

Energy Independence and Security Act of 2007 Implementation – The Energy Independence and Security Act (EISA) of 2007 called for the USGS to develop a methodology for a national geologic carbon sequestration assessment and conduct a national assessment using the new methodology. Activities related to geologic carbon sequestration are implemented in the Energy Resources Program; however, funding resides in the Climate and Land Use Change mission area and a description of those activities can be found in the Climate and Land Use Change section. EISA also called for the USGS to assist the BLM in evaluating geologic carbon sequestration on public lands. In addition, EISA directed the USGS to complete a comprehensive nationwide geothermal resource assessment that examines the full range of geothermal resources of the United States.

The ERP portfolio consists of six components: National Oil and Gas Resources; Geothermal Resources; New Energy Frontier – Wind; National Coal Resources; World Oil and Gas Resources, and Energy Information and the Environment. Brief summaries of these components are given below.

National Oil and Gas Resources

(Estimates for 2012 enacted, $15.0 million; 2013 CR, $ 15.0 million; 2014, $15.0 million)

The Nation's future petroleum energy supplies will likely come from a mix of domestic oil and gas fields, oil and gas imports, and unconventional resources such as shale gas, tight gas sands, coalbed methane and, in the longer term, unconventional resources such as natural gas hydrates. Concern about greenhouse gas emissions, legislation such as the Energy Policy Act of 2005 and EISA of 2007, and concern about fuel prices and energy security have increased the importance of identifying and characterizing the Nation's domestic petroleum resources, especially natural gas.

The ERP is estimating the volume of undiscovered oil and gas resources in the United States, including those under Federal lands, in support of the scientific inventory of oil and gas resources mandated by the EPCA (P.L. 106-469 §604). ERP is also participating in the interagency coordination activities in support of the 2012 Memorandum of Understanding (MOU) among DOI (USGS), DOE, and EPA, aimed at providing research and technologies that support sound policy decisions by Federal, state, and local agencies responsible for ensuring the prudent development of oil and gas resources while protecting human health and the environment: *http://unconventional.energy.gov/* .

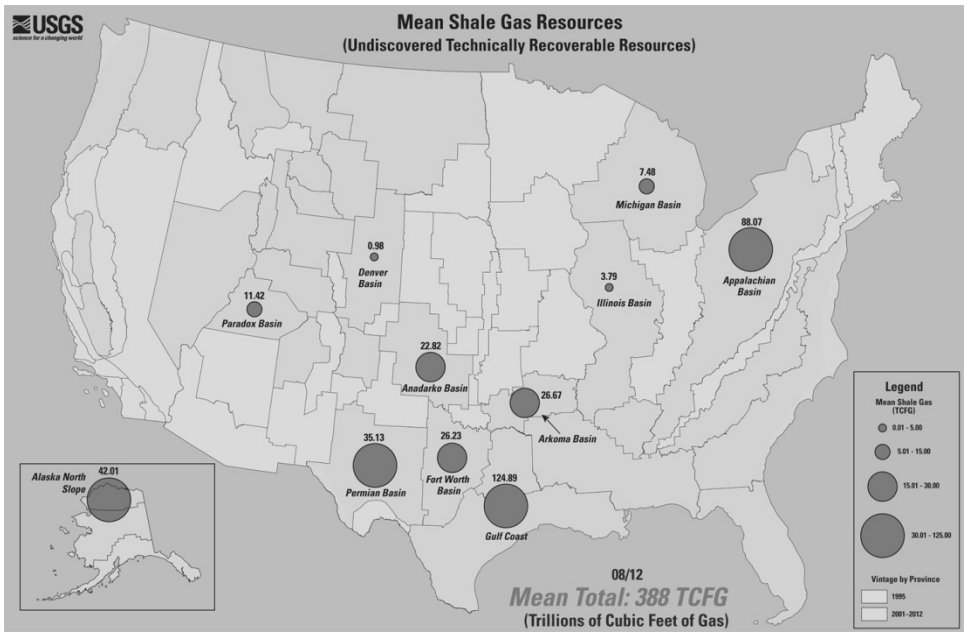
The USGS will continue to update its oil and gas resource assessments for the United States and the world using a consistent, peer-reviewed methodology as authorized in the Energy Policy Act of 2005 (P.L. 109-58 §364). In 2012, the ERP released several domestic assessments including the Utica Shale and East Coast Mesozoic Basins. In 2013 and 2014, the USGS will complete assessments of the Eagle Ford, and update the assessments of the Bakken Shale and the Barnett Shale.

Alaska – The North Slope of Alaska is thought to have the greatest remaining petroleum resource potential of any U.S. onshore area. The ERP conducts in-depth studies of the geology and the oil and gas resources in this world-class petroleum province. In 2012, the USGS released the first-ever shale-oil and shale-gas resource assessment of the Alaska North Slope. Though there is a large range of uncertainty associated with these resources, recent success of shale oil and shale gas development in the lower-48 states demonstrates the technical viability of such resources. This new USGS assessment provides an estimate of potential resources that may be technically viable in this frontier region. Work in 2013 and 2014 focuses on improving the stratigraphic resolution of Cretaceous–Tertiary strata of the Chukchi Shelf, which will help improve the understanding of petroleum systems of all of Arctic Alaska and may have implications for the U.N. Convention on Law of the Sea.

Gulf Coast Region – The Gulf Coast region is one of the major hydrocarbon-producing areas of the world. This ERP effort provides geologic, geophysical, and geochemical framework studies necessary to enable USGS scientists to better assess potential for undiscovered resources of oil-, gas-, and coal-bearing rocks of Texas, Louisiana, Mississippi, and Alabama; and extend potential onshore plays to the state offshore for use by the Bureau of Ocean Energy Management (BOEM) for its offshore Federal resource assessments. During 2013 and 2014, project staff will continue framework studies, including those of the Austin Chalk, and to help in the geological identification of “sweet spots” within continuous assessment units.

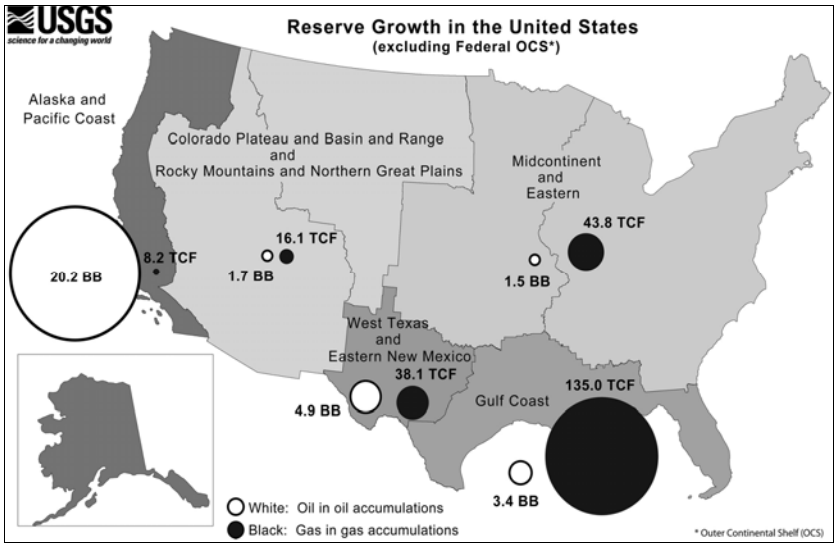
Continuous (Unconventional) Resources – Estimates show the largest remaining undiscovered domestic gas resource occurs in what USGS scientists term "continuous" accumulations, e.g., coalbed methane and basin-centered gas from low-permeability geologic units such as 'tight gas' and ‘shale gas’

reservoirs. (Note: This type of resource is also called "unconventional.") Understanding continuous gas resources, the fastest growing resource produced in the United States, is critical for the responsible use of this energy resource, the sustainability of the domestic energy supply, and policy decisions regarding energy and economic security. Research areas to be emphasized during 2013 and 2014 include understanding the formation, the petrophysical properties, and the ultimate production of these resources so as to continually improve our assessments, as well as providing publicly available information that aids multiple objectives, from responsible development to science-based policy decisions.



Shale gas resources from the 2012 assessment update to the National Oil and Gas Assessment.

Reserve Growth – Given the importance of reserve growth in existing oil and gas fields to overall petroleum supplies, the ERP has a research activity focused on this aspect of the resource spectrum. Reserve growth is the increase in estimated volumes of oil and natural gas that can be recovered from discovered (known) fields and reservoirs through time. Most reserve growth results from delineation of new reservoirs, field extensions, or improved recovery techniques, thereby enhancing efficiency, and necessitating recalculation of reserves due to changing economic and operating conditions. In 2012, the ERP released a new estimate for potential additions to domestic oil and gas reserves from reserve growth in discovered, conventional accumulations in the United States. The USGS estimates that the mean potential conventional reserve additions for the United States total 32 billion barrels of oil, 291 trillion cubic feet of gas, and 10 billion barrels of natural gas liquids, constituting 10 percent of the overall U.S. oil and gas endowment. In 2012, the ERP also released estimates of reserve growth for the world, which total 665 billion barrels of oil, 1,429 trillion cubic feet of natural gas, and 16 billion barrels of natural gas liquids. In 2013 and 2014 work will continue on publishing additional scientific and information products stemming from the assessments.



Results from the 2012 USGS reserve growth assessment for the United States, exclusive of the Federal OCS.

Gas Hydrates – Currently, the ERP works closely with the governments of several countries, including the Indian Directorate General of Hydrocarbons (DGH) and the Government of the Republic of Korea, to study, characterize, and explore for hydrates off the coasts of India and the Republic of Korea. These collaborative efforts help move the collective knowledge of this underexplored resource forward and are directly applicable to studies in the United States. The ERP also works extensively on U.S. gas hydrates, most notably on the Alaska North Slope and the Gulf of Mexico, and applies lessons learned from elsewhere to these domestic resources. The ERP recently completed the first-ever resource estimate of technically recoverable gas hydrate on the Alaskan North Slope, and ERP will continue in 2013 and 2014 to work with DOE and industry in analyzing results from recent production tests, as well as supporting efforts for a long-term gas hydrate test well program in northern Alaska. the USGS is also working with BLM to conduct a geologic-based analysis of the occurrence of gas hydrates within Northern Alaska. This analysis is part of a larger Gas Hydrate Development Lifecycle Assessment Project (a cradle-to-grave "assessment" of several representative gas hydrate "fields" in northern Alaska), designed to determine the role gas hydrates may play as a future domestic energy resource and to characterize the potential environmental and economic impact of gas hydrate exploration and development.

Oil Shale Resources – The Energy Policy Act of 2005 (P.L. 109-58 §369), recognized the need for updated information on domestic oil shale resources and in accordance with the legislation, the USGS has completed assessments of Green River Formation oil shales. These assessments are of the in-place resources because there is currently no economically viable method to develop oil shale resources. Work subsequent to these assessments is focusing on assessments of what is technically recoverable using various production technology scenarios.

Geothermal Resources

(Estimates for 2012 enacted, $1.6 million; 2013 CR, $1.6 million; 2014, $3.6 million)

In support of the Energy Policy Act of 2005 (P.L. 109-58 §226), the USGS published a national assessment of geothermal resources capable of producing electric power. The majority of geothermal resources in the United States are on public lands and data are important for responsible management of public resources. New research and assessment work is critical to understand geothermal systems and to determine the extent to which geothermal resources can play a part in the domestic energy mix. There are unconventional geothermal resources with potential for electrical generation; the most promising are

Enhanced Geothermal Systems (EGS). EGSs are geothermal resources that require some form of additional engineering to develop permeability necessary for circulation of hot water or steam and recovery of heat for electrical power generation. New research studies, in coordination with DOE and BLM, will focus on understanding geologic and hydrologic aspects of EGS development and providing a framework for future assessments of EGS resource potential. In 2013 and 2014, research will include studies of geothermal potential in sedimentary basins, and on developing an improved understanding of formation and evolution of permeable faults and fractures that form most geothermal reservoirs, and how they may affect resource use and relate to induced seismicity. This information will be used in future assessments, to better quantify the potential contribution from this domestic, renewable energy source.

New Energy Frontier – Wind

(Estimates for 2012 enacted, $1.1 million; 2013 CR, $1.0 million; 2014, $1.0 million)

The ERP, in response to the Secretary of the Interior's New Energy Frontier Initiative, is developing a quantitative methodology that can be applied nationwide to assess the impacts associated with wind energy development on wildlife. In 2012, the ERP sponsored workshops that brought together experts, including from BLM, BIA, BOEM, FWS, NOAA, academia, industry, and nongovernmental organizations, to work toward common approaches in the development of a wind energy impact assessment methodology. Results of these workshops will guide future research and the methodology development. These efforts facilitate collaboration and ensure long-term viability of information products that contribute to the Nation's understanding of the management and effects of wind energy. Work in 2013 and 2014 will include continuing to reach out to stakeholders and those with technical expertise in wildlife impacts associated with wind energy and to start developing a draft assessment methodology.

National Coal Resources

(Estimates for 2012 enacted, $1.5 million; 2013 CR, $1.5 million; 2014, $1.5 million)

The USGS recently revised its assessment methodology to determine the subset of U.S. coal resources that are available for mining and are technically and economically recoverable (the coal reserve base). Federal and State land managers use these results to support land use decisions; environmental regulators use the information to evaluate compliance with regulations stemming from the 1990 Amendments to the Clean Air Act; and economists use the results to forecast economic trends at regional and national scales. The ERP works closely with counterparts at other organizations (BLM, the Energy Information Administration, for example) to ensure revised products address a variety of needs. The ERP published in 2013 an updated assessment, including the first-ever basin-wide assessment of economically recoverable coal, of the Powder River Basin, the largest source of domestic coal supply. Analysis of the coal resources in the Colorado Plateau will start in 2013 and continue on into 2014.

World Oil and Gas Resources

(Estimates for 2012 enacted, $1.6 million; 2013 CR, $1.6 million; 2014, $1.6 million)

The USGS World Petroleum Assessment Project conducts geologic studies to improve understanding of the quantity, quality, and geologic distribution of world oil and gas resources. Location information and type of undiscovered global petroleum resource are critical to energy policy and energy security, and have important geopolitical implications. In 2012, the USGS released an assessment of global undiscovered, technically recoverable, conventional petroleum resources (Figure 3). This new assessment is a complete reassessment of the world since the last USGS World Petroleum Assessment in 2000. Many new areas were included in the current study. In 2013 and 2014, particular emphasis will be placed on the global assessment of technically recoverable resources in continuous (unconventional) accumulations, such as tight gas, tight oil, shale gas, and coalbed gas. Currently, there is no global unconventional resource assessment, yet it is one of the most requested products of the ERP. Assessments will be published as

they are finalized, so as to be timely in the release of this information. Work in 2013 and 2014 will focus on countries such as India, China, parts of South America, and Europe.

Energy Information and the Environment
(Estimates for 2012 enacted, $5.6 million; 2013 CR, $6.9 million; 2014, $6.9 million)

Coal Quality – Currently, coal provides about 42 percent of all U.S. electricity and about 45 percent of the world's electricity. Although coal is a reliable, plentiful, and inexpensive energy source, coal usage carries significant environmental challenges and impacts. However, there are ways to make coal utilization cleaner and safer through engineering advances and integration of geologic and geochemical studies on coal usage. The USGS provides information on how elements in coal partition during combustion and helps to quantify the fate of coal combustion products in the environment. USGS coal quality research focuses on a range of issues that affect our Nation and the world, including land disturbances, coal emissions, coal combustion by-products, and waste handling. Geochemical data and research results are relevant to future coal assessments and are available to land managers and decisionmakers at DOI and other Federal agencies, State agencies, industry, and the general public.

Energy Information – Delivering information and improving the capacity to do so is a high priority for the ERP. In 2011, ERP launched a redesigned Web site to improve discovery and navigation, serve more information, and reduce maintenance. A significant proportion of all visits to the USGS's main Frequently Asked Questions site are related to ERP topics. In 2011 and 2012, the ERP worked with the DOE and OSTP, to make a number of ERP products available on a unified Federal Web site that is part of the *data.gov* initiative. All of these efforts will continue in 2013 and 2014, so that ERP science and information is served through a number of means and is more readily available to a variety of users.

National Coal Resources Data System - contains information on location, quantity, attributes, stratigraphy, and chemical components of U.S. coal deposits. A long-term partnership of the USGS and State Geological Surveys enables this sustained effort to collect and analyze basic data, build and verify the digital databases, and serve these USGS-maintained datasets. In 2013 and 2014, the State Coop activity will continue to collect data on coal and shale gas from those States for which the USGS has current agreements.

Produced Waters – Oil and gas production often uses and yields significant quantities of water, thus information related to water and fluids associated with energy resource development is critical. ERP has studied produced waters for a long time, but has recently turned its focus to those waters produced with unconventional resources (shale gas, tight oil, etc.). ERP research will provide information on the volume, quality, impacts, and possible uses of water produced during oil, gas, and coalbed natural gas production and development. In 2013 and 2014, ERP will continue collaborative research on beneficial use of produced waters and the environmental impacts of such use; study naturally occurring radioactive materials in produced waters and controls on them; and develop water budgets associated with oil and gas production to supplement oil and gas resource assessments. ERP's base activities to understand environmental impacts associated with oil and gas development will support the interagency hydrofracturing initiative as well as the President's 2014 budget.

Uranium – Nuclear energy now accounts for about 20 percent of U.S. generated electricity. Updated knowledge of the geologic setting, occurrence, and estimates of the magnitude of the undiscovered U.S. uranium resource endowment is critical to inform planning efforts about potential domestic uranium supplies. The USGS is currently developing a methodology and framework for an updated assessment of undiscovered uranium resource potential of the United States (to be finalized in 2013). In 2012, a USGS scientist was elected chair of the Organization for Economic Cooperation and Development – Nuclear Energy Agency/International Atomic Energy Agency's Uranium Group; this is the first U.S.

representative elected to chair the Uranium Group in more than 30 years. Work in 2013 and 2014 will expand beyond resource assessment to develop a life-cycle approach that complements the national resource assessment with evaluating the effects of mining in various geological environments.

Science and Decisions Center

(Estimates for 2012 enacted, $1.2 million; 2013 CR, $1.2 million; 2014, $1.2 million)

The mission of the USGS Science and Decisions Center (SDC) is to advance the use of science in resource management decisions through research and applications on ecosystem services, decision science including adaptive management, and resilience and sustainability. In fiscal year 2012, SDC worked with other Federal and non-Federal organizations to improve linkages between ecosystem services science and application through leadership in developing the scientific program for ACES (A Community on Ecosystem Services) and Ecosystem Markets 2012, an international conference on linking science, practice, and decisionmaking. USGS scientists also provided technical leadership in developing a DOI Adaptive Management Applications Guide, which provides DOI and other Federal and non-Federal organizations with guidance on applying adaptive management in resource management decisionmaking. the USGS also collaborated with the U.S. Forest Service to develop a publication for middle school students on adaptive management. In fiscal year 2013, SDC is working with partners to develop a framework for integrating adaptive management decision processes with an ecosystem services analytical framework. the USGS is also working with other agencies to estimate the value of ecosystem services in support of resource management decisions. USGS scientists are collaborating with partners to develop a framework for integrating energy and mineral resource assessments with biological and water resources data to consider criticality, economic interrelationships, and the consequences of alternative decisions in economic terms. A pilot study on natural resources and their interrelationships is being developed in the Powder River Basin in Wyoming.

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Activity: Energy, Minerals, and Environmental Health
Subactivity: Contaminant Biology

2012 Actual: $9.2 million (65 FTE)
2013 CR: $9.2 million (65 FTE)
2014 Request: $14.0 million (81 FTE)

Overview

Contaminant Biology Program (CBP) science is a key resource for managing and protecting the health of the Nation's environment, including the health of fish and wildlife populations. In its 2007 science strategy, the USGS identified *The Role of the Environment and Wildlife in Human Health* as a strategic focus through which the USGS "can make substantial contributions to the well-being of the Nation and the world."

The CBP, working in close collaboration with the Toxic Substances Hydrology Program (TSHP), will implement the U.S. Geological Survey Environmental Health Strategic Science Plan (EH SSP). The Program will fund research and activities that support the priorities identified in the EH SSP. To maximize resources, CBP will continue working in close partnership with other USGS mission areas and a multitude of State and Federal agencies and NGOs. These collaborative activities provide a valuable foundation for USGS leadership in the field of environmental health science. In 2014, based on the priorities described in the EH-SSP, the CBP will emphasize providing the natural science needed by resource managers, health professionals, policymakers and the public in three main areas:

- Anticipating, detecting, and preventing adverse health impacts from newly emerging environmental diseases;
- Reducing the impact of environmental diseases on the environment, fish, wildlife, and people including improving management approaches for mitigating the health effects of combined exposure to contaminants and pathogens; and
- Disaster resilience, as the USGS program lead, the CBP will be coordinating and supporting the portfolio of USGS activities to help the Nation prepare for and respond to health related threats resulting from natural and man-made disasters.

Through these activities, the CBP provides leadership and science to inform regulatory decisions; enhance remediation and restoration technologies, and improve best management practices to prevent or mitigate the adverse health impacts of environmental diseases and disasters.

Program Performance

Providing the Natural Science Needed to Anticipate, Detect, and Prevent the Health Impacts of Emerging Environmental Diseases.

Environmentally driven diseases are caused by disease agents such as contaminants and toxins (e.g., endocrine disruptors, pesticides, pharmaceuticals, mercury) and infectious pathogens (e.g., prions, viruses, bacteria, parasites) that constitute a critical threat to environmental health including fish, wildlife, and people. Threats from newly emerging disease agents will continue to increase, resulting in increased health risks and economic vulnerability. Historically, scientists relied on established monitoring programs to assess changes in the environmental conditions that affect disease. That approach allows decisionmakers to react to past changes, but leaves a significant scientific gap in the Nation's ability to identify and anticipate emerging health threats. As the number of environmental health threats continues

to grow and become increasingly complex, sound science, informed decisionmaking and early action will be critical for timely and cost-effective prevention and mitigation. Utilizing the strategic actions described in the EH SSP, along with input from natural resource, agricultural and public health managers CBP will continue to work to ensure that (1) the Nation's capabilities for anticipating and identifying emerging environmental health threats are enhanced; (2) resources are leveraged among partners; (3) data gaps are identified and filled; and (4) information is made available to decisionmakers in a useful and timely manner.

New activities in 2014 will support assessing the health and ecological impacts of resource extraction such as hydraulic fracturing and uranium mining. These activities will be conducted in collaboration with Federal agency partners and will compliment concurrent work being done by the USGS Toxic Substances Hydrology program. Establishment of baseline concentrations in sentinel species at selected new extraction sites (before extraction begins), along with determining priority toxicological pathways of exposure and biological effects of exposure, are crucial to evaluate if chemical and radiation contamination are increased due to extraction activities and pose unacceptable risk to biota. The results will be used for developing prevention and mitigation strategies to ensure that the health and sustainability of natural resources are balanced with economic development.

The Natural Science Needed to Reduce the Impact of Environmental Diseases.

Environmental factors also influence the distribution, transmission, and severity of existing diseases. It is estimated that 24 percent of the global disease burden and 23 percent of all human deaths are attributable to environmental factors; understanding these factors is critical. Environmental changes resulting from increasing demands for resources and changes from natural processes can increase the risk of exposure to disease agents. Exposure can occur directly from the environment (via water, soil, etc.) or from contact with other organisms (via the food chain, vector-borne, etc.). There is still a significant gap in understanding how changes in environmental processes affect the health of animals and people. The CBP combines research, monitoring, and predictive models to identify and understand the sources, bioavailability, spread, and physiological impacts of emerging disease agents on fish and wildlife species.

In 2013, the USGS is leading a tri-national (United States, Canada, Mexico) effort to assess how geochemical, land-use, and climatological factors affect mercury deposition across Western North America. This work which integrates geospatial information on habitat, land-use, and climate models to identify species that are most at risk and to provide resource managers with a tool to more effectively control mercury impacts.

Historically, researchers studied the effects of pathogens and contaminants in isolation; yet animals and people are often exposed to both simultaneously It is critical to identify and assess the potential combined effects of toxicological and infectious agents in the environment. For example, in 2014 CBP funded research focused on identifying and evaluating the long term impacts of endocrine disrupting chemicals (EDCs) on fish and wildlife health with implications for human health will continue to be a priority.

Exposure to EDCs can cause reductions in reproduction, deformities, behavioral abnormalities, as well as immune dysfunction. Complimentary laboratory research and field investigations will be focused on: (1) understanding how EDCs impact the immune function and disease resistance; (2) assessing sources and effects of agricultural-related EDCs on the health of birds, fish and amphibians; (3) identifying both trans-generational genetic effects and behavioral effects in fish and wildlife species; and (4) investigating the movement of EDCs through ecosystems to characterize risk across species and identify vulnerable species. The results of these studies will be used to better quantify risk and evaluate potential tools that resource managers might use to reduce EDC exposure and impacts in fish and wildlife species.

Disaster resilience: helping the Nation prepare for and respond to health related threats resulting from natural and man-made disasters.

the USGS has internationally recognized expertise related to the environmental health impacts of disaster, impacts that can affect public health, animal health, and the economic well being of the Nation. The USGS provides science to Federal agencies tasked with responding to immediate and long term the environmental health impacts of natural and anthropogenic disasters. A disaster event can be a catalyst for the release of hazardous materials containing contaminants or pathogens into the environment (ex. leaking of radiation after earthquake damage to a nuclear reactor, release of contaminants or pathogens from a wastewater treatment plant due to flooding) or can result in environmental conditions that can promote infectious disease outbreaks.

For example, in 2011 the Fukushima I Nuclear Power Plant suffered major damage from the 9.0 earthquake and subsequent tsunami that hit Japan. The USGS was asked to provide information on the potential effects of radiation on fish and wildlife in the area. In 2013, CBP conducted pilot studies to characterize wind dispersion and long term impacts of uranium exposure on wildlife species.

CBP serves as the USGS point of contact for coordinating the portfolio of the USGS chemical and biological threat preparedness and response activities. The USGS partners with and provides expertise to Interior, the Department of Homeland Security (DHS), the U.S. Department of Agriculture (USDA) , the Department of Health and Human Services, the U.S. Department of State, the Department of Defense, the Smithsonian Institute, and the U.S. Agency for International Development to develop disease models, maps, and diagnostic tools for detecting health threats related to disasters and provides advice on response strategies for fish, wildlife and zoonotic diseases. For example, *"The White House National Science and Technology Council Subcommittee on Foreign Animal Disease Threats (FADT) 2012-2016 Research and Development Plan"* identifies as a high priority development of an interagency framework for preparing for and responding to high consequence diseases (HCDs) in wildlife such as migratory birds and white-tail deer. HCDs have the potential to produce significant public health, agricultural, ecological and economic impacts. In 2013 CBP, serving as the Federal wildlife lead, initiated and co-led an interagency effort to compile and assess the scientific knowledge needed for development of the framework. The result will be a report that identifies currently available data and capabilities; gaps in knowledge and tools; and Federal communication needs that are critical for protecting human and animal health as well as the economic well-being of the Nation. The report will be used by state and Federal agencies and the White House to inform discussions on development of the national framework.

With heightened concerns regarding terrorism there is an increasing awareness of the value of using fish and wildlife disease events as a system for detecting human health threats due naturally occurring or intentionally introduced to chemical agents and zoonotic diseases (diseases transmissible between animals and people). Many of the "Select Agents and Toxins" listed in the National Select Agent Registry (a list of select pathogens and toxins deemed a potential threat to human or animal health) can affect or be transmitted by fish or wildlife. At the request of state and Federal partners, CBP scientists conduct field investigations of fish and wildlife mortality events and develop new methods for detecting and understanding the effects of environmental disease agents. In 2013, CBP and its partners developed a new method for measuring chronic domoic acid exposure in sea lions. Domoic acid is a potent neurotoxin that can be released during harmful algal blooms. Exposure to the toxin can result in neurological damage including temporary or permanent memory loss, seizures, and potentially death. The toxin can cause serious health problems in mammals such as sea lions and humans that regularly consume fish or shellfish laden with the toxin. These studies will be valuable for assessing the long term effects domoic acid exposure in animals and humans.

Going forward the USGS will continue to serve as Federal lead agency in this area. In 2014, the USGS will continue to lead and expand this effort by working closely with state and Federal agencies, non-governmental organizations and academia on high priority tasks such as the development of predictive modeling and forecasting tools for assessing the risk of emerging health threats.

Activity: Energy, Minerals, and Environmental Health
Subactivity: Toxic Substances Hydrology

2012 Enacted: $10.6 million (61 FTE)
2013 CR: $10.6 million (61 FTE)
2014 Request: $16.1 million (72 FTE)

Overview

The Toxics Substances Hydrology Program (TSHP) supports environmental contamination research, which provides reliable scientific information and tools that explain the occurrence, behavior, and effects of toxic substances in the Nation's natural environments.

Contamination problems addressed by the TSHP are widespread and pose significant risk to human health and the environment. The TSHP focuses on contamination issues of emerging concern based on input from Federal, State, tribal, and local entities, nongovernmental organizations, and others. The program supports laboratory and field based research conducted by large multidisciplinary teams of USGS and other scientists. Field studies are conducted at representative sites, watersheds, or regions. Results provide a foundation for informed decisionmaking by resource managers, regulators, industry, and the public, helping to improve environmental monitoring, characterize and manage contamination, develop best management practices, form regulatory policies and standards, register the use of new chemicals, and guide chemical manufacture and use.

The TSHP reacts rapidly to emerging issues; develops new methods and collects field data in the most susceptible environmental settings across the Nation; maintains field networks and research sites that provide a focal point for interdisciplinary research; addresses contamination problems at a wide range of geographic scales and environmental settings, and provides fundamental knowledge of the inherent clean-up capacity of our natural environments. Scientific findings are distributed broadly via briefings, workshops, technical meetings, and scientific reports. In the 5-year period 2007–2011, the TSHP produced about 900 scientific publications. The program directly supports the USGS Science Strategy and Interior goals by providing a scientific foundation for decisionmaking. In 2014, the TSHP will work closely with the CBP to develop an implementation strategy for the new USGS Environmental Health Science Strategy. More information about the TSHP is available on the Web at *http://toxics.usgs.gov/*.

Program Performance

The TSHP has two primary components: investigations of subsurface point-source contamination and investigations of watershed-scale and regional-scale contamination.

Investigations of Subsurface, Point-source Contamination
(Estimates for 2012, $4.2 million; 2013 CR, $4.2 million; 2014, $4.6 million)

These investigations improve capabilities to describe, manage, and remediate subsurface contamination from local releases, such as chemical spills, leaking storage tanks, industrial discharges, and leakage from landfills and other waste facilities. The knowledge and new methods developed at intensely studied, representative sites are applied to similar sites across the Nation. In 2013, the TSHP is investigating mixed chemical and low-level radioactive waste emanating from a closed low-level radioactive waste repository in the arid southwest, and in 2014, will address the role of volatile organic compounds in facilitating the transport of radionuclides in the subsurface. The TSHP is currently investigating solvent contamination at a closed Navy testing facility in a sedimentary fractured rock aquifer, and in 2014 will

characterize the processes that contribute to the persisting release of solvent residues from the rock matrix and the implications for protracted and expensive pump-and-treat remediation. This investigation continues to benefit from support of the Strategic Environmental Research and Development Program (SERDP; an EPA, DOD and USEPA consortium). The TSHP is investigating crude oil contamination from a ruptured petroleum pipeline, and in 2014 will quantify processes controlling volatilization of residual hydrocarbons in the unsaturated zone and the degradation of high-molecular weight hydrocarbons that are persisting at the site. The TSHP also is investigating a wastewater contaminant plume associated with a wastewater treatment facility, and in 2014 will integrate information on the evolution of the microbial community, residual nutrients and metals on sediments, and estimates of oxygen consumption to explain the persistence and evolution of the contaminant plume.

Antibiotics in Groundwater Change Natural Bacterial Community – USGS scientists demonstrated that the ecology of natural subsurface bacteria changed after exposure to the antibiotic sulfamethoxazole (SMX), an antibiotic commonly used to treat sinus infections and pneumonia. This study is important because subsurface bacteria are critical to providing nutrients plans and other organisms that on which our natural systems depend. This study indicates that SMX contamination may change the nature of bacterial flora in the environment and supports previous laboratory work indicating that natural bacterial processes and ecological functions that many plant depend upon may be affected by environmentally occurring SMX. More information is available on the Internet at:
http://toxics.usgs.gov/highlights/bacteria_gw.html

> *"…the [USGS] papers about the Ashumet Valley sewage plume were particularly helpful in understanding what we could possibly encounter in the investigation of the CAFO. We are particularly impressed with the level of effort, cost, time, and expertise it took to fully investigate the Ashumet Valley sewage plume … Thank you for producing outstanding scientific works at the Cape Cod site that explore important aspect of groundwater contamination, and in particular the Ashumet Valley series of papers.*"
>
> – David Miesbach, Supervisor, Groundwater Unit, Water Quality Assessment Section, Nebraska Department of Environmental Quality

VOCs Transport and Potential Significance to Buried Radioactive Wastes – In 2012, a team of scientists from the USGS and Portland State University working at the TSHP Amargosa Desert Research Site (ADRS) in Nevada found that volatile organic compounds (VOCs) emanating from a closed low-level radioactive waste landfill migrated as much as 300 meters from the landfill through the subsurface area located just above groundwater resources known as the unsaturated zone. This study was critical because the VOCs could impact local ground water resources. Elevated levels of VOCs were measured throughout the 110-meter thick unsaturated zone. The VOCs originate from wastes disposed of with the radioactive waste. In this first-of-its-kind study, a wide range of VOCs were observed - gasoline components such as xylene, benzene, and toluene, industrial solvents such as trichloroethylene (TCE) and tetrachloroethylene (PCE), and chlorofluorocarbons (CFCs Results of this study can inform decisions regarding the disposal, management, and monitoring of mixed radioactive and conventional wastes. More information is available on the Internet at:
http://toxics.usgs.gov/highlights/adrs_vocs.html

Natural Attenuation Accelerates TCE Cleanup in Fractured Rock Aquifer –Naturally occurring processes can assist in the cleanup of toxic substances. TSHP research at the Naval Air Warfare Center (NAWC) Research Site in West Trenton, New Jersey determined that natural biodegradation of trichloroethylene (TCE) at the site contributes substantially to TCE removal operations. An active pump-and-treat system is presently removing about 630 kilograms of TCE per year (kg/yr) at the site. A methodology developed at the site estimated that natural biodegradation of TCE removes an additional 500 kg/yr. Natural TCE biodegradation does not incur the economic costs of a pump-and-treat and is a welcome addition to overall cleanup operations at this site. The methodology for estimating TCE biodegradation rates in fractured rock aquifers is now available for application at other solvents-

contaminated fractured bedrock sites. More information is available on the Internet at: *http://toxics.usgs.gov/highlights/tce_biodegradation.html*

Investigations of Watershed-scale and Regional-scale Contamination
(Estimates for 2012, $6.4 million; 2013 CR, $6.4 million; 2014, $11.5 million)

These investigations address nonpoint-source contamination problems typical of widespread land uses or human activities that may pose a threat to human and environmental health throughout a significant portion of the Nation. These investigations include developing laboratory and field methods to ensure accurate measurement of contaminants, characterizing contaminant sources, investigating mechanisms by which contamination affects aquatic ecosystems, and investigating the processes that transform contaminants into different and possibly more toxic forms. In 2013, the TSHP is investigating emerging contaminants in human animal and industrial wastes, and in 2014 this project is undertaking a major effort to characterize chemical mixtures and identify new environmental contaminants using forensic approaches. USEPA is participating in this study and is using field samples and chemical analyses provided by the USGS to test new screening assays for biological activity. In 2013, the TSHP is continuing studies of new and commonly used pesticides in common pesticide-use settings across the Nation, and in 2014 is assessing atmospheric transport of the herbicide glyphosate, the effects of pyrethroid insecticides on salmon, and continuing to test the toxicity of fungicides on non-target organisms, such as insect gut fungi. In 2013, the TSHP is studying mercury cycling and methylation in aquatic ecosystems, and in 2014, will be integrating assessments of the processes controlling mercury methylation in the world's major oceans. The TSHP also is studying the environmental impacts of metals mining, and in 2014, is initiating a new investigation of the environmental impacts of uranium extraction and cost efficient remediation strategies is being coordinated with the Energy Resources, Mineral Resources, and Contaminant Biology Programs. In addition, planning for implementation of the water quality enhancement activities as part of the WaterSMART effort will begin.

New Approach for Evaluating Fish Metal Toxicity - In 2013, a new approach was developed for evaluating the toxicity of metals to fish in streams affected by mining impacts. USGS scientists demonstrated that metals levels in such rivers can fluctuate considerably on a daily cycle, which makes evaluating impacts on the health of aquatic organisms challenging. The approach was developed at two Montana streams affected by historical metal contamination; Silver Bow Creek in southwestern Montana, and High Ore Creek north of Butte, Montana. More information is available on the Internet at:*http://toxics.usgs.gov/highlights/fish_toxicity_method_hl.html*

Hormones in Land-Applied Biosolids Could Affect Aquatic Organisms - Scientists from the USGS and Colorado State University found that hormones from biosolids applied to fields could affect the health of aquatic organisms if rainfall runoff reaches streams. Artificial rainfall runoff from agricultural test plots where biosolids were applied as fertilizer contained several estrogens, androgens, and progesterone. The occurrence of natural and synthetic hormones in streams is a growing concern because low part-per-trillion concentrations of these chemicals have caused endocrine disruption in aquatic organisms. Biosolids are created from the sludge generated by the treatment of sewage at wastewater treatment plants (WWTPs) and are known to contain natural and synthetic hormones. The study results advance our knowledge of potential impacts of biosolids application on streams and aquatic organisms and will assist wastewater-treatment-plant, water-resource, and wildlife managers design biosolids management and use practices. More information is available on the Internet at: *http://toxics.usgs.gov/highlights/biosolids_runoff.html*

Improvements in Wastewater Treatment Reduces Fish Endocrine Disruption - A team of scientists from the USGS, the University of Colorado, and the City of Boulder, Colorado, demonstrated that improvements to the treatment process at a wastewater treatment facility (WWTF) reduced endocrine

disruption in fish exposed to wastewater effluent discharged from the facility. the USGS had already established that organic chemicals that were not removed in wastewater treatment before the improvements were having substantial effects on local fish. This study, completed in 2012, evaluated changes in the levels of a wide variety of contaminants after a major ($45 million in cost) upgrade to the Boulder, Colorado, WWTF, in which the facility was converted from a biological filter plant with solids contact to an activated sludge treatment. The scientists found that the WWTF upgrade enhanced removal of hormones (steroidal estrogens) and other endocrine disrupting compounds from the wastewater, documented a decrease in some endocrine disrupting chemicals resulting from voluntary reductions in chemical use, and resulted in a decrease in fish endocrine disruption. Understanding the effectiveness of various treatment and chemical use alternatives is essential for a comprehensive and successful approach to reduce the effects of endocrine disrupting chemicals in streams. More information is available on the Internet at: *http://toxics.usgs.gov/highlights/fish_toxicity_method_hl.html*

Activity: Natural Hazards

		2013 Full Yr. CR (PL 112-175)	2012 Enacted	2014 Fixed Costs and Related Changes (+/-)	2014 Program Changes	2014 Internal Transfer	2014 Budget Request	Change from 2012 Enacted (+/-)
Earthquake Hazards ($000)		*54,379*	53,879	607	3,438	0	57,924	4,045
	FTE	*243*	242	0	4	0	246	4
Volcano Hazards ($000)		*24,122*	24,122	364	212	0	24,698	576
	FTE	*151*	151	0	1	0	152	1
Landslide Hazards ($000)		*3,168*	3,168	52	473	0	3,693	525
	FTE	*21*	21	0	2	0	23	2
Global Seismographic Network ($000)		*5,151*	5,151	32	-17	0	5,166	15
	FTE	*13*	13	0	0	0	13	0
Geomagnetism ($000)		*2,004*	2,004	32	91	0	2,127	123
	FTE	*18*	18	0	0	0	18	0
Coastal & Marine Geology ($000)		*42,221*	42,821	583	5,550	0	48,954	6,133
	FTE	*236*	237	0	5	0	242	5
Total Requirements ($000)		***131,045***	**131,145**	**1,670**	**9,747**	**0**	**142,562**	**11,417**
	Total FTE	***682***	**682**	**0**	**12**	**0**	**694**	**12**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Summary of Program Changes

Request Component	($000)	FTE	Page
Earthquake Hazards	**3,438**	**4**	
Earthquake Products and Improved Monitoring in Eastern U.S.	1,200	0	B-51
Hydraulic Fracturing	1,700	3	B-31
Rapid Disaster Response: Robust Monitoring Networks	850	1	B-45
General Program Reduction	-312	0	B-64
Volcano Hazards	**212**	**1**	
Rapid Disaster Response: Early Warning Networks	400	1	B-45
General Program Reduction	-188	0	B-64
Landslide Hazards	**473**	**2**	
Rapid Disaster Response: Early Warning Networks	500	2	B-46
General Program Reduction	-27	0	B-64
Global Seismographic Network	**-17**	**0**	
General Program Reduction	-17	0	B-64
Geomagnetism	**91**	**0**	
Enhance Monitoring	108	0	B-52
General Program Reduction	-17	0	B-64
Coastal & Marine Geology	**5,550**	**5**	
Coastal Lidar	2,000	2	B-30
Eliminate Management-Supporting Habitat and Service Mapping	-2,150	-8	B-59
Enhanced Coastal Storm Response Capability	850	3	B-53
Great Lakes Beach Health Study	-600	-1	B-59
Science for Coastal and Ocean Stewardship	5,750	9	B-38
General Program Reduction	-300	0	B-64
Total Program Change	**9,747**	**12**	

** Estimated changes in FTEs compare against actual 2012 FTE usage, not 2012 enacted formulation estimates.

Justification of Program Changes

The 2014 Budget Request for Natural Hazards is $142,562,000 and 694 FTE, a net program change of +$11,417,000 and +12 FTE from the 2012 Enacted Budget. For more information on the Natural Hazards Mission Area changes, please see Section B, Program Changes as referenced in the table.

Activity Summary

The Natural Hazards Activity is comprised of six subactivities;

- Earthquake Hazards Program (EHP; *http://earthquake.usgs.gov*)
- Volcano Hazards Program (VHP; *http://volcanoes.usgs.gov*)
- Landslides Hazards Program (LHP; *http://landslides.usgs.gov*)
- Global Seismographic Network (GSN; http://earthquake.usgs.gov/monitoring/gsn)
- Geomagnetism Program (*http://geomag.usgs.gov*)
- Coastal and Marine Geology Program (CMGP; *http://marine.usgs.gov*)

Natural hazards threaten the safety, security, and economic well-being of our Nation's communities as well as impact natural resources and surrounding ecosystems. Much of the Nation's infrastructure is aging and vulnerable to sudden extreme events, and the cost of response to and recovery from disasters continues to rise. Expanding population in coastal zones, floodplains, wildland-urban interfaces, and areas prone to earthquakes and volcanic eruptions heightens risk of future disasters.

In the face of these challenges, the USGS provides emergency responders, policymakers, and the public with the scientific information and knowledge necessary to reduce vulnerability to losses from earthquakes, floods, hurricanes, landslides, magnetic storms, tsunamis, volcanic eruptions, and wildfires. Working with its partners, cooperators, and customers, the USGS delivers a clear understanding of the processes driving these hazards, societal vulnerability to these threats, and strategies for achieving more resilient communities.

As required under the Disaster Relief Act of 1974 (P.L. 92–288), the USGS has the delegated Federal responsibility for monitoring and notification of earthquakes, volcanic activity, and landslides in the United States. For many other hazards, the USGS directly supports the warning responsibility of the National Oceanic and Atmospheric Administration.

The breadth of the USGS hazard mission extends across all of our mission areas as can be seen in our response to Hurricane Sandy. More than 160 USGS scientists, technicians, and specialists responded to Hurricane Sandy's approach and aftermath, from Virginia to Massachusetts to deliver data and analysis to emergency managers. USGS efforts began prior to Sandy coming ashore with the deployment of sensors from prepositioned staging areas to measure rising storm surge levels, conducting airborne LiDAR to measure pre-storm coastal topography and bathymetry, and forecasting probability of coastal impacts to assist preparedness of first responders. A USGS forecast tool predicted the likelihood of impacts to beaches and dunes using predicted storm-induced water levels and known coastal elevations to forecast three severities of coastal change – erosion, overwash, and inundation. Hurricane Sandy's impacts have been significant. Many USGS tidal sensors recorded peaks of record and several were completely overtopped. In addition, high-water marks flagged by USGS crews show sizeable storm surge, including 18.98 feet at Long Branch, NJ; 12.93 feet at the Verazzano Narrows Bridge between Brooklyn and Staten Island, NY; and 7.43 feet at Lindenhurst on Long Island, NY. The USGS continues to provide

information to assist recovery and restoration and to assist redevelopment efforts focused on establishing resilient coastal communities and ecosystems.

This mission area includes USGS activities that characterize and assess coastal and marine processes, conditions, change and vulnerability. USGS expertise in marine geology, geophysics, and oceanographic disciplines provides science and information products essential to the implementation of priority objectives, and identifies critical needs for science and information to support broad objectives that include ecosystem restoration and protection, adaptation to climate change, and sustainable development and resources use. The USGS actively engages with other Interior bureaus, Federal agencies, and regional ocean alliances to provide data and tools to support national and regional objectives. USGS efforts to improve and increase understanding in these areas provides managers and policymakers at all levels with tools to make better and more cost effective decisions that anticipate changing conditions and the consequences of resource use, management, and restoration.

Planning for the USGS Natural Hazards Mission Area is being guided by the newly released *Natural Hazards Science Strategy—Promoting the Safety, Security, and Economic Well-Being of the Nation* (Circular 1383-F). This strategy focuses on core responsibilities and identifies strategic actions to strengthen the Survey's ability to deliver on this mission. The Mission Area's programs also represent important contributions to interagency partnerships, including the multi-agency National Earthquake Hazard Reduction Program (NEHRP), National Space Weather Program (NSWP), and National Tsunami Hazard Mitigation Program, among others. Activities undertaken by these USGS programs are identified as priorities in numerous National Science and Technology Council planning documents, including the Subcommittee on Disaster Reduction's (SDR) *Grand Challenges for Disaster Reduction* (2005), and associated hazard-specific implementation plans for earthquakes, coastal storms, landslides, hurricanes, space weather, tsunamis, and volcanic eruptions (2008-2010), and in joint SDR/U.S. Group on Earth Observations documents *Improved Observations for Disaster Reduction: Near-Term Opportunity Plan* (2006) and *Achieving and Sustaining Earth Observations* plan (2010).

Through the Science Application for Risk Reduction (SAFRR) project, the USGS is working with emergency managers to improve warning systems, enhance emergency response, and speed disaster recovery. SAFRR, created in 2011, builds on the successful Multi-Hazards Demonstration Project, experimented in new ways of applying USGS hazard science to build resilience in southern California. Scenarios developed by that project led to the Great Southern California ShakeOut public preparedness drills in 2008, which has grown into a nationwide series of ShakeOuts with over 14.7 million people in 2012. The same approach to building an end-to-end scenario of catastrophic impacts has been applied to a California-wide winter storm in the ARkStorm scenario, which is now being used by emergency managers for drills and by many others to work through the impacts of an event that strikes that State with the same frequency as large San Andreas earthquakes and with potentially even greater consequences. SAFRR is also developing a Pacific Basin tsunami scenario to aid port managers in their planning strategies that models the economic and social impacts to the U.S. West Coast and Hawaii of a plausible tsunami generated by a magnitude 9.0 Alaskan earthquake. The SAFRR will continue to work with partners, research institutions, communities, businesses, and governments, to improve utilization of existing USGS natural hazards information to identify needs and gaps and to develop new products that increase the use of USGS science. Scenarios akin to ShakeOut and ARkStorm will remain a cornerstone of activity. These science-based scenarios are recognized internationally as a fundamental shift in the way science can communicate to serve society.

