Program Changes

Program Changes - USGS Initiatives

Component	Subactivity	2013 Program Change Amount ($000)	FTE Changes
WaterSMART		**13,000**	**51**
	Fisheries: Aquatic & Endangered Resources	[1,250]	[5]
	Contaminant Biology	[1,000]	[4]
	Toxic Substances Hydrology	[2,500]	[11]
	Groundwater Resources	[2,500]	[10]
	National Water Quality Assessment	[3,500]	[19]
	Hydrologic Networks and Analysis	[500]	[2]
	National Cooperative Geologic Mapping Program	[1,000]	[0]
	National Geospatial Program	[750]	[0]
Rapid Disaster Response		**8,601**	**12**
	Land Use Change	[750]	[4]
	Earthquake Hazards	[851]	[1]
	Volcano Hazards	[1,000]	[3]
	Landslide Hazards	[500]	[4]
	National Streamflow Information Program	[5,500]	[0]
Science for Coastal and Ocean Stewardship		**6,750**	**12**
	Coastal and Marine Geology	[5,750]	[12]
	Science Synthesis, Analysis, and Research	[1,000]	[0]
Hydraulic Fracturing		**13,000**	**29**
	Fisheries: Aquatic & Endangered Resources	[2,200]	[10]
	Energy Resources	[3,000]	[12]
	Earthquake Hazards	[1,100]	[2]
	Groundwater Resources	[2,100]	[0]
	Hydrologic Research and Development	[2,000]	[1]
	Science Synthesis, Analysis, and Research	[600]	[1]
	National Cooperative Geologic Mapping Program	[2,000]	[3]
Ecosystem Priority		**16,201**	**52**
	Fisheries: Aquatic & Endangered Resources	[901]	[5]
	Terrestrial, Freshwater & Marine Environments	[5,100]	[15]
	Invasive Species	[4,000]	[11]
	Climate Variability	[500]	[0]
	Land Use Change	[1,500]	[6]
	Contaminant Biology	[200]	[0]
	Toxic Substances Hydrology	[200]	[1]
	National Water Quality Assessment	[1,500]	[3]
	National Streamflow Information Program	[300]	[2]
	Hydrologic Research and Development	[300]	[1]
	Science Synthesis, Analysis, and Research	[1,000]	[5]
	National Geospatial Program	[700]	[3]
Total: USGS		**57,552**	**156**

Program Changes - USGS Increases

Component	Subactivity	2013 Program Change Amount ($000)	FTE Changes
White-Nose Syndrome		**1,000**	**1**
	Wildlife: Terrestrial & Endangered Resources	[1,000]	[1]
Coral Reefs		**500**	**1**
	Terrestrial, Freshwater & Marine Environments	[500]	[1]
Brown Tree Snakes		**500**	**0**
	Invasive Species	[500]	[0]
Climate Research and Development		**1,000**	**0**
	Climate Variability	[1,000]	[0]
Rare Earth Elements Research		**1,000**	**5**
	Mineral Resources	[1,000]	[5]
New Energy Frontier - Wind Energy		**1,000**	**2**
	Energy Resources	[1,000]	[2]
Eastern US Earthquake Research and Assessment		**1,600**	**-4**
	Earthquake Hazards	[1,600]	[-4]
Data Preservation *		**1,000**	**3**
	Science Synthesis, Analysis, and Research	[1,000]	[3]
Program Increase		**8,000**	**4**
	Carbon Sequestration	[250]	[0]
	Science Support for DOI Bureaus	[6,450]	[4]
	Hydrologic Research and Development	[1,300]	[0]
Total: USGS		**15,600**	**12**

Program Changes - USGS Decreases

Component	Subactivity	2013 Program Change Amount ($000)	FTE Changes
Landsat Development		**-1,750**	**0**
	Land Use Change	[-1,750]	[0]
Mineral Resources		**-5,000**	**-39**
	Mineral Resources	[-5,000]	[-39]
Mineral External Research Program		**-250**	**0**
	Mineral Resources	[-250]	[0]
Energy Resources - Conventional Energy		**-1,000**	**-2**
	Energy Resources	[-1,000]	[-2]
Impact of Environmental Contaminants		**-500**	**-3**
	Contaminant Biology	[-500]	[-3]
Methods Development and Assessments		**-2,000**	**-11**
	Toxic Substances Hydrology	[-2,000]	[-11]
Great Lakes Beach Health		**-600**	**-1**
	Coastal and Marine Geology	[-600]	[-1]
Multi-Hazards		**-700**	**-2**
	Volcano Hazards	[-700]	[-2]
Volcano Observatory Assessments		**-300**	**-1**
	Volcano Hazards	[-300]	[-1]
Availability Studies		**-2,000**	**-11**
	Groundwater Resources	[-2,000]	[-11]
Methods Development and Monitoring		**-6,049**	**-35**
	National Water Quality Assessment	[-6,049]	[-35]
Federal Network Operations		**-2,847**	**0**
	National Streamflow Information Program	[-2,847]	[0]
Information Management and Delivery		**-3,300**	**-19**
	Hydrologic Networks and Analysis	[-3,300]	[-19]
Interpretative Studies		**-4,963**	**-16**
	Cooperative Water Program	[-4,963]	[-16]
Elimination		**-6,490**	**-2**
	Water Resources Research Act Program	[-6,490]	[-2]
Ecosystem Science Centers		**-700**	**-6**
	Science Synthesis, Analysis, and Research	[-700]	[-6]
NGGDP *		**-996**	**-3**
	Nat'l Geological & Geophysical Data Preservation	[-996]	[-3]
NCGMP Federal and State Partnerships		**-1,500**	**-2**
	National Cooperative Geologic Mapping Program	[-1,500]	[-2]
Administrative Services		**-4,137**	**-21**
	Science Synthesis, Analysis, and Research	[-446]	[-3]
	Science Support	[-2,369]	[-8]
	Security and Technology	[-1,322]	[-10]
Operations and Maintenance Efficiencies		**-4,390**	**0**
	Rental Payments and Operations & Maintenance	[-4,390]	[0]
Total: USGS		**-49,472**	**-174**

* The increase and decrease noted in the above tables is not an increase to the budget request. For details see page B-36.

Program Changes - USGS Internal Transfers

Subactivity	Internal Transfer	2013 Program Change Amount ($000)	FTE Changes
Internal Transfer		**15,802**	**63**
Science Support	Internal Transfer from Information Resources	[4,479]	[18]
Security and Technology	Internal Transfer from Information Resources	[2,732]	[11]
Science Synthesis, Analysis, and Research	Internal Transfer from Information Resources	[8,591]	[34]
Internal Transfer Decrease		**-15,802**	**-63**
Information Resources	Internal Transfer to Science Synthesis, Analysis, and Research	[-8,591]	[-34]
	Internal Transfer to Science Support	[-4,479]	[-18]
	Internal Transfer to Security and Technology	[-2,732]	[-11]
Internal Transfer Total		**0**	**0**

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Priority Increases

WaterSMART

WaterSMART						
		2011 Actual	2012 Enacted	Program Changes (+/-)	2013 Budget Request	Change from 2012 Enacted (+/-)
Fisheries: Aquatic & Endangered Resources		499	498	1,250	1,748	1,250
	FTE	0	0	5	5	5
Geographic Analysis and Monitoring		499	498	0	498	0
	FTE	0	0	0	0	0
Contaminant Biology		0	0	1,000	1,000	1,000
	FTE	0	0	4	4	4
Toxic Substances Hydrology		0	0	2,500	2,500	2,500
	FTE	0	0	11	11	11
Groundwater Resources		2,090	2,685	2,500	5,185	2,500
	FTE	0	0	10	10	10
National Water Quality Assessment		0	0	3,500	3,500	3,500
	FTE	0	0	19	19	19
Hydrologic Networks and Analysis		2,849	4,293	500	4,793	500
	FTE	2	3	2	5	2
National Cooperative Geologic Mapping Program		0	0	1,000	1,000	1,000
	FTE	0	0	0	0	0
National Geospatial Program		0	0	750	750	750
	FTE	0	0	0	0	0
Total Requirements		**5,937**	**7,974**	**13,000**	**20,974**	**13,000**
	Total FTE	**2**	**3**	**51**	**54**	**51**

Justification of 2013 Program Changes

The 2013 budget request for the U.S. Geological Survey's WaterSMART Availability and Use Assessment initiative is $20,974,000 and 54 FTE, a net program change of +$13,000,000 and +51 FTE from the 2012 Enacted level.

Overview

WaterSMART is a multidisciplinary effort designed to further understand the complex linkage between water quantity, quality, and the environment, resulting in improved management of this finite resource. The USGS possesses both the skills and foundational resources to unlock this knowledge and provide water resource, wildlife, 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. 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, through the combined efforts 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 water uses, including ecological uses.

Program Performance

Estimating Water Budget Indicators **(+$100,000/0 FTE)**

Hydrologic Networks and Analysis (+$100,000/0 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. The USGS will make available 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.

Ecological Water Science **(+$100,000/0 FTE)**

Hydrologic Networks and Analysis (+$100,000/0 FTE)

The USGS will advance understanding of water availability needs of wildlife and habitat. The process involves three major steps:

- Classify the streams across the Nation for their hydro-ecological type;
- Systematically examine the ecological response to hydrologic alteration; and
- Develop flow alteration – ecological response relationships for each type of river or stream.

Efforts in 2011 and 2012 have concentrated on developing the classification system for streams and supporting ecological water needs work in the geographic focus area studies. Efforts in 2013 will include completing the classification system and developing means to efficiently access biological databases that allow for the systematic analysis of ecological responses to hydrologic alteration.

National/Regional Synopsis and Surveys **(+$500,000/+3 FTE)**

National Water Quality Assessment (+$500,000/+3 FTE)

The USGS will conduct national and regional surveys of emerging environmental contaminants, which identify major emerging water quality issues. Funding will support methods development necessary to conduct these surveys. For example, new methods to measure emerging contaminants in environmental media and new bioassays that identify potential biological activity of exposures will be needed.

