

U.S. GEOLOGICAL SURVEY FY 2001 BUDGET JUSTIFICATION

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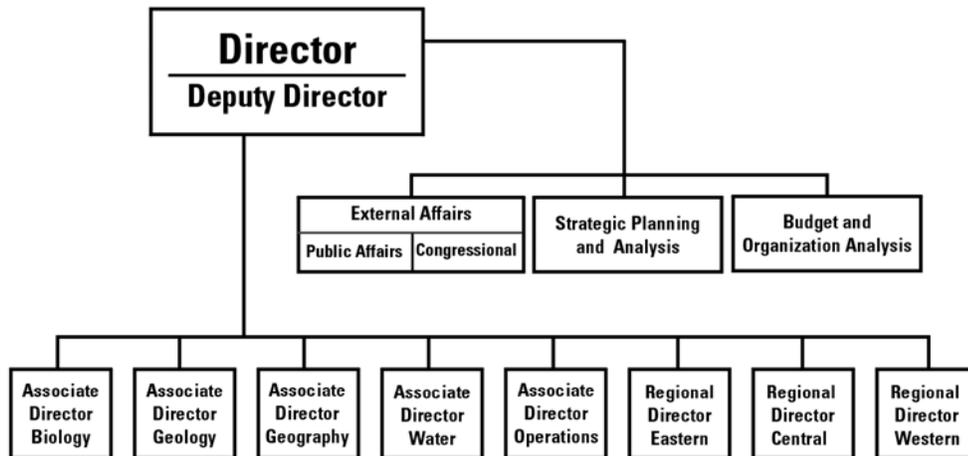
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USGS Government Performance and Results Act Consolidated Report

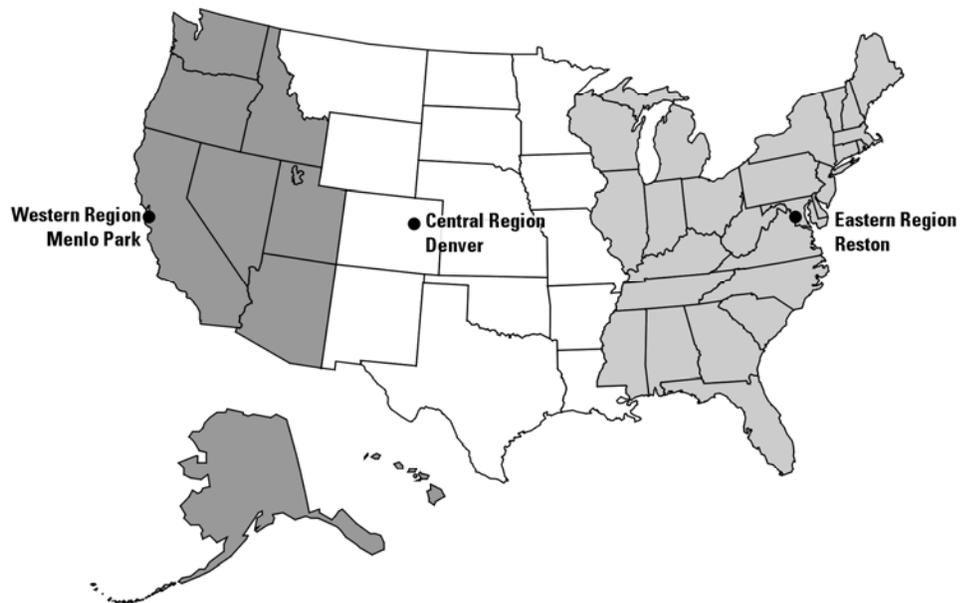
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U.S. Geological Survey



NOTE: This chart reflects the current reorganization which is awaiting final DOI approval.

USGS Regional Structure



General Statement

Science for a Changing World

The United States government has many critical funding needs: paying for the health, safety, and well being of its citizens; ensuring safe and abundant housing; offering education; maintaining public lands; and furnishing dependable travel venues to move commerce. Balancing all of these pressing needs requires increases for scientific research.

Science and scientific research enables the Federal government to meet its obligations in all of the areas mentioned above. Because our world is changing at a faster pace than ever before, we need to understand the impacts of these changes and learn how to best manage them. Without science, leaders and decision makers at all levels of the public trust find themselves trying to lead the country down a road without a road map. Science provides the key to not only finding out how to get somewhere, but also to arriving safely. The fiscal year 2001 budget request for the U.S. Geological Survey (USGS) is \$895.4 million – a net increase of \$82 million over its FY 2000 enacted level. The requested increase for USGS will address many issues of critical importance to our society and its welfare, including natural hazards, the competing demands for natural resources, and preservation of America’s natural resources legacy. The increased funding will help USGS to respond to some of the myriad requests for its scientific research, analysis, monitoring programs and for accessible information so highly valued by its many customers. The USGS must be able to grow in order to keep up with the demand for its work and data. Most of its work has been completed on a modest scale; “pilot” levels. Because of the success of its work, USGS always receives requests to do more.

The Nation needs a balanced portfolio of research about conditions of our planet. There must be a balance among land, oceans, and atmosphere, and there must be a balance between research done from space and that which is conducted from or strongly linked to the Earth’s surface. USGS focuses on the land and the life forms of the land. NOAA focuses on the atmosphere and the oceans. NASA, as well as NOAA and USGS, applies space technology to study all of these systems. The USGS budget proposed for FY 2001 is a step toward regaining the right balance – putting increased emphasis on the land, water, and biological resources.

The USGS is the Nation’s largest water, earth, and biological science and civilian mapping agency. We work in close cooperation with more than 2,000 organizations across the country (and the world, as well) to provide reliable, impartial scientific information to resource managers, planners, and other customers. **USGS information, gathered in every State, is critical to the Nation’s well being** and to future ability to minimize the loss of life and property from natural disasters. Our science programs help avert the human and economic consequences of natural disasters that take the lives of citizens and cost billions annually in the United States. The USGS biological, geological, hydrological, and mapping programs are essential to the effective stewardship of the Nation’s cultural and natural resources, including the Department of the Interior’s management of more than 450 million acres of Federal land. USGS data collection and analytic capabilities contribute to the conservation and sustainable development of the Nation’s natural resources. Other Federal agencies and State and local governments use USGS water, biological, energy and mineral resources, and mapping information and capabilities to guide planning, management, and regulatory programs.

“Progress is meaningless if we don't know where we're going. Unless we try to visualize what is beyond the horizon, we will always occupy the same shore.”

Representative George Brown (1993)

Even given the fiscal constraints facing the Nation's purse and the accountability to the taxpayers who fill it, **justifying science programs is not difficult** when one applies a "relevancy" filter and asks of science programs and scientists: What do you want to accomplish? Why do you want to do it? and What will be the result of doing it? Science programs that pass this relevancy test generate benefits to society that far outweigh their economic costs.

USGS is poised to do a great deal of work in FY 2001 to enhance the health, safety, and protection of the Earth and the species that inhabit it. In many cases the health of the natural system is failing; the safety of our citizens is at risk. USGS research is needed to ensure the vitality and production of the land and its resources. With the requested increases, USGS will be able to produce the objective, credible data and information that will assist decision makers in arriving at answers to solve or manage these challenges.

With an increase in FY 2001, USGS will complete some programs, expand some current programs, and begin new ones as well. Both new starts and expansions advance the USGS mission and its core programs in the earth and life sciences and do so in a manner that supports Secretary Babbitt's goal of delivering USGS scientific information and tools to the decision makers and managers who need it. In addition to the Administration's Lands Legacy Initiative, USGS has developed four overarching themes within which program components address natural resources management challenges related to people, wildlife, and the land and resources that support them. The themes are safety, communities, lands and resources, and natural heritage. They propose questions, describe the impetus behind the questions, and offer tools to answer the questions. The answers are obtainable, but not without significant additional funding in FY 2001.

Safer Communities +\$7.1 million – The cost of natural disasters – earthquakes, floods, volcanoes, coastal storms – has skyrocketed to more than \$50.0 billion per year. The USGS helps communities become more resilient to natural disasters by providing fundamental understanding of and information on them in real-time. The USGS proposes to enhance its ability to provide advance warning of impending natural disasters, enabling communities to save lives and property. From the study of earthquakes in Alaska and the Pacific West, to floods in high-risk areas around the Nation, USGS efforts will help create stronger and safer communities.

Livable Communities (+\$47.0 million) – Americans want communities where they can enjoy a healthy environment and earn a decent living. To balance competing demands for natural resources, recreational opportunities, wildlife habitat, and economic growth, planners need reliable tools and an immense amount of information. The USGS delivers these products to the doorsteps of communities, helping them to plan for intelligent resource use and growth. With the funding proposed for FY 2001, USGS will work with local communities to solve natural resource problems by providing easy access to understandable, usable information on the natural resources vital to community health.

Sustainable Resources for the Future (+\$15.3 million) – Understanding how the land responds to change is essential for our continued enjoyment of the natural landscape in the future. With additional funding in FY 2001, USGS will develop tools to predict how the land interacts with the oceans and air and how it reacts to the many uses humans make of it. Focused research on river, coastal, and wetland habitats and other critical landscapes will increase our understanding of how these major systems respond to change and enable us to develop restoration tools for areas that have been altered. With a solid understanding of how the Earth works, we can help to ensure thriving landscapes for people and wildlife.

America's Natural Heritage (+\$16.7 million) – A vital part of America's natural legacy is its parks, refuges and other public lands, many of which are entrusted to the Department of the Interior. These landscapes and the fish and wildlife they support are key to our core national identity. USGS, in partnership with stakeholders throughout the Nation, is helping land and resource managers preserve our natural heritage by monitoring, assessment, and research that address issues of critical importance. With the funds requested in FY 2001, USGS will focus on developing tools to understand and control invasive species, develop habitat conservation plans, protect and restore habitat for migratory birds, and evaluate the health and stability of coral reefs. This work will provide the scientific foundation for preserving the places America cares about.

Lands Legacy in 2001

Fiscal year 2001 is the second year of the Administration's "Lands Legacy" Initiative. It builds on America's commitment to its natural environment through the preservation of public lands and national treasures and through partnerships with local communities and States to protect open spaces and natural resources. The Department of the Interior FY 2001 budget includes \$735.0 million in support of the Lands Legacy Initiative. USGS will contribute to this initiative, requesting \$50.0 million in new funding for State Planning Partnerships. These partnerships will provide community, local, and State decision makers and Federal resource managers with geospatial data, earth science information, and information technology tools they need to more fully achieve the goals of the Lands Legacy initiative, including more effectively protected open space, sustainable development, and improved quality of life. Access to these tools will strengthen partners ability to preserve natural resources, identify optimal lands for acquisition, design effective land-use and development strategies, and mitigate natural hazards. Three program components make up the USGS Lands Legacy Request: Community/Federal Information Partnership, Urban Dynamics - Decision Support, and Decision Support for Resource Management, The program components are discussed below.

The science programs conducted by the USGS are developed according to science plans based on sound management. **Goals related to USGS science are contained in the USGS Strategic Plan** and are **customer driven**. Our commitment to our customers follows through in our budget and accompanying annual plan with their increased emphasis on providing natural science data and research that meet the highest priority needs of our customers. This focus strengthens our contribution to the resolution of complex issues and our tie to the outcomes achieved by our customers through science-based decision-making.

Integration of USGS' scientific disciplines enables land and resource managers to more clearly understand and preserve the habitats that support healthy fish and wildlife populations, provide recreation and family fun, and nourish the national spirit. Reliable and objective information about our natural heritage leads to responsible decision making for healthy, thriving parks, refuges and other public lands for our children and grandchildren. The FY 2001 budget request is presented in the following summary tables, text, graphics, and supporting justifications.

Summary of FY 2001 Program Changes

The **USGS budget request for FY 2001 is \$895 million, a net increase of \$82 million over the FY 2000 enacted budget.** Included in this amount is an increase of \$18 million to cover uncontrollable costs (e.g., salary increases). Additionally, the budget contains decreases of \$22.2 million representing projects that are nearing completion in 2000 or lower priority projects being ended in FY 2001.

This year the **Lands Legacy** (+\$50 million) initiative includes State Planning Partnership and consists of Community/Federal Information Partnership, Urban Dynamics – Decision Support, and Decision Support for Resource Management. These programs are described individually as they fit under the theme categories below.

Safer Communities +\$7.1 million

Earthquakes +\$2.6 million – Building on the success of FY 2000 pilot projects, USGS will use the proposed increase to expand and modernize its earthquake monitoring in urban areas in the United States, reflecting the plans developed for the USGS Real Time Hazards Initiative and for the Advanced National Seismic System. A total of 150 regional/urban seismic stations will be installed or upgraded.

Volcanoes +\$0.5 million – From FY 1996 to 2000, USGS has installed, operated, and maintained seismic monitors at 20 active volcanoes in Alaska's Aleutian Islands. These monitors provide rapid information about volcanic activity to the aviation community so that airplane encounters with ash clouds can be averted. The proposed increase will enable USGS to expand this real-time volcano monitoring seismic monitors installed at one additional high-risk Alaskan volcano.

Floods +\$4.0 million – The proposed increase will improve the existing USGS streamgaging network in two ways. First, it will add stations to address the current shortfall of 800 National Weather Service (NWS) flood forecast points that do not have a nearby streamgage. Second, it will upgrade existing gages to provide the real-time information that is critically important to local emergency managers and the public during floods. The USGS is working with the NWS and other partners to determine the best location for these improvements. A list of gages to be added or reactivated is available from USGS in March 2000.

Livable Communities +\$47.0 million

Urban Dynamics - Decision Support +\$10.0 million – The increase, part of the Administration's Lands Legacy program, will expand efforts to understand landscape change in large metropolitan regions and assess the impacts of such changes on a regional scale. USGS will also improve and apply technology for monitoring, analyzing, and predicting landscape changes. Investigations of urban growth will draw on historical trends to compare the effects of physical, social, and economic factors on land use changes. USGS will transfer historical data and tools to organizations around the country to plan for sound urban growth.

Community/Federal Information Partnership (C/FIP) +\$30.0 million – The proposed increase, part of the Administration’s Lands Legacy program, will fund partnership projects across the country to increase creation and use of geospatial information for informed decision-making. These C/FIP partnerships are aimed at developing local solutions to local problems by integrating base map data with geologic, biologic, hydrologic, soils, and land cover information. Of this amount, \$25 million will be allocated to competitively awarded matching grants and cooperative agreements to provide communities access to geospatial data and geographic information system technology.

Accessible Data Transfer +\$2.0 million – The USGS has been successful in marketing its natural science products and services on the Internet to a point in which its networks are becoming saturated. Customers are routinely routed over the internal network to meet their needs, making USGS data and computer systems vulnerable to security breaches and retarding internal processing due to increased traffic. Unless we invest in systems technology, the USGS network will become inundated with more requests, as more customers request USGS data. The increase will enable USGS to expand, improve reliability and speed for data delivery, and provide real-time data to customers by upgrading data transmission lines connecting major USGS centers (Reston, VA; Denver, CO; Menlo Park, CA; EROS Data Center in Sioux Falls, SD). This investment in information management and transmission infrastructure will enable USGS to expand on the Ohio Pilot and other partnership models. In so doing, USGS will make the information available to other regions of the country in order to enhance the ability of communities and local, regional, and State decision makers to address their unique natural resource and related issues.

Landsat 7 Program Operations +\$5.0 million – Landsat 7 data need to be collected, transmitted, received, processed, stored, and made available for distribution. The proposed increase will meet the need to ensure stability of Landsat 7 system operations over the long term. Data from Landsat satellites have provided the United States and other users with a continuous stream of land-image data since 1972. The wealth of data now available provides an unprecedented ability to look at changes on the Earth over nearly three decades. These data sets are of great value to the scientific community. USGS has partnered in various ways with the Landsat programs over the years and responsibility for operation of Landsat 7 is a logical fit with the core mission of USGS.

**Sustainable Resources for the Future
+\$15.3 million**

Aquatic Resources - Columbia River +\$4.0 million – Over the past 50 years, the Columbia River landscape has changed. Urbanization, heavy logging, and agricultural development have affected its natural resources, including Pacific salmon. With this increase, USGS will provide integrated science to managers charged with recovery of Pacific salmon, trout, and sturgeon in four areas (habitat characterization, restoration of habitat altered by humans, biological and geophysical factors limiting fish populations, and the socio-economic factors of restoration). With the proposed funding, USGS will provide an understanding of the relationship between the behavior of downstream migrating salmon and the hydraulic dynamics of river flow. It will establish a foundation for restoring natural processes within the river and for monitoring system health. Regional-scale maps that help define the riverine ecosystem needed to improve survival of critical species and serve human needs will also be developed.

Great Lakes +\$0.5 million – Many government agencies and other organizations have conducted natural-science studies related to change in the lakes or on the land. But there has been no regional approach linking science in the lakes to science in the watershed and the surrounding region. The USGS will begin to make that linkage with a study of Lake Michigan's watershed and lake processes and how they affect fish. Integrated activities will include water sampling, geologic studies, habitat data inventory, shoreline mapping, and analysis of land-use change. Inclusion of this kind of information into a Great Lakes data base will give managers the information they need to make better decisions affecting the future of the lakes.

Yellowstone +\$0.4 million – The USGS will develop models of habitat use for threatened species. Part of the decline of the grizzly can be traced to human activities such as development and the degradation, fragmentation, and loss of habitat – effects also felt by other species, such as mule deer and wolves. Other work in FY 2001 will focus on historical inventories of land use and land change to document changes over time, climate data bases to show temperature and precipitation, and the development of software for display and analysis of climate data. This proposed work continues collaborative efforts of the Greater Yellowstone Area Initiative, developed in partnership with U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, and U.S. Forest Service.

Mojave Desert +\$0.4 million – In 2001, USGS, in partnership with the California Desert Managers Group (DMG), will focus new efforts on water and ecological resources in the Mojave Desert. Existing water data (ground-water levels, spring sources, water chemistry, and surface water) will be compiled into a spatial data base for analysis by DMG partners and other stakeholders. The USGS will complete a draft protocol for desert-wide use to monitor water chemistry and quality, water levels, discharge, and water use.

Decision Support for Resource Management +\$10.0 million – This increase is part of the Administration's Lands Legacy Initiative, State Planning Partnerships program. The funding will support Lands Legacy objectives and help States and communities preserve local lands and habitat. The increase will develop decision support tools for managers at local, State, and Federal levels who address high-priority resource issues.

**America's Natural Heritage
+\$16.7 million**

DOI Science +\$15.0 million

- **DOI Science Priorities +\$13.0 million** – Managing America's public lands requires an integrated scientific approach to ensure that decisions are based on sound understanding of ecosystems and the processes that occur within them. In FY 2001 a new Department of the Interior Agreement, signed by all DOI bureau directors, will be implemented to provide integrated scientific research and information necessary for DOI land and resource decisions. The increase will be used to develop projects to meet the high-priority management requests from each bureau at the following funding levels: \$3 million each for Bureau of Land Management, U.S. Fish and Wildlife Service, and National Park Service, and \$1 million each for Bureau of Indian Affairs, Bureau of Reclamation, Minerals Management Service, and Office of Surface Mining.
- **Amphibian Research and Monitoring +\$2.0 million** – Part of DOI Science, the proposed increase will fund monitoring surveys in the Upper and Lower Mississippi River Basins. Many

species make up the amphibian fauna of the United States. Research in local areas over the past 10 years indicates a dramatic decline in some amphibian populations, although the exact extent and cause of losses remain unknown. USGS leads a national program to determine the status of amphibians and to investigate potential factors causing their declines and malformations. The proposed increase will support the compilation and analysis of geospatial data to characterize habitat in areas of demonstrated amphibian loss and to develop methods to use spatial analysis techniques to predict potential loss.

Fish and Wildlife Disease +\$1.0 million – The increase will provide detailed information about the distribution of the West Nile virus in birds of the East and Gulf Coast States. This information will enable public health agencies to anticipate where the disease is likely to occur or spread, quickly test diseased birds, and mitigate the impacts of this deadly encephalitis disease on humans. Brain lesions in birds have been a growing concern since they were first diagnosed in 1994. With funding for new research, USGS will better understand such wildlife diseases. USGS will increase its grant to the Southeastern Cooperative Wildlife Disease Study to assist with both projects.

Coop Units +\$0.7 million – The Cooperative Research Units program consists of 39 Cooperative Fish and Wildlife Research Units located on university campuses in 37 States. The cooperative program allows government and non-government entities with common interests and responsibilities for natural resource management to work together to address biological resources issues. The increase will complete a multi-year effort to fill and support all science vacancies in the Cooperative Fish and Wildlife Research Units program.

A New Look

This year's budget justifications (or "Greenbook") have a slightly different look. Full descriptions of program changes follow in the "Program Change" section. This new section is designed to focus the reader's attention on what is changing in current programs and to provide a strong justification for the requested change. Within this section, each program increase is discussed in terms of what the issue is that prompts the request for an increase; why USGS is uniquely qualified to address the issue; what USGS may be doing in its current program related to the issue; the 2001 change described in budget program element detail; partners and customers associated with the issue; and expected products from the increased effort. Government Performance and Results Act (GPRA) data for the increases are summarized at the end of the Program Change section. Following the program change section is the base narrative of current USGS programs. The program change and the base sections are will be cross referenced to one another to aid navigation through the Greenbook.

Analysis by Activity

Activity (\$000)	2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from 2000
National Mapping Program	126,717	+1,596	+26,969	155,282	+28,565
Geologic Hazards, Resources, and Processes	211,222	+4,796	+8,791	224,809	+13,587
Water Resources Investigations	185,819	+5,292	+6,465	197,576	+11,757
Biological Research	136,896	+2,177	+19,708	158,781	+21,885
Science Support	67,104	+1,791	+2,000	70,895	+3,791
Facilities	85,618	+2,418	0	88,036	+2,418
TOTAL, SIR	813,376	+18,070	+63,933	895,379	+82,003

UNITED STATES GEOLOGICAL SURVEY

Federal Funds

General and special funds:

SURVEYS, INVESTIGATIONS, AND RESEARCH

For expenses necessary for the United States Geological Survey to perform surveys, investigations, and research covering topography, geology, hydrology, biology, and the mineral and water resources of the United States, its territories and possessions, and other areas as authorized by 43 U.S.C. 31, 1332, and 1340; classify lands as to their mineral and water resources; give engineering supervision to power permittees and Federal Energy Regulatory Commission licensees; administer the minerals exploration program (30 U.S.C. 641); and publish and disseminate data relative to the foregoing activities; and to conduct inquiries into the economic conditions affecting mining and materials processing industries (30 U.S.C. 3, 21a, and 1603; 50 U.S.C. 98g (1)) and related purposes as authorized by law and to publish and disseminate data; [\$823,833,000] \$895,379,000, of which \$50,000,000 is for Lands Legacy; and of which [\$60,856,000] \$62,879,000 shall be available only for cooperation with States or municipalities for water resources investigations; and of which \$16,400,000 shall remain available until expended for conducting inquiries into the economic conditions affecting mining and materials processing industries; [and of which \$2,000,000 shall remain available until expended for ongoing development of a mineral and geologic data base;] and of which \$32,322,000 shall be available until September 30, 2002 for the operation and maintenance of facilities and deferred maintenance; and of which [\$137,604,000] \$158,781,000 shall be available until September 30, [2001] 2002 for the biological research activity and the operation of the Cooperative Research Units: *Provided*, That none of these funds provided for the biological research activity shall be used to conduct new surveys on private property, unless specifically authorized in writing by the property owner: *Provided further*, That no part of this appropriation shall be used to pay more than one-half the cost of topographic mapping or water resources data collection and investigations carried on in cooperation with States and municipalities. (*Department of the Interior and Related Agencies Appropriations Act, 2000, as enacted by section 1000(a)(3) of the Consolidated Appropriations Act, 2000 (P.L. 106-113).*)

Appropriation Language and Citations

1. For expenses necessary for the United States Geological Survey to perform surveys, investigations, and research covering topography, geology, and the mineral and water resources of the United States,
 - X **43 U.S.C. 31(a)** provides for establishment of the Office of the Director of the Geological Survey, under the Interior Department, and that this officer shall have direction of the Geological Survey, and the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain.
2. Its Territories and possessions, and other areas as authorized by law.
 - X **43 U.S.C 31(b)** provides that, "The authority of the Secretary of the Interior, exercised through the Geological Survey of the Department of the Interior, to examine the geological structure, mineral resources, and products of the national domain, is expanded to authorize such examinations outside the national domain where determined by the Secretary to be in the national interest."
 - X **43 U.S.C. 1332(a)** provides that, "It is the declared policy of the United States, that the subsoil and seabed of the Outer Continental Shelf appertain to the United States and are subject to its jurisdiction, control, and power of disposition as provided in this subchapter."
 - X **43 U.S.C. 1340** provides that, "Any agency of the United States and any person authorized by the Secretary may conduct geological and geophysical exploration in the Outer Continental Shelf. ..."
3. Classify lands as to their mineral and water resources;
 - X **43 U.S.C. 31(a)** provides that, "The Director of the Geological Survey, ... shall have the direction of the Geological Survey, and the classification of public lands and examination of the geological structure, mineral resources, and products in the National domain. ..."
4. give engineering supervision to power permittees
 - X **43 U.S.C. 959** provides that, "The Secretary of the Interior is authorized and empowered, ... to permit the use of right of way through the public lands, forest, and other reservations of the United States ... for electrical plants, poles, and lines for the generation and distribution of electrical power, ...**Provided**, that such permits shall be allowed within or through any of said parks or any forest, military, Indian, or other reservation only upon approval of the Chief Officer of the Department under whose supervision such park or reservation falls and upon a finding by him that the same is not incompatible with the public interest ..."
 - X **43 U.S.C. 961** provides that, "The head of the department having jurisdiction over the lands be, and he is, authorized and empowered, ... to grant an easement for right of way, ... over, across and upon the public lands and reservations of the United States for electrical poles and lines for the transmission and distribution of electrical power ... upon a finding by him that the same is not incompatible with the public interest ..."