In January 2012, the Secretary of the Interior signed Secretarial Order 3188, which established the DOI Strategic Sciences Group (SSG) within the Office of the Secretary. The mission of the SSG is to provide Interior with the standing capacity to rapidly assemble trained teams of scientists to conduct science-based assessments and construct interdisciplinary scenarios of environmental crises affecting resources,

and provide the results of this work to Interior leadership as usable knowledge. Led by co-leaders from the USGS and one other Interior bureau (currently the National Park Service), the SSG adds a new dimension to the USGS Natural Hazards Mission Area by providing a mechanism for scientists to inform decisionmakers of the potential consequences and possible interventions within the coupled human-natural system impacted by a crisis event. The SSG is based on the success of the DOI Strategic Sciences Working Group, which was a temporary entity formed as part of Interior's response to the 2010 Deepwater Horizon Oil Spill. During an environmental crisis, the Secretary can direct the SSG to activate a crisis science team composed of experts from government, academia, non-governmental organizations, and the private sector to build scenarios and deliver information to decisionmakers and resource managers. During non-crisis times, the SSG will develop science-based assessments and interdisciplinary scenarios, identify hazard impacts and possible interventions to reduce such impacts, and make necessary preparations for activating Crisis Science Teams. Over the past year, the SSG has established its operational plan and deployed a crisis science team to support the Hurricane Sandy Rebuilding Task Force.

As a result of the bureau's realignment of functions and responsibilities, the function of emergency management was realigned from the Director's immediate office to the Office of the Associate Director for Natural Hazards. The Deputy Associate Director for Natural Hazards serves as the USGS Emergency Management Coordinator and works closely with the DOI Office of Emergency Management, FEMA and other agencies and organizations to execute the emergency management responsibilities of the bureau. The bureau's Hazard Response Executive Committee (HREC) also is managed from this office. The skills and expertise of many USGS employees are used to respond to a variety of natural hazards and related emergencies. The USGS takes seriously its responsibility to provide necessary resources to plan, prepare, respond, and recover from emergencies.

Mission Area 4: Provide a Scientific Foundation for Decisionmaking
Goal #3: Provide Scientific Data to Protect and Inform Communities
Strategy #1: Monitor and Assess Natural Hazards Risk and Resilience

Strategic Plan Performance Measures	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Target	2012 Actual	2013 Target	2014 Target	2008 - 2014 Trend
Strategy #1: Monitor and Assess Natural Hazards Risk and Resilience										
Percent completion of earthquake and volcano hazard assessments for moderate to high hazard areas (Earthquake Hazard Program & Volcano Hazard Program) (SP)	USGS	26.6%	28.5%	30.8%	34.0%	36.6%	36.9%	38.0%	39.5%	
		53	57	62	68	73	73.7	76	79	
		200	200	200	200	200	200	200	200	
Percent implementation of optimal earthquake and volcano monitoring for moderate to high hazard areas (EHP & VHP) (SP)	USGS	24.1%	24.6%	26.1%	29.5%	29.6%	32.9%	29.9%	29.9%	
		48	49	52	59	59	65.8	60	60	
		200	200	200	200	200	200	200	200	

Strategic Plan Performance Measures	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Target	2012 Actual	2013 Target	2014 Target	2008 - 2014 Trend
Strategy #2: Identify and Model Causes and Impacts of Changes to the Earth and Ocean Systems										
Percent of regional and topical ocean and coastal studies that cite USGS products within three years of study completion (Coastal and Marine Geology Program - CMGP)	USGS	80.0%	80.0%	80.0%	81.3%	78.6%	78.6%	80.0%	81.8%	
		24	24	24	26	22	22	20	18	
		30	30	30	32	28	28	25	22	

Supporting Performance Measures

Supporting Performance Measures and/or Milestones	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Plan	2012 Actual	2013 Plan	2014 Plan
Number of monitoring stations operated by Volcanoes Hazard Program (VHP)	USGS	734	743	743	765	773	785	785	785
Number of systematic analyses and investigations completed (EHP)	USGS	132	146	146	146	146	101	135	125
Number of systematic analyses and investigations completed (VHP)	USGS	71	99	75	124	75	80	75	70
Number of systematic analyses and investigations completed (Landslide Hazard Program)	USGS	15	15	15	15	15	15	15	14
Percent completion of optimal monitoring (EHP)	USGS	22.0% 1,562/7,100	23.0% 1,633/7,100	26.0% 1,846/7,100	30.4% 2,158/7,100	30.2% 2,142/7,100	36.1% 2,564/7,100	30.2% 2,142/7,100	30.2% 2,142/7,100
Percent completion of optimal monitoring (VHP)	USGS	26.0% 2,291/8,800	26.1% 2,299/8,800	26.2% 2,308/8,800	28.6% 2,520/8,800	29.0% 2,552/8,800	29.7% 2,610/8,800	29.6% 2,604/8,800	29.6% 2,604/8,800
Percent completion of optimal monitoring (GSN)	USGS	79.0% 80.6/102	86.0% 87.7/102	86.5% 88.2/102	88.6% 90.4/102	88.2% 90/102	89.8% 91.55/102	88.2% 90/102	88.2% 90/102
Percent completion of optimal monitoring (Geomagnetism)	USGS	46.0% 13.8/30	45.0% 13.5/30	57.3% 17.2/30	84.7% 25.4/30	83.3% 25/30	85.8% 25.76/30	83.3% 25/30	83.3% 25/30
Cost of collection and processing of Light Detecting and Ranging (LIDAR) data for coastal characterization and impact assessments (per megabyte of data collected) (CMGP)	USGS	0.5	0.44	0.39	0.34	0.31	0.53	0.35	0.25
USGS deployed in fall 2013 a new LiDAR collection system called EARRL-B. This instrument dramatically increases the capacity of USGS to collect high resolution elevation data (both topographic and bathymetric in near shore locations), resulting in a large increase of gigabytes collected in 2013 and planned for 2014, with large simultaneous reductions for collection costs per megabyte.									
Number of gigabytes of LIDAR data collected annually (CMGP)	USGS	NA	100	555	300	300	100	2,000	4,250
USGS deployed in fall 2013 a new LiDAR collection system called EARRL-B. This instrument dramatically increases the capacity of USGS to collect high resolution elevation data (both topographic and bathymetric in near shore locations), resulting in a large increase of gigabytes collected in 2013 and planned for 2014, with large simultaneous reductions for collection costs per megabyte.									
Number of systematic analyses and investigations completed (CMGP)	USGS	200	200	214	152	190	190	178	160

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Activity: Natural Hazards
Subactivity: Earthquake Hazards

2012 Enacted: $53.9 million (242 FTE)
2013 CR: $54.4 million (243 FTE)
2014 Request: $57.9 million (246 FTE)

Overview

Of all natural hazards facing the United States, earthquakes have the greatest potential for inflicting catastrophic casualties, damage, economic loss, and disruption. Damaging earthquakes are infrequent, but their consequences can be immense. According to recent studies, a major earthquake in an urbanized region of the United States could cause several thousand deaths and possibly $250 billion dollars in losses. In addition to California, many parts of the country are also at risk, including the Mississippi River Valley, Pacific Northwest, Intermountain West, Alaska, Hawaii, U.S. Territories, and parts of the Eastern seaboard. Population growth over the past decade has increased earthquake risk, and now more than 165 million people in 37 States live in areas vulnerable to earthquake damage, more than half the U.S. population.

As required under the Disaster Relief Act of 1974 (P.L. 92–288), the USGS has the delegated Federal responsibility for monitoring and notification of seismic activity in the United States. The USGS provides the scientific information and knowledge necessary to reduce deaths, injuries, and economic losses from earthquakes and earthquake-induced tsunamis, landslides and liquefaction. 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 provide seismic monitoring coverage for the Nation.

The Earthquake Hazards Program (EHP) is the applied Earth science component of the four-Agency National Earthquake Hazards Reduction Program (NEHRP, last reauthorized by the Earthquake Hazards Reduction Authorization Act of 2004, P.L. 108–360). A reauthorization bill for the program is currently under consideration in Congress. 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 losses in the United States.

The EHP includes the following four program components, described in more detail below:

- Assessment and Characterization of Earthquake Hazards;
- Monitoring and Reporting Earthquake activity and Crustal Deformation;
- Conducting Research into Earthquake Causes and Effects; and
- Earthquake and safety information for loss reduction.

Partnerships are crucial to the program's success. Approximately 25 percent of the total EHP budget is directed toward research grants and cooperative agreements with universities, State agencies, and private technical firms to support research and monitoring activities. This external funding is leveraged by funds from other Federal agencies, States, and the private sector.

Direction for the EHP is established in the strategic plans of the USGS and Department of the Interior, through periodic reviews by the congressionally established external Scientific Earthquake Studies Advisory Committee, and through communication with partners and stakeholders. EHP-funded activities

undergo both management and scientific review of project concepts and of final project proposals when submitted for initial funding using a program council responsive to regional and topical needs.

Program Performance

Assessment and Characterization of Earthquake Hazards

The USGS contributes to earthquake hazard mitigation strategies by developing seismic hazard maps that describe the likelihood and potential effects of earthquakes Nationwide, especially in the urban areas of highest risk. Federal, State, 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 the USGS for 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 Maps are used to develop new, unified model building codes for the United States. These digital maps integrate a wide range of geological and geophysical information to estimate the maximum severity of ground shaking that each given location is expected to experience during coming decades. The USGS works closely with earthquake researchers, engineers, and State and local government representatives across the Nation to ensure the maps represent the most current and accurate information available. USGS science underlies the 2012 version of the International Building Code (IBC), the code that has been adopted throughout most of the United States as the standard for building design.

Because the scale of the national seismic hazard maps precludes taking into account local variations in the size and duration of seismic shaking caused by small-scale geologic structures and soil conditions, the USGS is also producing more 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. Modeling of ground motion is provided for engineering applications. In conjunction with release of these targeted products, the USGS conducts workshops to assure the proper transfer of knowledge and to help design effective mitigation strategies.

Key projects in assessment and characterization include:

National Seismic Hazard Maps – USGS scientists are developing the next version of the national hazard maps. In 2012, USGS convened workshops in several key regions to gather updated information on faults from academic, state, and private-sector colleagues. A new earthquake rupture forecast for California is being developed in partnership with the California Geological Survey and the Southern California Earthquake Center (SCEC, a university research consortium), and USGS seismologists are working with the Pacific Earthquake Engineering Center to update seismic ground motion models across the United States. Draft maps will receive extensive public review in 2013 prior to final release in 2014.

Hazard Maps for Urban Areas – Urban seismic hazard maps are a refinement of the National Seismic Hazard Maps that include details about local geologic site conditions that effect earthquake ground motions and liquefaction. During 2012, the USGS completed and released detailed hazard maps for the Tri-State (Evansville) area of Indiana, Kentucky, and Illinois. Partners in the project included the State geological surveys of Indiana, Kentucky, and Illinois, the Southwest Indiana Disaster Resistant Community Corporation, the Central United States Earthquake Consortium (CUSEC), and Purdue University.

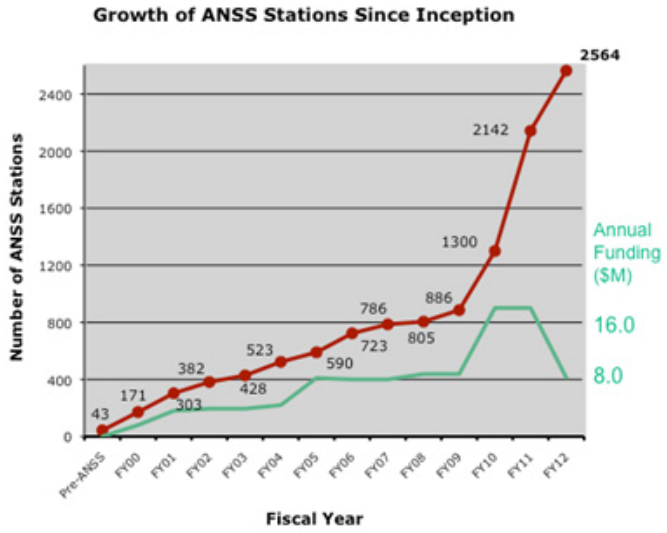
In 2013, the USGS is focusing on advancing a collaborative urban seismic hazard mapping project in the high-risk St. Louis, Salt Lake City, and Reno-Carson City urban areas. Partners in the St. Louis project include the University of Missouri at Rolla, Missouri Department of Natural Resources, and the Missouri State Geological Survey. In Utah and Nevada, the USGS is partnering with geoscientists from those States' geological surveys and academic institutions in a multi-year effort to collect geological and geophysical field data and to develop models that will be the basis for urban hazard maps.

Hazard Maps for U.S. Territories – In 2012, the USGS released new hazard maps for Guam, the Northern Marianas, and American Samoa. (Those for Puerto Rico and the Virgin Islands were updated in 2010.) USGS seismologists and engineers met with government officials and technical experts in each territory, to introduce the maps and discuss their implications and uses.

Monitoring and Reporting of Earthquake Activity and Crustal Deformation

Deployment of the Advanced National Seismic System (ANSS) is focused on expanding and improving the performance and integration of national, regional, and urban seismic monitoring networks in the United States. The system consists of a national ANSS Backbone network, the National Earthquake Information Center (NEIC), 14 partner-operated regional networks in areas of moderate-to-high seismic activity, and the National Engineering Strong Motion Project for monitoring earthquake shaking in structures.

The development of the ANSS is currently about 30 percent complete. By the end of 2012, the USGS and partners had installed a cumulative total of 2,564 ANSS earthquake monitoring stations, including 1,634 channels of data recorded in buildings and other structures. The network is now capable of detecting almost all felt earthquakes in the United States, except in remote areas of Alaska. The NEIC now typically reports on domestic earthquakes within minutes of their occurrence. The NEIC provides information on potentially damaging earthquakes to the National Command Center; the White House; the Departments of Defense, Homeland Security (including FEMA), Transportation, Energy, and Interior; State offices for disaster services; numerous public and private infrastructure management centers (e.g., railroads and pipelines); the news media; and the public. Rapid earthquake notifications are delivered by e-mail and text message to over 355,000 subscribers, and a suite of earthquake information products such as *ShakeMaps*, *Did You Feel It?* maps, rapid *PAGER* estimates of financial and human impacts, and technical data are available on the program's Web site, which receives more than two million hits every day. The USGS also provides near-real-time data to NOAA's tsunami warning centers, supporting tsunami monitoring in the Pacific Rim and disaster alerting in Alaska, Hawaii, Washington, California, and U.S. Territories in the Western Pacific.



Graph shows a large increase in the number of ANSS stations in 2010-2012. This is a result of investments through the American Recovery and Reinvestment Act (ARRA) and by the Veterans Administration (VA), for the instrumentation of VA hospitals, nationwide.

Earthquake Early Warning – Modern seismic networks can, in favorable circumstances, provide seconds to tens of seconds of warning before the onset of strong shaking (Earthquake Early Warning, or EEW). For the past six years the USGS has funded both research and development toward establishing an earthquake early warning capability in California. Funds from the American Recovery and Reinvestment Act were used in 2010 and 2011 to support the modernization of seismic instrumentation necessary to support the generation of warnings. A test system is operating now; two of the university partners of the ANSS (CalTech and U.C. Berkeley) have been delivering warnings to a small group of test users since January, 2011. However, the test system is still in the development phase, and considerable additional investment must be made to demonstrate reliability, improve accuracy, establish products for public warning, and expand geographic coverage.

Regional Earthquake Monitoring – As part of the ANSS, the USGS and cooperating universities operate regional seismic networks in areas of high seismicity. Data from all U.S. seismic networks are used to monitor active faults and ground shaking, in much greater detail and accuracy than is possible with the national-scale network. Each region has appropriate local data processing capabilities; regional data are contributed to a national ANSS catalog of earthquakes. ANSS regional networks serve as State or local distribution points for information about earthquakes to the public, local and State agencies, and other regional interests. The regional data centers also relay earthquake data in real time to the USGS NEIC, as well as to other regional networks. The centers provide information about regional earthquake hazards, risks, and accepted mitigation practices, and those centers located at universities provide training and research facilities for students. To support partner activities in regional earthquake monitoring, approximately $6.4 million was provided in 2012 through cooperative agreements. In 2012, the USGS supported 14 regional seismic networks, structural arrays and geotechnical arrays, operated by the following colleges and universities:

Seismic Monitoring Networks Supported by the USGS	
California Institute of Technology	University Nevada Reno
Columbia University, Lamont-Doherty Earth Observatory	University of Memphis
Montana Bureau of Mines and Geology	University of Oregon
Saint Louis University	University of South Carolina
University of Alaska Fairbanks	University of Utah
University of California Berkeley	University of Washington
University of California San Diego	

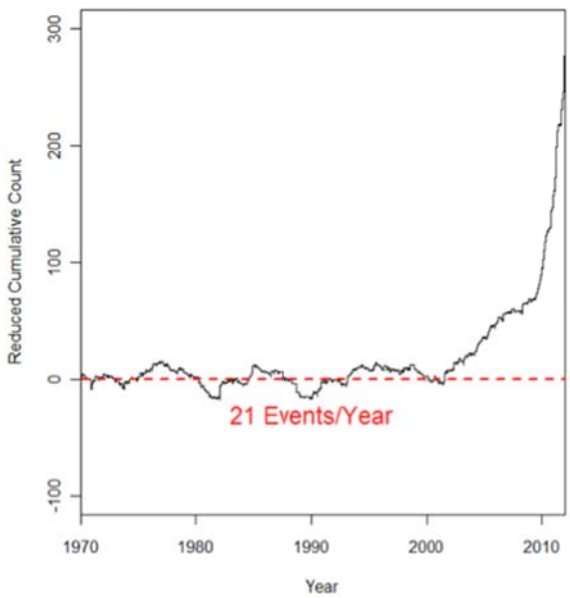
Geodetic Monitoring Networks Supported by the USGS	
Central Washington University	University of Memphis
San Francisco State University	University of Nevada Reno
University of California Berkeley	University of Utah
University of California San Diego	

In 2013 and 2014, funding for regional seismic and geodetic network operations remains a high priority, and is being directed toward ensuring robust regional network operations and maintenance.

Research into Earthquake Causes and Effects

The USGS conducts research on the causes, characteristics, and effects of earthquakes. This research has direct application in increasing the accuracy and precision of the Agency's earthquake hazards assessments, earthquake forecasts, earthquake monitoring products, and earthquake mitigation practices.

Induced Seismicity – The development of underground oil and gas (UOG) resources has the potential to induce seismic events, primarily through wastewater disposal. Researchers have long known that human actions can cause earthquake activity, from petroleum extraction to water reservoir impoundments and fluid injection into the subsurface. Although very small magnitude ("microseismic") events are commonly produced by hydraulic fracturing operations, current understanding suggests that the potential risk of felt or damaging earthquakes is greatest from wastewater disposal.



Increased Rate of Earthquakes in the U.S. mid-continent
Seismicity rate tripled in 2001;
Increase is tied to wastewater injection

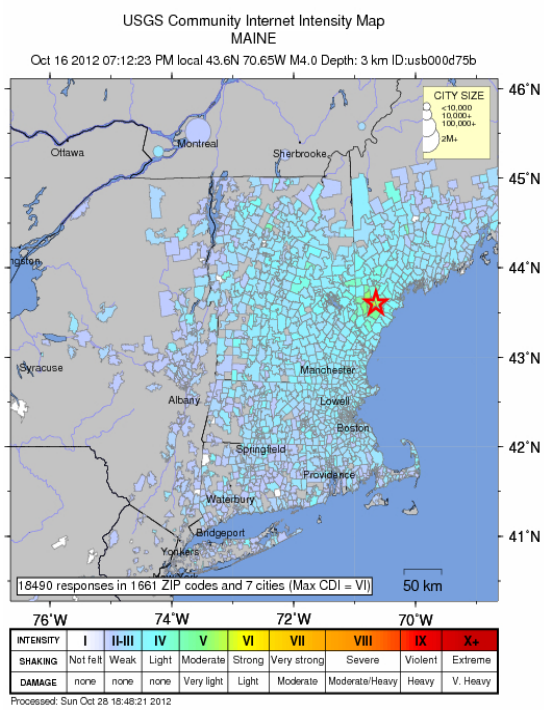
Although the risk of inducing felt seismic events directly stemming from hydraulic fracturing operations is believed to be low, there is some concern that potentially hazardous seismic events can be induced through disposal of flowback and produced water through underground injection control disposal wells. Confidence can be built by demonstrating that the extensive set of empirical observations on operations to date is consistent with predictive models over a range of geologic conditions and operational parameters. There is a need for more data and analysis to relate UOG operations to induced seismic events, to connect these events to specific operational parameters and geologic conditions, and to develop mitigation plans for decisionmakers attempting to minimize seismic risks. USGS is working with the DOE and EPA to undertake this research, and working with industry on case studies that will illuminate the physical factors controlling the phenomenon.

Forecasting hazards from earthquake sequences – Earthquakes occur in sequences, typically a largest event followed by many aftershocks, some of them large and potentially damaging. A large earthquake may also trigger the occurrence of an earthquake on a nearby fault at a later time. The USGS is engaged in research to quantify changes in earthquake probabilities with time, in response to observations of the seismogenic process from data such as earthquakes or geodetic deformation.

New research and development efforts began in 2012 will continue in the proposed Program plan. In 2013 and beyond, USGS will develop, validate, and use state-of-the-art scientific methods to:

- estimate earthquake probabilities, hazard, and risk over relevant time periods and spatial windows when probabilities may have changed;
- provide a suite of new products useful to society, ranging from one-time earthquake forecasts, to continuously updated, online releases, to user-customized estimates for decision support and situational awareness; and
- work in cooperation with international partners so that our forecasts of earthquake hazard in foreign countries are compatible with those made by authoritative sources in those countries. The products released abroad from these forecasts, however, need to be explored in more depth.

Eastern U.S. Earthquake Hazard Research and Assessment – In 2013, work was proposed to be directed toward assessing the hazard posed by Eastern U.S. earthquakes. If funded, several techniques will be applied to this task, including geological reconnaissance of target areas for evidence of prehistoric earthquakes, airborne geomagnetic and gravity surveys, high resolution Light Detecting and Ranging (LiDAR) imaging, three-dimensional seismic exploration surveys to identify buried faults, seismic analyses of attenuation of seismic shaking with distance, and analyses of amplification of shaking due to soft soils within urban centers. Outcomes will include improvement of seismic hazard criteria used in building codes, land-use decisions, and mitigation strategies, to reflect regional earthquake potential and local near-surface sediment and soil conditions. This work will lead to detailed urban seismic hazard maps for Boston, MA; Philadelphia, PA; Charleston, SC; Washington, D.C.; and New York City, NY.



The "Transportable Array", a massive array of portable seismometers that is part of the NSF-sponsored EarthScope facility, has moved into the Eastern United States in 2013. Many of the studies proposed in the USGS effort will make use of or complement the dramatic increase of instrumentation that the EarthScope project will bring to the area. Additionally, the requested support will be used to take advantage of local knowledge and expertise through targeted grants to State geological surveys and academic institutions. The geophysical and remote sensing surveys will be done under contracts with qualified private firms.

Supporting External Research Partnerships – External collaboration advances targeted research and addresses specific needs of the USGS using the experience and knowledge of world experts. The EHP provides competitive, peer-reviewed, external research support through competitive grants and cooperative agreements that enlist the talents and expertise of the academic community, State government, and the private sector.

External program activities include: mapping seismic hazards in urban areas; developing credible earthquake planning scenarios including loss estimates; defining the prehistoric record of large earthquakes; investigating the origins of earthquakes; improving methods for predicting earthquake effects; and developing a prototype system for an earthquake early warning system (see previous discussion). The USGS also has a cooperative agreement with the Southern California Earthquake Center (SCEC), a 40-institution research consortium funded by the USGS and the NSF. The following table lists the institutions and agencies that received grants and cooperative agreements in 2012. It is anticipated that a similar number and range of partners will receive assistance in 2013.

USGS 2012 Grants for Earthquake Research and Hazards Assessments	
Association of Bay Area Governments	Brigham Young University
Boise State University	Brown University
California Institute of Technology	Earthquake Engineering Research Institute
Fugro Consultants, Inc.	Georgia Institute of Technology
Harvard University	Kentucky Geological Survey
M. Tuttle & Associates	Massachusetts Institute of Technology
Missouri Department of Natural Resources	Optim Seismic Data Solutions

USGS 2012 Grants for Earthquake Research and Hazards Assessments	
Pennsylvania State University	Pacific Engineering and Analysis
San Diego State University	Portland State University
Southern Methodist University	Southern California Earthquake Center/USC
Tufts University	Stanford University
University of California Berkeley	University of Arkansas Little Rock
University of California Irvine	University of California Davis
University of California at Riverside	University of California Los Angeles
University of California at Santa Barbara	University of California San Diego
University of Durham	University of Colorado Boulder
University of Memphis	University of Illinois
University of Oregon	University of Nevada at Reno
University of Texas Austin	University of Southern California
University of Washington	University of Utah
URS Corporation, Inc.	University of Wisconsin Madison
Virginia Polytechnic and State University	Utah Geological Survey

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Activity: Natural Hazards
Subactivity: Volcano Hazards

2012 Enacted: $24.1 million (151 FTE)
2013 CR: $24.1 million (151 FTE)
2014 Request: $24.7 million (152 FTE)

Overview

Volcanic eruptions are among the most destructive phenomena of nature, and even a small event can cause significant damage and economic impact. The 2010 eruption of Eyjafjallajökull Volcano in Iceland was minor in almost every respect, except that its ash plume drifted over Western Europe creating a worldwide disruption in air travel that cost the global economy billions of dollars. Unlike many other natural disasters however, volcanic eruptions can be predicted well in advance of their occurrence, providing the time and breathing room needed to blunt the worst of their effects.

Under the Stafford Act (P.L. 93–288), the USGS has the responsibility to issue timely warnings of potential geologic disasters, including volcanic eruptions, to the affected populace and civil authorities. The USGS Volcano Hazards Program (VHP) has the experience and expertise needed to make such forecasts. Advanced warning can mean the difference between a natural spectacle and a natural disaster.

Volcanic hazards take many forms, some direct and immediate like lava flows and explosive eruptions, and some more insidious like air pollution or the effect of abrasive particles of a light ash on aircraft and other vehicles or infrastructure. What all these destructive phenomena have in common is that they can be forecast and their threats can be mitigated. Commercial and military aviation for example take great care to organize their operations to minimize the chance of an ash encounter, depending on the USGS to provide timely information about potential and ongoing volcanic activity. Likewise, citizens living on or around active volcanoes rely on the USGS to provide not only short term predictions of volcanic activity, but also the information and advice needed to reduce their exposure to volcanic hazards over the long term.

Effective volcano monitoring requires not only a robust network of instruments, but also the skill and experience needed to understand the resulting data. The VHP conducts thorough hazard assessments of threatening volcanoes that consist of geologic mapping, detailed field observations, laboratory work, and data analysis. These result in formal, published “Hazard Assessment” products that are both scientifically accurate and accessible to the non-specialist. VHP scientists also conduct geological and geophysical research into basic volcanic processes. Such research identifies patterns and trends in data that create deeper insight into the meaning and significance of monitoring data.

The Nation’s volcano monitoring infrastructure remains incomplete. In 2005 the VHP conducted an inventory of the Nation’s volcanoes, assessing the overall threat posed by each and comparing this to the existing monitoring capability. The resulting document (pubs.usgs.gov/of/2005/1164/) details the monitoring gaps present at many of our most threatening volcanoes, and serves as a blueprint for a National Volcano Early Warning System (NVEWS). Since then, progressive implementation of NVEWS has been a VHP priority, and several notable successes have been achieved (e.g., major modernization of the Hawaii and Yellowstone monitoring networks).

The VHP works closely with other Federal science agencies to leverage their strengths and capabilities in support of volcano monitoring, and to provide them the information they need to do their jobs. The National Oceanic and Atmospheric Administration (NOAA), the National Science Foundation (NSF), and

National Aeronautics and Space Administration (NASA) all cooperate with VHP, providing satellite and sensor data that are critical for volcano monitoring. The VHP sends information and data about volcanic activity and ash plumes to the National Weather Service (NWS), the Federal Aviation Administration (FAA), and the Department of Defense (DoD). Interaction at the State and local level is also important.

Program Performance

Response to Eruption and Volcanic Unrest – the VHP's primary goal is to provide timely and accurate forecasts of potential volcanic hazards. Much of our attention, therefore, focuses on those volcanoes already erupting, or those showing elevated levels of seismic activity, abnormal ground deformation, or excess gas or thermal output. Kilauea Volcano, in Hawaii, now in its 31st year of near-constant eruption, continues to challenge USGS scientists at the Hawaiian Volcano Observatory (HVO). Lava output from Kilauea averages 5 cubic meters per second, enough to fill 200 Olympic-sized swimming pools in a day. While most of the lava flows produced during this eruption have covered vast areas of Hawai`i Volcanoes National Park, the last 5 years of lava activity has been predominantly on State of Hawaii Natural Area Reserve lands and a now-abandoned subdivision immediately adjacent to the Park. This long eruption has taken a significant permanent toll: lava from Kilauea has destroyed hundreds of homes and other structures and resulted in several deaths. Recent USGS studies underscore the reality that Kilauea eruptions can be large, ash-producing explosions, making it the most threatening volcano in the United States. The HVO works closely with National Park Service and State and county emergency management agencies to minimize the damage and health risks posed by Kilauea's ongoing eruption.

Long Valley Caldera in California, near the resort town of Mammoth Lakes, has entered a period of renewed volcanic unrest with increased seismicity and ground uplift of about 1 inch per year. The California Volcano Observatory has stepped up volcano monitoring in Long Valley, and continues to follow the situation closely.

The town of Brawley, California, about 15 miles southeast of the Salton Buttes volcanic center, experienced an intense swarm of earthquakes in August, 2012. Because of its proximity to the Salton Buttes, the California Volcano Observatory responded to the swarm by concluding that it was not of volcanic origin. This event illustrates one of the essential but often overlooked purposes of the Volcano Hazards Program: to declare, with authority, the absence of a volcanic threat. Without such a declaration, resources can be expended needlessly while preparing for hazards that will not occur.

Organizational Improvements – Accurate forecasts of volcanic activity are by themselves insufficient to mitigate the risks posed by volcanoes to surrounding communities and the Nation; the affected populace must also have the knowledge and information necessary for effective action. For this reason, in 2012 the VHP formally assigned to each of the five volcano observatories geographical areas of responsibility, which taken together contain all of the Nation's potentially hazardous volcanoes as set forth in the NVEWS threat analysis.

Areas of Responsibility (AOR):

- 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**

The five observatories are responsible for managing volcanic crises, volcano monitoring, community preparedness, and coordinating research.

An especially noteworthy achievement of 2012 was the establishment of the California Volcano Observatory (CalVO), with responsibility for all volcanoes within California and Nevada. These include the high threat volcanoes Shasta, Lassen, and Long Valley Caldera, along with about 15 other lower threat volcanic centers. Along with providing improved name recognition, CalVO also better aligns with the California Emergency Management Agency (CalEMA) and the California Geological Survey (CGS). The Long Valley Observatory (LVO), which had focused on Long Valley Caldera and its associated volcanic field, is now defunct, with CalVO assuming all of LVO's previous responsibilities.

CalVO's establishment has already yielded results: CalEMA and CalVO have partnered together to prepare a statewide volcano hazard and risk assessment for incorporation in the 2013 California Disaster Preparedness Plan issued by the Office of the Governor. CalVO and CalEMA have also partnered with NOAA and FAA representatives to create the first California Volcanic Ash Hazard Plan for Aviation.

The USGS reorganized the Yellowstone Volcano Observatory from a three-part cooperative among the National Park Service, the USGS, and the University of Utah to broader consortium that includes several more agencies, including the University of Wyoming, the Wyoming State Geological Survey, the Idaho Geological Survey, the Montana Bureau of Mines and Geology, and UNAVCO. The new consortium, which will take effect in January 2013, broadens the YVO's constituency, better serves the local communities, better engages local emergency managers, and clarifies the leadership role of the USGS and NPS.

Community Preparedness and Public Communication – The Internet is the primary tool for VHP to inform the public of volcanic activity (or to confirm that no activity is occurring). The VHP has completed a reengineering of its public Web site infrastructure, and is about 50 percent through a complete redesign of the Web site's content. This effort aims to provide better and timelier information about volcanoes and related hazards to the public and our partner agencies, and to do so reliably under conditions of very high demand. Since October 2012, the VHP provides a Volcano Notification Service (VNS), a free service that sends e-mail notifications about the status of volcanic activity and other significant events at volcanoes in the United States. The VNS can be customized to deliver reports for certain volcanoes, or a region of volcanoes, and for the types of notifications desired. At present, the VNS has about 2,500 subscribers. The full suite of VHP Web-based products is now registered in the safety.data.gov and the hazards.data.gov databases as of August 2012. In 2014, VHP will finish the upgrade and redesign of its Web presence, thereby freeing resources to explore new technologies (e.g., social media) that will improve our ability to quickly disseminate notifications and forecasts.

The FEMA-National Disaster Preparedness Training Center-USGS course "Volcano Crisis Awareness" was delivered and certified by FEMA as a for-credit class. The course has modules tailored to the Cascades, Hawaii, and Alaska. The VHP had a critical role in developing the course. In 2012, the course was taught twice in the Pacific Northwest.

The year 2012 marked the two important centennials for the VHP. The first was the founding of the Hawaiian Volcano Observatory (HVO), which was established by Dr. Thomas A. Jaggar, Jr., on the rim of Kilauea Volcano in January 1912. The second was the monumental eruption of Alaska's Katmai Volcano in June 1912, the largest volcanic eruption of the 20th century. In Hawaii, the HVO's 100th anniversary was celebrated with an Observatory open house that drew thousands of visitors, a major scientific conference: "the American Geophysical Union Chapman Conference on Hawaiian Volcanoes: From Source to Surface," which drew 180 scientists from 12 different countries, and a USGS publication on the history of the Observatory (http://pubs.usgs.gov/gip/135/). In commemoration of the Katmai

eruption, the USGS published a volume summarizing 100 years of research on the eruption and its impact on the science of volcanology. (http://pubs.usgs.gov/pp/1791/). VHP scientist Judy Fierstein presented a public lecture on the eruption at several different venues throughout the country, drawing large and enthusiastic crowds.

Scientific and Technical Achievements – Ash from explosive eruptions is the most far-reaching of volcanic hazards, affecting transportation, utility operations, agriculture, and human health. VHP scientists have developed a physics-based, numerical model to forecast—hours to days into the future—both dispersion of ash clouds in the atmosphere and deposition of ash on the ground. The model, called Ash3D, will be used in collaboration with partners such as local emergency managers, the National Weather Service, and U.S. Air Force Weather Agency to estimate ash hazard zones before and during eruptions. The software has an intuitive, user-friendly Web interface with many useful presets ready to simulate likely eruption scenarios, and it can be used for an eruption of any volcano worldwide, an important capability for the Air Force.

Newberry, a very high threat volcano located south of Bend, OR, had been largely unmonitored until the summer of 2012. Following the general plan set out by the NVEWS analysis, the USGS developed and installed a modern, high quality network of volcano monitoring instruments.

International Efforts – The Volcano Disaster Assistance Program (VDAP), a joint project with USAID Office of Foreign Disaster Assistance (OFDA), continues to build monitoring infrastructure and crisis response capacity in Latin America and the Western Pacific regions, including new project work in Indonesia, Papua New Guinea, Colombia and other Latin American countries. The VDAP is supported by the OFDA and brings important hazard mitigation lessons home for use in the United States. Noteworthy recent VDAP activities include crisis responses to unrest and eruptions in Colombia, Chile, Indonesia, and Saudi Arabia. All of the VDAP's foreign responses follow requests from foreign governments made through their U.S. Embassies, which are evaluated by the Department of State and the OFDA in terms of humanitarian benefit and U.S. foreign policy. Of particular note is the role that the VDAP played in assisting the Indonesian government's response to the violent 2010 eruption of the Merapi Volcano, which helped save more than 10,000 lives.

Future Directions

While continuing to use our existing infrastructure and resources to pursue our core mission objective of providing timely and accurate forecasts of potential volcanic hazards, the VHP also plans several new initiatives that promise to strengthen our mitigation capabilities over the coming years. Our first objective is to grow and improve the Nation's volcano monitoring infrastructure. Two high very high threat volcanoes Glacier Peak, 70 miles northeast of Seattle, WA, and Mount Hood 50 miles east of Portland, OR, loom large in our near-term plans. The VHP, in partnership with the U.S. Army Corps of Engineers and Southern Methodist University, will install a seismic and infrasound network on Pagan, a high threat volcano in the Commonwealth of the Northern Mariana Islands in 2013.

Over the next few years, the VHP will move the Ash3D system from a prototype/testing platform to fully operational status. This will involve the complete integration of Ash3D's forecasts into our monitoring procedures and information products. We will also work with our key partners to help them incorporate the Ash3D output into their decisionmaking processes, and we anticipate significant interest in from new end users, such as power companies and other organizations with highly exposed infrastructure.

The USGS is a major participant in the National Science Foundation's $5 million per year GeoPRISMS (Geodynamic Processes at Rifting and Subducting Margins) Program, which will study the geology and geophysics of continental margins, focusing on the Cascadia and the Alaskan-Aleutian subduction zones.

VHP scientists worked closely with their academic partners to secure $3 million in GeoPRISMS funding for a “slab-to-surface” geophysical and geochemical imaging effort at Mount St. Helens. This collaboration will take place over the next three years and promises to reveal the volcano’s plumbing system with unprecedented resolution. Similar collaborative research opportunities for projects in the Alaskan-Aleutian subduction zone are anticipated in 2014, and VHP scientists have already taken active roles in GeoPRISMS prioritization workshops focused on the Alaskan-Aleutian margin.

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Activity: Natural Hazards
Subactivity: Landslide Hazards Program (LHP)

2012 Actual: $3.2 million (21 FTE)
2013 CR: $3.2 million (21 FTE)
2014 Request: $3.7 million (23 FTE)

Overview

Landslide hazards research concentrates on understanding landslide processes, developing and deploying instruments that monitor threatening landslides, and forecasting the onset of catastrophic movement of future landslides. Research on processes and forecasting methodologies is conducted on the types of landslides that result in human and economic losses in the United States such as landslides related to steep slopes, heavy rains, and vegetation loss due to wildfires.

The USGS deploys near-real-time monitoring systems at active sites to gather continuous rainfall, soil-moisture, and pore-pressure data needed to understand the mechanisms of landslide occurrence. Such understanding can form the scientific underpinnings for early warning of conditions that may trigger landslides. A landslide early-warning system based on such information is useful in reducing hazards in landslide-prone areas.

USGS scientists respond to landslide emergencies and disasters nationwide. Federal, State, and local agencies are assisted through landslide site evaluations and recommend strategies for reducing ongoing and future damages from landslides. The Landslide Hazards Program (LHP) works in conjunction with the National Weather Service (NWS) to issue advisories and press releases regarding the potential for landslide activity in previously burned areas in southern California. For foreign disasters, the USGS works with the USAID OFDA in responding to appeals for technical assistance from affected countries.

Consistent with Interior's goal to protect lives, resources, and property by providing information to assist communities in managing risks from natural hazards, the USGS provides timely information through the National Landslide Information Center (NLlC). The Center communicates with the public about current emergency responses and provides information to the external user-community through fact sheets, books, reports, and press releases.

Program Performance

Primary LHP activities include conducting landslide hazard assessments, landslide monitoring, and disseminating landslide information.

Landslide Hazard Assessment Activities

In 2012, the LHP delivered emergency assessments of debris flow hazards following several major fires in Colorado and California. The report and maps generated from these assessments were provided to the public, the U.S. Forest Service (USFS), the NWS, and local county emergency response, public works, and flood control agencies before the onset of winter rains. These products were provided as part of the Multi-Hazards Demonstration Project for southern California and the desert Southwest. Other assessment activities include assessment of rock fall hazards at Timpanogos Cave National Monument and at Yosemite National Park, ongoing monitoring, modeling and assessments in western Oregon, and hazard assessments and inventories of landslides in glacial lake clays in northern Pennsylvania.

The LHP provides susceptibility maps, hazard assessments, and emergency warnings to a broad range of Federal and State agencies ranging from the USFS to local community emergency managers. All of these jurisdictions use USGS products to mitigate the effects of landslides and debris flows through land use planning, response planning, and warning systems. In 2013 and 2014, the LHP will continue to provide information to counties and other jurisdictions in Oregon, California, Colorado, Pennsylvania, New York, Tennessee, and to Interior land management agencies along with other Federal agencies that incorporate this information into emergency response and land use plans and warning systems.

In 2012, the LHP published a number of major publications including: 1) a low-cost method to measure the timing of post-fire flash floods and debris flows; (2) a major study investigating the effects of climate change on landslide hazards in the United States; and (3) a ground-breaking study that shows that most large landslides on the Oregon coast are of seismic origin, and that reactivation of the slides due to seismic loading could result in large displacements, potentially blocking tsunami evacuation routes.

Landslide Monitoring Activities

Sustained efforts in landslide monitoring have led to significant advances in understanding of slope stability and landslide processes. In 2013 and 2014, the LHP will continue to: develop rainfall thresholds for areas burned in the desert Southwest, and Western and Rocky Mountain States that will refine the predictive capabilities of the joint NOAA/USGS early warning system and monitor and analyze the rainfall response of landslides and landslide-prone areas in western Oregon, at the Ferguson landslide near Yosemite National Park, along U.S. Highway 50 in California, and at Chalk Cliffs in Colorado.

In 2013 and 2014, the LHP will continue to respond to landslide emergencies in the United States and internationally and to monitor landslides where necessary. Information and maps of post-fire debris flows in southern California will be entered into interactive geographic information system (GIS) databases to provide immediate and comprehensive response tools for decisionmakers and the public. In 2012, the LHP released a Web-based survey instrument, "*Did You See It Slide?,"* for the public to register landslide information after it happens in their neighborhoods with a goal of engaging citizens in learning about and reporting landslide hazards.

Landslide Information Dissemination Activities

The LHP will continue to respond to inquiries from the public, educators, and public officials on hazard mitigation, preparedness and avoidance strategies for landslide hazards. The NLIC will continue to provide leadership for the National Landslide Hazard Exchange Group, a group of landslide experts from the USGS and State geological surveys who are striving to create an inventory of landslides in the United States.

The Landslide Handbook, "*A Guide to Understanding Landslides,"* was translated into Portuguese, Japanese, Chinese, and Spanish with the dedicated help of the Geological Survey of China and the World Bank. This publication, coauthored by USGS and Geological Survey of Canada scientists, is an important layperson's guide that explains what citizens can do to mitigate the threat of landslide hazards. In 2011, this publication won the Geological Society of America Burwell Award and the International Coalition of Landslides Best Publication Award. In 2012, the translation of this handbook into Ukrainian was begun; in 2013, the handbook is being republished by the International Consortium on Landslides and will be distributed to its members around the world.

In 2012, the LHP launched a new Web site called "Did You See It", which allows citizens to report landslides that then become part of a national inventory. The USGS hopes that this new interactive citizen-science initiative will go far in educating the public about landslide hazards, as well as eventually

contributing vital data to the national inventory of landslides. In 2014, the program plans to conduct a customer satisfaction survey of citizens who have contributed to the Web site.

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Activity: Natural Hazards
Subactivity: Global Seismographic Network

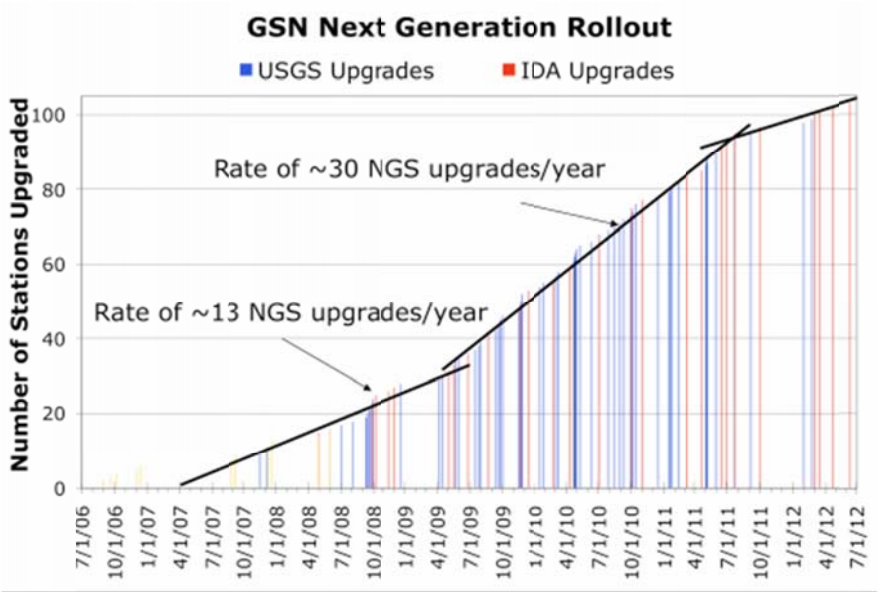
2012 Actual: $5.2 million (13 FTE)
2013 CR: $5.2 million (13 FTE)
2014 Request: $5.2 million (13 FTE)

Overview

The Global Seismographic Network (GSN) provides high-quality seismic data needed for earthquake alerting, tsunami warning, hazard assessments, national security (through nuclear test treaty monitoring), earthquake loss reduction, and research on earthquake sources and the structure and dynamics of the Earth. The GSN is a joint program between the USGS and the National Science Foundation (NSF), and is implemented by the USGS, the Institute for Geophysics and Planetary Physics (IGPP) of the University of California and the Incorporated Research Institutions for Seismology (IRIS), a consortium of universities. The network currently consists of 150 globally distributed seismic stations, installed over two decades by the USGS and the IGPP.

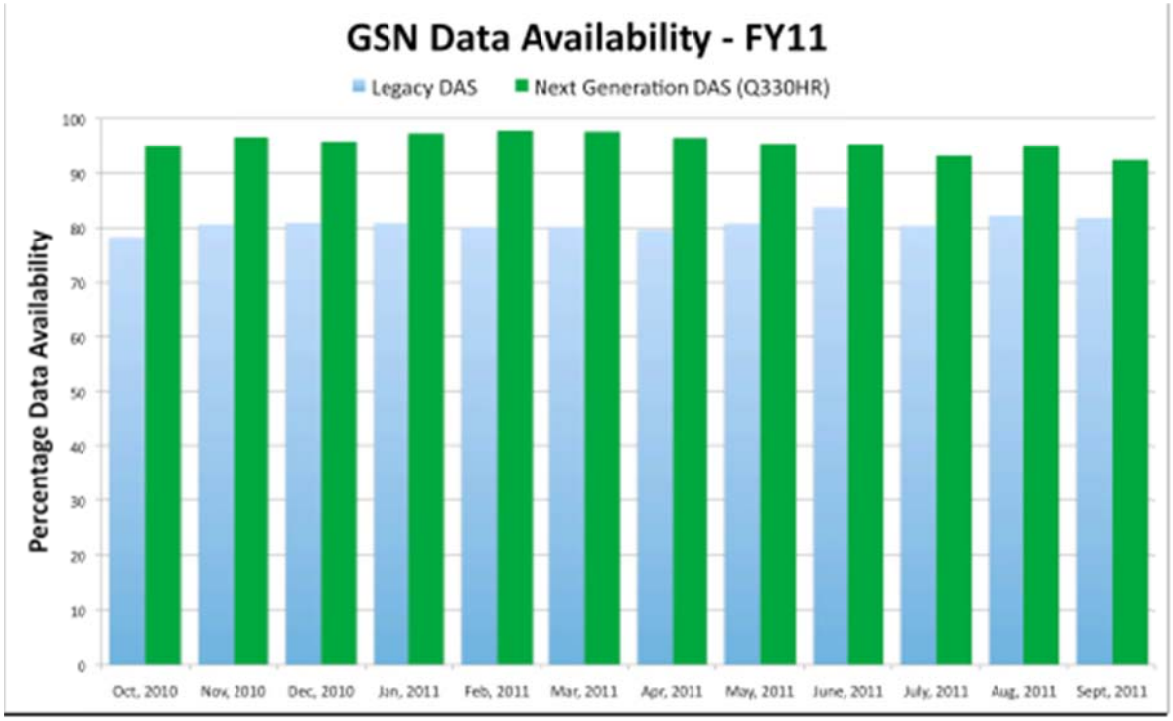
Network operation is accomplished in cooperation with international partners who, in most cases, provide facilities to shelter the instruments and personnel to oversee the security and operation of each station. USGS responsibilities include station maintenance and upgrades, the monitoring and maintenance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

An important aspect of GSN activities is evaluating, developing, and advancing new technologies in sensors, instrument installation, data acquisition, and management. To improve performance, stations with unusually high background noise are relocated to quieter sites or configurations (e.g., burying sensors in boreholes) so that smaller events (earthquakes or explosions) or other signals of interest may be detected.



Graph at left shows progress implementing station upgrades, but by USGS (blue) and by International Deployment of Accelerometers (IDA) (red). With economic stimulus funds provided to USGS in 2010-2011, the rate was doubled. These "next generation" upgrades will be completed in 2013.