National Groundwater Monitoring Network **(+$2,500,000/+10 FTE)**

Groundwater Resources (+$2,500,000/+10 FTE)

A National Groundwater Monitoring Network (NGWMN) is authorized under the SECURE Water Act (P.L. 111-11) Section 9507 (b), which states that: “The Secretary shall develop a systematic groundwater monitoring program for each major aquifer system located in the United States.”

The USGS will begin the necessary steps toward full implementation of the NGWMN as conceptualized by the Advisory Committee on Water Information Subcommittee on Ground Water in their report "A National Framework for Ground Water Monitoring in the United States." In 2013, the USGS will transition from the pilot-scale NGWMN data portal to a production-scale portal. Using hydrologic understanding and modeling tools currently available and being developed for selected major aquifers, as part of groundwater availability studies, USGS scientists will identify monitoring locations to enhance the national monitoring network. In consultation with State and local agencies, the USGS will incorporate qualified wells and springs from State and local agencies into the NGWMN. The USGS will begin expansion of the groundwater climate response network to improve the understanding of the effects of climate change on groundwater recharge and availability. The proposed NGWMN will bring comparable monitoring data together from disparate sources in order to close spatial data gaps and evaluate national-scale groundwater levels, quality, and rates of change.

A Brackish Aquifer Assessment is also authorized by the SECURE Water Act. Hydrologic understanding for selected major aquifers gained through the regional groundwater availability studies will be used to assist in identification of brackish groundwater resources. In addition, the USGS, in consultation with State and local water resource agencies, will begin assembling available data and other relevant information in order to identify significant brackish groundwater resources located in the United States and develop a work plan for the national Brackish Aquifer Assessment.

Water Quality Enhancement **(+$6,750,000/+31 FTE)**

Fisheries: Aquatic and Endangered Resources	(+$1,250,000/+5 FTE)
Contaminant Biology	(+$1,000,000/+4 FTE)
Toxic Substances Hydrology	(+$2,000,000/+10 FTE)
National Water Quality Assessment	(+$2,000,000/+12 FTE)
National Cooperative Geologic Mapping	(+$500,000/+0 FTE)

Efforts in this component will produce a national synthesis of knowledge on the degree to which water quantity and quality combine to influence water resource availability for both human and ecosystem uses. It will focus on understanding the natural and human-induced variability in the water quality and water quantity linkage; developing fundamental ways of assessing the degree to which water quality and quantity combine to influence water availability for human uses and ecosystem services; and improving understanding of the cause and effect linkages between water quantity and quality. This involves the integration of water quality and quantity information and relating this to the human and ecological needs for water within immediate settings.

Funding for this effort will help predict the hydrologic and ecologic consequences of new dam construction and, more importantly, dam removal and failure as the Nation's 75,000+ dams age and outlive their original purpose. In 2013, a comprehensive monitoring strategy will be developed for assessing dam removal sites and a priority system for how these resources will be used to monitor the effects of dam removals. A plan for piloting these efforts at high-priority dam sites will also be part of the first year of funding. Reconnaissance of existing sediment and water quality will be used to shape a program for predicting the consequences of new dam construction on human and ecological communities.

This synthesis effort will add a strong component of water quality to the water availability analysis. Water quality will be examined in the context of suitability of ambient water for environmental needs, as well as the potential increased costs for making the raw water suitable

for intended human needs. In 2013, the USGS will develop a plan for this comprehensive national synthesis, identify early synthesis products that can be developed and published, and to begin the long-term effort of assembling the necessary datasets for the national synthesis.

Program and Information Management **(+$2,050,000/+4 FTE)**

National Water Quality Assessment	(+$500,000/+2 FTE)
Hydrologic Networks and Analysis	(+$300,000/+2 FTE)
National Cooperative Geologic Mapping	(+$500,000/0 FTE)
National Geospatial Program	(+$750,000/0 FTE)

Managing the various data streams and integrating this information into a cohesive picture is a major effort under WaterSMART. In 2012, a system is being developed for managing the data for estimating flows at ungaged stations and effectively serving this to the public. Future efforts will concentrate on storing, integrating and serving all of the information about water budget components within a defined watershed. The end result will be a Web-based system in which one can 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 will be used to develop the overall water budget and access information on historical trends in water budget components. Other data and information management efforts will focus on supporting ecological water needs science by providing more effective ways to access biological data from multiagency sources and integrate that data with hydrologic information. WaterSMART will 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 will 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.

As part of WaterSMART, the USGS will develop specialized tools, based on the USGS National Hydrography Dataset (NHD), to help resource managers target basins and watersheds of environments, and ecosystems of particular concern, from a water quantity, quality, or use perspective. Current NHD tools are being used to create pollutant discharge models, allow analysis of upstream and downstream water quality, help establish regional nutrient water quality criteria and total maximum daily loads, modeling of fish passage barrier removal, and calculation of basin characteristics for peak-flow frequency and flow duration. Within WaterSMART, the NHD will be used to locate and address water use infrastructure, including points of withdrawal, diversions, interbasin transfers, and return flows.

Predictive Models **(+$1,000,000/+3 FTE)**

Toxic Substances Hydrology	(+$500,000/+1 FTE)
National Water Quality Assessment	(+$500,000/+2 FTE)

USGS researchers will 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 will 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 Spatially Referenced Regressions on Watershed attributes (SPARROW) and Watershed Regressions for Pesticides (WARP), which link concentrations

and loads of pesticides, nutrients, sediment, or salinity to sources and hydrologic conditions will 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 will be developed.

Improving USGS Rapid Disaster Response through Preparedness and Robust Monitoring

Rapid Disaster Response						
		2011 Actual	2012 Enacted	Program Changes (+/-)	2013 Budget Request	Change from 2012 Enacted (+/-)
Geographic Analysis and Monitoring		300	550	750	1,300	750
	FTE	1	1	4	5	4
Earthquake Hazards		715	715	851	1,566	851
	FTE	0	0	1	1	1
Volcano Hazards		800	800	1,000	1,800	1,000
	FTE	0	0	3	3	3
Landslide Hazards		200	200	500	700	500
	FTE	3	3	4	7	4
National Streamflow Information Program		520	60	5,500	5,560	5,500
	FTE		0	0	0	0
Total Requirements		**2,535**	**2,325**	**8,601**	**10,926**	**8,601**
	Total FTE	**4**	**4**	**12**	**16**	**12**

Justification of 2013 Program Changes

The 2013 budget request for Improving USGS Rapid Disaster Response through Preparedness and Robust Monitoring is $10,926,000 and 16 FTE, a net program change of +$8,601,000 and +12 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 hazards pose to human and natural systems and how to reduce losses and improve response. Recent events included the Midwest flooding, the Deepwater Horizon Oil Spill, Japan's Great Tohoku earthquake and Pacific-wide tsunami, the Icelandic volcanic eruption, and vector-carried disease and epidemics. Faced with rising expectations for rapid, robust information in response to these events, the 2013 budget request will allow the USGS to strengthen its capabilities both before and after disasters strike.

Program Performance

Robust Monitoring Networks for Effective Warning **+$7,851,000/+8 FTE**

Earthquake Early Warning and Rapid Event Characterization (+$851,000/+1 FTE)

Earthquake Hazards Program (+$851,000/+1 FTE)

To develop an earthquake early warning system similar to the one used successfully in Japan during the Tohoku earthquake, USGS monitoring networks must be improved to provide warning of earthquakes already underway to nearby areas. Academic partners of the USGS in California and Washington have recently received funding from a private foundation for research and scientific development of such a warning system on the U.S. west coast. In order for the

USGS Advanced National Seismic System (ANSS) to take the results of this research effort to implementation and deliver early warnings, further development of the ANSS is needed. The proposed work will build on the investments made by the USGS in 2009-2011, using American Recovery and Reinvestment Act (ARRA) funding, to upgrade seismic and Global Positioning System (GPS) networks in California, Oregon and Washington, which will enable earthquake detection and evaluation within seconds.

Improvements to both hardware and software will enable existing seismic and geodetic monitoring networks to process the seismic signals quickly and complete the early warning system. This process will begin with telecommunications improvements, so that warning can be delivered more quickly, and will extend to a partnership with social scientists to better understand how the technical information can be most effectively communicated. The result will be a system better suited to support emergency managers and other decisionmakers as they respond to earthquake activity.

Improve Rapid Response to Eruptions of Volcanic Ash (+$1,000,000/+3 FTE)

Volcano Hazards Program (+$1,000,000/+3 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 will 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 international aviation from even remote volcanoes in Alaska and the Northern Marianas. 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, ash-fall modeling capability to provide emergency managers, decisionmakers, and the public with the best possible information on expected time of onset and amount of ash fall. Working together with the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS), the USGS will engage users to design and provide useful text and graphic products derived from model runs and real-time observations. This will be complemented by field work to construct a more comprehensive database of ash-fall deposits in the Western United States to better inform and guide preparedness. Upgrades will 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.

Expanded Debris Flow Warning System (+$500,000/+4 FTE)

Landslide Hazards Program (+$500,000/+4 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 will expand the successful partnership to northern California and the southern part of Oregon. It will 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.

Innovative Streamgaging and Hydrologic Modeling to Reduce Flood Damages (+$5,500,000/0 FTE)

National Streamflow Information Program (+$5,500,000/0 FTE)

Effective flood fighting requires timely river forecasts, highly reliable real-time situational awareness of river levels and flood flows, and geospatial understanding of the extent and timing of potential flood inundation, all of which the USGS can provide. New technologies such as the acoustic Doppler current profiler (ADCP), which the USGS pioneered and developed, enables the USGS to provide more accurate and timely data, thus enabling forecasters to leverage recent improvements in precipitation monitoring and watershed modeling so that forecasts are more reliable. In addition, the use of mobile networks has expanded the potential applicability of USGS streamgaging capabilities. Both developments (the ADCP and mobile networks) contributed to the U.S. Army Corps of Engineers' successful management of Mississippi floodwaters in May 2011. There are growing demands to provide temporary real-time situational awareness of flood levels to threatened communities that lack permanent USGS streamgages. The recently developed, rapidly-deployable streamgage can be deployed to address this need by providing water level information needed to monitor flood heights, especially as water levels approach elevations requiring management of reservoir releases or levee performance. In 2013, USGS efforts will include development and staging of rapidly-deployable streamgages and other instrumentation, as well as rapid-deployment of field teams to temporarily collect emergency streamflow data and interface with local responders and local news media, in addition to adding more permanent streamgages.