5. and Federal Energy Regulatory Commission licensees;
 - X **16 U.S.C. 797(c)** states that, "To cooperate with the executive departments and other agencies of States or National Governments in such investigations; and for such purposes the several departments and agencies of the National Government are authorized and directed upon the request of the commission, to furnish such records, papers and information in their possession as may be requested by the commission, and temporarily to detail to the commission such officers or experts as may be necessary in such investigations."
6. administer the minerals exploration program;
 - X **30 U.S.C. 641** provides that, "The Secretary of the Interior is hereby authorized and directed, in order to provide for discovery of additional domestic mineral reserves, to establish and maintain a program for exploration by private industry within the United States, its territories and possessions for such minerals, excluding organic fuels, as he shall from time to time designate, and to provide Federal financial assistance on a participating basis for that purpose."
7. and publish and disseminate data relative to the foregoing activities;
 - X **43 U.S.C. 41** provides for the publication of geological and economic maps, illustrating the resources and classification of the lands, and reports upon general and economic geology and paleontology. This section also provides for the scientific exchange and sale of such published material.
 - X **44 U.S.C. 1318** provides for publication, by the Geological Survey, of various reports, including a report of mineral resources of the United States, bulletins and professional papers, and monographs. This section also specifies, in some instances, numbers of copies to be printed and the distribution thereof.
 - X **44 U.S.C. 1320** provides for the distribution by the Director of the Geological Survey of copies of sale publications to public libraries.
8. Conduct inquiries into the economic conditions affecting mining and materials processing industries...and related purposes as authorized by law and to publish and disseminate data;
 - X **30 U.S.C. 3** provides for inquiry into the economic conditions affecting the mining, quarrying, metallurgical, and other minerals industries. This section also provides for the dissemination of information concerning these industries.
 - X **30 U.S.C. 21(a)** provides for an annual report on the state of the domestic mining minerals, and mineral reclamation industries, including a statement of the trend in utilization and depletion of resources.
 - X **30 U.S.C. 1603** provides for ...improved collection, analysis, and dissemination of scientific, technical and economic materials information and data from Federal, state, and local governments, and other sources as appropriate...@

9. Provided, That () shall be available only for cooperation with States or municipalities for water resources investigations:
- X **43 U.S.C. 48** provides that, "...amounts received by the Geological Survey from any State, Territory or political subdivision thereof in carrying on work involving cooperation to be used in reimbursing the appropriation from which the expense of such work was paid, was from the act making appropriations for the Department of the Interior for the fiscal year ending June 30, 1928, and for other purposes, act January 12, 1927, ch. 277, 1, 44 Stat. 963, and has not been repeated in subsequent appropriation acts."
 - X Similar provisions were contained in the following act: 1926--May 10, 1926, ch. 277, 1, 44 Stat. 487.
10. Of which () shall remain available until expended for conducting inquiries into the economic conditions affecting mining and materials processing industries;
- X **P.L. 104-208, Omnibus Appropriations Act (Interior and Related Agencies portion)**
11. Of which () shall be available until September 30, (), for the biological research activity and the operation of the Cooperative Research Units:
- X **P.L. 104-208, Omnibus Appropriations Act (Interior and Related Agencies portion)**
12. Provided, That none of the funds provided for the biological research activity shall be used to conduct new surveys on private property, unless specifically authorized in writing by the property owner:
- X **P.L. 104-208, Omnibus Appropriations Act (Interior and Related Agencies portion)**
13. Provided further, That no part of this appropriation shall be used to pay more than one-half the cost of any topographic mapping or water resources investigations carried on in cooperation with any State or municipality.
- X **43 U.S.C. 50** provides that, "The share of the Geological Survey in any topographic mapping or water resources investigations carried on in cooperation with any State or municipality shall not exceed 50 per centum of the cost thereof. ..."

Permanent authority:

14. Provided further, that in fiscal year 1984 and thereafter, all receipts from the sale of maps sold or stored by the Geological Survey shall be available for map printing and distribution to supplement funds otherwise available, to remain available until expended.
- X **43 U.S.C. 42a**

15. Provided further, That in fiscal year 1986 and thereafter, all amortization fees resulting from the Geological Survey providing telecommunications services shall be deposited in a special fund to be established on the books of the Treasury and be immediately available for payment of replacement or expansion of telecommunications services, to remain available until expended.

X **43 U.S.C. 50a** with the establishment of the Working Capital Fund (WCF) in FY 1991, the Telecommunications Amortization Fund account and its end of year FY 1990 balances were included in the WCF.

16. Provided further, that, heretofore and hereafter, in carrying out work involving cooperation with any State, Territory, possession, or political subdivision thereof, the Geological Survey may, notwithstanding any other provisions of law, record obligations against accounts receivable from any such entities and shall credit amounts received from such entities to this appropriation.

X **43 U.S.C. 50b**

17. Provided further, That in Fiscal Year 1987 and thereafter the Geological Survey is authorized to accept lands, buildings, equipment, and other contributions from public and private sources and to prosecute projects in cooperation with other agencies, Federal, State, or private.

X **43 U.S.C. 36c** This authority for contributions was in the appropriation language annually from FY 1983 through FY 1986 and was made permanent in FY 1987.

18. Provided, That upon enactment of this Act and hereafter, final costs related to the National Petroleum Reserve in Alaska may be paid from available prior year balances in this account.

X **P.L. 100-446, Department of the Interior and Related Agencies Appropriations Act, 1989**

19. Established a Working Capital Fund which is detailed in the Working Capital Fund section of this book

X **P.L. 101-512, Department of the Interior and Related Agencies Appropriations Act, 1991**

20. Provided further, That beginning October 1, 1990, and thereafter, funds received from any State, territory, possession, country, international organization, or political subdivision thereof, for topographic, geologic, or water resources mapping or investigations involving cooperation with such an entity shall be considered as intragovernmental funds as defined in the publication titled "A Glossary of Terms Used in the Federal Budget Process."

X **P.L. 101-512, Department of the Interior and Related Agencies Appropriations Act, 1991**

This authority exempts non-Federal cooperative funds from sequester as defined in 1985 amendments (P.L. 99-177) to the Budget Impoundment and Control Act of 1974.

21. Provided further, That beginning in fiscal year 1998 and once every five years thereafter, the National Academy of Sciences shall review and report on the biological research activity of the Survey:

X **P.L. 104-208, Omnibus Appropriations Act (Interior and Related Agencies portion)**

Uncontrollable and Related Cost Changes

(Dollar amounts shown in thousands)

Additional cost in FY 2001 of January Pay Raises

	2000 Estimate	2001 Change
2000 Pay Raise	NA	+\$4,727
	2000 Estimate	2001 Change
2001 Pay Raise	NA	+\$13,271

The January 2001 pay raise amount above was calculated before the Presidential Policy pay raise amount was available to the Department of the Interior. In total, the sum of the amounts above for pay raise costs is nearly the same as the correct amount. The amounts above offset the equivalent of a 4.025% for the full fiscal year rather than 3.975%, that is, they are 0.05% too high. The amounts above are based on raises of 4.4% and 3.9% respectively, rather than the actual 4.8% for January 2000 and the President=s requested 3.7% for January 2001. The Office of Budget will compile the correct amounts and provide them to the Appropriations Subcommittees and post them on our website (www.doi.gov/budget) soon after the release of the President=s budget request.

Other Uncontrollable Cost Changes

	2000 Estimate	2001 Change
Rental Payments	\$54,355	+\$1,359

The adjustment is for changes in the costs payable to General Service Administration resulting from changes in rates for office and non-office space as estimated by GSA.

	2000 Estimate	2001 Change
Department working capital fund changes	\$5,951	+\$501

The change reflects expected changes in the charges for Department services and other services through the working capital fund.

	2000 Estimate	2001 Change
One Fewer Pay Day	NA	-\$1,788

This adjustment reflects the fact that there is one fewer pay day in FY 2001 than in FY 2000.

Technical Adjustments

The two technical adjustments reflected in the FY 2001 Budget Justification are:

- § A \$1.0 million redirection from the Biological Research activity to the Facilities activity to complete repairs to the Fish Health Laboratory at the Leetown Science Center (\$0.5 million) and retrofitting a research vessel located on the Great Lakes (\$0.5 million).

- § An adjustment of \$0.5 million from the National Mapping Program activity to reflect funding for the Great Lakes Mapping Coalition within the Geologic Landscape and Coastal Assessments subactivity, Earth Surface Dynamics program.

Summary of Requirements

(Dollar amounts in thousands)

Appropriation: Surveys, Investigations, and Research

	<u>FTE/T</u>	<u>Amount</u>	<u>FTE/T</u>	<u>Amount</u>
Appropriation enacted, 2000			6,438	813,376
Uncontrollable and Related Changes:				
Additional Cost in 2001 of January 2000 Pay Raise	--	+4,727		
Additional Cost in 2001 of January 2001 Pay Raise	--	+13,271		
Rental Payments	--	+1,359		
Increased Departmental WCF Costs	--	+501		
One Fewer Pay Day	--	<u>-1,788</u>		
Subtotal, Uncontrollable and Related Changes	--	18,070		
Program Change			<u>--</u>	<u>+63,933</u>
TOTAL REQUIREMENTS (2001 Request)			6,464	895,379

Summary of Requirements (continued)

Comparison by Activity:	1999 Actual	2000 Estimate	Uncontrol. & Related Changes	Program Change	2001 Budget Request	Inc (+) Dec (-) from 2000
National Mapping Program						
Mapping data collection & integration	63,691	56,330	+228	+10,769	67,327	+10,997
Earth science information management & delivery	36,388	34,270	+641	+2,000	36,911	+2,641
Geographic research & applications	38,069	36,117	+727	+14,200	51,044	+14,927
Subtotal	138,148	126,717	+1,596	26,969	155,282	+28,565
Geologic Hazards, Resources, & Processes						
Geologic hazard assessments	76,237	69,111	+1,275	+2,850	73,236	+4,125
Geologic landscape & coastal assessments	73,935	65,435	+1,304	+10,450	77,189	+11,754
Geologic resource assessments	88,487	76,676	+1,717	-4,009	74,384	-2,292
Subtotal	238,659	211,222	+4,296	+8,791	224,809	+13,587
Water Resources Investigations						
Water resources assessment & research	103,991	91,037	+2,012	-2,694	90,355	-682
Water data collection & management	30,218	29,167	+949	+9,159	39,275	+10,108
Federal/State coop water program	70,137	60,553	+2,326	0	62,879	+2,326
Water resources research act program	5,055	5,062	+5	0	5,067	+5
Subtotal	209,401	185,819	+5,292	+6,465	197,576	+11,757
Biological Research						
Biological research & monitoring	138,388	113,232	+1,690	+7,508	123,430	+10,198
Biological information management & delivery	11,443	10,484	+259	+10,500	21,243	+10,759
Cooperative research units	12,497	13,180	+228	+700	14,108	+928
Subtotal	162,328	136,896	+2,177	+19,708	158,781	+21,885
Science Support	27,204	67,104	+1,791	+2,000	70,895	+3,791
Facilities	21,501	85,618	+2,418	0	88,036	+2,418
Total Requirements	797,241	813,376	+18,070	+63,933	895,379	+82,003
Total FTE	6,442	6,438		+26	6,464	+26

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43 U.S.C. 31 et seq. The Organic Act of March 3, 1879, as amended, established the United States Geological Survey. This section provides, among other matters, that the USGS is directed to classify the public lands and examine the geological structure, mineral resources, and products within and outside the national domain. This section also establishes the Office of the Director of the Geological Survey, under the Department of the Interior. The Director is appointed by the President by and with the advice and consent of the Senate. P.L. 102-285, Sec. 10(a) establishes United States Geological Survey as its official name.

2 U.S.C. 681-688 Congressional Budget and Impoundment Control Act of 1974 et seq. This section discusses the general Federal budget process, including rescissions, reservations, and deferrals of budget authority.

5 U.S.C. 305 Title 5 deals with Government Organization and Employees. It includes personnel matters (classification, pay rates, benefits, etc.), the Freedom of Information Act, the Privacy Act, the Computer Matching and Privacy Act, and other issues related to general Federal functions and employment. The Appendices to Title 5 include the Federal Advisory Committee Act (FACA) of 1972, Inspector General mandates, and other matters that include Federal entities such as the USGS.

7 U.S.C. 136 Federal Environmental Pesticide Control Act of 1972 (P. L. 92-516), amended the 1947 Federal Insecticide, Fungicide and Rodenticide Control Act (P.L. 80-102) program for controlling the sale and distribution of "economic poisons". The law requires registration of pesticides to avoid unreasonable adverse affects to humans or the environment.

7 U.S.C. 2201 Rural Development and Policy Act of 1980. Requires the Secretary of Agriculture to obtain the advice of the Secretary of the Interior as to whether certain lands that are being patented, disposed of, or exchanged are mineral in character.

7 U.S. C. 2204 Authorizes the Secretary of Agriculture to enter cooperative agreements with other Federal agencies and other organizations concerning water management for rural areas.

15 U.S.C. 631, 631a Small Business Acts. Fosters the economic interests of small businesses and sets forth procedures. Federal agencies are encourages to use small businesses for services and other contracted activities.

15 U.S.C. 2901, 2908 The National Climate Program Act of 1978 established a national climate program to assist the Nation and the world in understanding and responding to natural and human-induced climate processes and their known and potential effects. The Department of the Interior has a mandated role in this Program.

15 U.S.C. 2921-2953 The Global Change Research Act of 1990 (P.L. 101-606) established the United States Global Change Research Program aimed at understanding and responding to global change, including the cumulative effects of human activities and natural processes on the environment, to promote discussions toward international protocols in global change research, and for other purposes.

15 U.S.C. 5631-5658 The Land Remote Sensing Policy Act of 1992 enables the United States to maintain its leadership in land remote sensing by providing data continuity for the Landsat program. The Act assigns responsibility for the "National Satellite Land Remote Sensing Data Archive" to the Department of the Interior. The Act also authorizes and encourages the Department of the Interior and other Federal agencies to carry out research and development programs in applications of these data and makes Landsat data available to the public.

16 U.S.C. 17 et seq. Parts of Title 16, Conservation, such as National Park Service Organic Act, as amended and supplemented, apply to the USGS. Notably, the Outdoor Recreation Act of June 23, 1936 authorizes the Secretary of the Interior to sponsor, engage in, and assist in research relating to outdoor recreation, directly or by contract or cooperative agreements, and make payments for such purposes; undertake studies and assemble information concerning outdoor recreation; and cooperate with educational institutions and others in order to assist in establishing education programs and activities and to encourage public use and benefits from outdoor recreation.

16 U.S.C. 350 et seq. Coastal Barrier Resources Act of 1992. Designates various underdeveloped coastal barrier islands depicted by specific maps for inclusions in the Coastal Barrier Resource System.

16 U.S.C. 661 et seq. Fish and Wildlife Coordination Act of March 10, 1934 (P. L. 79-732) authorizes the Secretary of the Interior to prepare plans to protect wildlife resources, to conduct surveys on public lands, and to accept funds or lands for related purposes; authorizes the investigation and reporting of proposed Federal actions that affect the development, protection, rearing, and stocking of all species of wildlife and their habitat in controlling losses, minimizing damages, and providing recommendations to minimize impacts on fish and wildlife resources.

16 U.S.C. 703-711 Migratory Bird Treaty Act of 1918, as amended, Implements four international treaties that individually affect migratory birds common to the United States, Canada, Mexico, Japan, and the former Soviet Union. This Act establishes Federal responsibility for protection and management of migratory and nongame birds, including the establishment of season length based on scientific information relative to zones of temperature, distribution, abundance, breeding habits and times and lines of migratory flight of migratory birds. It also establishes the Secretary of the Interior's responsibility for bag limits, and other hunting regulations, and issuance of permits to band, possess, or otherwise make use of migratory birds.

16 U.S.C. 715 Migratory Bird Conservation Act. Establishes the Migratory Bird Conservation Commission; authorizes the Secretary of the Interior to conduct investigations and publish documents related to North American birds.

16 U.S.C. 742 et seq. Fish and Wildlife Act of 1956 authorizes the Secretary of the Interior to conduct investigations, prepare and disseminate information, and make periodic reports to the public regarding the availability and abundance and the biological requirements of fish and wildlife resources; provides a comprehensive national fish and wildlife policy and authorizes the Secretary of the Interior to take steps required for the development, management, advancement, conservation, and protection of fisheries and wildlife resources through research, acquisition of refuge lands, development of existing facilities, and other means.

16 U.S.C. 753a The Fish and Wildlife Improvement Act of 1978 as amended by P.L. 95-616, authorizes the Secretary of the Interior to enter into cooperative agreements with colleges and universities, State fish and game agencies, and nonprofit organizations for the purpose of developing adequate, coordinated, cooperative research and training programs for fish and wildlife resources.

16 U.S.C. 931-939 Great Lakes Fishery Act of 1956 implements the Convention on Great Lakes Fisheries between the United States and Canada; authorizes construction, operation and maintenance of sea lamprey control works; and established the Great Lakes Fisheries Commission.

16 U.S.C. 1131 The Wilderness Act of 1964 and numerous subsequent related Acts requires the USGS to assess the mineral resources of each area proposed as wilderness or established as wilderness. The studies are to be on a planned and recurring basis. The original series of studies have been completed and no recurring studies have been requested or funded.

16 U.S.C. 1361 et seq. Marine Mammal Protection Act of 1972, as amended, establishes a responsibility to conserve marine mammals with management authority vested in the Department of the Interior for the sea otter, walrus, polar bear, dugong, and manatee.

16 U.S.C. 1531 et seq. Endangered Species Act of 1973, as amended, provides for the conservation of threatened and endangered species of fish, wildlife, and plants; and authorizes establishment of cooperative agreements and grants-in-aid to States that establish and maintain active and adequate programs for endangered and threatened wildlife and plants.

16 U.S.C. 1600 et seq. Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act of 1976. The USGS is a party in an interagency agreement with the Forest Service to assess the mineral resources of National Forests.

16 U.S.C. 2801 et seq. National Aquaculture Act of 1980 directs the Secretary of the Interior to participate in the development of a National Aquaculture Development Plan and authorizes research, development, and other activities to encourage the development of aquaculture in the United States.

16 U.S.C. 3141 et seq. The Alaska National Interest Lands Conservation Act of 1980. Section 1008 of the Act authorizes the Secretary of the Interior to conduct studies, or collect and analyze information obtained by permittees, of the oil and gas potential of non- North Slope Federal lands. Section 1010 of the Act requires that the Secretary of the Interior assess the oil, gas, and other mineral potential, and expand the minerals data base, for all public lands in Alaska. Section 1011 of the Act requires an annual minerals report be presented to Congress. These responsibilities have been delegated to the USGS. The Geological Survey has made and may be called upon to make water studies pertinent to implementation of the Act.

16 U.S.C. 4701 et seq. Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (P.L. 101-646), establishes a Federal program to prevent introduction of and to control the spread of introduced aquatic nuisance species.

22 U.S.C. 3201 et seq. The Nuclear Non-Proliferation Act of 1978 provides that under Title V, United States Assistance to Developing Countries, the USGS assists, through the State

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Department and the Agency for International Development, in evaluation of nuclear facilities sites in other countries.

25 U.S.C. 450 et seq. The Tribal Self-Governance Act of 1994. The USGS participates in the Tribal Self-Governance Program by identifying USGS activities that may be available for Tribal operation under the Self-Governance Act. The USGS discusses its programs and activities with interested Tribal governments.

29 U.S.C. 651 Occupational Safety and Health Act of 1970.

30 U.S.C 21(a) The Mining and Minerals Policy Act of 1970 The Materials and Minerals Policy, Research and Development Act of 1980, emphasizes the USGS' responsibility to assess the mineral resources of the Nation.

30 U.S.C. 201 The Federal Coal Leasing Amendments Act of 1976 provides that no lease sale may be held on Federal lands unless the lands containing the coal deposits have been included in a comprehensive land-use plan. The Act provides that the Secretary is authorized and directed to conduct a comprehensive exploratory program designed to obtain sufficient data and information to evaluate the extent, location, and potential for developing the known recoverable coal resources within the coal lands. The USGS provides data and information from its coal research and field investigations which are useful to the BLM to meet the requirements of the coal leasing program.

30 U.S.C. 1026 Section 6 of the Geothermal Steam Act Amendments of 1988 requires the Secretary of the Interior to (1) maintain a monitoring program for significant thermal features within units of the National Park System, and (2) establish a research program to collect and assess data on the geothermal resources within units of the National Park System with significant thermal features in cooperation with the USGS. Section 8 of the Geothermal Steam Act Amendments of 1988 requires the USGS to conduct a study of the impact of present geothermal development in the vicinity of Yellowstone National Park on the thermal features within the park.

30 U.S.C. 1028 The Energy Policy Act of 1992 directs the USGS to establish a cooperative government-private sector program with respect to hot dry rock geothermal energy resources on public lands, to convene a workshop of interested governmental and private parties to discuss the regional potential for hot dry rock geothermal energy in the Eastern U.S., and to submit a report to Congress containing a summary of the findings and conclusions of the workshop. The Act also supports recurring assessments of the undiscovered oil and gas resources of the United States.

30 U.S.C. 1121 The Geothermal Energy Research, Development, and Demonstration Act of 1974 provides that the Department of the Interior is responsible for the evaluation and the assessment of the geothermal resource base, including the development of exploration technologies.

30 U.S.C. 1201 et seq. Surface Mining Control and Reclamation Act of 1977, as amended, established the Office of Surface Mining Reclamation and Enforcement (OSM). OSM depends in part upon the USGS for a determination of the probable hydrologic consequences of mining and reclamation operations.

30 U.S.C. 1419 et seq. The Deep Seabed Hard Mineral Resources Act of 1980 provides authorization for conducting a continuing program of ocean research that "shall include the development, acceleration, and expansion, as appropriate, of the studies of the ecological, geological, and physical aspects of the deep seabed in general areas of the ocean where exploration and commercial development are likely to occur" The USGS, based on expertise developed in regional offshore geologic investigations, provides geological and mineral resource expertise in responding to the requirements of the Act.

30 U.S.C 1601 et seq. The Mining and Minerals Policy Act of 1970, National Materials and Minerals Policy, Research and Development Act of 1980, reemphasize the responsibility of the USGS to assess the mineral resources of the Nation.

31 U.S.C. 97 Fees and Charges for Government Services and Things of Value. This section directs that each service or thing of value provided to a person be self sustaining to the extent possible. Further, the head of each agency may prescribe regulations establishing the charge for each service or thing of value. Each charge is to be fair, based on the costs to the Government or the value of the service or thing to the recipient, public policy or interest served, and other relevant facts.

31 U.S.C. 901 note Chief Financial Officers Act of 1990.

31 U.S.C. 1535 Economy Act of 1932, as amended, authorizes any agency to obtain goods and services from and reimburse any other agency.

31 U.S.C. 3302 The custody and possession of public money by Federal officials is dealt with in this section.

31 U.S.C. 3501 et seq. Budget Accounting and Procedures Act of 1950. Federal Managers' Financial Integrity Act of 1982.

31 U.S.C. 3901-3906 Prompt Payment Act.

31 U.S.C. 6301 et seq. Federal Grant and Cooperative Agreement Act of 1977 provides criteria for distinguishing between contract, grant and cooperative agreement relationships and provides discretionary authority to vest title to equipment or other tangible personal property purchased with contract, grant or cooperative agreement funds in nonprofit research or higher education institutions.

31 U.S.C. 7501 Single Audit Act of 1984 (P.L. 98-502) .

31 U.S.C. 9701 Independent Office Appropriations Act of 1952; Title 5 - Fees and charges for Government services and things of value. This Act encouraged Federal services and products (•things of value•) to be as financially self-sustaining as possible. It authorized costs to be charged for Federal services and products based on the costs to the Government, the value of the service or thing to the recipient, and the public policy or interest served.

33 U.S.C. 883(a) The Great Lakes Shoreline Mapping Act of 1987 in Section 3202(a) requires that the Director of the National Oceanic and Atmospheric Administration "...in consultation with the Director of the United States Geological Survey, shall submit to the Congress a plan for preparing maps of the shoreline of the Great Lakes under section 3203." The act further requires in Section 3203 that "...subject to authorization and appropriation of funds, the Director,

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in consultation with the Director of the United States Geological Survey, shall prepare maps of the shoreline areas of the Great Lakes."

33 U.S.C. 1251 et seq. Federal Water Pollution Control Act Amendments of 1972 and its successors, the Clean Water Act of 1977 and the Water Quality Act of 1987, authorize extensive water quality planning, studies, and monitoring under the direction primarily of the Environmental Protection Agency (EPA). The USGS is called upon to participate in many of these activities, partly by EPA and partly by State agencies in the Federal-State Cooperative Program. The act of 1987 includes new water quality work concerning Chesapeake Bay, the Great Lakes, Estuary and Clean Lakes Programs, and studies of water pollution problems in aquifers.

33 U.S.C. 1401 The Marine Protection, Research, and Sanctuaries Act of 1972 provides that the Secretary of Commerce must consult with the Secretary of the Interior prior to designating marine sanctuaries. The USGS provides information regarding the energy and mineral resource potential in areas being considered for designation as marine sanctuaries.

33 U.S.C. 2201 et seq. Water Resources Development Act of 1990, authorizes a program for planning, construction, and evaluation of measures for fish and wildlife habitat rehabilitation and enhancement; cooperative effort and mutual assistance for use, protection, growth, and development of the Upper Mississippi River system; implementation of a long-term resource monitoring program; and implementation of a computerized inventory and analysis systems.

33 U.S.C. 2701 et seq. The Oil Pollution Act of 1990, provides enhanced capabilities for oil spill response and natural resource damage assessment. Includes the identification of ecologically sensitive areas and the preparation of scientific monitoring and evaluation plans. Research is to be directed and coordinated by the National Wetlands Research Center.