Because of its real-time data delivery, the GSN has become a critical element of continuous USGS hazard warning activities. Ninety-seven percent of GSN stations transmit real-time data continuously to the USGS National Earthquake Information Center in Golden, Colorado, where they are used, along with data from other networks, to rapidly determine the locations, depths, magnitudes, and other parameters of earthquakes worldwide. The high quality of GSN data allows for the rapid determination of the location and orientation of the fault that caused the earthquake, and provides an estimate of the length of the fault that ruptured during the earthquake. These parameters are essential for modeling earthquake effects.



All GSN data are available to the public and scientists around the world via the IRIS Data Management Center (DMC). Data from the GSN are used extensively for basic and applied research on earthquakes, Earth structure, and other geophysical problems in studies conducted and supported by the USGS and other agencies such as the NSF, the U.S. Department of Energy (DOE), and the U.S. Air Force (USAF).

Program Performance

In 2014, the USGS will:

- Continue to operate the 100-station, USGS portion of the GSN at a high level of data recovery, real-time telemetry performance, and high cost-efficiency;
- Begin installation of new GSN sensors, which are being procured in 2013 with funds provided by the Department of Energy; and
- Work with partners such as IRIS, the U.S. Air Force, the Comprehensive Nuclear Test Ban Treaty Organization, and the International Federation of Digital Seismographic Networks, to improve the efficiency of station operations and reduce maintenance costs.

Other Agency programs will continue to be supported through this effort, including:

- NOAA's Tsunami Warning Program and National Tsunami Hazard Reduction Program;
- The U.S. Air Force and Department of Energy nuclear test monitoring research programs; and
- The NSF, whose Earth science research programs use GSN data for research on Earth structure and dynamics, wave propagation, earthquake source complexity, and climate change.

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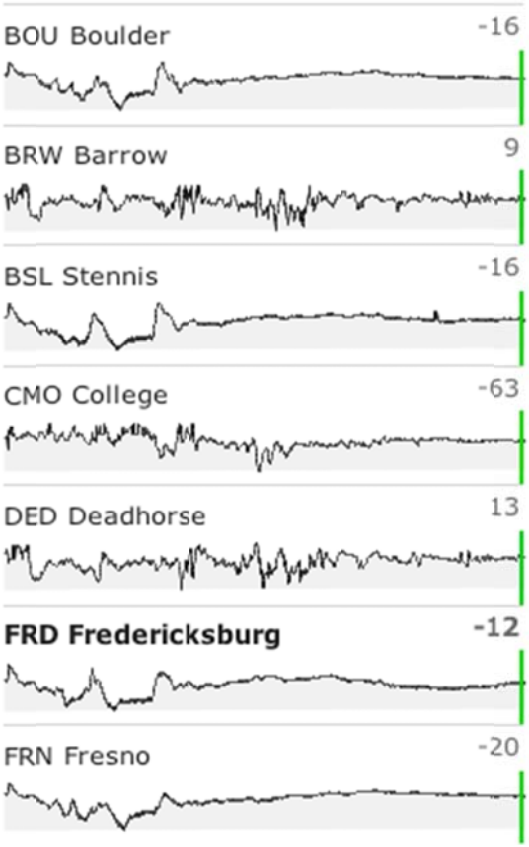
Activity: Natural Hazards
Subactivity: Geomagnetism

2012 Actual: $2.0 million (18 FTE)
2013 CR: $2.0 million (18 FTE)
2014 Request: $2.1 million (18 FTE)

Overview

Large magnetic storms can cause electrical blackouts, losses of radio communication, affect global-positioning systems, and damage satellite electronics. Damaging storms occur an average of four times a decade, with smaller events occurring more frequently. Magnetic storms can be detected up to two days in advance by monitoring the sun. They come in all sizes, but the largest storms tend to occur when sunspots (concentrations of magnetic energy on the surface of the sun) are most numerous. The monitoring of such "space weather" is a shared responsibility of several U.S. government agencies, including NOAA, NASA, and the U.S. Air Force. The USGS has the unique responsibility of monitoring geomagnetic activity at the Earth's surface, where most of the effects of magnetic storms are actually realized.

The USGS Geomagnetism program is an integral part of the National Space Weather Program (NSWP), which coordinates activities in Department of Defense, NOAA and NSF. The USGS provides ground-based observations of geomagnetic activity, operating a network of magnetic observatories capable of accurately measuring the geomagnetic field across a wide range of timescales (see: *http://geomag.usgs.gov-/research/spaceweather.php*). The program provides magnetic data and products to various governmental, academic, and private institutions, and conducts research on the nature of geomagnetic variations for purposes of scientific understanding and hazard mitigation. The USGS coordinates its work with foreign national geomagnetism programs through INTERMAGNET, a worldwide consortium of observatory programs, and the International Association of Geomagnetism and Aeronomy.



As solar activity rises in the current cycle, 2013 is expected to bring numerous magnetic storms, caused by the dynamic interaction of the Sun, the solar wind, and the Earth's magnetic field. Large storms can adversely affect the infrastructure and activities of our modern, technology based society. They can cause the loss of radio communication, reduce the accuracy of global-positioning systems, damage satellite electronics and affect satellite operations, enhance radiation levels for

astronaut and high-altitude pilots, increase pipeline corrosion, and cause voltage surges in electric power grids, causing blackouts.

The estimated annual economic impact of magnetic storms runs into the hundreds of millions of dollars. Continuous, real-time monitoring of the geomagnetic field is important for national security. Drilling programs undertaken by the oil and gas industries rely on magnetic orientation, and these can be degraded during magnetic storms, particularly at high latitudes. Magnetic-field data are also used to check historical property boundaries, many of which were originally established using magnetic orientation from compasses.

Within the NSWP, a major effort in 2013 is the development of an interagency implementation plan for a unified space weather capability. The USGS is participating in this activity by representing the ground-based sensing component for geomagnetic activity.

Program Performance

Program activities include operating geomagnetic observatories, managing data and developing products, and conducting scientific research to develop ground-based diagnostics for hazard mitigation. These activities will continue in 2014, with an emphasis on developing products useful for mitigating the consequences of geomagnetic storms.

Geomagnetic Observatory Operations

The USGS operates a network of 14 geomagnetic observatories, distributed across the United States and its Territories. Data are collected continuously from each observatory by a variety of instruments housed in buildings designed to provide environmental stability and to ensure long-term baseline accuracy. Each site is visited regularly to conduct calibrations of the instruments. Data are transmitted in real time to project headquarters in Golden, Colorado, via a set of satellite and Internet linkages. Operational systems upgrades, combined with portable acquisition system design for testing of new operational configurations and rapid deployments, will benefit users through improved data quality, timeliness, and availability.

Data Management and Product Development

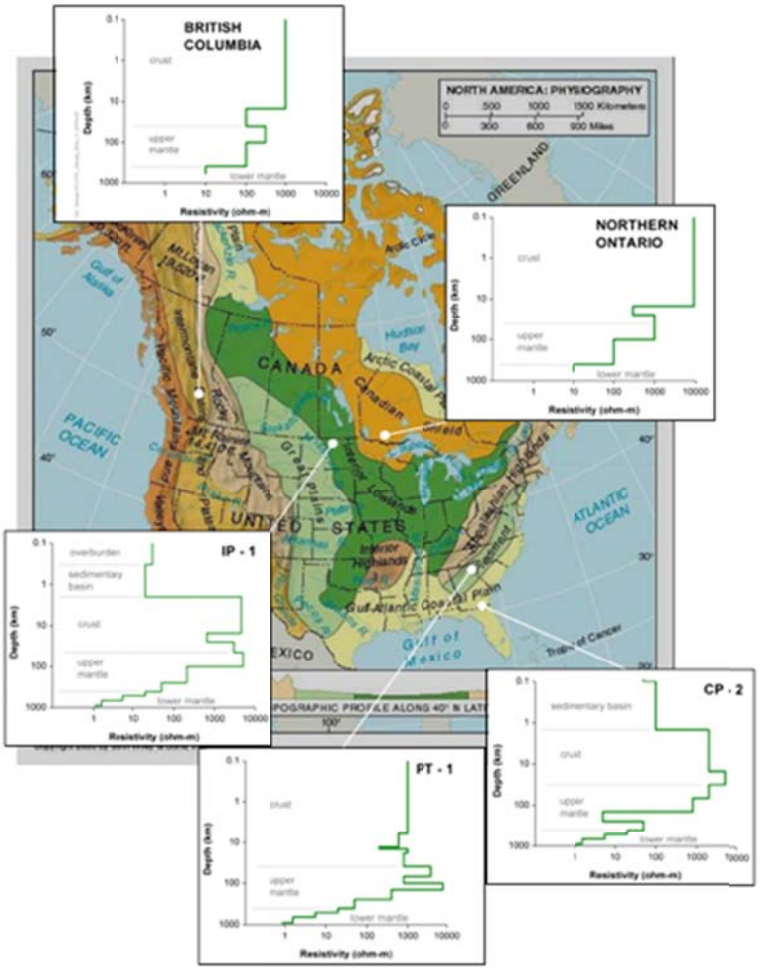
Once data from the observatories are received in Golden, Colorado, they undergo initial processing and are organized for immediate transmission to both NOAA's Space Weather Prediction Center in Boulder, Colorado, and the Air Force Weather Agency in Omaha, Nebraska. For longer-term studies, the magnetic data are further refined using periodic calibrations for each observatory, making them useful for research on rapid magnetic field variations and for mapping the field on a global scale. These fully calibrated, definitive data are published yearly in cooperation with foreign national geomagnetism programs, working through the INTERMAGNET consortium. The USGS also distributes magnetic field data, maps, and real-time data products through the *http://geomag.usgs.gov* Web site, which receives an average of over 30,000 Web hits per day from the public.

Scientific and Applications Research

The USGS conducts geomagnetic research to better understand basic physical processes and the effects of solar-terrestrial interaction on the infrastructure and activities of our modern, technologically based society. Recent projects have included development of statistical and time series methods for characterizing long term changes in geomagnetic activity; development of a method for mapping magnetic disturbance during storms; development of methods for measuring magnetic storm intensity;

analysis of the recent solar-cycle minimum; analysis of possible links between solar-terrestrial interaction and global climate change; and analysis of claims of magnetic precursors to earthquakes.

In response to the solar maximum that is anticipated in 2013, USGS research staff are developing methods for constructing improved crustal electrical conductivity maps that are needed for diagnosis and prediction of storm-time, localized geomagnetically-induced currents of concern to the power-grid industry; conduct research and development on algorithms for identifying and cataloging geomagnetic substorms; and develop methods for estimating the rate of occurrence of rare magnetic storms, including methods for estimating the errors associated with these occurrence rates. Results from these projects will help make assessments of geomagnetic hazards and the risks that they pose.



Geomagnetically-induced currents (GICs), flowing along electric power-transmission systems and other electrically-conducting infrastructure, are produced by a naturally induced geo-electric field during geomagnetic disturbances. The USGS, in collaboration with the USGS Crustal Geophysics Program, National Resources Canada, the NOAA Space Weather Prediction Center and the NASA-Goddard Space Flight Center, will use the proposed funding to build monitoring tools including a nationwide conductivity model, a local magnetic field model and regional electric field estimates.

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Activity: Activity: Natural Hazards
Subactivity: Coastal and Marine Geology Program

2012 Actual: $42.8 million (237 FTE)
2013 CR: $42.2 million (236 FTE)
2014 Request: $49.0 million (242 FTE)

Overview

The Coastal and Marine Geology Program (CMGP) applies capabilities in marine geology, geochemistry and oceanography to provide information and research products on conditions and processes critical to the management of the Nation's coastal, ocean and Great Lakes environments. Program activities include characterizing ocean and coastal geological setting, processes, and change to provide the framework understanding for management and policy in response to a range of issues; developing regional and national hazard, resource and environmental assessments of coastal and marine conditions, change, and vulnerability; developing models of coastal and marine change; and developing and implementing national, regional, and topical studies that advance knowledge relevant to national issues.

Program Performance

The CMGP supports field and interpretive activities to provide environmental mapping to meet management needs within Marine Sanctuaries, National Parks, Fish and Wildlife Refuges, Marine Monuments, and for management of fisheries and other living marine resources in State and Federal Waters. Those benthic habitat and other mapping programs that exclusively respond to the needs of management agencies will be eliminated in 2014. Continuing service mapping will only be supported where it enables scientific studies addressing CMGP research priorities and where substantial cost-sharing from partnering agencies is available.

A Great Lakes beach health study has been completed in 2013. The USGS worked collaboratively with NOAA, the EPA, and State and local public health agencies to expand the use of beach health predictive models to over 40 recreational beaches in five Great Lake States; developed new rapid field technology to determine bacteria concentrations at beaches; and increased understanding of the occurrence of true, rather than indicator, pathogens and viruses. This work provides beach managers the ability to issue warnings and closures, which have substantial public health and economic consequences, with greater certainty of risk.

For 2014, program performance will reflect a significant shift in USGS activities, that is, the full deployment of a new EARRL-B capability to collect topographic-bathymetric elevation data across the land water interface up to a depth of 16 to 25 feet depending upon water clarity. The USGS will continue work with Interior and other Federal agencies to establish data standards and delivery systems to increase application of research products; to collect and integrate data for coastal and marine maps and data layers; and to characterize the vulnerability of marine habitats and energy, communication and transportation structures to seafloor change. The USGS, as Interior's primary member of the Interagency Task Force on the Extended Continental Shelf (ECS), will characterize the seafloor and geologic features in the North Atlantic as the outcome of conducting science research cruises with global-class vessels available through the University-National Oceanographic Laboratory System (UNOLS).

Removal of the Elwha Dam in 2011 resulted in a large, turbid river plume transporting sediments all the way to the coastal waters in the Strait of Juan de Fuca. USGS studies are providing information on the impact of sediment suspended in water and deposited within the river and along the coast. The plume led

to reduced light levels reaching the seafloor near the river's mouth, in turn likely leading to negative effects on photosynthesizing organisms such as phytoplankton and kelp that support fisheries and provide habitat. Decreases in seaweed abundance were documented by ongoing USGS-led scuba dive studies, but nearshore invertebrates and fish were still abundant during the first season of post-dam removal monitoring. The increased turbidity and sedimentation observed by the Lower Elwha Klallam Tribe and USGS scientists at the Elwha River estuary is renewing important habitat for juvenile salmon. The observation of their first natural passage in nearly 100 years is just a first indication of restoration of the Elwha's uniquely productive fisheries. It is also highly symbolic to the Lower Klallam people, who for years saw reduced salmon runs in the fisheries that had nourished their ancestors.

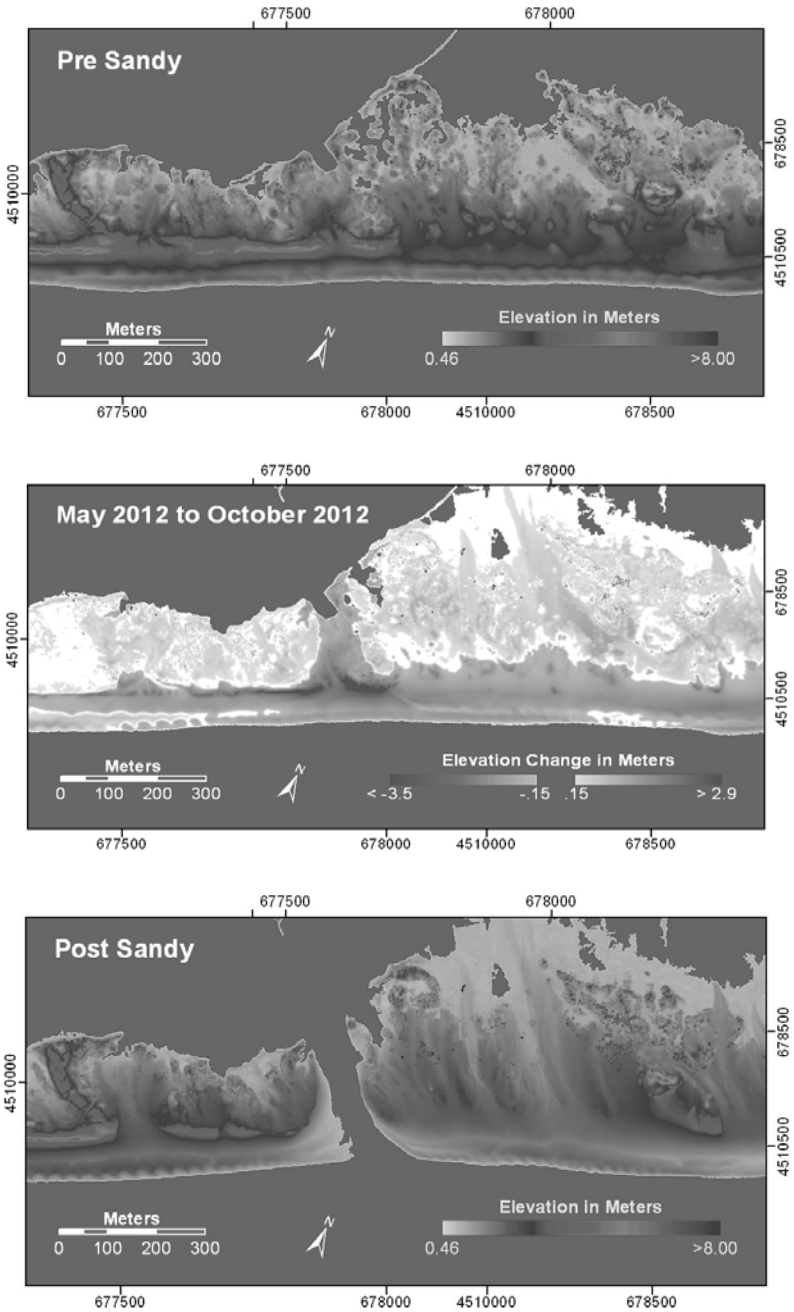
Hurricane Sandy – As Hurricane Sandy moved northward along the U.S. Atlantic coast in October 2012, USGS scientists worked to determine where and how the storm's waves and surge might dramatically reshape the beaches and dunes that stand between the storm and coastal developments. Through a complex modeling process that uses coastal elevations, wave forecasts, and potential storm surge, they forecast the likelihood of a range of coastal changes that might be expected during a Sandy landfall, including:

- Dune erosion was very likely for the majority of the sandy beaches along the Maryland and Delaware coasts with widespread overwash also very likely in many areas.
- Most of the New Jersey coast was very likely to experience extensive beach and dune erosion and many areas were very likely to overwash.
- Along the south shore of Long Island, New York, the models predicted extensive beach and dune erosion as well as intermittent overwash.

The USGS was able to deploy a new LiDAR technology, EARRL-B, to collect pre-storm elevation data over some of the barrier islands in New York, New Jersey, Delaware, and Maryland. The EAARL-B LiDAR is able to collect both topographic and shallow water bathymetric data that will allow documentation of both elevation changes and sediment redistribution above and below the shoreline. Immediately following landfall, oblique aerial photography and LiDAR surveys, using EAARL-B in New Jersey and contract surveys of Fire Island, Delaware, Maryland, Virginia, and North Carolina, were conducted to determine change in elevations and the extent and nature of impacts. These data are available to emergency responders and other agencies, such as NOAA, the U.S. Army Corps of Engineers, and FEMA. In addition, post-storm field measurements of the beaches and dunes were collected. Comparisons of data collected before and subsequent to the storm show the nature, magnitude and spatial variability of the coastal response. These data will be used to further refine forecasting models for storm-induced erosion and to provide updates for future assessments of coastal vulnerability.

The USGS acquired an airborne LiDAR survey of post-storm topography of Fire Island on November 5, 2012, to measure coastal change resulting from Hurricane Sandy. Comparisons of the post-storm elevation data to LiDAR data collected prior to Sandy's landfall are used to characterize the nature, magnitude, and spatial variability of hurricane-induced coastal changes, such as beach erosion, overwash deposition, and island breaching. These measurements complement field-based observations of coastal change that were collected immediately prior to and three days after landfall.

Below are pre-storm elevation maps, post-storm elevation maps, and elevation difference maps. The elevation change shows a widespread retreat of the beach and lowering of the dunes, leaving this coastline far more vulnerable to future storms.



Pelican Island and Fire Island, New York. This location is within Fire Island National Seashore near Old Inlet—a very narrow portion of the island that has experienced breaching in previous large storms. The island breached during Sandy, creating a new inlet, eroding the beach and cutting through 4-m high dunes.

Exploring Mars – USGS research scientist Dave Rubin, as the Leader of the Mars rover *Curiosity* Geology Science Theme team, applied his expertise in sediments, both modern and ancient, and how they are moved and deposited by water and wind to understanding sedimentary rock structures on Mars. His computer animations depicting the formation of bedding structures, particularly cross-beds (layers within a bed that are at an angle to the main bedding plane), have proved extremely valuable in the interpretation of complex bedding patterns exposed in outcrops imaged by *Curiosity*.

Deepwater Horizon – Nearly two years after the *Deepwater Horizon* oil spill, the meticulous, long-term efforts of scientists have established that the brown, wilted, dying corals found at Mississippi Canyon lease block 294 were indeed damaged by a plume of oil from the spill. Evidence was acquired using geochemical analyses, sediment cores, coral samples, and seafloor imagery. The damage is distinct from studies of other benthic communities in parts of the Gulf where oil naturally seeps up from the seafloor and is a wellspring of life, not a source of damage.

Sea Level Rise – Rates of sea-level rise are increasing three to four times faster along parts of the U.S. Atlantic coast than globally, according to a U.S. Geological Survey (USGS) report published in *Nature Climate Change* in June 2012**.** These USGS scientists analyzed tide-gauge data along the Atlantic coast, removing long-term trends associated with vertical land movements and showing that the sea-level-rise hotspot is consistent with the slowing of Atlantic Ocean circulation. Models show that this change in circulation may be tied to changes in water temperature, salinity, and density in the subpolar North Atlantic.

Off Shore Wind Energy – In response to natural resource managers' concerns, USGS scientists have compiled information on the strength and variability of bottom shear stress, and the consequent frequency and intensity of sediment mobility events, because of possible impacts of installation of offshore wind turbines where near-bottom forces may induce scour around structures and cables. Seafloor processes have been modeled from Cape Hatteras (NC) to Cape Cod (MA) and are available through the US GS Sea Floor Stress and Sediment Mobility Database. The database provides spatially and seasonally resolved statistics on bottom shear stress estimated at an approximately 5-kilometer scale using numerical models.

In 2014, a variety of efforts will address the resiliency of vulnerable communities, both human and ecological:

Enhancing Coastal Communities – In 2014, regionally-focused efforts in the Arctic and Pacific Islands, while addressing objectives specific to those regions, will provide models for application to national issues arising in other regions.

This effort to improve the integrated science needed to inform sustainable development of resources, in the right places and the right ways, and will balance with mandates to conserve the Nation's unique coastal and marine Arctic ecosystems under Interior's stewardship. A significant portion of the Nation's undiscovered oil and gas potential and a vast proportion of the Nation's endowment of wildlife, biodiversity, and wild places can be found in the U.S. Arctic. It is a place where native peoples must also thrive through sustainable economies, infrastructures, and culturally important subsistence foods. The Arctic is not static; its changing climate is increasing access to exploitable resources, bringing the world to the Arctic through polar navigation routes, and shifting fish, wildlife, and plant habitats in ways that are not fully understood. The increase will support new understanding in several major areas important to current and future energy and natural resource decisions in the Arctic.

Integrated Resource and Coastal Vulnerability Assessments – Pacific Island Communities – Accelerated sea level rise in low lying Pacific Islands threatens coastal communities by impacting groundwater supplies and agro-forestry production; and exposes coastal ecosystems and communities to erosion, storm inundation, and groundwater salinization. Recent storm events, combined with extreme high tides, have highlighted the vulnerability of these communities, resulting in widespread coastal flooding, erosion, and groundwater contamination in the Republic of the Marshall Islands and the Federated States of Micronesia, in which the Interior has a vested interest. The extreme vulnerability of these communities to changing sea level and ocean conditions represents a serious potential threat through impacts to public safety, environmental health, and food and water security. In 2014, the USGS will focus on selected vulnerable population centers in the Pacific Islands to develop assessments, forecasts,

and decision-support tools to anticipate consequences of more frequent, persistent, and extreme wave run-up, overwash, and coastal inundation on communities and the resources on which they depend.

Comprehensive Mapping and Resource Assessments – In 2014, in priority regions, the USGS will engage with Federal, State, tribal, and other regional partners to provide access to comprehensive maps and assessments of seabed and coastal conditions and vulnerability. These efforts will support Interior priorities by focusing on areas proposed for advancing renewable energy development (e.g., Interior's Smart from the Start initiative for offshore wind energy development off the Atlantic coast). Activities supported will include development of comprehensive seabed and geologic characterization; multi-resolution and multi-temporal elevation models; indices of seabed disturbance potential and resilience; assessments and forecasts of the vulnerability and response of indicator species; and integrated coastal vulnerability assessments.

The USGS has a unique Federal role to provide the geologic characterization of public lands required to assess hazard and resource potential. Marine assessments of hazard sources and the location and potential of energy and mineral resources are the foundation for policy and management decisionmaking across the vast Exclusive Economic Zone (EEZ) and the Extended Continental Shelf (ECS). Assessments in these poorly surveyed and remote regions require marine field programs utilizing large research vessels and specialized technologies. Access to these assets and effective utilization of USGS resources demands collaborative marine field programs with other USGS programs, Federal agencies, and academic partners. In 2014, opportunities to leverage ongoing USGS activities, such as the ECS study, and broader federally-supported programs will ensure that expensive marine field programs are cost effective and meet the compelling need for marine geologic surveys and the resulting resource and hazards assessments.

Collecting Coastal LiDAR Data – Accurate, precise, and up-to-date elevation data are the foundational requirement for efforts to quantify current and future coastal vulnerability to storms, flooding, tsunamis, and climate driven change. In 2014, provision of more accurate elevation data and resulting products that enhance access for varied applications would substantially reduce a major uncertainty in existing decision-support tools, facilitate development of improved models, and enable users to access appropriately formatted and merged data streams. Prioritization of data collection would be coordinated with NOAA through the 3D Elevation Program (3DEP), the Interagency Working Group for Ocean and Coastal Mapping (IWG-OCM), and the Interagency National Digital Elevation Program (existing coordination groups chaired by the USGS with wide agency participation) to ensure application of appropriate technologies; to effectively utilize 3DEP procurement process for private sector data collection; to ensure that all data meet shared standards reflecting application and integration requirements; and to support cooperative development of data collection, processing, and delivery capabilities across the community of practice. In 2014, efforts will focus on addressing priority data gaps and newly arising needs in the as identified through stakeholder engagement with regional ocean alliances and coastal resource and emergency management agencies at the State, tribal, and Federal levels. The proposed activity will advance 3DEP objectives through collection of bathymetric and topographic "near shoreline" elevation data, and integration of elevation data from other sources, to provide seamless elevation coverage across coastal settings as required for adaptive management of terrestrial and submerged resources and to forecast the coastal change vulnerability of resources and communities.

Enhanced Coastal Storm Response – The USGS, in anticipation of Hurricane Sandy and through the subsequent response and recovery, provided pre-storm forecasts of Sandy impacts; surveys to assess coastal and community impacts; and updated assessments of coastal condition and vulnerability reflecting the altered post-storm landscape. The resulting data and tools have high-visibility and have established expectations for continued USGS products to meet the needs of coastal resource and emergency managers at both the State and Federal level.

Demands for USGS data and products subsequent to Hurricane Sandy exceeded USGS capacity. In response, the CMGP is implementing changes to ensure that data and products are more readily available (through, for example, the *ocean.data.gov* portal), that standard products meet broad needs, and that users have tools to easily access and integrate information to meet their specific requirements. Efforts in 2014 will support evaluation of the accuracy and effectiveness of current forecast products; development of improved models for storm impacts, and development of products for application to specific management needs for public safety, infrastructure vulnerability, and cultural and natural resource management. Efforts will include collaborative efforts with diverse users, particularly DOI and State resource managers.

Activity: Water Resources

		2013 Full Yr. CR (PL 112-175)	2012 Enacted	2014 Fixed Costs and Related Changes (+/-)	2014 Program Changes	2014 Internal Transfer	2014 Budget Request	Change from 2012 Enacted (+/-)
Groundwater Resources ($000)		*8,731*	8,731	133	3,858	0	12,722	3,991
	FTE	*74*	74	0	13	0	87	13
National Water Quality Assessment ($000)		*61,570*	61,570	973	-500	0	62,043	473
	FTE	*521*	521	0	0	0	521	0
National Streamflow Information Program ($000)		*28,977*	28,977	221	7,047	0	36,245	7,268
	FTE	*139*	139	0	0	0	139	0
Hydrologic Research and Development ($000)		*12,667*	11,417	546	4,402	0	16,365	4,948
	FTE	*100*	99	0	7	0	106	7
Hydrologic Networks and Analysis ($000)		*30,597*	29,797	423	1,260	0	31,480	1,683
	FTE	*259*	259	0	2	0	261	2
Cooperative Water Program ($000)		*62,632*	62,632	785	-403	0	63,014	382
	FTE	*386*	387	0	-1	0	386	-1
Water Resources Research Act Program ($000)		*6,490*	6,490	4	-5,494	0	1,000	-5,490
	FTE	*2*	2	0	0	0	2	0
Total Requirements ($000)		***211,664***	**209,614**	**3,085**	**10,170**	**0**	**222,869**	**13,255**
	Total FTE	***1,481***	**1,481**	**0**	**21**	**0**	**1,502**	**21**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Summary of Program Changes

Request Component	($000)	FTE	Page
Groundwater Resources	**3,858**	**13**	
Hydraulic Fracturing	2,100	6	B-31
WaterSMART: Baseflow and Recharge and Regional GW Availability	1,200	4	B-7
WaterSMART: Groundwater Network	627	3	B-7
General Program Reduction	-69	0	B-65
National Water Quality Assessment	**-500**	**0**	
Ecosystem Priority: California Bay Delta	1,000	1	B-20
Ecosystem Priority: Chesapeake Bay	500	2	B-20
Ecosystem Priority: Upper Mississippi River	200	2	B-20
Methods Development and Assessments	-5,000	-29	B-60
WaterSMART: National/Regional Synopsis and Surveys	500	5	B-7
WaterSMART: Predictive Models	500	3	B-7
WaterSMART: Program and Information Management	500	3	B-7
WaterSMART: Water Quality Enhancement	1,800	13	B-7
General Program Reduction	-500	0	B-65
National Streamflow Information Program	**7,047**	**0**	
Streamgages	7,161	0	B-53
General Program Reduction	-114	0	B-65
Hydrologic Research & Development	**4,402**	**7**	
Ecosystem Priority: California Bay Delta	982	1	B-20
Ecosystem Priority: Puget Sound	200	1	B-20
Hydraulic Fracturing	2,200	2	B-31
Streamgage R&D	1,000	1	B-53
WaterSMART: Streamflow Estimation and Stressors to Hydrology - Water Use Research	300	2	B-7
General Program Reduction	-280	0	B-65
Hydrologic Networks & Analysis	**1,260**	**2**	
Data Collection and Research	-867	-9	B-60
WaterSMART: Ecological Flows	746	5	B-7
WaterSMART: Ecological Water Science	100	1	B-7
WaterSMART: Estimating Water Budget	100	1	B-7
WaterSMART: Program and Information Management	1,400	4	B-7
General Program Reduction	-219	0	B-65
Cooperative Water Program	**-403**	**-1**	
Interpretive Studies/Assessments	-4,000	-25	B-60
NAQWA Related Studies	1,000	7	B-54
Water Science and Technical Support forTribes	1,000	7	B-54
WaterSMART: Streamflow Estimation and Stressors to Hydrology - Water Use Research	2,000	10	B-7
General Program Reduction	-403	0	B-65
Water Resources Research Act Program	**-5,494**	**0**	
Water Resources Research Act	-5,490	0	B-61
General Program Reduction	-4	0	B-65
Total Program Change	**10,170**	**21**	

** Estimated changes in FTEs compare against actual 2012 FTE usage, not 2012 enacted formulation estimates.

Justification of Program Changes

The 2014 Budget Request for Water is $222,869,000 and 1,502 FTE, a net program change of +$13,255,000 and +21 FTE from the 2012 Enacted Budget. For more information on the Water Resources Mission Area changes, please see Section B, Program Changes as indicated in the table.

Activity Summary

The Water activity is comprised of seven subactivities:

- Groundwater Resources Program (GWRP, *http://water.usgs.gov/ogw/gwrp*);
- National Water Quality Assessment (NAWQA) (NAWQA, *http://water.usgs.gov/nawqa*);
- National Streamflow Information Program (NSIP) (NSIP, *http://water.usgs.gov/nsip*);
- Hydrologic Research and Development (HRD); (HRD, *http://water.usgs.gov/nrp/hrd*);
- Hydrologic Networks and Analysis (HNA); (HNA, *http://water.usgs.gov/hna*);
- Cooperative Water Program (CWP) (CWP, *http://water.usgs.gov/coop*); and
- Water Resources Research Act (WRRA) Program (WRRI, *http://water.usgs.gov/wrri*).

Since 1879, the U.S. Geological Survey (USGS) has addressed issues of water availability and quality, drought, and flood hazards. This legacy continues through the efforts of hydrologic professionals and support staff located in all 50 States and Puerto Rico. As the primary Federal science agency for water information, the USGS monitors and assesses the amount (quantity) and characteristics (timing and quality) of the Nation's freshwater resources, assesses sources and behavior of contaminants in the water environment, and develops tools to improve management and understanding of water resources. Information and tools allow first responders, the public, water managers and planners, and policy makers to:

- Minimize loss of life and property as a result of water-related natural hazards, such as floods, droughts, and land surface movement;
- Manage freshwater, both above and below the land surface, for domestic, public, agricultural, commercial, industrial, recreational, and ecological uses;
- Protect and enhance water resources for human health, aquatic health, and environmental quality; and
- Contribute to wise physical and economic development of the Nation's water resources for the benefit of present and future generations.

Fundamental to USGS water science is the collection and public dissemination of data describing the quantity and quality of the Nation's freshwater resources. During the past 120 years, the USGS has collected streamflow data at over 26,000 sites, water-level data at over 850,000 wells, and chemical data at over 338,000 surface-water (streams, rivers, natural lakes, and man-made reservoirs) and groundwater (water beneath the land surface) sites. This data is freely available online through the National Water Information System (NWIS) at *http://waterdata.usgs.gov/nwis.*

Water resources research, information, and monitoring activities support the USGS Science Strategy to provide scientific information on water availability and quality of the United States in order to inform the public and decisionmakers about the status of freshwater resources and how they are changing. Efforts of Water Mission Area scientists also support the USGS Science Strategy themes of understanding

ecosystems and predicting ecosystem change, providing a scientific foundation for energy and mineral resources for America's future, climate variability and change, the natural hazards, risk, and resilience assessment program, and the role of the environment and wildlife in human health.

The water quality and hydrologic data, and the analytical information provided through the USGS water programs are used by a variety of stakeholders, including other Interior bureaus, Department of Homeland Security (DHS), the United States Department of Agriculture (USDA), the Environmental Protection Agency (EPA), the National Weather Service, the Army Corps of Engineers, State, tribal, and local governments, academia, consulting and advocacy organizations, industry, and private citizens. The long-term data collection and analyses of the streamflow and groundwater data are important to water supply planners to identify the influence of population growth, land use change, and climate variability on current and future water availability.

Research and assessments generated through the USGS water programs, many of which are conducted cooperatively with other agencies, serve as the foundation for many USGS mission goals, including water availability, ecosystem health, water quality and drinking water, hazards, energy, and climate. For example, the water programs support data collection and interpretative studies in 48 USGS Water Science Centers located nationwide. Assessments are conducted to quantify water withdrawals, watershed budgets, groundwater/surface water relations, evapotranspiration, and surface water flows needed for ecosystem sustainability.

Technical excellence and unbiased results are the hallmark of the USGS water programs. The quality assurance of all data and science products are conducted to ensure technical excellence and to ensure that information collected across State boundaries is nationally consistent, comparable and suitable for inclusion in the USGS national hydrologic databases. The high-quality technical support also provides a structured manner for transferring new technology to the USGS investigative and data activities in each State. USGS products are widely recognized as unbiased, high quality, and readily available at no cost to other agencies, the scientific community, and the public.

One area where the USGS water programs strive for excellence is integrating the use of program resources to provide science that informs common societal questions. One of those common societal questions involves water availability and use. The Nation must determine if there is enough freshwater, of acceptable quality, to meet both human and ecological needs, today and into the future. The USGS has organized its resources around an effort that we call the National Water Census (Water Census) to help answer this question. The Water Census draws resources from six programs within the Water Mission Area and another six programs from other USGS Mission Areas to fund science efforts towards this end. Together these programs plan the approach and execution of the Water Census tasks that will provide technical information that inform water availability decisions.

Mission Area 4: Provide a Scientific Foundation for Decisionmaking
Goal #2: Provide Science for Sustainable Resource Use, Protection, and Adaptive Management
Strategy #4: Monitor and Assess Water Availability and Quality

Strategic Plan Performance Measures	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Target	2012 Actual	2013 Target	2014 Target	2008 - 2014 Trend
Strategy #4: Monitor and Assess Water Availability and Quality										
Percent of U.S. with groundwater availability status and trends information (Groundwater Resources Program)	USGS	8%	13%	15%	18%	20%	20%	20%	23%	
		3	5	6	7	8	8	8	9	
		40	40	40	40	40	40	40	40	
Percent of U.S. with current streamwater quality status and trends information (National Water Quality Assessment Program)	USGS	34%	52%	69%	86%	100%	103%	3%	5%	
		1,707	2,575	3,409	4,273	4,956	5,109	1,559	3,118	
		4,956	4,956	4,956	4,956	4,956	4,956	60,390	60,390	
Percent of U.S. with current groundwater quality status and trends information (NAWQA)	USGS	56.33%	67.46%	77.87%	89.11%	91.24%	100.2%	8.68%	18.23%	
		476	570	658	753	771	847	1,650	3,464	
		845	845	845	845	845	845	19,000	19,000	
Percent of USGS planned streamgages that are fully funded by the National Streamflow Information Program (National Streamflow Information Program)	USGS	10.5%	7.3%	7.3%	8.8%	9.7%	10.0%	9.3%	12.2%	
		500	349	349	421	460	476	442	581	
		4,756	4,757	4,757	4,758	4,758	4,758	4,758	4,758	
Percent of U.S. with completed, consistent water availability products (Hydrologic Network and Analysis)	USGS	n/a	n/a	n/a	n/a	0%	0%	0%	5.0%	
		n/a	n/a	n/a	n/a	-	-	-	105	
		n/a	n/a	n/a	n/a	2,112	2,112	2,112	2,112	
Number of water monitoring sites supported jointly with State, local, or Tribal cooperators (Cooperative Water Program)	USGS	21,800	20,600	20,000	17,850	17,500	18,655	18,000	18,500	

Supporting Performance Measures

Outputs, Supporting Performance Measures, and/or Milestones	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Plan	2012 Actual	2013 Plan	2014 Plan
Number of knowledge products on the water availability of the Nation's water resources provided to support management decisions (GWP)	USGS	21	15	25	40	25	35	20	20
Number of knowledge products on the water availability and quality of the Nation's water resources provided to support management decisions (NAWQA)	USGS	80	50	80	43	128	69	30	50
Number of knowledge products on the water availability and quality of the Nation's water resources provided to support management decisions (Hydrologic Research & Development)	USGS	249	203	220	250	200	123	120	120
Number of knowledge products on the water availability and quality of the Nation's water resources provided to support management decisions (HNA)	USGS	9	11	12	11	11	11	9	7
Number of knowledge products on the water availability and quality of the Nation's water resources provided to support management decisions (CWP)	USGS	250	237	230	325	200	387	300	300
Number of retrievals of groundwater and surface water quantity and quality data and information (NSIP, HNA, GWP, NAWQA, and CWP)	USGS	133,000,000	154,000,000	175,000,000	283,258,614	292,000,000	314,369,456	301,000,000	301,000,000

Activity: Water Resources
Subactivity: Groundwater Resources

2012 Enacted: $8.7 million (74 FTE)
2013 CR: $8.7 million (74 FTE)
2014 Request: $12.7 million (87 FTE)

Overview

Groundwater is among the Nation's most precious and increasingly important natural resources. Groundwater is the primary source of drinking water for approximately half the Nation's population, provides about 40 percent of the irrigation water necessary for the Nation's agriculture, sustains the flow of most streams and rivers, and helps maintain a variety of aquatic ecosystems. Continued availability of groundwater is essential for current and future populations and the economic health of our Nation.

The Groundwater Resources Program (GWRP) provides objective scientific information and interdisciplinary understanding necessary to assess and quantify availability and sustainability of the Nation's groundwater resources. Results of those efforts provide information used in decisionmaking by resources managers, regulators, other government agencies, and individuals in the public and private sectors. The goals of the program are to:

- Provide fundamental information about groundwater availability in the Nation's major aquifer systems;
- Characterize natural and human factors that impact recharge, storage, and discharge in the Nation's major aquifer systems, and improve understanding of these processes;
- Develop and test new tools and field methods to analyze groundwater flow systems and their interactions with surface water; and
- Provide scientific leadership across all Federal programs about the Nation's groundwater resources, including research directions, quality control, technology transfer, and information storage and delivery.

The program coordinates with and complements other USGS programs by providing new methods, tools, and information used in monitoring, assessment, and resource management activities. Goals of the GWRP directly support the USGS Science Strategy focus on the Water Census theme whereby providing scientific information on water availability and quality of the United States to inform the public and decisionmakers about the status of groundwater resources and how they are changing. GWRP scientists also support USGS Science Strategy themes of climate variability and change, understanding ecosystems and predicting ecosystem change, and the natural hazards, risk, and resilience assessment program.

Program Performance

National and Regional Groundwater Evaluations
(2012 Enacted, $3.4 million; 2013 CR, $3.34 million; 2014 Request, $3.34 million)

The GWRP is the principal entity within the USGS for assessing availability of groundwater resources of the Nation's most important regional aquifers. Studies comprise individual assessments of regional groundwater flow systems that cover a variety of hydrogeologic terrains and are used to develop a comprehensive regional and national perspective. Collectively, these individual studies are the foundation for the national assessment of groundwater availability. Availability studies, conducted in cooperation

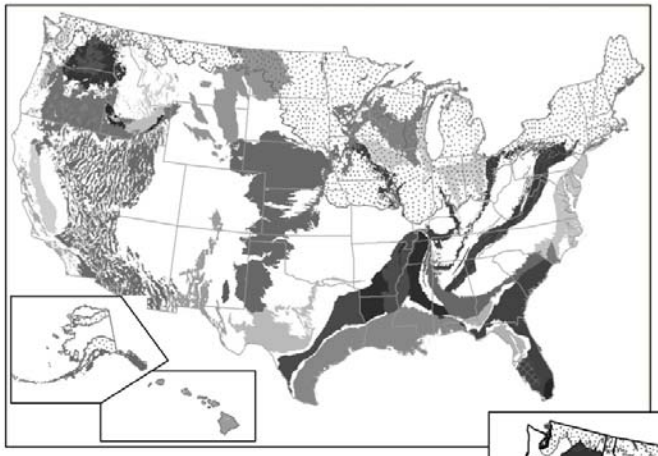
with other Federal, State, tribal and local governments and the private sector, involve computer-based groundwater flow models to document effects of human activities and climate variability on groundwater levels, depletion, storage, and interaction with surface water.

Progress being made on National and Regional Groundwater Evaluations – The Groundwater Resources Program provides scientific information and understanding necessary to assess and quantify the availability and sustainability of the Nation's groundwater resources. Results of those efforts provide information used in decisionmaking by resources managers, regulators, other government agencies, and individuals in the public and private sectors. Regional studies of groundwater availability are being conducted to quantify current aquifer resources, evaluate how those resources have changed over time, and provide tools to forecast how much water will be available in the future. In 2012, four regional water resource assessments and related data collection took place in the following principal aquifer systems (see figure).

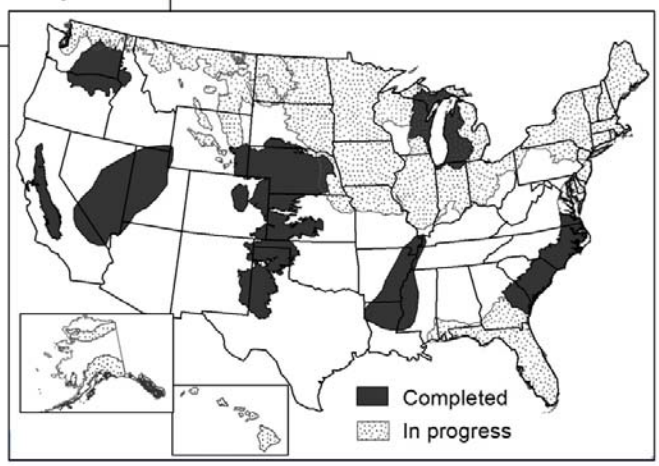
- **High Plains Aquifer** (SD, NE, WY, CO, KS, OK, NM, TX)
  The aquifer serves as a primary source of drinking water for most residents (> 2 million people) of the region, and also sustains more than one fourth of the Nation's agricultural production. This amount of groundwater production makes the High Plains aquifer by far the most intensively pumped principal aquifer in the United States.
- **Northern Atlantic Coastal Plain Aquifer System** (Long Island, NY to NC)
  Eleven million people or 41percent of people living above the aquifer use groundwater as their supply. Above this aquifer is the most densely populated area associated with any single principal aquifer in the United States.
- **Williston and Powder River Basins** (MT, ND, SD, WY)
  The regional Lower Tertiary and Upper Cretaceous aquifer system are the shallowest, most accessible, and in some cases, the only potable aquifers within the Northern Great Plains. These aquifers contain a major part of the Nation's reserves of coal and natural gas and are a water-supply alternative for some of the Nation's most rapidly developing oil reserves in the "Bakken" play.
- **Glacial Aquifer System** (all or parts of 25 northern States from Maine to Washington and Alaska)
  The glacial aquifer system groundwater availability study is one of the USGS efforts in response to the Department of Interior WaterSMART initiative. This study complements other regional aquifer studies through the Groundwater Resources Program designed to develop a national assessment of groundwater availability as part of a national Water Census. The glacial deposits are the source for the largest withdrawals for public and domestic supply in the United States. An estimated 22.5 million people rely on the glacial aquifer system for their drinking water, and of that amount, 17 million people tap these deposits with private wells.

In 2013 and 2014, one new regional groundwater availability assessment is planned to begin each year. These regional assessments are part of an effort to evaluate more than 30 regional aquifers across the Nation and when added to past and future studies will collectively lead to a national assessment of groundwater availability (see figure). Circular 1323 describes the approach to be used for the assessment *http://pubs.usgs.gov/circ/1323/*. More specifically in 2013, the Hawaiian volcanic-rock aquifers (HI islands) study will begin. These aquifers are the main and most reliable source of drinking water on the islands supplying water to 1.4 million residents, diverse industries, and a large component of the U.S. military in the Pacific. Faced with growing demand and the potential negative environmental effects on availability a dependable supply of freshwater for the residents of the Hawaiian Islands is of the highest priority. In 2014, the Ozark Plateaus aquifer system (AR, KS, MO, OK) is the next scheduled regional resource assessment to begin. It is predominantly a freshwater system that is almost entirely surrounded

by, but hydraulically isolated from, neighboring saline groundwater flow system. Groundwater from the Ozark aquifer is the primary source of freshwater for most public supply systems that use groundwater exclusively, and for most self-supplied domestic water users in the area. Population within the study area has steadily increased to over 6.4 million people as of the 2010 Census and is experiencing a corresponding increase in commercial, industrial, and residential water demand.



Priority Aquifers that Collectively Make Up National Assessment of Groundwater Availability



Status of Regional Groundwater Availability Studies

Groundwater Interactions
(2012 Enacted, $3.3 million; 2013 CR, $3.4 million; 2014 Request, $7.4 million)

Over the past decade, groundwater issues have evolved in scope and complexity as a result of escalating demands for the resource. USGS scientists address this increasing complexity by targeting information needs with a multi-disciplinary approach to understanding groundwater and linkages to humans and the natural environment. The GWRP will continue activities related to groundwater assessment while investigating all aspects of groundwater and its interdependence with the environment.

Field Methods and Model Development – The GWRP supports development of new field techniques and computer models to maintain cutting-edge assessments. Research on new and emerging geophysical methods and applications are underway to evaluate groundwater resources at a variety of scales. Near surface geophysical techniques are being used to rapidly and effectively characterize the shallow subsurface and to monitor hydrologic and remediation processes in ways not previously possible with standard technology. The USGS leads development of numerical techniques which are essential tools needed to manage water resources in complex environments across differing spatial and temporal scales. A prime example of USGS leadership is the development and continued evolution of the USGS Modular

Groundwater Flow Model (MODFLOW) the most widely used groundwater flow model in the world used to solve practical problems in the study of groundwater resources.