The USGS is engaged in a demonstration effort to develop and standardize site-specific hydraulic models that convert forecasted flows into flood maps, enabling emergency management officials at the Federal, State, tribal and local levels to assess the flood threat. In 2013, this effort will be expanded. For the first time, emergency management officials and the general public can see, on a street-by-street basis, the expected extent of a flood hours, or even days, before it occurs. Such information can assist in reducing damages and in time, may help increase public acceptance of the value of floodplain management, reducing the devastating toll of floods on American communities.

Disaster Scenarios and Strategic Science Crisis Response +$750,000/+4 FTE

Geographic Analysis and Monitoring (+$750,000/+4 FTE)

To prepare for the impacts of hazards before they strike, the USGS will develop fully realized scenarios of disaster events in collaboration with Federal, State, local, and university partners, by simulating a real hazard event. By understanding the potential impacts of these hazards before they hit, the USGS will strengthen capabilities in warning, responding and recovering from such events. These scenarios will 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 to inform community decisionmaking on hazard mitigation and emergency response. In 2013, efforts will facilitate development of a standing Department of the Interior (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 will engage with other Interior bureaus, the Landscape Conservation Cooperatives (LCC), and the Department of the Interior Climate Science Centers (DOI CSC).

Science for Coastal and Ocean Stewardship

Science for Coastal and Ocean Stewardship						
		2011 Actual	2012 Enacted	Program Changes (+/-)	2013 Budget Request	Change from 2012 Enacted (+/-)
Coastal and Marine Geology		500	2,000	5,750	7,750	5,750
	FTE	2	5	12	17	12
Science Synthesis, Analysis and Research		0	0	1,000	1,000	1,000
	FTE	0	0	0	0	0
Total Requirements		**500**	**2,000**	**6,750**	**8,750**	**6,750**
	Total FTE	**2**	**5**	**12**	**17**	**12**

Justification of 2013 Program Changes

The 2013 budget request for Science for Coastal and Ocean Stewardship is $8,750,000 and 17 FTE, a net program change of +$6,750,000 and +12 FTE from the 2012 Enacted level.

Overview

Increased population growth, energy development and resource use in coastal, ocean and the Great Lakes areas have increased the need for scientific information to help local communities, State, tribal and Federal entities in decisionmaking and management. The National Ocean Policy (NOP) establishes priority objectives to ensure that current and future uses of ocean, coastal, and Great Lakes ecosystems and resources are effectively managed in a way that maintains and enhances the environmental sustainability of multiple uses. A cornerstone of the NOP is Coastal and Marine Spatial Planning (CMSP), a comprehensive mechanism to advance national objectives for our coasts, oceans, and Great Lakes. The USGS is recognized as a critical source of integrated 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 the CMSP component of the NOP.

This initiative will allow the USGS to expand efforts in those regions where CMSP objectives intersect with the Interior's responsibilities for energy resource development, adaption to climate change, ecosystem sustainability, and resilience of vulnerable native and indigenous communities. Addressing CMSP requirements in the Northeast, Mid-Atlantic, and Pacific Northwest, the USGS will provide information products across all regional areas, providing a model for effective information delivery for national CMSP implementation. In the Pacific Islands and Arctic, the USGS will develop additional products to enable native and indigenous communities to anticipate and respond to threats and opportunities in areas most vulnerable to climate change. A particular USGS focus will be on the processes of coastal and seafloor change that are linked to ecosystem health, maintenance of critical habitats, and the vulnerability and consequences associated with alternative and conventional energy development.

Program Performance

Comprehensive Mapping and Resource Assessments (+$2,250,000/+3 FTE)

Coastal and Marine Geology	(+$2,000,000/+3 FTE)
Science Synthesis, Analysis, and Research	(+$250,000/0 FTE)

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., the 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; multiresolution and multitemporal 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. Increased funding will 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.

In 2013, efforts will focus on enhancing access to and application of existing data and models. Development of consistent formats and delivery tools for CMSP priority geospatial, oceanographic, and biological information will provide CMSP planning bodies and other users increased access to information while decreasing inefficiencies in locating, evaluating, and integrating relevant information resources. Providing quality assured data in standard formats will minimize effort required by users and facilitate integration within and across regional areas to enable comparison of environmental responses to facilitate better planning decisions. New data and products will result from efforts that will 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.

Regionally Focused Integrated Research and Assessments (+$4,500,000/+9 FTE)

Coastal and Marine Geology	(+$3,750,000/+9 FTE)
Science Synthesis, Analysis, and Research	(+$750,000/0 FTE)

The products and activities discussed above have broad relevance across all CMSP regions and provide for more directed efforts focused on issues, conditions, and processes of particular

regional relevance. Regionally-focused efforts, while addressing objectives specific to those regions, will provide models for application to national issues arising in other regions.

Integrated Resource and Coastal Vulnerability Assessments – Arctic

The proposed increase will 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.

The proposal will support new coastline vulnerability assessments to define risks of seawater inundation, barrier island loss, shoreline change, and forecasts of likely landscapes under current and future climate scenarios. Products will inform coastal infrastructure considerations and integrate with ongoing USGS Arctic North Slope wildlife habitat forecasting to help support community decisions on means to sustain public safety, economic development, and subsistence and other natural resources. Specifically, the USGS will produce:

- Improved geological and geophysical data to refine understanding of oil and gas resources (through acquisition and interpretation of about 9,000 line-kilometers 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), improving understanding of the petroleum potential across EEZ and ECS.
- 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 will 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; developing 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.
- 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 engaging native communities through training

youth in USGS project efforts, designing community protocols for information sharing, and piloting approaches to incorporate local knowledge into project efforts.

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. 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.

Products developed will 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.

Hydraulic Fracturing

Hydraulic Fracturing						
		2011 Actual	2012 Enacted	Program Changes (+/-)	2013 Budget Request	Change from 2012 Enacted (+/-)
Fisheries: Aquatic & Endangered Resources		99	108	2,200	2,308	2,200
	FTE	1	1	10	11	10
Wildlife: Terrestrial & Endangered Resources		161	0	0	0	0
	FTE	0	0	0	0	0
Energy Resources		4,600	4,600	3,000	7,600	3,000
	FTE	23	23	12	35	12
Earthquake Hazards		0	300	1,100	1,400	1,100
	FTE	0	1	2	3	2
Groundwater Resources		135	520	2,100	2,620	2,100
	FTE	1	1	0	1	0
Hydrologic Research and Development		357	50	2,000	2,050	2,000
	FTE	1	0	1	1	1
Science Synthesis, Analysis and Research		105	0	600	600	600
	FTE	1	0	1	1	1
National Cooperative Geologic Mapping Program		0	0	2,000	2,000	2,000
	FTE	0	0	3	3	3
Total Requirements		**5,457**	**5,578**	**13,000**	**18,578**	**13,000**
	Total FTE	**27**	**26**	**29**	**55**	**29**

Justification of 2013 Program Changes

The 2013 budget request for hydraulic fracturing research is $18,578,000 and 55 FTE, a net program change of +$13,000,000 and +29 FTE from the 2012 Enacted level.

Overview

In March 2011, the White House released a "Blueprint for a Secure Energy Future," a comprehensive plan to reduce America's oil dependence, save consumers money, and make the United States a leader in clean energy industries. The Blueprint supports responsible development of the Nation's oil and natural gas, with the specific goals of promoting safe practices and reducing energy imports. The Interior, the U.S. Department of Energy (DOE), and the Environmental Protection Agency (EPA) each have a critical role to play in this mission.

With appropriate safeguards, shale gas and other unconventional resources can play an important role in the onshore domestic energy mix of the United States to meet its current and future energy needs. Shale and other gas formations are found throughout much of the United States and occur beneath Federal, State, tribal and private lands. Development and extraction of these unconventional oil and gas resources is increasingly 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 proppants under high pressure. Concerns over potential environmental, health, and safety impacts of hydraulic fracturing are increasing, while our understanding of these impacts is not well-developed, as evidenced by a lack of peer-reviewed literature and agency reports on such effects. Potential effects may include impacts to water resources, including contamination of aquifers and surface waters from drilling and hydraulic fracturing chemicals; cross-contamination of aquifers through faulty well construction and casing installation, release of methane and other greenhouse gases into aquifers, contamination from radioactive elements and other toxic chemicals in waters recovered during gas production, and impacts to the water supply. Other potential impacts may

include unintended seismic events from the subsurface injection of recovered drilling and rock formation fluids; deleterious effects on terrestrial and aquatic wildlife and ecosystems, landscape changes including soil erosion and habitat fragmentation, airborne pollutants, and socio-economic impacts to communities.