40 U.S.C. 471 Federal Property and Administrative Services Act of 1949.

40 U.S.C. 601 Public Buildings Amendment Act of 1972.

40 U.S.C. 606 Public Buildings Act of 1959.

41 U.S.C. 252 Competition in Contracting Act of 1984.

41 U.S.C. 601-613 Contract Disputes Act of 1978.

42 U.S.C. 300f et seq. Pursuant to the Safe Drinking Water Act, as amended, the USGS and EPA have an interagency agreement covering aquifer studies conducted by the USGS relating to sole source aquifers.

42 U.S.C. 1006 et seq. Solid Waste Disposal Act of 1976.

42 U.S.C. 2021b et seq. Low-Level Radioactive Waste Policy Act (1980) required intra-State or multi-State (regional) arrangements for disposal of low-level radioactive waste by July 1, 1986. The USGS provides geohydrologic research and technology to Federal and State agencies developing plans for low level waste management. The amending Act of 1985 included approval of seven interstate compacts.

42 U.S.C. 2210b, 2231 The Nuclear Regulatory Commission Authorization Act requires the Secretary of Energy to monitor and report to the President and Congress on the viability of the

domestic uranium industry. Under a Memorandum of Understanding between the Department of Energy and the Department of the Interior, the USGS provides information on domestic uranium resources to the Energy Information Agency.

42 U.S.C. 4321 et seq. The National Environmental Policy Act of 1969, as amended. The USGS reviews Environmental Impact Statements (EIS) prepared by other agencies under the authority of this Act. The USGS reviews EIS for nuclear power plant sites and other critical facilities. The USGS is called upon to provide technical review or inputs to resource-related actions proposed by other Federal agencies.

42 U.S.C. 5201 et seq. The Disaster Relief Act of 1974, Section 202(a), states that "The President shall insure that all appropriate Federal agencies are prepared to issue warnings of disasters to State and local officials." In addition, Section 202(b) states that "The President shall direct appropriate Federal agencies to provide technical assistance to State and local governments to insure that timely and effective disaster warning is provided." The Director of the Geological Survey, through the Secretary of the Interior, has been delegated the responsibility to issue disaster warnings "...for an earthquake, volcanic eruption, landslide, or other geologic catastrophe."

42 U.S.C. 5845(c) The Energy Reorganization Act of 1974 directs all other Federal agencies to "...(2)...furnish to the (Nuclear Regulatory) Commission...such research services... for the performance of its functions; and (3) consult and cooperate with the Commission on research development matters of mutual interest and provide such information and physical access to its facilities as will assist the Commission in acquiring the expertise necessary to perform its licensing and related regulatory functions." The USGS conducts geological mapping in areas where future nuclear reactor construction is anticipated and conducts topical investigations of various geologic processes that could imperil the safe operation of the reactors or other critical energy facilities.

42 U.S.C. 6901 et seq. Resource Conservation and Recovery Act of 1976 and the Hazardous and Solid Waste Amendments of 1984 require EPA to promulgate guidelines and regulations for identification and management of solid waste, including its disposal. The expertise of the USGS is a present and potential source of assistance to EPA in defining and predicting the hydrologic effects of waste disposal.

42 U.S.C. 7418, 7470, et seq. The Clean Air Act of 1977, as amended, requires Federal facilities to comply with air quality standards to the same extent as non-governmental entities; and establishes requirements to prevent significant deterioration of air quality and, in particular, to preserve air quality in national parks, national wilderness areas, national monuments and national seashores.

42 U.S.C. 7701 et seq. The Earthquake Hazards Reduction Act of 1977 sets as a national goal the reduction in the risks of life and property from future earthquakes in the United States through the establishment and maintenance of a balanced earthquake program encompassing prediction and hazard assessment research, seismic monitoring and information dissemination. P.L. 101-614 reauthorizes the National Earthquake Hazards Reduction Act.

42 U.S.C. 8901 et seq. The Clean Air Act Amendments of 1990 (P.L. 101-549) called for continuation of the National Acid Precipitation Assessment Program (NAPAP) that was established under the Acid Precipitation Act of 1980. The Secretary of the Interior is renamed as a member of the task force that directs NAPAP. The USGS is an active participant in the

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research program and coordinates interagency monitoring of precipitation chemistry. The USGS National Coal Resources Data System was named by the Environmental Protection Agency (EPA) as the official data base for information on coal quality. The EPA, utility companies, and coal mining industries use the data base to estimate the amount of air pollution derived from coal -combustion.

42 U.S.C. 9601 et seq. Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) established a Superfund to help finance the massive cleanup programs needed at sites that are heavily contaminated with toxic wastes. The USGS is called upon by the EPA and State agencies to investigate and determine the extent of contamination and remedial measures at some of these sites. The amendments of 1986 reauthorize for 5 years EPA's program to clean up the Nation's worst toxic dump sites.

42 U.S.C. 10101 et seq. Nuclear Waste Policy Act of 1982 on disposal of high-level radioactive wastes defines DOE as lead agency with responsibility for siting, building, and operating high-level radioactive waste repositories. The law requires participation by the USGS in a consultative and review role to the DOE. The Nuclear Waste Policy Amendments Act of 1987 (Title V of the Omnibus Budget Reconciliation Act of 1987) identifies the Yucca Mountain, Nevada, site as the first site to be studied to see if it is suitable for disposal of high level nuclear waste. The 1987 Act also provides that the Department of Energy conduct a survey of potentially suitable sites for a monitored retrievable storage (MRS) facility.

42 U.S.C. 10301 et seq. The Water Resources Development Act of 1986, as amended, provides for water resources research, information transfer, and student training in grants and contract programs that will assist the Nation and the States in augmenting their science and technology to discover practical solutions to water shortage and quality deterioration problems.

43 U.S.C. 31 et seq. The Organic Act of March 3, 1879, as amended, established the United States Geological Survey. This section provides, among other matters, that the USGS is directed to classify the public lands and examine the geological structure, mineral resources, and products within and outside the national domain. This section also establishes the Office of the Director of the Geological Survey, under the Department of the Interior. The Director is appointed by the President by and with the advice and consent of the Senate. P.L. 102-285, Sec. 10(a) establishes United States Geological Survey as its official name.

Particularly: Section 4 of the Continental Scientific Drilling and Exploration Act of 1988 requires that "The Secretary of the Department of Energy, the Secretary of the Department of the Interior through the United States Geological Survey, and the Director of the National Science Foundation assure an effective, cooperative effort in furtherance of the Continental Scientific Drilling Program of the United States."

And: 43 U.S.C. 31c. National Geologic Mapping Act of 1992 (P.L. 102-285). Establishes in the USGS a National Cooperative Geologic Mapping Program. Section 4(c) states "The objectives of the geologic mapping program shall include (1) determining the Nation's geologic framework through systematic development of geologic maps at scales appropriate to the geologic setting and the perceived applications, such maps to be contributed to the national geologic map data base; (2) development of a complementary national geophysical-map data base, geochemical-map data base, and a geochronologic and paleontologic data base that provide value-added descriptive and interpretive information to the geologic-map data base; (3) application of cost-effective mapping techniques that assemble, produce, translate and disseminate geologic-map information and that render such information of greater application

and benefit to the public; and (4) development of public awareness for the role and application of geologic-map information to the resolution of national issues of land use management."

43 U.S.C. 38 Topographic surveys; marking elevations. This section provides for the establishment and location of permanent benchmarks used in the making of topographic surveys.

43 U.S.C. 41 Publications and reports; preparation and sale. This section provides that the publications of the USGS shall consist of geological and economic maps illustrating the resources and classification of lands and other reports.

43 U.S.C. 42 et seq. Distribution of maps and atlases, etc. This section authorizes and directs the Director of the Geological Survey, upon the approval of the Secretary of the Interior, to distribute topographic and geologic maps and atlases of the United States. The prices and regulations are to be fixed by the Director with the approval of the Secretary. This Section further provides that copies of each map or atlas, not to exceed five hundred, shall be distributed gratuitously among foreign governments, departments of our own Government, literary and scientific associations, and to educational institutions or libraries. It also section authorizes all receipts from the sale of maps sold or stored by the USGS to be retained by the USGS to supplement other available funds.

43 U.S.C. 43 Copies to Senators, Representatives and Delegates. This section provides that one copy of each map and atlas shall be sent to each Senator, Representative, and Delegate in Congress, if published within his term, and that a second copy be placed at the disposal of each.

43 U.S.C. 44 Sale of transfers or copies of data. This section provides that the Geological Survey may furnish copies of maps to any person, concern, institution, State or foreign government.

43 U.S.C. 45 Production and sale of copies of photographs and records; disposition of receipts. This section authorizes the USGS to produce and sell on a reimbursable basis, copies of aerial or other photographs, mosaics, and other official records. It also discusses the disposition of the receipts from those sales.

43 U.S.C. 49 Extension of cooperative work to Puerto Rico. This section authorizes the making of topographic surveys in Puerto Rico by the USGS.

43 U.S.C. 50 The share of the USGS in any topographic mapping or water resources investigations carried on in cooperation with any State or municipality shall not exceed 50 per cent of the cost thereof.

43 U.S.C. 364 et seq. U.S. Board on Geographic Names. This law, approved July 25, 1947, establishes the U.S. Board on Geographic Names to provide for uniformity in geographic nomenclature and orthography throughout the Federal Government, and to promulgate in the name of the Board official geographic names as well as decisions and principles with respect to geographic names. The Secretary of the Interior provides staff assistance to the Board under the law.

43 U.S.C. 371 note Reclamation Projects Authorization and Adjustment Act of 1992.

43 U.S.C. 506 et seq. The Reclamation Safety of Dams Act of 1978 requires the USGS to participate in direct interchange of science information with other agencies. Geologic data developed under the Geologic Hazards Surveys are applicable to dam safety analyses.

43 U.S.C. 1334 et seq. Outer Continental Shelf (OCS) Lands Act, authorizes the Secretary of the Interior to prescribe rules and regulations to provide for the prevention of waste and conservation of the natural resources of the OCS; to conduct geological and geophysical explorations of the OCS; directs the Secretary of the Interior to conduct a study of any region in any gas and oil lease sale to obtain information necessary for assessment and management of environmental impacts on human, marine and coastal areas which may be affected by oil and gas development on such areas.

43 U.S.C. 1701 et seq. The Federal Land Policy and Management Act (FLPMA) of 1976 specifically requires that the USGS do a wilderness mineral survey by 1991 of each area Bureau of Land Management (BLM) recommends for wilderness suitability. The studies are to be on a planned and recurring basis. The original series of studies have been completed. As part of the implementation of the FLPMA, the BLM enlists the USGS hydrologic data base and expertise in connection with BLM's responsibility regarding coal reserves on and beneath Federal lands.

43 U.S.C. 1865 The OCS Lands Act Amendments of 1978 provide for management of oil and natural gas in the Outer Continental Shelf and for other purposes. The Minerals Management Service is responsible for carrying out all functions in direct support of management of the OCS program. The USGS provides indirect support to the Department's management activities through its basic mission to examine the geological structure, mineral resources, and products of the national domain which, offshore, includes the EEZ.

44 U.S.C. 35 Paperwork Reduction Act.

44 U.S.C. 1318 Classes and sizes of publications; report of mineral resources; number of copies; reprints; distribution. This section gives very specific and detailed instructions concerning the numbers of copies to be printed and the distribution of certain USGS publications.

44 U.S.C. 1319 Specific appropriations required for monographs and bulletins. The scientific reports known as the monographs and bulletins of the USGS may not be published until specific, detailed estimates, and specific appropriations based on these estimates, are made for them.

44 U.S.C. 1320 Distribution of publications to public libraries. The Director of the USGS shall distribute to public libraries that have not already received them, copies of sale publications on hand at the expiration of five years after date of delivery to the Survey document room, excepting a reserve number not to exceed two hundred copies.

44 U.S.C. 1903 Distribution of publications to depositories; notice to Government components; cost of printing and binding. Upon request of the Superintendent of Documents, components of the Government ordering the printing of publications shall either increase or decrease the number of copies of publications furnished for distribution to designated depository libraries and State libraries so that the number of copies delivered to the Superintendent of Documents is equal to the number of libraries on the list.

46 U.S.C. 31(a) and (b) The Coastal Zone Management Act of 1976 provide that each department, agency, and instrumentality of the Executive Branch of the Federal Government may assist the Secretary of Commerce, on a reimbursable basis or otherwise, in carrying out research and technical assistance for coastal zone management.

50 U.S.C. 98 The Strategic and Critical Materials Stock Piling Act of 1946 as amended by its Revision Act of 1979. Section 8 of the Act supports the USGS programs for assessment of domestic minerals, especially for strategic and critical minerals, to complement the Federal mineral stockpile program.

P.L. 81-82, P.L. 82-231 Arkansas River Compact and Yellowstone River Compact, respectively. Congress has granted its consent to many interstate water compacts. For such compacts, the USGS provides administrative support for the Federal representative, usually appointed by the President. Also, the USGS collects hydrologic data for 25 interstate compacts. The data collection is supported partly by the Federal Program and partly by the Federal-State Cooperative Program.

P.L. 93-322 Special Energy Research and Development Appropriation Act, 1975, provided funds "for energy research and development activities of certain departments" The USGS water resources investigations in coal hydrology support that legislation.

P.L. 102-580 Water Resources Development Act of 1992 establishes a National Contaminated Sediment Task Force, with USGS as a member, to conduct a comprehensive national survey of aquatic sediment quality.

P.L. 104-106 Federal Acquisition Reform Act of 1996 mandates the continued career development and training of the acquisition workforce.

P.L. 104-134 Debt Collection Improvement Act of 1996.

P.L. 104-147 reauthorizes the Water Resources Research Act of 1984 (P.L. 98-242, as amended by P.L. 101-397) through September 30, 2000, to provide for water resources research, information transfer, and student training through grant and contract programs that will assist the Nation and the States in augmenting their science and technology to discover practical solutions to water supply and water quality problems.

P.L. 104-208 FY 1997 Omnibus Appropriations Act.

P.L. 105-47 An Act to authorize appropriations for carrying out the Earthquake Hazards Reduction Act of 1977.

P.L. 105-83 FY 1998 Interior and Related Agencies Appropriations Act.

P.L. 105-97 National Wildlife Refuge System Improvement Act of 1997.

Safer Communities

Initiative Component	FY 2001 Program Change \$(000)	Page Reference
Earthquakes	2,600	36
Volcanoes	500	37
Floods	4,000	37
Total	7,100	

“Thanks for putting the water stages on the web! We operate a fish farm adjacent to the Brunner Island Power Plant along the west shore of the Susquehanna River, just south (about 1 mile) of the York Haven Hydro Dam. We call the 800 number regularly during high water events to determine the approximate time we will need to run our dewatering pumps. Due to our location and water handling systems, we change from gravity discharge to pumped discharge whenever the river reaches cautionary stage at Harrisburg. Lately, we’ve been observing the Marietta station, thinking it might have a closer relationship to the farm. What do you think? Having up to the minute data available on the web has allowed me to track the river flows, forecasts, warnings, . . . from my computer at home as well as work. Even though the “flood anxiety” is always present during river rises, it helps a lot to have the information available so that we can plan our strategies accordingly. Thanks to all of you at USGS for maintaining the facilities that we who are impacted by the river rely upon for survival!”

Real Time Hazards

+\$7.1 million

Issue

The cost of natural disasters – earthquakes, volcanoes, floods – has skyrocketed in recent decades. The Nation's Pacific Rim is **earthquake** country. Both San Francisco and Anchorage have been hit this century by great earthquakes, and recent studies by USGS and others show that the Pacific Northwest is also vulnerable to large magnitude earthquakes. Earthquake hazards also exist in other parts of the United States such as the Mississippi River valley near St. Louis and Memphis. Overall, 39 States are exposed to significant earthquake risk. In the minutes following a damaging earthquake in an urban area, there is critical requirement for accurate information on the severity and distribution of strong ground shaking. Emergency managers, managers of transportation and utility networks, providers of public services and the public in general need this information quickly in order to respond promptly and effectively to the emergency. This information is also needed by building code officials to strengthen the earthquake provisions that guide building design and provide for safer communities and less expensive disasters.

Safe air travel is imperiled by the threat of crippling damage to aircraft from volcanic-ash clouds drifting at high altitudes, particularly in the North Pacific where heavily traveled air routes overlie Alaska's numerous active volcanoes. Lying along a 1,600-mile arc, Alaska's 40-plus **volcanoes** compose an active chain that has averaged two eruptions a year for the last 50 years. Repairing damage from these volcanoes has cost more than \$400 million in the last decade alone. Anchorage International Airport is the busiest cargo hub in the United States, and cargo and passenger air traffic in the North Pacific is steadily increasing. The airport's economic survival depends on rapid detection and notification of eruptions beneath Alaskan air routes.

Can real-time information help??

Early warning of volcanic eruptions in Alaska played a major role in reducing damage to aircraft from volcanic ash clouds: from \$160 million during the eruptions of Mt. Redoubt in 1989-90 to less than \$8 million during the eruption of Mt. Spurr in 1992. The warnings also prevented life-threatening situations for the airline passengers and crew.

More lives and property are lost due to **flooding** than any other natural disaster, and every State in the Nation is affected. The National Weather Service and the U.S. Army Corps of Engineers estimate that, in recent years, flood losses average more than \$5 billion per year, in part because communities have inadequate information about flood hazards or do not have access to timely warnings and forecasts. Less than half of the 18,000 communities that participate in the National Flood Insurance Program have adequate information to define the risk of flooding. The National Weather Service uses USGS streamflow data to provide flood forecasts at 3,100 locations, but there are still many communities in flood-prone areas that do not have advance warning of potential flooding. In a November 1998 report to Congress, "A New Evaluation of the USGS Streamgaging Network," USGS provided an update on how well the current USGS streamgaging network and data dissemination systems are meeting five critical Federal goals, including providing information on flooding. The report identified deficiencies in the ability of the streamgaging network to meet both the flood mitigation and flood warning needs of the Nation.

USGS Role

The USGS has the primary Federal responsibility for monitoring and issuing warnings concerning earthquakes and volcanoes and provides the streamflow and related hydrologic information needed by the National Weather Service to predict and monitor floods. In all of the USGS programs in these areas, hazards experts work closely with local, State, and Federal partners, in pursuit of the national goals of reducing the toll of natural disasters and building disaster resilient communities.

Current Program

The current USGS hazards program includes the study of earthquakes, volcanoes, landslides, floods, and geomagnetic storms, and activities within the individual hazards programs are varied. In addition to conducting research to understand the basic processes that produce hazard events, USGS documents where and how hazard events have occurred and develops models that assist in disaster response and mitigation planning. USGS also seeks to develop better monitoring techniques and faster, more reliable communication links, so that information is quickly available to all that need it during these crises.

Earthquakes: The USGS is responsible for monitoring earthquakes throughout the United States. Under the National Earthquake Hazards Reduction program, the USGS, in cooperation with universities, States, and other Federal agencies, operates a National Seismic Network consisting of broad-band instruments located throughout the United States; operates and maintains regional seismic networks in areas with high earthquake activity; and through the National Strong Motion Program operates and maintains strong-motion recorders in 35 States and territories. Significant progress is being made to integrate the regional and national seismic networks into a National Seismic System with a seismic monitoring and data distribution system for the country. This will allow data to be shared across national and regional networks in real time and the coordination of rapid earthquake response at regional and national levels. The strong-motion data show the amplitude, frequency, and duration of ground and building motions caused by large earthquakes located near the recorders. The information is used in computer models and scale models of structures to test their performance under realistic earthquake shaking.

Volcanoes: The USGS monitors selected volcanoes with a combination of instruments and techniques to detect the rise of magma in the Earth's crust so that timely warnings of eruptions can be issued. Priorities for deciding which volcanic areas to monitor and the extent of monitoring are based on the likelihood, style, and magnitude of eruptions and on the potential impacts of volcanic activity on people and economic systems. USGS monitoring is conducted primarily at its four volcano observatories that collaborate as appropriate with universities or State and Federal agencies:

- Hawaiian Volcano Observatory (HVO) on the Island of Hawaii, where the most recent eruption of Kilauea Volcano, which began in 1983, still continues,
- Cascades Volcano Observatory in Vancouver, Washington, which monitors the volcanoes of the Cascade Range in Washington and Oregon (in partnership with the University of Washington) and northern California,
- Alaska Volcano Observatory (AVO), a cooperative effort of the USGS, the University of

Alaska Fairbanks, and the State of Alaska Division of Geological and Geophysical Surveys. AVO monitors the volcanoes of Alaska, which threaten not only local populations but also aircraft and travelers using the major air routes across the North Pacific. AVO also is responsible for disseminating warnings about dangerous eruptions and ash clouds from Kamchatkan volcanoes that may affect planes flying in U.S.-controlled airspace, and

- Long Valley Volcano Observatory in California, which focuses on the large Long Valley volcanic center where complex signs of volcanic unrest have recurred episodically since 1980. The USGS also supports seismic monitoring of the Yellowstone volcanic region in partnership with the University of Utah.

Floods: USGS operates more than 7,000 streamflow gages, more than half of which provides information to the National Weather Service, which in turn issues flood warnings when a river or stream reaches dangerous levels. Roughly two-thirds of these stations transmit data by satellite or radio to primary users of the information, and about 4,000 of these stations provide fast updates on streamflow over the Internet to farmers, homeowners, emergency management officials, and others who use this information to protect their homes and businesses. However, the gages are currently funded through a patchwork of cooperative agreements. Although the USGS currently operates real-time streamgages at more than 2,000 "service locations" for which NWS issues flood forecasts and warnings, nearly 800 such locations lack USGS streamflow data. In addition to monitoring streamflow, USGS documents flood events by determining water- surface profiles and areas of inundation, estimating by indirect means any high discharges that could not be directly measured and, in some cases, documenting the changes in the shape of the land or river channel associated with channel or floodplain erosion and/or deposition. These results are vital aspects of the Nation's flood information base, as they lead to improvements in the risk estimates for flooding.

FY 2001 Program Change

Earthquake Hazards Program +\$2.6 million – The USGS proposes to expand and modernize its earthquake monitoring in urban areas in the United States according to the plans developed for the USGS Real Time Hazards Initiative and for a national Advanced National Seismic System. New instruments will be installed along with fast transmission capabilities to enable nearly instantaneous estimates of earthquake location, magnitude, and assessment of damage. This information is crucial to saving lives, reducing injuries, and protecting critical infrastructure. After an earthquake, maps of the severity and distribution of ground motion are of primary importance to emergency managers and become the basis for recovery and redevelopment. The data are also needed to design

Can real-time information help??

"I just wanted to say "Thank You" for having your web site made available to everyone on the Internet. As a member of the Caltrans Bridge crew here in San Bernardino county, information on the recent quakes such as the 7.1 we had last weekend was found right here at your site within a few minutes of signing on. After being "tossed" out of bed I ran to my computer to find out where and how BIG the quake was. We were able to call the nearest maintenance yard which was Barstow. We could tell them where to go out and inspect the area affected by the quake and report back to us. Knowing that the quake happened in a remote area by looking at the real-time map, we had our crew stand by until we got word from the Barstow Maintenance Crew that there was little damage to our bridges. **I can't tell you how much time and money was saved knowing where to look by having this site at our finger tips. Great work.**

County Bridge Crew

and construct new structures. The Increase would allow a total of 150 new regional/urban seismic stations to be upgraded. Proposed locations for upgraded seismic monitoring are:

- **Seattle, Washington:** 20 strong motion detectors and 10 regional seismometers will be installed,
- **Anchorage, Alaska:** 10 strong motion detectors and 10 regional seismometers will be installed, and
- **San Francisco Bay Area, California:** 30 strong motion detectors and 10 regional seismometers will be installed. This is an initial piece of a multi-year program in the San Francisco Bay Area, which will ultimately constitute 1,000 strong motion detectors and 300 seismometers.

Other cities proposed for modernization may include Salt Lake City, Utah (20 strong motion detectors and 10 regional seismometers), Memphis, Tennessee (10 strong motion detectors), and Reno, Nevada (10 strong motion detectors and 10 regional seismometers).

Volcano Hazards Program +\$0.5 million – Long-term operation of real-time volcano monitoring in Alaska is needed to help mitigate volcanic risk to aviation. From FY 1996 to 2000 with funding from the Federal Aviation Administration of \$2 million annually, the USGS has installed, operated, and maintained seismic monitors at 20 active volcanoes in Alaska’s distant and relatively inaccessible Aleutian Islands for the purpose of rapidly providing information about impending volcanic activity to the aviation community so that encounters with ash clouds can be averted. The proposed increase would enable the USGS to expand this real-time volcano monitoring capability to an additional high-risk Alaskan volcano.

Hydrologic Networks and Analysis

+\$4.0 million – The proposed FY 2001 increase would enhance the USGS ability to provide real-time streamflow data for flood forecasting as well as providing information for flood hazard mitigation. The increase would add streamgaging stations to the network to address the current shortfall of 980 locations where NWS does not have adequate streamflow data, upgrade the instruments at existing stations, provide backup computer and communication systems for reliable data delivery, increase the amount of time-critical data collected during major floods and droughts, and provide new technology for collecting streamflow data and new methods for analyzing and disseminating flood and drought hazard data. The increase will allow USGS to:

Can real-time information help??

Your animated map of daily stream flow conditions for the contiguous 48 states for the past 30 days is a real eye opener! In particular, it shows how terribly dry conditions continue to be in the western portion of North Carolina, while the rest of us have been momentarily restored by the hurricane season. At a national policy level, this should be a very valuable tool to keep legislators and their staffs informed as to what the RELATIVE conditions are - as they go about their business of allocating scarcer federal dollars for agricultural and other aid programs.... USGS map products and on-line web sites provide exceptional value for my tax dollar because they empower all of us to do far better work than we could do on our own.

Conservation Commissioner, Massachusetts

- Build 50 new streamgaging stations or reactivate former stations that will provide data for enhancing flood warning and forecasting capabilities.
- Upgrade 100 existing streamgaging stations by flood hardening existing stations, adding or

Safer Communities

upgrading telemetry and other instruments, or extending stage-discharge ratings to the 200-year flood level.