Data and Groundwater-Level Monitoring – The GWRP is also fundamentally involved in the collection, analysis, and dissemination of a wide variety of groundwater information. Groundwater level information stored in USGS databases are made available for several networks in an easily accessible manner via the Internet at *http://groundwaterwatch.usgs.gov/*. The Groundwater Climate-Response Network is one example of the type of information being provided. This network is used to assess the changes in groundwater conditions caused by climate stresses, especially drought.

Improved Modeling Techniques Instrumental in the Evaluation and Management of the Nation's Water Resources – The GWRP provided essential support for the application, testing, and development of groundwater flow and solute transport modeling capabilities necessary for solving practical problems in availability and management of the Nation's groundwater resources. Predictive models are needed to make informed decisions in many emerging areas related to the effects of groundwater development. These critical tools are used by States and local governments, as well as groundwater scientist and engineers in the private sector on a regular basis as an integral part of their work. In 2012, MODFLOW was applied in the USGS to more than 200 projects addressing topics such as groundwater availability and sustainability, groundwater and surface water interactions, and groundwater management strategies. In addition, models based on the MODFLOW suite of software are providing insight into the effects of drought and climate change on groundwater systems, benefits and challenges of artificial groundwater recharge, and saltwater intrusion into coastal aquifers.

Enhanced modeling tools are presently being applied to densely populated areas of southern Florida to evaluate alternative water-management practices and their effects on municipal well fields, protected wetland ecosystems, and the potential for flooding in low-lying areas. GWRP continued to support development and evolution of modeling capabilities with private and public sector scientists while maintaining a leadership role to more accurately simulate, predict, and describe stream-aquifer interaction, groundwater flow to wells, and movement of subsurface contaminants. An example demonstrating GWRP scientist leadership, collaboration, and enhanced capabilities is apparent in the ability to simulate saltwater intrusion in regional coastal aquifer systems. Existing modeling tools have difficulties simulating saltwater intrusion at the regional scale but the new formulation enables all scientists as well as State and municipal agencies to better manage the threat of coastal aquifer salinization caused by intense development, sea-level rise, and future climate variability. In Florida, Broward County saltwater intrusion study, Tsala-Apopka Plain integrated surface water/groundwater interaction study, and the urban Miami-Dade County integrated surface water/groundwater interaction study are all instances where this GWRP sponsored model development has improved ability to manage critical groundwater resources.

In 2013 and 2014, the Groundwater Resources Program will continue to support MODFLOW enhancements with updates to help scientist and engineers simulate common features in groundwater systems. New features will be added to the model to incorporate advancements in our understanding of groundwater hydrology, to respond to changes in user needs, and to take advantage of constantly increasing computer power. Moreover, the GWRP will support application of USGS groundwater models in complex aquifer settings and examine challenging water-resource management issues such as addressing water availability (drought), optimization of water resources, saltwater intrusion, climate variability, and the effects of groundwater withdrawals on aquatic ecosystems in streams.

Groundwater Level Networks, Monitoring, and Data Delivery – Initial steps have been taken to begin the work necessary to carry out authorizing language in the SECURE Water Act (P.L. 111-11) Section 9507 (b) related to the development of a groundwater monitoring program for each major aquifer system

in the United States. The National Groundwater Monitoring Network (NGWMN) is being proposed as a collaborative monitoring network among Federal, State, tribal, and local agency data providers. Steps taken in 2012 towards implementation of the NGWMN as conceptualized by the Advisory Committee on Water Information Subcommittee on Groundwater include compiling and reporting on the results of pilot testing with state agencies in six states, development of a pilot "portal" to provide NGWMN groundwater levels and quality from the USGS and the pilot States to the public, and enhancement of the NGWMN design document, based on the lessons learned from the pilot studies.

Collection and monitoring of basic groundwater information are required to assess and quantify the availability of the Nation's groundwater resources. The USGS maintains a database of groundwater data records compiled from about 850,000 wells used in groundwater hydrology studies over the past 100 or more years. Wells are monitored for a variety of purposes such as statewide and regional monitoring of ambient conditions, or for local monitoring of drawdown, aquifer tests, or even earthquake effects on water levels. The GWRP makes many of these data available in an easily accessible manner via the Internet at *http://groundwaterwatch.usgs.gov/*.

As a complement to these networks and in response to expanding human and environmental demands, the USGS periodically evaluates water levels on a regional scale to properly inventory groundwater reserves in areas experiencing intense development. Aquifers and aquifer systems have been and are being monitored, such as the High Plains Aquifer, Floridan Aquifer System, Columbia Plateau Regional Aquifer System, the Sparta-Memphis Aquifer, and the Atlantic Coastal Plain Aquifer System.

In 2013 and 2014, data collection and groundwater level monitoring network activities will continue along with progress on the implementation of the National Groundwater Monitoring Network. Established national, regional, State, and local monitoring networks will continue to be enhanced to improve access to groundwater information in a timely and cost-effective manner. These networks are possible with the continued support from the Cooperative Water Program in conjunction with local partners. The GWRP will also continue to support regional evaluations of groundwater conditions where groundwater resources have been intensively developed. The acquisition, management, and distribution of fundamental groundwater data will continue to be a high priority task for the program.

Technical Support
(2012 Enacted, $2.0 million; 2013 CR, $2.0 million; 2014 Request, $2.0 million)

This support provides quality control to assure technical excellence of groundwater field programs and provides a structured way of transferring new technology to activities conducted at USGS Water Science Centers in each State. This program component also provides a formal way of establishing research priorities and making groundwater information available to others agencies, the scientific community, and the public.

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Activity: Water Resources
Subactivity: National Water Quality Assessment

2012 Enacted: $61.6 million (521 FTE)
2013 CR: $61.6 million (521 FTE)
2014 Request: $62.0 million (521 FTE)

Overview

In 1991, Congress established the National Water-Quality Assessment (NAWQA) Program within the U.S. Geological Survey to address a fundamental question:

> "What is the status of the Nation's water quality and is it getting better or worse?"

Since then, the NAWQA Program has been a primary source of objective and nationally consistent water-quality data and information on the quality of the Nation's streams and groundwater. NAWQA data and models provide answers to where, when, and why the Nation's water quality is degraded, and what can be done to improve and protect it for human and ecosystem needs. This information is used by national, tribal, regional, State, and local agencies, as well as other organizations, to develop more effective, science-based policies and strategies for protecting and managing water quality and aquatic ecosystems. (*http://water.usgs.gov/nawqa/xrel.pdf*).

Program Performance

Two decades of NAWQA monitoring and modeling have resulted in a solid foundation of data and scientific understanding and improved capability within the water community to address current and future water quality issues. During its first decade, (1991-2001 or Cycle 1), the NAWQA Program completed interdisciplinary baseline assessments of the quality of streams, groundwater, and aquatic ecosystems in 51 of the Nation's largest and most important river basins and aquifers. The assessments were based on sampling at 505 stream sites and more than 5,000 wells.

During its second decade, (2001-2012 or Cycle 2), NAWQA built upon the baseline assessments by reporting on how water-quality conditions are changing over time and by developing regional-scale water-quality models to extrapolate findings to unsampled areas. For example, in 2012, NAWQA released a major national report and online, interactive maps that show how groundwater quality conditions have changed in the last 20 years. Although water-quality conditions in most wells met USEPA drinking water standards or guidelines; the proportion of samples exceeding the limits for nitrate and dissolved solids increased from 12 to 15 percent. Most of the increases in concentrations occurred in shallow wells installed in urban and agricultural areas. The implication of this finding is that concentrations of these contaminants in deep aquifers are likely to increase during the next decade as shallow groundwater with elevated concentrations move downward. The potential for contamination of the deep aquifers is important because these aquifers are commonly used for public water supply, and because restoration of groundwater is difficult and expensive.

Also during Cycle 2, NAWQA began developing tools that resource managers can use to evaluate the likely consequences of different management practices or policy scenarios. For example, in 2012, maps showing the sources and amounts of nutrient loads from different watersheds that feed into 21 estuaries and bays in the Gulf of Mexico were prepared using USGS Spatially Referenced Regression On Watershed Attributes (SPARROW) models and data from more than 700 monitoring sites in the southeast collected by the USGS and other Federal, State, and local agencies. An online, interactive decision

support system provides easy access to these regional models that describe how rivers receive and transport nutrients from natural and human sources to sensitive waters throughout the Gulf of Mexico. Users can evaluate source reduction scenarios that target one or more nutrient sources to evaluate changes in the amount of nutrients transported downstream. SPARROW findings also are being used by the USDA and conservation partner organizations to prioritize watersheds for nutrient management strategies, as part of the USDA Mississippi River Basin Healthy Watersheds Initiative. NAWQA science also supports the USGS mission for understanding stream ecosystem health and ecosystem changes driven by climate and human activities on the landscape as well as the national hazards, risk, and resilience assessment program.

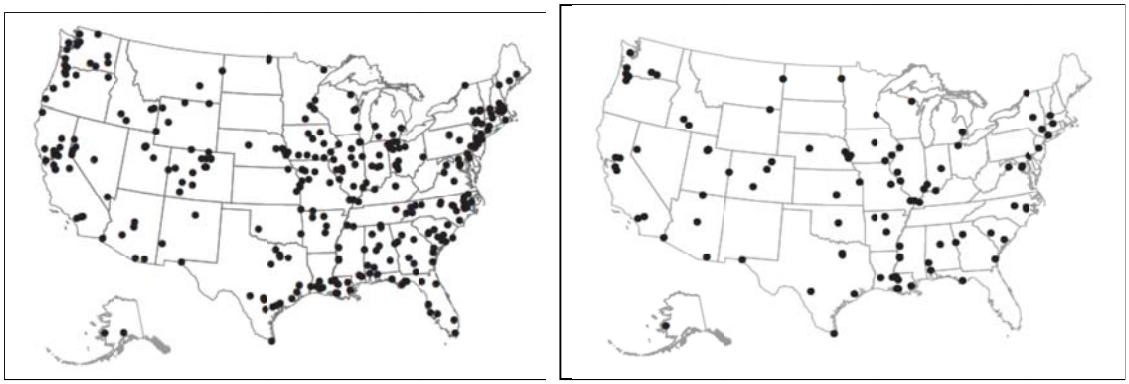
> *"NAWQA has evolved from a water-quality program emphasizing data collection and trend assessments to one that has the potential to predict and forecast pollution occurrence and trends under multiple scenarios at nationally significant scales".*
> National Research Council (2012, p 158)

For NAWQA's third decade (2013-2023 or Cycle 3), a science plan describing a 10-year strategy for assessing the Nation's freshwater quality and aquatic ecosystems was developed. The plan continues strategies that have been central to NAWQA's long-term success, but also adjusts approaches, monitoring intensity, and study design to address monitoring and science needs identified by NAWQA stakeholders and the National Research Council (2012), which reviewed the plan *http://www.nap.edu/openbook.php?record_id=13464&page=R1*. The plan addresses stakeholder needs for more timely reporting of water-quality information, science, and tools, for example, (1) annual Web-based reporting of concentrations, loads, and trends of nutrients, sediment, and other contaminants in rivers draining into important coastal estuaries; (2) maps showing the distribution of nitrate, arsenic and other contaminants in important water-supply aquifers at the depth tapped by domestic or public-supply wells: or (3) model-based decision support tools that allow managers to access water-quality models to evaluate how water quality or stream ecosystems may change in response to different scenarios of population growth or climate change.

Surface Water-Quality Monitoring and Modeling

(2012 Enacted, $24.0 million; 2013 CR, $24.0 million; 2014 Request $24.2 million)

Restoring and enhancing water-quality monitoring networks, particularly for surface water and continued development of water-quality models are the two highest priorities for the NAWQA Program during the next decade. The NAWQA Program will continue to focus on nutrients, sediment, pesticides and other contaminants in key agricultural and urban settings in the Mississippi River Basin and waters flowing into other important estuaries, such as Chesapeake Bay, San Francisco Bay/Delta and Puget Sound. Water-quality monitoring in 2013 will be done at 100 of the 313 sites recommended in the science plan for the third decade of NAWQA. Five monitoring sites will be instrumented with state-of-the-art water-quality sensors that will provide real time, continuous data for selected water-quality constituents including nitrate, dissolved organic carbon and turbidity. These data will provide the ability to improve instream estimates of nutrient and sediment loads that are the basis for water-quality models. Biological assessments of the condition of algal, macroinvertebrate, and fish communities will be conducted at the urban, agricultural, and undeveloped small stream sites.



A **B**

Figure 1. A. Locations of 313 stream and river sites recommended for sampling during Cycle 3
B. Locations of 100 stream and river sites sampled beginning in Fiscal Year 2013

In 2013, the first of a planned series of targeted regional water-quality monitoring studies will focus on the stream quality in the heavily agricultural upper Midwest, a region encompassing parts of 10 States. The Midwest Stream Quality Assessment is being designed in collaboration with the States and the U.S. Environmental Protection Agency (EPA) to complement their assessments of ecological conditions under the EPA National Rivers and Streams Assessment program. The NAWQA Program will sample about 100 sites weekly for pesticides, nutrients, and sediment starting in the spring of 2013. Data on habitat and the condition of algal, macroinvertebrate, and fish communities will also be measured. The USGS Columbia Environmental Research Center, will measure water and sediment toxicity and aquatic organisms will be tested for biomarkers of contaminant exposure.

Other regional-scale studies to determine the influence of streamflow alteration on aquatic communities in support of WaterSMART are being planned in collaboration with stakeholders for the lower Colorado basin, southern California, and parts of New England.

In 2014, NAWQA would continue to work towards expanding the national network of long-term, water quality monitoring sites to support the goals of the program by partnering with other USGS programs, the States and other organizations in key undeveloped, agricultural, and urban settings in the Mississippi, and other major river basins throughout the United States. Water-quality models that estimate nutrient and sediment loads (SPARROW, and pesticide concentrations in streams (WARP; (WAtershed Regressions for Pesticides) will be updated and enhanced in four large regions (west, southeast, northeast, and Mississippi River Basin). Planned enhancements include providing improved spatial resolution, updated contaminant source data, as well as simulation of seasonal to annual variations in streamflow and contaminant concentrations and loads that will improve decision-support tools used for evaluating how nutrient and sediment loads will change in response to changes in climate, land use, or management policies. Depending on the availability of resources another regional water-quality monitoring study will be planned in collaboration with the States and other stakeholders. Candidate areas include the Southeast as well as the Northeast, southern Rockies, southern California and the Pacific Northwest.

Groundwater Quality Monitoring and Modeling

(2012 Enacted, $18.6 million; 2013 CR, $18.6 million; 2014 Request, $18.8 million)

NAWQA is the only Federal program that monitors the status of the Nation's groundwater quality and reports on how these conditions are changing over time. During the next decade, proposed budgets are

sufficient to support groundwater monitoring in 16 Principal Aquifers that collectively account for more than 75 percent of the groundwater used as a source of drinking water for the Nation (fig. 3). Statistical models and monitoring data will be used to provide maps showing the concentrations of selected contaminants at the depth zones used for domestic and public supply. Groundwater quality data for the California Central Valley, Coastal Lowlands of the Carolinas, the Glacial, and Northern Atlantic Coastal Plain principal aquifers will be combined with flow models produced by the Groundwater Resources Program to provide a three-dimensional assessment of the amount of groundwater available, its vulnerability to contaminants derived from natural and (or) human sources, and an understanding of how groundwater quality will respond to changes in climate, overlying land use, and water use over time. Initial testing will be done during 2013 in the California Central Valley.

About 2,500 wells that are part of 79 monitoring networks previously sampled by NAWQA will be resampled for nitrate, arsenic and other potentially toxic trace elements and constituents to determine how water-quality conditions are changing beneath urban and agricultural lands and in deeper domestic wells. Subsets of wells in selected networks will also be sampled for pesticides, contaminants of emerging concern (pharmaceuticals, hormones, and high production volume chemicals), radiochemicals, microbial contaminants, and tracers that indicate the approximate age of the groundwater. About 1,500 deep public supply wells will be sampled to help characterize water-quality conditions in parts of the aquifers that were not examined in previous NAWQA assessments. In 2013, about 170 wells that are part of 7 monitoring networks in 12 States will be resampled.

The California State Water Resources Control Board has worked closely with the U.S. Geological Survey to develop a comprehensive monitoring and assessment Program for California's groundwater basins. The approach, methods and results from NAWQA studies have been fully integrated into California's plans to evaluate groundwater quality on a statewide basis.
Arthur G. Baggett Jr., State Water Resources Control Board

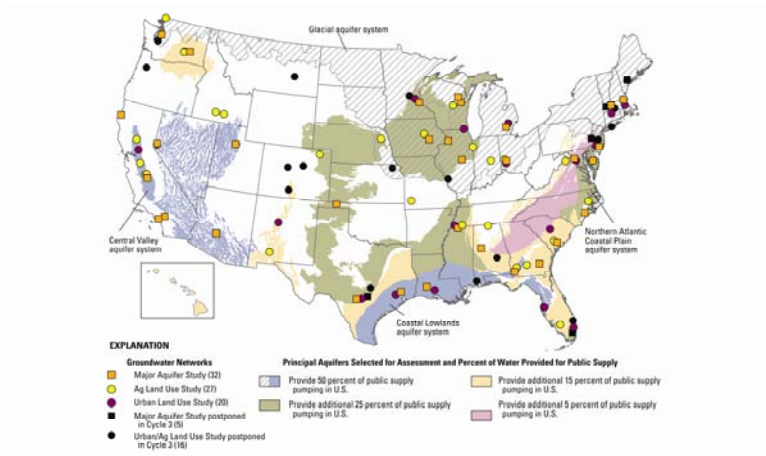


Figure 2. Seventy-nine well networks in 16 principal aquifers will be resampled during Cycle 3 to determine how groundwater-quality conditions are changing. Each network consists of 25 to 30 wells in the same principal aquifer distributed randomly across areas ranging from several hundred to several thousand square miles. Seven networks will be resampled in 2013 with a similar number of networks to be resampled in future years. Resampling of 21 other networks proposed in the Science Plan (shown here as black symbols) has been postponed because of funding constraints.

Supporting Research and Methods

(2012 Enacted, $5.9 million; 2013 CR, $5.9 million; 2014 Request, $5.9 million)

To ensure NAWQA data collection and analyses are relevant to emerging issues, about 10 percent of program resources are devoted to developing state-of-the art methods and innovative techniques that help to provide greater understanding of the factors affecting water quality conditions and trends. For example, USGS scientists developed a new statistical method for tracking changes in water quality and evaluating progress toward reducing nitrogen and phosphorus delivery from watersheds to critical estuaries such as the Chesapeake Bay. The new method takes into consideration seasonality, variations in river flow, and the long-term trends that are driven by the wide range of human activities in the watershed, such as wastewater treatment and changing land management practices.

Technical and Science Support of USGS Activities

(2012 Enacted, $12.5 million; 2013 CR, $12.5 million; 2014 Request, $12.5 million)

High quality, nationally consistent monitoring data and information used in reporting of trends and in water-quality models across the Nation is a signature strength of NAWQA and other water resources research. To ensure this quality and consistency, national-level technical support for staff scientists working on the NAWQA Program is critical. Technical support includes: national-level training in water-quality field techniques, laboratory methods development, quality-control of chemical and biological analyses, improvements to the National Water Information System used for storage and retrieval of hydrologic data; development of the National Hydrography Dataset ; acquiring and processing contaminant source data used in water-quality models; and support of the National Water Quality Monitoring Council.

The ability to monitor and detect pesticides and other contaminants at concentrations as low as economically and technically feasible is critical to identify emerging issues and to track changes in concentrations over time. Beginning in 2013, new laboratory instrumentation and analytical methods for pesticides used by the National Water Quality Laboratory are expected to result in as much as a 70 percent increase in the number of compounds that can be measured (from 143 to 242); while reducing the time required by the chemists for analysis and, thus reducing the total costs of analysis by about 40 percent. Because the new methods requires less water for analysis, additional cost savings are achieved because less time is needed to process samples in the field and because costs to ship samples to the laboratory are lower.

Similarly, a new analytical method for measuring the concentration of nitrate in water is more automated and thus is expected to reduce costs by as much as 30 percent. Equally important, the new procedure supports the Administration's emphasis on use of green technology by eliminating the use of toxic cadmium as a reagent in the method.

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Activity: Water Resources
Subactivity: National Streamflow Information Program

2012 Enacted: $29.0 million (139 FTE)
2013 CR: $29.0 million (139 FTE)
2014 Request: $36.2 million (139 FTE)

Overview

The mission of the U.S. Geological Survey's National Streamflow Information Program (NSIP) is to provide the streamflow information and understanding required for national, state, and local economic well-being, the protection of life and property, and effective and efficient water resource management. The USGS currently operates over 8,000 streamgages nationwide in partnership with other Federal, State, and tribal entities; this network is designed to provide long-term, accurate and unbiased streamflow information and interpretation to meet the multiple needs of many users. The USGS streamgage network provides relevant, high-quality information to all users. Data is collected using nationally consistent methods, which enable comparability of data across jurisdictional boundaries and acceptance of results by water management agencies and courts at all levels of Government.

The NSIP as planned includes five major objectives:

- Develop and maintain an enhanced, stable streamgaging network fully funded by NSIP to meet national needs for streamflow information;
- Improve timeliness, reliability, and convenience of streamflow information delivery to users;
- Complete regional assessments of existing and future streamflow information to identify trends and to estimate streamflow at locations without streamgages;
- Improve understanding of floods and droughts through expanded measurements and analyses; and
- Perform and fund research and development activities to advance equipment technologies and measurement and analysis techniques for a better understanding of flow in rivers and greater information accuracy at lower cost.

Other USGS programs rely on the NSIP for streamflow information required for their analyses, among them: NAWQA, Climate and Land Use Change Mission Area, Hazards Mission Area, the Ecosystem Mission Area, and the GWRP. The USGS WaterSMART Availability and Use Assessment will require streamflow information and regional evaluations to assess water availability in different regions of the United States. Aquatic biology programs (such as the Fisheries program) require streamflow information to help determine timing and quantity of river flow required for different habitats and species (ecological flows).

In addition, other Federal agencies rely on streamflow data and information to meet their mission and other obligations. Examples include the National Weather Service for predicting floods, the Federal Emergency Management Agency for identifying flood prone areas, the National Park Service for managing water resources, the U.S. Army Corps of Engineers for operation of locks and dams, and the Bureau of Reclamation for dam and water conveyance systems operation. State, tribal, and local water management agencies depend on NSIP-provided streamflow information to assess and manage water resources for water supply, waste assimilation, fisheries management, and recreation.

NSIP's Streamgages that Uniquely Support Federal Needs

The enhanced streamgage network that would be fully funded by the NSIP for more long-term network stability is designed to provide streamflow information to meet five Federal needs:

- Sentinel (reference) Watersheds – Identify appropriate locations and operate and maintain streamgages to provide streamflow information to describe responses to changes in climate, land use, and water use in watersheds across the country that are relatively unaffected by flow regulation or diversion and typify major eco-regions and river basins;
- Interstate and International Waters – Provide streamflow information to support interstate compacts, court decrees, and international treaties and at stateline and international crossing of rivers that drain at least 500 square miles at the border crossing;
- Streamflow Forecasts – Provide real-time and historic stage and streamflow information to support flood and streamflow forecasting by the National Weather Service and other Federal agencies across the country;
- Major River Basin Outflows – Account for the flow of water from each of the Nation's 350 major river basins to downstream basins, estuaries, oceans or the Great Lakes; and
- Water Quality – Provide streamflow information to support national USGS water-quality networks that cover the Nation's largest rivers; intermediate-sized rivers; and small, pristine watersheds.

When completely built out, the NSIP Federal-need streamgages reflect that portion of the USGS national streamgage network to be funded exclusively by USGS appropriated funds. New program funds in 2012 allowed the Program to move toward that goal and provide stability to the network by reestablishing recently-discontinued streamgages and to offset reduced funding from State, tribal, and local agencies to support operation and maintenance of additional existing streamgages. This NSIP increase provided funds to water science centers for operation and maintenance of threatened streamgages that would have been discontinued because of loss of supporting State and local funds.

Program Performance

Flood inundation mapping advances – In most years, flooding causes the greatest amount of property damage and loss of human life of all natural disasters. One of the most effective ways of reducing these losses is advanced warning of the flood and knowledge of the areas that are likely to be flooded. The National Weather Service (NWS) provides flood forecasts using models that are calibrated, checked, and verified using USGS supplied streamflow information. Recently, the USGS has helped developed a new tool to assist first responders and the general public in knowing what areas will be flooded and how deep those flood waters will be for a given storm based on the NWS flood forecast. This tool produces maps of areas expected to be flooded along a given river reach for given floods and how deep the flood waters will be based on the flood forecasts. The maps are developed based on models calibrated with USGS streamflow information. These maps are maintained in a USGS database and are freely available to anyone at any time. For 2013 and 2014, additional river reaches will be mapped for estimates of flood inundation and we will continue to work with other Federal agencies (National Weather Service, Corps of Engineers, and Federal Emergency Management Agency) and private companies to enhance and provide consistent flood inundation maps for the public and emergency responders.

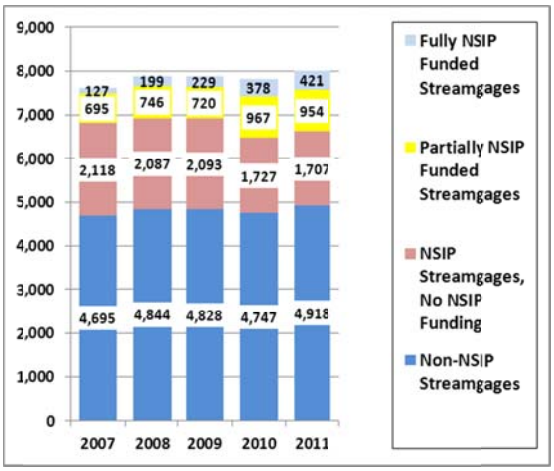
The NSIP is comprised of the following nine components:

Federal Network Operations
(2012 Enacted, $19.25 million, 2013 CR, $19.25 million, 2014 Request $25.5 million)

This program component is dedicated to maintaining and operating a stable, reliable, and continuous nationwide Federal-interest streamgage network for measuring streamflow and related environmental variables (precipitation, temperature). The 2014 increase proposed for the NSIP would enable the USGS to provide additional stability to the streamgage network by funding (either fully or with partners) streamgages that would otherwise be discontinued due to a shortage of funds. It is expected that the NSIP would be able to fully fund at least another 100 NSIP streamgages and partially fund another 200 streamgages.

In addition to funding some of the NSIP Federal-goal streamgages, these funds are used to upgrade field equipment to more technically sophisticated equipment in order to provide more accurate and reliable streamflow information at less cost, and to flood-harden streamgages that are in harm's way of floods but are critical to providing flood forecasts and warnings.

Streamflow monitoring and information delivery stability – The USGS streamgage network provides streamflow information and understanding for National, State, and local economic well-being, the protection of life and property, and efficient and effective water resource management. This streamgage network is funded by the national Streamflow Information Program (NSIP), over 850 State, local, regional, and tribal agencies, other Federal agencies, and the Cooperative Water Program. Instability of the network occurs when any of the funding partners reduce their funding contribution and the USGS NSIP, or others, do not have the resources available to make up the difference. To help stabilize the network, the NSIP provides funds, when available, to either fully fund or to partially fund with partners Federal need streamgages that are at risk of being discontinued. In 2012, the NSIP provided full funding for 423 Federal need streamgages, and partially funds with partners 1,026 streamgages. For 2013 and 2014, the NSIP will continue to provide streamgage network stability by providing funding for Federal need streamgages that are threatened to be discontinued due to partner funding decreases. The attached graph shows the increase in the number of active NSIP Federal need streamgages that have been partially and fully funded by the NSIP over the last few years and the decrease in the number of NSIP streamgages with no NSIP funding.



Hydrologic Extremes
(2012 Enacted, $0.2 million; 2013 CR $0.2 million; 2014 Request $0.7 million)

This program component is designed to improve understanding of hydrologic extremes (floods and droughts) by more intensive data collection during and immediately following the event and analyses of the collected information. There will be funds made available in 2014 to fund Flood and Drought Coordinators. These Coordinators would help plan and oversee the USGS response to ongoing floods and droughts as well as developing documentation for nationally consistent data acquisition and analyses. In addition the coordinators will direct the deployment of Rapid Deployable Streamgages during times of extreme flows.

Regional Streamflow Assessments
(2012 Enacted, $0.3 million; 2013 CR, $0.3 million, 2014 Request, $0.6 million)

This program component provides regional assessments and interpretation of streamflow information to provide estimates of streamflow at ungaged locations and to identify trends in streamflow due to changing land use, water use, and climate. These regional products directly support the USGS Science Strategy priority of a national Water Census to inform the public and decisionmakers about resource availability. As the effects of climate change on water resources are better understood, it is recognized that existing streamflow information must be continually evaluated to identify trends in streamflow. This would enable water resource managers to plan more effectively for future water supplies. Climate change will potentially effect the location, frequency, and severity of floods and droughts. In 2013 and 2014, methods and technologies will be investigated and developed for future applications. These assessments also enable the USGS to assess the current streamgage network's ability to provide the streamflow information required to the regional and trend analyses. In 2014, Rapid Deployable Streamgages (RDS) would be made available for use following wild-fires and for assessment of ecological flow assessments.

Information Delivery
(2012 Enacted, $2.4 million; 2013 CR, $2.4 million; 2014 Request, $2.4 million)

The NSIP develops, implements, and maintains a highly reliable system for real-time and historic streamflow information delivery to customers that includes data processing, quality assurance, storage, and easy data access. The funds are needed to help ensure that the NWIS database, critical to the success of the NSIP, is operated and maintained at peak efficiency and effectiveness. In addition, further efforts are needed to provide real-time data users with information on the range of uncertainty of the streamflow information they use to make decisions on a regular basis. For 2014, some of these funds would be used to help upgrade the software for time series information, which covers most of the USGS streamflow information.

Development of Methods and Equipment
(2012 Enacted, $1.7 million; 2013 CR, $1.7 million; 2014 Request $1.7 million)

NSIP funds investigation, development, and implementation of new methodologies and equipment to more accurately, safely, and inexpensively obtain and deliver streamflow information. Recent examples include expanded and enhanced use of acoustic methods to measure river velocity and discharge; use of radar to measure water level directly without instrumentation in the river; and development of statistical methods to transfer flow characteristics from measured locations to ungaged locations. These funds have also been used to develop Rapid Deployable Streamgages (RDS) and to develop processes for providing consistent flood inundation maps. The NSIP continues to fund the development of the StreamStats program that allows the estimation of natural streamflow characteristics at any site on any stream in the Nation. The NSIP would continue to support the development of the USGS model that estimates daily streamflow (PRMS).

Rapidly Deployable Streamgages now available – The NSIP has helped develop and utilize streamgages that can be rapidly delivered and put into operation providing real-time streamflow

information to the USGS and others via the Web within an hour of arriving on site. These streamgages were used this past year to provide better spatial understanding of the wide spread floods and droughts. These streamgages have also been used to be a back streamgage where permanent streamgages have been lost or in danger of being inundated. These temporary streamgages could also be used in areas with recent wildfires to measure the changes caused by the fires and to better describe and understand aquatic habitat, both natural conditions and disturbed. In most cases, the rapidly deployable streamgages can be shipped within a day and can stay in operation anywhere from a few days to a few years. For 2013 and 2014 the goal will be to develop additional real time streamgages and deploy them in not only flood situations but also in drought areas, recent wildfire areas, and habitat assessment areas.

Program Coordination
(2012 Enacted, $0.45 million; 2013 CR, $0.45 million; 2014 Request, $0.75 million)

Continued success of the NSIP is linked to coordination efforts with other USGS programs, outside funding partners, stakeholders, and other interested parties in addition to providing educational documentation on streamflow information. These efforts are central to developing and implementing short-term and long-term direction of program and the approach to meet program goals. In 2014, the increase reflects changes to where funds are expended due to the recent USGS Water Mission Area reorganization. Activities that directly meet NSIP coordination goals are now funded directly from these funds and in 2014 would include analyses on the value to society of streamflow information and other projects to better understand, explain, and present this information.

Technical Support
(2012 Enacted, $3.4 million; 2013 CR, $3.4 million, 2014 Request, $3.4 million)

The NSIP provides technical support for geographically distributed USGS water resources studies and data collection activities, including mechanisms for quality control, technology transfer, priority setting, and method and technology standardization. Technical support is necessary for the continued success and benefit of the program.

Integrated Multi-Hazards Demonstration Project
(2012 Enacted, $0.5 million; 2013 CR, $0.5 million; 2014 Request, $0.5 million)

In 2007, the USGS began the integrated Multi-Hazards Assessment and Mitigation Demonstration Project. NSIP funding is used to support streamgages that provide data used in landslide predictions and tidal surges resulting from both storms and the aftermath of wildfires. These funds are allocated by the Hazards Mission Area.

Energy Efficiency and Climate Change Initiative
(2012 Enacted, $0.8 million; 2013 CR, $0.8 million; 2014 Request, $0.65 million)

These funds will be used to implement methods to improve estimates of irrigation and thermoelectric power generation water withdrawals across the Nation and will build on the effort begun in 2010. These funds are allocated by the WaterSMART Program.

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Activity: Water Resources
Subactivity: Hydrologic Research and Development

2012 Enacted: $11.4 million (99 FTE)
2013 CR: $12.7 million (100 FTE)
2014 Request: $16.4 million (106 FTE)

Overview

The Hydrologic Research and Development (HR&D) program conducts research on complex problems in the hydrologic sciences and supports research and development needs of the other USGS Water Resources Subactivities, as well as other USGS Mission Areas. HR&D program investigations integrate hydrological, geological, chemical, climatic, and biological science to address water-resources issues. Efforts of the HR&D program are multidisciplinary and require collaborative relations, both among scientists funded by the program and with scientists in other USGS programs, in Federal and State agencies, universities, and foreign countries.

The long-term goals of HR&D are to:

- Improve understanding of physical processes controlling distribution of the Nation's surface-water resources to assist in mitigating effects of floods and droughts;
- Understand the relations between energy production and water resources availability and quality;
- Develop and share new modeling tools for understanding water availability and predicting effects of management activities and climate change on that availability;
- Identify the role of human-produced and natural contaminants on ecological and biogeochemical processes in the hydrologic cycle;
- Develop new tools to document availability and transport of subsurface water and associated solutes to inform groundwater management decisions; and
- Improve understanding of erosional processes, particularly from burned landscapes, governing the source, mobility, and deposition of sediment and associated contaminants in order to improve management of rivers, dams, and reservoirs, and to reduce effects of contaminated sediments on water quality and stream ecosystems.

Goals of the HR&D program directly support the Interior's Strategic Plan goal and USGS Science Strategy focus on providing scientific information on water availability and quality of the United States as a means to inform the public and decision makers about the status of its freshwater resources and how they are changing. HR&D activities directly support all elements of the USGS Science Strategy. For example, HR&D research has led directly to:

- Detection of the effects of climate warming on snowmelt in the West and the possible effects of future warming (Climate Variability);
- Production of methods to better determine frequency of extreme floods (Hazards);
- Development of analytical methods to detect hydrocarbons in groundwater (Energy and Minerals);
- Development of applied watershed models to understand and predict streamflow (Water Availability and Use);

- Identification of mechanisms that allow tree islands to form in the Everglades (Ecosystems and Ecosystem Restoration); and
- Documentation of effects of human-use compounds on aquatic ecosystems (Human and Wildlife Health).

HR&D Program research has resulted in refinement of existing groundwater and watershed models and development of new modeling techniques to describe uncertainties and forecast changes in the hydrologic cycle. These efforts directly support the USGS WaterSMART Availability and Use Assessment initiative. Research activities described in the program performance section have significantly contributed to understanding of climate change impacts on water supply and our basic understanding of climate variability and change. Research in HR&D is conducted with other USGS programs.

Program Performance

Long-term Interdisciplinary Research
(2012 Enacted, $11.4 million; 2013 CR, $12.7 million; 2014 Request, $16.4 million)

Plans and accomplishments of each scientific project are reviewed annually. In addition, in-depth reviews of each project are conducted on a three-year cycle to examine the relation of project work to the USGS mission; productivity, relevance, and scientific impact; and plans and goals for the next three years. Some key outcomes of the program follow. Because most of the research produced by the HR&D Program is published in peer-reviewed journals, additional scientific review occurs through this process. HR&D funded scientists publish, on average, two peer-reviewed journal articles per year.

Million year-old groundwater used for Maryland's water supply – HR&D-funded scientists recently documented for the first time the occurrence of groundwater that is more than one million years old in a major water-supply aquifer along the Atlantic Coast. The study used multiple state-of-the-art groundwater dating techniques developed through the HR&D Program, to assess groundwater residence times in the upper Patapsco aquifer underlying Maryland. The oldest groundwater was found in the deepest parts of the aquifer, but groundwater even in shallower parts of the aquifer is tens to hundreds of thousands years old. The age of the water is an indication of the time since water was recharged to the aquifer from surface sources. Modern-day pumping rates have lowered water pressures and changed water chemistry, affecting the aquifer's ability to provide freshwater for drinking and other uses. Concerns over saltwater intrusion in some areas have led water managers to increasingly move groundwater production from shallower aquifers to the deeper upper Patapsco aquifer, which has caused groundwater levels to decline. The study findings will help understand the patterns and rates of groundwater movement in aquifers along the entire Atlantic Coastal Plain. More specifically, the State of Maryland will use the information to better manage and use their groundwater resources so as to protect their long-term sustainability. The findings bring into focus that current users are withdrawing groundwater that was recharged eons ago and accentuate the need to review current water-supply management strategies and develop new tools and models to protect valuable groundwater resources for the future. In 2013 and 2014, HR&D will continue to support development of groundwater age-dating methods and similar interpretive studies being conducted around the Nation.

Groundwater depletion and sea level rise – Development of groundwater resources for agricultural, industrial, and municipal purposes has greatly expanded since 1950, and consequent depletion of this resource has had many negative consequences, including land subsidence, reduced well yields, and diminished spring and stream flows. A comprehensive analysis by L. Konikow indicates that cumulative global groundwater depletion totaled 4,500 km^3 during 1900-2008, almost the volume of Lake Michigan. Because most of this depleted groundwater ultimately is transferred to the oceans, 13 millimeters of

global sea-level rise, more than 6 percent of the total sea-level rise since 1900, can be attributed to groundwater pumping. The annual rate of groundwater depletion has accelerated in recent decades and was greatest during 2000-2008, when groundwater depletion balanced about 13 percent of observed sea-level rise. HR&D will support related studies in 2013 and 2014 to quantify groundwater depletion and its impacts.

Post-wildfire watershed response – HR&D Program scientists are studying burned watersheds and developing tools to predict post-wildfire watershed response, including storm runoff peak flows, sediment yield, and water quality. These tools are being used by resource managers for adaptation and mitigation in burned areas. Impacts of wildfire are becoming greater as human populations expands into fire-prone areas throughout the world and as climate change is forecasted to lead to increased wildfires in the future. Hyper-dry soil conditions immediately after wildfires prevent infiltration of rainfall, producing catastrophic floods from relatively minor rain events. The USGS is working with utilities to ensure that drinking water supplies remain safe and treatment facilities are not damaged by wildfire-impacted source waters. The HR&D is supporting ongoing research, monitoring, and publication of journal articles in 2013 and 2014.

Induced seismicity – HR&D Program groundwater hydrologists, in support of the USGS Hydraulic Fracturing initiative, have begun a new collaboration with the USGS Earthquake Hazards Program scientists on seismicity induced by development of geothermal and hydrocarbon energy resources, and disposal of waste fluids. The expected outcome of these studies is to inform the development of standards or protocols for pumping rates and volumes for various subsurface properties that would minimize the potential for induced seismicity. Support for this activity will continue in 2013 and 2014.

A USGS National Hydrologic Model - Accurate estimates of total water availability, changes in the timing and source of flow, and measures of the uncertainty of these estimates are essential in assessing the response of the Nation's watersheds and ecosystems to climate and land use changes. A National Hydrologic Model (NHM) framework is being developed to support coordinated, comprehensive, and consistent hydrologic model development for numerous programs within each of the USGS Mission Areas. This framework is advancing development of standard methods for hydrologic modeling studies, using technology that makes the best available data readily accessible to modelers. In 2013 and 2014, the HR&D will support development of enhancements to the framework and build coarse and medium scale hydrologic models for watersheds in many parts of the Nation.

San Francisco Bay-Delta ecosystem modeling – The CASCaDE (Computational Assessments of Scenarios of Change for the Delta Ecosystem) project was conceived to provide a scientific basis for difficult decisions facing resource managers of the Sacramento-San Joaquin Delta, the hub of California's water delivery system and an ecosystem in severe decline. Delta decisionmakers are legally bound to co-equally manage water supplies and ecosystem health in the midst of climate change, intended or unintended major structural changes to the Delta, non-native invasive species, and other interacting drivers. CASCaDE is a project implementing and linking multiple models representing about 10 different scientific disciplines toward examining multiple possible scenarios of ecosystem change over this century. In assessing possible future responses of the physical and ecological San Francisco Bay-Delta system to floods, droughts, earthquake induced levee rupture, ecosystem restoration, exotic species, contaminant inputs, and water management, CASCaDE supports Water, Climate and Land Use Change, Ecosystems, Natural Hazards, and Environmental Health mission areas. This project is expected to provide a template for similar hyper-disciplinary, integrated, model-based assessments of the futures of other coastal ecosystems. (*http://cascade.wr.usgs.gov/*) HR&D support will continue in 2013 and 2014; products will include publications and model code and output that will be used by resource managers to manage water and ecosystems in the Bay-Delta system.

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Activity: Water Resources
Subactivity: Hydrologic Network and Analysis

2012 Enacted: $29.8 million (259 FTE)
2013 CR: $30.6 million (259 FTE)
2014 Request: $31.5 million (261 FTE)

Overview

The HNA supports long-term national networks for the collection of data on water quality and atmospheric deposition, including the National Stream Quality Accounting Network (NASQAN), the Hydrologic Benchmark Network (HBN), the National Atmospheric Deposition Program/National Trends Network (NADP/NTN) and the National Water Quality Monitoring Network (NWQMN). Data on and analysis of the quantity and quality of water in the Nation's streams, lakes, and aquifers are necessary for wise planning, development, utilization, and protection of the Nation's water resources.

Water-quality and hydrologic data and analytical information provided by this program are used by a variety of stakeholders, including other Interior bureaus. The USGS and National Park Service have a water-quality partnership that is funded by this program. The EPA and U.S. Department of Agriculture are both customers for water-quality information, the National Weather Service uses the real-time flood level information, State, tribal, local governments, academia, consulting and advocacy organizations, industry, and private citizens all use the water-quality and flood level information data provided by this program.

The HNA program supports the Department's goal of improving the understanding of national ecosystems and resources through partial support of the Priority Ecosystems Science program of the USGS. The HNA also supports the climate change research and provides data for WaterSMART assessment studies. The HNA program supports WaterSMART and the Water Census through work to estimate flows are ungaged stations, water use information aggregation and analysis, and work on ecological water science. This program funds studies of climate variability and change, watershed modeling activities in support of the Bureau of Reclamation, the USGS water-quality partnership with the NPS, and support for the USGS National Research Program in the hydrologic sciences.

The HNA program supports, maintains and enhances USGS data delivery systems to process and disseminate water data and study results beyond the immediate needs of funding agencies or programs. This activity has two products: publications and the computer-based National Water Information System (NWIS).

The HNA program also supports activities of the Advisory Committee on Water Information (ACWI), a Presidential Federal Advisory Committee, and its subcommittees. ACWI represents the interests of water-information users and professionals in advising the Federal Government on Federal water-information programs and their effectiveness in meeting the Nation's needs. Member organizations help to foster communications between the Federal and non-Federal sectors on collecting, standardizing, and sharing water information, ultimately resulting in reduced Federal costs for operating resource management and environmental protection programs.

Program Performance

Development of Downscaled Climate Simulations over North America – The USGS has developed an array of high-resolution simulations of present and future climate over Western North America (WNA) and Eastern North America (ENA). The simulations are intended to provide a long time series of consistent surface and atmospheric variables for use in climate-related research. In addition to providing high-resolution weather and climate data for the past, present, and future, a methodology for processing, summarizing, viewing, and delivering the climate datasets to a wide range of potential users was developed. Important features of the high-resolution climatology of temperature, precipitation, snow water equivalent (SWE), and soil moisture are consistently reproduced in all model runs over WNA and ENA. The simulations provide a potential range of future climate change for selected decades and display common patterns of the direction and magnitude of changes. As expected, there are some model to model differences that limit interpretability and give rise to uncertainties. (*http://pubs.usgs.gov/of/2011/1238/)*.

Documentation of Changes in the Chemistry and Biology Upper Klamath and Agency Lakes, Oregon Due to Engineered Levee Breaches – Water Quality studies in the Upper Klamath and Agency Lakes found that wetland areas undergoing restoration, and those being used for water storage, function very differently relatively to the established wetland within the Upper Klamath Lake National Wildlife Refuge, adjacent Upper Klamath Lake. Water quality factors such as chemical make-up and presence of invertebrates varied. Developing long-term management strategies for water quality in the Upper Klamath Basin requires recognition of the multi-year time scales associated with restoring wetlands that provide natural, seasonal ecosystem function and services. (*http://pubs.usgs.gov/of/2012/1057/)*

Planned work in 2013 and 2014 includes studying the chemistry and age of discharge from springs in Shenandoah National Park. This work would improve our understanding of ground-water ages and susceptibility of water resources to contamination, along with improving our understanding of dating young fractions in mixtures pumped from wells.

In 2013 and 2014, the USGS will conduct work on hydrologic modeling and sea-level-rise components of the San Francisco Bay to evaluate hydrologic impacts of potential climate change scenarios. This work will also lead to an understanding of regional- and national-scale effects of historical and projected climate change with studies of 1) the influence of freshwater runoff on changes in tidal amplitudes (regional), and 2) the role of climate variability and change on historical duration of snow-cover events (national).

Hydrologic Networks
(2012 Enacted, $5.9 million; 2013 CR, $5.9 million; 2014 Request, $5.9 million)

This program component includes long-term national networks for the collection of data on water quality and acid precipitation, including the National Stream Quality Accounting Network, the Hydrologic Benchmark Network, and the National Atmospheric Deposition Program / National Trends Network. This program component also includes activities related to the new National Water Quality Monitoring Network, a multi-agency effort conducted under the auspices of the Ocean Action Plan.

The goals of this program component are to:

- Monitor the chemical quality of rain and snowfall;
- Monitor streamflow and the water quality of streams to fulfill USGS obligations for specific river basin compacts and treaties; and
- Monitor the water quality and trends of selected major rivers.

Hydrologic Analysis
(2012 Enacted, $9.5 million; 2013 CR, $9.5 million; 2014 Request, $9.7 million)

This program component includes studies of climate variability and change, watershed modeling activities in support of the Bureau of Reclamation, the USGS water-quality partnership with the NPS, and support for the USGS NRP in the hydrologic sciences. In part, these efforts support data needs of the USGS WaterSMART efforts. The goals of this program component are:

- Provide direct technical support to Interior bureaus for hydrologic concerns;
- Provide direct technical support to the NPS for water-quality concerns; and
- Develop decision-support systems for specific river basins in the Western United States.

Investigating Projected Sea-Level Rise in Chesapeake Bay – As a result of climate change and variability, sea level is rising throughout the world, but the rate along the east coast of the United States is higher than the global mean rate. The USGS, in cooperation with the city of Newport News, Virginia, conducted a study to evaluate the effects of possible future sea-level rise on the salinity front in two tributaries to Chesapeake Bay, the York River, and the Chickahominy/James River estuaries. Results for both estuaries indicated that high freshwater river flow was effective in pushing the salinity back toward Chesapeake Bay. Model results indicated that increases in mean salinity will greatly alter the existing water-quality gradients between brackish water and freshwater. This will be particularly important for the freshwater part of the Chickahominy River, where a drinking-water-supply intake for the City of Newport News is located. For more information go to *http://pubs.usgs.gov/of/2011/1191/*.

Information Delivery
(2012 Enacted, $6.1 million; 2013 CR, $6.1 million; 2014 Request, $6.1 million)

This program component includes delivery of results and water information beyond the immediate needs of funding agencies or programs. This activity has two products: publications and the computer-based National Water Information System (NWIS) to serve information to the public. This component of the HNA program also supports activities of ACWI, a Presidential FACA, and its subcommittees. The goal of this program component is to maintain and enhance USGS data delivery systems to process and disseminate water data and study results.