Program Performance

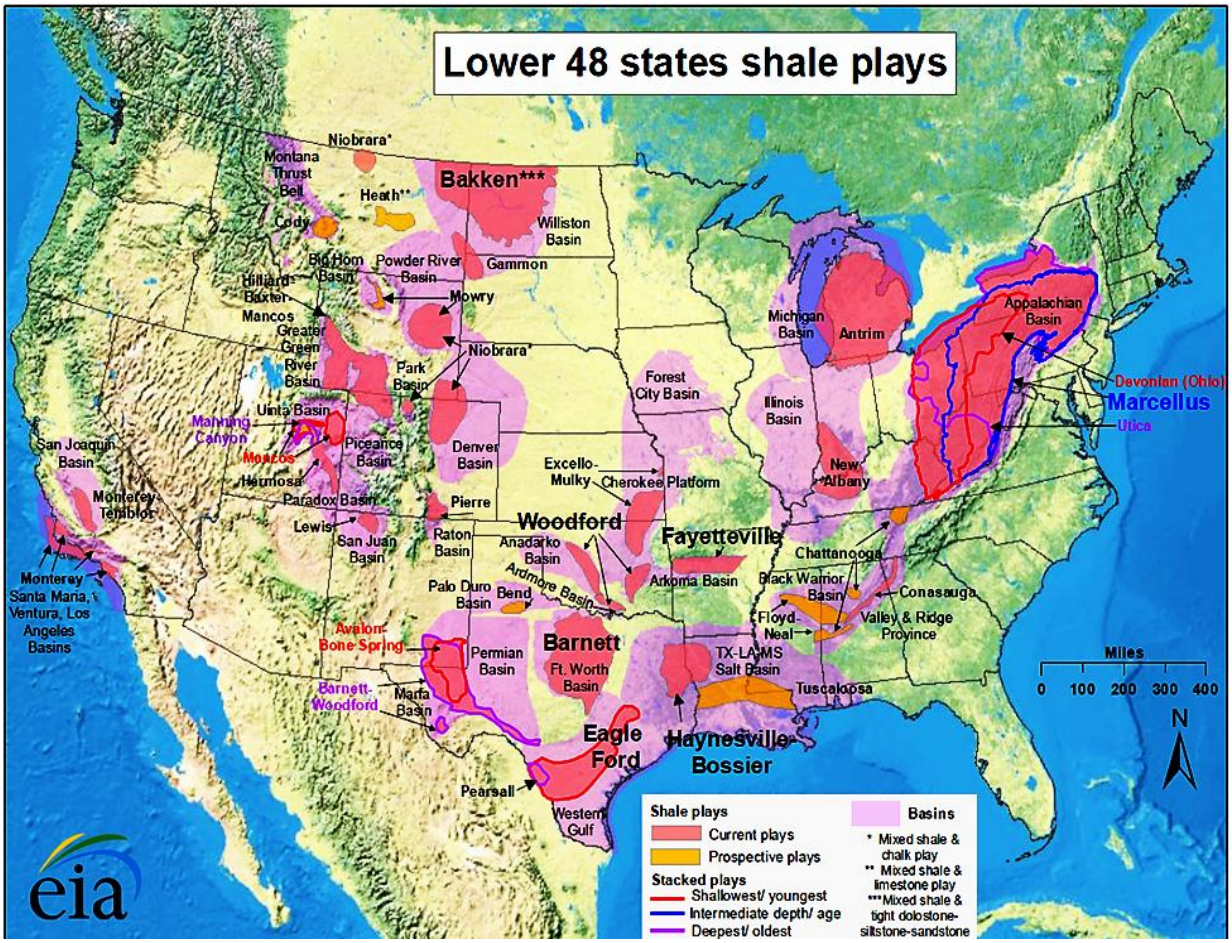
Hydraulic Fracturing (+$13,000,000/+29 FTE)

The 2013 budget supports a collaborative interagency research and development effort by the USGS, DOE, and EPA to address the highest priority challenges associated with safely and prudently developing unconventional oil and gas resources. The goal of this effort is to understand and minimize potential environmental, health, and safety impacts of energy development through hydraulic fracturing. Through this effort, the three agencies will build on current work, and collaboratively identify and coordinate priority research and development activities that support sound management and policy decisions by Federal, State, tribal, and local entities responsible for ensuring prudent development of energy resources and protecting human health and the environment.

In 2012, USGS research efforts are focused on the following: protecting water supply and water quality; obtaining background water quality measurements; studying effects on land use, terrestrial wildlife, and aquatic resources; studying induced seismicity; and conducting research and assessment on domestic unconventional oil and gas resources. These efforts are designed to understand the unconventional resource base, conditions of water quality and availability, and habitat conditions prior to land disturbance, drilling, and hydraulic fracturing (baseline studies). Studies are underway in several shale gas basins. In the Marcellus Shale gas area, for example, the USGS is studying the potential impact of hydraulic fracturing and gas production on water quality and the occurrence of natural gas in private water wells (the occurrence of so-called “stray gas”). The presence of gas in private water wells is of significant concern to citizens living in areas where shale gas production is underway.

The budget increase in 2013 will support priority research in eight areas: water quality and supply; monitoring and characterization of stray gas; characterizing the gas resource and related geologic framework; impacts on landscapes, habitats, and living resources; induced seismicity and earthquake triggering; socioeconomics of community changes; air emissions and pollutants; and comprehensive data integration. Research efforts will include assessments of undiscovered, technically recoverable, unconventional resources, evaluation of the potential for induced seismicity, development of groundwater flow models, new groundwater tracer techniques to detect the movement of hydraulic fracturing fluids, and water budget studies.

Deliverables include an atlas of U.S. unconventional hydrocarbon resource distributions based on current assessments; landscape-level maps that portray effects of land fragmentation; maps and databases of geochemical characteristics of formation fluids; sources of marginal-quality (e.g., brackish) water to replace fresh water used in hydraulic fracturing; three-dimensional geologic models to better understand rock structures to characterize the hydro-geologic framework; estimates of water use and hydrologic budgets; databases and reports characterizing surface water and groundwater quality; tables, databases and maps showing occurrence and distribution of naturally occurring radioactive elements; reports outlining effects of hydraulic fracturing and associated activities on terrestrial and aquatic species; and a draft protocol for evaluating the potential for earthquakes from the subsurface injection of fluids.



Map prepared by the Energy Information Agency showing locations of shale gas plays in the United States

USGS science for hydraulic fracturing will be conducted in collaboration with partners at the Federal, State, tribal and local levels to address their issues and concerns and to provide stakeholders with the basis for making policy, planning, regulatory, and resource management decisions.

Ecosystem Priorities

Ecosystems Priorities						
		2011 Actual	2012 Enacted	Program Changes (+/-)	2013 Budget Request	Change from 2012 Enacted (+/-)
Chesapeake Bay *		5,860	7,349	2,500	9,849	2,500
	FTE	24	29	10	39	10
Columbia River		12,907	12,537	1,100	13,637	1,100
	FTE	50	48	4	52	4
Florida Everglades		6,893	6,882	1,000	7,882	1,000
	FTE	30	30	2	32	2
Puget Sound		6,406	6,396	1,000	7,396	1,000
	FTE	26	26	5	31	5
California Bay-Delta *		6,012	6,002	2,000	8,002	2,000
	FTE	12	12	4	16	4
Upper Mississippi River		4,870	4,862	200	5,062	200
	FTE	23	23	1	24	1
Klamath Basin		2,631	2,631	901	3,532	901
	FTE	0	0	5	5	5
Upper Mississippi - Asian Carp		0	0	1,000	1,000	1,000
	FTE	0	0	3	3	3
Asian Carp Control and Great Lakes Framework**		121	2,617	2,000	4,617	2,000
	FTE	1	6	6	12	6
Sustaining Environmental Capital		0	0	2,000	2,000	2,000
	FTE	0	0	3	3	3
Information Synthesis and Management		0	0	1,000	1,000	1,000
	FTE	0	0	5	5	5
DOI Climate Science Center - Tribes		0	0	500	500	500
	FTE	0	0	0	0	0
Land Use Science		0	0	1,000	1,000	1,000
	FTE	0	0	4	4	4
Total Requirements		**45,700**	**49,276**	**16,201**	**65,477**	**16,201**
	Total FTE	**166**	**174**	**52**	**226**	**52**

* Updates from the BIB Corsscut Table includes: $110,000 for Land Remote Sensing that was added back into the 2013 Request, the reduction of $22,000 for Hydrologic Networks and Analysis is taken Information Management and Delivery, and $634,000 for Land Remote Sensing that was added back into the 2013 Request.

** Does not include 2012 $4,000 across the board reduction

Justification of Program Change (+$16,201,000/+52 FTE)

The 2013 budget request for Ecosystem Priorities is $65,477,000 and 226 FTE, a net program change of +$16,201,000 and +52 FTE from the 2012 Enacted.

Overview

Ecosystems support life on Earth. 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. Impartial scientific information is needed to improve societal understanding of the importance and function of ecosystems. 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 Interior's public trust stewardship responsibilities for the Nation's lands and waters.

Increases in 2013 will 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 will 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 will focus on invasive brown tree snakes and white-nosed syndrome in bats. Actions will be implemented to support the Administration's efforts in sustaining environmental capital.

Program Performance

Chesapeake Bay **(+$2,500,000/+10 FTE)**

Terrestrial, Freshwater, and Marine Environments	(+$1,300,000/+5 FTE)
Geographic Analysis and Monitoring	(+$500,000/+2 FTE)
Contaminant Biology	(+$100,000/+0 FTE)
Toxic Substances Hydrology	(+$100,000/+1 FTE)
National Water Quality Assessment	(+$500,000/+2 FTE)

The USGS provides critical science to restore the Nation's largest estuary and carry out the President's Chesapeake Bay (Bay) Executive Order (EO) strategy and associated action plan. The Interior, through the USGS, the U.S. Fish and Wildlife Service (FWS), and the National Park Service (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 NOAA, to strengthen science to support all of these goals. In 2013, the requested increase will enhance research to restore two key species in the EO strategy—brook trout and black ducks. The USGS will:

- Coordinate with agencies addressing the impact of shale-gas drilling to identify potential impacts on brook trout and develop predictive habitat models for native brook trout using landscape analysis and environmental DNA to assist in the siting of well pads and supporting infrastructure. The USGS will enhance efforts to identify potential impacts of land use and climate change on stream temperatures to help the FWS and the U.S. Forest Service plan for protection and restoration of brook trout populations. In addition, the USGS will continue development of science necessary to identify landscape sources of endocrine disrupting compounds and the specific pathways by which these emerging contaminants enter the Susquehanna and Potomac basins and threaten fisheries, wildlife, and human health.
- The USGS will enhance studies of black ducks to support the FWS and the Black Duck Joint Venture in achieving the EO goal to increase black duck populations. Additional funding will be used to improve an energetics model for wintering black ducks within the refuge system. A new effort would start to couple the energetics model with new models

of sea level rise and land use change to predict future impacts on coastal wetland and help identify the best areas for restoration of black duck habitats.