- Develop and operate an improved flood and drought information system for serving both real-time and historical streamflow data and information. The first phase of the implementation would ensure the reliable delivery of real-time river stage and discharge data via the World Wide Web.
- Conduct systematic surveys of major floods and droughts to document the magnitude and extent of the event and the causal factors.
- Develop new technology for measuring streams and rivers during floods and improve the statistical and deterministic methods for assessing flood and drought hazards. The new methods and data will be used for regional evaluations of flood frequency. These analyses will provide new information for Flood Insurance Rate Maps and help communities determine appropriate floodplain management and other mitigation measures.

Can real-time information help??

This has been a great tool. During the Floyd troubles we heard many rumors that Rocky Mount dam had just broken. We were working in Tarboro so this was a big concern for many during this time. We were able to check the levels and see this was not the case. Also lost communication with relatives near Roanoke River. But because we could see the river was not at flood stage from this service you have provided we felt better.

Concerned citizen, North Carolina

Partners and Customers

The USGS works closely with scientists in other agencies; public-safety officials at the Federal, State, and local levels; government land managers; business leaders; the media; land developers and planners; educational institutions; and citizens' groups. Information is disseminated through briefings, workshops, maps, scientific publications, videos, digital databases, web sites, newspaper articles, and interviews with news and education media. During crises, USGS personnel work directly with authorities responsible for public safety.

Products

The USGS provides science-based solutions to real problems that people face before, during, and after a natural disaster. Reliable information, available when people need it, saves lives and property and empowers people to protect themselves and their communities.

Livable Communities

Initiative Component	FY 2001 Program Change \$(000)	Page Reference
Community/Federal Information Partnerships	30,000	40
Urban Dynamics – Decision Support	10,000	44
Accessible Data Transfer	2,000	48
Landsat	5,000	50
Total	47,000	

“I finally understood the importance of materials flow in the sustainability discussion and I am already incorporating references to Industrial Ecology in my presentations on sustainability.”

It “showed that while sediment retention has been perceived as a benefit of wetlands, the sediments can have very negative effects on wetland function. This will have an important effect on designing wetlands for water quality improvement.”

“The information will play a useful role in designing long-term monitoring and research programs. Our programs are ... concerned with evaluating the long-term consequences of the Exxon Valdez oil spill on the living resources of Prince William Sound, Cook Inlet and the northwestern Gulf of Alaska.”

“... They run a spectacular web site with great FTP access to all sorts of GIS data. If you need CD copies of items on the site to avoid download hassles you can get those too. This mix of free downloads and fairly priced reproductions is a good example of "customer" orientation without any bogus confusion between government and business.”

“Information developed by this group will be very helpful in determining the impact of our management actions in northwest Oregon forests. The actions and decisions affected include timber sales, operation of recreation facilities, and maintenance of forest road systems and protection of important wildlife habitats. The associated issues are very important and the subject of public attention and debate. The research findings will help provide information on issues where very little scientifically credible information exists.”

Community/Federal Information Partnership

+\$30.0 million

Issue

America's communities need spatially referenced environmental and natural resource data to make decisions that ensures quality of life and strong, sustainable economic growth. Communities' increased demand for these data provides opportunities to leverage Federal data investments, resulting in increased and current data coverage for communities and others. Cooperative data development aids collaborative decision making for issues of interest to communities and Federal agencies and helps to make Federal and State scientific data and expertise available to local communities. There has been concern over the accessibility of digital access in communities across the country. Some communities have good access; others have little to none. The Community/Federal Information Partnership (C/FIP) program begins to bridge this "digital divide."

USGS Role

USGS partnership programs share expertise and data essential to many environmental, natural hazard, and socioeconomic issues facing communities. Competitively awarded matching resources provided through C/FIP would enhance USGS efforts with local, State, and Tribal governments, the private sector, academia, and others to advance the capacity of communities to create and use spatially referenced data. The House Appropriations Committee endorsed this type of cooperation in its FY 99 report: "The Committee endorses the idea of the National Spatial Data Infrastructure (NSDI) and expects the Survey to expand the partnerships and cooperation with State and local governments and the private sector to create an NSDI" (House Interior Appropriations Subcommittee Report 105-609, FY 99). Efforts (\$25 million) will emphasize cooperative work by USGS and State partners to work with communities to develop, interpret, and use geographic, geologic, and biological data and to develop standards that help communities access and integrate these data. Remaining resources (\$5 million) will improve USGS capability to provide citizens spatially referenced earth and biological science information through the National Spatial Data Infrastructure (NSDI) and the National Biological Information Infrastructure (NBII).

Current Program

With funding provided by the General Services Administration (GSA), the Federal Geographic Data Committee (FGDC) sponsored six NSDI Community Demonstration Projects to support the use of geographic data for decisionmaking in local areas. Competitively awarded grants funded these pilot projects. USGS, through the FGDC, coordinated making GSA funding available to communities across the country to illustrate the use of geographic information and the benefits of improved liaison between Federal, State, and local communities. USGS served as a programmatic adviser on one of the six pilot projects, a project located in Gallatin County, MT. Each project addressed issues of specific concern to the local community, such as watershed and water quality management, disaster preparedness and recovery, urban growth and land use planning, and using geographic information for crime prevention. The success of these demonstration projects provided the framework for the development of the C/FIP initiative. See <http://www.fgdc.gov/nsdi/docs/comfedip.html> for more information on specific projects.

FY 2001 Program Change

The USGS requests an additional \$30 million for cross-program projects aimed at developing solutions for integrating base map data with geologic, biologic, hydrologic, soils, and land cover information. Funds totaling \$25 million for the Mapping Data Collection and Integration (\$10 million), National Cooperative Geologic Mapping Program (\$7 million), and Biological Information Management and Delivery (\$8 million) subactivities will be allocated through competitively awarded, matching grants and other cooperative mechanisms to fund community-based activities. Funds will support new research to collect geospatial data and provide technical assistance to effectively use this data.

This increase is part of the Administration's Lands Legacy initiative, State Planning Partnerships program. The additional funding will support the Lands Legacy's objectives, and in particular, help States and communities preserve local lands and habitat. C/FIP will assist State and local entities in land-use planning, and in identifying appropriate lands for acquisition and open space protection by developing, interpreting, and delivering geospatial information to communities.

Mapping Data Collection and Integration +\$10.0 million: The increase will provide competitively awarded matched funds to work with State and local governments to collect and integrate geospatial data such as orthoimage, elevation, and hydrography data. These standardized data types serve multiple purposes at all levels of government, such as the integration of elevation and hydrographic data for flood predictions. They also have myriad uses for management of government and private lands, environmental research and planning, hazards response, and commercial applications.

Earth Science Information Management and Delivery +\$2.0 million: The increase will improve Internet access (hardware and software) to enable citizens to readily tap USGS holdings of regional and State-based geographic, cartographic, and remote sensing information. These efforts will be accomplished in coordination with the Federal Geographic Data Committee and the National Spatial Data Infrastructure.

National Cooperative Geologic Mapping Program +\$7.5 million: The increase will be used to advance partnerships between the USGS, communities, State geological surveys and universities. The increase will expedite the development and production of new digital geologic maps and expansion of the Internet-based national geologic map database to meet needs specified by communities in the competitive C/FIP funding process. These scientific maps are needed by public- and private sector communities to reach informed decisions on water, environment, hazards, and land resource issues. However, ready access, objective interpretation, and effective communication are needed to apply these technical data to societal issues and decisions. Increased access through the geologic map database, effective public access and communication provided by the State surveys and community-based prioritization are hallmarks of this national geologic mapping effort to make relevant geologic map information available and useable by communities.

Energy Resources +\$0.5 million: The USGS, through its Energy Resources Program, has developed an Internet information distribution system, GEO-Data Explorer (GEODE), that serves both general interest and detailed project-level information representing the scientific breadth of the organization for use in decision making at the community level. The funds will be

used to support State and local government efforts to integrate and analyze digital geospatial data needed for local land and resource management decisions using GEODE. These data sets may include land ownership, resource distribution, satellite imagery, infrastructure networks, hydrology, zoning boundaries, and data from other USGS programs as needed. The system is designed for easy operation. At the first level, information from USGS fact sheets or national- and regional-scale maps of low resolution is made available through the click of a mouse button. The second level is designed for technical Internet users who may be interested in higher resolution data typically generated by USGS research projects and more advanced data mining and spatial capabilities.

Water Information Delivery +\$2.0 million: The increase will accelerate the process of providing more detailed stream and watershed "addresses" for the Nation. Much as a street address provides a commonly used means for locating buildings, standardized stream and watershed addresses provide a means for locating and sharing observations of the quantity or quality of surface waters and watershed conditions. Much of the work performed within this program would be aimed at defining a watershed address for every location in the United States. The address standard meets a critical need for improving the ability of Federal, State, local, and watershed based organizations to exchange information for better watershed management. The greater specificity of new codes for local watershed addresses will give much more detail in defining watershed information, thus helping citizens, scientists, and public officials to organize information about watershed conditions much more effectively. In addition, the program will significantly enhance the digital framework that defines the Nation's rivers. It would identify about 2 million river reaches, each with location information, relationship to the watershed units, and information on the upstream-downstream relationship of all of these river reaches. Much of this work would be performed by USGS, but some would be accomplished through existing and new partnership arrangements with a variety of other Federal and State agencies and academic institutions that are already doing some work in this arena.

Biological Information Management and Delivery +\$8.0 million: The USGS, through two key information programs, Gap Analysis (GAP) and the National Biological Information Infrastructure (NBII), provides a variety of broad-scale biological information to users across the country for help in making natural resource management decisions. This requested increase will enhance both of these programs by funding the cooperative activities of local communities, universities, State agencies, and others to collect and integrate local and regional-level biological data into the GAP and NBII systems. Emphasis will be on increasing the scope of data available from the Gap Analysis Program (+\$4.0 million) to include invertebrate species and freshwater aquatic environments building on pilots in Missouri and Ohio. The portion of the increase devoted to the NBII (+\$4.0 million) will be used to expand the current program by establishing information nodes for providing rapid, integrated access to detailed information on high priority biological science topics such as invasive species, Pacific salmon, and amphibians. Key partners in this initiative include: academic institutions, The Nature Conservancy, the International Association of Fish and Wildlife Agencies, and The Association of Systematics Collections. Geographic areas to be targeted include the Pacific Northwest, Southern Appalachia, Texas, California, and Hawaii.

Partners and Customers

The USGS partners with many organizations for geographic, geologic, biologic, and water data. State partners include geological surveys, State and regional fish and wildlife agencies, and natural heritage agencies. Other partners include private companies, universities, natural history

museums, and regional and Federal agencies. C/FIP extends benefits of these partnerships to communities and establishes new partnership opportunities with communities.

Customers include organizations and individuals working on critical issues facing communities, such as land and water resource management, emergency response, transportation, economic development, and mitigation of risks from natural hazards. Shared map information on rivers and lakes help those interested in environmental issues share and relate observations and develop and understand options. C/FIP-sponsored partnerships can also provide communities with access to USGS technology and other resources. The USGS will use competitive “matching fund” grant programs and other partnership mechanisms to carry out the C/FIP initiative.

Products

- Communities in the lower Mississippi region, Great Lakes, southwest, southeast, and Pacific Northwest among other places, will be invited to participate in C/FIP in order to leverage other USGS scientific work in these areas.
- New orthoimage, elevation, geologic, biologic, and hydrographic data will be collected in cooperation with local communities to support their needs by creating new data products and digital maps.
- More detailed stream and watershed locator addresses for the Nation will be created, improving the ability of Federal, State, local, and watershed based organizations to exchange information for improved watershed management.
- Improved ability of communities to find and use a variety of biological data for a selected species, topic area, or geographic location.
- Improved integration of and Internet accessibility to the geospatial, hydrologic, biologic, coastal and marine, geologic map, and mineral resources long-term databases.
- Data holdings will be increased in the geospatial and geologic map databases, NSDI, and the NBII because of an increase in local community contributions.
- Better access will be provided to local watershed decision-makers so they can more easily tap the 40 long-term databases by local watershed address.
- Increased ability for USGS and partner agencies to deliver data and to make science information available and understandable to local communities through the Internet.
- Increased ability of USGS to deliver systematic analyses & investigations to local communities through the Internet.

Urban Dynamics – Decision Support

+\$10.0 million

Issue

A review of newspaper headlines around the country shows that traffic congestion, vulnerability to natural hazards (such as floods, fires, earthquakes), loss of open-space, air and water pollution, and other quality of life concerns are foremost in the public eye. At the same time Americans recognize that growth of urban areas creates jobs and places to live and contributes to economic well being. Hundreds of initiatives to address urban growth are on local and regional agendas around the country. Political leaders and policy and decision makers are under pressure to implement approaches and solutions that address environmental issues while stimulating economic growth and the vitality of their communities.

The growth of the Nation=s urban and suburban regions is not a new phenomenon but is the consequence of a growing population that enjoys high per capita consumption of resources and increasingly resides in urbanized areas. Natural habitats are being changed and their interface with human habitats altered in ways that affect animal and plant communities. Sustainable sources of clean drinking water may be under stress in regions experiencing rapid growth. The availability and transportation of the natural resources necessary to fuel the growth of urban infrastructure (e.g., stone, gravel, and crushed rock) are directly affected by growth. For these and other reasons it is critical that the national consequences of urban change be understood to effectively manage urban growth in a manner that will maintain economic development and our natural resources for the future.

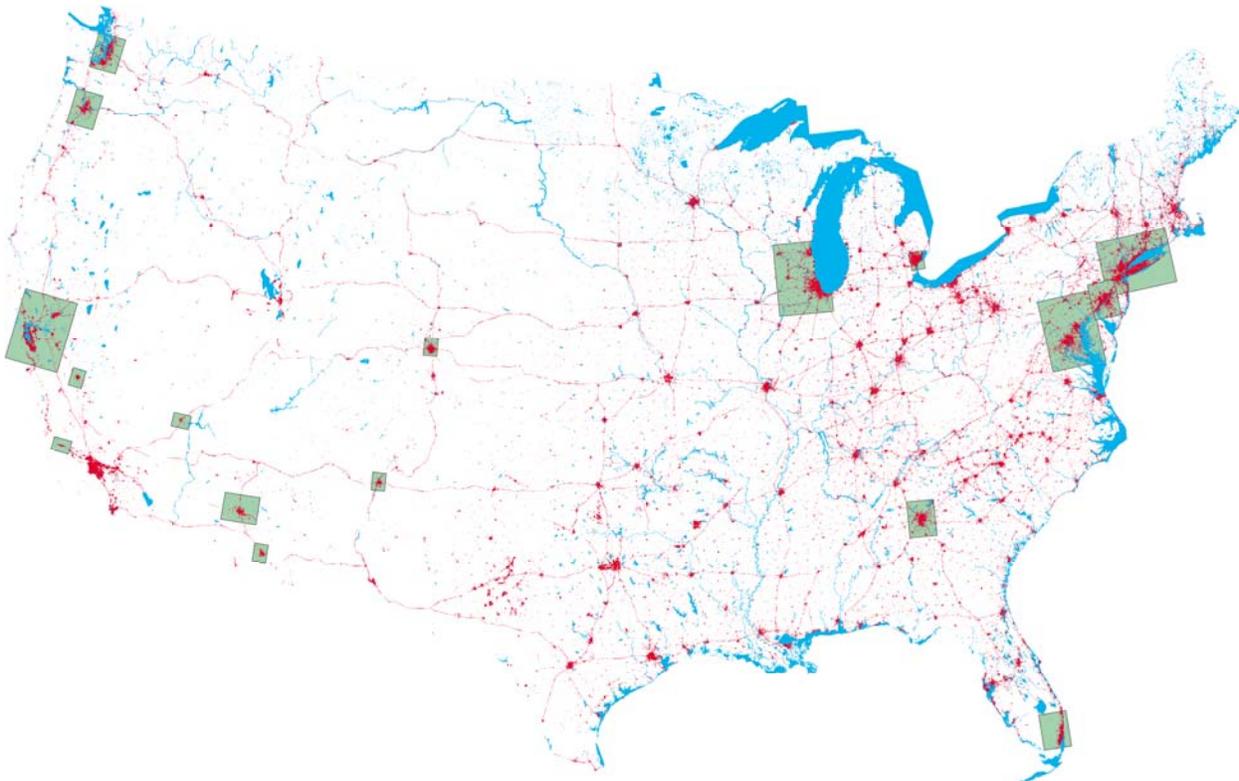
USGS Role

Through research and analysis, the USGS brings unbiased scientific observation and data to bear on these complex issues. The integration of scientific data, information, and understanding with the tools and methodologies for their effective application will help local leaders solve the complex issues they face. No other Federal agency or organization can contribute the breadth of scientific expertise at a regional scale.

These issues are not confined to one sector of society or one region, nor are they the responsibility of one Federal, State, local, non-profit, or private organization to address; rather, they affect all corners of the Nation and require the collective expertise of both the public and private sectors to control. As with most of its programs, the USGS will transfer the knowledge and experience gained in these investigations to others. With over 120 years of natural science data and information, the USGS is the largest holder of this type of earth science information. Through many national programs the USGS collects, analyzes, and distributes up-to-date information about the Nation=s natural resources.

Current Program

The USGS is addressing the dynamics of urban environments through a four-component program that involves (1) compilation of historic, retrospective data on growth at regional scales around the nation; (2) geographic analysis to reveal the rates, patterns, trends, causes, and consequences of the documented growth; (3) development and application of models to simulate urban futures; and (4) application of the first three components to societal problems. The San Francisco/Sacramento, Baltimore/Washington, New York, Philadelphia, Chicago/Milwaukee, and Portland/Vancouver regions have historic data undergoing geographic analysis. Different modeling approaches to simulating growth are under development and model application has been achieved for San Francisco, Baltimore-Washington, and Albuquerque. Applications that focus on the accessibility of infrastructure resources, the availability and quality of ground water, the contamination of ecosystems, and changes in riparian habitats have been conducted in several regions. Other urban dynamics activities are underway in Las Vegas, the Middle Rio Grande Basin in New Mexico, the Detroit River corridor, the Front Range corridor of Colorado, South Florida, and Lake Tahoe. The figure below presents areas around the Nation where work is being conducted or planned under this program initiative.



Results of the urban areas studied to date have been beneficial to local, regional, and state officials. Animations documenting past and in some cases potential future urban growth have been produced. These animations have been shown on television, reported on in the popular press, and discussed in professional literature. Several States have used USGS products to demonstrate that better control of rapid urban growth is critical to the future of a region. The data bases built to date contain a wealth of information that have been used by universities and

other organizations in studying urban growth and its effects on the environment, ecology, and resources.

FY 2001 Program Change

This increase is part of the Administration's Lands Legacy initiative, State Planning Partnerships program. The additional funding will support the Lands Legacy's objectives, and in particular, help States and communities preserve local lands and habitat. Urban Dynamics will make USGS information and technical expertise available to State and local entities to help them plan for future growth and understand possible changes in their urban and natural environment. It will involve both new research and information analysis completed cooperatively by the USGS and the participating communities, universities, and organizations.

Geographic Research and Applications +\$10.0 million: The USGS will increase its efforts to (1) understand landscape change in large metropolitan regions, (2) assess the impacts of these changes on regional ecosystems and resources, (3) enhance and apply technology for monitoring, analyzing, and predicting rates, patterns, and impacts of landscape changes resulting from natural and human causes, and (4) provide decision makers with accurate data and better understanding for improved decision making, policy, and planning. Integrated scientific investigations of the causes and consequences of urban growth will draw on historical trends that compare the effects of various physical, social, and economic factors on why and how changes in land use types evolve. Hypotheses on what controls growth and what effects growth has on water quality and quantity, land condition, resource accessibility, natural hazard vulnerability, and ecosystem viability, among other things, will be investigated. Historical data sets and the tools and methodologies for their analysis will be transferred to organizations around the country for use in grassroots initiatives focused on urban growth and related issues.

Partners and Customers

Customers for this initiative include local community leaders and decision-makers, State officials, university researchers, community groups, and the public. News organizations and other general publications have also shown a strong interest in the maps and video animations that provide a historical perspective of the urbanization process.

Local and State decision-makers need an integrated environment of decision support tools and scientific information to help them make informed land management decisions. They also need the scientific work that provides an understanding of the impacts of land use change on natural habitats, the environment, local ecology, and other resources. Researchers need the national databases created by this work to conduct further analysis of and correlation to environmental factors. They also use USGS products to produce and calibrate models of future urban growth and its impacts to the environment and resources. Community groups and the public are using temporal data and the increased understanding of land use change to promote their individual initiatives and interests.

Past USGS urban dynamics studies have relied on many different partners. These partnerships typically involve in-kind services and a shared research agenda. For example, for the Baltimore/Washington region collaborators were the University of California-Santa Barbara, the University of Maryland-Baltimore County, NASA, Bureau of the Census, Library of Congress, Smithsonian Institution, and the Maryland Historic Trust.

Products

This initiative will integrate geographic, biologic, hydrologic, and geologic data, information, and knowledge for understanding the dynamics of urban development. The initiative will also provide the spatial databases and earth science data that document the land use history of large metropolitan regions. Other products will include (1) documentation of natural community responses to habitat change, (2) models of the changes in urbanization and the availability of aggregate resources, (3) assessments of the effects of urban sprawl on water quality, water supply needs, and environmental indicators, (4) an interpreted database that objectively sets the baseline for future measurement of habitat change and human demographics/expectations on a landscape scale, (5) development of models of human-environment interactions and effects, and (6) ecological planning and design protocols for expanding and enhancing urban green space, recreational parks, and streetscapes, to their maximum ecological potential.

Accessible Data Transfer

+\$2.0 million

Issue

The Internet has become the delivery mechanism of choice for many USGS customers. In the past 2 years, the number of “hits” on the USGS Home Page has grown 100 percent while the number of users has increased 32 percent. Other USGS Internet sites report similar growth. The TerraServer, a web site developed by Microsoft Corporation in a Cooperative Research and Development Agreement with the USGS, offers USGS image data to the public and receives an average of 5 million “hits” per day.

The USGS network is approaching a time when it will be unable to transfer the data and information necessary to meet the internal needs of scientists and provide the accessibility expected by our customers. The amount and complexity of natural science data is growing explosively. At the same time, rapid development in information technology is allowing for faster delivery of data and information to customers. These changes create a climate of increased expectation by our customers.

The USGS has been so successful in marketing the availability of our natural science data, products, and services on the Internet and through the Department of Interior Network (DOINet) that our networks are now saturated. We have resorted to routing outside customers over our internal network to meet their expectations for around-the-clock, rapid access, and speedy data delivery – which makes USGS data and computer systems vulnerable to security breaches. This is markedly slowing down the network for our own internal research needs.

USGS Role

The mission of the USGS is to serve the Nation by providing reliable scientific information to the public. Today the Internet is a primary means of providing that information. We are uniquely qualified to meet the Nation’s need for natural science information. Our great wealth of information goes back 120 years, much of it is not available anywhere else. Forty long-term national databases are being maintained to hold and disseminate the tremendous amounts of data and information collected and produced by the USGS.

We have a long history of making data accessible, available, and delivering it to customers. Because of our unique federal role, the USGS is positioned to make available or provide access to data and information produced by customers, stakeholders, and others through the National Spatial Data Infrastructure and the National Biological Information Infrastructure. The USGS has achieved significant success in using the Internet to support operations and deliver natural science data and information to the nation. In just 5 years, the USGS placed more than 300,000 pages of information and ten’s of thousands of data sets on the Internet. This is expected to grow rapidly as more current data products and legacy data and information are made available via the Internet.

Current Program

Over 300 USGS offices located in all 50 states and several territories collect, maintain, and archive natural science data and information. Major regional offices in Reston, VA; Denver, CO; and Menlo Park, CA, hold significant amounts of data and information for their region or as part of a national database. The EROS Data Center in Sioux Falls, SD, is the archive for satellite images and other geospatial data and holds over a petabyte of data (a petabyte is 1,125,899,906,842,624 bytes; a petabyte is equal to 1,024 terabytes.). All of these offices are connected to the Internet.

The USGS currently uses the DOINet for most of its Internet connectivity. DOINet is the Department of the Interior's (DOI) integrated communications network. It is dedicated to supporting all DOI bureaus, improving bureau communications and reducing DOI's networking costs. DOINet ensures network compatibility within the Department and access to the Internet. The USGS currently spends about \$2.0 million per year for network connectivity as part of the DOINet under the terms of GSA's FTS2000 contract. However, DOI's Office of Information Management Resources has determined that DOINet, as it is currently operated, will no longer be used after fiscal year 2000. Each DOI bureau will be responsible for determining their Internet connectivity and purchase that connectivity under GSA's FTS2001 contract.

FY 2001 Program Change

Science Support +\$2.0 million: In the OhioView pilot project, the USGS learned valuable lessons about delivering natural science data via the Internet. The proposed increase will provide the infrastructure for USGS to more efficiently and expeditiously disseminate scientific information to its customers and to decisionmakers. It is a necessary investment for USGS to expand and replicate the OhioView model and other partnership models to other parts of the country. This initiative will increase network capacity between major USGS offices as they form the primary link between the USGS and the Internet. This will allow the USGS to increase data transfer capacity, improve reliability and speed, for delivery of data, World Wide Web pages, and real-time data to our customers. The USGS will use commercial sources to purchase and lease connectivity between these major sites for Internet connectivity.

Partners and Customers

All USGS customers will benefit from this initiative. Customers want and need the full range of USGS data and information delivered and accessible via the Internet. External customers that currently receive USGS products via the Internet will be better served by the enhancements to network connectivity.

Products

No new products will result from this initiative. However, this initiative will enable the USGS to deliver up-to-date information faster than the current performance.

Landsat

+\$5.0 million

Issue

Landsat, the world's first civil earth-observation satellite program, has provided the United States and international users with a continuous stream of land-image data since 1972. Data from the historical Landsat archive are gaining in scientific and commercial value as changes on the Earth's surface can be identified, compared, and analyzed across 3 decades. These data, both historical and up-to-the-minute, are increasingly depended on by local planners and decision makers for urban growth scenarios applications, for analysis of post natural disasters such as flooding and forest fires, and for targeting scant resources to the most severe areas of coastal erosion. The cloud-free imagery data being acquired now are the premier tool for these applications and for global scientific studies.