Technical Support
(2012 Enacted, $8.3 million; 2013 CR, $9.1 million; 2014 Request, $9.8 million)

This program component includes national technical support for geographically distributed USGS water-resources studies, including quality control to ensure the technical excellence of water resources programs. Technical support also provides a structured way of transferring new technology to USGS investigative and data activities that are primarily conducted in the USGS Water Science Centers located in each State, and a formal way of establishing priorities for water-resources research by the USGS. In addition, this program component supports various bureau-level activities such as CALFED science coordination.

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Activity: Water Resources
Subactivity: Cooperative Water Program

2012 Enacted: $62.6 million (387 FTE)
2013 CR: $62.6 million (386 FTE)
2014 Request: $63.0 million (386 FTE)

Overview

The Cooperative Water Program (CWP) is the Water Mission Area's "on-the-ground" presence working in every State and Territory of the United States, in partnership with about 1,600 local, State, and tribal agencies (or "Cooperators").

Jointly funded local, State, and tribal activities with the CWP national program allows Cooperators to bring emerging water issues to the table, including, for example, pharmaceuticals in drinking water and impacts of hydraulic fracturing on water resources, to which the USGS can respond quickly and raise those issues to regional and national visibility and priority.

Program Strengths:

- Visibility to emerging issues across regions and the Nation.
- Consistent data and science across regions and the Nation for large-scale problem-solving of national water priorities and initiatives.
- Built-in relevance to local, State, and tribal regulatory, management, and policy decisions and jurisdictional disputes.
- Foundation for national hydrologic observational networks.

Together, each year more than 700 jointly funded assessments address the Nation's most pressing water resources issues, including flood and drought mitigation, water availability, safe drinking water, sustainable ecosystems, impacts of energy development, and climatic changes, while providing science, innovative tools, models, and technology that are relevant to local, State, and tribal regulatory, management, and policy decisions and jurisdictional disputes.

Jointly funded monitoring through the CWP provides the foundation for USGS national hydrologic observations and data networks, real-time capabilities, and data delivery across the Nation, including, for example, support for nearly 6,000 (or 72 percent) of the Nation's streamgages; 9,000 groundwater observation wells; and 4,000 water-quality monitoring sites.

To each CWP assessment and monitoring activity, the USGS brings broad scientific and interdisciplinary expertise; long-standing, high-quality, nationally consistent procedures and quality-assurance; and long-term management and timely delivery of national data. By maintaining strict quality assurance across State boundaries, USGS hydrologic observations and science are consistent and comparable across watersheds and geographic regions and through time. The CWP thereby supports large-scale syntheses and problem solving to address USGS priorities and initiatives, such as related to the development of a national Water Census, as well as enhances the transfer and application of innovative tools and technology to solve similar issues across the Nation.

Program Performance

Summaries of 2012 accomplishments and products, categorized by the USGS mission area, are provided on the CWP Web site at: *http://water.usgs.gov/coop/*. The program produced over 380 peer-reviewed science publications in the USGS report series and journals in 2012, and supported monitoring using

national consistent methodology at more than 18,500 sites to track streamflow, groundwater levels, and water quality in wells and surface-water bodies. Selected accomplishments addressing four national priorities are presented below.

Water Availability/Water Census – Foundational and often long-term assessments and research on water availability were conducted through the CWP in all 47 Water Science Centers in 2012. These studies provide critical input to the national Water Census in determining water use (including consumptive use), *environmental flows*, water budgets, and groundwater and surface water relations. Development of statistical models and other assessment tools helped to assess conditions over broad geographical areas (including those lacking monitoring) and to allow forecasting into the future. For example, the Washington State Department of Ecology and Yakama Nation used USGS model-estimates in their groundwater management strategies to manage water rights and protect streamflows for sockeye salmon and other critical aquatic species, as well as to evaluate effects of agriculture water conservation, conjunctive use of groundwater and surface water, and artificial groundwater storage on future water availability.

> *"USGS is an indispensable partner with our agency, providing believable, relevant, scientifically sound and timely information that complements our State's water planning and management and conservation of our water resources. We depend on this valuable, long-term and ongoing cooperation as we monitor the availability of surface water and ground water (quantity and quality) and assess and model these resources across the State so that our managers can maintain the appropriate balance among water-supply development, economic growth, and preservation of our critical fish and wildlife habitats."*
>
> *Ken Rentiers, Deputy Director, South Carolina Department of Natural Resources, Division of Land, Water and Conservation*

In 2013 and 2014, monitoring, assessments and research will continue to enhance understanding of water availability and support the development of a Water Census. Additional focus will be placed on estimating streamflow at ungaged sites for more accurate water budgets; tracking site-specific public-supply and other water use information (as opposed to aggregate); developing consumptive use coefficients and methodology (particularly associated with irrigated agriculture); assessing watershed water budgets; developing climate models to track long-term patterns in groundwater and surface water flow; modeling environmental flows for sustained ecosystems; and advancing evapotranspiration measurement and assessment techniques.

Selected CWP assessments and monitoring will continue to address water availability issues on tribal lands. Through a network of streamflow gages and groundwater monitoring stations, the data and information collected from these sites is used by the tribes to address such topics as water rights, water use, hydrologic conditions, and water-quality issues. The USGS will continue development of quantitative models of water budgets, including groundwater and surface-water interactions, that provide information on how multiple stressors, such as groundwater pumping and climate change, affect instream flows so that tribal river managers can develop effective strategies to maintain and restore critical habitats and healthy ecosystems. Funding for tribal cooperators, including an increase in the 2014 budget will be allocated in coordination with the DOI Secretary's Indian Water Rights Office and other Bureaus (such as BIA and Bureau of Reclamation) that support the Federal trust responsibility for water in Indian Country.

> *"Our partnership with the USGS has led to key insights that have helped us understand the scope of toxic contamination in the Columbia River, a key step to reducing contaminants and improving water quality."*
>
> *Debrah Marriott, Executive Director of the Lower Columbia Estuary Partnership*

Environmental Health, Water Quality and Drinking Water – Assessments and research on water quality and drinking water were conducted in all 47 Water Science Centers in 2012 through the CWP. Many of these studies focused on emerging issues, such as pharmaceuticals contaminating drinking water; toxic polycyclic aromatic hydrocarbons(PAHs) in streams; and harmful algal blooms. An evolving issue of concern with both a national (United States) and global impact relates to the occurrence of cyanobacteria and associated toxins and taste-and-odor compounds. *CWP activities relating to cyanobacteria* were ongoing, completed, or in planning stages in at least 20 Water Science Centers in 2012. Specific outcomes to these activities were improved decisions in water supply management and protection of public health through: (1) an enhanced understanding of environmental factors including biological, physiochemical, hydrological, and meteorological, affecting the occurrence, fate, transport, and temporal variability of cyanobacteria and associated toxins and taste-and-odor compounds; (2) real-time monitoring strategies to develop early warning systems; and, (3) development of models and other assessment tools to predict occurrence. For example, a CWP study was released in July 2012, done in cooperation with the city of Lawrence, the city of Topeka, Johnson County WaterOne, Kansas Water Office, and the Kansas Department of Health and Environment that tracked the fate and transport of cyanobacteria and associated toxins and taste-and-odor compounds from upstream reservoir releases in the Kansas River. A follow-up 5-year Kansas River study (through 2017) was initiated to develop a real-time water-quality notification system for drinking-water suppliers using the Kansas River as a source-water supply (for about 800,000 people in northeastern Kansas).

In 2013 and 2014, monitoring and assessments will continue to look at emerging contaminants and other water-quality issues in streams and groundwater needed for drinking, sustained ecosystems, recreation, and other uses. Studies will continue to support and provide watershed insights to meet national objectives of the National Water-Quality Assessment (NAWQA), including on the transport and fate of nutrients through watersheds to receiving waters; enhancement of real-time continuous monitoring at streams and rivers; natural and man-made contaminants in deep groundwater used for drinking; ecological modeling of ecosystems; and forecasting of water quality resulting from land-use and climate change.

Energy Development – CWP jointly-funded activities were proposed or were ongoing in 2012 in more than 15 States, to establish baseline water quantity and quality observations and assessments as natural gas exploration and production accelerates among different geologic and environmental settings across the United States For example, the USGS worked cooperatively with multiple counties and municipal water authorities in northern and central Pennsylvania to monitor streams, groundwater, water quality, and benthic invertebrate and fish communities in areas associated with Marcellus Shale exploration. Similarly, the USGS worked cooperatively with multiple partners, including the Arkansas Natural Resources Commission; Arkansas Game and Fish Commission; Arkansas Water Resources Center Duke University; and White County, Arkansas to monitor and assess streams, lakes, and groundwater in north-central Arkansas associated with the Fayetteville Shale exploration—an area underlain by the Fayetteville shale, which is the fourth largest recoverable gas play in the United States A computer watershed model of hydrologic processes was developed to track movement of water and possible contaminants among the surface-water and groundwater resources.

In 2013 and 2014, monitoring and assessments will continue to fill in spatial and temporal information gaps in in areas of natural gas exploration and production. Additional focus would be placed on monitoring of hydraulic fracturing derived contaminants in water and sediment and assessment of impacts of energy development on channel morphology and sustainability of stream habitat and aquatic communities.

Hazard Mitigation - CWP real-time data and analyses from thousands of streamgages and groundwater level monitoring helped to inform emergency management decisions and water planning in every State in 2012. In addition to highly reliable real-time monitoring of river levels and flood flows at gaged stations, the CWP supported the development of the assessment tool "StreamStats" in nearly 30 States, in concert with State Departments of Transportation and other cooperators to estimate streamflow at ungaged streams in order to build safe bridges and roads and manage water supplies for drinking, ecosystems, and other water demands. The CWP also supported the development of standardized hydraulic models that convert forecasted flows into flood inundation maps, enabling emergency management officials and general public to see the expected extent of a flood before it occurs, reducing the possible devastating toll of floods on communities. For example, digital flood-inundation maps of the Blanchard River in Ottawa, Ohio, were created by the USGS in cooperation with partners (including USDA, NWS, and the Village of Ottawa, Ohio). The year 2012 also brought unusual drought conditions through much of the Midwest states, including Iowa, Nebraska, Minnesota, Illinois, South Dakota, and Wisconsin. In Iowa, for example, flows were less than 25 percent of normal streamflow conditions for the majority of the State. USGS crews made extra streamflow and groundwater level measurements in a number of States so that cooperators had sufficient data to make water management decisions.

> *"The Arizona Department of Water Resources (ADWR) greatly values the USGS streamflow program in Arizona and the invaluable data that it provides. ADWR shares [USGS] concern for the future operation and maintenance of stations for which long-term cooperator support has not yet been secured. Twelve stations threatened to be discontinued combine for more than 600 years of streamflow data, including three having more than 80 years of record each. These at-risk stations collect data from rivers and streams important to water management and flood monitoring in Arizona."*
>
> *Sandra Fabritz-Whitney, Director, ADWR*

In 2013 and 2014, activities will continue to support hazard mitigation in monitored areas, as well as in unmonitored areas through the development and application of assessment and forecasting tools (such as StreamStats as anticipated in 10 additional States). Additional focus would be on expanding the application and development of flood inundation mapping and development of forecasting models and statistical techniques to estimate groundwater levels in areas of drought over time.

Data Collection Activities
(2012 Enacted, $37.0 million; 2013 CR, $38.5; 2014 Request, $38.7 million)

Over the past few years, the CWP has provided sole Federal support or partial support for over half the sites where the USGS collects data on surface-water levels and flow, groundwater levels, and groundwater quality. The CWP supports data collection of surface-water quality needed for State compliance with requirements of the Clean Water Act and collection of streamflow data important to water supply planners to identify the influence of climate variability and change on water availability.

These data provide resource managers with information they need to determine suitability of water for various uses, identify trends in water quantity and quality, and evaluate effects of various stresses on the Nation's groundwater and surface-water resources. Data collected at USGS monitoring sites are provided free of charge to everyone on the Internet. This includes historical data as well as real-time data. The real-time data are routinely used by emergency management agencies, State and municipal agencies, businesses, irrigators, and recreational users.

Most USGS data collection stations serve multiple purposes and many are funded, wholly or in part, through joint-funding agreements with one or more partners. Normally, these stations, though funded by

various organizations, are operated as part of an integrated network that provides benefits to a broad community of users and comprise the majority of the USGS national hydrologic data network.

Interpretive Studies and Technical Development
(2012 Enacted, $25.6 million; 2013 CR $24.1 million; 2014 Request, $24.3 million)

In addition to data-collection activities, the CWP supports about 700 hydrologic studies each year. Water resource studies define, characterize, and evaluate the extent, quality, and availability of water resources. Results of these investigations are published and provided to cooperating agencies that use them as the basis for managing water resources for which they are responsible. Also, these investigations follow national methodology and thereby provide information that is synthesized and applied to a variety of hydrogeologic and climatic settings across the Nation, greatly expanding the usefulness and transferability of USGS study results nationwide. Advancements in innovative tools, technology and statistical modeling also are transferred among WSCs and help to solve similar issues across the Nation.

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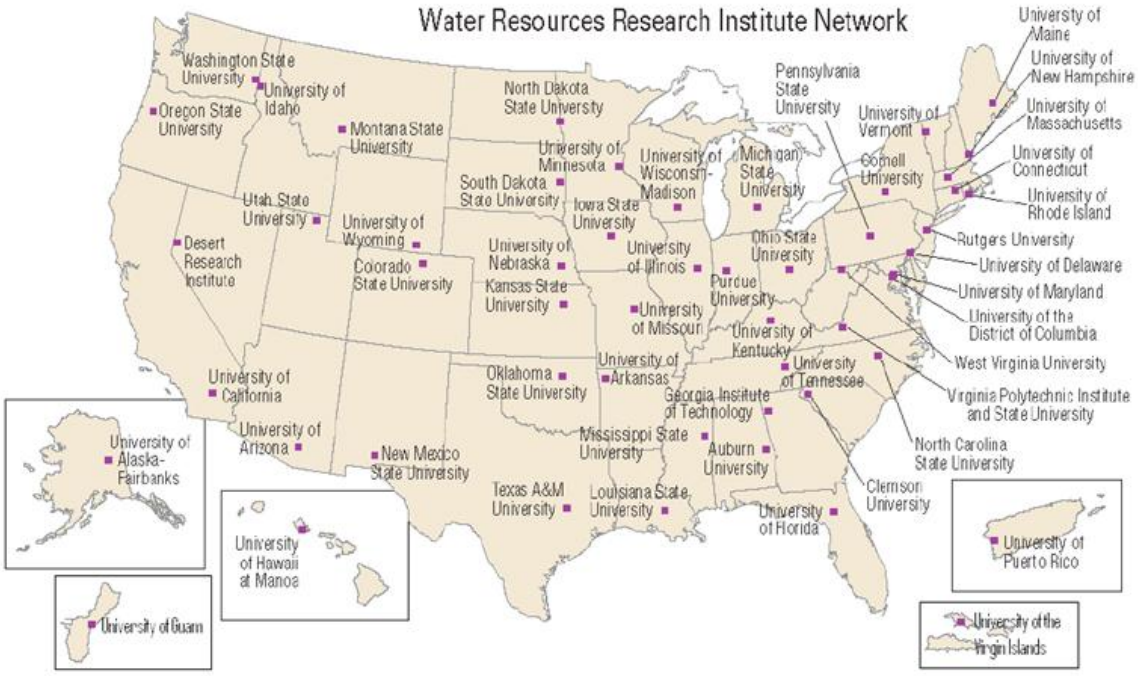
Activity: Water Resources
Subactivity: Water Resources Research Act Program

2012 Enacted: $6.5 million (2 FTE)
2013 CR: $6.5 million (2 FTE)
2014 Request: $1.0 million (2 FTE)

Budget Realignment

The **Water Resources Research Act** (WRRA) of 1984 established 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. There are 54 Institutes: one in each State, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam. The Guam institute also serves as the Federated States of Micronesia and the Commonwealth of the Northern Mariana Islands.



Overview

The 54 Water Institutes provide new opportunities for young people through research and education efforts. Student internships supported by the Institutes provide practical training experience for the next generation of hydrologic scientists and engineers and afford students the opportunity to participate in research projects while encouraging them to pursue careers in water resources.

The Water Resources Research Act Program provides an institutional mechanism for promoting State, regional, and national coordination of water resources research, training and coordination and information and technology transfer. In 2012, through Federal appropriations, the program provided training and

support to more than 200 undergraduate and graduate students by involving them in institute-sponsored research activities. With its matching requirements, the program is also a key mechanism for promoting State investments in research and training. In fact, the Institutes have developed a constituency and a program that far exceeds that supported by their direct Federal appropriation.

Program Performance

Though the program contributes to the Interior goal and the USGS Science Strategy focus of providing scientific information on water availability and quality of the United States, there are no performance measures specifically linked to this program. Historically, the Institutes support training for more than 600 students and production of 1,000 publications annually. The proposed budget reduction would eliminate funding of the annual base grants. The competitively awarded portion of the program would continue. The USGS will work with the Program in 2013 and 2014 to develop more rigorous oversight of the program and ensure that Federal investments at each of the Institutes effectively and consistently maximize national science goals and leverage all available resources, particularly in the areas of water availability, quality, and climate change.

Activity: Core Science Systems

		2013 Full Yr. CR (PL 112-175)	2012 Enacted	2014 Fixed Costs and Related Changes (+/-)	2014 Program Changes	2014 Internal Transfer	2014 Budget Request	Change from 2012 Enacted (+/-)
Science Synthesis, Analysis, and Research ($000)		*25,888*	25,388	170	10,585	0	36,143	10,755
	FTE	*111*	111	0	1	0	112	1
National Cooperative Geologic Mapping Program($000)		*25,901*	25,901	323	2,035	0	28,259	2,358
	FTE	*116*	116	0	0	0	116	0
National Geospatial Program ($000)		*63,188*	62,988	893	8,891	0	72,772	9,784
	FTE	*333*	333	0	-3	0	330	-3
Total Requirements ($000)		***114,977***	**114,277**	**1,386**	**21,511**	**0**	**137,174**	**22,897**
	Total FTE	***560***	**560**	**0**	**-2**	**0**	**558**	**-2**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Summary of Program Changes

Request Component	($000)	FTE	Page
Science Synthesis, Analysis and Research Program	**10,585**	**1**	
Earth and Environmental Observations Innovation and Applications	9,000	1	B-36
Ecosystem Priority: Eco Informa	800	0	B-20
Geological and Geophysical Data Preservation	400	0	B-55
Hydraulic Fracturing	185	0	B-31
Science for Coastal and Ocean Stewardship	300	0	B-38
General Program Reduction	-100	0	B-65
National Cooperative Geologic Mapping Program	**2,035**	**0**	
Hydraulic Fracturing	2,000	0	B-31
WaterSMART: Program and Information Management	200	0	B-7
General Program Reduction	-165	0	B-65
National Geospatial Program	**8,891**	**-3**	
3DEP: Enhanced Elevation for the Nation	9,000	0	B-29
Alaska Mapping	1,044	0	B-55
Ecosystem Priority: Columbia River	354	0	B-20
Ecosystem Priority: Puget Sound	450	0	B-20
Federal Geographic Data Committee	-1,697	-3	B-61
WaterSMART: Program and Information Management	200	0	B-7
General Program Reduction	-460	0	B-65
Total Program Change	**21,511**	**-2**	

** Estimated changes in FTEs compare against actual 2012 FTE usage, not 2012 enacted formulation estimates.

Justification of Program Changes

The 2014 Budget Request for Core Science Systems (CSS) is $137,174,000 and 558 FTE, a net program change of +$22,897,000 and -2 FTE from the 2012 Enacted Budget. For more information on the CSS Mission Area changes, please see Section B, Program Changes as indicated in the table.

Activity Summary

As part of the Nation's largest water, Earth, and biological science and civilian mapping agency, the CSS Mission Area conducts national-focused Earth-system-science to deliver an understanding of the Earth's complex geologic structure, a comprehensive and high resolution characterization of the Nation's land surface, and analytical methods of understanding and characterizing biological habitats and biodiversity. CSS conducts core sciences across a broad range of fields from structural geology, geomorphology, and geophysics, to geography and remote sensing, evolutionary biology and biogeography. Products include interpretive studies, scientific publications, three-dimensional geologic models, geologic and topographic maps, all of which are essential for informed public policy decisionmaking and economic development.

Modern mapping includes Earth observations from many platforms (such as satellite, airborne, and unmanned aerial vehicles) and uses continuously evolving technologies that can sense and map an expanding list of features, such as gravity, magnetism, thermal signatures, and more using the latest technologies. Through collaborative efforts with Federal, State, tribal and local partners, CSS delivers nationally consistent, high-quality geologic, topographic, and biogeographic information. Detailed, accurate information about the nature and origin of the geology of an area, portrayed through geologic maps and three-dimensional frameworks, is essential for identifying mineral, oil, and gas resources, finding and protecting groundwater, guiding earthquake damage prediction, identifying landslide and post-wildfire hazards, guiding transportation planning, and generally improving the quality of life and economic vitality of the Nation. Highly accurate elevation maps and data, for example, are essential for hazards mitigation, conservation, infrastructure development, national security, coastal shore line erosion, and many other applications. The benefits apply to flood risk management, agriculture and precision farming, water supply, homeland security, renewable energy, aviation safety, and other activities.

Earth and natural science research is based on the cumulative observation, analysis, and documentation made by generations of researchers. The USGS is the custodian of the record of much of those activities for the Nation, and collections managed by CSS are foundational resources for future research activities. CSS collections include national map databases, physical samples, data derived for analysis, published research, current and historical photographs, field notes, and records produced in the pursuit of science. These collections continue to grow and now are largely in digital format. Physical and digital collections are the starting point for much of our future research efforts. The contexts that these materials provide for ongoing efforts are important and valuable to researchers across the USGS. This information has evolved into the critical baseline "infrastructure" needed to underpin the economy.

The CSS Mission Area uses its information resources to create a more integrated and accessible environment for existing and new USGS data resources and participates in building global integrated science platforms. CSS also leads the USGS in the development and implementation of national standards that aid in the creation, management, and dissemination of digital Earth systems information to stakeholders. CSS includes the following subactivities and associated Web sites:

Science Synthesis, Analysis, and Research (SSAR)

Core Science Analytics and Synthesis - *http://www.usgs.gov/core_science_systems/csas/*

Libraries - *http://library.usgs.gov/*

Data Preservation Program - *http://datapreservation.usgs.gov/*

J.W Powell Center for Analysis and Synthesis - *http://powellcenter.usgs.gov/*

National Cooperative Geologic Mapping Program (NCGMP)

Main program page - *http://ncgmp.usgs.gov/*

The National Geologic Map Database - *http://ngmdb.usgs.gov/ngmdb/ngmdb_home.html*

FEDMAP component - *http://ncgmp.usgs.gov/about/fedmap.html*

STATEMAP component - *http://ncgmp.usgs.gov/about/statemap.html*

EDMAP component - *http://ncgmp.usgs.gov/about/edmap.html*

Federal Advisory Committee - *http://ncgmp.usgs.gov/about/evaluation/faca_intro.html*

National Geospatial Program (NGP)

Geospatial liaison site at *http://liaisons.usgs.gov/geospatial/*

The National Map site - *http://nationalmap.gov/*

US Topo site - *http://nationalmap.gov/ustopo/index.html*

US Board on Geographic Names site - *http://geonames.usgs.gov/index.html*

Hazards Data Distribution System site - *http://hdds.usgs.gov/hdds2/*

The National Map viewer and download platform site - *http://nationalmap.gov/viewer.html*

The National Atlas of the United States of America® site - *http://www.nationalatlas.gov/*

Historical Topographic Map Collection site - *http://nationalmap.gov/historical/index.html*

Geospatial Research - *http://cegis.usgs.gov/*

Office of the Secretariat - *http://www.fgdc.gov/*

Geospatial Platform - *http://www.geoplatform.gov*

SSAR conducts fundamental and applied research and provides capabilities that support the entire science life cycle. This subactivity is comprised of the J.W. Powell Center for Analysis and Synthesis; the National Geological and Geophysical Data Preservation program; the USGS Libraries program; and the Core Science Analytics and Synthesis program. SSAR provides unique scientific collaborative opportunities and preserves and makes available rock and ice core samples for scientific research. SSAR maintains a comprehensive and up-to-date compilation of data about U.S. land in conservation status. It enhances CSS's ability to advance the USGS Science Strategy by developing, identifying, and implementing best practices for accessing, integrating, visualizing, and delivering USGS data and information.

The NCGMP cooperates with State geological surveys to provide publications, digital geologic maps, and multidimensional models and visualizations that help to sustain and improve the quality of life and economic vitality of the Nation and to mitigate natural hazards. Of note, the program makes geologic mapping data from all of North America publically and freely available by way of the National Geologic Map Database. Recently the program marked the 20th anniversary of the National Geologic Mapping Act that established the NCGMP and the partnership with State geological surveys and universities. Since its inception, the program has leveraged $95.0 million in Federal funding matched by the State geological surveys to collaboratively produce modern geologic maps for the Nation and $8.0 million matched by universities to train the next generation of geologic mappers—more than 1,000 college geoscience students to date.

The NGP publishes geospatial baseline data and maps of the Nation's topography, natural landscape, and built environment. Federal, State, and other users incorporate these data and maps into their business activities. Such applications include enhanced elevation data for understanding seismic and landslide hazards and forecasting floods; hydrography data to analyze water quality, quantity, and use; and, topographic maps essential for scientific field work and providing a base onto which geology and other scientific data can be mapped. The program works with cooperators to consolidate funding to acquire new data through the private sector, which is an activity that provides data to all partners at lower unit costs and ensures that industry standards are followed. The program then publishes these standardized data to promote their reuse, which reduces the possible later duplication of data acquisition efforts. The baseline is *The National Map*, a set of databases of map data and information from which customers can download data and derived map products and use Web-based map services. Through the Geospatial Liaison Network, the NGP works with cooperators to share the costs of acquiring and maintaining these geospatial data. The National Atlas of the United States of America® fosters an understanding of broad geographic patterns, trends, and conditions useful for national assessments.

The Federal Geographic Data Committee (FGDC) promotes consistent data and metadata standards, system interoperability, and cross-government best business practices for geospatial resources, policies, standards, and technology as part of the National Spatial Data Infrastructure. The FGDC Office of the Secretariat, administered by the USGS, provides support to the FGDC Chair and Vice Chair, the 32 member agencies, and Federal geospatial initiatives and priorities that enhance information availability for decisionmaking and science, increase information delivery efficiencies, and reduce duplication of Federal Geospatial data assets through shared contracting and leveraging economies of scale. The Geospatial Platform is an Internet-based capability that provides a suite of well-managed, highly available, and trusted geospatial data, services, and applications for use by Federal agencies and their State, local, tribal, and regional partners. The Geospatial Platform is the service and delivery mechanism for Federal geospatial portfolio assets, and the integration point for shared leveraging of information from, and with, other State, local, tribal, and non-governmental information sources. This approach provides increased return on existing geospatial investments by promoting the reuse of data, applications, and tools.

Mission Area 4: Provide a Scientific Foundation for Decisionmaking
Goal #4: Develop a Comprehensive Science Framework for Understanding the Earth
Strategy #1: Develop an Integrated Data Framework that is used to Guide Science- Based Stewardship of Natural Resources
Strategy #2: Generate Geologic Maps and Models for Sustaining Resources and Protecting Communities
Strategy #3: Advance the Earth Science Application of Geospatial Information

Strategic Plan Performance Measures	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Target	2012 Actual	2013 Target	2014 Target	2008 - 2014 Trend
Percent of online natural resource products available via National Biological Information Infrastructure* whose utility is validated through user interactions and downloads (Science Synthesis, Analysis and Research (SSAR)	USGS	20.5%	21.3%	21.5%	19.8%	0.0%	0.0%	0.0%	Measure Discontinued	
		21	21	22	20	-	-	-	-	
		100	100	100	100	100	100	100	-	
Percent of the U.S. that is covered by at least one geologic map and is available to the public through the National Geologic Map Database (NCGMP)	USGS	47.7%	48.9%	49.4%	50.0%	50.8%	50.6%	51.6%	52.6%	
		1,687,637	1,729,771	1,746,550	1,767,763	1,797,019	1,789,944	1,825,318	1,860,692	
		3,537,438	3,537,438	3,537,438	3,537,438	3,537,438	3,537,438	3,537,438	3,537,438	
Percent of the area of 48 states and DC published as high-resolution base geospatial databases and topographic map images that depict current geospatial information (NGP)	USGS	N/A	26%	64%	100%	33%	35%	67%	100%	
		N/A	13,203	32,013	50,515	17,895	18,546	35,789	53,684	
		N/A	50,414	50,414	50,414	53,684	53,684	53,684	53,684	

Supporting Performance Measures

Outputs, Supporting Performance Measures and/or Milestones	Bureau	2008 Actual	2009 Actual	2010 Actual	2011 Actual	2012 Plan	2012 Actual	2013 Plan	2014 Plan
Percent of U.S. with land characterization and species distribution information available for resource management decisionmaking updated in the last 5 years (SSAR)	USGS	37%	77%	88%	91%	98%	98%	100%	100%
Number of metadata records (Data Preservation)	USGS	NA	600,000	1,052,038	741,545	1,341,545	2,019,866	2,819,866	3,519,866
Annual production of geologic maps for the Nation (summed and represented as a percent of U.S. land area) made available to the public through the National Geologic Map Database (NCGMP)	USGS	4.15%	2.90%	2.70%	2.00%	1.80%	1.80%	1.80%	1.80%
Percent of records available through core science national products whose utility is validated by user access or downloads (SSAR)	USGS	NA	NA	NA	NA	3-year Baseline to be Established	3-year Baseline to be Established	Baseline to be Established	TBD

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Activity: Core Science Systems
Subactivity: Science Synthesis, Analysis, and Research

2012 Actual: $25.4 million (111 FTE)
2013 CR: $25.9 million (111 FTE)
2014 Request: $36.1 million (112 FTE)

Overview

Science Synthesis, Analysis and Research (SSAR) combines fundamental and applied research, provides scientific data and information analytics and synthesis and long-term preservation of scientific data and library collections. SSAR includes the J.W. Powell Center for Analysis and Synthesis (Powell Center); the National Geological and Geophysical Data Preservation (NGGDPP) program; the USGS Libraries program; and the Core Science Analytics and Synthesis program (CSAS).

Program Performance

USGS Grants Ensure Important Data Preservation and Fund Students – In 2012, the NGGDPP awarded grants to 22 States to inventory, digitize and preserve endangered at-risk datasets. This includes data collected from energy exploration, seismic investigations, and aerial photogrammetric surveys. This historical data is fundamental to ongoing scientific investigations provides key information to aid future economic development such as predicting injection zones in deep carbon dioxide research wells, or understanding ecosystem health by using preserved aerial photos to delineate historical distribution of sea grasses in order to better understand declining health estuaries. Nationwide and including matching State funds, over $1.3 million resulted from these efforts. This includes funding over 19,000 student hours, helping universities train the next generation of scientists and engineers. It is estimated that $600,000 will be awarded to 25-30 States in 2013 and 2014 to inventory collections of geological and geophysical data, create metadata for individual items in those data collections, create or update digital infrastructure, and rescue data at risk.

USGS Community for Data Integration Provides a Foundation for Efficient Data Sharing – The Community for Data Integration (CDI) is a community of practice dedicated to advancing integration capabilities for scientific data. CDI is a multi-Federal, State, and non-government organization. CDI has achieved successes in many areas including citizen science, 3D/4D modeling and visualizations, and efficient scientific computing and analysis.

In 2012, CDI supported several successful projects including development of:

- The National Water Information System (NWIS) Snapshot Tool, which provides access to long term water data using Web services;
- Geo Data Portal, an application that allows users to process large amounts of climate data for modeling purposes;
- The Data Management Web site, a reference site that provides scientists with best practices for data and knowledge management; and
- Mobile applications that allow scientists to directly record and upload field data, have ready access to protocols for biological occurrences, and view a real-time display for biodiversity data.

Technology-Enabled Science Capabilities for the Multi-Agency National Fish Habitat Partnership – The USGS completed Version 2.0 of the National Fish Habitat Partnership (NFHP) Data System. The

NFHP asked the USGS to lead the development and implementation of national standards and a Web-based system to provide a geospatial data viewer and access to downloadable data, maps, metadata, and map services. The system provides broad dissemination of reported assessment scores achieved through synthesizing and analyzing available national datasets. Version 2.0 incorporates capabilities for partners and collaborators to upload data to the NFHP Data System that can be shared with stakeholders and contribute to refining future national assessments. For users, Version 2.0 provides streamlined data access and download capabilities. Data management and delivery tools are powered by two existing USGS systems to enhance the data sharing, documentation, and delivery capabilities available to partners. Those systems are the USGS ScienceBase, which provides the data file upload and catalog services, and the USGS Core Science Metadata Clearinghouse, which assists with documenting and preserving best practices that improve access and data use.

The John Wesley Powell Center for Analysis and Synthesis
(Estimates for 2012, $0.1 million; 2013, $0.1 million; 2014, $0.3 million)

The Powell Center serves as a catalyst for innovative thinking in Earth system science research focusing on multi-faceted issues. The scientist-driven center, which provides unique opportunities for scientific collaboration among government, academic, and industry scientists, completed its second full year of operation in 2012, after being piloted in 2009 and 2010. In 2012, eight new Working Groups were selected through peer-review by the Science Advisory Board, and hosted at the Powell Center along with the five continuing Working Groups, for a total of 13 active Groups. These Working Groups focused on major ecosystem challenges including specific impacts of climate change, water quality and availability, and other aspects of natural resources sustainability and environmental health. In 2012, high performance computing capabilities were established allowing for large-scale data analyses, a capability highlighted in the March 2012 White House initiative on Big Data. As of the end of 2012, products of the Working Groups include seven publications and two Web site portals. Six new Working Groups have been selected for initial meetings in 2013 out of a total of 19 proposals submitted. The 2013 call for proposals process requires applicants to include a plan for data management. In 2014, the Powell Center would continue to provide opportunities of scientific collaboration through the Working Groups.

Data Preservation
(Estimates for 2012, $1.9 million; 2013, $1.8 million; 2014, $2.0 million)

NGGDPP efforts are dedicated to the preservation of physical geoscience samples, and analog and digital geoscience data including rock and ice cores, fossils, fluid samples of oil, gas, and water, and geochemical samples. This information populates the National Digital Catalog of archived materials to include inventories of geological and geophysical data collections and metadata on individual items within those collections. To accomplish this work, the USGS cooperates with State geological surveys and other Interior bureaus. Included in Data Preservation are two critical repositories:

Core Research Center (CRC) – The CRC was established in 1974 to preserve valuable rock cores for use by scientists and educators from government, industry, and academia. The cylindrical sections of rock are permanently stored and available for examination and testing at the core storage and research facility in Denver, Colorado. The CRC is currently one of the largest and most heavily used public core repositories in the United States and encourages use of its facility by all interested parties. The CRC also houses, in volume, the second largest Federal fossil collections in the United States. The fossil curation staff has conducted digital georeferencing on over 20,000 fossil localities, thus making these portions of the databases projectable in mapping and commercial software. In addition, the CRC provides technical assistance as, for example, it did for a USGS drilling crew at the Adobe Buttes drill site near Delta CO, in support of the ongoing National Oil and Gas Assessment performed by the USGS Energy Resources Team. In the spring of 2012, the CRC staff transported the core to the CRC warehouse and slabbed

(cutting the core length-wise) the entire 1,200 feet of core which is being studied by the USGS Energy Resources Team for USGS Oil and Natural Gas assessments. In 2013, the CRC is meeting the high demand from industry, academia and USGS scientists for access to these collections and will continue this in 2014.

National Ice Core Laboratory (NICL) – The NICL is the Nation's repository for storing, curating, and studying ice cores recovered from ice sheets, ice caps, and glaciers of the world, predominately from Antarctica and Greenland. The NICL facility provides the ice core research community with the capability to conduct examinations and measurements on the working scientific collections of ice cores while preserving the integrity of these cores in a safeguarded, temperature-controlled environment for current and future investigations. The NICL is a National Science Foundation (NSF) funded facility that is operated and maintained by the USGS through an interagency agreement. Research on the ice cores supports the scientific goals of the National Science Foundation, Division of Polar Programs in the fields of paleoclimate reconstruction, and atmospheric change and history of the Earth.

USGS Libraries Program

(Estimates for 2012, $5.9 million; 2013, $5.9 million; 2014, $6.1 million)

The USGS Libraries Program identifies, acquires, manages, and provides access to a broad collection of scientific information including USGS publications to a wide range of internal and external customers. Currently, it maintains physical and digital collections and provides automated tools for accessing these collections both onsite and remotely. In 2012, the USGS Libraries Program maintained over 1.8 million physical items and incorporated the holdings of smaller USGS collections, such as the Fort Collins Science Center library and the U.S. Antarctic Resource Center. Hardcopy formats, such as books, maps and microfilm, are being digitized; services to locate and acquire rare or specialized research products needed by USGS staff continue to be an asset; and current holdings acquired prior to 1975 were converted to meet modern cataloging standards.

In 2013, the Libraries Program is focusing on transforming the libraries to meet the demand for greater digital access and less physical content. The Libraries Program is conducting assessments of information management technologies, automated services, and digital content and minimizing replication of physical collections across the Libraries program to meet the goals for space reduction, program efficiency, and library system consolidation. In 2014, the USGS Libraries Program will continue to transform by migrating to a new digital environment and adapt existing systems and services to maintain accurate and efficient support of scientific research by both USGS staff and the public.

Core Science Analytics and Synthesis

(Estimates for 2012, $17.5 million; 2013, $18.1 million; 2014, $27.7 million)

CSAS conducts biological occurrence data acquisition, biological taxonomic analysis and interpretation, computational analytics, and informational synthesis. It provides leadership in expanding the capacity for collection of and access to analysis, integration, synthesis, and modeling of scientific data. In fulfilling this responsibility, CSAS leverages its broad capabilities in the following areas:

The USGS Science Strategy emphasizes applied Earth systems information research with a focus on data integration and new methods of investigation. In 2012, CSAS worked closely with other mission areas to leverage expertise and apply it to the computing and information needs of science research projects. To help respond to complex and sometimes perplexing science questions, CSAS collaborates with other USGS Mission Areas, and partners with institutions, programmers, modelers, application developers, and others.

Scientific inquiries and interpretation require timely access to scientific data. To achieve this, CSAS leads the USGS Community for Data Integration and other communities of practice (e.g., pollinators; invasive species); conducts hands-on training on metadata standards and for common methodologies, tools and applications; and contributes to the development, adoption and implementation of standards.

In 2013 and 2014, CSAS continues to play a vital role in science and continues to perform research and analysis related to conservation science, vegetation classifications, and taxonomy.

CSAS maintains products and capabilities that make national-level data available through interactive systems that facilitate integration, modeling, and visualization of the data. They include:

- **Biodiversity Information Serving Our Nation (BISON) –** This national integrated resource for U.S. Federal and non-Federal biological occurrence data is near public release, with more than 108 million records. BISON serves as the U.S. connection to the Global Biodiversity Information Facility and is envisioned as the lead biodiversity hub of the EcoINFORMA informatics capability recommended in the July 2011 report on sustaining environmental capital by the President's Council of Advisors on Science and Technology.
- **Gap Analysis Program National Data Layers (GAP) –** GAP builds and maintains three unique datasets: land cover, land stewardship, and species distributions. The USGS and other Federal agencies, States, local government, and others use GAP as a source for up-to-date, standardized environmental data that help to determine habitat suitability and sometimes guide land purchase decisions.
- **Integrated Taxonomic Information System (ITIS) –** With nearly 750 million scientifically vetted entries, ITIS is the authoritative source for scientific names of species and higher level groups of organisms in North America and the world. ITIS is produced in conjunction with eight other Federal partners who use it as the authority for taxonomic information. Its partnership with the European-based Species 2000 enhances it as a worldwide resource.
- **National Fish Habitat Action Plan Data System (NFHAP-DS) –** NFHAP-DS is a data system that provides users with geospatial data visualization, and downloadable maps, metadata, and map services capabilities. Members of the National Fish Habitat Partnership, which include Federal agencies and others, use this system to upload, interact with, and download data, reducing data processing workload and increases accessibility needed for national habitat assessments to better inform decisionmakers.
- **Ocean Biogeographic Information System of the United States (OBIS-USA) –** OBIS-USA helps producers of marine biological data describe and store their data according to internationally-sanctioned standards. OBIS-USA provides access to more than seven million records, and is the official hub for the United Nations' Education, Science and Cultural Organization's Intergovernmental Oceanographic Commission. It also supports National Ocean Policy priority objectives by providing access to critical data that inform decisionmakers.
- **ScienceBase –** ScienceBase is a data and information management platform that enables data uploading, documentation, sharing, and metadata services through standards-compliant Web assistance that allow other applications and Web sites to use its cataloged resources. It assists science teams with tracking and acquiring information by helping organize information resources and improving information discovery.
- **Community for Data Integration (CDI) –** CDI is a collaboration of USGS scientists, data managers, policy experts, other organizations that promote data management best practices and data integration capabilities. It is an instrumental community of practice for leveraging expertise and resources.

- **Science Data Management –** This component provides USGS scientists with data management standards, training, quality control, and tools. It provides searchable metadata to locate, evaluate and access Earth science data.

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Activity: Core Science Systems
Subactivity: National Cooperative Geologic Mapping

2012 Enacted: $25.9 million (116 FTE)
2013 CR: $25.9 million (116 FTE)
2014 Request: $28.3 million (116 FTE)

Overview

In a time when so many of the solutions to the Nation's most pressing problems lie in the ground beneath our feet, the National Cooperative Geologic Mapping Program (NCGMP) advances the understanding of the nature of the materials—rocks, energy resources, water—and processes such as characterization, containment, and flow. This nationwide program of geologic research produces about 100 peer-reviewed journal articles annually on surficial and bedrock geology, mapping, and multidimensional models that provide fundamental research and data that underpin all of the themes of the USGS Science Strategy. These primary findings and data are applied in natural hazards mitigation, water resources delineation, energy and minerals exploration, climate change studies, and ecosystem and environmental health analysis and are readily accessible through the National Geologic Mapping Database.

In 2012, NCGMP marked the 20th anniversary of the National Geologic Mapping Act of 1992, which established the NCGMP and the exemplary partnership with State geological surveys and universities. As mentioned above, over its history, the program has leveraged $95.0 million in Federal funding matched by the State geological surveys to collaboratively produce modern geologic maps for the Nation and $8.0 million matched by universities to train the next generation of geologic mappers—more than 1,000 college geoscience students to date.

National Cooperative Geologic Mapping

"A foundational science program: determining the geologic framework of areas determined to be vital to the economic, social, or scientific welfare of the Nation."

National Geologic Mapping Act 2009

New geologic map of the Great Smoky Mountains National Park

USGS
science for a changing world

Prepared in cooperation with the National Park Service

Geologic Map of the Great Smoky Mountains National Park Region, Tennessee and North Carolina

By Scott Southworth, Art Schultz, John N. Aleinikoff, and Arthur J. Merschat

Pamphlet to accompany
Scientific Investigations Map 2997
Supersedes USGS Open-File Reports 03–381, 2004–1410, and 2005–1225

2012

U.S. Department of the Interior
U.S. Geological Survey

The geology of the Great Smoky Mountains National Park region of Tennessee and North Carolina was studied from 1993 to 2003 as part of a cooperative investigation by the USGS with the National Park Service (NPS). The 1:100,000-scale geologic map will support cooperative investigations with the NPS, including the development of a new soil map by the Natural Resources Conservation Service and the All Taxa Biodiversity Inventory an inventory of the estimated 100,000 species of living organisms in the park. Map and explanatory pamphlet available at http://pubs.usgs.gov/sim/2997/.

Geologic maps and frameworks define the subsurface shape of aquifers, how much water can be stored in them, and parameters for water movement through the ground. Geologic mapping products also provide critical information for predicting and mitigating natural hazards, such as landslides, earthquakes, and volcanoes. For example, the USGS provides the Federal Emergency Management Agency with landslide risk-assessment maps that are used to help make decisions on road closures and home evacuations. The program also funds a project constructing three-dimensional maps through time of earthquake-induced ground shaking. These maps, based on accurate geologic parameters, are critical for earthquake disaster planning and mitigation efforts.

A major Federal geologic mapping partnership is that between the USGS and the National Park Service (NPS). The NCGMP is the principal USGS partner coordinating and prioritizing geologic mapping studies with the NPS. NCGMP-funded projects work with other Federal land management agencies such as the U.S. Fish and Wildlife Service, the Bureau of Land Management, and the U.S. Forest Service.

A hallmark of NCGMP, the National Geologic Map Database is a major collaborative effort with the Association of American State Geologists (AASG). This national database provides rapid access for the general public, scientists, and decisionmakers to well-documented and standardized Federal and State geoscience information that can be used to support research, understanding, and decisions on a number of societal needs. Of note in 2012, a newly redesigned Web interface elicited universal praise. Through annual workshops, this project leads national-level information exchanges and the development of more efficient methods for digital mapping, cartography, geographic information system analysis, and information management.

The NCGMP works in close collaboration with State geological surveys, such as with the Great Lakes Geologic Mapping Coalition, which is a Federal-State partnership created to produce urgently needed, detailed, three-dimensional surficial-materials maps that provide a foundation for making sound economic and environmental decisions related to ground water resources, land, and other natural resources of the Great Lakes.

Universal Praise from Users of the New Mapviewer for the Geologic Map Database

"As a regulator for the CA-EPA, I have extremely limited access to paper copies of geologic maps. These maps provide critical information for developing conceptual site models. Your website integrates geologic maps for different scales in one easily accessible location. The ability to download pdf copies of geologic maps, and more importantly - gis datasets if available, is an invaluable resource that will be utilized by many geologists in the future. The most important suggestion that I have is to promote this website to as many geoscientists as possible."

John K.
California Department of Toxic Substances Control
November 2012

"I just wanted to congratulate you on seeing this MapView utility become a powerful and accessible part of earth science. It was a major topic of discussion on the NRC review panel where we last talked about the infrastructure for digital mapping. The MapView is truly useful and a dream to pick up effortlessly. Besides the viewing of geological maps and topographic base maps, the retrieval of the underlying maps and publications works really well, especially when a map is available on-line."

George B.
Department of Earth and Planetary Science
University of California, Berkeley
November 2012

Program Performance

NCGMP Honors the 1,000th EDMAP Student – In 2012, the NCGMP celebrated the 17th anniversary of its education component (EDMAP) and, more notably, the funding of its1000th student, an undergraduate geology student at the University of Kansas. This student worked with fellow geology Bachelors' candidates on a project in the Kansas River Valley corridor, where they mapped river landforms and characterized the stratigraphy to decipher the nature of change in the Kansas River system.

EDMAP is designed to train the next generation of geologic mappers, and the program's success in educating Earth science students comes from the relationships built among the USGS, academic institutions, and State Geological Survey partners. Students are mentored during their mapping projects by not only their professor, but also by professional geologists and scientists in Government and the private sector.

The USGS EDMAP program is highly regarded throughout the Federal Government and academic communities as being one of the most effective Earth science education programs that focuses on geosciences workforce training and as a pipeline for geologic mapping professions. In satisfaction surveys of the student participants, respondents report that they have gained valuable research and mapping skills that enable them to be highly competitive in the geosciences job market upon graduation. In addition, many EDMAP alumni have pursued academic careers and are in turn educating a new generation of earth scientists. For more information, go to:
http://www.usgs.gov/core_science_systems/access/fall_2012/article-1.html

First Annual National Geologic Map Day – During the American Geosciences Institute (AGI)'s Earth Science Week, the USGS and the AASG partnered with the AGI to celebrate the first annual Geologic Map Day on October 19, 2012. The event concluded Earth Science Week, which boasts the participation of roughly 49 million people annually. Focused primarily on K-12 educators, Geologic Map Day is designed to inform the general public while engaging students across the Nation and to advance STEM education efforts. Teachers were provided with wide-ranging materials related to geologic mapping, reinforced by classroom visits from local scientists with geologic mapping expertise, knowledge, and field experience.

Through these nationwide outreach efforts, Geologic Map Day informs not only students but also business leaders, public policymakers, and land managers by answering questions such as: What is a geologic map? How is it created? How can you read it? For what can it be used? By reinforcing the significance of and varying applications for geologic maps, whether it be in the classroom or in the boardroom, Geologic Map Day serves to illustrate the vital role geology plays in our Nation's infrastructure, economic development, and countless societal issues. For more information, go to:
http://www.earthsciweek.org/geologicmap/index.html

A Best Practice for Federal, State, and University Collaboration – In close cooperation with the AASG, the NCGMP has led two decades of successful cooperation among Federal, State, and university partners to deliver modern digital geologic maps to the communities that need them. Three outstanding efforts of the past year typify this strong partnership: release of the *Bedrock Geologic Map of Vermont;* completion of a major geologic map series in Kentucky; and the USGS–Virginia Geological Survey collaboration on the 2011 Virginia earthquake.