- Enhance monitoring and assessment of progress toward the water quality goals of the total maximum daily load. The USGS will work with partners to add critical monitoring sites in the watershed and improve techniques to assess and explain progress toward reducing nutrients and sediment. The USGS will work with the U.S. Department of Agriculture (USDA) to evaluate the effect of agricultural practices implemented as part of the 2008 Farm Bill Chesapeake Initiative and with Environmental Protection Agency and States to assess both agricultural and urban practices.
- Expand the Chesapeake land conservation prioritization system, which is considered a prototype by Secretary Salazar for the America's Great Outdoors initiative. The system, being developed with the NPS and NatureServe, will be used to help States, Federal agencies, and nongovernmental organizations identify areas to focus land conservation funding.
- Increase research on the effectiveness of winter cover crops in reducing both soil erosion and nitrogen runoff from agricultural fields into the Chesapeake Bay. Research is conducted in collaboration with the USDA Agricultural Resource Service, the Maryland Department of Agriculture, and local Soil Conservation Districts. Project scientists will 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.

Columbia River **(+$1,100,000/+4 FTE)**

Terrestrial, Freshwater, and Marine Environments	(+$300,000/+1 FTE)
Contaminant Biology	(+$100,000/+0 FTE)
Toxic Substances Hydrology	(+$100,000/+0 FTE)
National Streamflow Information Program	(+$100,000/+1 FTE)
National Geospatial Program	(+$500,000/+2 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 will 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 will address forage fish life histories, invasive species, related climate impacts, chemical and physical habitat degradation, and effects on economic and trust species. USGS scientists will 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 will take effect in 2025, could potentially affect flow regimes. USGS researchers will 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 2013 will address early detection and risk reduction of aquatic invasives in the Columbia River system.

USGS researchers will determine conditions in mainstem, estuarine, and tributary systems that increase the risk of 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, Brazilian pepper, and the Burmese python. The SFERTF recognizes the challenges that invasive species pose to the success of overarching ecosystem restoration efforts as well as achieving particular performance measures regarding plant and animal community sustainability and survivorship and distribution of species such as crocodiles and alligators. Funding will 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.

Puget Sound **(+$1,000,000/+5 FTE)**

Terrestrial, Freshwater, and Marine Environments (+$500,000/+3 FTE)
Hydrologic Research and Development (+$300,000/+1 FTE)
National Geospatial Program (+$200,000/+1 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, likely will 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 Indian 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 will support managers and decisionmakers by developing process-based monitoring and models at the ecosystem scale to identify and address risks to salmon. In addition, USGS researchers will 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 will 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 will provide managers with information on ecosystem responses to specific post-removal restoration actions, to ensure that restoration is effective.

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

Terrestrial, Freshwater, and Marine Environments	(+$1,000,000/+3 FTE)
National Water Quality Assessment	(+$1,000,000/+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 impacts 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, USGS scientists have developed a network of real-time flow monitoring stations in the Delta. These stations will be augmented to assist with determining the causes and rates of decreased sediment supply and to monitor turbidity fields in the Delta, which may have implications for Delta smelt survival and movement. The USGS will expand its research efforts to understand how flow conditions, water quality, and fish behavior affect fish survival, particularly Delta smelt survival. In doing so, the USGS will advance fundamental understanding, and the interactions among, the physical, chemical, biological, 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 will 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 will 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.

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

National Streamflow Information Program	(+$200,000/+1 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 may impact 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 also shared with State and local partners in this five-State region (Minnesota, Wisconsin, Illinois, Iowa and Missouri).

Klamath Basin Restoration Agreement **(+$901,000/+5 FTE)**

Fisheries: Aquatic and Endangered Resources (+$901,000/+5 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 will 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.

Asian Carp **(+$3,000,000/+9 FTE)**

Invasive Species ($3,000,000/+9 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. Also 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 posed by Asian carp and actions needed to minimize their impact in Minnesota and has unique capabilities in the region to provide research critical to its implementation.

Upper Mississippi River [+$1,000,000/+3 FTE]

Funding will 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 “Asian Carp Action Plan” developed by the Minnesota-Wisconsin Asian Carp Task Force. The increase will target specific research gaps identified in these planning efforts, including creating and improving methods to detect Asian carp at low population levels; identifying potential spawning locations in the UMRS; identifying habitats and locations most vulnerable to colonization by these invasive fishes; and improving and developing methods for targeted containment and control of Asian carp in UMRS habitats.

Great Lakes [+$2,000,000/+6 FTE]

Funding will 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; estimating minimum river length and water temperature to predict potential spawning locations of Asian carp in the Great Lakes Basin; identifying and developing attractant pheromones 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 will enable research to accelerate beyond the "proof of concept" stage and focus on transferring technology to managers for field use.

Sustaining Environmental Capital **(+$2,000,000/+3 FTE)**

Terrestrial, Freshwater, and Marine Environments (+$2,000,000/+3 FTE)

The recent President's Council of Advisors on Science and Technology (PCAST) report, titled *Sustaining Environmental Capital: Protecting Society and the Economy* (January 2012) notes that "Ecosystems and the biodiversity they embody constitute 'environmental capital' on which human well-being heavily depends." This "capital" includes clean water, storm protection, pollution prevention and mitigation and many other goods and services. Management decisions and actions such as ecosystem restoration, climate adaptation plans, or long term monitoring and assessments should take into account biodiversity and ecosystem services so that trade-offs between management alternatives can be understood and incorporated into decisionmaking. Questions such as, "Which management action will yield the greatest economic benefit to communities from restoration of commercial fisheries, prevention of floods or protection of at-risk species?" can be answered through such an approach. An ongoing assessment of the value of ecosystem services inherent in management options and decisions enhances our ability to make science-based decisions that reduce the risk and uncertainty of management and that best enhance the well-being of communities. Development of a framework that allows ongoing national assessment of biodiversity and ecosystems services will be a key first step in promoting sustainability in this project. This effort will require development of effective methods for incorporating the results of these assessments into management decisions as well as an enhanced informatics and a broad data integration system coordinated across Federal agencies.

The project will evaluate existing USGS, Interior, and partner data and information from monitoring and ecosystem restoration programs to identify candidates for assessment of biodiversity and ecosystem services. Potential examples include Gulf of Mexico and other ecosystem restoration efforts; the Bureau of Land Management's Assessment, Inventory and Monitoring (AIM) Strategy; and USGS assessment efforts such as WaterSMART pilots and National Water-Quality Assessment (NAWQA) study units. Funding dedicated to this project will permit the USGS to provide assessments in selected pilot areas, leading to the development of better methods and approaches to integrating assessments of biodiversity and ecosystem services with monitoring and research that is ongoing within existing programs. Development of a scalable national assessment framework may inform activities such as assessments of biodiversity and ecosystems services driven by the National Climate Assessment and provide a national example that could be used by the International Science-Policy Platform of Biodiversity and Ecosystem Services. While other agencies have incorporated ecosystem services into

mapping (EPA's National Atlas of Ecosystem Services) and for environmental markets in rangeland, forests and agriculture (USDA), this initiative would build on these efforts to support the first coordinated multidepartmental effort of its kind in the Federal Government to develop a standardized ecosystem services framework.

Ecosystem Information Management **(+$1,000,000/+5 FTE)**

Science Synthesis, Analysis, and Research (+$1,000,000/+5 FTE)

In response to the President's Council on Science and Technology Advisors (PCAST) report on *Sustaining Environmental Capital: Protecting Society and the Economy*, the USGS proposes to provide tools, models and applications that allow ecosystems resource managers and users to access and interact meaningfully with ecological data from a broad range of sources, improve data documentation through complete and standardized metadata, and apply data to aid in ecological forecasting in priority regions where ecosystems are vulnerable to change. Researchers will apply their expertise in standards, data synthesis and interoperability, and information discovery to accomplish these activities by assembling a robust and flexible data service for ecosystem activities in critical areas including the Chesapeake Bay, the Columbia River, the Puget Sound, and the Upper Mississippi River, with a focus on key management issues including the spread of invasive species, secure water supply, and energy development. The newly developed data service for ecosystems activities would be used to aid data discovery, provide improved accessibility, and increase understanding of relevant data.

In 2013, researchers will work closely with all of the USGS mission areas and other Interior bureaus to move forward in developing a national monitoring framework. This framework will be a standards-based, integrated capability for management of, and access to, data and information critical to ecosystems management and restoration. It will include high quality data, curated in consistent, standard formats that can be modeled for ecosystem forecasting, visualized, or downloaded and integrated into models or other applications. The framework will be augmented by related USGS efforts, including the Integrated Taxonomic Information System, which provides the scientific and common nomenclature for species; the Protected Areas Database of the United States, which contributes information about the status of land designated for conservation across the Nation; and the Gap Analysis Program national datasets for land cover and species distributions. The framework will allow comparisons of environmental responses at broader scales for better planning decisions.

Partnerships with the data.gov initiative in other subject areas such as the Ocean and Energy portals will be leveraged to provide public portal access to the data service. Integrated assessment decision-support tools currently being developed and tested in various habitat conservation and ecosystem restoration initiatives will be linked to the foundational data service to inform planning and management groups and facilitate exploration of multiple restoration scenarios and resource tradeoffs.

Department of the Interior Climate Science Centers – Tribes (+$500,000/0 FTE)

National Climate Change and Wildlife Science Centers/Department of the Interior Climate Science Centers (+$500,000/0 FTE)

A key effort identified in Secretarial Order 3289, in the development of the DOI CSCs was to partner with local Tribes to satisfy their climate science needs. The proposed increase will support the Northwest DOI CSC and the Northeast DOI CSC in working closely with tribal partners to identify key resource management endpoints in the Columbia River and Great Lakes ecosystems, respectively. USGS researchers will then develop climate driven, ecosystem based models that will allow tribal managers to project impacts to natural resources of concerns. Results from this work will be used to develop adaptation management strategies to help ensure long-term sustainability of these resources.

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

Geographic Analysis and Monitoring (+$1,000,000/+4 FTE)

The Geographic Analysis and Monitoring Program (GAM) conducts research on the land changes occurring in the United States to better assess the causes and consequences of land cover change. The program will 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, GAM researchers will analyze how these ecosystem changes impact the services provided by the ecosystems, including water filtration and storage, carbon sequestration, fisheries, and recreation. Research will be conducted in collaboration with other Interior bureaus, the DOI CSCs, the LCCs, other Federal agencies, and State and local governments. Research products will 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.