USGS Role

In 1994, a Presidential Decision Directive established a Landsat Program Management structure comprising the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the Department of the Interior (DOI/USGS). In 1999, these agencies agreed that the Landsat 7 mission should be managed by the Department of the Interior, the Nation's primary land-management agency, through the USGS. To ensure the long-term collection, archive management, and distribution of worldwide image data acquired by Landsat 7, the USGS has assumed NOAA management oversight responsibilities within the Landsat Program, including oversight of U.S. Government access rights to all Landsat data in international cooperator archives. Over time, the best regional archives of Landsat 7 data acquired outside the U.S. will be at international cooperator receiving sites. The USGS will maintain a mutually beneficial working relationship with international receiving stations in order to ensure access, by the U.S. scientific community and others, to seasonal global data sets.

Current Program

With the launch of Landsat 7 in April 1999, the USGS began capturing and processing seasonal global data sets of land image data. In just a few months of data collection, the program has captured cloud free imagery of the entire planet for the first time. Current USGS core mission responsibilities include coordination and management of the Landsat 7 international ground receiving and processing facilities and assumption of NOAA program oversight responsibilities. The USGS is working with NASA in FY 2000 to transition long-term management of the mission, with full USGS responsibility to begin in FY 2001. This transition allows the USGS to conduct an aggressive data collection effort to ensure the key mission responsibility of ensuring comprehensive geospatial data coverage and maintenance of permanent archives.

FY 2001 Program Change

Mapping Data Collection and Integration +\$5.0 million: The recent launch of Landsat 7 will improve the quantity and quality of remote sensing data and greatly expand the applications of this information. To be used effectively, the data need to be received, processed, stored, and available for distribution. As the volume of data and its uses have expanded greatly in the recent past and will undoubtedly continue to expand rapidly in the future, the resources needed to manage the incoming data need to expand in order to keep pace. While approximately half of the Landsat 7 mission annual costs can be recovered through data sales and international receiving station fees, base funding is required to ensure stable program operations over the long term. The \$5 million increase in FY 2001 meets the need for operational stability and will fund a competitively awarded commercial contract to maintain satellite operations.

Partners and Customers

The USGS carries out its Landsat Program Management responsibilities in partnership with NASA. In addition to Federal scientists and land managers, the USGS has traditionally provided thousands of government, corporate, and individual customers across the country and around the world with Landsat data. A pilot program is also in place with a consortium of academic and government agencies in Ohio to provide near-real-time Landsat 7 data on each orbital pass over the entire state, after which consortium members will share and redistribute the data to local users.

Products

The cloud-free and global nature of the data sets serve the needs of national and international land-management and earth-science agencies, State and local government planning bureaus, commercial engineering, mapping and earth-resource companies, and a host of entrepreneurs that exploit satellite image data for many purposes. Also, users can now combine sharper images with many more data sets than in the past, allowing GIS users to derive tomorrow's breakthrough remote sensing products.

Sustainable Resources for the Future

Initiative Component	FY 2001 Program Change \$(000)	Page Reference
Columbia River – Aquatic Resources	4,000	54
Great Lakes	500	57
Greater Yellowstone Area	400	59
Mojave Desert	400	61
Decision Support for Resource Management	10,000	63
Total	15,300	

“This research is part of a larger effort to develop and evaluate... alternatives for juvenile salmon and steelhead in the Snake and Columbia Rivers. Results have been/will be used to make decisions on which salmon recovery strategies are most likely to be effective.... USGS scientists have good record of being ‘credible’ and unbiased in their reporting and analysis of results.”

“Product is used to keep current regarding status of Great Lakes fish community and its relation to sea lamprey management. Product also serves as an excellent reference for future use. Product has direct influence on sea lamprey management options and their potential impact on fish community. ”

“The information on prey fish communities is essential to management decisions on predator stocking levels and the general well being of the lake ecosystem. In addition prey species information is used in modeling exercises.”

“We used the mallard model to guide planning. The model allowed us to predict outcomes of planned management actions. It is an extremely valuable decision making tool.”

“The refuge has always needed a computer program to help make decisions on our complex water management program. It is much easier to look at a complex data sets and have the program provide alternative management strategies.”

Columbia River – Aquatic Resources

+\$4.0 million

Issue

The Columbia River basin, as well as the entire Pacific Northwest, has experienced tremendous landscape-scale change over the last 50 years. The Columbia River is a highly engineered system with 8 major hydropower dams, and numerous small dams, diversions, and alterations to its natural state. Also, the landscape has undergone significant urbanization, heavy logging, and agriculture development that have contributed to impacts on the natural resources of the system. Pacific salmon are one of the natural resources most significantly impacted in the region. Several salmon and trout populations are, or soon will be, listed as threatened or endangered, and other species such as white sturgeon and Pacific lamprey are potentially at risk.

USGS Role

In March 1999, the President proposed a new partnership to restore the Pacific salmon. The Pacific Coastal Salmon Recovery Initiative is designed to recover salmon by accelerating the use of Federal science and technology. USGS brings a broad array of science and technology skills to address the problems in the Columbia River Basin and throughout the Pacific Northwest. This array of skills enables USGS to provide basic understanding of the relation between behavior of downstream migrating salmon and the hydraulic dynamics for river water flow, and a conceptual foundation of restoring natural processes within the river and determining how best to monitor system health. USGS has the capability to meet regional-scale needs for basic geologic/geomorphic maps that can help define how much of a functioning riverine ecosystem is needed to improve survival of critical species, while maintaining human oriented benefits of the system.

Current Program

Across all Divisions, USGS expends approximately \$3.5 million in base funds and nearly twice that amount in reimbursable funds on science that supports understanding of fish population declines. A significantly greater amount of effort is directed at understanding aquatic ecosystems of the Pacific Northwest.

FY 2001 Program Change

USGS will devote its broad capabilities in physical, chemical, biological, and geographic information gathering and analyses to the complex problems of restoring salmon in the Pacific Northwest. Community leaders, resource managers, and the public have critical decisions to make to restore fish populations. Before these decisions can be made, scientific information is needed to effectively consider available options. A report recently released by the Committee on Environment and Natural Resources on restoration of salmon concluded that the current lack of success in restoration is in part due to an inadequate scientific base in fundamental areas.

Geographic Research and Applications +\$0.5 million: Geographic research will focus on

the social-economics of fish restoration decision-making by carrying out a structured process called the INtegrated science and Community-based values in Land-use DEcision-making (INCLUDE). The process will identify issues and values critical to stakeholders and perform cost-benefit analyses of management alternatives. Research will analyze and improve, where needed, existing geographic data sets in critical fish habitat watersheds.

Coastal and Marine Geology +\$0.5 million: Geologic research will investigate the influence of geomorphic change and sedimentation on the quality of salmon and trout habitat in the Columbia basin. Channel morphology and sediment processes are important factors for modeling hydraulic flow, temperature, and sediment transport. Pilot studies will focus on representative segments of the Columbia River and selected tributary watersheds. The research will integrate geologic data with other information in a Geographic Information System (GIS) for the Columbia River basin. Because natural and human-induced changes to geologic systems fundamentally influence habitat quality and the aquatic productivity, the predictive models and decision support systems for the Columbia basin will take them into account.

Hydrologic Research and Development +\$1.0 million: Hydrologic research will examine river reaches in the Columbia River basin to compare and contrast habitats with varying ecological functions. It will consider hydrologic and hydraulic information (discharge, flow velocity, minimum flow, ramping rates), geomorphic features (depth, cross-section, sediment load and channel bedform) and biogeochemical and food web processes (nutrient and energy dynamics). The aim will be to maintain and enhance the overall biological productivity and ecological health of the Columbia River, particularly the recovery of salmon and trout.

Biological Research and Monitoring +\$2.0 million: Biological research will link closely to studies of temperature, flow, and stream morphology/substrate conducted by other USGS divisions to support aquatic resources management in a basin-wide, integrated framework. Research will encompass aquatic habitat alterations influenced by land uses such as road building, irrigation, logging and urbanization. It will study how these activities affect fish production, migration, and survival. Researchers will look at risk factors associated with delays at dams, transport, and other stressors such as disease and contaminants and at critical ecological interactions affecting fish assemblages, including predation, competition, and invasive species. Studies will focus on salmon and bull trout early life history, particularly how fish populations are affected by factors important for sustaining primary productivity. Genetic and ecological requirements for cutthroat and bull trout restoration will be another research focus. Researchers will study the behavioral and genetic interactions between hatchery and wild salmon and trout, and the hatchery conditions needed to improve restoration.

Partners and Customers

The Federal government will carry out a critical role in salmonid conservation by facilitating the integration of science and information emanating from Federal, Tribal, State, academic, and local agencies. The Federal government also will ensure that provisions are made for consistent, high-quality information to be broadly disseminated to all stakeholders. Within the DOI, the Fish and Wildlife Service, Bureau of Reclamation, Bureau of Land Management, National Park Service, and Bureau of Indian Affairs are involved in the management of fish and wildlife resources, public lands, and water resources within the Columbia River Basin. Other Federal partners in scientific study and resource management include the Bonneville Power Administration, Army Corps of Engineers, National Marine Fisheries Service, Environmental Protection Agency, U.S. Forest Service, and National Oceanic and Atmospheric Administration.

Products

USGS will undertake a multi-disciplined approach to provide information needed by resource managers charged with recovery of critical species. Four areas of study and information gathering will provide a range of products that encompass habitats required by endangered fish populations. These include:

Habitat characterization and quality -

- Geospatial representation of physical, chemical, and biological factors that determine productivity,
- Physical and biological models to examine temperature and flow interactions that influence migration and survival,
- Identification of habitat and landscape components that limit population sustainability,
- Analysis of linkages among habitats required by fish populations throughout their life cycle from headwaters to the estuary.

Science for restoration of habitat altered by human actions -

- A framework for examining what aspects of habitat are limiting and what can be done to improve trout, salmon, and sturgeon numbers,
- Tools to predict impacts of management alternatives,
- Technical assistance and interpretation of existing data.

Biological and geophysical factors limiting fish populations -

- Identification of risk factors associated with stressors (such as disease and contaminants) that are mediated by the cumulative effects of management actions,
- Identification of genetic requirements for re-establishing salmonid populations,
- Evaluation of the consequences of genetic change from hatchery supplementation on viability and productivity of salmon and trout, and means to reduce deleterious genetic effects.

Socio-economics of salmon restoration decision-making -

- Carry out the INtegrated science and Community based values in Land Use DEcision making (INCLUDE) that will identify issues and values critical to stakeholders and perform cost-benefit analyses of management alternatives,
- Analyze and improve, where needed, existing geographic data sets in fish habitat watersheds and assist in development and use of decision support systems.

Great Lakes**+\$0.5 million****Issue**

Population growth and demographic shifts, along with associated development, resource use, and land-use changes, have profoundly affected the Great Lakes Region. Among issues that currently receive attention due to human activities are: increasing use of Great Lakes water, and diversion of lake water out of the region; land-use changes such as urban and suburban growth, loss of prime agricultural lands, and restrictions in land use; availability of building resources such as glacial gravel, aggregate, and crushed stone; persistent chemicals in the lakes and on land that accumulate in fish and animal tissue and affect human and wildlife health; urban area brownfields; drinking-water contamination by pathogens; beach closings due to fecal contamination; introduction and spread of exotic species in the lakes, rivers, and inland lakes; and loss of critical habitat for fish and wildlife.

Because humans are not the only agents of change, issues related to natural climatic and geologic processes also receive attention. Such processes control the levels of the lakes and their shipping and recreation seasons, and significantly affect maritime transportation, wetland alteration and loss, shoreline erosion, flooding, periods of drought, and sustenance of biologic communities.

Many government agencies, universities, non-governmental organizations, and citizen groups have conducted natural-science studies related to these issues in the lakes or on the land. However, no regional organization has coordinated an approach to linking science in the lakes to science in the watershed and the surrounding region. This is a necessary linkage so that decision makers have the appropriate technical information to make informed decisions.

USGS Role

USGS scientists are responding to cooperators' needs for increased support for decisionmaking in the Great Lakes Region. The USGS is the only natural-science agency that transcends many jurisdictional boundaries and has the expertise to provide multidisciplinary information on various scales and to integrate information on lake and watershed processes in support of such decision making.

Current Program

The USGS recently completed the Great Lakes Region strategic plan to increase and sharpen the focus of USGS activities in the region, guide scientific research, and foster the coordination and integration of proposed studies to leverage with ongoing activities. The USGS will develop a science plan for FY 2001 activities that takes into account existing program work, already underway by groups such as the Central Great Lakes Geologic Mapping Coalition; the programs of the eight USGS District offices in the region; the Western Michigan and Lake Erie NAWQA studies; the USGS Biological Resources Great Lakes Program; and the Chicago and Detroit urban mapping effort and the USGS National Mapping Program. All of these programs

have produced advances in geologic, hydrologic, water quality, cartographic and biologic information in the Great Lakes Region.

FY 2001 Program Change

Earth Surface Dynamics +\$0.5 million: The USGS effort will initially focus on Lake Michigan to look at watershed and lake processes and how they affect the living resources, primarily fish. Integrated activities will include water-quality sampling for various contaminants, geologic studies, habitat data inventory including effects of land use change on habitat loss, shoreline mapping to determine changes in coastlines, and analysis of land use change. This effort will complement other USGS programmatic activities that focus on the Great Lakes watershed and surficial processes and glacial framework of the Great Lakes region. The incorporation of the above earth and biological information into a single integrated Great Lakes database that will occur as studies progress will help managers make better decisions with respect to the future of all of the Great Lakes.

Partners and Customers

Other Federal, State, and local agency programs also will be considered, as will Canadian and bi-national programs, so that USGS activities will complement the work of those outside the Bureau. Such organizations include, but are not limited to, the International Joint Commission, the Great Lakes Commission, the Great Lakes Fishery Commission, the U.S. Environmental Protection Agency's Great Lakes National Program Office, the National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Laboratory, the U.S. Army Corps of Engineers, the Council of Great Lakes Governors, State, county, and municipal governments, the Midwest Natural Resources Group, and other non-governmental organizations. With a knowledge of these programs and organizations, all USGS scientists working in the region will be able to establish effective partnerships and develop research priorities that meet the needs of those responsible for making resource management decisions.

Products

In order for the USGS Great Lakes science plan to be successful, the data USGS collects and the information based on the data must be targeted and rapidly disseminated to meet customer needs. The customers of USGS information in the Great Lakes Region include lawmakers, regulatory authorities, management agencies, scientists, nonprofit organizations, and the general public. Each of these audiences will require targeted products in order for the information to be most beneficial.

Greater Yellowstone Area**+ \$0.4 million****Issue**

An increasing number of people are drawn to live and recreate in the Greater Yellowstone Area (GYA) ecosystem, which contains the Nation's oldest National Park, unique wildlife resources, and the influences of one of the largest dormant volcanic areas in North America. Coexistence with wildlife is a delicate balance as the area is developed and wildlife habitat is fragmented. Managing this balance requires vastly improved information on landscape attributes (geology, topography, vegetation, climate, roads and trails, and hydrology), parallel information on the utilization of the landscape by wildlife and humans, and on the dynamic interactions among wildlife species.

USGS Role

Due to the long history of natural resource research in the GYA, USGS scientists are responding to cooperators to provide increased support for decision making in this area. The USGS is the only natural-science agency that transcends many jurisdictional boundaries and has the expertise to provide sound, independent, interdisciplinary information at various scales and to integrate information on lake and watershed processes in support of such decision making. The recent establishment of the Northern Rocky Mountain Science Center will help focus science needs, integrate multidisciplinary studies, and enhance collaboration with the National Park Service, Fish and Wildlife Service, Bureau of Land Management, and other stakeholders working in the GYA.

Current Program

The Greater Yellowstone Area Initiative was developed in partnership with the Bureau of Land Management, the National Park Service, and the U.S. Fish and Wildlife Service to conduct integrated interdisciplinary scientific analysis of the physical, chemical and biological characteristics of the region. Its intent is to foster better understanding to encourage informed natural resource decision making among Federal, State, and local resource management agencies, and the private sector. Resource managers in the GYA have identified integrated land information as a major requirement for integrated decision making. For these reasons, the Initiative focuses its work on the landscape scale.

The research strategy in the GYA focuses on four critical focus areas: wildlife - habitat interactions, human - habitat interactions, human - wildlife interactions, and biophysical processes (climatic, geologic, hydrologic, etc.). A strategic plan has been developed that provides an overview of each focus area, documents the current status of research, identifies key knowledge gaps, and defines research activities to eliminate these knowledge gaps. A common thread throughout all focus areas is the development of consistent contiguous spatial and temporal data sets that cover the entire GYA at a meaningful scale.

In addition to these focus areas, the research, data assembly/management, and modeling/decision support system development called for in the strategic plan will also investigate and account for the synergistic relationships that exist between the focus areas.

The effects of these relationships will be included in the various decision support tools developed for resource managers and policy makers. These tools will allow managers and policy makers to examine and evaluate multiple aspects/factors pertinent to land and resource management and to develop land management scenarios to determine human impacts on wildlife and habitat.

FY 2001 Program Change

Biological Research and Monitoring +\$0.4 million: For FY 2001, the USGS is bringing existing scientific data into a common spatial framework (geographic information system) for collaborative decisionmaking that reflects the needs of land and resource managers in the Greater Yellowstone area. Specific activities conducted with additional funding in FY 2001 include the development of more user-friendly software to enhance utility of existing climate data for decision making, historical inventories of land use and land change, and habitat selection analyses for threatened and other species such as the grizzly bear. By developing and sharing data resources with Federal and State agencies, information will be consistent and useful across ownership and management unit boundaries, and in a form that can be applied to management decisions concerning wildlife and its habitat, local zoning, geothermal and mineral resources, and natural hazards.

Partners and Customers

Direct and primary users of this research will be the member agencies in the GYA including Yellowstone National Park, Grand Teton National Park; the Gallatin, Shoshone, Custer, Bridger Teton, Beaverhead, Deer Lodge, and Targhee National Forests; U.S. Fish and Wildlife Service; Bureau of Land Management; the State Fish and Game agencies for the States of Idaho, Montana, Utah and Wyoming; and USGS. Other Federal, State, and local government agencies will benefit indirectly as results of this research are applied throughout the Greater Yellowstone Area.

Products

The project will produce contiguous biophysical geo-spatial data sets and graphical user interfaces, decision support tools, Web-based analysis tools, peer-reviewed publications providing ecological insights, and probabilistic habitat use models. The USGS has released a CD-ROM of the Digital Atlas of the GYA that displays thematic coverages of the GYA at various spatial scales. The CD-ROM was developed by the Aurora Partnership, a consortium of government and non-government organizations. Products such as the CD-ROM are likely to have application, and be transferable, to other Federal and State wildlife management units outside the region.

Mojave Desert
California Desert Water Resources and Ecological Monitoring

+\$0.4 million

Issue

Springs, wetlands, and riparian areas and other water-dependent habitats are highly significant in the California portion of the Mojave Desert. Although limited in extent, they are rich in biodiversity, support numerous endangered, threatened and sensitive/endemic species, such as the desert tortoise, and provide desirable recreational opportunities for visitors. Rapid population growth on the edge of the Mojave Desert has resulted in increased demands for limited water resources. This competition for water is adversely impacting both water-dependent habitats, essential to the survival of desert plant and animal species, and recreation areas.

The Mojave Desert in California has extensive Federal lands. Between them, the Department of the Interior (DOI) and Department of Defense (DOD) manage three national parks, the 12 million acre California Desert Conservation Area, and 5 of the Nation's premier military training bases. Management decisions must increasingly rely on the need for water and biological research, which USGS is conducting in partnership with DOI, DOD, and State agencies through the California Desert Managers Group (DMG).

Successful land management of these desert lands depends on the use of current scientific information on the physical and biological resources and their trends. It is especially important to know the condition of the resource and how that condition is changing in response to management actions and natural and human change. Without a way to assess changing conditions, land managers cannot measure conservation progress or the effectiveness of actions prescribed in land management plans.

USGS Role

Insufficient hydrologic and biological data are available to adequately understand the complexities of the Mojave Desert ground water aquifer systems and their associated biological resource values. USGS has the capability to organize and compile new hydrologic information into a spatial database and establish monitoring protocols for both hydrologic and ecological conditions. USGS expertise in assessing ecological conditions and in developing both hydrologic and ecological monitoring protocols is essential to this project. Completion of tasks in this project will require the expertise of hydrologists and biologists, aided by geologists and geographers. This work will be done in partnership with NPS, BLM, and FWS as a project coordinated by the DMG.

Current Program

USGS has compiled hydrologic data (ground water levels, spring sources, water chemistry, surface water gaging) and is working on regional modeling of hydrologic systems. The USGS place-based study, Recoverability and Vulnerability of Desert Ecosystems, is identifying additional threats to ecosystems and assisting restorations.

FY 2001 Program Change

Geographic Research and Applications +\$0.4 million: In FY 2001, USGS, in partnership with the DMG, will focus this new initiative on monitoring of both water and ecological resources. Existing water data, such as groundwater levels, spring sources, water chemistry, and surface water, will be compiled into a spatial database for analysis by DMG partners and other stakeholders. The USGS will also complete a draft protocol that can be used desert-wide to monitor water chemistry and quality, water levels, discharge, and water use. The USGS will assess existing ecological monitoring strategies, develop a conceptual model of ecological system functions, and begin to design a practical and scientifically sound monitoring effort. When completed, the hydrological and ecological monitoring protocols can be used to track trends in water use and availability, and demonstrate the dependence of biological systems on a stable water supply.

Partners and Customers

Land management agencies participating in the California DMG (DOI, DOD, State of California) are the primary customers. The information will also be made available to communities, the private sector and the public. These customers need ready access to integrated scientific information on status and trends of the desert's hydrologic and ecological systems. This project will be undertaken jointly with NPS, BLM, and FWS, under the auspices of the DMG. Costs of the projects will be shared among FWS, NPS, BLM and DOD.

Products

USGS will produce practical protocols for monitoring and assessing the condition of both hydrologic and ecological resources for use by DOI, DOD, and State of California land managers. USGS will also produce databases and, in conjunction with the DMG, decision support systems that will be readily accessible by land managers over the Internet. In addition to members of the DMG, the information will also be made available to communities, the private sector, and the public which need ready access to integrated scientific information on status and trends of the desert's hydrologic and ecological systems. Among the specific products to be created by USGS in conjunction with NPS, BLM, FWS, and DOD partners and funds, USGS will have primary responsibility for: compilation and organization of existing hydrologic data into a spatial database for use in Geographic Information Systems; first draft of a protocol that can be used desert-wide to monitor water chemistry/quality, water levels, discharge, water use and surface water gaging; initiation of compilation of components of water budget for ground water flow system; preliminary evaluation of the role of climate on water budgets; and development of a conceptual model of ecological system functions.

Decision Support for Resource Management**+\$10.0 million****Issue**

Every day, managers at the local, regional, State, and Federal government level face difficult decisions about the complex natural resources under their care. The decisions they make affect water, earth resources such as sand and minerals, and native species such as fish, migratory birds, endangered species, and numerous other plants and animals, and the habitats upon which those organisms depend. Those decisions also affect the lives and livelihood of people in surrounding communities. Despite a massive accumulation of information about the environment, many decision-makers now find themselves in a quandary of how best to tap and interpret the rich library of scientific data necessary to balance the demands placed on the resources they manage.

Most of the data the USGS produces are in computer-readable forms that can be used in geographic information and decision support computer systems. Decision support systems have the potential to integrate data, methods, models, and other tools, within a framework that explicitly addresses the process of making decisions. While these computer systems cannot make the decisions for the land or resource manager, the systems are able to help the manager view the land in different perspectives, study different scenarios, and conduct what-if analyses.

About 70 percent of the cost of building a decision support system is aggregating and organizing existing data that will be used in the system. By better documenting the data with standards developed by the Federal Geographic Data Committee and formatting the data into commonly available formats, USGS could make more of its data and information useable at lower cost by land and resource managers. There are, however, no standards for predictive models that would be used in a decision support system. Because of a lack of standards, predictive models that are built for one system cannot be easily used in another system. Existing predictive models or decision support systems cannot always easily be linked together or otherwise used in conjunction with each other. This raises the cost for the land or resource manager to build the systems they need to help them in their decision making rather than using existing systems.

These challenges need to be addressed to allow natural resource managers to make informed decisions about the Nation's resources.

USGS Role

USGS is uniquely qualified to support land and resource decision-makers. The USGS will bring to bear all of its scientific capabilities — biologic, hydrologic, geologic, and geographic. Integration of these scientific disciplines will help land and resource managers solve the complex issues they face. Natural resource decision-making requires access to large amounts of scientific data and information from various disciplines, delivered in a form that can be readily used by resource managers. Through this initiative, the USGS will continue to build upon this unique capability and provide critical support to agency and private partners, especially those participating in the Administration's Lands Legacy initiative.

Current Program

Over the last several years, the USGS has increased its efforts to integrate scientific data and information within the bureau to help decision-makers at local, regional, and State levels. An example of this is the Upper Mississippi Decision Support System. Other Federal agencies, State officials, and resource managers along this river corridor use this system to produce scientific charts, graphs, and maps that allow them to study different scenarios for addressing specific management issues. Other decision support systems have been developed to provide access to energy resource assessments, to evaluate and apply water-allocation and management strategies, and to provide a better understanding of the issues involved in areas undergoing urbanization.

FY 2001 Program Change

This increase is part of the Administration's Lands Legacy initiative, State Planning Partnerships program. The additional funding will support the Lands Legacy's objectives, and in particular, help States and communities preserve local lands and habitat. The decision support systems developed through this initiative will provide the scientific, technological, and information management support that modern-day natural resource managers require to effectively address complicated, multifaceted problems.