The Vermont map *(http://pubs.usgs.gov/sim/3184/)* will aid resource managers and land management agencies in identifying and protecting aquifers, evaluating resources and land use, preparing for natural hazards such as earthquakes and land subsidence, choosing safe sites for waste disposal, and protecting sensitive ecosystems. The USGS, Vermont State, and university geologists and geosciences students worked closely together to provide the data and information that made this remarkable compilation possible.

In 2013, the Kentucky Geological Survey (KGS) and partners celebrated the completion and publication of their 30- by 60-minute geologic map series, compiling 25 individual maps. The KGS and NCGMP geologic mappers and staff contributed to the effort, including collaborations from 1960 to 1980, which produced the original geologic maps that laid the framework for this series. The new map series is a testament to the work that can be accomplished through Federal-State-university partnerships.

Following the 5.8 magnitude earthquake that struck the U.S. east coast in August 2011, the USGS and Virginia State seismologists and geologic mappers immediately teamed up to investigate this seismic event that was felt by more people in the United States than any other in our history. The USGS and State surveys developed a joint research effort to obtain information such as geophysics and Light Detection And Ranging (LiDAR) that are critical to understanding the geology contributing to the intense shaking and to provide mapping of faults. This information is used to identify regions of potential future seismicity and to aid municipalities in hazard mitigation strategies to protect lives and property.

In 2013, review panels that include scientists and representatives from Federal and State governments, the private sector, and academia critically reviewed work plans for the three main program components: Federal Mapping program, (FEDMAP), State Mapping program, (STATEMAP), and Education Mapping Program, (EDMAP). Review panels will continue this effort in 2014.

FEDMAP – Federal Geologic Mapping Science and Applications
(Estimates for 2012, $17.8 million; 2013, $17.8 million; 2014, $19.0 million)

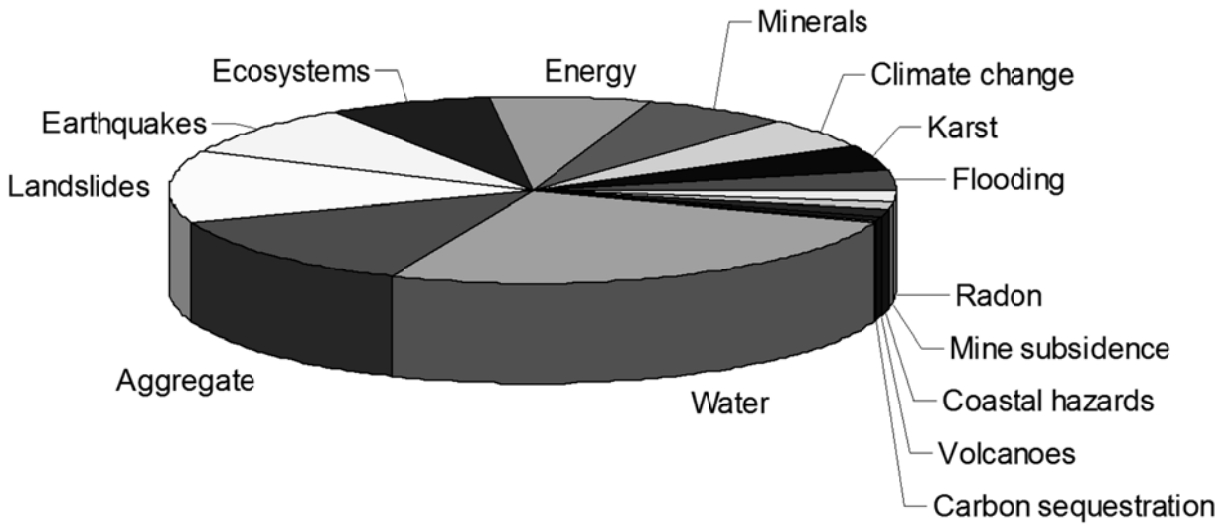
The FEDMAP component of the NCGMP supports about 25 regional geologic mapping and synthesis projects that cross jurisdictional boundaries. Priorities for this work are established jointly with Interior and other Federal agencies such as the NPS. New and ongoing geologic mapping work plans are evaluated annually by a FEDMAP Review Panel, which includes representatives from State geological surveys, the NPS, and USGS researchers that have diverse scientific backgrounds. Examples of NCGMP interdisciplinary geologic mapping accomplishments that contribute to answering a breadth of the Nation's natural resource issues include:

- Groundwater availability, movement, and contamination across the United States, such as in Texas, Oklahoma, New Mexico, and Colorado, Arizona, and New England;
- Earthquake and other hazards mitigation in the Seattle-Portland urban corridor, California, the Central United States, and Virginia;
- Ecosystem health in the Platte River Basin, in national parks, the Appalachian Blue Ridge Mountains, on Native lands in cooperation with tribal nations, and along the U.S.-Mexico border;
- Climate change understanding in the mid-Atlantic, California, and the Greater Platte River Basin, and Mojave Desert; and
- Energy and mineral resource occurrence in Nevada, Arizona, Colorado, and Wyoming.

STATEMAP – Serving State Priorities for National Needs
(Estimates for 2012, $7.5 million; 2013, $7.5 million; 2014, $8.6 million)

The STATEMAP component of the NCGMP currently supports geologic mapping studies conducted by 45 State geological surveys through a competitive cooperative agreement program that matches every Federal dollar with a State dollar. Since STATEMAP's inception in 1993, more than $95.0 million has been matched by 48 States. In each State, geologic mapping priorities are determined with the help of State Mapping Advisory Committees that include representatives from all levels of government, the private sector, academia, and industry. Currently, more than 500 individuals offer their time on these committees to prioritize geologic mapping needs. States propose mapping projects based on their highest priority societal, economic, and scientific issues. Some of the priority issues for State geologic mapping projects are as follows:

Societal Applications of Federal and State Geologic Mapping



Many STATEMAP geologic mapping projects provide critical information needed by States and industry. Program outcomes from geologic mapping for the 2012 proposal cycle include mapping that provides information primarily for groundwater quantity and quality projects across the United States. STATEMAP geologic maps may aid in understanding hydraulic fracturing in the development of unconventional gas production.

EDMAP – Training the Next Generation of Geoscientists
(Estimates for 2012, $0.6 million; 2013, $0.6 million; 2014, $0.7 million)

The EDMAP component of the NCGMP supports the training of a new generation of geoscientists in universities and colleges through a competitive matching-fund cooperative agreement program. Through the EDMAP program, students learn the fundamental principles of geologic mapping and field techniques. Since EDMAP's inception in 1996, more than $7.9 million from the NCGMP has supported geologic mapping efforts of 1,048 students working with more than 230 professors at 152 universities in 45 States, the District of Columbia, and Puerto Rico. Sponsoring universities match, dollar-for-dollar, the Federal EDMAP funding they are awarded.

The Federal Advisory Committee for the NCGMP conducts an annual review of the program. In response to the most recent committee recommendations, the USGS is increasing cooperative research among Federal, State, and academic organizations across the country, working to increase numbers and the diversity of students entering geoscience education, engaging a broad stakeholder base in the development of mid-range program plans, and enhancing outreach and program visibility. The USGS will continue these efforts in 2014.

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Activity: Core Science Systems
Subactivity: National Geospatial Program

2012 Actual: $63.0 million (333 FTE)
2013 CR: $63.2 million (333 FTE)
2014 Request: $72.8 million (330 FTE)

Overview

The National Geospatial Program (NGP) organizes, updates, and publishes the geospatial baseline of the Nation's topography, natural landscape, and built environment through *The National Map*; fosters a general understanding of the Nation's broad geographic patterns, trends, and conditions through The National Atlas of the United States®; and conducts geospatial research to discover new approaches for updating and using geospatial data and for reducing costs of these activities. Users throughout the Federal Government, including those in the Departments of the Interior (Interior), Agriculture (USDA), Commerce, and Defense; the Environmental Protection Agency and the Federal Emergency Management Agency; and States, tribes and other organizations employ NGP geospatial data and Web services to support their decisionmaking and operational activities. The NGP devotes most of its attention to users in the areas of water resource and flood risk management, geologic mapping, geologic hazards, and natural resource management. NGP-sponsored cooperative data acquisition projects reduce duplication of expenditures among Federal agencies and with State and local governments, and result in millions of dollars in contracts for America's geospatial industry. The NGP supports the Interior's responsibilities for national geospatial coordination, and carries out USGS's governmentwide leadership responsibilities for elevation, hydrography and watershed boundaries, geographic names, and orthoimagery data.

The Federal Geographic Data Committee Office of the Secretariat (FGDC OS) coordinates geospatial activities across Federal agencies and with non-Federal organizations under Office of Management and Budget (OMB) Circular A-16 and Executive Order 12906. The FGDC OS provides support for key Federal geospatial initiatives and priorities, including the Geospatial Platform that enhance information availability for decisionmaking and science, increase information delivery efficiencies, and reduce duplication of Federal Geospatial data assets through shared contracting that leverage economies of scale.

Program Performance

3D Elevation Program (3DEP) – Enhanced Elevation for the Nation Initiative – The 3DEP initiative is a plan to systematically collect enhanced elevation data over the United States during an eight-year period. In 2012, a study funded by NGP and partners identified 602 mission-critical activities of 34 Federal agencies, the 50 States, selected local and tribal government, private, and other organizations that would benefit from enhanced elevation data. The organizations would receive up to $13.0 billion annually in new benefits from enhanced elevation data. The NGP worked with partners to identify an optimal program design to meet needs identified in the study. The 3DEP approach would meet 58 percent of needs, up from fewer than 10 percent of needs met with the current approach. The 2012 National Earth Observations Strategy sponsored by the Office of Science and Technology Policy identified enhanced elevation data from sensors such as Light Detection And Ranging (LiDAR) among the top ten needs of 500 systems reviewed. The National Geospatial Advisory Committee and the National States Geographic Information Council endorsed the initiative.

In 2012, the NGP pooled funds with cooperators to acquire $19.9 million worth of enhanced elevation data, and entered into agreements to receive an additional $7.1 million worth of data. These efforts remap elevation for 4.5 percent of the United States. The program provides quality assurance for the data

received, and publishes the data for use by government, industry and the public. In 2013, the NGP is working with Federal partners to develop a cooperative funding strategy for the initiative, is working with cooperators to match $3.5 million of program funds for additional data acquisition, and is processing and publishing acquired data. In 2014, the NGP will work with cooperators to match an additional $3.5 million of program funds for data acquisition, and process and publish acquired data.

Remapping Alaska – The NGP is working with the State of Alaska and Federal partners to replace the more than half-century-old topographic maps for Alaska. New and accurate geospatial data are used to improve aviation safety; understand and mitigate the effects of coastal erosion and storm surges; provide infrastructure for Arctic shipping and resource extraction; and protect biodiversity and habitats. The NGP and its partners are working on a five-year effort (2013-2018) to acquire data to remap the State. The topographic maps generated from the data would be completed in 2019.

Initial efforts emphasize the replacement of elevation data for the State. In 2012, the NGP supported Interior in organizing the Alaska Roundtable, a group of Federal agencies developing a funding solution to remap the State, which was originally proposed by the Alaska congressional delegation and supported by the Administration. The State also works with the group. The program and its cooperators pooled funds to acquire elevation data for the northwest corner of the State and areas along the Gulf of Alaska, and completed acceptance and processing of data for south-central Alaska. The program funded updates for hydrography data. It produced prototypes of replacement topographic maps for the State, and met with users to obtain feedback. In 2013, the program is working with cooperators to acquire elevation data (with emphasis in the northern third of the State) and update hydrography and will continue these efforts in 2014. The NGP started new topographic map production in 2013 with a goal of 400 maps, and ramp up to 900 maps per year in 2014.

Geospatial Platform – The FGDC Office of the Secretariat (OS), in support of the FGDC Chair (Interior) and Vice-Chair (OMB), the 32 Federal member agencies, and the Geospatial Platform Managing Partner (Interior, Office of the Chief Information Officer), is supporting the implementation of the Geospatial Platform to support problem solving and policy formulation for complex issues facing the Nation. The Geospatial Platform provides a suite of well-managed, highly available, and trusted geospatial data, services, and applications for use by Federal agencies and their State, local, tribal, and regional partners and includes the release of collaborative online communities for shared geospatial data investment planning and service acquisition to reduce duplicative investment and increase return on investment.

In 2012, Geospatial Platform Version 1 was released in tandem with its FGDC member agency endorsed *Business Plan* and joint funding agreement establishing its inaugural community for prototyping and lesson learning. In 2013, a transitional year, Version 2 is being released and includes collaborative community support tools, new issue-focused collaborative communities, full integration of cataloging services with data.gov, enhanced data discovery, and implementation of the shared cloud-based, data hosting environment. In 2014, the Geospatial Platform will move to a fully operational phase with guidance from the *Business Plan* and Geospatial Platform Oversight Body.

WaterSMART – In 2013, the USGS funded (+$0.2 million) work associated with the WaterSMART initiative. In 2014, the USGS would continue to integrate into the National Hydrography Dataset locations of water use. Such locations, from the Site-specific Water Use Data System, are places where water is withdrawn, diverted, transferred, or returned to the Nation's hydrographic network. The integration of these data would allow managers to view and model the downstream and interbasin effects of water use.

Cooperative Data Acquisition and User Engagement

(Estimates for 2012, $14.0 million; 2013, $14.0 million; 2014, $25.0 million)

The Cooperative Data Acquisition and User Engagement (Engagement) budget component funds cooperative data acquisition projects with other Federal, State, local, and tribal government organizations. Most funding is applied to acquire new enhanced elevation and hydrography data, and to honor multi-year imagery data acquisition commitments with the USDA. In 2012, the program matched $7.2 million of program funds with $55.7 million of cooperator resources to acquire $62.9 million of elevation, hydrography, imagery, and other geospatial data. The program is pursuing similar projects and matching ratios in 2013 and plans to in 2014, although the program expects a decline in available Federal and State agency matching funds which will slow data acquisition efforts.

The Engagement component also funds interactions with users to identify needs that can best be met by the program. Such engagement activities ensure the relevance of NGP products and services to users. The program focuses on four priority "communities of use" that closely align with the USGS Science Strategy: water resource and flood risk management, geologic mapping, geologic hazards, and natural resource management. Initial efforts focus on needs identified by users in the USGS, and will be expanded to Interior and other government entities. In 2012, the program organized "communities of use" for the water resource and flood risk management and geologic mapping communities. In 2013, the program is adding geologic hazards and natural resource management. The National Map User Conference proposed for 2013 provides a forum for user engagement. The program planning process for 2014 activities will incorporate needs identified by the communities of use in 2013. Results from user interactions in 2014 will inform program actions in 2015 and beyond.

National Map Program Development

(Estimates for 2012, $31.8 million; 2013, $32.0 million; 2014, $32.2 million)

The National Map Program Development (Development) component funds quality assurance and processing of acquired geospatial data, and integration of the data into national databases. Most resources are devoted to elevation, hydrography, imagery, and geographic names geospatial data. Geospatial transportation, structures, boundaries, and land cover data also are managed. The Development component funds maps generation and other products derived from the databases, such as the US Topo electronic topographic maps.

Elevation: With the completion of medium resolution elevation data coverage for the conterminous United States in 2012, attention in 2013 focuses on enhanced elevation data to begin implementation of the 3DEP initiative described above in the Program Performance section. This work will continue in 2014. The program will receive, quality assure, and integrate enhanced elevation data for approximately five percent of the Nation a year. In 2013 and 2014, it will consolidate its elevation operation activities.

Hydrography and Watershed Boundaries: During 2012, the NGP completed the first three-year update cycle for major rivers in the conterminous United States, and the integration of most Mexican and Canadian hydrography data for watersheds that span the U.S. border. During 2012-14, the program will assure the quality and integrate detailed hydrography data updates submitted by Federal and State data maintenance stewards. In 2013, the NGP is investigating the best way to update data for Alaska. The approach will be implemented in 2014. In 2014, the program will pursue the integration of storm water drainage for large urban areas where information about the flow of water is lacking in the program's databases. To better support the WaterSMART activities and others interested in water use, the NGP is adding locations where water is diverted from natural flows. This work will continue through 2014. During 2012 and 2013 the program improved and now continues improvement of the quality of the drainage network in anticipation of providing users additional drainage network information in 2014.

Geographic names: The NGP maintains names data and staffs the Board on Geographic Names authorized by P.L. 80-424. In 2012, the NGP anticipates ingesting the remaining geographic names data acquired under contract during prior years, and refocusing its activities to maintain geographic names that the Board on Geographic Names adjudicates.

Orthoimagery: During 2012 and 2013, the Development component funded half of Interior's contribution to the USDA National Agriculture Imagery Program (NAIP), which acquires imagery of the conterminous United States over a three-year period. The program will participate in the renegotiation of the agreement with USDA for the period 2015-2017. The NGP works with National Geospatial-Intelligence Agency (NGA) to acquire detailed imagery over the Nation's urban areas. In 2012, the NGP acquired data for 46 urban area projects using NGA and NGP resources to match cooperators' funds, and anticipates another 34 urban area projects in 2013.

US Topo: In 2012, the NGP completed the second three-year production cycle for US Topo electronic topographic maps for the conterminous United States. The map content is from *National Map* databases and NAIP imagery. The program will remap the conterminous United States during 2013-2015. The program anticipates mapping Hawaii during 2013, and mapping Alaska during 2013-2019. In 2013, the NGP begins implementing a new map design for the US Topo developed through the Geospatial Research component (see below).

Natural Hazards Response and Geospatial Data Delivery

(Estimates for 2012, $6.7 million; 2013, $6.7 million; 2014, $6.8 million)

The Natural Hazards Response and Geospatial Data Delivery (Delivery) component provides Web access to event-based geospatial data for emergency responders, and NGP products and services to users. It also funds The National Atlas of the United States®.

The Delivery component provides unique geospatial data required by the emergency response community. In 2012, NGP provided imagery and geospatial data for flooding, hurricane, tornado, wildfire, volcanic, and landslide events in 32 States. In 2013, the program is updating the user interface to the data access system. In 2013, the NGP responds to emergencies with tailored geospatial data, and leads USGS geospatial response coordination. These efforts will continue in 2014.

The NGP publishes its digital geospatial data and maps through data downloads, Web-based map services, and a map viewer. In 2012, the program investigated a new technique for faster display of online maps. The Delivery component is implementing the approach in 2013 and will complete the effort in 2014. In 2013, the program is transitioning data made available for download to a commercial cloud-computing capability and will continue this in 2014. In 2012, the program released scanned copies of 178,000 historical topographic maps, and is releasing the remaining historical maps in 2013. During 2012, users downloaded 1.2 million US Topo maps and 2.7 million historical topographic maps.

The National Atlas delivers authoritative Federal geographic information carefully integrated to present a coherent look at America through map and data services. It is popular with educators, businesses, and citizens. In 2012, the program published new base map data suitable for national and regional map displays. In 2013 and continuing through 2016, the National Atlas is shifting focus to the development and delivery of new online services and interactive map products.

Geospatial Research

(Estimates for 2012, $5.0 million; 2013, $5.0 million; 2014, $5.0 million)

The Geospatial Research component funds applied research that improves the efficiency and effectiveness of NGP operations, products, and services, and contributes to the Nation's understanding of geospatial science. In 2012, the NGP completed electronic topographic map design and map generalization research. The NGP is using the results to improve the design of the US Topo maps and to take advantage of detailed hydrography data for maps at regional and national scales. In 2013, the program tested working with public volunteers to capture updated information for structures in Colorado, and anticipates expanding the effort nationally in 2014. In 2014, the NGP will initiate a new round of research project with universities. Candidate topics include new means of using LiDAR data in support of the 3DEP initiative and high-performance computing applications of geospatial data.

Federal Geographic Data Committee – Office of the Secretariat

(Estimates for 2012, $5.5 million; 2013, $5.5 million; 2014, $3.8 million)

The FGDC is an interagency committee that coordinates the collection, use, and dissemination of geospatial information to develop the National Spatial Data Infrastructure. It promulgates standards, system interoperability, geospatial shared services, and best business practices, policies, technology, and partnerships. The Secretary of the Interior chairs the FGDC, and the Deputy Director for Management, OMB serves as the Vice-Chair. The FGDC OS provides executive, administrative, and technical support to the FGDC.

In 2012, the FGDC launched the Geospatial Platform, an Internet-based capability providing shared and trusted geospatial data, services, and applications for use by government agencies, their partners and the public, and completed the Geospatial Platform's *Business Plan* and *Business Case*. The FGDC executed phase two of a geospatial cloud computing testbed collaboratively developing cloud-based, geospatial computing environments that are pre-approved for deployment across agencies, reducing individual deployment costs. Best practices from the testbed are being leveraged for the establishment of the Geospatial Platform's shared data hosting environment. The Secretariat supported all FGDC activities, including the FGDC committees, the National Geospatial Advisory Committee, development of geospatial standards, establishment of the Geospatial Platform as a Shared Service, and the cooperative agreements program. The cooperative agreements program provides State and locally matched funding in support of Geospatial Platform and OMB *Circular A-16 Supplemental* activities.

> "The ability to quickly visualize combinations of different types of data will allow decisionmakers and citizens to make timely, informed judgments on important land and resource issues. The Geospatial Platform will also promote efficiency and reduce duplication of effort by providing the means to create unique maps that can be built once and reused many times".
>
> Anne Castle, Interior's Assistant Secretary for Water and Science, and FGDC Chair.

In 2013, the FGDC OS continues to support FGDC activities focusing support on development and release of Version 2 of the Geospatial Platform. Version 2 includes issue-focused collaborative community tools; Geospatial Marketplace for consolidated data buys that leverage shared contracting and increased economies of scale; enhanced data cataloging and service discovery; and shared cloud-based, data hosting environment implementation. In 2013, the FGDC OS is working with FGDC agencies to develop their A-16 Supplemental Implementation strategy. In 2014, the Geospatial Platform will move to an operational phase and continue to mature its shared services with guidance from the *Business Plan* and Geospatial Platform Oversight Body.

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Activity: Administration and Enterprise Information

		2013 Full Yr. CR (PL 112-175)	2012 Enacted	2014 Fixed Costs and Related Changes (+/-)	2014 Program Changes	2014 Internal Transfer	2014 Budget Request	Change from 2012 Enacted (+/-)
Science Support ($000)		*91,786*	91,786	152	-928	0	91,010	-776
	FTE	*467*	467	0	-8	0	459	-8
Security and Technology ($000)		*25,028*	25,028	914	-1,394	0	24,548	-480
	FTE	*85*	85	0	-10	0	75	-10
Total Requirements ($000)		***116,814***	**116,814**	**1,066**	**-2,322**	**0**	**115,558**	**-1,256**
	Total FTE	***552***	**552**	**0**	**-18**	**0**	**534**	**-18**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Summary of Program Changes

Request Component	($000)	FTE	Page
Science Support	**-928**	**-8**	
Reduction to Administrative Services	-1,906	-8	B-62
Earth Scientists for Tomorrow	1,000	0	B-14
General Program Reduction	-22		B-65
Security & Technology	**-1,394**	**-10**	
Reduction to Administrative Services	-1,229	-10	B-63
General Program Reduction	-165	0	B-63
Total Program Changes	**-2,322**	**-18**	

** Estimated changes in FTEs compare against actual 2012 FTE usage, not 2012 enacted formulation estimates.

Justification of Program Changes

The 2014 Budget Request for Administration and Enterprise Information (AEI) is $115,558,000 and 534 FTE, a net program change of -$1,256,000 and -18 FTE from the 2012 Enacted Budget. This activity funds the executive, managerial, and accountability activities, and the information technology and bureau support services of the U.S. Geological Survey (USGS). The request reflects previous realignments including realigning the funding and services of Enterprise Information Resources to Science Synthesis, Analysis and Research in the Core Science Systems Mission Area, and Science Support and Enterprise Security and Technology in this activity. For more information on the AEI Mission Area changes, please see Section B, Program Changes as indicated in the table.

Activity Summary

The AEI activity is comprised of two subactivities:

- Science Support
- Security and Technology

The AEI Mission Area is the framework for conducting science and includes bureau and area executive leadership and management that provide guidance, direction, and oversight of all USGS science activities. Additionally, this activity provides business and information systems; organizes and conducts planning and budgeting; provides policy guidance and direction; implements, monitors, and enforces statutory requirements; manages people, funds, facilities and information technology; ensures scientific rigor and integrity; and communicates our mission and science to the Congress and public.

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Activity: Administration and Enterprise Information
Subactivity: Science Support

2012 Enacted: $91.8 million (467 FTE)
2013 CR: $91.8 million (467 FTE)
2014 Request: $91.0 million (459 FTE)

Overview

The Science Support subactivity provides bureauwide 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 our mission and science. The key areas are:

The USGS **Office of the Director** performs chief executive officer and chief operating officer responsibilities.

The science mission area **Associate Directors** establish program direction and goals, and serve as science advisors to the Director in their respective program areas.

The **Regional Executives** exercise line management responsibility for the science centers and implement science projects on the landscape.

The **Office of Budget, Planning, and Integration (BPI)** secures Federal funding resources needed for the USGS to perform its mission goals, facilitates information sharing internally and externally, and provides in-depth analyses and integration of budget and performance data for the USGS to understand, anticipate, and respond to the changing demands resulting from public policy decisions and science needs.

The **Office of Communications and Publishing (OCAP)** guides and conducts external and internal communications and provides publishing and Web development services. The Science Publishing Network prepares science reports and maps for publication including technical writing, editing and graphical displays. This information is widely used across the Nation by members of Congress and their staff, other natural resource planners and managers, recreational hunters and hikers, and emergency response officials, and the media.

The **Office of Science Quality and Integrity (OSQI)** establishes and implements standards for scientific integrity and excellence and administers programs for ethics, education, development, and collaboration including the USGS Office of Ethics, the National Youth program, the Mendenhall Postdoctoral Fellowships, bureauwide education activities, and the Office of Tribal Relations.

The **Office of Administration and Enterprise Information (OAEI)** establishes policies, coordinates and conducts activities in the areas of accounting and fiscal service, general services, security, safety and occupational health, acquisitions and grants, internal controls, technology transfer, facilities and property, environmental protection, and business systems. The Associate Director is the Chief Financial Officer (CFO), Assistant Director for Information Resources (ADIR) and Designated Agency Safety and Health Official (DASCHO). OAEI also manages the execution of the AEI program and the Campaign to Cut Waste.

The **Office of Human Capital (OHC)** provides executive-level leadership for policy direction, management, and oversight of the human capital programs, including human resources and employee development. The OHC formulates and implements human capital strategies to ensure consistency with merit system principles, veteran's preference, organizational and employee development, personnel policies, and other public policies.

Program Performance

Bureau leadership will continue to focus on finding innovative ways to deliver high quality services to support science activities, improve stewardship of resources, develop the workforce and reduce costs within the bureau's control.

Acquisition Goals – The USGS met key socioeconomic acquisition goals in 2012, including awards to businesses in the categories of small disadvantaged, women-owned, service-disabled-veteran owned, and Historically Underutilized Business (HUB) Zone. The USGS achieved a performance based acquisition level well over 70 percent, compared to a goal of 50 percent.

The Office of Acquisition and Grants (OAG) has several initiatives in place to improve USGS performance in the small business area with a projection to meet all small business socioeconomic goals in 2013 and 2014. Performance based acquisition will remain high against the governmentwide goal.

Achieving Cost Efficiencies for Science (ACES) – In 2012, the USGS chartered a formal, executive-led, bureauwide process to examine all aspects of the USGS for efficiency and effectiveness and encourage innovation. The ACES process completed data gathering and analysis of facilities utilization, science center efficiencies, science management and programming organization and structure, administrative and technology services, headquarters functions, and the numbers and boundaries of areas in 2013 and beyond. Four reports were presented to the bureau with recommendations affecting all aspects of science management, facilities utilization, and business practices. Recommendations such as consolidating geographic areas into a smaller number of regions, consolidation of science centers, and streamlining required business processes are being implemented.

American Recovery and Reinvestment Act – The USGS obligated 99.5 percent of funding on schedule. This funding provided two new Great Lakes research vessels, modernized the streamgage network, and achieved a decade or more of progress in the Advanced National Seismic System.

Employee Education – In 2012, the USGS National Training Center (NTC) in Denver, CO, increased training and development opportunities using distance learning technologies for a variety of courses including science and technical course offerings. New online courses developed internally increased by 30 percent. The use of deployable laptops, shipping pre-configured computers for classes held at USGS office locations throughout the country, increased by 10 percent. Video streaming live classes taught in NTC classrooms allowed remote USGS attendees to access training, reducing the impact of travel costs. Leveraging these distance learning technologies delivers mission critical training and employee development opportunities in a cost efficient way. In 2013, an internal solicitation will identify and help fund additional new online classes for development and delivery across the bureau.

The Organization Development focus area also promoted efficiencies by working with groups who meet virtually by helping them to establish solid ground rules, processes and procedures for successful meeting management. Further, the program has introduced technology to assist group decisionmaking, for example, voting and prioritizing using an electronic Audience Response System for meetings.

The Office of Employee Development (OED) further enhanced efficiencies by continuing to reduce hardcopy course materials, offering instead, electronic materials and evaluations for courses held at the National Training Center and other USGS office locations. The USGS Supervisory Challenge and Leadership Intensive course materials were migrated to flash drives, eliminating the hard-copy binders that were used previously.

The USGS Mentoring Program is diversifying to offer multiple types of mentoring to a greater number of individuals as a tool for growth and development and to enhance job satisfaction, skills and knowledge. The program is implementing e-mentoring and utilizing the Internet to reduce costs while reaching a larger number of people quickly, building communities and offering a vast opportunity to share information.

In 2013, the OED is establishing an advisory board to conduct a programmatic and operational review, the findings of which will allow the OED to continue to provide outstanding organizational and employee development services and to further effect efficiencies in our utilization of technology and diversification in delivery methods and modalities.

Energy Efficiency and Environmental Management – The USGS is developing a $1.4 million alternatively financed project that will install energy efficiency upgrades at 11 of its largest energy-consuming science centers. The Energy Savings Performance Contract (ESPC) will be awarded by the end of first quarter 2014. When completed, the implemented energy conservation measures are expected to reduce both facility energy consumption and greenhouse gas emissions. The ESPC is paid with energy savings so there is not a capital investment from Federal funding.

Fundamental Science Practices (FSP) – These vital policies that govern the integrity of the scientific process including the development, review, and release of scientific information were updated in 2012 to provide streamlined approval processes, stronger safeguards for data, and guidance for how scientists can provide objective scientific recommendations, ensuring impartiality and non-advocacy. In addition, the USGS reengineered the Information Product Delivery System, which provides the official record of adherence to Fundamental Science Practices during development, peer review, and final approval of USGS scientific publications. The system was moved to SharePoint and redesigned, making it easier and faster to use.

Outreach with Key Stakeholders – The OCAP coordinated 63 congressional briefings during 2012 on key issues including adaptive management, Asian carp, earthquake early warning, energy and mineral resources of the Arctic, the energy-water nexus, a new global conventional energy assessment, Hurricane Sandy, Landsat, paleoclimate studies, rare earths and other critical minerals, water availability, white-nose syndrome in bats, wildfire, groundwater, and hydraulic fracturing, showcasing the USGS's partnerships with State and local governments and other Federal agencies in supporting science-based decisionmaking on natural resource issues. The OCAP prepared witnesses for 14 hearings and conducted more than 200 courtesy visits to congressional offices. USGS social media efforts in 2012 resulted in more than 241,000 Twitter followers, 34,000 Facebook followers, and 636,666 video views on YouTube. The USGS was recognized on two Federal agency top 10 lists: Number 10 in most retweets per tweet, and number 6 for most engaged audience. The USGS was also ranked number 15 for most Twitter mentions over the past 12 months. To reach the public during 2012 hurricane events, the USGS developed a series of Web-based products, top stories, news releases, congressional notifications, and social media engagements informing emergency planners and communities on how to prepare for and respond to Hurricanes Isaac and Sandy. The USGS also began implementation of a 5-year strategy to re-engineer the USGS Web to enhance the ability of customers to find and access USGS information, data and products; meet requirements of the White House Digital Strategy; and establish the Web as a strategic

business asset. OCAP staff was recognized by the National Association of Government Communicators with nine Blue Pencil/Gold Screen awards, the most for any Federal agency in 2012.

Real Property – In 2013, to support the Interior's real property cost savings targets, the USGS continued to focus on its Cost Savings and Innovation Plan objectives. These included improving space utilization through consolidation, colocation and the use of technology and programs such as teleworking; moving the bureau toward the 180 square foot per person standard for office space; targeted disposals of unneeded space and assets; and cost containment. Significant progress was made. The USGS released 315,000 square feet of space back to the General Services Administration at the USGS's three largest locations in Reston, VA; Lakewood, CO; and Menlo Park, CA.

Science Education – The USGS participated in developing the Federal Science, Technology, Engineering and Mathematics (STEM) education and workforce needs report, "A Report from the Federal Coordination in STEM Education Task Force, Committee on STEM Education, National Science and Technology Council, February 2012." Additionally, the USGS has contributed to the final report of the Committee on STEM Education, expected to be released in early 2013. The USGS supported and participated in the development of the new "The DOI STEM Education and Employment Pathways Strategic Plan, Fiscal Year 2013 – Fiscal Year 2018." The USGS provides critical early STEM experiences through its education programs, resources for teachers, and research opportunities for students to work with USGS scientists.

Technology Transfer – The Federal Technology Transfer Act, 15 USC 3710 as amended, requires each Federal laboratory having 200 or more full-time scientific, engineering and related technical positions to establish a research and technology application function. Within the USGS, this function is housed in the Office of Policy and Analysis where staff service USGS Science Centers and offices throughout the country. In 2014, the USGS would continue negotiating and drafting Cooperative Research and Development Agreements (CRADAs), Technical Assistance Agreements (TAA), Facility Service/Use Agreements (FSUA), Material Transfer Agreements (MTA), and Patent Licenses. This office also manages the USGS intellectual property and inventions program; markets USGS technology opportunities and assistance to industry, non-profits, academic institutions, and State agencies; and provides training to USGS personnel on technology transfer and intellectual property protection. At the end of 2012, the USGS held 45 current patents. During 2012, the U.S. Patent and Trademark Office accepted filings for two new USGS patent applications, making for a total of 16 patents pending. The table below summarizes the number of projects in 2012.

Active 2012	Total Number	Private	Non-Profits	Academic Institutions	Government Entities	International Entities	Partner Contributions ($000)	USGS/In-Kind Contribution ($000)
CRADAS	17	15	1	0	1	0	2,300	600
TAA	145	56	34	15	16	24	5,400	1,200
Patent Licenses	20	19	1	0	0	0	72	0

USGS science and research contributes to a broad range of valuable collaborative projects in the private and academic sector. During 2012, the USGS executed nine new Material Transfer Agreements. With expansion of its facility use program, the USGS has increased the number of specialty analytical laboratory services to 28, providing unique capabilities to the United States, foreign partners, and academia. The total number of new user agreements executed during 2012 was 194.

Transportation Management – The USGS identified fleet reduction targets, necessary to comply with Executive Order 13576 Delivering an Efficient, Effective, and Accountable Government and the Campaign to Cut Waste. The USGS issued reduction targets bureauwide and established a "Justification for Vehicle Addition" template for any vehicles added to the fleet. In 2013, improvements are being made to fleet utilization and maintenance entries in the Financial Business Management System and the USGS will provide fleet reduction target updates to meet the fleet reduction requirements as set forth in E.O. 13576. The "Justification for Vehicle Addition" form will be utilized as a tool to assess the need to increase the number of alternative fuel and higher fuel economy vehicles and eliminate growth in the USGS fleet. Potential alternatives for fulfilling vehicle requirements, including vehicle exchange and shared allotments, will be explored prior to new vehicle purchases.

USGS Ethics Office proactively assists USGS employees – Through the use of the electronic opinion filing system (Ethics OFS), USGS ethics opinions are stored in a fully searchable database, which helps provide continuity across mission areas, regions and scientific disciplines, and enables ethics counselors to be more efficient and responsive to requests for ethics advice. The Ethics Office averages over 70 written opinions per month as well as reviews of requests for outside work, acceptance of contributions and travel expenses from non-Federal entities, and conflict of interest waivers that enable USGS scientists to serve as officers or members of boards of directors of professional scientific organizations.

Workforce Planning – Recently developed workforce analysis and evaluation tools are being used to advance a comprehensive bureau-level workforce plan. The plan is a roadmap for aligning people with the organization's strategic direction that will be implemented in 2013 and beyond.

Youth: Earth Scientists for Tomorrow – Investments in Youth programs are critical to achieving the USGS mission today and ensuring that we have a workforce that is ready to tackle the challenges of tomorrow. In 2012, the USGS continued to expand the National Association of Geoscience Teachers/U.S. Geological Survey Cooperative Summer Field Training Program, the Nation's longest-run science internship program. The USGS also expanded its STEM partnerships with mayors of major cities, which started with the city of Denver, CO, in 2011, and expanded to Albuquerque, NM, in 2012. This collaborative program with the Denver and Albuquerque city governments provides jobs and STEM training for diverse inner-city high school students. The USGS designed and provided support for the 2012 Native Youth in Science – Protecting Our Homelands summer science camp. The USGS partnered with the Education Department of the Mashpee Wampanoag Tribe on this unique pilot project that paired USGS scientists with tribal culture keepers to ensure that the course material was presented to the Wampanoag youth (grades 6-8) in a context that interwove Western science and traditional ecological knowledge (TEK). These examples highlight USGS's unique role of working with a wide array of cooperators to bring world class earth science to decisionmakers, communities and schools.

In 2013, the USGS Youth Office is leveraging resources to increase focus on diversity recruitment, outreach, and engagement by pursuing new strategies and incentives and reducing redundancies. Two highlights that occurred in the first quarter of 2013 include: (1) the USGS Human Resources Office dedicated a position to collaborate with the Youth Office on recruitment efforts; and (2) the Hydrotech Council of Managers and Scientists was created to effectively recruit and hire hydrologic technicians. In partnership with minority serving colleges, the Council assists current and potential partner schools in curriculum development, presentations and information sessions to promote careers in the Earth sciences.

In 2014, the USGS proposed increase would be used to establish the science component of the 21st Century Conservation Service Corps (21CSC). This 21st Century Conservation and Natural Resources Science Corps would put young Americans to work providing science for decisionmaking in support of protecting, restoring, and enhancing public and tribal lands and waters. The USGS would engage other Interior bureaus, Tribes, learning institutions and governmental and non-governmental organizations, to create partnerships and projects. The proposed funding would include the following science activities:

- Career pathways in conservation and natural resources science would be provided to 50 students from underrepresented groups, by coupling Science Corps internships with cooperative training programs at two and four year colleges. This would help build upon and expand current hydrologic, biologic, and physical science technician programs with Gateway (Phoenix, AZ), Vermillion (Ely, MN), South Dakota, and Northern Virginia Community Colleges, and would be expanded to new minority serving institutions and tribal colleges. The Science Corps would also provide internships, mentoring, and training in life skills, such as how to effectively apply to college, to approximately 50 urban high school youth by working with city governments, city schools, and inner city summer programs. Current pilot programs in Denver, CO, and Albuquerque, NM would be expanded and new programs in Washington, D.C., and other cities would be created.
- The development of a new Science Corps program of approximately 100 undergraduate students will work with Interior bureaus and partners, such as the National Science Foundation, University of Texas, Student Conservation Association, and GeoCorps America to create recruitment, hiring, and project placement processes that can be readily used by others. The students will work with USGS scientists and others on projects that support USGS mission goals. In addition, an effective, low cost evaluation methodology would be developed and implemented to ensure youth programs are meeting goals, are based on best practices, and provide an evidence-based improvement process.

Activity: Administration and Enterprise Information
Subactivity: Security and Technology

2012 Enacted: $25.0 million (85 FTE)
2013 CR: $25.0 million (85 FTE)
2014 Request: $24.5 million (75 FTE)

Overview

The Security and Technology (S&T) subactivity provides the critical information technology (IT) foundation for the USGS science mission by implementing advances in IT and computing capability and using them to facilitate research, data gathering, analysis and modeling, scientific collaboration, knowledge management and work processes. This subactivity also supports the Department of the Interior (Interior) information technology transformation.

Information Assurance protects infrastructure and data from improper or malicious access or manipulation, protects the integrity and availability of science information, and preserves the confidentiality of privacy and other sensitive information. Oversight is applied to IT 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 10 major systems and over 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.

Telecommunications support timely transmission and sharing of emergency and routine data such as from earthquakes, flooding, and volcanic eruptions. This complex architecture is used to provide timely access to global environmental data to promote, protect, and enhance the Nation's economy, security, environment, and quality of life. To fulfill its responsibilities, the telecommunications program acquires and manages the investments for voice, data, video, and radio/wireless subsystems within the USGS, including working capital funds (WCF), to assist with capital investment funding. This component also provides regular voice and computer network services.

The USGS Video Program provides for the management and hosting of $1.3 million in video teleconferencing (VTC) infrastructure that supports video and audio communications between scientists and their constituents as a complement to standard voice communications. With over 40 VTC endpoints throughout the Nation, the USGS has been increasingly exploiting its use to save on travel costs, enhance communications, and enable cost-saving telework initiatives.

The USGS Radio Program provides strategic and operational support to the science mission, including radio frequency spectrum management for almost 1,000 radio frequency assignments and risk management for over $85 million of radio enabled assets including maritime mobile, hydrological, ground penetrating radio, weather radar, satellite communications, water-metering systems, underwater communications systems, aeronautical mobile and wildlife-tracking systems.

The USGS Voice Program encompasses a wide range of services consisting of a system of highly reliable, dedicated voice circuits working in conjunction with a switching and conferencing system to create voice loops. These voice loops interconnect the 127 different voice distribution systems and additional landlines that support the diverse scientific mission centers. A heavily leveraged WCF provides for voice equipment upgrades and replacements and assistance to bureau sites in private branch

exchange (PBX) upgrades. A Blanket Purchase Agreement (BPA) has also been established to allow for standardization on a single, consistent voice platform, thus reducing the cost for equipment and support.

The USGS Data Network Program provides the necessary tools for scientists to share substantial amounts of information and data across the network. It supports critical hazards programs that monitor earthquakes, floods, and volcanoes across the Nation and around the world. The Telecommunications Program manages the wireless local area networks (WLAN) that enable users to connect to the USGS network via laptop, smartphone and tablet, and move freely about without losing connectivity. The USGS is moving increasingly toward an untethered workplace, enabled significantly by the finalization of an enterprise WLAN contract of $2.9 million over three years to reduce overall costs. WLAN boosts the efficiency of employees, saves on cabling costs, and makes the network more accessible; without funding, these efficiencies and benefits are lost.

Computing Infrastructure provides data storage and Web-based collaboration tools, directory services, Internet and Intranet services, GIS support, and a "one-stop shop" service desk. The primary services include secure authentication, group policy management, directory services, naming services, IT asset management, and security compliance monitoring. E-mail within the USGS is used as the primary avenue of delivering information quickly throughout the USGS, as well as to cooperators and colleagues throughout the world. It allows scientists to quickly receive notifications from automated systems that send information on earthquakes, volcanoes, landslides, tsunami, hurricanes, and flooding around the country and sometimes the world.

Information Management conducts planning for future requirements, prevents loss of capability through investment control, and supports sound investment strategies (capital planning and investment control). In addition, Information Management oversees a broad suite of activities that support information discovery and delivery and ensures the collection, storage, sharing, preservation and publication of scientific data according to Federal laws and regulations. The USGS Enterprise Web (EWeb) Program is a network of people and resources focused on providing access to USGS digital resources. The EWeb Program includes a secure and reliable hosting infrastructure through the National Web Server System (NatWeb). EWeb also provides policies, guidance, services, and tools to enable the effective delivery of USGS science and information products.

The Investment Management Program works to ensure that IT funds are spent in the most efficient and effective manner to support the science mission of the USGS. The program works to increase the use of enterprise contracts and other strategic sourcing approaches combined with more standardization of tools and services to optimize IT spending and support a great amount of scientific research.

Capital Planning and Investment Control (CPIC) is a decisionmaking process for ensuring that IT investments integrate strategic planning, budgeting, procurement, and the management of IT in support of the USGS mission. The USGS IT Investment Portfolio was $146 million in 2012, and is expected to decrease to $136 million over the next two years.

USGS DOI Enterprise Services supports Information Technology Transformation, technology streamlining and cost and service efficiency initiatives through contributions to the DOI IT Working Capital Fund.

Program Performance

The Security and Technology subactivity will continue to meet the increasing demand for science information delivery services by focusing on four key priorities: enhancing science information delivery; protecting science data and assets; maintaining operations; and supporting Information Technology Transformation initiatives.

Science Information Delivery: Enhancing public access to USGS data

The Records and Information Delivery program, in support of the Administration's goals to increase cross-agency and public access to government data, published seven high value science datasets in 2012. As a result, USGS total data.gov holdings increased by 20 percent in 2012, representing approximately 80 percent of Federal non-census Geodata. The USGS was routinely ranked number 1 for dataset and tools views and usage in 2012. In 2013, an additional four science datasets will be published with the expectation that this number would be maintained or increased in 2014. These efforts will support the Earth Observations Innovation and Applications initiative that is proposed in 2014. This initiative is the DOI contribution to the Big Earth Data Initiative, for more details go to the Program Changes section.

In 2012, the USGS FOIA program exceeded the administration's 20-day benchmark requirement with a 12-day average turn-around, and public access to the FOIA reading room was 400 percent higher than in past years. The USGS FOIA program was acknowledged by the Secretary of Interior as a best practice and helped the Department of the Interior achieve the highest rating in FOIA amongst cabinet level agencies. In 2013 and 2014 this program will continue as a best-practice activity as government data becomes more accessible to the public.

In alignment with multi-year information and IT greening initiatives, in 2012, the USGS achieved digitization of 80 percent of the USGS Store's science products by making them available online; this reduced paper products by 70 percent. The USGS also closed the 2,700 square foot Reston product store, which represents an $80,000 in annual cost avoidance. In 2013 and 2014, the science product digitization will continue toward the goal of having 100 percent of appropriate science products being available online.

Science Data and Assets: Preserving science data for future generations

In 2012, the USGS focused on preserving science for future generations by ensuring that data from 35 science projects were preserved as one-of-a-kind, high-value datasets, documents, reports, maps, imagery and other information, and are available digitally for science research and the public. This preservation activity is the culmination of a five year effort that has successfully "saved" data from 70 science projects that span more than 100 years of research in energy resource availability, water, ecosystems, climate, hazards, and geography. Now preserved and digitally accessible, these data are being made available to the science community, stakeholders, and the public for the first time, serving diverse scientific needs today and for future generations. In 2013, the USGS plans to preserve data from 38 science projects, and in 2014 data from 40 science projects would be preserved.

Operations: Providing the operational infrastructure to ensure science success

In 2012, the USGS led several strategic initiatives to support green IT and technology innovation by optimizing data center services to external parties; by consolidating and accelerating virtualization efforts; by replacing equipment with more energy efficient devices; and by closing three data centers. Also in 2012, the USGS accelerated a mobile workforce strategy by implementing and expanding the use of service desk attended and unattended technologies. As a result more employees were able to telework

effectively, first-level issue resolution was increased, service technicians were freed up to focus on other priorities, and customer satisfaction was at an all-time high of 4.91 percent on a 5 point scale. The USGS adoption rate of mobility devices increased over 200 percent. In 2013 and 2014 the USGS will expand these greening efforts by continued consolidation and acceleration of virtualization efforts and equipment replacement.

In 2012, the USGS established an "untethered high-speed" telecommunications project for a next generation high-capacity data and voice distribution network to support scientific research and public information delivery. This project accelerated telecom modernization initiatives to remove IT security and technical barriers to improve accessibility, to promote telework, and to reduce operation cost for voice and data services. As a result of this project, state-of-the-art next generation telecom services were created, including implementing wireless networks at four of the largest bureau locations; reducing deferred maintenance costs for voice systems by 25 percent through replacement; modernizing 40 percent of the wide area network infrastructure resources; and upgrading 60 percent of site circuits. These upgrades enhanced the bureau's ability to collect, process, synthesize, and disseminate information at a near real-time basis. These efforts laid the foundation for a 2013 and 2014 anticipated cost avoidance of $600,000 for voice services, an 80 percent reduction from wireless networks over wired networks, and a 30 percent reduction in circuit cost for data services.