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Other Program Changes

Program Increases

Ecosystems

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

White-nose syndrome (WNS) is a wildlife disease that has resulted in the loss of approximately six million bats of six different species in eastern North America. Since first described in 2007, WNS has been detected in 16 States and four Canadian provinces, and the disease continues to spread. The disease is caused by a recently discovered fungus, *Geomyces destructans*, which may have been accidentally introduced to North America by a tourist who visited a cave in Europe. Bats are the primary predators of night-flying insects, and the natural pest-control services that they provide are valued at an average of $22.9 billion to agriculture in the continental United States each year (*SCIENCE, Volume 332, April 1, 2011)*. WNS research and monitoring programs continue to provide critically needed science information to Interior, State, and tribal wildlife management agencies. Ongoing USGS research and monitoring activities are geared toward providing enhanced disease surveillance, improved diagnostic tools, and 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 increase in the Wildlife Program would be used to enhance surveillance and diagnostic capacity to detect the continued spread of WNS; bolster research on environmental factors controlling persistence of the fungus in the environment; develop management tools, particularly the development of a vaccine; and conduct research on mechanisms by which WNS causes mortality in bats, focused on immunology and pathogenesis.

Coral Reef Ecosystem Research (+$500,000/+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 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 2013, the increase in Terrestrial, Freshwater, and Marine Environments will enable USGS investigators to increase research in support of the NOP and the U.S. Coral Reef Task Force (CRTF) in collaboration with the Office of Insular Affairs. The USGS will provide the science to better understand how corals respond to natural and anthropogenic changes in the environment by increasing the 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 will 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)**

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 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 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 Invasive Species Program will 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.

Climate and Land Use Change

Climate Research and Development **(+$1,000,000/0 FTE)**

The USGS Climate Research and Development (R&D) Program's long-standing and globally respected expertise in studies of past climate, geology, hydrology, geography, and biology provides the opportunity to document patterns of climate and land use change on daily to millennial timescales and to assess the impacts of changes on local, regional, and national scales. Climate R&D activities are designed to advance 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 these changes. Climate R&D data contributions improve model performance and the ability to forecast likely changes under a range of climate and land use scenarios.

This increase will support priority climate research in areas such as studies of the paleoclimate records and studies on sea level rise and its impact on ecosystems, including coastal wetlands and estuaries, mountain habitats, deserts, and marine ecosystems.

Carbon Sequestration (+$250,000/0 FTE)

The 2013 proposed increase will be used to complete the biologic and geologic national assessments as well as publish the assessment reports, journal papers, and models. The program will continue to collaborate with other Interior bureaus, Federal agencies, State Geological Surveys, universities, and user communities on future carbon research.

Science Support for DOI Bureaus (+$6,450,000/4 FTE)

The USGS continues to support the Landscape Conservation Cooperatives (LCC), as well as other Federal, State, tribal, academic and private ecoregional fish, wildlife and land conservation efforts by delivering integrated ecological and population modeling science across national efforts. USGS climate science support takes a variety of forms, depending upon the LCC and USGS bureau needs. USGS climate change research, data management, modeling, and tool development can be employed to inform new Federal, State, tribal, and private management strategies for terrestrial and freshwater fish and wildlife species. The USGS has provided both dedicated research scientists and access to a full range of expertise within USGS science centers to respond to USGS bureau and LCC identified priorities. In addition, USGS efforts to support the LCCs include funding for development of database tools to deliver necessary information to LCC staff easily, inexpensively, and quickly. The FWS, the Bureau of Land Management (BLM), and NPS have identified a number of high priority issues that transcend specific LCCs which include science support for adaptive management and structured decisionmaking and other strategic and tactical research to meet the priority information needs identified by the FWS; NPS priority research on climate change adaptation and ecosystem change in parks, and other high priority biological research, monitoring, and technical assistance; and BLM priorities on non-forest fire research and ecoregional assessments of western systems.

Energy Minerals and Environmental Health

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

The USGS Mineral Resources Program (MRP) will conduct research on rare earth element (REE) resources to understand the geologic processes that concentrated known REE resources at specific localities in the Earth's crust in order to assess quantities, qualities, and areas of undiscovered REE resources for potential future supply. Geologic, geochemical, and geophysical characterization studies of domestic REE districts and deposits will provide criteria to be applied in the assessment of undiscovered REE resources, both domestically and internationally. REE resources in more unconventional geologic environments will be evaluated as new sources of potential REE supply. Research on mineral environmental pathways and biogeochemical behavior of REE and associated metals will be conducted to better understand potential impacts of REE resource development on human and ecosystem health, providing critical information for sustainable development or REE resources.

New Energy Frontier – Wind Energy (+$1,000,000/+2 FTE)

USGS research, modeling, and monitoring are already being applied to evaluate the impacts to fish and wildlife associated with the widespread development of wind energy. The infrastructure needed for energy capture and transmission includes wind turbines as well as towers, cables, roads, and sea bed corridors, and with an impact of increased boat traffic. This increase will allow the USGS to increase efforts directed toward understanding and assessing the impacts of

existing and projected large-scale development of wind farms. The Energy Resources Program will work toward developing an assessment methodology for impacts of wind energy development that can be applied nationwide. To that end, the USGS will hold several workshops to bring together multidisciplinary expertise in the field of wind energy impacts, to develop a consensus of what an impact assessment should include, review what science is already robust, and identify what further science needs to be conducted. The workshops will be held throughout 2012, the results of which will direct the research needed and guide development of the assessment methodology in 2013 and 2014.

Natural Hazards

Eastern U.S. Earthquake Hazard Research and Assessment (+$1,600,000/-4 FTE)

The magnitude 5.8 earthquake in central Virginia on August 23, 2011, was felt by approximately 30 million people in 20 States, shut down a nuclear power plant for several months, and resulted in over $100 million in property damages. This event provided new and dramatic evidence of the earthquake hazard in the Eastern United States and the potential for widespread disruption and damage this threat poses. This event also provides an exceptional opportunity to advance understanding of the causes of earthquakes in the Eastern United States, to refine our assessments of future seismic shaking intensity and distribution, and to promote the implementation of this new knowledge in building codes and other public safety measures.

It is generally thought that Eastern earthquakes occur on ancient geologic faults that have been re-activated in the current stress conditions in the Earth's crust. The scientific approach in the Earthquake Hazards Program will be to examine in detail the geologic and tectonic setting of the Virginia earthquake and then use this information as a guide to identify similar locations in the Eastern United States that may be susceptible to earthquakes. Target regions of interest are eastern South Carolina, eastern Tennessee, western Ohio, northeastern New Jersey (New York City area), northern New York, and central New Hampshire; all areas with low level but persistent seismicity. Particular attention will be given to areas near large urban centers.

In 2013, work will be directed toward 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 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.

A continental scale, transportable seismic array under project EarthScope, sponsored by the NSF, will move into the Eastern United States during 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.

In 2013, the Earthquake Hazards Program expects the FTE estimate to decrease as a result of attrition and implementation of workforce plans.

Water Resources

Hydrologic Research and Development (+$1,300,000/0 FTE)

Understanding Organic Matter for Cleaner Water

Characteristics and fluxes of natural organic matter determine the transport of carbon, nutrients, and contaminants in surface water. Recently developed techniques for continuous in-situ fluorescent measurements of organic matter have been demonstrated to substantially improve understanding of the fate of organic matter, as well as mercury and other toxic metals that bind to natural organic matter. Development of an extensive, continuous monitoring network for organic matter will inform development of cost effective best practices to reduce exposure to contaminants in lakes and streams and promote safer water supplies and healthier aquatic ecosystems.

The 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. These models are widely used by resource managers concerned with water availability for domestic, agricultural, industrial, and recreational use as well as the health of aquatic and riparian ecosystems. The National Hydrologic Model will support coordinated, comprehensive, and consistent hydrologic model development for numerous programs within the USGS, as well as water resource managers in other bureaus, Federal agencies, and States.

Fire and Water: Hydrologic Impacts of Wildfire

Wildfires have increased in size and severity in the United States in the last 30 years. Over 60 million people are supplied with water from mountain river basins that contain vegetation susceptible to burning by wildfires. Large fires and post-fire consequences in the watersheds of major population centers like Denver have increased awareness of fire effects on water supplies and ecosystem services. Fire affects the timing, quantity, and quality of water from watersheds and has impacts on several provisioning, regulating, and cultural components of ecosystem services. Fire science research in the USGS is of vital importance to the Nation and the USGS leads the national effort to measure and predict the effects of fire on water supplies. However gaps remain in our capability to understand and predict the timing and magnitude of fire effects on water supplies, including flooding, sediment impacts from erosion and debris flows, the form and fate of contaminants and other chemicals entrained in the water during post-fire flows, and effects on water treatment processes including the assessment of risk of the formation of disinfection byproducts. The proposed increase will enable the USGS to strengthen our capability to assess the resiliency of the Nation's water supply to natural hazards and will increase our ability to respond to pressing issues of climate variability and ecosystem change.

Understanding and Adapting to Warming in Northern Alaska

Interior Alaskan ecosystems are responding to dramatic warming that has persisted for several decades, resulting in measurable changes in temperature, moisture, vegetation, streamflow, and permafrost distribution. Accurate predictions of future system responses are critical to understanding and forecasting the effects of climate change on the Nation's northern resources and providing objective information necessary for the public and policymakers to derive informed decisions for adaptation strategies. The USGS has established a research and observation project within the Yukon River Basin (YRB) of interior Alaska, with research components that link changes in climate and water to their effects on wildlife, human subsistence, and climate regulation.

Increased funding in 2013 will support development of integrated empirical and mechanistic based forecasting models of changing permafrost, hydrology, vegetation dynamics, terrestrial wildlife habitat and diversity, and aquatic productivity. Beneficiaries of the USGS work include: the tribal Watershed Council; tribal and local governments and the communities they represent; the FWS; and Alaska State agencies including the Departments of Community and Economic Development, Environmental Conservation, Fish and Game, Natural Resources, and Transportation and Public Facilities. Products developed will include, baseline permafrost mapping and incorporation into hydrologic models with imposed climate variation to evaluate consequences of warming and a multidiscipline assessment of lake drying and related effects on wildlife and ecosystems. Publications would include maps, modeled results, USGS reports, and journal articles. The modeling will also be critical for managing infrastructure, as well as natural resources in Alaska in the future.