The USGS will work in the Lower Mississippi region to help farmers, local officials, and natural resource planners in implementing the best management practices in heavily farmed areas of the floodplain. USGS scientists will conduct a pilot study in the Grand Canyon Corridor (coordinated with other Federal agencies) integrating remote sensing and other geospatial data to help resource managers. USGS will collect, integrate, and interpret geospatial, hydrologic, geologic, and biologic data in the U.S./Mexico Border region to aid resource managers and decision-makers on both sides of the border. This study would continue and expand investigations of water supply and water quality problems in this region. The USGS will contribute to the Lewis and Clark Expedition Bicentennial Commemoration by producing decision support systems for resource managers involved in land acquisition decisions.

Mapping Data Collection and Integration +\$0.4 million: The proposed increase will help address the geospatial data requirements of USGS scientists as they develop and implement data integration and predictive modeling capabilities that address resource management decisions. The integration and modeling of land surface and urban growth information with other physical, cultural, and historic information will result in a focus of geospatial data collection on digital imagery, hydrography, elevation, and land cover characterization within the appropriate study areas.

Geographic Research and Applications +\$2.0 million: The proposed increase will allow the USGS to strengthen data integration and predictive modeling capabilities that address resource management decisions. Emphasis will be placed on integrating and modeling land surface and urban growth information with other physical, cultural and historic information for the subject areas. Work will also be undertaken with industry representatives to develop standards for decision support system models and data that are compatible with standards for geographic data endorsed by the Federal Geographic Data Committee.

Mineral Resources Program +\$1.2 million: The increase will permit the USGS to expand its current activities in developing decision support systems needed by land managers dealing with issues related to natural resources (such as sand and gravel) and the historical impact of mining. Pilot studies will be conducted applying advanced visualization techniques to remotely sensed data that can quickly help inform land management decisions and allow for rapid prioritization of resource issues. USGS geologic data bases, an essential part of proposed resource modeling and decision support systems, also will be standardized and integrated with other USGS data and systems.

Water Information Delivery +\$2.7 million: The increase would permit the USGS to develop better and more user-friendly simulation tools that can be used by land and water resource managers to predict outcomes of resource management actions under their consideration, and to make decisions about issues such as permitting ground water withdrawals, acquisition of land for habitat preservation, relicensing of power projects, and restoration of engineered river systems. The USGS will develop tools that (1) combine geochemical, microbiological, and hydrological information to provide quantitative information about water flow characteristics and water quality conditions in a study area, (2) simulate two-dimensional flow and transport in streams and rivers of variable gradients and flow conditions, and (3) provide new three-dimensional versions of ground-water models that can be used to more accurately describe the subsurface and processes of contaminant transport. In addition, the USGS will develop new tools for determining uncertainty in simulations – an important factor for land managers to consider in seeking solutions to complex issues. More sophisticated quantitative models that are user-friendly for inputting data and displaying results will provide a managers with better options to use the Nation=s water resources more wisely.

Biological Research and Monitoring +\$1.2 million: This increase will provide the means to develop decision support tools for public and private resource managers charged with addressing several high priority resource issues, such as Habitat Conservation Planning in the southwestern and western United States, an endeavor that will aid both U.S. and Mexican conservation efforts. Decision support tools will be created for riverine and wetlands management in the Lower Mississippi Valley and the Pacific Northwest to benefit farmers, local officials, and natural resource planners in implementing best management practices and land acquisition policies. Other tools that are developed will be directed toward better management and monitoring for broader resource issues, such as migratory birds and sensitive fish populations.

Biological Information Management and Delivery +\$2.5 million: The increase would allow the USGS to provide new biological, physical, cultural, and historic data, information products, and analytical tools to State and Federal land managers and others along the Lewis and Clark corridor. The effort will highlight the biodiversity status of the corridor and will include cartographic, geologic, and water resources data integrated in a robust decision support system to aid the protection and restoration of national assets. This system will provide a characterization of land parcels in a manner similar but more expansive than the recent Gap Analysis pilot study conducted on the segment of the Missouri River between Fort Peck Dam and Great Falls, Montana. The geographic information system-based decision support tool will also be useful in supporting policy decisions on long-term land acquisition strategies aimed at

protecting viewsheds, key wildlife habitats, historic sites, and popular recreation sites along the corridor.

Partners and Customers

Customers for this initiative are those concerned with land and resource management in local and State governments, Department of the Interior bureaus, and other Federal agencies. The USGS will also continue to work with the Department of the Interior's U.S./Mexico Border Field Coordinating Committee to coordinate work in that part of the country.

The USGS will continue to work with the Lewis and Clark Interagency Memorandum of Understanding group to coordinate the design and building of decision support systems.

Work will also be undertaken with the Aurora Partnership, a consortium of government, academia, and commercial vendors, to develop standards for decision support system models and data that are compatible with standards for geographic data endorsed by the Federal Geographic Data Committee. USGS scientists will work with scientists in academia and private industry to establish standards for predictive models, computer simulations, and scientific visualizations so that they can be used in many different decision support systems.

The partnerships used for the efforts described in this initiative generally do not involve the exchange of funds from the USGS to other organizations. Rather, members of these partnerships each typically contribute technical, scientific, financial, or other forms of support under a shared research and development agenda. By sharing the workload and costs, more solid, long-lasting, and productive relationships are forged.

Products

The USGS will design and build decision support computer systems for the Lower Mississippi Region, Alaska's North Slope, in the U.S./Mexico Border region, and along the Lewis and Clark trail. The USGS will develop a robust decision support system that will provide physical, cultural, and historic information along the Lewis and Clark corridor using a broad range of data and information provided by USGS, other Department of the Interior bureaus, and other agencies. The system will provide land managers a scientific characterization of the Lewis and Clark corridor using Gap Analysis data as well as geologic, cartographic, and water resources information. The natural resources and cultural information provided through a decision support system will serve as a basis for comparing current conditions and ecological processes to those that existed 200 years ago, which will help support policy decisions on long-term land management of and potential Federal land acquisition in the area. Geologic mapping and geochemical sampling data in the U.S./Mexico Border region will be integrated with hydrologic and biologic data to improve land management decisions on both sides of the border.

America’s Natural Heritage

Initiative Component	FY 2001 Program Change \$(000)	Page Reference
DOI Science (\$15.0 million)		
DOI Science Priorities	13,000	68
Amphibian Research and Monitoring	2,000	71
Fish and Wildlife Disease	1,000	74
Cooperative Research Units	700	76
Total	16,700	

“This research provides the park with empirical data that describes how bobcat and coyote territories are affected by roads and the urban interface in a fragmented landscape. The information will be used to make informed decisions about management along park boundaries and roads. This information may contribute to decisions regarding future land acquisitions. It also provides important information to share with neighboring public land managing agencies, that will allow the NPS to better evaluate adjacent land management, and influence land management at the landscape level. The information on disease transmission in urban versus rural areas may influence decisions about pets on trails and in residences in the park, and how we educate park neighbors about the impact of the pets on park wildlife. The NPS also understands that these research results will be critical to evaluating the effect that the recent natural reestablishment of coyotes in the park is having on bobcat and gray fox populations and habitat use.”

“The information provided by North American Amphibian Monitoring Program is current and easily available over the www. Because the protocols have been peer reviewed and often validated with specific research studies, they are very helpful in efficiently planning solid monitoring and research projects of my own.”

“Results of the work completed will determine how we manage our forest lands for Roosevelt elk; the Coop Units work has redefined what we now consider optimum habitat for elk and will change how we manage road closures for the species.”

DOI Science

\$15.0 million

DOI Science has two components, DOI Science Priorities and Amphibian Research and Monitoring, each of which represents important DOI management requests for science-based decisionmaking. DOI Science Priorities includes top management priority requests to the USGS for science research and information as determined by each DOI

DOI Science	(\$000)
DOI Science Priorities	13,000
Amphibian Research & Monitoring	<u>2,000</u>
Total	15,000

bureau, under the Agreement on USGS Research Support for DOI Resource Management Bureau Needs. These priorities cover a broad spectrum of multidisciplinary biological and earth science expertise. Amphibian Research and Monitoring, conducted in partnership with the National Park Service, Fish and Wildlife Service, and Bureau of Land Management, is a national program, led by the USGS, to determine the status of amphibians and to investigate potential factors causing their declines and malformations.

DOI Science Priorities

+\$13.0 million

Issue

Department of the Interior (DOI) land and resource managers deal with complex management and regulatory issues concerning America's parks, refuges, and public lands. These lands provide habitats for a diverse array of native and (or) invasive species, and contain vital natural resources that must be managed for multiple purposes. Managing land and other resources for which DOI has legislated responsibility, while preserving ecosystem health, requires an integrated scientific approach, incorporating the disciplines of biology, cartography, geology, and hydrology, to ensure that decisions are based on sound understanding of ecosystems and the processes that occur within them.

USGS Role

The Department of the Interior is implementing the Agreement on USGS Research Support for DOI Resource Management Bureau Needs, signed by all the DOI bureau directors in early FY 1999. This agreement recognizes the role of the USGS as the science provider for DOI and outlines the budget development process necessary to ensure the provision of sound and effective USGS science support for the DOI bureaus. The process involves assessing the status of current science support, identifying gaps and cross-bureau applications, and formulating priorities for USGS research in support of DOI bureaus' land management needs.

Current Program

DOI Science Priorities is a new initiative that integrates the scientific expertise of the USGS to address complex DOI land and resource management decisions. This increase will fund projects that complement programmatic work between USGS and DOI bureaus.

FY 2001 Program Change

Funding increases (in \$000) for DOI Science Priorities are broken down by subactivity as follows:

Geographic Research and Applications	1,300
Earth Surface Dynamics	1,950
Hydrologic Networks and Analysis	3,250
Biological Research and Monitoring	<u>6,500</u>
Total	13,000

The disciplines funded by these subactivities will be coordinated at the regional level to provide integrated, multidisciplinary science in response to complex management needs for the following DOI requests which are grouped thematically:

Strategies for Ecosystem Restoration: Federal managers require scientific information to achieve desired landscape conditions through ecosystem restoration on a watershed, habitat, or ecosystem basis. In FY 2001, USGS will plan to initiate work on the following DOI requests: acid mine drainage studies on the Monongahela River (OSM), abandoned mine land reclamation studies in selected watersheds in western states (BLM), effects of oil and gas development on habitats of sage grouse, mule deer and pronghorn in southwestern Wyoming (BLM), studies of “big river fish” such as the bonytail chub and razorback sucker reintroduced in the Lower Colorado River Basin (FWS), and impact on dam removal on fish habitats (FWS). BIA has requested that USGS provide research and information to assist selected Tribes in the development of Integrated Resource Management Plans.

Ecosystem Monitoring Protocols: Ecosystem monitoring provides land and resource managers with the information they need to evaluate the status and trends of animals, plants, and habitats, model and monitor ecosystem restoration activities, and assess the outcomes of management practices. In FY 2001, DOI managers have requested: inventory and monitoring protocols to assist wildlife refuges (FWS); status and trends of the genetic diversity of salmon and trout species in central and southern California (FWS); development of water quality and ecological models to support adaptive management strategies for BOR reservoirs on the Colorado River; ground water flow models and water quality studies of the desert southwest to determine water rights issues (NPS); mineral resource assessments for use in development of resource management plans in Oregon (BLM); and identification of gas hydrates and effect of resource development on associated exotic worm tube communities in the Gulf of Mexico (MMS).

Rangeland and Riparian Health: Rangeland ecosystems in arid and semi-arid environments are often limited in their ability to adjust to ecological stresses such as cattle and sheep grazing, invasion of non-native species, large resident populations of wild horses, and fire. USGS will begin a study to determine the long-term genetic viability and behavioral characteristics of wild horse herds and their effect on rangeland health in Utah and Nevada (BLM); and research the role of fire in rangeland ecosystems, including the effects and ecological consequences of fire and post-fire treatments on ecosystem response (BLM).

Declining Species and Species at Risk: The USGS will assist DOI bureaus in developing national monitoring protocols; assessing status and trends, including demographic parameters; assessing the quantity, quality, and suitability of existing habitats; and understanding the effects of land management practices on the habitats of those declining and at-risk species that may

lead to the identification of alternative management practices in order to promote species viability (BLM, FWS). Suggested species for study include declining plant and bird species in Hawaiian forests; several species in the Columbia Basin shrub steppe; species endemic of alkali scrub habitats in Central Valley (CA); and colonial waterbirds/seabirds in the Gulf of Mexico, the Great Lakes, and other coastal regions.

Impacts of Invasive Species: DOI bureaus lack information in three broad categories: (1) ecosystem level effects of invasive species; (2) specific control techniques and their consequences; and (3) regional, integrated invasive species management plans that take into account current land management practices and the effects they have on the containment or spread of exotic species. Specific work requested by BLM includes determining how weeds, such as the perennial pepperweed, spread, the impacts of weeds distribution on range forage productivity, and determining treatment options and restoration techniques.

Quick Response (FWS) and Natural Resources Preservation Programs (NPS): FWS and NPS have identified the need for place-specific science at the field level to enhance land and resource management capabilities. These studies are characterized as short-term needs for biological scientific information and can address many issues, including invasive species, threatened and endangered species, contaminants, and other issues that require immediate response.

A common theme underlying all these categories is the need for the results of research investigations and tactical science to be available to land managers in GIS formats and (or) decision support systems.

Partners and Customers

The USGS works closely with each of the DOI bureaus, and State and local agencies in planning, coordinating, and implementing projects. For DOI Science Priorities, USGS initiated regional meetings in FY 1999 with each DOI bureau to determine regional priority science needs. National-level meetings refined the list of priorities and the resulting requests are described in the Program Change section (below). In FY 2001 the requested \$13 million will be used to develop projects that address the following level of effort: \$3 million each for BLM, FWS, and NPS, and \$1 million each for BIA, BOR, MMS, and OSM. Each DOI bureau has provided USGS with a list of top management issues that require research and or applied science to address solutions. The priorities and projects will be further defined as USGS continues the collaboration and discussion with other bureaus.

Products

The USGS will make data, systematic analyses, and reports available through GIS-formats, CD-ROMs, Web-based data and reports, and peer-reviewed publications. Among products that DOI bureaus have requested are geo-spatial data sets, decision support tools, web-based analysis tools, hydrologic and ecological models, resource assessments, and cartographic displays of information.

Amphibian Research and Monitoring

+\$2.0 million

Issue

At least 230 species of frogs and salamanders make up the amphibian fauna of the continental United States. Focused research in local areas over the past 10 years has indicated unabated declines in some amphibians, though the exact extent of losses remains unknown. Reports of malformed frogs, toads, and salamanders are also increasing. In May 1998, an international meeting of experts convened by the National Science Foundation concluded that significant amphibian declines have occurred in protected areas not subjected to obvious changes in habitat, such as National Parks, Wildlife Refuges, and wilderness areas.

Declines and malformations in amphibian populations have been reported from many parts of the world, including the United States. Amphibians are considered good indicators of general ecosystem health due to their close association with various aquatic habitats and sensitivity to different environmental stresses. Habitat destruction and alteration have been shown to cause amphibian declines, but significant declines have occurred in protected areas not subjected to obvious changes in habitat. The USGS is leading a coordinated research effort extending beyond the Department of Interior (DOI) to other Federal, State, and academic partners, to track the status of amphibians nationwide and investigate potential causative factors for their decline.

USGS Role

With perhaps the largest cadre of professional herpetologists in the U.S., the USGS is uniquely qualified to investigate the twin issues of amphibian declines and malformations. Its scientists are in the forefront of tracking amphibian populations, documenting environmental change, and conducting research designed to understand amphibian development, life history and potential causes of decline.

Current Program

The USGS has taken the lead in this important national initiative. Biologists are conducting amphibian surveys on DOI lands, hosting training workshops, designing databases, and managing data collection. Scientific studies are underway that investigate disease, contaminants, ultra-violet radiation, and habitat alteration factors that could cause amphibian decline. Since most amphibians in the U.S. are water-dependent for one or more stages of their complex life cycle, USGS hydrologists are describing the basic water quality and generally assessing past and present habitat at many amphibian survey sites. It is widely believed that changes in habitat are responsible for the decline of many amphibian populations. To help address this concern, USGS cartographers and geographers are providing high-resolution maps of survey sites, and developing novel approaches to analyze land-use, land-cover, and other geospatial information to correlate habitat change with amphibian declines.

To coordinate this nationwide and interagency effort, the USGS has developed a comprehensive Amphibian Research and Monitoring Initiative has been developed to define the roles and responsibilities of various institutions and organizations inside and outside the USGS, including DOI and other stakeholders with natural resource management responsibilities. The framework established in the Initiative addresses where surveys will be conducted, the

frequency of surveys, what amphibian populations and habitat variables will be measured, and how survey data will be managed. Information tools and management prescriptions will be transferred to resource managers responsible for arresting or reversing amphibian declines and malformations.

FY 2001 Program Change

The Amphibian Research and Monitoring Initiative proposes conducting a nationwide survey of amphibian populations and comprehensive research studies on causal factors. Funding provided in FY 2000 will enable USGS to initiate surveys in 5 of 7 biogeographic regions. The funding increases requested in FY 2001 will provide full support for the 5 regions where work is already underway, provide partial support for the 2 remaining regions, and enable USGS to initiate the research component of the Initiative.

Geographic Research & Applications +\$0.1 million: The proposed increase for Amphibian Research and Monitoring will support the compilation and analysis of geospatial data to characterize habitat in areas of demonstrated amphibian loss and to develop methods to use spatial analytical techniques to predict potential amphibian loss.

Toxic Substances Hydrology Program +\$0.5 million: The request will fund comprehensive research studies on causal factors for declining amphibians related to hydrologic changes and contaminants. It will enable hydrologic and water-quality characterizations, and causal-factors research to be conducted in the Upper and Lower Mississippi River Basins in FY 2001. It will also support a more comprehensive evaluation of the range of environmental contaminants that may influence amphibian declines across the Nation.

Biological Research and Monitoring +\$1.4 million: A portion (\$1.075 million) of this request will fund monitoring surveys in the Upper and Lower Mississippi River Basins in FY 2001 to meet national Initiative objectives mentioned above. Amphibian malformations have been observed in the upper reaches of the Mississippi River, and there is much anecdotal information suggesting declines in numerous amphibians in the Lower Mississippi River basin, but additional funding is needed to begin surveys in these regions.

The funding would also increase research (\$0.265 million) on disease (chytrid fungus), parasite (nematodes), and contaminant effects on amphibians. Preliminary findings indicate that these environmental insults, acting alone or in combination, may be contributing to widespread amphibian declines and/or malformations.

Additional resources (\$60,000) are requested to increase data storage, analytical, and reporting capability. The structure of standardized databases would be expanded and enhanced to accommodate status and trend information from other Federal, State, and private amphibian monitoring programs. Collection and management of data generated by monitoring and research activities is critical to the overall effort.

Partners/Customers

DOI bureaus are major partners in this effort. The National Park Service, Fish and Wildlife Service, and the Bureau of Land Management also received new appropriations in FY 2000 to work with USGS on this important amphibian initiative. In addition, the USGS will work with

other Federal, State, non-governmental organizations and academic institutions to expand survey coverage and data collection beyond DOI lands. These partners are seeking information concerning the status and trends of amphibians, sites where amphibians are declining, factor(s) responsible for declines, and recommended alternative activities that may be pursued in an adaptive management context. These partnerships will include web-based data sharing, development and use of common survey protocols and databases, sharing and leveraging funds, and training workshops and symposia to exchange information and expertise.

Products

The USGS-led effort will produce long-term density and distribution information, cause and effect research findings, decision support systems, and other tools needed by partners to inform planning and management actions to halt or reverse the declines and malformations of amphibians on their lands.

Fish and Wildlife Disease

+1.0 million

Issue

Late in August 1999, an encephalitis outbreak occurred in New York City. Within weeks the mosquito-borne disease had spread to many counties in New York, Connecticut, and New Jersey. Dozens of people were infected and seven died. Biologists from the USGS National Wildlife Health Center soon identified crows and other birds as the natural host and carrier for the virus. The deadly virus was identified as the West Nile variety, never before found in the United States. Although the cold fall weather removed the immediate threat of mosquitoes infecting people, USGS scientists have continued to monitor the spread of the virus in bird populations. As a result scientists have discovered the virus in eighteen native bird species in New York, New Jersey, Connecticut and Maryland.

Emerging and exotic diseases threaten restoration of the Nation's trust fish and wildlife species, including salmon. Climatic change, pollution, and land development stress both fish and wildlife populations, predisposing them to disease. Viral diseases (such as infectious salmon anemia and retroviral sarcoma) as well as a resurgence of latent pathogens such as "coldwater disease," affect fish hatcheries and endangered species re-introduced into the wild. We lack the baseline data needed to determine the distribution of such diseases, and to devise control methods.

Brain lesions in birds (avian vacuolar myelinopathy or AVM) have been a growing concern since they were first diagnosed in 1994. Originally diagnosed in bald eagles and coots in Arkansas, the syndrome has been detected in other birds, especially ducks, and in other southeastern States.

USGS Role

USGS is an international leader in fish and wildlife health. USGS has broad expertise in infectious and noninfectious diseases as well as other wildlife health matters. The presence of supporting disciplines within USGS provides access to other facets of science, such as assessments of water quantity and quality, spatial data from geographic information systems, and data about geological settings.

Current Program

Wildlife disease research supports a national program dealing with all aspects of wildlife health issues providing research and technical support to the FWS, other Federal agencies, and State fish and wildlife agencies. Fish disease research focuses on development of better methods for detection of causative agents, fish species resistance to disease, the role of environmental contaminants upon the disease cycle, improved diagnosis of disease, and development of new vaccines. The results are used to understand the factors that control the distribution and transmission of fish diseases and the effects on fish restoration efforts.

FY 2001 Program Change

Biological Research and Monitoring +\$1.0 million: The largest portion of this increase will be used to better understand the deadly West Nile encephalitis virus. Crows and other birds that carry the virus will be studied and their role in spreading the disease to humans documented. The funding increase will also enable USGS to expand its research on Avian vacuolar myelinopathy (AVM) disease, to help curb its spread. These funds will also increase the USGS grant to the Southeastern Cooperative Wildlife Disease Study to assist with both these projects.

This increase will also provide for the development of immunologic detection systems for infectious salmon anemia, a devastating disease of Atlantic salmon, to monitor, contain, and control the potential devastating impact of this virus upon the salmonid populations of the U.S. Additional resources will be directed toward study of fungal diseases in Chesapeake Bay fish.

Partners/Customers

The U.S. Fish and Wildlife Service, the U.S. Department of Agriculture, State fish and wildlife departments, commercial and sports fisheries as well as public health agencies would benefit from simple, cost-effective tools for diagnosing fish and wildlife diseases such as whirling disease, pfiesteria, avian cholera, and botulism. Diagnostic tools are the first step toward developing control measures.

Products

The most important product will be detailed information of the geographic distribution of the West Nile virus in bird populations of the East and Gulf coast States. The National Wildlife Health Center has been able to use sick and dead crows as a visible indicator of the West Nile virus. Public health agencies will be able to anticipate where the disease is likely to occur, quickly test diseased birds and mitigate the impacts of the deadly encephalitis disease on humans.

Other wildlife diseases (such as AVM) that cause brain lesions in bald eagles and ducks will be better understood. In addition, the USGS will study certain fish and aquatic diseases and make available to the State and Federal wildlife managers the means to stop the spread of disease in wild and endangered fish populations.

Cooperative Research Units

+\$0.7 million

Issue

Over the past 3 fiscal years, the Unit program received programmatic increases totaling \$2.5 million. These funds were used to staff and support existing science vacancies reducing the number of unfunded Unit science vacancies from 20 in FY 1997 to only 2 in FY 2000. Recruitment actions completed or in progress during FY 1999 and early FY 2000 include Unit scientist positions in Alabama, Alaska, Arizona, Arkansas, California, Georgia, Hawaii, Louisiana, Maine, Maryland, Massachusetts, Minnesota, New Mexico, Pennsylvania, South Dakota, Texas, Vermont, Washington, West Virginia, and Wisconsin. These positions will increase the breadth of expertise of the Cooperative Research Units program and allow the program to better address contemporary issues raised by natural resource managers, and to meet USGS commitments to university and State cooperators.

USGS Role

The USGS is the lead Federal agency in this cooperative program, contributing Federal scientific staff to work with State agencies and universities to address resource information needs for science-based management of resources, and training needs of the next generation of natural resource professionals. The USGS staffs each Unit with two to five Federal research scientists. Cooperating universities provide office space, administrative support, and access to university facilities. The State game and fish agencies provide base funding and logistical support for research activities. The support of all Cooperators achieves a pooling of resources that provides a multiplier effect for everyone, thus enhancing the program's cost-effectiveness to each Cooperator. USGS also provides Federal administrative support to all Units and for the national program and represents the national interest of the collective of program Cooperators.

Current Program

The Cooperative Research Units program consists of 39 Cooperative Fish and Wildlife Research Units located on university campuses in 37 States. The mission of the Cooperative Research Units program is threefold: (1) to provide scientific research for the understanding and management of fish, wildlife, and other natural resources; (2) to provide technical assistance to natural resource managers in the application of scientific information to natural resource policy and management; and (3) to train future natural resource professionals.

FY 2001 Program Change

Cooperative Research Units +\$0.7 million: The proposed increase will complete a multiyear effort to fill all science vacancies in the Cooperative Research Units program and support existing science positions. Filling these vacancies (created through attrition and funding shortfalls to date) will enable the USGS to meet its commitment to its State and university partners in this cost-shared program. Full staffing will increase the breadth of technical expertise available to State and Federal resource managers to address contemporary and emerging natural resource issues. It will also increase the capability of Units to respond to a

greater number of State and Federal information needs. Staffing Unit vacancies will provide additional opportunities for USGS to partner with universities in the training of the next generation of natural resource professionals. The budget initiative will not expand the number of Units or scientific positions beyond those already authorized, nor enhance operational support to existing Units.