In 2013 and 2014, the Telecommunications Program will be developing a new VTC architecture that will include a centralized scheduling system, support for all infrastructure and endpoints, cloud-based VTC, and reporting on return on investment to track usage increases, savings on travel, and greenhouse gas emission reduction. Without funding, the current VTC architecture will result in unnecessary spending and underutilization of current assets.

Information Technology Transformation (ITT) Initiative

In December 2010, the Department began an ITT initiative to consolidate and streamline IT services, personnel, and IT infrastructure by the end of 2014. In 2012 through 2014 the USGS is working with the CIO to migrate staff, equipment and other resources to the CIO and retire existing services and support functions under a fee-for-service model. The ITT initiative is supported by USGS staff, which are leading and participating on planning teams. Additionally, the USGS will implement the following CIO new services: cloud based email and collaboration system; forms management system; electronic records system; content management system; mobile device management system; risk management services; migration of applications and data centers to a vender-based cloud solution; consolidation of telecommunications infrastructure; and move end-user support services to the CIO. Transition and implementation are assessed to the USGS by the Department and will be self-funded with efficiency savings the CIO anticipates will occur upon successful migration and implementation of new services by the close of 2014.

Activity: Facilities

		2013 Full Yr. CR (PL 112-175)	2012 Enacted	2014 Fixed Costs and Related Changes (+/-)	2014 Program Changes	2014 Internal Transfer	2014 Budget Request	Change from 2012 Enacted (+/-)
Rental Payments and Operations & Maintenance ($000)		*93,141*	93,141	-1,457	5,517	0	97,201	4,060
	FTE	*55*	55	0	0	0	55	0
Deferred Maintenance and Capital Improvements ($000)		*7,280*	7,280	0	0	0	7,280	0
	FTE	*0*	0	0	0	0	0	0
Total Requirements ($000)		***100,421***	**100,421**	**-1,457**	**5,517**	**0**	**104,481**	**4,060**
	Total FTE	***55***	**55**	**0**	**0**	**0**	**55**	**0**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Summary of Program Changes

Request Component	($000)	FTE	Page
Rental Payments and Operations & Maintenance	**6,385**	**0**	
Operations and Maintenance Efficiencies-Reduce Facilities Footprint	6,385	0	B-55
General Program Reduction	-868	0	B-64
Total Program Changes	**5,517**	**0**	

** Estimated changes in FTEs compare against actual 2012 FTE usage, not 2012 enacted formulation estimates.

The 2014 Budget Request for Facilities is $104,481,000 and 55 FTE, a net program increase of $4,060,000 from the 2012 Enacted Budget. For more information on the Facilities Mission Area change, please see Section B, Program Changes as indicated in the table.

Activity Summary

The USGS Facilities Activity provides safe, functional workspace for accomplishing the bureau's scientific mission. Funds support basic facility operations; security costs; facility maintenance in compliance with Federal, State, and local standards; and the provision of a safe working environment for USGS employees, visiting partners, and customers.

Assets include property consisting of land, buildings, or other improvements permanently attached to the land or a structure on it. The Department of the Interior (Interior) defines a facility as an individual building or structure. The USGS defines facilities to include all sites where USGS activities are housed and mission related work conducted. Facilities typically provide space for offices, laboratories, storage, parking, and shared support for cafeterias, conference rooms, and other common space uses. The USGS also classifies its eight large (greater than 45 feet in length) research vessels as laboratory facilities. Owned assets are usually part of a campus; for example, the Leetown Science Center includes all associated land, buildings, and other structures.

The Facilities Activity is comprised of two subactivities: Rental Payments and Operations and Maintenance (RP and O&M), and Deferred Maintenance and Capital Improvements (DMCI).

In 2013, the USGS plans to spend $143.1 million on rent and operations and maintenance. Of these costs, 65 percent ($93.1 million in 2013) are funded through this subactivity. The remaining costs are funded by reimbursable partners (26 percent) and science programs (9 percent). In 2013, the total facilities rent cost is

This activity supports Interior's goal of facilities improvement by tracking outcomes such as overall condition of buildings and structures as reported in the Federal Real Property Profile; reduction of energy intensity by three percent annually; percentage of square footage that meets Executive Order (E.O.) 13514 sustainable building goals; and percent of assets targeted for disposal that were disposed.

The facilities program goal is to meet bureau science needs while optimizing facilities location, distribution, and use to control or reduce costs. Objectives for meeting this goal include:

- Coordinating facility planning with science planning to provide safe, high-quality workspace aligned with science needs;
- Developing Asset Business Plans to meet asset management goals, continue annual surveys, and cyclic condition assessments;
- Meeting performance targets for improving space utilization, controlling rent and operating costs, and releasing unneeded space; Reducing deferred maintenance by renovating and constructing buildings and other facilities to replace assets otherwise no longer cost effective to operate;
- Establishing an effective maintenance program at each owned facility to meet industry best practices;
- Increasing co-location consistent with science program objectives; and
- Achieving energy performance goals.

Facility Planning – The USGS updated its Site-Specific Asset Business Plans (ABPs) to support the bureau's Asset Management Plan (AMP). The ABPs are 5- to 10-year plans addressing specific needs of a field unit, campus, or region including all assets reported in the Federal Real Property Profile (FRPP). The USGS ABPs effectively address the life cycle issues and characteristics of a site's real property assets. For the local facility or program manager, the ABPs help provide a profile of their current facilities, size, staffing, and utilization rate. The plans also anticipate future needs, create an awareness of recurring and one time space costs, plan mission operations with facilities in mind, and identify initiatives that may qualify for additional funding. The ABPs are also used as annual action plans to direct bureau area resources where they are most needed to support the USGS mission.

Cost Savings and Innovation Plan (CSIP) – Space savings are integral to rent and operations management. The USGS realizes space savings when locations are able to consolidate space or relocate to space with lower costs. The USGS is actively assisting Interior to meet its cost savings and innovation targets by proceeding with a Cost Savings and Innovation Plan (CSIP). The USGS's goals under the CSIP are to reduce its footprint and costs; move toward the 180 square foot (SF) per person utilization standard; and utilize space more efficiently by implementing computer technology and programs such as teleworking. In addition to implementing a centralized space action approval process to focus on meeting these goals, the USGS is prioritizing and funding CSIP projects with the shortest payback period while significantly reducing the bureau's footprint and costs.

The USGS relies on the Government Services Administration (GSA) owned and leased buildings for nearly 68 percent of the space it occupies. The USGS has no ability to reduce fixed rental rates at these sites and can only offset the higher facility costs by vacating space. Therefore, the primary emphasis will be on improving space utilization, disposal of underutilized assets; consolidating operations within and relinquishing space to GSA provided offices, laboratories, data centers, and warehouses at major USGS centers in Reston, VA; Denver, CO; and Menlo Park, CA.

The USGS owns 276 buildings situated on approximately 2,179 acres. These buildings total 1.3 million square feet (SF) and have a replacement value of approximately $312 million. Additionally, the USGS

owns 290 structures with a replacement value of $100 million. The owned inventory includes 10 ecological science centers; 5 ecological field and research stations, 1 land use center—the National Center for Earth Resources Observation Science (EROS), 10 geomagnetic, seismic and volcano observatories, and 7 miscellaneous owned properties such as stream gage stations, warehouses and a storage annex. The USGS also owns eight large research vessels that have operations and maintenance costs that are comparable to those of a USGS building. These vessels exceed 45 feet in length and perform overnight research to support biological, water resources, and marine geology research. Five of the vessels operate on the Great Lakes; two operate in California, and one in Alaska. The vessels are equipped with wet laboratories, trawls, gillnets, larval fish tow nets, equipment for limnological and contaminant sampling, acoustic fish-detection systems, and computers. All vessels also have state-of-the-art navigation systems to precisely locate sampling stations. The Great Lakes Science Center is the only organization in the United States and Canada that has a research vessel with deepwater capability on each of the Great Lakes.

As part of the Strategic Facilities Master Plan (SFMP), USGS facilities were ranked in terms of their mission dependency using a tool called the Asset Priority Index (API). Although the largest concentrations of employees are in GSA-controlled space in Reston, VA, Denver, CO, and Menlo Park, CA, 15 of the top 20 mission-critical assets are owned assets in other locations. These owned assets have specialized capabilities and are positioned on the landscape to address specific science issues.

For example, the National Wildlife Health Center (NWHC) in Madison, WI, maintains a high-security infectious disease facility that operates at the Biological Safety Level 3 (BSL-3), and is certified by the Centers for Disease Control and Prevention (CDC) to receive and work with “select” disease agents, and approved by the U.S. Department of Agriculture (USDA) to import, export, and transport domestic animal infectious agents. The NWHC is the only federal institution dedicated to understanding the role of wildlife health in conservation and public health. In the case of wildlife disease emergencies, the NWHC is the lead for Interior under the Department of Homeland Security’s National Response Plan. The 24-acre NWHC tract is surrounded by a 7-foot-high cyclone fence. The entrance to the science center has a high-security-card access gate. Each building has security card readers for entrance and security key pad systems. Twenty-four hour access to restricted areas is limited per CDC Select Agent requirements for BSL-3 laboratories. The Tight Isolation Research Building is further secured by an additional cyclone fence.

Another location is the EROS Data Center (EDC), centrally located in Sioux Falls, SD. When the idea of an EROS Center was conceived, it was decided that it needed to be centrally located for receiving data as Landsat satellites passed over the United States. A location was required where the EDC ground station could see the satellites as they orbited over the east coast, west coast, most of Canada and Mexico, i.e., the center of North America. The central location was a valid requirement 40- plus years ago and is a valid requirement yet today. The EDC’s location eliminates the need for locating a ground station both on the west coast and the east coast to ensure coverage of the conterminous United States—EDC does all that from a single site.

The USGS updated its SFMP in 2012 to refresh its Asset Priority Index process, identify areas of potential cost savings through a benchmark analysis, assess facilities funding sources and processes, and develop implementation plans with the goal of reducing the facilities funding need and improving management processes. The SFMP examined all existing USGS occupied facilities and identified cost saving opportunities for consolidation taking into account the importance of each location to the USGS mission.

The USGS’s Five Year Space Management Plan supports the bureau's SMP and site specific ABPs and provides a framework, strategic vision, and plan of action for effective bureau management of GSA provided space, USGS direct leases, and owned property. It is used by USGS management to implement

bureau space goals, including consolidation, co-location, and disposal. Information contained in the Bureau Asset Management Plan is focused on mission dependency and program requirements for space.

Bureau Systems – The USGS is utilizing the Financial and Business Management System (FBMS) to track the bureau's facilities cost at the asset level. The system allows for improved facility planning and reporting to the Department.

Maintaining America's Heritage – As the steward of priceless natural and cultural treasures, Interior is committed to preserving and maintaining operational facilities and major equipment. The USGS 2014 budget includes an estimated $26.4 million for Maintaining America's Heritage. This includes $7.3 million for DMCI, including facilities projects, equipment maintenance, maintenance management, condition assessment and project planning; and $19.1 million for O&M.

The **Facility Maintenance Management System (FMMS)** is the USGS's implementation of the commercial maintenance management software application Maximo™. The system is used to document maintenance requests and day-to-day maintenance activities, establish preventive maintenance schedules, and develop the Deferred Maintenance and Capital Improvement (DMCI) Five Year Plan. It supports efficient operation and maintenance of USGS facilities by providing accurate maintenance information to local, regional, and national facility managers. It includes a mobile work order component used by maintenance technicians at larger centers to document maintenance activities in the field without requiring a connection to the FMMS database. Use of FMMS supports the USGS' AMP by establishing an inventory and maintenance history on all constructed assets and associated equipment, standardizing maintenance business practices, facilitating maintenance reporting and data analysis, and supporting the budget and the DMCI five- year planning processes.

Activity: Facilities
Subactivity: Rental Payments and Operations and Maintenance

2012 Enacted: $93.1 (55 FTE)
2013 CR: $93.1 (55 FTE)
2014 Request: $97.2 (55 FTE)

Overview

The Rental Payments (RP) and Operations and Maintenance (O&M) Subactivity provides the USGS with funding needed to meet asset management goals and carry out Executive Orders (E.O.) related to Federal space.

The RP cost component provides rental payments for space occupied by the USGS to GSA, other Federal sources, private lessors, and cooperators. The USGS has unique facility requirements for supporting science functions and relies heavily on the GSA to meet those needs, including modern laboratory space. The USGS occupies approximately 4.2 million square feet of rentable space in about 171 GSA buildings nationwide, making the USGS one of the largest users of GSA space within Interior. Approximately 20 percent of USGS space is owned and the remaining 80 percent is provided by the GSA, direct leases, and cooperative and interagency agreements.

The O&M component provides funding for basic facility operations; security costs; facility maintenance in compliance with Federal, State, and local standards; and the provision of 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 asset. This includes preventive maintenance; cyclic maintenance; repairs; rehabilitation; replacement of parts, components, or items of equipment associated with the facility; adjustment, lubrication, and cleaning (non-janitorial) of equipment associated with the facility; periodic inspection; painting; reroofing; and resurfacing. Also included are special safety inspections and other activities to ensure smooth operation and to prevent breakdowns; scheduled equipment servicing (such as that for heating, ventilation, and air conditioning equipment); and maintenance for owned facility-support equipment such as snowplows and landscape-maintenance vehicles.

Operational costs at USGS owned, and some leased, facilities include electricity, water, and sewage; gasoline, propane, natural gas, diesel, and oil; janitorial services; groundskeeping; waste management and disposal; vehicles operated solely in direct support of operating the facility; annual certification for building systems such as fire systems, fire extinguishers, back- flow preventers, and fume hoods; and upkeep standards necessary to assure the anticipated useful life of the vessels, salaries and benefits of marine professionals operating the vessel, fuel, docking fees, inspections, minor repairs, cyclic maintenance, and at least one vessel haul-out per year. In addition to maintenance costs, salary costs associated with onsite staff responsible for the day-to-day operations of the facility and for maintaining it in operating order are included in the subactivity.

Program Performance

In 2012 and 2013, the Cost Savings and Innovation Plan (CSIP) provided the USGS with the ability to reduce its footprint by more than 400,000 rentable square feet (RSF). These efforts came from its three major centers; Reston, VA, Denver, CO, and Menlo Park, CA. Each of these centers were successful in

taking on major consolidation projects, reducing space requirements, actively seeking co-location opportunities and vacating more expensive space. The achieved results were the direct impact of the bureau's CSIP initiative.

At the USGS National Center in Reston, VA, the USGS performs building operations under GSA delegation and has day-to-day control of most space assignments. The USGS supports other agencies at the National Center, including a Department of the Interior computer center and office space occupying 28,000 SF and another Federal tenant, which occupies 73,500 SF of USGS-released space. The current agreements for these spaces will continue through 2014, providing the USGS with a space savings of 101,500 SF. This equates to approximately 10 percent reduction of space the USGS occupies at the National Center. Negotiations are happening between the USGS and the Interior's Business Center to occupy 23,500 SF. In addition, the DOI University is anticipated to move into 10,500 SF in 2014. This would be an additional reduction of 34,000 SF for the USGS and would benefit other Interior bureaus by co-locating. Total savings would then amount to 135,500 SF or 14 percent reduction of space at the National Center.

The Denver Federal Center consolidation efforts included moving out of older GSA-owned buildings into newer and more suitable buildings such as Building 25, Building 95, and Building 810. The endeavor further reduced the USGS space requirement by an additional 191,000 SF.

The Menlo Park Campus consolidation plan returned 38,000 SF back to the GSA by moving out of the entire first floor of Building 3 into existing USGS space on the campus such as Building 2, Building 11, and Building 15.

In 2014, the bureau is anticipating the same level of progress in trying to accomplish the saving targets set by the Interior. With seven projects planned, having an average payback of seven years, the USGS expects an additional reduction of 100,000 RSF. These projects would include further consolidations at the DFC, the proposal for a co-location in Boulder City, NV, and continuing consolidations at the Menlo Park Center. At the Menlo Park Center, plans to install an Intrusion Detection System and an Access Control System would provide the ability to reduce its guard service.

The USGS is dedicated to achieving energy and water use reduction and renewable energy consumption goals, set forth in E.O. 13423, Strengthening Federal Environmental, Energy, and Transportation Management; the Energy Independence and Security Act of 2007 (EISA); and E.O. 13514, Federal Leadership in Environmental, Energy, and Economic Performance, and has implemented an energy management plan to guide programs toward meeting mandated goals. The USGS continues to reduce its energy and water use and is ahead of the energy and water conservation goals set forth by the President.

In 2014, the USGS will make every effort to ensure that when entering lease agreements, provisions that encourage energy and water efficiency will be incorporated. Build-to-suit lease solicitations shall contain criteria encouraging sustainable design and development, energy efficiency, and verification of building performance. In addition, a preference for buildings having the Energy Star building label will be included in the selection criteria for acquiring leased buildings, and leasing companies will be encouraged to apply for the Energy Star building label.

In 2013 the USGS began utilizing the Interior's Financial and Business Management System (FBMS) to track all of its utility costs and consumption. This action was helpful in ensuring the Interior had a consistent methodology for collecting and reporting purposes.

In compliance with the December 2, 2011, Presidential Memorandum, Implementation of Energy Savings Projects and Performance-Based Contracting for Energy Savings, the USGS is developing a multi-million

dollar alternatively financed project to be awarded by December 31, 2013. The project will install energy efficiency upgrades at our largest consuming science centers and will prioritize Energy Conservation Measures (ECMs) with the greatest return on investment, leveraging both direct appropriations and performance contracting, consistent with guidance by the Office of Management and Budget. As the bureau strives to meet and exceed the Executive Orders related to Greenhouse Gas Reductions, this project will reduce energy consumption at our facilities, and help meet the President's December 2, 2011 memorandum stating that the Federal Government will enter into a minimum of $2 billion in performance-based contracts in Federal building efficiency within 24 months.

In 2014, the USGS Facility Energy Program will ensure that all facilities understand the energy and water efficiency mandates and goals, and will provide guidance and assistance, as necessary. The program will promote alternative financing, renewable energy technologies, sustainable design principles in all projects, and training to ensure that field personnel have the tools necessary to meet the energy and water efficiency mandates.

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Activity: Facilities
Subactivity: Deferred Maintenance and Capital Improvements

2012 Enacted: $7.3 million (0 FTE)
2013 CR: $7.3 million (0 FTE)
2014 Request: $7.3 million (0 FTE)

Overview

The USGS has developed a Deferred Maintenance and Capital Improvements (DMCI) Five Year Plan. The plan provides the projects of greatest need in priority order, with focus first on critical health and safety and critical resource protection. The bureau has undertaken an extensive effort to develop this plan in the field, where the urgency of remediation and science program impact are most visible.

The DMCI subactivity funds address the highest priority USGS facility and equipment needs according to departmental guidance. The current funding level addresses approximately nine percent of the facilities deferred maintenance and capital improvements backlog of $63.2 million (as reported in the 2012 FRPP). The condition assessment program includes annual surveys and a cyclic process for comprehensive onsite inspections to document deferred maintenance.

Facilities projects reflect comprehensive evaluations conducted by independent architectural and engineering firms. These installation-wide assessments help establish core data on the condition of USGS constructed assets.

Through the asset management planning process, the USGS can identify real property assets that are candidates for disposition. Any asset that is no longer critical to the mission, in poor condition, or no longer cost effective to maintain is a candidate for possible disposal.

The USGS has stewardship responsibility for unique mission equipment assets such as hazard warning networks, river cableways, and streamgaging stations, all of which require maintenance and capital investments to preserve their functionality. Projects targeting these assets are included under the Equipment Section of the DMCI 5-year plan.

The USGS prioritizes critical DMCI needs according to the Interior's guidelines. Five-year plans are developed and updated on an annual basis using the uniform, departmentwide process. Plans are subject to adjustments in outyears due to funding changes and revised priorities based on comprehensive facility condition assessments, annual condition surveys, and emergency needs. The goal of the five-year planning process is to focus limited resources on projects that are both mission critical and in the most need of repair or replacement. The ranking equation is designed to accommodate many types and sizes of projects, from simple to complex. The Interior worked with the bureaus to develop new criteria and methodology for project prioritization of deferred maintenance projects that places the highest priority on facility buildings based on their Facility Condition Index (FCI) and Asset Priority Index (API) ranking. This emphasizes projects that involve mission critical assets in unacceptable condition with less emphasis on non-mission critical assets.

The new criteria and methodology also takes into account:

- Projects that are clearly aligned with Interior, bureau, office and program missions, initiatives, and strategic goals;
- Projects that clearly define a positive return on investment, leverage outage interest, and reduce operation and maintenance liabilities;
- Projects that increase DOI operation and maintenance liabilities; and
- Projects that have unacceptable risk levels should the project not be completed.

The condition assessment process identifies deferred maintenance needs and determines the current replacement value of constructed assets. Knowing the estimated cost of deferred maintenance and the replacement value of constructed assets allows the USGS to use the industry standard FCI as a method of measuring facility condition and condition changes. It is an indicator of the depleted value of capital assets. Funds are also available through the condition assessment process to identify, report, and track any asbestos, environmental, and disposal liability sites on departmental lands according to guidelines issued by Interior's Office of Environmental Policy and Compliance.

Program Performance

DMCI funds associated with the USGS Streamgaging Network provided the ability to upgrade cable cars to a recent design that ensures the car can safely absorb stresses and protect the employee operating the cable car during the course of performing their work at a station.

The USGS utilizes the Facility Maintenance Management System (FMMS) to develop the bureau's DMCI five-year plan. Proposed DMCI projects are entered in FMMS as deferred maintenance work orders. Selected projects become the basis of the bureau's five-year plan submission. Beginning in 2013, condition assessment results were automatically imported in FMMS, which provided an automated repository of deficiency findings and the actions taken to address them. In some cases these deficiencies became the basis for DMCI projects.

The FMMS is connected to the Department's FBMS through the use of an automated interface that synchronizes real property data between both systems. In addition to other tasks, the interface provides a means to transfer deferred maintenance backlog data calculated in FMMS to FBMS for reporting purposes. In 2014 the USGS will continue to strengthen the data linkage, analysis, and reporting capabilities between asset deficiencies and the work undertaken to correct them.

The USGS continues to use industry standard cost modeling to project the appropriate sustainment level for operations and maintenance funding and to identify voids in critical cyclical and preventive maintenance practices and processes.

In 2012, 15 DMCI projects were completed at a total cost of $2.3 million. Included in these projects were the repairs and improvements provided to the USGS's research vessel, the Grayling. The vessel serves as a base of operations for the USGS on the Great Lakes. Fulfillment of the Grayling's role in achieving the USGS Great Lakes Science Center mission depends on a safe and fully functional vessel for the crew and research scientists working onboard. The Grayling provides the platform for research by investigators in Lake Huron and Lake Michigan including work on hydro acoustics, food web dynamics, and fish community and population dynamics. Another project was the replacement of an energy efficient chiller in the main building at the National Wildlife Health Center. The research performed at the National Wildlife Health Center requires the usage of 100 percent outside air without return. The air standard

requires a tremendous amount of energy to dehumidify and cool the outside air during the summer time. Replacing the inefficient 30 year old chiller will provide a substantial energy savings by improving energy efficiency and reducing greenhouse gas emissions.

2014 Deferred Maintenance and Capital Improvement Plan

The following table lists, in priority order, the proposed projects and equipment to be addressed by DMCI in 2014, within available funding. ($000)

	PROJECT NUMBER/DESCRIPTION
CHEBOYGAN VESSEL BASE $123	1923911 - Replace Roof on Warehouse
NATIONAL WILDLIFE HEALTH CENTER $150	1928486 - Rehabilitate Main Building Laboratory Water Piping for Potable Water Compliance
NORTHERN APPALACHIAN RESEARCH CENTER $40	1919960 - Redevelopment of Well 1
EARTH RESOURCES OBSERVATION AND SCIENCE DATA CENTER $25	1920671 - Install Conference Room and Bathroom Lighting Motion Sensors
GREAT LAKES SCIENCE CENTER $1,950	B201000002G - Renovate North Laboratory Wing
FREDERICKSBURG OBSERVATORY $41	G2010CAF101 - Improve Site Lighting and Security
NATIONAL WILDLIFE HEALTH CENTER $165	1928496 - Replace Main Building Fan Systems
EARTH RESOURCES OBSERVATION AND SCIENCE DATA CENTER $73	1923352 – Install Tower Safety Barrier, Jersey Barriers, Security Barrier for Main Entrance
MARROWSTONE MARINE FIELD STATION $111	B2009MI001 - Replace Perimeter Fencing and Entry Gate
S.O. CONTE ANADROMOUS RESEARCH CENTER $52	1907376 - Replace and Upgrade Building Automation System
EARTH RESOURCES OBSERVATION AND SCIENCE DATA CENTER $142	1923355 - Remove and Replace 6 Vintage Distribution and 1 Vintage Tie Switch Gears with New in the Mundt Federal Building
S.O. CONTE ANADROMOUS RESEARCH CENTER $229	1919937 - Replace and Upgrade Overhead Crane Access Doors and Actuators
EARTH RESOURCES OBSERVATION AND SCIENCE DATA CENTER $41	13EROSDM006 - Install Sprinkler System in Digital Archive and Replace Sprinkler Valves
PATUXENT WILDLIFE RESEARCH CENTER $605	B20010005PW - Repair Heating Ventilation and Air Condition (HVAC) in Gabrielson Building. Partial Funding in FY 2014. Final to be Funded in FY 2015
COST SAVINGS AND INNOVATION PLAN (CSIP) $2,225	Denver Federal Center and Menlo Park Campus Consolidation

2014 Equipment Projects

PROJECT NAME/PROJECT AMOUNT	PROJECT DESCRIPTION
113 Sites Nationwide $240	Repair or Replace Cablecars (W1998A10000): 600 Cablecars are Active and in Use Nationwide
Northern California Seismic Network $200	Replace Network Analog and Microwave Stations (G987160001): Replace Earthquake Network Stations Providing Seismic Monitoring and Warning for Large Metropolitan Areas.
Condition Assessments (CA) $210	Condition Assessments/Engineering Support: Complete CA's for the Identification of Maintenance and Capital Improvement Needs, Provide Engineering Services Support for Funded Projects, and Conduct Surveys to Determine Asbestos-Related Cleanup, Environmental and Disposal Cost.
Maintenance Management System (MMS) $350	Maintenance Management System (MMS): Implement and Maintain a Maintenance Management System that Meets Bureau Reporting and Oversight Requirements.
Program and Project Management Support $308	Project Planning: Contract Architectural, Engineering, Management and Design Services for Complex Projects, Particularly for Developing Project Requirements and Cost Estimates.

Working Capital Fund Overview

The U.S. Geological Survey (USGS) Working Capital Fund (WCF) was established to allow for the efficient financial management of the components listed below. The WCF was made available for expenses necessary for furnishing materials, supplies, equipment, work, and services in support of USGS programs, and as authorized by law (authorization information begins on page 3 of this section), to agencies of the Federal Government and others. The WCF consists of four components:

1. The WCF **Investment** Component provides a mechanism to assist USGS managers in planning for and acquiring goods and services that are too costly to acquire in a single fiscal year or that, due to the nature of services provided must operate in a multi- as opposed to a single-year basis of funding. Investments are supported by documented investment plans that include estimated acquisition/replacement costs, a schedule of deposits, and approval of the plans, deposits and expenditures by designated USGS officials.
   - **Telecommunications Investments** are used for telecommunication hardware, software, facilities, and services. Examples include replacement or expansion of automatic exchange systems and computerized network equipment such as switches, routers, and monitoring systems.
   - **Equipment Investments** are used for the acquisition, replacement, and expansion of equipment for USGS programs. Equipment may include, but is not limited to, hydrologic, geologic, and cartographic instruments, laboratory equipment, and computer hardware and software.
   - **Facilities Investments** support facility and space management investment expenses for USGS real property, including owned and leased space. Authorized investment expenses include nonrecurring and emergency repair, relocation of a facility, and facility modernization. The component does not include annual expenses such as rent, day-to-day operating expenses, recurring maintenance, or utilities.
   - **Publications Investments** are used for the preparation and production of technical publications reporting on the results of scientific data and research. Research projects typically are three to five years in duration, and planning the medium in which to report results occurs over the life of the project. The Publications Investment Component provides a mechanism for establishing an efficient, effective, and economical means of funding publications costs over the duration of the research.

2. The WCF **Fee-for-Service** Component provides a continuous cycle of client services for fees established in a rate-setting process and, in some cases, with funding provided by appropriated funds. Fees are predicated upon both direct and indirect costs associated with providing the services, including amortization of equipment required to provide the services.
   - **The National Water Quality Laboratory (NWQL)** conducts chemical and biological analyses of water, sediments, and aquatic tissue for all USGS science centers and other customers, including other USGS mission areas, other Interior Bureaus, and non-USGS customers. The NWQL also does biological classification for these customers. NWQL analysis services are provided on a reimbursable basis, with the price of services calculated to cover direct and indirect costs.
   - **The USGS Hydrologic Instrumentation Facility (HIF)** provides hydrologic instrumentation on a fee-for-service basis. The facility provides its customers with hydrologic instruments that

can be rented or purchased, maintains a technical expertise on instrumentation, and tests and evaluates new technologies as they become available in the marketplace.

- **Bureau Laboratories –** There are currently three laboratories within the Water Resources Mission Area that perform gaseous dissolved chlorofluorocarbon measurements, environmental microbiology analyses and isotope-ratio measurements of water, sediments, rocks, and gases for all USGS mission areas, and for USGS customers.
- **The National Training Center** conducts USGS training programs. Examples include specialized training for USGS employees, cooperators, and international participants in many facets of earth science, as well as computer applications, management and leadership seminars, and various workshops.
- **Drilling –** There are currently two drilling units, based in Lakewood, CO, and Henderson, NV. The drilling units provide drilling services to conduct exploratory drilling for obtaining geologic samples and cores in difficult hydrogeologic environments and the emplacement of sampling devices and sub-surface sensors for hydrologic investigations.

3. The GSA **Buildings Delegation** Component is used to manage funds received under the delegated authority for the J.W. Powell Building and Advanced Systems Center in Reston, VA, as provided by 40 U.S.C. 121 (d) and (e) (formerly subsections 205 (d) and (e) of the Federal Property and Administrative Services Act of 1949, as amended, and 40 U.S.C. 486 (d) and (e), respectively). Delegated functions include building operations, maintenance, cleaning, overseeing fire and life safety, maintaining high voltage switchgear and fire alarms, recurring repairs, minor alterations, historic preservation, concessions, and energy management. Because of the size of the Reston buildings and the need to expend the facility funds in a manner corresponding to GSA's no-year funding (Federal Buildings Fund) mechanisms and the GSA National Capital Region long-range capital improvement plan, no-year funding is a prerequisite to administering the delegation. Public Law 104–208, Section 611, provides that, for the fiscal year ending September 30, 1997, and thereafter, any department or agency that has delegated authority shall retain that portion of the GSA rental payment available for operation, maintenance, and repair of the building and the funds shall remain available until expended. This WCF component was established in 2004 to provide USGS with this no-year flexibility.

4. The **Enterprise Services** Component operates in a businesslike manner, recovering fees for various consolidated services provided to USGS mission areas and other Federal agencies. By leveraging these services through a unified effort, USGS achieves cost and business efficiencies that would otherwise be lost.

The Science Publishing Network (SPN) operates within the Enterprise Services Component of the WCF. The SPN provides high quality publishing support for science information products while improving its operational effectiveness and efficiencies. The SPN offers a wide range of publishing services to authors of USGS information products and others. Services include consultation, technical editing, illustrating, layout and design, Web services, printing management and distribution, electronic publishing as well as other publishing needs.

Appropriation Language and Citations

Permanent authority:

1. Provided further, That, in fiscal year 1986, and thereafter, all amortization fees resulting from the Geological Survey providing telecommunications services shall be deposited in a special fund to be established on the books of the Treasury and be immediately available for payment of replacement or expansion of telecommunications services, to remain available until expended.

   - **43 U.S.C.50a** established the Telecommunications Amortization Fund, which was displayed as part of the Surveys, Investigations and Research appropriation from 1986 through 1990. Beginning in 1991, the Telecommunications Amortization Fund was merged into the WCF described in the next citation.

2. There is hereby established in the Treasury of the United States a working capital fund to assist in the management of certain support activities of the United States Geological Survey (hereafter referred to as the "Survey"), Department of the Interior. The fund shall be available on and after November 5, 1990, without fiscal year limitation for expenses necessary for furnishing materials, supplies, equipment, work, facilities, and services in support of Survey programs, and, as authorized by law, to agencies of the Federal Government and others. Such expenses may include laboratory modernization and equipment replacement, computer operations, maintenance, and telecommunications services; requirements definition, systems analysis, and design services; acquisition or development of software; systems support services such as implementation assistance, training, and maintenance; acquisition and replacement of computer, publications and scientific instrumentation, telecommunications, and related automatic data processing equipment; and, such other activities as may be approved by the Secretary of the Interior.

   There are authorized to be transferred to the fund, at fair and reasonable values at the time of transfer, inventories, equipment, receivables, and other assets, less liabilities, related to the functions to be financed by the fund as determined by the Secretary of the Interior. Provided, That the fund shall be credited with appropriations and other funds of the Survey, and other agencies of the Department of the Interior, other Federal agencies, and other sources, for providing materials, supplies, equipment, work, and other services as authorized by law and such payments may be made in advance or upon performance: Provided further, That charges to users will be at rates approximately equal to the costs of furnishing the materials, supplies, equipment, facilities, and services, including such items as depreciation of equipment and facilities, and accrued annual leave: Provided further, That all existing balances as of November 5, 1990, from amortization fees resulting from the Survey providing telecommunications services and deposited in a special fund established on the books of the Treasury and available for payment of replacement or expansion of telecommunications services as authorized by Public Law 99-190, are hereby transferred to and merged with the working capital fund, to be used for the same purposes as originally authorized. Provided further, That funds that are not necessary to carry out the activities to be financed by the fund, as determined by the Secretary, shall be covered into miscellaneous receipts of the Treasury.

   P.L. 101-512 Department of the Interior and Related Agencies Appropriations Act, 1991 This authority established a Working Capital Fund account in 1991. The Telecommunications Amortization Fund was included as part of the WCF and all balances of the Telecommunications Amortization Fund existing at the end of 1990 were transferred to the WCF. These balances were to be used for the same purposes as originally authorized.

P.L. 103-332 Department of the Interior and Related Agencies Appropriations Act, 1995 The amendments that were made in this appropriations act are shown in underline in the second citation shown above. This authority expanded the use of the Working Capital Fund to partially fund laboratory operations and facilities improvements and to acquire and replace publication and scientific instrumentation and laboratory equipment.

United States Geological Survey

Federal Funds

General and special funds:

WORKING CAPITAL FUND

Program and Financing

(In millions of dollars)

Identification Code 14-4556-0-4-306		2012 Actual	2013 CR	2014 Budget Request
	Obligations by program activity:			
08.01	Working Capital Fund	89	106	86
	Budgetary resources:			
	Unobligated balance:			
10.00	Unobligated balance carried forward, start of year	83	79	71
10.21	Recoveries of prior year unpaid obligations	2		
10.50	Unobligated balance total	85	79	71
	Budget Authority:			
	Spending Authority from offsetting collections, disc			
17.00	Collected	83	98	79
19.30	Total budgetary resources available	168	177	150
	Memorandum (non-add) entries:			
19.41	Unexpired unobligated balance, end of year	79	71	64
	Change in obligated balances:			
	Obligated balance, start of year:			
30.00	Unpaid obligations, brought forward, Oct 1	37	29	63
30.10	Obligations incurred, unexpired accounts	89	106	86
30.20	Outlays, Gross	-95	-72	-71
30.40	Recoveries of prior year obligations	-2	0	0
	Obligated balance, end of year:			
30.50	Unpaid Obligations, end of year (gross)	29	63	78
	Budget authority and outlays, net:			
	Discretionary			
40.00	Budget authority, gross	83	98	79
	Outlays, gross:			
40.10	Outlays from new discretionary authority	48	44	36
40.11	Outlays from discretionary balances	47	28	35
40.20	Outlays, gross	95	72	71
	Offsets against gross budget authority and outlays:			
	Offsetting collections (collected) from:			
40.30	Federal Sources	-83	-98	-79
40.70	Budget authority, net (discretionary)			
40.80	Outlays, net (discretionary)	12	-26	-8
41.80	Budget authority, net (total)			
41.90	Outlays, net (total)	12	-26	-8

WORKING CAPITAL FUND

Balance Sheet

(In millions of dollars)

Identification Code 14-4556-0-4-306		2011 Actual	2012 Actual
	ASSETS:		
	Federal assets:		
1101	Fund balances with Treasury	119	108
	Investments in U.S. securities:		
1106	Receivables, net		
1803	Other Federal assets: Property, plant and equipment, net	26	26
1999	Total assets	145	134
	LIABILITIES:		
2101	Federal liabilities: Accounts payable		
2201	Non-Federal liabilities: Accounts payable	8	5
2999	Total liabilities	8	5
	NET POSITION:		
3300	Cumulative results of operations	137	129
3999	Total net position	137	129
4999	Total liabilities and net position	145	134

WORKING CAPITAL FUND

Object Classification

(In millions of dollars)

Identification Code 14-4556-0-4-306		2012 Actual	2013 CR	2014 Budget Request
	Reimbursable obligations:			
	Personnel compensation:			
11.1	Full-time permanent	18	18	18
11.3	Other than full-time permanent	1	1	1
11.5	Other personnel compensation	1	1	1
11.9	Total personnel compensation	20	20	20
12.1	Civilian personnel benefits	6	6	6
21.0	Travel and transportation of persons	1	1	1
23.1	Rental payments to GSA	2	2	2
23.3	Communications, utilities, and miscellaneous charges	1	2	1
24.0	Printing and reproduction	0	1	1
25.1	Advisory and Assistance Services	1	1	1
25.2	Other services	11	16	10
25.3	Other purchases of goods and services from Government Accounts	6	7	6
25.4	Operation and maintenance of facilities	4	5	4
25.7	Operation and maintenance of equipment	4	3	3
26.0	Supplies and materials	5	5	5
31.0	Equipment	27	31	25
32.0	Land and structures	1	6	1
99.9	Total new obligations	89	106	86

WORKING CAPITAL FUND

Employment Summary

Identification Code 14-4556-0-4-306		2012 Actual	2013 CR	2014 Budget Request
	Reimbursable:			
2001	Civilian full-time equivalent employment	244	244	244

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SURVEYS, INVESTIGATIONS, AND RESEARCH

Summary of Requirements by Object Class

(Millions of Dollars)

Appropriation: Surveys, Investigations, and Research				Fixed Costs & Related Changes		Program Changes		2014 Request	
Object Class		FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount
11.1	Full-time permanent		435		4		5		444
11.3	Other than full-time permanent		43		0		1		44
11.5	Other personnel compensation		7		0		0		7
	Total personnel compensation	5,439	485	0	4	92	6	5,531	495
12.1	Civilian personnel benefits		140		2		1		143
21.0	Travel and transportation of persons		23		0		4		27
22.0	Transportation of things		5		0		1		6
23.1	Rental payment to GSA		61		-2		0		59
23.2	Rental payments to others		4		0		0		4
23.3	Comm., utilities and misc. charges		15		0		0		15
24.0	Printing and reproduction		1		0		0		1
25.1	Advisory and assistance services		13		0		0		13
25.2	Other services from non-Fed sources		89		0		36		125
25.3	Other goods and services from Fed sources		76		0		0		76
25.4	Operation and maintenance of facilities		14		0		0		14
25.7	Operation and maintenance of equipment		16		0		0		16
26.0	Supplies and materials		18		0		4		22
31.0	Equipment		33		0		32		65
32.0	Land and structures		1		0		0		1
41.0	Grants, subsidies, and contributions		81		0		4		85
	Total requirements		**1,075**		**4**		**88**		**1,167**

This information is displayed in budget authority (not obligations) by object class.

SURVEYS, INVESTIGATIONS, AND RESEARCH

Summary of Requirements by Object Class

(Millions of Dollars)

Appropriation: Surveys, Investigations, and Research		**2013 CR**		**2014 Request**		**Increase or Decrease**	
Reimbursable Obligations		**FTE**	**Amount**	**FTE**	**Amount**	**FTE**	**Amount**
	Personnel compensation						
11.1	Full-time permanent		160		160		0
11.3	Other than full-time permanent		30		30		0
11.5	Other personnel compensation		5		5		0
	Total personnel compensation	2,838	195	2,838	195	0	0
12.1	Civilian personnel benefits		57		57		0
21.0	Travel and transportation of persons		12		12		0
22.0	Transportation of things		4		4		0
23.1	Rental payments to GSA		20		20		0
23.2	Rental payments to others		1		1		0
23.3	Communications, utilities and miscellaneous Charges		6		6		0
25.1	Advisory and assistance services		3		3		0
25.2	Other services		60		60		0
25.3	Other purchases of goods and services from Government accounts		30		30		0
25.4	Operation and maintenance of facilities		4		4		0
25.7	Operation and maintenance of equipment		10		10		0
26.0	Supplies and materials		11		11		0
31.0	Equipment		18		18		0
41.0	Grants, subsidies, and contributions		29		29		0
	Total requirements		**460**		**460**		**0**

United States Geological Survey

Federal Funds

General and special funds:

SURVEYS, INVESTIGATIONS, AND RESEARCH

Program and Financing

(Millions of Dollars)

Identification Code 14-0804-0-1-306		2012 Actual	2013 CR	2014 Estimate
	Obligations by program activity:			
00.01	Ecosystems	166	161	180
00.02	Climate and Land Use Change	141	142	156
00.03	Energy, Minerals, and Environmental Health	99	99	107
00.04	Natural Hazards	135	133	142
00.05	Water Resources	216	217	223
00.06	Core Science Systems	117	115	136
00.07	Administration and Enterprise Information	112	125	116
00.08	Facilities	104	102	104
07.99	Total direct obligations	1,090	1,094	1,164
08.01	Reimbursable program	448	448	448
08.02	Reimbursable program – EPA Great Lakes	12	12	12
08.99	Total reimbursable obligations	460	460	460
09.00	Total new obligations	1,550	1,554	1,624
	Budgetary resources:			
	Unobligated balance:			
10.00	Unobligated balance brought forward, Oct 1	393	405	386
10.11	Unobligated balance transfer from other accts {72-0306}	1	0	0
10.21	Recoveries of prior year unpaid obligations	15	0	0
10.50	Unobligated balance (total)	409	405	386
	Budget authority:			
	Appropriations, discretionary:			
11.00	Appropriation	1,070	1,075	1,167
11.30	Appropriations permanently reduced	-2	0	0
11.60	Appropriation, discretionary (total)	1,068	1,075	1,167
	Spending authority from offsetting collections, discretionary:			
17.00	Collected	441	460	460
17.01	Change in uncollected payments, Federal sources	38	0	0
17.50	Spending auth from offsetting collections, disc (total)	479	460	460
19.00	Budget authority (total)	1,547	1,535	1,627
19.30	Total budgetary resources available	1,956	1,940	2,013

SURVEYS, INVESTIGATIONS, AND RESEARCH

Program and Financing cont'd

(Millions of Dollars)

Identification Code 14-0804-0-1-306		2012 Actual	2013 CR	2014 Estimate
	Memorandum (non-add) entries:			
19.40	Unobligated balance expiring	-1	0	0
19.41	Unexpired unobligated balance, end of year	405	386	389
	Change in obligated balance:			
	Unpaid obligations:			
30.00	Unpaid obligations, brought forward, Oct 1	384	368	308
30.10	Obligations incurred, unexpired accounts	1,550	1,554	1,624
30.11	Obligations incurred, expired accounts	4	0	0
30.20	Outlays (gross)	-1,548	-1,614	-1,657
30.40	Recoveries of prior year unpaid obligations, unexpired	-15	0	0
30.41	Recoveries of prior year unpaid obligations, expired	-7	0	0
30.50	Unpaid obligations, end of year	368	308	275
	Uncollected payments:			
30.60	Uncollected payments, Fed sources, brought forward, Oct 1	-475	-480	-480
30.70	Change in uncollected payments, Fed sources, unexpired	-38	0	0
30.71	Change in uncollected payments, Fed sources, expired	33	0	0
30.90	Uncollected payments, Fed sources, end of year	-480	-480	-480
	Memorandum (non-add) entries:			
31.00	Obligated balance, start of year	-91	-112	-172
32.00	Obligated balance, end of year	-112	-172	-205
	Budget authority and outlays, net:			
	Discretionary:			
40.00	Budget authority, gross	1,547	1,535	1,627
	Outlays, gross:			
40.10	Outlays from new discretionary authority	898	1,351	1,432
40.11	Outlays from discretionary balances	650	263	225
40.20	Outlays, gross (total)	1,548	1,614	1,657
	Offsets against gross budget authority and outlays:			
	Offsetting collections (collected) from:			
40.30	Federal sources	-269	-262	-262
40.33	Non-Federal sources	-205	-198	-198
40.40	Offsets against gross budget authority and outlays (total)	-474	-460	-460

SURVEYS, INVESTIGATIONS, AND RESEARCH

Program and Financing cont'd

(Millions of Dollars)

Identification Code 14-0804-0-1-306		2012 Actual	2013 CR	2014 Estimate
	Additional offsets against gross budget authority only:			
40.50	Change in uncollected payments, Fed sources, unexpired	-38	0	0
40.52	Offsetting collections credited to expired accounts	33	0	0
40.60	Additional offsets against budget authority only (total)	-5	0	0
40.70	Budget authority, net (discretionary)	1,068	1,075	1,167
40.80	Outlays, net (discretionary)	1,074	1,154	1,197
41.80	Budget authority, net (total)	1,068	1,075	1,167
41.90	Outlays, net (total)	1,074	1,154	1,197

SURVEYS, INVESTIGATIONS, AND RESEARCH

Object Classification

(Millions of Dollars)

Identification Code 14-0804-0-1-306		2012 Actual	2013 CR	2014 Estimate
	Direct obligations:			
	Personnel compensation:			
11.1	Full-time permanent	431	435	444
11.3	Other than full-time permanent	43	43	44
11.5	Other personnel compensation	7	7	7
11.9	Total personnel compensation	481	485	495
12.1	Civilian personnel benefits	138	140	143
13.0	Benefits for former personnel	1	0	0
21.0	Travel and transportation of persons	23	23	27
22.0	Transportation of things	5	5	6
23.1	Rental payments to GSA	60	61	59
23.2	Rental payment to others	4	4	4
23.3	Comm., utilities, and miscellaneous charges	15	15	15
24.0	Printing and reproduction	1	1	1
25.1	Advisory and assistance services	18	13	13
25.2	Other services from non-Fed sources	101	108	122
25.3	Other goods and services from Fed sources	76	76	76
25.4	Operation and maintenance of facilities	14	14	14
25.7	Operation and maintenance of equipment	16	16	16
26.0	Supplies and materials	22	18	22
31.0	Equipment	33	33	65
32.0	Land and structures	1	1	1
41.0	Grants, subsidies, and contributions	81	81	85
99.0	Direct obligations	1,090	1,094	1,164

SURVEYS, INVESTIGATIONS, AND RESEARCH

Object Classification cont'd

(Millions of Dollars)

Identification Code 14-0804-0-1-306		2012 Actual	2013 CR	2014 Estimate
	Reimbursable obligations:			
	Personnel compensation:			
11.1	Full-time permanent	160	160	160
11.3	Other than full-time permanent	30	30	30
11.5	Other personnel compensation	5	5	5
11.9	Total personnel compensation	195	195	195
12.1	Civilian personnel benefits	57	57	57
21.0	Travel and transportation of persons	12	12	12
22.0	Transportation of things	4	4	4
23.1	Rental payments to GSA	20	20	20
23.2	Rental payments to others	1	1	1
23.3	Comm., utilities, and miscellaneous charges	6	6	6
25.1	Advisory and assistance services	4	3	3
25.2	Other services from non-Fed sources	57	60	60
25.3	Other goods and services from Fed sources	30	30	30
25.4	Operation and maintenance of facilities	4	4	4
25.7	Operation and maintenance of equipment	10	10	10
26.0	Supplies and materials	13	11	11
31.0	Equipment	18	18	18
41.0	Grants, subsidies, and contributions	29	29	29
99.0	Reimbursable obligations	460	460	460
99.9	Total new obligations	1,550	1,554	1,624

SURVEYS, INVESTIGATIONS, AND RESEARCH

Employment Summary

Identification Code 14-0804-0-1-306		2012 Actual	2013 CR	2014 Estimate
	Direct:			
1001	Civilian full-time equivalent employment	5,431	5,439	5,531
	Reimbursable:			
2001	Civilian full-time equivalent employment	2,838	2,838	2,838
	Allocation account:			
3001	Civilian full-time equivalent employment	27	27	27

Funding of U.S. Geological Survey Programs (Obligations)

(Thousands of Dollars)

	2012 Actual	2013 CR	2014 Estimate
Surveys, Investigations, and Research (SIR)			
Ecosystems			
Appropriated			
Multi-Year appropriation	165,584	160,757	180,172
No-Year appropriation	1	0	0
Total (appropriated)	**165,585**	**160,757**	**180,172**
Reimbursements			
Non-Federal (Domestic) sources			
Technology Transfer	1,691	1,691	1,691
Miscellaneous	6,799	6,799	6,799
Subtotal (non-Federal domestic sources)	8,490	8,490	8,490
Non-Federal (Foreign) sources			
Miscellaneous	21	21	21
Subtotal (non-Federal Foreign sources)	21	21	21
State and local sources			
States-Coop (matched - In-Kind Services) NON ADD	1,061	1,061	1,061
States-Coop (unmatched)	1,763	1,763	1,763
Subtotal (state and local sources)	1,763	1,763	1,763
Federal sources			
Department of Agriculture	2,103	2,103	2,103
Department of Commerce			
Nat'l Oceanic & Atmospheric Admin	276	276	276
Department of Defense			
Corps of Engineers	19,590	19,590	19,590
Other	3,473	3,473	3,473
Department of Energy			
Bonneville Power Administration	2,739	2,739	2,739
Other	351	351	351
Department of Interior			
Bureau of Land Management	4,562	4,562	4,562
Bureau of Ocean Energy Management	1,265	1,265	1,265
Bureau of Reclamation	10,210	10,210	10,210
Fish and Wildlife Service	8,392	8,392	8,392
National Park Service	2,188	2,188	2,188
Office of Secretary			
National Business Center	1,272	1,272	1,272
Office of Surface Mining	100	100	100
Department of State	673	673	673
Department of Transportation	271	271	271
Environmental Protection Agency	412	412	412
Health and Human Services	302	302	302
National Aeronautics & Space Admin	336	336	336
Subtotal (Federal sources)	58,515	58,515	58,515
Total (reimbursements)	**68,789**	**68,789**	**68,789**
Total: Ecosystems	**234,374**	**229,546**	**248,961**

	2012 Actual	2013 CR	2014 Estimate
Surveys, Investigations, and Research (SIR)			
Climate and Land Use Change			
Appropriated			
Multi-Year appropriation	93,686	91,673	102,277
No-Year appropriation	47,464	50,439	53,337
Total (appropriated)	**141,150**	**142,112**	**155,614**
Reimbursements			
Non-Federal (Domestic) sources			
Technology Transfer	15	15	15
Miscellaneous	372	372	372
Subtotal (non-Federal domestic sources)	387	387	387
Non-Federal (Foreign) sources			
Corporacion Andina de Fomento	395	395	395
Miscellaneous	74	74	74
Subtotal (non-Federal Foreign sources)	469	469	469
State and local sources			
States-Coop (matched - In-Kind Services) NON ADD	60	60	60
Subtotal (state and local sources)	0	0	0
Federal sources			
Agency for International Development	4,058	4,058	4,058
Central Intelligence Agency	806	806	806
Department of Agriculture	739	739	739
Department of Commerce			
Nat'l Oceanic & Atmospheric Admin	258	258	258
Department of Defense			
Corps of Engineers	603	603	603
National Geospatial-Intelligence Agency	21	21	21
Other	1,036	1,036	1,036
Department of Energy	20	20	20
Department of Homeland Security			
Federal Emergency Management Agency	80	80	80
Department of Interior			
Bureau of Indian Affairs	199	199	199
Bureau of Land Management	39	39	39
Bureau of Reclamation	263	263	263
Fish and Wildlife Service	465	465	465
National Park Service	619	619	619
Office of Secretary			
National Business Center	2,350	2,350	2,350
Department of State	533	533	533
Environmental Protection Agency	1,077	1,077	1,077
Federal Aviation Administration	5	5	5
Health and Human Services	129	129	129
National Aeronautics & Space Admin	8,729	8,729	8,729
National Science Foundation	172	172	172
Sale of maps, photos, reproductions, & digital products	612	612	612
Subtotal (Federal sources)	22,813	22,813	22,813
Total (reimbursements)	**23,669**	**23,669**	**23,669**
Total: Climate and Land Use Change	**164,819**	**165,781**	**179,283**

	2012 Actual	2013 CR	2014 Estimate
Surveys, Investigations, and Research (SIR)			
Energy, Minerals, and Environmental Health			
Appropriated			
Multi-Year appropriation	98,125	98,802	107,144
No-Year appropriation	891	578	0
Total (appropriated)	**99,016**	**99,380**	**107,144**
Reimbursements			
Non-Federal (Domestic) sources			
Technology Transfer	778	778	778
Miscellaneous	606	606	606
Subtotal (non-Federal domestic sources)	1,384	1,384	1,384
Non-Federal (Foreign) sources			
Islamic Republic of Mauritania	641	641	641
Miscellaneous	386	386	386
Subtotal (non-Federal Foreign sources)	1,027	1,027	1,027
State and local sources			
States-Coop (unmatched)	61	61	61
Subtotal (state and local sources)	61	61	61
Federal sources			
Department of Agriculture	173	173	173
Department of Commerce			
Nat'l Oceanic & Atmospheric Admin	100	100	100
Other	60	60	60
Department of Defense			
Corps of Engineers	728	728	728
National Geospatial-Intelligence Agency	151	151	151
Other	7,292	7,292	7,292
Department of Energy	169	169	169
Department of Interior			
Bureau of Land Management	1,533	1,533	1,533
Bureau of Reclamation	118	118	118
Fish and Wildlife Service	1,400	1,400	1,400
National Park Service	89	89	89
Office of Secretary			
National Business Center	267	267	267
Department of Justice	35	35	35
Department of State	336	336	336
Environmental Protection Agency	1,119	1,119	1,119
National Aeronautics & Space Admin	281	281	281
National Science Foundation	4	4	4
Subtotal (Federal sources)	13,855	13,855	13,855
Total (reimbursements)	**16,327**	**16,327**	**16,327**
Total: Energy, Minerals, and Environmental Health *	**115,343**	**115,707**	**123,471**

* This table does not include obligations from the unobligated balance transfer from USAID, which is included in MAX. The amount for FY 2012 is $430K.