Core Science Systems

Data Preservation **(+$1,000,000/+3 FTE)**

In 2013, the USGS proposes to move the National Geological and Geophysical Data Preservation Program (NGGDPP) to a new budget subactivity: Science Synthesis, Analysis, and Research (SSAR) in Core Science Systems. This request does not reflect an actual increase in the overall USGS budget request for this effort; it moves the funding and functions to the SSAR subactivity as part of an internal transfer of funds (see the associated decrease for Data Preservation). Efforts are 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 USGS cooperates with State geological surveys and other Interior bureaus.

Program Decreases

Climate and Land Use Change

Landsat Development (-$1,750,000/0 FTE)

The USGS received $2.0 million in the 2012 Omnibus appropriations bill to support program development activities for Landsat satellites 9 and 10. In 2012, these funds are being used to consider options to obtain, characterize, manage, maintain, and prioritize land remote sensing data and to support the evaluation of alternatives for a Landsat 9 mission and other means for acquiring data. This evaluation of alternatives will help inform the 2014 budget formulation process. In 2013, this activity will be decreased by $1.75 million, providing $250,000 to continue these efforts. The USGS will continue to work with the Office of Science and Technology Policy, the National Aeronautics and Space Administration (NASA), and the NOAA to examine alternatives for providing land remote sensing data in a cost effective manner.

Energy Minerals and Environmental Health

Mineral Resources (-$5,000,000/-39 FTE)

The MRP supports data collection, analysis, and research to better understand the nature and availability of domestic and global mineral resources. Recognizing fiscal constraints, difficult choices resulted in targeted reductions of this program to support priorities, such as research on rare earth elements, as well as advancing priorities elsewhere in the budget request. Reductions in this program will result in elimination of research on the relationship between minerals and human health, and reduction in support for other mineral environmental work. The reduction will impact collection of geologic and mineral deposit data in Alaska; collection, analysis, and dissemination of international minerals information and material flow studies; and reduce analytical capabilities, resulting in the consolidation of analytical facilities supported by the MRP. The reduction will also require a phased initiation of the new domestic mineral resource assessment in 2013, which will proceed with stepwise implementation, extending the time required to complete the assessment. This reduction will reduce the MRP's ability to assist other Federal agencies who rely on timely, accurate, and unbiased mineral resource data and information for land management and policy decisionmaking.

Mineral Resources External Research Program (-$250,000/0 FTE)

The Mineral Resources External Research Program (MRERP) is the only Federal source of grant funding for research outside of the Federal Government to address key problems related to nonfuel mineral resources. The proposed funding reduction will terminate the MRERP in 2013, and end support to States and universities to conduct this research. Recognizing fiscal constraints, difficult choices resulted in targeted reductions, such as funding for grants, so funds could be used to support departmental and Administration priorities elsewhere in the budget.

Energy Resources – Conventional Energy (-$1,000,000/-2 FTE)

Since 1975, the Energy Resources Program's (ERP) State Cooperative Project has developed and funded cooperative agreements with more than 30 State geological agencies, focused primarily on the collection of coal resource data. State agency geologists collect and evaluate geologic data that are used by States and the USGS for resource evaluation. The States enter

the information into the National Coal Resources Data System, which is used for the USGS coal resource assessments. Funding to many of the States would be eliminated. Agreements would be continued only with those States for which information is needed on current assessments. The ERP also conducts research, assessment, and environmental impacts of oil shale. The ERP recently released in-place assessments of the richest oil shale deposits in the country, estimating 4.2 trillion barrels of oil. Reductions will slow work to determine how much of that oil is technically recoverable within these basins, as well as environmental impacts of potential oil shale development. Fiscal constraints resulted in difficult choices to target reductions so that funds could be used to support priorities elsewhere in the budget, including priorities such as New Energy Frontier.

Impact of Environmental Contaminants **(-$500,000/-3 FTE)**

Contaminant Biology activities focus on understanding the role of environmental drivers key to sustaining human and animal health. The proposed funding decrease would reduce research to assess impacts of environmental contaminants (including endocrine disrupting chemicals) on human, animal, and ecosystem health. The decrease would reduce support for technical assistance on emerging issues and environmental disasters, such as the Deepwater Horizon Oil Spill. This funding reduction will eliminate monitoring and data collection used by States to meet national water quality criteria under the Clean Water Act. Research activities would continue at a reduced level. Fiscal constraints resulted in difficult choices to target reductions so that funds could be used to support priorities elsewhere in the budget, such as WaterSMART.

Methods Development and Assessments **(-$2,000,000/-11 FTE)**

Toxic Substances Hydrology activities address emerging environmental contamination problems that pose significant risk to human, ecological, and environment health by conducting research which provides reliable scientific information and tools that explain the occurrence, behavior, and effects of toxic substances in the Nation's natural environments. The proposed reduction would substantially decrease activities that characterize environmental contamination by pharmaceuticals, endocrine-active chemicals, pesticides, and other priority and emerging environmental contaminants. The proposed decrease would substantially limit developing new laboratory methods to measure previously unmeasured emerging contaminants; quantifying relative contributions of contaminants from various industrial, agricultural, and human and animal waste sources; identifying adverse ecological health effects; and assessing human exposure through drinking water from both domestic and public water supplies. The proposed decrease would terminate plans to initiate studies on environmentally friendly approaches to uranium resource extraction and shale gas development. Other Federal agencies would rely on existing information to protect the environment and drinking water, and to approve the safe use of pesticides, pharmaceuticals, and other industrial chemicals. Fiscal constraints resulted in difficult choices to target reductions so that funds could be used to support priorities elsewhere in the budget, such as WaterSMART.

Natural Hazards

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

This study implements the Coastal Ecosystems near-term priority of the Ocean Research Priorities Plan. Working collaboratively with NOAA, EPA and State and local public health agencies, the USGS has expanded 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 expanded 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. Reductions would terminate efforts to expand the availability of such tools and end research efforts to mitigate the occurrence and consequence of pathogen "events" and better understand the controls of such events and their consequences for ecosystem and human health. Sustained application of tools previously provided, and migration of model enhancements into the decisionmaking framework, will only be supported as resources from end users (local and regional public health agencies) allow. Fiscal constraints resulted in difficult choices to target reductions so that funds could be used to support other coastal and ocean priorities.

Multi-Hazards - National Volcano Early Warning System (-$700,000/-2 FTE)

This decrease reduces the second phase of the National Volcano Early Warning System under Multi-Hazards Initiative (NVEWS) enhancements, which were focused on monitoring infrastructure in Alaska and on programwide observatory interoperability. The first phase of NVEWS implementation was applied programwide with funding through American Recovery and Reinvestment Act of 2009. With NVEWS funds first introduced to the base program in 2011 and increased in 2012, the monitoring network at Makushin Volcano was enhanced to NVEWS standards and network improvements were made at Newberry Volcano, Oregon. Observatory interoperability was achieved with respect to exchange and analyses of seismic data. Work will continue on other aspects of data management, on partnering with the National Earthquake Information Center (NEIC) to provide 24/7 backup alerting of seismic unrest, and on other monitoring-related enhancements, however the pace of progress will be slowed. Fiscal constraints resulted in difficult choices to target reductions so that funds could be used to support priorities elsewhere in the budget, including Rapid Disaster Response.

Volcanic Observatory Assessments (-$300,000/-1 FTE)

Geologic and geophysical investigations that provide a volcanic hazards framework will be reduced or slowed with an impact on the capabilities of USGS volcano observatories. These investigations typically consist of geologic mapping (in conjunction with geochemical, geochronological, and petrological studies) or geophysical surveys to best understand the processes that built the volcano over time, and that continue. Scientific background, updated hazard assessments and the ability to provide local land managers, emergency managers, and communities with scientific information utilized to assess vulnerability and likely scenarios would be impacted by this reduction. Fiscal constraints resulted in difficult choices to target reductions so that funds could be used to support priorities elsewhere in the budget, including priorities such as Rapid Disaster Response.

Water Resources

Availability Studies (-$2,000,000/-11 FTE)

The Groundwater Resources Program (GWRP) is currently conducting multidisciplinary regional studies of groundwater availability that are the building blocks for a national assessment and is the principal government entity examining this important national resource. Reductions would result in the following regional groundwater evaluation studies being terminated: the Floridan

aquifer system (AL, FL, GA, and SC); the Northern Atlantic Coastal Plain aquifer system (DE, MD, NJ, NY, and VA); and the Lower Tertiary/Upper Cretaceous aquifer system of the Northern Great Plains (MT, ND, SD, and WY). The regional assessment of groundwater status and trends in the Hawaiian volcanic-rock aquifers that was scheduled to begin in 2013 would not be started. These reductions are proposed in order to address priorities identified in the WaterSMART initiative and specifically to establish a National Groundwater Monitoring Network (NGWMN) as authorized by the SECURE Water Act. In 2013, the USGS will begin implementation and development of this national network, which will provide some support for existing GWRP activities (Climate Response Network) and WaterSMART (indices) but will not replace the regional groundwater availability assessments.

Methods Development and Monitoring **(-$6,049,000/-35 FTE)**

The National Water-Quality Assessment Program (NAWQA) is responsible for providing nationally consistent descriptions of current water quality conditions and changes in these conditions for the Nation's freshwater streams and aquifers. With proposed decreases the NAWQA Program would begin making changes to prepare for restoring the national stream and groundwater quality monitoring networks to levels specified in the Cycle 3 Science Plan for the period 2013-2022, but would not accomplish major restoration of a number of long term water quality monitoring sites at this level. NAWQA will not be able to meet the 2013 planned performance measure—to complete 10 percent of the decadal national assessment (as specified in the Cycle 3 Science Plan) of streams and groundwater in support of water resource decisionmaking. Instead, 2.3 percent and 3.3 percent of the decadal assessments for streams and groundwater, respectively, would be completed in 2013. This represents an overall reduction of about 75 percent from the 2013 assessment activity called for in the Cycle 3 Science Plan. The decrease allows for a redirection of funds to address the priority issues identified in WaterSMART, which provides an additional $3.5 million to the NAWQA Program.