Partners/Customers

The Cooperative Research Units program is a unique model of cooperative partnerships among Federal and State Governments, academia, and the Wildlife Management Institute. These partnerships are maintained as one of USGS's strongest links to Federal and State land and natural resource management agencies. More than 12 Federal bureaus have developed cooperative relationships with the Unit program, relying on the economy of the program, the expertise of the science in the program, and the quality and timeliness of the products.

Products

The Unit program initiates and completes approximately 200 research projects annually, with more than 1,100 active research projects at any given time. Technical and/or management reports are generated for each project and provided to sponsoring agencies. Technical agency reports are complemented by scientific publications (numbering more than 300 annually) to more broadly distribute the findings and make results more available to the scientific and management community. Assistance also is provided to sponsoring agencies for interpreting and applying research findings. This is done through personal contacts, and participation in workshops, and technical committees. Through affiliations with host universities, Unit scientists advise and mentor more than 600 graduate students annually.

Program Decreases

Initiative Component	FY 2001 Program Change \$(000)	Page Reference
Mapping Data Collection & Integration	-4,631	80
Geographic Research & Applications	-100	80
Volcano Hazards	-250	81
Coastal & Marine Geology	-500	81
Mineral Resources	-3,200	81
Energy Resources	-2,509	81
Toxic Substances Hydrology	-1,740	82
Hydrologic Research & Development	-2,454	82
Hydrologic Networks & Analysis	-2,791	82
Biological Research & Monitoring	-3,992	83
Total	22,167	

National Mapping Program Program Decrease Statement

Mapping Data Collection and Integration (-\$4.631 million):

Geospatial Data Production (-\$2.631 million): The proposed decrease would reduce the number of digital orthophoto quads (DOQs), digital elevation data (DEMs), digital hydrography data (DLGs and National Hydrography Dataset), and revised topographic maps produced within the National Mapping Program by USGS and/or its partners. Taken alone, this decrease will reduce the amount of funds used to match funds from cooperators. However, the reduction in geospatial data produced with base funding will be offset by the cost-shared data produced with the proposed increases for Community/Federal Information Partnerships.

High-Performance Computing and Communication (-\$2.0 million): The decrease would reduce the amount of funding provided for high-performance computing and communication, a \$3.0 million pilot completed in FY 1999 that delivers natural science data to a consortium of academic institutions in Ohio. This funding is being refocused for an expansion of USGS information delivery through the Accessible Data Transfer initiative (see the Program Change section for more details). The remaining funds (\$1.0 million) will support operation and maintenance of the project with the OhioView Consortium.

Geographic Research and Applications:

Hyperspectral Remote Sensing (-\$0.1 million): The proposed decrease eliminates funding for hyperspectral remote sensing.

Geologic Hazards, Resources, and Processes Program Decrease Statement

Volcano Hazards Program (-\$0.25 million): The proposed reduction reflects savings from not extending a cooperative agreement with the University of Hawaii to support monitoring and research activities of the Hawaiian Volcano Observatory.

Coastal and Marine Geology Program (-\$0.5 million): The proposed reduction results from completion of a pilot project using the Light Distance and Ranging (LIDAR) technology to evaluate and monitor habitat of Chinook Salmon and Summer Chum Salmon.

Mineral Resources Program (-\$3.2 million): The proposed reduction will end a 3-year-old effort that has improved access to mineral information in Alaska (the major objectives of this effort will have been achieved by the end of FY 2000), and studies that have improved information about gold deposits in the Great Basin in Nevada.

Energy Resources Program (-\$2.509 million): The proposed reduction will phase out several economic and environmental studies. By the end of FY 2000, preliminary maps related to these studies will be produced showing the regional distribution and severity of acid mine discharge and mine pool blow outs in the central Appalachians. This decrease will also eliminate funding for the Coal Availability/Recoverability Studies collaborative project with the State Geological Surveys.

Water Resources Investigations Program Decrease Statement

Toxic Substances Hydrology Program -\$1.74 million: The decrease is based on completion of research characterizing subsurface contamination from crude oil and related petroleum hydrocarbons in Bemidji, Minnesota, and completion of a research project on the processes that affect the migration of contamination in fractured-rock terrains. The decrease also reflects the discontinuation or reduction of lower priority projects, including research to identify the processes controlling the exposure of aquatic organisms to pesticides and the resulting ecological effects in the San Francisco Bay-Estuary, and a study to determine whether a range of new "emerging" water contaminants (including human and veterinary antibiotics, prescription and non-prescription drugs, industrial and household chemicals, and hormones) enter natural waters.

Hydrologic Research and Development -\$2.454 million: Part of the decrease is attributable to completed research projects, and the remainder reflects a reduction in ongoing but lower priority work on:

- the mobility and degradation of nutrients;
- the effect of human activities on selected watersheds;
- water and contaminant transport through fractured rock;
- "emerging" contaminants that have recently been identified in water resources;
- how microorganisms alter the chemistry and productivity of aquatic environments and potable water supplies.

Hydrologic Networks and Analysis -\$2.791 million: This reduction eliminates most of the appropriated funding for the Climate Variability and Change portion of the Global Change Hydrology Program; however, a project to measure and analyze glacier growth and shrinkage would continue. Also, the Hydrologic Research and Development Program would continue to fund some global change research related to biogeochemical budgets and carbon sequestration. The reduction eliminates support for several studies that were begun in FY 2000, including studies of ground water on the island of Molokai, Hawaii, a hydrologic study of Noyes Slough in the area of Fairbanks, Alaska, and a study of ground water in southern Maryland.

Biological Research Program Decrease Statement

Biological Research and Monitoring (-\$3.812 million): Although USGS efforts will continue in the following science topics and subtopics, the individual projects listed are coming to an end in FY 2000 or being curtailed.

Ecosystems (-\$0.9 million):

- Wetland projects that address restoration techniques and stress
- Fire ecology projects on fuels and fire frequencies.
- Research on the role of oil and gas platforms on reef fish ecology.
- Ecological process and global change studies.

Wildlife (-\$0.7 million):

- Waterfowl, marine mammals and predators studies.

Contaminants (-\$0.4 million):

- Abandoned mine lands, metal toxicity studies, and population impacts in large rivers and streams.
- Smelter studies at Coeur d'Alene Basin in Idaho.

Fisheries and Aquatic Systems (-\$0.5 million):

- Atlantic salmon biology, Great Lakes fisheries, and upper Mississippi habitat studies.

Endangered and At Risk Species (-\$0.5 million):

- West Indian manatee, black-footed ferret, and native Hawaiian birds.

Application of Science Information to Management (-\$0.1 million):

- Restoration ecology and adaptive management studies

Status and Trends (-\$0.7 million):

- Monitoring activities on fishes in the Great Lakes region, boreal land birds in Alaska, and vegetation and animal communities in western National Parks.
- Methods development for monitoring Federal lands.

Yukon River Chum Salmon Program (-\$0.180 million): In FY 2000, the USGS expanded its research on Yukon River salmon to compare fecundity, spawning, hatching survival, and survival of downstream emigrants among tributaries. The USGS proposes to eliminate funding for this project in FY 2001.

Government Performance and Results Act

GPRA Program Activity	FY 2001 Program Change \$(000)	GPRA Consolidated Report Page Reference
Hazards	+11,085	7
Environment and Natural Resources	+70,918	14
Total	+82,003	

“As we enter the new millennium, I believe it is appropriate to reaffirm our commitment to the objectivity, impartiality, and integrity of our scientific programs...We should remind ourselves of our obligation as Federal employees to provide information that meets the highest standards...Honesty and integrity in all aspects of our scientific enterprise, maintaining our impartiality, and ensuring that our information and products are used to benefit the public as a whole must continue to be hallmarks of U.S. Geological Survey science....Each employee has a role in assuring the accuracy of data, interpretations, and products. Meeting our high quality standards requires that employees follow protocols, obtain appropriate reviews, and apply quality assurance procedures to eliminate any errors” Directors message to all USGS employees, December 1999

“The success of our strategic plan will depend on our ability to assign responsibility for progress, to measure that progress, and to hold appropriate people accountable with rewards for success and consequences when things don’t measure up. In the broadest sense, each one of us is responsible and each one of us will be accountable.” Directors message to all USGS employees, January 2000

Government Performance and Results Act

The USGS has two mission goals or GPRA Program Activities:

- Hazards and
- Environment and Natural Resources.

In the annual plans, performance targets are aggregated as a Bureau total for each of these GPRA Program Activities. Four budget activities — National Mapping Program; Geologic Hazards, Resources and Processes; Water Resources Investigations; and Biological Research — contribute directly to the aggregate. The Survey's remaining two budget activities — Science Support and Facilities — support all programmatic activities and their funding has been distributed on a *pro rata* basis to the two GPRA Program Activities. In this budget request, the funding and performance contributions to FY 2001 targets are summarized for each budget activity as well as the funding initiatives in the tables that follow.

The FY 2001 safer communities/real-time hazards initiative will accelerate achievement of the Hazards long-term goal. Similarly, the initiatives that address issues related to people, wildlife, and the land and resources that support them will increase our contribution to the performance targets for the Environment and Natural Resources goal.

Along with the rest of the Interior bureaus, USGS has combined GPRA performance reporting and planning requirements into a single document to accompany the FY 2001 Budget. In the consolidated document (the buff colored pages in the back of this Budget Justification) we present an overview of what we have accomplished in FY 1999, what we plan to accomplish in the current fiscal year – FY 2000 – and what we propose to accomplish in FY 2001 with the budget resources we are requesting.

Budget Distributed to GPRA Program Activities

Budget Activity/Subactivity (\$000)	FY 2000 Enacted Appropriations Less Reductions			FY 2001 Pres Budget		
	Total	Hazards	Env & NR	Total	Hazards	Env & NR
National Mapping Program	126,717	7,950	118,767	155,282	7,950	147,332
Mapping Data Collection & Integration	56,330	5,250	51,080	67,327	5,250	62,077
Earth Science Info Management & Delivery	34,270	1,250	33,020	36,911	1,250	35,661
Geographic Research & Applications	36,117	1,450	34,667	51,044	1,450	49,594
Geologic Hazards, Resources, & Processes	211,222	84,108	127,114	224,809	90,200	134,609
Geologic Hazard Assessments	69,111	69,111	0	73,236	73,236	0
Geologic Landscape & Coastal Assessments	65,435	14,997	50,438	77,189	16,964	60,225
Geologic Resource Assessments	76,676	0	76,676	74,384	0	74,384
Water Resources Investigations	185,819	14,764	171,055	197,576	18,764	178,812
Water Resources Assessment & Research	91,037	0	91,037	90,355	0	90,355
Water Data Collect. & Management	29,167	4,190	24,977	39,275	8,190	31,085
Fed-State Coop Water Program	60,553	10,574	49,979	62,879	10,574	52,305
Water Resources Research Act Program	5,062	0	5,062	5,067	0	5,067
Biological Research	136,896	0	136,896	158,781	0	158,781
Biological Research & Monitoring	113,232	0	113,232	123,430	0	123,430
Biological Info. Management & Delivery	10,484	0	10,484	21,243	0	21,243
Cooperative Research Units	13,180	0	13,180	14,108	0	14,108
Programmatic Total	660,654	106,822	553,832	736,448	116,914	619,534
Science Support (prorated)	67,104	10,737	56,367	70,895	14,086	59,552
Facilities (prorated)	85,618	13,699	71,919	88,036	14,086	73,950
Appropriations Total (Not including supplementals)	813,376	131,258	682,118	895,379	142,343	753,036

**Hazards GPRA Program Activity
FY 2001 Performance Targets Disaggregated by Budget Activity and Initiative**

GPRA Program Activity	Hazards				
	Monitoring Networks Maintained	Risk Assessments Delivered	Real-time Streamgages (Cumulative)	Real-time Earthquake Sensors (Cum.)	Stakeholder Meetings
FY 98 Baseline	6	16	4,571	100	16
FY 99 Annual Performance—Actual	6	16	5,132	120	19
Performance Measure Change for FY 2000			Real-time streamgages on the Web 4,500 baseline		
FY 00 Annual Target	6	10	4,700	200	13
FY 01 Annual Target	6	9	5,000	350	13
FY 01 Base Target by Budget Activity					
National Mapping Program	1	0	0	0	1
Geo Hazards, Resources, & Process	4	6	0	280	7
Water Resource Investigations	1	3	4,700	0	5
Biological Research	0	0	0	0	0
FY 01 Program Change increments by Initiative					
Safer Communities—Earthquakes				+70	
Safer Communities—Volcanoes	Enhance network				
Safer Communities—Floods			+300		
Livable—Accessible Data +0.32M of \$2.0M	Enhance network speed, security, and capacity				

Note: Our numeric targets are focused on completions of science such as risk assessments, systematic analyses, and decision support systems that are accessible and used by our customers. All targets include completions of long term projects funded in part by prior year monies. In the same way, funding initiatives such as those in FY 2001 include some long-term efforts the completion of which will not be achieved until outyears.

Program Change

**Environment & Natural Resources GPRA Program Activity
FY 2001 Performance Targets Disaggregated by Budget Activity and Initiative**

GPRA Program Activity	Environment & Natural Resources				
Performance Measure	Long-term data collection & mgmt efforts maintained & improved & large data infrastructures supported	New systematic analyses & investigations delivered	Decision support systems or predictive models developed or improved & delivered to customers	University-based partnerships for natural systems analysis	Stakeholder Meetings
FY 98 Baseline	40	865	5	270	212
FY 99 Annual Performance—Actual	40	959	6	238	473
FY 00 Annual Target	46	995	6	248	438
FY 01 Annual Target	47	1077	9	258	459
FY 01 Base Target by Budget Activity					
National Mapping Program	9	0	1	0	26
Geologic Hazards, Resources, & Processes	23	21	1	0	27
Water Resources Investigations	4	200	1	56	300
Biological Research	10	796	1	192	84
Ecosystems	0	8	2	0	6
FY 01 Program Change increments by Initiative					
Offsets for uncontrollable costs		-24	-1		-2
Livable/Lands Legacy—DSS/communities +\$10.0M	Enhanced integration	+3	+1		
Livable/Lands Legacy—C/FIP +\$30.0M	Improve integration of long-term databases	Improve delivery to local communities	Improve DSS thru increased data holdings and better data integration		+6
Livable—Landsat +\$5.0M					+2
Livable—Accessible Data +\$1.68M of \$2.0M	Enhance network speed, security, and capacity				
Sustainable/Lands Legacy—DSS/Res Mgmt +\$10.0M	Improve integration of long-term databases		+1		
Sustainable—Aquatic Syst.—Columbia +\$4.0M	Augment data collection	0 (+8 in outyears)	0 (+2 in outyears)	0	+1
Sustainable—+\$1.3M—Great Lakes, Mojave, Yellowstone	+1	+1	+1	0	+5
Heritage—DOI Science +\$13.0M	0	+72	+1	0	+4
Heritage—Amphibians +\$2.0M		0 (+12 in outyears)			
Heritage—Coop Units +\$0.7M				+10	
Heritage—Fish & Wildlife Disease +\$1.0M		(+5 in outyears)			

Geologic Hazards, Resources, and Processes

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes ¹	FY 2001 Budget Request	Change from FY 2000
Geologic Hazard Assessment	69,111	+1,275	+2,850	73,236	+4,125
Geologic Landscape & Coastal Assessment	65,435	+1,804	+9,950	77,189	+11,754
Geologic Resource Assessment	76,676	+1,717	-4,009	74,384	-2,292
Total Requirements \$000	211,222	+4,796	+8,791	224,809	+13,587

¹ See Program Change section for details.

Activity Summary

Introduction

Through its programs within the Geologic Hazards, Resources, and Processes Activity, the USGS identifies and helps meet the earth science information needs of a wide variety of Federal, State, and local agencies, and the private sector. This information is used to evaluate resource potential, to define risks associated with natural hazards, and to characterize the potential impact of natural geologic processes on human activity, the economy, and the environment.

Hazards -- These programs are designed to produce information and understanding that will lead to a reduced impact of natural hazards and disasters on human life and the economy. The United States is subject to a variety of natural hazards (earthquakes, volcanic eruptions, landslides, coastal storms, and erosion) that present grave threats to people and property. The occurrence of these hazardous events are inevitable and uncontrollable. However, the extent of damage and loss of life can be reduced through pre-event planning; social, economic, and engineering adaptations; provision of real-time warning capabilities, and more effective post-event emergency response. Central to this pre-planning is the availability of accurate, scientifically based assessments that define the nature and degree of risk. The more precisely that risks can be defined, the greater the likelihood that appropriate mitigation strategies will be adopted (e.g., building codes for new construction and retrofitting; insurance systems, land use plans; design and location/routing of critical infrastructure such as highways, bridges, subways, water, sewer, gas, electric, and petroleum distribution networks). USGS geologic hazards programs conduct basic and applied research, gather data, operate monitoring networks, perform assessments, and disseminate findings to the public for the purpose of advancing capabilities to better define risk and encouraging appropriate response to these risks.

Resources -- These programs assess the availability and quality of the Nation's mineral and energy resources to include the economic and environmental effects of resource extraction and use. The availability and cost (both economic and environmental) of energy and mineral resources, their extraction and use, are limiting factors to human development. Throughout its history, our Nation has faced important, and often controversial, decisions regarding the use of

Federal lands, environmental management, and the supply of energy and mineral resources to sustain development and enable growth. Federal land management agencies are required to develop plans that reconcile competing demands for resource development with other human activities, while recognizing environmental values and providing for the sustainability of resources and natural environments.

Providing unbiased, scientifically valid assessments of the potential energy and mineral supply of the United States, and the environmental consequences of developing these resources, are core functions of the USGS. Historically, heavy emphasis within the USGS energy and mineral resource programs was given to fundamental research on ore genesis and the formation of mineral and energy deposits. The USGS energy and mineral resource programs have evolved in recent years to emphasize: (a) developing and applying improved methods for oil, gas, coal, and mineral assessments, through use of advanced computer modeling, (b) bringing together resource quality and availability data to enable assessment of environmental considerations by public and private entities involved in energy and mineral resource extraction and use, and (c) gathering and disseminating census-style information on the development and use of mineral and energy resources, both domestically and internationally for use by other government agencies and the private sector.

Geologic Processes and Systems -- These programs distinguish the effects of human activities from natural changes operating at or near the earth's surface to enable more effective and efficient resource and environmental management decisions. Society needs to develop knowledge of the Earth's natural processes and cycles -- their rates, frequencies, magnitudes, and how they affect each other. Armed with such knowledge, we can respond better to both natural and human-induced changes. Natural hazards are less costly if their likely effects can be mapped and quantified. Resources can be more efficiently used if the impacts of their extraction can be anticipated. Damaged or endangered ecosystems can be repaired more effectively if the natural processes that form and maintain them are accounted for in remediation plans. Strategies for conserving and using the Nation's lands and resources are improved when the natural processes at work are recognized as well as the costs of working against them.

Federal Role

The Federal role in conducting science to understand geologic hazards, resources, and processes. This role derives from the U.S. Government's responsibilities to protect the lives and property of its citizens, to support continued economic growth and competitiveness, and to assist society in anticipating and coping with the enormous forces of nature that shape and control the landscape.

Natural hazards have significant social and economic impact on our Nation. Annually, as many as 10 potentially damaging earthquakes strike the conterminous United States and more than 5,000 shocks large enough to be felt occur throughout the entire country. The United States has 65 active and potentially active volcanoes, more than all other countries except for Indonesia and Japan. During the 20th century, volcanic eruptions in Washington, California, Alaska, and Hawaii devastated thousands of square miles and caused substantial economic and societal disruption and, in the worst instances, loss of life. Notably, volcanic ash poses a unique threat to air traffic. Landslides, which cause about \$1-2 billion in damages and more than 25 fatalities each year in the U.S., pose serious threats to transportation and housing as well as infrastructure that supports fisheries, tourism, timber harvesting, mining, and energy production.

The USGS geologic hazards programs contribute to the reduction of human and economic losses and disruptions associated with these natural hazards by (1) defining, assessing, and monitoring potential earthquake, volcano, and landslide hazards as the basis for loss-reduction strategies and actions by government and the private sector; (2) providing analyses and real-time information and warnings for improved disaster response, for reducing losses from future disasters, and for enhanced public awareness of these natural hazards; and (3) expanding the fundamental knowledge of earthquake, volcano, and landslide generation, effects, and geologic processes for more effective risk-mitigation and disaster-response strategies.

Minerals and mineral products account for about \$500 billion of the Nation's gross domestic product. The expanding need for minerals in the United States and the world demands research in new techniques and concepts to assess the Nation's mineral wealth and provide accurate mineral resource information for national policy. At the same time, Federal and State agencies and industry are concerned with the environmental consequences of past and current mineral extraction activities. The ability to make informed decisions about these issues depends on having current, accurate scientific information on known and potential resources and on environmental and economic implications of their development.

The Nation faces the challenge of simultaneously addressing an expanding appetite for energy, a growing dependence on imported oil, and an increasing demand that energy resource extraction and use be environmentally benign. The USGS addresses this challenge by generating and providing energy information. This information is used by others to shape policies regarding domestic and foreign energy resources, to make wise decisions regarding Federal land use, and to maintain a healthy domestic energy industry increasingly composed of smaller companies. Knowledge of the national and world endowment of oil, natural gas, and coal is of fundamental importance to informed decisionmaking regarding the security and economic welfare of the United States.

Every year greater proportions of the landscape are built upon and paved; large amounts of carbon dioxide, sulfur dioxide, methane, and nitrous oxides are released to the atmosphere; marginal lands are stressed by agricultural practices encouraging the spread of deserts; and prodigious quantities of wastes are buried just beneath the Earth's surface. Human activities such as these can be directed toward working with natural processes to the extent possible (at acceptable cost to society) and away from activities in conflict with natural processes (which incur maximum costs). A comprehensive understanding of the dynamism of the Earth's surface is essential if the Nation is to enjoy, rather than endure, life through the next century.

Customers and Partners

Hazards -- The USGS cooperates and coordinates closely with local, State, and other Federal agencies and the university community to determine and provide for their needs for earth science information critical for developing mitigation strategies. For example, the USGS is an important partner of the National Earthquake Hazards Reduction Program, cooperating closely with the Federal Emergency Management Agency (FEMA), the National Science Foundation (NSF), and the National Institute of Standards and Technology (NIST). The USGS also monitors about 25 U.S. volcanoes posing the greatest risk and provides information on potential eruptions to Federal, State, and local emergency agencies. For example, the USGS cooperates with the National Weather Service (NWS) and the Federal Aviation Administration (FAA) who

provide warnings to the airline industry and aircraft on hazards due to volcanic ash from explosive eruptions. Through these and other cooperative arrangements, the USGS helps assure that the needs for risk assessments of hazards are met.

Resources -- The Federal Government manages about one-third of the Nation's land area. It also manages the Exclusive Economic Zone, which extends 200 nautical miles from the Nation's coasts and encompasses an area that exceeds the Nation's land area. The USGS is the primary provider of earth science mineral and energy resource information and assessments for Federal agencies such as the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) who are responsible for managing these areas. The USGS also works closely with the Department of Energy (DOE) in implementation of the National Energy Strategy. The USGS cooperates with many local and State agencies and coal and electric power producers to assess the availability and quality of coal resources. Every five years, the USGS publishes an assessment of the Nation's oil and natural gas resources. The assessment is used by land managers, energy producers, utility managers, and policymakers, among others. The USGS cooperates with State geological surveys in conducting coal availability and coal quality studies. Regional consortia are being developed between the USGS and the State geological surveys, electric utilities, coal producers, and with the Electric Power Research Institute to assess coal quantity and quality in several coal-producing basins. Finally, the USGS cooperates with hundreds of domestic and international producers and users of mineral commodities to compile reports on the supply and utilization of these resources for purposes of economic development and national security.

Geologic Processes and Systems -- The USGS coordinates with a large number of local, State, and Federal agencies on a wide range of geologic, coastal, and marine studies. For example, the USGS cooperates and coordinates with Federal land management agencies, including the BLM, USFS, National Park Service (NPS), U.S. Fish and Wildlife Service (FWS), Bureau of Indian Affairs (BIA) and others to provide basic geologic and interpretive information tailored to their issues. On environmental issues, the USGS coordinates with the U.S. Environmental Protection Agency (EPA), DOE, the Department of Defense (DOD), and State and local environmental agencies to assist in characterizing sites and providing needed information on the nature, magnitude, and source of contamination problems. In the coastal environment, the USGS cooperates closely with the National Marine Fisheries Service, and the Sanctuaries and Reserves Division of the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers to provide the marine and coastal geologic information necessary for developing management plans. Locally and regionally, the USGS coordinates with State geological surveys and other State agencies, communities, and universities. The objectives of the close cooperation and coordination are to: (1) assure that the USGS is addressing priority issues and that the information is prepared and presented in a form that is readily usable and (2) assure that the appropriate mix of scientific expertise, including personnel from State and local agencies and universities as necessary, is addressing identified problems.

Geologic Hazard Assessments Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Earthquake Hazards	43,893	+867	⁽¹⁾ +2,600	47,360	+3,467
Volcano Hazards	17,181	+284	+250	17,715	+534
Landslide Hazards	2,580	+48	0	2,628	+48
Global Seismographic Network	3,464	+33	0	3,497	+33
Geomagnetism	1,993	+43	0	2,036	+43
Total Requirements \$000	69,111	+1,275	+2,850	73,236	+4,125

¹ See Program Change section for details on Safer Communities (+\$2,600)

Earthquake Hazards

Current Program Highlights

The USGS Earthquake Hazards Program helps reduce deaths, injuries, and property losses from earthquakes through understanding of their characteristics and effects and by providing the information and knowledge needed to mitigate these losses.

The USGS Earthquake Hazards Program is a major component of the National Earthquake Hazards Reduction Program (NEHRP) authorized by P.L. 105-47. The program coordinates its activities with the three other principal NEHRP agencies: FEMA, NSF, and NIST. The USGS has the responsibility, within NEHRP, to identify and characterize earthquake hazards, to monitor seismic activity, and to conduct research in support of earthquake hazard assessments and loss reduction practices and strategies.