	2012 Actual	2013 CR	2014 Estimate
Surveys, Investigations, and Research (SIR)			
Natural Hazards			
Appropriated			
Multi-Year appropriation	134,281	132,230	142,216
Total (appropriated)	**134,281**	**132,230**	**142,216**
Reimbursements			
Non-Federal (Domestic) sources			
Technology Transfer	1,156	1,156	1,156
Miscellaneous	2,259	2,259	2,259
Subtotal (non-Federal domestic sources)	3,415	3,415	3,415
Non-Federal (Foreign) sources			
Miscellaneous	152	152	152
Subtotal (non-Federal Foreign sources)	152	152	152
State and local sources			
States-Coop (matched - In-Kind Services) NON ADD	423	423	423
States-Coop (unmatched)	909	909	909
Subtotal (state and local sources)	909	909	909
Federal sources			
Agency for International Development	2,828	2,828	2,828
Department of Agriculture	49	49	49
Department of Commerce			
Nat'l Oceanic & Atmospheric Admin	105	105	105
Department of Defense			
Corps of Engineers	679	679	679
Other	1,829	1,829	1,829
Department of Energy	1,699	1,699	1,699
Department of Interior			
Bureau of Land Management	497	497	497
Bureau of Ocean Energy Management	142	142	142
Bureau of Reclamation	66	66	66
Fish and Wildlife Service	127	127	127
National Park Service	213	213	213
Department of State	270	270	270
Department of Transportation	13	13	13
Department of Veterans Affairs	1,594	1,594	1,594
Environmental Protection Agency	289	289	289
General Services Administration	9	9	9
National Aeronautics & Space Admin	8,824	8,824	8,824
National Science Foundation	49	49	49
Nuclear Regulatory Commission	1,130	1,130	1,130
Subtotal (Federal sources)	20,412	20,412	20,412
Total (reimbursements)	**24,888**	**24,888**	**24,888**
Total: Natural Hazards *	**159,169**	**157,118**	**167,104**

* This table does not include obligations for the Spectrum Relocation Fund, since it is a mandatory fund. MAX obligations do include the Spectrum Relocation Fund. The amounts included in MAX are: FY 2012 $1K; and FY 2013 $966K. This table also does not include obligations from the unobligated balance transfer from USAID, which is included in MAX. The amount for FY 2012 is $151K.

	2012 Actual	2013 CR	2014 Estimate
Surveys, Investigations, and Research (SIR)			
Water Resources			
Appropriated			
Multi-Year appropriation	216,255	216,800	222,533
No-Year appropriation	22	0	0
Total (appropriated)	**216,277**	**216,800**	**222,533**
Reimbursements			
Non-Federal (Domestic) sources			
Permittees & licensees- Fed Energy Regulatory Commission	5,531	5,531	5,531
Technology Transfer	1,333	1,333	1,333
Miscellaneous	4,598	4,598	4,598
Subtotal (non-Federal domestic sources)	11,462	11,462	11,462
Non-Federal (Foreign) sources			
National Drilling Company	755	755	755
Miscellaneous	263	263	263
Subtotal (non-Federal Foreign sources)	1,018	1,018	1,018
State and local sources			
States-Coop (matched)	62,632	62,632	63,014
States-Coop (matched - In-Kind Services) NON ADD	1,190	1,190	1,190
States-Coop (unmatched)	94,710	94,710	94,328
Subtotal (state and local sources)	157,342	157,342	157,342
Federal sources			
Department of Agriculture	1,428	1,428	1,428
Department of Commerce			
Nat'l Oceanic & Atmospheric Admin	122	122	122
Department of Defense			
Corps of Engineers	36,488	36,488	36,488
National Geospatial-Intelligence Agency	652	652	652
Other	11,477	11,477	11,477
Department of Energy			
Bonneville Power Administration	750	750	750
Other	6,938	6,938	6,938
Department of Homeland Security			
Federal Emergency Management Agency	5,018	5,018	5,018
Other	1,096	1,096	1,096
Department of Interior			
Bureau of Indian Affairs	358	358	358
Bureau of Land Management	4,169	4,169	4,169
Bureau of Reclamation	17,705	17,705	17,705
Fish and Wildlife Service	2,088	2,088	2,088
National Park Service	2,571	2,571	2,571
Office of Secretary			
National Business Center	20	20	20
Office of Surface Mining	58	58	58
Department of State	2,151	2,151	2,151
Department of Transportation	238	238	238
Environmental Protection Agency			
Great Lakes Initiative - Restoration Program	12,432	12,432	12,432
Other	8,921	8,921	8,921
Health and Human Services	306	306	306
National Aeronautics & Space Admin	359	359	359
National Science Foundation	102	102	102
Nuclear Regulatory Commission	70	70	70
Tennessee Valley Authority	481	481	481
Miscellaneous	54	54	54
Subtotal (Federal sources)	116,052	116,052	116,052
Total (reimbursements)	**285,874**	**285,874**	**285,874**
Total: Water Resources	**502,151**	**502,674**	**508,407**

	2012 Actual	2013 CR	2014 Estimate
Surveys, Investigations, and Research (SIR)			
Core Science Systems			
Appropriated			
Multi-Year appropriation	116,914	115,171	136,508
Total (appropriated)	**116,914**	**115,171**	**136,508**
Reimbursements			
Non-Federal (Domestic) sources			
Technology Transfer	52	52	52
Miscellaneous	547	547	547
Subtotal (non-Federal domestic sources)	599	599	599
State and local sources			
States-Coop (unmatched)	7,391	7,391	7,391
Subtotal (state and local sources)	7,391	7,391	7,391
Federal sources			
Department of Agriculture	1,411	1,411	1,411
Department of Commerce			
Nat'l Oceanic & Atmospheric Admin	81	81	81
Other	162	162	162
Department of Defense			
Corps of Engineers	533	533	533
National Geospatial-Intelligence Agency	4,960	4,960	4,960
Other	1,272	1,272	1,272
Department of Education	15	15	15
Department of Energy	42	42	42
Department of Homeland Security			
Federal Emergency Management Agency	5,339	5,339	5,339
Department of Interior			
Bureau of Indian Affairs	299	299	299
Bureau of Ocean Energy Management	34	34	34
Bureau of Reclamation	784	784	784
Fish and Wildlife Service	1,053	1,053	1,053
National Park Service	1,385	1,385	1,385
Office of Secretary			
National Business Center	299	299	299
Other	15	15	15
Office of Surface Mining	117	117	117
Department of Justice	62	62	62
Department of State	35	35	35
Department of Transportation	62	62	62
Department of Treasury	15	15	15
Department of Veterans Affairs	15	15	15
Environmental Protection Agency	42	42	42
General Services Administration	35	35	35
Health and Human Services	15	15	15
Housing and Urban Development	35	35	35
National Aeronautics & Space Admin	365	365	365
National Science Foundation	1,108	1,108	1,108
Miscellaneous	15	15	15
Subtotal (Federal sources)	19,605	19,605	19,605
Total (reimbursements)	**27,595**	**27,595**	**27,595**
Total: Core Science Systems	**144,509**	**142,766**	**164,103**

	2012 Actual	2013 CR	2014 Estimate
Surveys, Investigations, and Research (SIR)			
Administration and Enterprise Information			
Appropriated			
Multi-Year appropriation	111,982	124,931	115,570
Total (appropriated)	**111,982**	**124,931**	**115,570**
Reimbursements			
Non-Federal (Domestic) sources			
Map Receipts	2,029	2,029	2,029
Sale of photos, reproductions, and digital products	341	341	341
Technology Transfer	105	105	105
Miscellaneous	58	58	58
Subtotal (non-Federal domestic sources)	2,533	2,533	2,533
Federal sources			
Central Intelligence Agency	438	438	438
Department of Agriculture	3	3	3
Department of Interior			
Bureau of Indian Affairs	88	88	88
Bureau of Safety and Environmental Enforcement	81	81	81
Office of Secretary			
National Business Center	6,957	6,957	6,957
Other	479	479	479
Office of Surface Mining	4	4	4
General Services Administration	10	10	10
Nuclear Regulatory Commission	10	10	10
Sale of maps, photos, reproductions, & digital products	835	835	835
Remote Sensing Data Purchases	27	27	27
Subtotal (Federal sources)	8,932	8,932	8,932
Total (reimbursements)	**11,465**	**11,465**	**11,465**
Total: Administration and Enterprise Information	**123,447**	**136,396**	**127,035**

	2012 Actual	2013 CR	2014 Estimate
Surveys, Investigations, and Research (SIR)			
Facilities			
Appropriated			
Multi-Year appropriation	100,875	95,493	97,160
No-Year appropriation	3,120	6,542	7,280
Total (appropriated)	**103,995**	**102,035**	**104,440**
Reimbursements			
Federal sources			
Department of Defense	1,139	1,139	1,139
Subtotal (Federal sources)	1,139	1,139	1,139
Total (reimbursements)	**1,139**	**1,139**	**1,139**
Total: Facilities	**105,134**	**103,174**	**105,579**

SIR Summary:			
Appropriated			
Multi-Year appropriation	1,037,702	1,035,857	1,103,580
No-Year appropriation	51,498	57,559	60,617
subtotal (appropriated)	1,089,200	1,093,416	1,164,197
Reimbursements			
Non-Federal Sources			
Map Receipts	2,029	2,029	2,029
Domestic	26,241	26,241	26,241
Foreign	2,687	2,687	2,687
State and local sources	167,466	167,466	167,466
Federal Sources	261,323	261,323	261,323
subtotal (reimbursements)	459,746	459,746	459,746
Total: SIR *	**1,548,946**	**1,553,162**	**1,623,943**

* This table does not include obligations for the Spectrum Relocation Fund, since it is a mandatory fund. MAX obligations do include the Spectrum Relocation Fund. The amounts included in MAX are: FY 2012 $1K; and FY 2013 $966K. This table also does not include obligations from the unobligated balance transfer from USAID, which is included in MAX. The amount for FY 2012 is $581K.

United States Geological Survey

Trust Funds

CONTRIBUTED FUNDS

Special and Trust Fund Receipts

(Millions of Dollars)

Identification Code 14-8562-0-7-306		2012 Actual	2013 CR	2014 Estimate
01.00	Balance, start of year	0	0	0
	Receipts:			
02.20	Contributed Funds, Geological Survey	1	1	1
04.00	Total: Balances and collections	1	1	1
	Appropriations:			
05.00	Contributed Funds	-1	-1	-1
07.99	Balance, end of year	0	0	0

Program and Financing

(Millions of Dollars)

Identification Code 14-8562-0-7-306		2012 Actual	2013 CR	2014 Estimate
	Obligations by program activity:			
08.01	Donations and contributed funds	1	1	1
09.00	Total new obligations	1	1	1
	Budgetary resources:			
	Unobligated balance:			
10.00	Unobligated balance brought forward, Oct 1	1	1	1
	Budget authority:			
	Appropriation, mandatory:			
12.01	Appropriation (trust fund)	1	1	1
12.60	Appropriation, mandatory (total)	1	1	1
19.30	Total budgetary resources available	2	2	2
	Memorandum (non-add) entries:			
19.41	Unexpired unobligated balance, end of year	1	1	1

CONTRIBUTED FUNDS

Program and Financing cont'd

(Millions of Dollars)

Identification Code 14-8562-0-7-306		2012 Actual	2013 CR	2014 Estimate
	Change in obligated balance:			
30.10	Obligations incurred, unexpired accounts	1	1	1
30.20	Outlays (gross)	-1	-1	-1
	Obligated balances, end of year (net):			
	Budget authority and outlays, net:			
	Mandatory:			
40.90	Budget authority, gross	1	1	1
	Outlays, gross:			
41.00	Outlays from new mandatory authority	0	1	1
41.01	Outlays from mandatory balances	1	0	0
41.10	Outlays, gross (total)	1	1	1
41.80	Budget authority, net (total)	1	1	1
41.90	Outlays, net (total)	1	1	1

Object Classification

(Millions of Dollars)

Identification Code 14-8562-0-7-306		2012 Actual	2013 CR	2014 Estimate
	Direct obligations:			
99.5	Below reporting threshold	1	1	1
99.9	Total new obligations	1	1	1

Employment Summary

Identification Code 14-8562-0-7-306		2012 Actual	2013 CR	2014 Estimate
	Direct:			
1001	Civilian full-time equivalent employment	6	6	6

Employee Count by Grade

(Total Employment)

	2012 Actual	2013 Estimate	2014 Estimate
Executive Level V	1	1	1
SES	22	22	22
Subtotal	23	23	23
SL – 00	5	9	9
ST – 00	47	47	47
Subtotal	52	56	56
GS/GM – 15	566	552	558
GS/GM – 14	783	764	772
GS/GM – 13	1,267	1,237	1,249
GS – 12	1,606	1,567	1,584
GS – 11	1,313	1,281	1,295
GS – 10	18	18	18
GS – 9	950	927	937
GS – 8	243	237	240
GS – 7	665	649	656
GS – 6	241	235	238
GS – 5	390	381	385
GS – 4	294	287	290
GS – 3	246	240	243
GS – 2	86	84	85
GS – 1	49	48	48
Subtotal	8,717	8,508	8,595
Other Pay Schedule Systems	224	224	224
Total employment (actual/estimate)	9,016	8,811	8,898

Mandatory Budget and Offsetting Collection Proposals

The USGS does not have any legislative proposals in the 2014 President's budget that impact receipts or mandatory spending levels.

Section 405 Compliance

This section describes details related to any assessments to, or within the USGS to support bureauwide services and functions. Details regarding the USGS's payments to the Department of the Interior's Working Capital Fund, and payments to other Federal Agencies are included in the External Administrative Costs subsection. Additional information on internal assessments and cost allocation methodologies can be found in the Bureau Administrative Costs subsection.

	2014 Estimate ($000)
External Administrative Costs	
The Department of the Interior's Working Capital Fund	
WCF Centralized Billings	$17,562
WCF Direct Billings	$9,428
Payments to Other Federal Agencies	
Worker's Compensation Payments	$2,593
Unemployment Compensation Payments	$379
GSA Rental Payments	$72,127
Bureau Administrative Costs	
Shared Program Costs	$10,241
Internal Bureau Overhead	$39,500

External Administrative Costs

The Department of the Interior's Working Capital Fund

The Department's Working Capital Fund was established pursuant to 43 U.S.C. 1467, to provide common administrative and support services efficiently and economically at cost. The Fund is a revolving fund, whereby capital is expended to provide services for customers who pay for the services. Customers consist of the Department's bureaus and offices, as well as other Federal agencies. Through the use of centrally provided services, the Department standardized key administrative areas such as commonly used administrative systems, support services for those located in and around the Main and South Interior building complex, and centrally managed departmental operations that are beneficial to the bureaus and offices.

Centralized billing is used whenever the product or service being provided is not severable or it is inefficient to bill for the exact amount of product or service being procured. Customers are billed each year using a pre-established basis that is adjusted annually to reflect change over time. The following table provides the actual centralized billing to the USGS for 2012 and estimates for 2013 and 2014.

Working Capital Fund Revenue
Centralized Billing
Geological Survey
($ in thousands)

Activity/Office	2012 Actual	2013 Pres Budget	2013 Revised	2014 Estimate
Other OS Activities				
Secretary's Immediate Office				
Document Management Unit	0.0	26.7	26.7	15.1
FOIA Tracking & Reporting System	19.4	21.0	21.0	35.2
Office of the Executive Secretariat	19.4	47.7	47.7	50.3
Alaska Affairs Office	12.5	12.7	12.7	15.0
Alaska Resources Library and Information Services	166.4	157.8	157.8	167.9
Secretary's Immediate Office	178.9	170.6	170.6	182.9
Departmental News and Information	102.9	89.7	89.7	87.1
Office of Communications	102.9	89.7	89.7	87.1
Departmental Museum	156.7	151.7	151.7	144.7
Secretary's Immediate Office	156.7	151.7	151.7	144.7
Asbestos-Related Cleanup Cost Liabilities	0.2	0.2	0.2	0.2
FedCenter	2.2	2.1	2.1	2.2
Compliance Support ESF-11/ESF-11 Web Site	0.0	2.3	2.3	2.3
Office of Environmental Policy and Compliance	2.4	4.5	4.5	4.7
Invasive Species Council	214.4	206.0	206.0	216.4
Invasive Species Coordinator	38.3	38.3	38.3	40.0
Office of Policy Analysis	252.8	244.4	244.4	256.5
International Affairs Office				
CPIC	19.6	24.6	24.6	28.7
Office of Budget	19.6	24.6	24.6	28.7
Financial Internal Controls & Performance Reporting (Activity Based:	128.7	95.5	95.5	97.6
Travel Management Center	27.8	27.3	27.3	26.4
e-Travel (Formerly: e-Gov Travel)	119.4	429.6	429.6	267.9
Office of Financial Management	275.9	552.4	552.4	391.9
FBMS Master Data Systems & Hosting	180.2	141.2	140.8	120.8
Interior Collections Management System	2.2	2.1	2.1	2.1
Space Management Initiative	40.8	35.7	35.7	41.2
Renewable Energy Certificates	3.0	2.7	3.0	3.3
Facility Maintenance Management System	3.7	4.5	4.5	4.5
Office of Property and Acquisition Management	229.8	186.1	186.1	171.9
Planning and Performance Management	138.5	135.3	135.3	135.5
Office of Planning and Performance Management	138.5	135.3	135.3	135.5
Departmentwide OWCP Coordination	31.2	29.4	29.4	28.0
OPM Federal Employment Services	53.7	53.7	53.7	53.2
Accessible Technology Center	40.0	35.0	35.0	40.1
Accountability Team	60.3	69.1	69.1	60.5
Employee and Labor Relations Tracking System	3.5	3.3	3.3	3.4
Veterans Disabilities Hiring Programs				27.3

Working Capital Fund Revenue
Centralized Billing
Geological Survey
($ in thousands)

Activity/Office	2012 Actual	2013 Pres Budget	2013 Revised	2014 Estimate
Other OS Activities				
Office of Human Resources	188.6	190.6	190.6	212.6
EEO Complaints Tracking System	1.7	1.7	1.7	1.6
Special Emphasis Program	6.2	5.4	5.4	5.2
Office of Civil Rights	7.8	7.1	7.1	6.8
Occupational Safety and Health	202.1	188.9	188.9	191.3
Safety Management Information System	159.5	145.4	145.4	138.5
Office of Occupational Health and Safety	361.7	334.3	334.3	329.9
DOI Learn	212.7		0.0	0.0
Leadership Development Programs (formerly: DOI Executive Forums)	15.1	86.7	86.7	90.9
SESCDP & Other Leadership Programs	21.2	0.0	0.0	0.0
Dept-Wide Training Prgms (formerly: Online Learning)	61.0	246.4	246.4	241.6
Learning and Performance Center Management	50.5	0.0	0.0	0.0
Albuquerque Learning & Performance Center	11.9	11.3	11.3	11.3
Anchorage Learning & Performance Center	9.6	0.0	0.0	0.0
Denver Learning & Performance Center	27.4	26.2	26.2	26.2
Washington Learning & Performance Center	67.0	65.9	65.9	65.9
DOIU Management	69.5	82.0	82.0	92.4
DOI University	545.8	518.5	518.5	528.3
Security (Classified Information Facility)	55.1	55.1	55.1	66.5
Law Enforcement Coordination and Training	106.0	99.7	100.7	99.6
Security (MIB/SIB Complex)	30.0	30.0	30.0	23.8
Victim Witness	19.6	20.8	19.8	20.7
Office of Law Enforcement and Security	210.7	205.6	205.6	210.7
Interior Operations Center	301.8	244.5	244.5	243.0
Emergency Preparedness	97.2	92.3	92.3	114.8
Emergency Response	135.2	128.4	128.4	173.4
MIB Health and Safety	0.5	0.6	0.6	0.5
Federal Executive Board	0.0		33.8	34.6
Office of Emergency Management	534.7	465.8	499.6	566.3
Aviation Management	0.0	315.7	267.2	529.9
Aviation Management Directorate	0.0	315.7	267.2	529.9
Electronic Records Management	98.6	126.2	126.2	217.6
TELECOM-Enterprise Services Network	2,657.0	2,495.5	2,495.5	2,579.0
Web & Internal/External Comm	55.2	0.0	0.0	0.0
Enterprise Architecture	418.9	356.6	356.6	395.6
Frequency Management Support	82.5	84.6	84.6	79.5
RISK MGMT - IT Security-IVV	273.2	199.6	214.3	240.7
Capital Planning	202.0	318.6	318.6	353.3
Privacy (Information Management Support)	81.1	58.4	46.3	93.7
RISK MGMT - IT Security - Information Assurance Division	430.6	118.6	118.6	138.5
END USER SVCS - Active Directory	350.2	356.2	356.2	362.7

Working Capital Fund Revenue
Centralized Billing
Geological Survey
($ in thousands)

Activity/Office	2012 Actual	2013 Pres Budget	2013 Revised	2014 Estimate
Other OS Activities				
Enterprise Resource Management	53.6	125.5	125.5	201.3
END USER SVCS - DOI Access & Personnel Security	144.8	130.1	130.1	144.3
NTIA Spectrum Management	152.6	169.3	169.3	125.2
Radio Program Management Office	104.8	90.3	90.3	84.5
Data at Rest	7.4	0.0	0.0	0.0
END USER SVCS - IT Asset Management	38.2	96.5	96.5	107.0
OCIO Project Management Office	92.1	0.0	0.0	0.0
RISK MGMT - Threat Management	128.7	358.2	358.2	364.1
TELECOM - IOS Collaboration	104.7	94.2	94.2	110.0
END USER SVCS - Unified Messaging	200.0	180.0	180.0	116.0
TELECOM - Federal Relay Service	7.0	6.3	6.3	6.0
HOSTING – Hosting Services				37.5
Office of the Chief Information Officer	5,683.3	5,364.8	5,367.4	5,756.7
Alternative Dispute Resolution Training	6.2	5.9	5.9	5.9
Collaborative Action and Dispute Resolution	6.2	5.9	5.9	5.9
Office of Valuation Services				
Conservation and Educational Partnerships	32.1	28.8	28.8	29.6
Youth, Partnerships and Service	32.1	28.8	28.8	29.6
Mail and Messenger Services	0.0	16.7	16.7	6.5
Health Unit	0.0	1.3	1.3	1.0
Federal Executive Board	0.0	33.8	0.0	0.0
Special Events Services	0.0	6.6	6.6	6.3
Safety and Environmental Services	0.0	2.1	2.1	1.6
Shipping and Receiving	0.0	1.5	1.5	1.1
Moving Services	0.0	1.1	1.1	0.8
Property Accountability Services	0.0	2.8	2.8	2.1
Family Support Room	0.0	0.1	0.1	0.1
Interior Complex Management & Svcs	0.0	3.9	3.9	2.9
Departmental Library	0.0	335.5	335.5	8.3
Mail Policy	0.0	41.9	41.9	40.7
Audio Visual Services	0.0		5.5	4.3
Space Management Services	0.0	1.4	1.4	1.1
Ofc of Facilities & Admin Services	0.0	448.7	420.3	76.8
Office of Valuation Services				
Contingency Reserve	18.5	17.6	17.6	17.7
Cooperative Ecosystem Study Units	56.9	56.9	56.9	51.4
CFO Financial Statement Audit	548.9	552.5	552.5	546.0
Glen Canyon Adaptive Management	95.5	123.8	123.8	130.4
Science Integrity Officer	0.0		0.0	0.0
Departmentwide Activities	719.9	750.7	750.7	745.5
e-Government Initiatives (WCF Contributions Only)	327.7	485.9	485.9	364.4
Volunteer.gov	15.1	15.1	15.1	15.1

Working Capital Fund Revenue
Centralized Billing
Geological Survey
($ in thousands)

Activity/Office	2012 Actual	2013 Pres Budget	2013 Revised	2014 Estimate
Other OS Activities				
Departmentwide Activities	342.8	500.9	500.9	379.5
Ethics	73.3	66.0	66.0	61.9
FOIA Appeals	12.7	11.4	11.4	26.0
Office of the Solicitor	86.0	77.4	77.4	87.9
Subtotal Other OS Activities	10,096.2	10,821.7	10,781.2	11,398.0

Working Capital Fund Revenue
Centralized Billing
Geological Survey
($ in thousands)

Activity/Office	2012 Actual	2013 Pres Budget	2013 Revised	2014 Estimate
National Business Center				
IBC IT Security Improvement Plan	373.3	373.3	373.3	373.8
MIB Data Networking	2.1	2.0	2.0	1.6
Information Mgmt. - Records Management	8.0	8.1	8.1	8.1
Telecommunication Services	9.1	8.6	4.6	3.7
Integrated Digital Voice Communications System	2.9	2.7	2.7	2.7
Desktop Services	22.9	17.0	17.0	17.1
Audio Visual Services	1.5	1.5	0.0	0.0
Interior Complex Cabling O&M	0.3	0.0		0.0
IBC Information Technology Directorate	420.0	413.2	407.7	407.0
FPPS/Employee Express - O&M	1,912.5	2,173.7	2,228.9	2,228.9
Drug Testing	9.3	10.7	10.7	6.5
IBC Human Resources Directorate	1,921.9	2,184.4	2,239.6	2,235.4
Departmental Library	341.2	0.0	0.0	0.0
Interior Complex Management & Services	3.8	0.0	0.0	0.0
Family Support Room	0.1	0.0	0.0	0.0
Property Accountability Services	2.8	0.0	0.0	0.0
Moving Services	1.1	0.0	0.0	0.0
Shipping and Receiving	1.5	0.0	0.0	0.0
Safety and Environmental Services	2.1	0.0	0.0	0.0
Space Management	1.4	0.0	0.0	0.0
Federal Executive Board	34.1	0.0	0.0	0.0
Health Unit	1.3	0.0	0.0	0.0
Mail and Messenger Services	14.7	0.0	0.0	0.0
Mail Policy	42.4	0.0	0.0	0.0
Special Events Services	7.3	0.0	0.0	0.0
IBC Administrative Operations Directorate	453.9	0.0	0.0	0.0
Financial Systems	1,886.7	1,695.6	1,632.0	653.2
IDEAS	89.6	75.3	75.3	31.2
Quarters Program	1.1	1.0	1.0	1.3
FBMS Master Data Management	115.7	143.2	143.2	170.3
IBC FBMS Conversion	29.9	0.0	0.0	0.0
Consolidated Financial Statement System	173.8	174.6	174.6	138.7
IBC Financial Management Directorate	2,296.9	2,089.7	2,026.1	994.7
Boise Acquisition Office	0.0		48.5	121.2
IBC Acquisition Services Directorate	0.0		48.5	121.2
FBMS Hosting/Applications Management	659.8	232.7	231.9	244.2
FBMS Redirect – FFS	379.8	425.9	491.3	1,354.2
FBMS Redirect - IDEAS	296.7	312.4	312.4	356.5
FBMS Help Desk - NBC Customer Support Center	0.0	429.8	428.2	451.0
IBC FBMS Support	1,336.3	1,400.9	1,463.8	2,405.9
Aviation Management	299.0	0.0	0.0	0.0
Aviation Management System - O&M	16.1	0.0	0.0	0.0
IBC Aviation Management Directorate	315.0	0.0	0.0	0.0

Working Capital Fund Revenue
Centralized Billing
Geological Survey
($ in thousands)

Activity/Office	2012 Actual	2013 Pres Budget	2013 Revised	2014 Estimate
National Business Center				
Subtotal National Business Center	**6,743.9**	**6,088.2**	**6,185.7**	**6,164.1**

Working Capital Fund Revenue
Centralized Billing
Geological Survey
($ in thousands)

Activity/Office	2012 Actual	2013 Pres Budget	2013 Revised	2014 Estimate
IT Transformation (ITT)	0.0	0.0	0.0	477.5
Office of the Chief Information Officer	0.0	0.0	0.0	477.5
Subtotal				**477.5**
TOTAL	**16,840.1**	**16,909.9**	**16,966.9**	**17,562.1**

Direct billing is used whenever the product or service provided is again severable, but is sold through a time and materials reimbursable support agreement or similar contractual arrangement. The following tables provide the actual direct and reimbursable collections from the USGS for 2012, and estimated billings and collections for 2013 and 2014.

Working Capital Fund Revenue
Direct Billing
Geological Survey
($ in thousands)

Activity/Office	2012 Actual	2013 Pres Budget	2013 Estimate	2014 Estimate
Other OS Activities				
Imagery for the Nation	951.0	950.2	950.1	950.1
Policy, Management and Budget	951.0	950.2	950.1	950.1
Office of Environmental Policy & Compliance				
Ocean Coastal Great Lakes Activities	52.5	52.5	52.5	52.5
Office of Policy Analysis	52.5	52.5	52.5	52.5
Office of Budget				
Single Audit Clearinghouse	0.2	0.2	0.2	0.2
Office of Financial Management	0.2	0.2	0.2	0.2
Federal Assistance Award Data System	2.0	0.0	0.0	0.0
Office of Acquisition and Property Management	2.0	0.0	0.0	0.0
e-OPF	193.1	200.5	158.5	157.9
EAP Consolidation	0.0	193.9	89.1	108.9
Worker's Comp Nurse Case Management	0.0		0.0	20.4
Office of Human Resources	193.1	394.5	247.6	287.2
EEO Training	16.7	16.7	16.7	16.7
EEO Investigations	6.3	3.0	3.0	3.0
Office of Civil Rights	23.0	19.7	19.7	19.7
Albuquerque Learning & Performance Center	8.8	8.8	8.8	8.8
Anchorage Learning & Performance Center	0.7		0.0	0.0
Denver Learning & Performance Center	20.1	20.2	20.2	20.2
Online Learning	57.5	57.5	57.5	57.5
Washington Leadership & Performance Center	33.3	33.6	33.6	33.6
DOI University	120.4	120.1	120.1	120.1
Office of Law Enforcement and Security				
Office of Emergency Management				
Oracle Licenses and Support	0.0	2,290.1	0.0	0.0
Enterprise Architecture Services	2,356.0	1,810.0	1,800.0	0.0
Microsoft Enterprise Licenses	899.5	1,634.5	0.0	0.0
RISK MGMT - Anti-Virus Software Licenses	336.4	272.6	231.9	308.0
TELECOM - Enterprise Services Network	3,093.5	2,988.9	2,988.9	2,988.9
END USER SVCS - DOI Access	535.1	852.2	852.2	984.0
RISK MGMT - Data at Rest Initiative	14.1	14.5	14.1	16.9
TELECOM - EID Rack Space	4.0	5.6	5.0	5.4
END USER SVCS - Unified Messaging	1,388.0	1,626.6	1,807.8	1,878.7
Office of the Chief Information Officer	8,626.6	11,499.0	7,700.0	6,687.8
Office of Valuation Services				
Creative Communications	0.0	20.7	10.0	10.0
Reimbursable Mail Services	0.0	6.7		0.0

Working Capital Fund Revenue
Direct Billing
Geological Survey
($ in thousands)

Activity/Office	2012 Actual	2013 Pres Budget	2013 Estimate	2014 Estimate
Other OS Activities				
Ofc of Facilities & Admin Services	0.0	27.3	10.0	10.0
Ofc of Facilities & Admin Services				
Aviation Management Directorate				
Departmentwide Programs				
Federal Flexible Savings Account (FSA) Program	328.1	359.7	359.7	359.7
FBMS Change Orders	204.2	180.0	180.0	180.0
Financial Business Management System	532.3	539.7	539.7	539.7
Office of International Affairs				
Subtotal Other OS Activities	**10,501.2**	**13,603.3**	**9,640.0**	**8,667.3**

Working Capital Fund Revenue
Direct Billing
Geological Survey
($ in thousands)

Activity/Office	2012 Actual	2013 Pres Budget	2013 Estimate	2014 Estimate
Interior Business Center				
Director, IBC Office of the Director				
Enterprise Technology Division	48.9	20.7	20.7	0.0
Enterprise Infrastructure Division	393.8	404.0	495.1	0.0
IBC Information Technology Directorate	442.7	424.6	515.8	0.0
Client Liaison and Product Development Division	5.5			
Personnel & Payroll Systems Division	13.8			
HR Management Systems Division	111.4	0.0		
Quicktime Services	428.6	0.0		
Payroll & HR Systems		829.6	743.6	760.8
IBC Human Resources Directorate	559.4	829.6	743.6	760.8
Creative Communications	15.9	0.0	0.0	0.0
Reimbursable Mail Services	6.5	0.0	0.0	0.0
IBC Administrative Operations Directorate	22.4	0.0	0.0	0.0
IDEAS	138.8	0.0		
IBC Financial Management Directorate	138.8	0.0	0.0	
Aviation Management	43.3			
IBC Aviation Management Directorate	43.3			
IBC Acquisitions Services Directorate				
IBC Information Technology Directorate				
Subtotal National Business Center	1,206.6	1,254.3	1,259.4	760.8
TOTAL	**11,707.7**	**14,857.6**	**10,899.4**	**9,428.2**

Payments to Other Federal Agencies

	2012 Actual	2013 Change	2014 Change
Worker's Compensation Payments	3,242	-204	-445
The adjustment is for the change in costs of compensating injured employees and dependents of employees who suffer accidental deaths while on duty. Costs for the BY will reimburse the Department of Labor, Federal Employees Compentsation Fund, pursuant to 5 U.S.C. 8147(b) as amended by Public Law 94-273.			
Unemployment Compensation Payments	720	-169	-172
The admustment is for projected changes in the costs of unemployment compensation claims to be paid to the Department of Labor, Federal Empoyees Compensation Account, in the Unemployment Trust Fund, pursuant to Public Law 96-499.			
GSA Rental Payments	72,894	807	-1,574
The adjustment is for changes in the costs payable to General Services Administration (GSA) and others resulting from changes in rates for ofice and non-office space estimated by GSA, as well as the rental costs of other currently occupied space. These costs include building security, the case of GSA space, these are paid to DHS. Costs of mandatory office relocations, i.e. relocations in cases where due to external events there is no alternative but to vacate the currently occupied space, are also included.			

* 2014 Change in Rental Payment was calculated using initial 2013 Rental amounts in the June 2011 Exhibit 54. This number is continually updated; above figures may not reflect the most up-to-date estimates, and may be understated.

Bureau Administrative Costs

Shared Program Costs

The USGS maintains less than one percent of its appropriation for other bureauwide support and science-related activities. These funds are used for initiatives which may be unfunded mandates, are crosscutting in nature, or respond to new and emerging scientific issues.

The funding for the initiatives in the Shared Program Costs are assessed at the budget activity level, based upon one of two methodologies: proportionately, based on total appropriated funds for the mission area; or proportionately, based on total funds for the mission area, including reimbursable funding sources, and are distributed to the initiatives efficiently. The methodology used is tied to the nature of the initiative. For instance, an initiative that is crosscutting to all the mission areas, but is purely an Interior priority (one in which an external partner is not a stakeholder, nor receives direct benefit of the service) would receive its funding based upon a calculation on appropriated funds only. Conversely, an initiative where all customers of the USGS either directly or indirectly receive benefit, such as the aforementioned information technology compliance and security upgrades, would be calculated to each of the mission areas based upon all funding sources, both appropriated and reimbursable. The initiatives on the Shared Program Cost Chart are vetted each year with the Executive Leadership Team of the USGS, and are decided upon in a voting process to ensure bureauwide concurrence.

The following initiatives are currently planned for the USGS's 2014 Shared Program Costs.

2014 USGS Shared Program Costs							
Mission Area	**Ecosystems**	**Climate & Land Use Change**	**Energy, Minerals & Enviromental Health**	**Natual Hazards**	**Water Resources**	**Core Science Systems**	**Total**
CALFED**	130,971	115,306	79,299	106,757	172,434	93,667	**698,434**
Grand Canyon Monitoring**	199,265	175,431	120,649	162,425	262,348	142,509	**1,062,627**
Regional Science**	515,257	453,629	311,972	419,996	678,378	368,498	**2,747,730**
John Wesley Powell Center**	93,061	81,931	56,346	75,856	122,523	66,555	**496,272**
International Program**	319,224	281,042	193,280	260,205	420,284	228,300	**1,702,335**
IT Transformaion*	621,509	446,512	307,856	422,000	1,350,524	386,141	**3,534,542**
Total Program Costs	**1,879,287**	**1,553,851**	**1,069,402**	**1,447,239**	**3,006,490**	**1,285,671**	**10,241,940**

* Proportionally Spread by Total Funds

** Proportionally Spread by Appropriated Funds

CALFED – The California Bay-Delta is recognized as one of the world's threatened treasures of biodiversity, which supports unique native species and their critical tidal habitats. The USGS participates in the CALFED Federal-State partnership which coordinates the efforts of 25 State and Federal agencies to improve the quality and reliability of California's water supplies while restoring the Bay-Delta ecosystem. USGS science contributes to restoration challenges such as water supply reliability, water quality, sustainability of native species, and flood risk.

Grand Canyon Monitoring – The USGS's Grand Canyon Monitoring and Research Center (GCMRC) is the science provider for the Glen Canyon Dam Adaptive Management Program. In this role, the research center provides the public and decisionmakers with relevant scientific information about the status and trends of natural, cultural, and recreational resources found in those portions of Grand Canyon National Park and Glen Canyon National Recreation Area affected by Glen Canyon Dam operations.

Regional Science – The implementation of the USGS Science Strategy calls for the integration of the full breadth and depth of USGS capabilities; building on existing strengths and partnerships. To that end, many of the USGS's historical "single-discipline" science centers are now reflections of this science strategy, and perform research and conduct science across many USGS mission areas, and need to respond quickly to new and emerging science issues. This funding brings scientists together to work across teams and across regions, to respond to the Nation's highest and changing priorities, respond to global trends, and conduct the best possible science.

John Wesley Powell Center – The John Wesley Powell Center for Analysis and Synthesis serves as a catalyst for innovative thinking in Earth system science research. Initiated as one means of implementing the USGS Science Strategy, the Powell Center supports scientist-driven interdisciplinary analysis and synthesis of complex natural science problems. USGS scientists are encouraged to propose working groups reflecting a mix of USGS scientists and their colleagues from government and academia focused on major earth science issues. The Powell Center work generates cutting-edge, high-visibility publications.

International Programs – The Office of International Programs is dedicated to high quality, timely, scientific study that is international in scope and that focuses on the USGS Science Strategy's themes. As one of the world's premier science agencies, the USGS has long recognized the mutual benefits resulting from interaction with scientific partners abroad and extending research and investigations to other

countries. By providing reliable scientific information about the Earth and its resources from an international perspective, the USGS Office of International Programs supports US foreign policy and national security; provides a basis for science diplomacy, and improves the scientific basis for managing ecosystems and natural resources.

DOI IT Transformation – This funding will be used to support Interior's efforts in IT Transformation. These funds will support the Department's activities related to data center consolidation, single-source messaging, and cloud-based electronic forms, records, documents and content management solutions.

Internal Bureau Overhead Cost Allocation Methodology

The USGS manages overhead costs at two levels—the bureau and science center. Bureau level costs include headquarters and area executive, managerial, supervisory, administrative, and financial functions and bureauwide systems. At the bureau level, funding appropriated to the Administration and Enterprise Information budget activity pays the bureauwide overhead costs in the same proportion as appropriated funding is to total funding. For this reason, bureauwide overhead costs collected on reimbursable support agreements are deposited within Administration and Enterprise Information program areas, as well.

The USGS assesses a bureau overhead rate, estimated to remain at 12 percent, on reimbursable work from non-Interior customers to recoup their share of bureau-level costs. In some cases, the USGS assesses a special or reduced rate when it can be demonstrated that indirect costs are substantially and consistently less than the norm and the amount collected covers the full costs, such as with pass-through funding where the Survey does not perform any of the actual work. The following table shows the funding available to the Administrative and Enterprise Information program, including the anticipated overhead collections to pay for bureauwide costs.

(Dollars in Thousands)

Source of Funding	2014 Budget Request	2014 Estimated Bureau Overhead Distribution	2014 Estimated Total
Administration and Enterprise Information			
Science Support Subactivity	91,010	30,810	121,820
Security & Technology Subactivity	24,548	8,692	33,240
Total Funding	**115,558**	**39,500**	**155,060**

At the science center level, because there generally is not an appropriated funding source to pay the local overhead (common services) costs, both the appropriated and reimbursable funding are assessed a percentage to cover their share of science center-level costs. Science center common services costs include center costs that are not directly attributable to a specific activity or project, such as managerial, supervisory, administrative, and financial functions and related systems, as well as costs incidental to providing services and products, such as postage, training, miscellaneous supplies and materials. The cost during 2012, for the local overhead, totaled $186.3 million from both appropriated and reimbursable funds.

In recognition of the USGS role as the science bureau for the Department of the Interior, the USGS is continuing to give Interior bureaus and offices a "preferred" customer rate on overhead charges for a significant portion of reimbursable work, to the extent that matching funds are available within the USGS budget. The maximum rate that cost centers may charge other Interior bureaus for common services and bureau costs combined remains 15 percent net. In 2014, of the 15 percent, 7.5 percent is applied to

bureau costs, and the remaining 7.5 percent is applied to common services costs. Cost centers must fund the common services costs not recovered (e.g., the difference between the cost center's standard common services costs and the 7.5 percent) from USGS appropriated funds. In this way, the USGS is partnering on the science needs of Interior from both the bureau and cost centers.

The Chief Financial Officer establishes the USGS bureau special rate for each fiscal year. The special rate for 2014 is estimated to remain at three percent. Cost centers do not charge more than the bureau special rate for facilities-related costs or their standard common services rate when funding is approved for a bureau-level special rate. Special rates are applied under the following circumstances:

- When the USGS receives funds from a non-USGS organization and awards a grant to a third-party entity.
- When the USGS receives funds from one or more non-USGS organizations to support, under USGS leadership, a strategic science objective that includes the USGS passing through funds to one or more third-party entities.
- When the USGS receives funds from a non-USGS organization for the purpose of the customer acquiring services through the Cartographic Services or the Remotely Sensed Data Contracts. The special rate helps encourage other Federal agencies to use these contracts for cartographic services and remotely sensed data, rather than establishing and managing their own contracts, and ensures greater data consistency through the use of common service providers.
- When the USGS receives funds from a non-USGS organization for the purpose of passing through the customer's funds to State and local governments for the direct purchase of geospatial data.
- Biology Cooperative Research Units (CRUs) are supported by a three-way partnership including the USGS, a State, and a university. The academic institutions where CRUs are co-located provide significant administrative support. In recognition of the direct services support received from the non-USGS partners, CRUs only recover one-half of the bureau rate (six percent) normally recovered from reimbursable customers or partners.

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