Federal Network Operations **(-$2,847,000/0 FTE)**

This reduction is for the increase in the National Streamflow Information Program's 2012 enacted appropriation, which was used to support the federally funded backbone of the streamgaging network. The decrease allows for a redirection of funds to address the priority issues identified in the Rapid Disaster Response, which funds NSIP at $5.5 million.

Information Management and Delivery **(-$3,300,000/-19 FTE)**

Targeted reductions to this program are proposed to fund priorities identified in the WaterSMART initiative, including information management and synthesis of water quality influences on water availability. The proposed reduction to the Hydrologic Networks and Analysis program would limit the availability of information on climate variability on water availability, particularly throughout the Western United States. Capacity to conduct watershed modeling that is conducted in support of the Bureau of Reclamation water management programs would be curtailed. The USGS water quality partnership with the NPS, which supports water quality management in the Nation's parks, would be reduced. Research on the effects of coal-bed methane production on water resources of the West will be inhibited. Because of a decrease in personnel to upgrade NWIS software, to keep real time systems running, and to archive streamed data in a timely manner, the proposed reduction would curtail the USGS's ability to provide real-time and archived water resources data and information to all users. HNA support of the activities of the Advisory Committee on Water Information (ACWI), a

Presidential Federal Advisory Committee Action team (FACA), and its subcommittees, will be reduced, including possible support of the annual meeting.

Interpretive Studies (-$4,963,000/-16 FTE)

The proposed reduction to the interpretative side of the Cooperative Water Program (CWP) reduces available science funding that supports foundational, and often long-term, assessments and research on water availability and water census issues, including on water use, environmental flows, groundwater and surface water relations, and water budgets; emerging topics first identified at local and State levels; quality assurance that ensures that information collected across State boundaries are consistent and comparable so that individual assessments inform and are integrated with key regional and national priorities, including water use, energy development, and sustainable ecosystems; and management decisions at local, State, and tribal levels. The number of the CWP water projects supporting the above science and research would be reduced by approximated 150 from 700 supported in 2012.

The proposed reduction affects both the interpretative side (as described above) and data collection activities, which currently support more than 75 percent of the Nation's streamgaging (6,000 gages), monitoring at 8,000 groundwater sites, and about 4,000 water quality sites. The number of data collection sites would decrease by 1,300 to about 16,200. In the current fiscally austere climate, the decrease in Cooperative Water funding allows the USGS to use scarce resources to address other Bureau priority issues.

Elimination - Water Resources Research Act (WRRA) (-$6,490,000/-2 FTE)

Established in 1984, by the Water Resources Research Act, the WRRA Program provides funding to 54 Water Resources Research Institutes at land grant universities—one in each State, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam for the Federal-State partnership in water resources research, education, and information transfer. The elimination of this program allows the USGS to redirect scarce funds to other priority issues, such as WaterSMART.

Core Science Systems

Ecosystems Science Centers (-$700,000/-6 FTE)

The proposed reduction in Science Synthesis, Analysis, and Research impacts data and information management, and information technology efforts at USGS ecosystems research science centers, including managing and documenting data and data integration projects. Ecosystems science center staff provide credible, applicable, unbiased information for science-based decisionmaking, particularly as it pertains to the conservation, management, and use of the Nation's biological resources. The proposed decrease would reduce staff scientists and data managers who perform Geographic Information System (GIS) analyses; build Web applications; and manage, document, and share scientific research and monitoring data related to invasive species, wildlife disease, bird conservation, restoration ecology, endangered species, fisheries and fish habitat, and other important science topics. As a result, resource managers will not have access to this information when making decisions regarding habitat restoration. The proposed decrease allows for a redirection of funds for priority ecosystem issues found particularly in the Chesapeake Bay, the Columbia River, the Puget Sound, and the Upper Mississippi River.

National Geological and Geophysical Data Preservation (-$996,000/-3 FTE)

The USGS proposes to move the funding and functions for this effort to Science Synthesis, Analysis and Research (see the associated increase for Data Preservation).

National Cooperative Geologic Mapping Program – Federal and State Partnerships (-$1,500,000/-2 FTE)

This program provides geologic maps and three-dimensional framework models that are used in planning, resource management, and mitigation of hazards. The USGS proposes to reduce funding in the NCGMP using the formula provided in the National Geologic Mapping Act. The NCGMP would continue to provide geologic maps of subsurface data important for developing models that conceptualize groundwater flow, mineral deposition, and earthquake shaking, but at a reduced level. Documenting landscape change for evaluating geologic hazards such as flash floods, dust storms, and drought would continue in 2013. The proposed decrease allows for a redirection of funds to focus on the WaterSMART and hydraulic fracturing priorities.

Administrative Services – Science Synthesis, Analysis, and Research (-$446,000/-3 FTE)

The proposed internal transfer, which would eliminate the Information Resources budget line, includes moving library services and information synthesis to Science Synthesis, Analysis, and Research. In 2013, the USGS proposes to reduce library services available at the Menlo Park and Flagstaff locations to basic support for onsite collections. These reductions are necessary to maintain the overall information capabilities of the entire bureau. The cuts are targeted in ways that maintain the investment in scientific research capabilities as provided by the USGS Libraries Program. The services being reduced in Menlo Park, CA and Flagstaff, AZ will be augmented by enhanced support bureauwide from the remaining full-service libraries in Denver, CO; Reston, VA; and Lafayette, LA.

Administration and Enterprise Information

Administrative Services – Science Support (-$2,369,000/-8 FTE)

The Science Support Subactivity includes science quality and integrity, communications, bureau leadership and budget formulation and analysis. The 2013 budget request required difficult choices including reductions in which administrative support will be impacted. Functions affected could include support services in acquisitions, policy analysis and accounting and financial management oversight. Acquisition and grant services necessary for conducting science projects could be delayed and could result in reducing the number of awards that can be made in a fiscal year. A reduction in Human Capital services could impact the ability to maintain existing levels of service to Interior, Office of Personnel Management, and USGS customers. Further, cooperative science projects and training with Native American Tribes will 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.

The reduction will also eliminate participation in professional conferences and trade show programs, which may impact the USGS's partnerships with the larger scientific community. These typically involve the USGS presence at major national events, including annual meetings of the Geological Society of America, the American Geophysical Union, and others. These

national meetings are a core outlet where USGS scientists build and share knowledge by presenting findings, which are the result of Federal investment in science, and by participating in panels with their peers. The decrease allows for a redirection of funds to advance administration and departmental priorities.

Administrative Services – Security and Technology (-$1,322,000/-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 will require reductions to the Enterprise Geospatial Information Services support effort that works with mission programs to leverage GIS software and services to visually communicate natural science information to improve scientific understanding. Science programs may have to share the costs to maintain critical systems. The decrease allows for a redirection of funds to address administration and departmental priorities.

Facilities

Operations and Maintenance Efficiencies (-$4,390,000/0 FTE)

The proposed reduction will degrade the condition and performance of the USGS real property portfolio by impairing the bureau's ability to complete annual operations and maintenance responsibilities, and deferring custodial and maintenance work that will add to the bureau's existing backlog of deferred maintenance. In turn, the USGS expects to see an increase in the frequency with which equipment and facility components will need more costly emergency repairs and replacements, as well as a shortening of the overall life cycle of our real property assets. Ultimately, emergency repairs have an impact on the science mission of the USGS through unplanned additional costs and unexpected outages.

The reduction will inhibit the USGS's ability to meet requirements of statutory energy goals; diminish efforts toward energy reduction, water conservation, and waste reduction; and inhibit meeting the environmental requirements in Executive Order (EO) 13423, Strengthening the Federal Environmental Energy and Transportation Management, and EO 13514, Federal Leadership in Environmental Energy and Economic Performance, and to efficiently and economically maintain its real property assets as required by EO 13327, Federal Real Property Asset Management.

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Internal Transfers

National Geological and Geophysical Data Preservation Program

In 2013, the NGGDPP is proposed to move to SSAR in Core Science Systems. This is accomplished through decreases to the NGGDPP and an increase to SSAR. Please refer to the program increases and decreases narratives for details.

Information Resources

Internal Transfer From:

		2013			
		Fixed Costs and Related Changes (+/-)	Program Change	Base Funding	Total
		162	-821	15,802	15,143
Information Resources($000)	FTE	0	-6	63	57

Information Resources **(-$15,143,000/-57 FTE)**

The 2013 budget request eliminates the Information Resources component of AEI and shows a program change for Administrative Services of -$821,000 and -6 FTE. The request realigns the program's funding to Science Support (-$4,293,000/-16 FTE), and Security and Technology (-$2,617,000/-10 FTE) in AEI, and the Science Synthesis, Analysis, and Research program (-$8,233,000/-31 FTE), in the Core Science Systems Mission Area.

Internal Transfer To:

		2013			
		Fixed Costs and Related Changes (+/-)	Program Change	Base Funding	Total
Science Synthesis, Analysis, and		88	-446	8,591	8,233
Research ($000)	FTE	0	-3	34	31
		46	-232	4,479	4,293
Science Support ($000)	FTE	0	-2	18	16
		28	-143	2,732	2,617
Security and Technology ($000)	FTE	0	-1	11	10
		162	**-821**	**15,802**	**15,143**
Internal Transfers Total	**FTE**	**0**	**-6**	**63**	**57**

Core Science Systems

Science Synthesis, Analysis, and Research Program **(+$8,233,000/+31 FTE)**

The USGS proposed to consolidate Biological Information Management and Delivery, National Geological and Geophysical Data Preservation and the USGS Libraries and information synthesis functions from Information Resources into a new budget line named Science Synthesis, Analysis, and Research (SSAR). The consolidation will bring together complementary functions and resources and with increases proposed in Ecosystem Priorities, hydraulic fracturing, and science for coastal and ocean stewardship will advance new information and knowledge synthesis and management tools.

Administration and Enterprise Information

Science Support **(+$4,293,000/+16 FTE)**

The USGS proposes to eliminate the Information Resources budget line and consolidate its communication, publishing, Web, and youth activities in Science Support.

Security and Technology **(+$2,617,000/+10 FTE)**

The USGS proposes to eliminate the Information Resources budget line and consolidate its enterprise infrastructure functions in Enterprise Security and Technology.