The USGS provides the professional expertise, technical resources, geographic extent, response capability, and the established reputation of scientific excellence and objectivity needed to address the responsibilities identified by NEHRP. Federal, State, and local government agencies, architects and engineers, insurance companies and other private businesses, land use planners, emergency response officials, and the general public all rely on the USGS for earthquake hazard information and knowledge. This information is used to refine building codes, develop land use strategies, safeguard lifelines and critical facilities, develop emergency response plans, and take other precautionary actions to reduce losses from future earthquakes.

The USGS contributes to earthquake hazard mitigation strategies by estimating and describing the likelihood and potential effects of moderate to large earthquakes in high-risk regions of the U. S. and by transferring this knowledge to people and agencies that can reduce the impact of a significant earthquake. The USGS also responds to earthquake emergencies by rapidly characterizing the probable size and extent of damage, assessing the continuing risks from

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aftershocks and related ground-motion and ground-failure hazards, and facilitating the work of response officials.

The program provides critical earth-science information for understanding earthquakes and for identification and quantification of potential earthquake hazards throughout the United States. This information is used to design and improve strategies for reducing losses from future earthquakes and to provide the knowledge needed to respond to earthquake emergencies. The USGS supplies information on earthquake mitigation strategies to a large and diverse public and private user community.

External Cooperative Agreements and Grants -- The USGS Earthquake Hazards Program supports a competitive, peer-reviewed, external program of cooperative agreements and grants that enlists the talents and expertise of State and local government, the academic community, and the private sector. The investigations and activities supported through the external program are closely coordinated with and complement the internal USGS program efforts. In general, routine monitoring efforts are supported through three-year cooperative agreements, research efforts are supported through one to two year grants. In FY 2000, 18 cooperative agreements were funded to support regional seismic monitoring efforts in various parts of the country. A total of 112 research grants were supported, 82 with universities and colleges, 10 with State Geological Surveys, and 20 with private sector companies (see chart below). Many of the external projects are co-funded with other agencies and sources, leveraging the effect of USGS support. External program activities include: monitoring and locating earthquakes by regional seismographic networks, mapping seismic hazards in metropolitan areas, developing credible earthquake planning scenarios including loss estimates, defining the prehistoric record of large earthquakes, investigating the origins of earthquakes, and improving methods for predicting earthquake effects. By involving the external community, the USGS program increases its geographical and institutional impact, promotes earthquake awareness across the Nation, encourages the application of new hazards assessment techniques by State and local governments and the private sector, and increases the level of technical knowledge within State and local government agencies. During FY 1997 through FY 2000, Congress provided \$6.0 million annually for competitively awarded earthquake research grants. The FY 2001 request maintains this same level of funding.

COOPERATIVE AGREEMENTS

Boston College	University of Memphis
California Institute of Technology	University of Nevada - Reno
Central U.S. Earthquake Consortium	University of Oregon
Columbia University	University of South Carolina
Massachusetts Institute of Technology	University of Southern California
Oregon State University	University of Utah
St. Louis University	University of Washington
University of Alaska	Virginia Tech
University of California - San Diego	University of Nevada - Reno

GRANTS

Battelle Memorial Institute	University of Arkansas (2)
Brown University	University of California - Berkeley (8)
California Institute of Technology (4)	University of California - Davis
Carleton University (3)	University of California - Los Angeles (2)
Central Washington University (2)	University of California - San Diego (4)
Columbia University	University of California - Santa Barbara (2)
GEO-HAZ Consultants, Inc. (2)	University of California - Santa Cruz
Georgia Institute of Technology	University of Colorado
Harvard University (3)	University of Illinois - Urbana/Champaign
Harvard-Smithsonian Center for Astrophysics	University of Kentucky
Humboldt State University	University of Memphis (4)
M Tuttle & Assoc (3)	University of Nevada - Reno (2)
Massachusetts Institute of Technology	University of North Carolina (2)
Nevada Bureau of Mines and Geology	University of Oklahoma
Oregon DOGAMI	University of Puerto Rico (3)
Oregon State University (3)	University of South Carolina
Pacific Geoscience Centre (2)	University of Southern California (3)
Piedmont Geosciences Inc	University of Texas - Austin (3)
Princeton University	University of Texas - El Paso (3)
Rensselaer Polytechnic Institute	University of Utah
Risk Engineering Inc.	University of Washington (3)
San Diego State University (3)	University of Wisconsin
San Francisco State University	URS Greiner Woodward Clyde
St. Louis University	URS Greiner Woodward Clyde Federal Services (6)
Stanford University (2)	Virginia Polytechnic Institute (3)
State University of New York - Buffalo	Washington Department of Natural Resources
Texas A and M University (2)	William Lettis and Associates (5)
University of Alaska	

Products for Earthquake Loss Reduction -- USGS seismic maps for the United States are being used to develop new, unified building codes for the United States. These maps are in digital format and give the maximum severity of ground shaking that can be expected during time periods of 50, 100, and 250 years, and are also being used to predict earthquake losses and to define insurance risks. A new seismic hazards map for Alaska was produced in 1998. In 1999, a new map for Hawaii was produced. Similar maps are being produced for Puerto Rico and the U. S. Virgin Islands, and efforts will begin for maps of American Samoa and Guam. Periodic review and updating of such maps to incorporate new information are among the highest priorities for the USGS. Development of these maps involves extensive consultation with earthquake researchers, engineers, and State and local government representatives. The maps integrate geologic mapping; fault locations, fault slip rates, and earthquake recurrence intervals; and analyses of crustal deformation, ground-motion patterns, and recent seismicity. The USGS is working to improve the base of geologic data for preparation of the next generation of seismic hazard maps.

Earthquake Hazards Assessments in Urban Areas -- The USGS is generating products that address the hazards in high to moderate risk urban areas, where the population and risks are

greatest, such as the San Francisco Bay area, Los Angeles, Seattle, Salt Lake, Memphis, and Charleston, South Carolina. Earthquake shaking scenarios are being developed for public planning, and modeling of ground motion is being provided for engineering applications. In conjunction with these products, the USGS conducts workshops to ensure the proper transfer of knowledge and to help design effective mitigation.

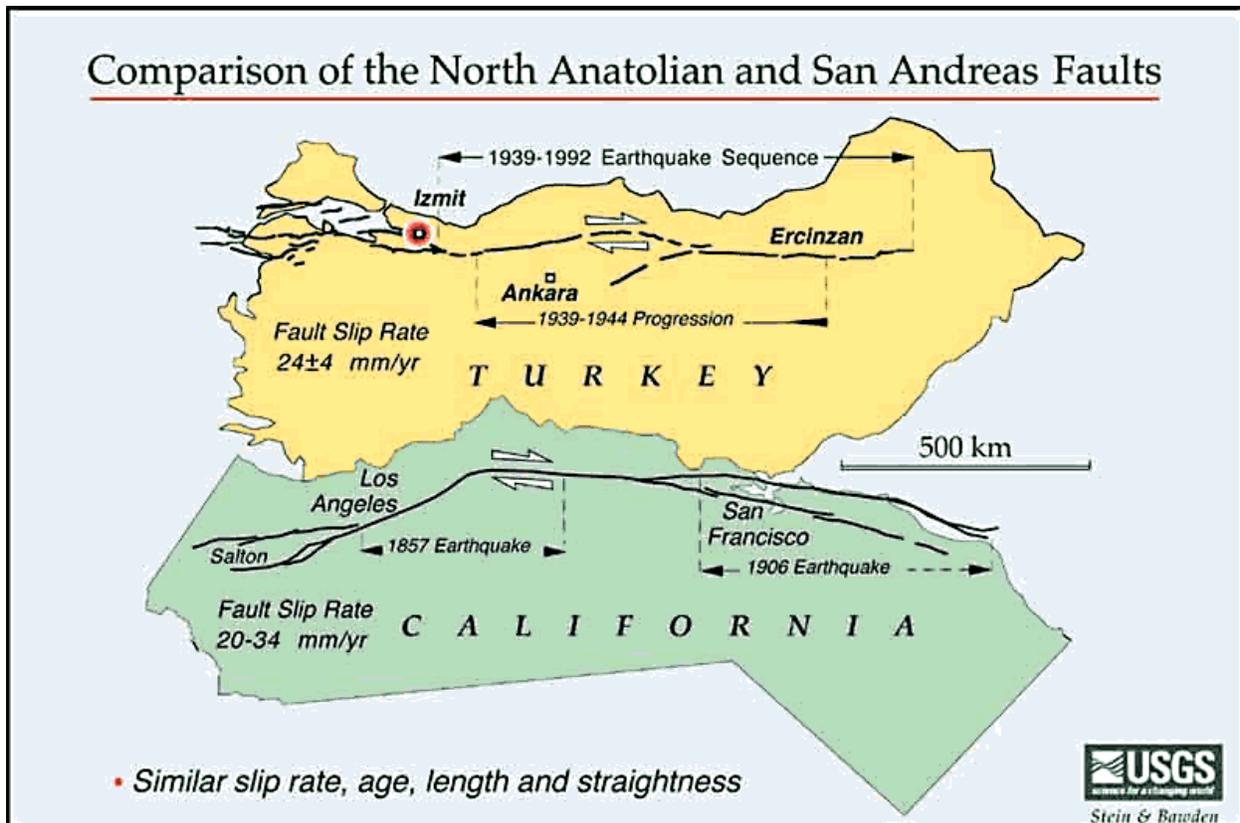
Regional Earthquake Monitoring -- The USGS and cooperating universities operate regional seismic networks in areas of high seismicity. Data from all U.S. seismic networks are used to monitor active tectonic structures in much greater detail than is possible with the national scale network. Each region has a local data center where the data are processed and regional catalogues of earthquakes are produced. These data centers serve as local distribution points for information about earthquakes, relaying earthquake data in real time to the National Earthquake Information Center as well as to other regional networks. Data centers also provide information about regional earthquake mitigation practices, and those data centers located at universities provide a training and research facility for students.

Monitoring Strong Motions Due to Earthquakes -- Conventional seismometers used in earthquake monitoring networks cannot accurately record strong ground and building motions caused by large, nearby earthquakes. Yet this technical data is extremely valuable for the design of earthquake resistant buildings and other structures. Through the National Strong Motion Program the USGS maintains about 840 strong motion recorders in 35 States and territories. The strong motion data show the amplitude, frequency content, and duration of strong accelerations caused by an earthquake. These parameters are direct inputs to computer models and scale models of structures to test their performance under realistic earthquake shaking.

Monitoring Changes in Shape of the Earth's Surface -- Geodetic networks provide essential information about movement of the land surface near faults and earthquake source zones. The USGS is working with universities and local agencies to conduct geodetic investigations using the global positioning system (GPS) and laser ranging surveys. A dense network of continuous GPS stations is being installed, in cooperation with NASA, NSF, and Scripps University, to determine the distribution of long-term crustal deformation and the spatial and temporal variations of the strain field in southern California. During the next two years, with funding support from USGS cooperators, new stations will be sited and installed, communications and data retrieval operations will be developed, and processing and archiving centers will be established. The USGS has a lead role in operation of the network, with responsibility to maintain stations and download data. In addition, the USGS is investigating a new satellite technology, Interferometric Synthetic Aperture Radar (InSAR), that has the potential of quickly and accurately providing large aerial maps of pre- and post-earthquake land deformation. Work is underway to develop computational tools necessary to efficiently analyze, interpret, and model InSAR data. The InSAR results in southern California will be used to augment, check, and if necessary correct the independent GPS measurements.

Post-Earthquake Investigations -- The USGS responds to large domestic earthquakes and to some foreign earthquakes by deploying portable seismic and geodetic instrumentation, conducting detailed geologic field investigations, and evaluating damage patterns in relation to geologic conditions and effects. These investigations provide essential information during and immediately after the emergency and an opportunity to make substantial advances in our understanding of earthquake geology and engineering. In FY 2000 post-earthquake investigations will include follow-up studies of three large earthquakes which occurred in 1999: the magnitude 7.4 and 7.1 earthquakes in Turkey and the magnitude 7.6 earthquake in Taiwan.

The Turkey earthquakes occurred on the North Anatolian fault, which is an excellent analog to the San Andreas. Studies will take advantage of the long history of recorded earthquake activity in Turkey (1500 years versus 150 years in California) to address how stress is transferred along the fault via earthquake activity. These studies should provide important insights into the behavior of strike-slip faults in general and will be particularly relevant to studies of the San Andreas fault. The earthquake in Taiwan was recorded on a dense network of digital accelerographs, capable of recording the ground motion on scale. As a result, an unprecedented data set exists that can be used to study site and building response to strong ground motion. Ultimately these studies will lead to advancements in building codes in regions proximal to active fault zones.



Additional Earthquake Research -- The USGS conducts research that has significant potential for breakthrough discoveries in earthquake hazard assessment and mitigation. The research is interdisciplinary, peer-reviewed, and coordinated with external partners through grants and cooperative agreements. Research results are incorporated rapidly in USGS earthquake loss reduction products.

A major focus of USGS earthquake research is in understanding earthquake occurrence in space and time. Ongoing USGS investigations seek to understand the physical conditions for earthquake initiation and growth; processes of earthquake triggering; how individual faults in the same region interact; why some faults slip slowly without generating earthquakes while others generate earthquakes; and the factors that control variations in recurrence intervals of earthquakes along the same fault.

Improving current techniques for forecasting the effects of strong ground motion will greatly improve seismic hazard maps for urban regions and is critical to cost-effective earthquake hazard mitigation. USGS earthquake research in this area addresses how complexities in the earthquake source, earth's crust, and near-surface soils and deposits influence seismic wave propagation and strong ground motion. Identifying and understanding the behavior of weak liquefiable sediments is also a priority. Research on ground failure in collaboration with structural and geotechnical engineers will lead to improved design of earthquake-resistant infrastructure.

USGS earthquake research also continues to address the problem of short-term warnings in the days or hours before damaging earthquakes. Well-documented geologic and (or) hydrologic signals preceded the Loma Prieta and Kobe earthquakes, warranting thorough investigation of these phenomena. The ongoing USGS earthquake prediction experiment at Parkfield, California, may permit not only the recording of pre-earthquake signals, but also the possibility of understanding their origin. USGS will continue research in the forecasting of earthquake aftershocks, which is of great value to citizens and public safety officials in the aftermath of large earthquakes.

Recent Accomplishments

Earthquake Probabilities for the San Francisco Bay Area -- On the basis of research conducted since the 1989 Loma Prieta earthquake, the USGS released the results of a Working Group study giving a 70% probability of at least one magnitude 6.7 or greater quake, capable of causing widespread damage, striking the San Francisco Bay region before 2030. This report, released in October of 1999, is far more comprehensive than the earlier, 1990 probability estimate. One of the major differences is that the new study analyzed five additional faults (Calaveras, Concord, Green Valley, Mount Diablo, and Greenville faults) compared to the 1990 study which only considered the San Andreas and Hayward-Roger's Creek faults. Additionally, the study did not restrict the assessment to earthquakes magnitude 7 or greater, as the 1990 report had done, but instead considered the potential for smaller earthquakes. This change was implemented so that an event comparable to the magnitude 6.7 Northridge earthquake, which killed 57 people and caused more than \$20 billion in damage, would be taken into account. The Working Group's assessment of the likelihood of moderate sized earthquakes in the Bay region found an 80% chance of one or more magnitude 6 to 6.6 quakes occurring before 2030. Conclusions from the working group's 2-year effort are presented in USGS Circular 1189 "Earthquake Probabilities in the San Francisco Bay Region: 2000 to 2030." These results were formally presented at a conference of the Association of Bay Area Governments held to commemorate the 10th anniversary of the Loma Prieta earthquake.

Hector Mine Earthquake -- The M7.1 Hector Mine earthquake occurred at 2:46 a.m. local time on October 16, 1999. The event was located in a remote, sparsely-populated part of California's Mojave desert, approximately 47 miles east-southeast of Barstow and 32 miles north of Joshua Tree. The earthquake occurred on the Lavic Lake fault, one of a series of closely spaced, northwest-trending, right-lateral strike-slip faults that traverse this portion of the Mojave Desert. Given that the Lavic Lake fault had not produced a large earthquake within the last 10,000 years, USGS scientists are conducting research to see if this kind of earthquake behavior is typical of the region or is just coincidental. The primary concern is their influence on the San Andreas fault, which is a major threat to the populated urban areas of Los Angeles, San Bernardino, and Palm Springs. The M7.1 Hector Mine event triggered small earthquake

activity as far south of the California-Mexico border, and some of these events occurred close to the southern end of the San Andreas fault.

Real-time Assessment of the Hector Mine Earthquake -- Although the Hector Mine earthquake was not noteworthy from a disaster standpoint, the event was significant as a test of the newly upgraded Southern California seismic network known as TriNet. Following the 1994 Northridge earthquake, FEMA funded a three-way effort among Caltech, the California Division of Mines and Geology, and the USGS to upgrade the antiquated southern California seismic network with digital, real-time, broad-band recording capability. Some of the network upgrades were achieved prior to the Hector Mine event, making TriNet the most sophisticated regional seismic network in the United States. With this state-of-the-art equipment in place, the location of the Hector Mine earthquake was pinpointed and magnitude measured within two minutes of the origin of the event. A map showing the distribution and severity of strong ground shaking was released within six minutes. Such immediate determination of critical earthquake parameters is essential for emergency response efforts, and thus the TriNet performance during Hector Mines provides a proof of concept for a real-time earthquake monitoring capability.

Such rapid assessment of ground shaking enables emergency response officials to immediately pinpoint the location and extent of damage and determine how to allocate scarce response-and-recovery resources. The location of greatest ground shaking and surface deformation is not always concentrated about the epicenter of an earthquake. In both the 1989 Loma Prieta and 1999 Kocaeli, Turkey, earthquakes, for example, significant damage occurred tens of kilometers away from the epicenter, due primarily to the distribution of poorly consolidated deposits which amplified strong ground motion. Therefore, without a means of quickly and systematically surveying the intensity of ground shaking following an earthquake, areas of significant damage could easily be overlooked. Emergency managers thus require more than the location and magnitude of an event – they need to know how intensely the ground shook and what the likelihood is of significant damage.

Seismic Network Integration -- The USGS operates a U.S. National Seismic Network (USNSN) consisting of 56 broad-band instruments distributed across the United States. The USGS and cooperating universities also operate regional seismic networks (RSNs) in areas of high seismicity. Data from all U.S. seismic networks are used to monitor active tectonic structures in much greater detail than is possible from the USNSN alone. Each regional network is responsible for cataloging earthquakes and serving as the distribution point for information on earthquakes and earthquake mitigation practices.

In the past year, the USGS Earthquake Hazards Program has made significant progress in integrating the regional and national seismic networks into a National Seismic System with seismic monitoring and data distribution system for the Nation. As a result, each of the USGS-supported regional seismic networks is now able to communicate with adjacent networks and with the USNSN in real time, thereby greatly improving performance at the regional and National level. Presently, almost 900 channels of seismic trace data flow into the National Earthquake Information Center (NEIC) in Golden, Colorado, from the regional and national networks. Likewise, the majority of seismic data produced by the RSNs is available on demand at the NEIC. Thus, the USGS now has the infrastructure in place to share data across networks in real time and to coordinate rapid earthquake response at the regional and National levels. In addition, this network integration provides back-up reporting capability should a regional network be damaged in a significant earthquake. The system also allows for the beginnings of a central repository combining significant RSN/USNSN data for all located earthquakes. Development of this system has been well coordinated between the NEIC and the regional

networks, and has also benefited from the contributions of several states, federal agencies, and private sector companies.

Foreign Earthquake Response -- In recent months, the USGS responded to two large foreign earthquakes, the magnitude 7.4 Kocaeli, Turkey, earthquake which occurred on August 17, 1999, and the magnitude 7.6 Taiwan earthquake which occurred on September 20, 1999. With respect to Turkey, the USGS dispatched geologists, geophysicists, and structural engineers to assist Turkish scientists at the Kandilli Observatory to document the damage and study the rupture. The team deployed instruments from Istanbul to Adaperazi over a two-month period. The instruments were to record strong ground motion from aftershocks and thereby determine the level of site amplification resulting from local soil conditions. These data, in turn, provide insights into how much of the earthquake destruction was caused by strong ground motion and how much was caused by construction practices. Information on site amplification is also important for revising building codes and for determining where rebuilding efforts should be focused. These are all critical contributions to any post-earthquake reconstruction effort. Research in Turkey was coordinated with Turkish colleagues and with other U.S. researchers including the National Institute of Standards & Technology, the National Science Foundation, and the Earthquake Engineering Research Institute. Results from the Turkey post-earthquake investigations were published in January 2000, in Circular 1193 entitled: "The Kocaeli, Turkey, earthquake of August 17, 1999."

The Taiwan response effort had a somewhat different focus. The Taiwan earthquake spawned major landslide activity in the mountainous regions of the island. Efforts were directed at systematically identifying, classifying, and cataloguing landslides, and using this information to forecast potential areas susceptible to future landslide activity. The Taiwan earthquake was also unique in terms of being recorded on-scale by a network of state-of-the-art seismographs densely distributed across the island. As such, the earthquake offers a first-time opportunity to study on-scale instrument recordings of strong ground motion in the earthquake zone. The USGS is working with Taiwan scientists at the Central Geological Survey to study these instrument responses and assess the level of ground shaking particularly in the vicinity of the earthquake's epicenter. The third and final component of post-earthquake cooperative studies with the Central Geological Survey was in the area of paleoseismology and studies of long-term seismic patterns in the Taiwan region. The USGS is well experienced at using the geologic record to determine earthquake recurrence rates and magnitude of slip during past earthquake ruptures. USGS scientists are working closely with geologists from the Central Geological Survey of Taiwan to share this expertise and help establish a long-term record of seismicity that can serve as a basis for future earthquake hazard assessments of Taiwan.

Earthquake Studies in the Los Angeles Basin -- The Los Angeles region is underlain by a network of active faults, including many that are deep and do not break the Earth's surface. These hidden faults include the previously unknown "blind" thrust fault responsible for the devastating January 1994 Northridge earthquake, the costliest quake in U.S. history. So that structures can be built or strengthened to withstand the quakes that are certain to occur in the future, the Los Angeles Region Seismic Experiment II (LARSE II) was designed to locate hidden earthquake hazards beneath the region to help scientists determine where the strongest shaking will occur.

LARSE II used sound waves traveling beneath the Earth's surface to produce images of these structures, similar to the method used to create an ultrasound image. During the major "active" part of this experiment in late October 1999, sound waves were generated by explosive charges

detonated beneath the surface in specially-drilled boreholes. The sound waves were received by over 1400 portable seismographs.

Integrated Earthquake Studies in the Central United States -- Four large earthquakes of near magnitude 8 with thousands of aftershocks struck the central Mississippi Valley during the winter of 1811-1812. This region continues to have the highest level of seismicity in the United States east of the Rocky Mountains. The Central United States Earthquake consortium (CUSEC) has been supported by FEMA to allow the emergency managers of Missouri, Illinois, Indiana, Kentucky, Tennessee, Mississippi, and Arkansas to jointly address earthquake response problems. Similarly the USGS Earthquake Hazards Program supports the CUSEC State Geologists to work together to assess earthquake hazards in the region. This cooperation has resulted in the publication of a map showing the relative potential for ground shaking and ground failure (liquefaction) for the seven-state area. The map also shows the infrastructure lifelines (interstate highways and pipelines) for the regions and how they are threatened by vulnerable soil conditions. In addition to the earthquake hazard information it conveys, the process of producing the map shows how federal support can allow State agencies to work together to address a common problem in a coordinated and consistent manner. The map was published by the USGS Mid-Continent Mapping Center.

Silicon Valley Earthquake Studies -- Urban areas built on shallow geologic basins filled with weakly consolidated material are particularly vulnerable to earthquake shaking. This was the cause of most of the earthquake damage in Mexico City in 1985 and the terrible loss of life (25,000) in Armenia in 1988. For the past two years the USGS, with partial funding through a Cooperative Research and Development Agreement (CRADA) with the Pacific Gas and Electric Company, has operated a dense, portable array of seismometers in the Santa Clara basin near San Jose, California. Almost all of the array stations triggered during an earthquake sequence in Nevada in August 1999 that was 250 miles away. This information was used to determine how the geologic structure of the Santa Clara basin amplifies and extends the duration of strong seismic shaking. These and similar studies in other urban areas in similar geologic settings will vastly improve our understanding of the variation of ground motions and our prediction of shaking from future earthquakes.

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Geomagnetism	1,993	+43	0	2,036	+43
Total Requirements \$000	69,111	+1,275	+2,850	73,236	+4,125

¹ See Program Change section for details on Safer Communities (+\$500) and program decrease (-\$250)

Volcano Hazards

Current Program Highlights

The USGS Volcano Hazards Program helps reduce the human and economic losses and disruptions associated with volcanic activity by (1) assessing and monitoring potential volcanic hazards, (2) providing warning information on volcanic activity and rapid monitoring response to volcanic crises, and (3) improving the scientific understanding of volcanic processes. With approximately 70 active and potentially active volcanoes, the United States is among the most volcanically vigorous countries in the world. During the twentieth century, volcanic eruptions in Washington, California, Alaska, and Hawaii devastated thousands of square miles and caused substantial economic and societal disruption and, in the worst instances, loss of life. With rising populations, development pressures, and expanding national and international air traffic over volcanic regions, the exposure of human life and enterprise to volcanic hazards is increasing. Under the Stafford Act (Public Law 93-288), the USGS has the responsibility to issue timely warnings of potential volcanic disasters to civil authorities and affected communities. The Volcano Hazards Program exists to lessen the harmful impacts of volcanic activity by monitoring potentially active volcanoes, forecasting eruptions, delineating the effects that may result, and helping determine appropriate mitigation actions.

Monitoring Potentially Active Volcanoes -- The USGS monitors volcanoes with a combination of instruments and techniques to detect the rise of magma in the Earth's crust so that forecasts and timely warnings of eruptions can be issued. By the end of FY 1999 the program was monitoring 42 U.S. volcanoes at its four volcano observatories which collaborate as appropriate with universities and State and Federal agencies:

- 1) The Hawaiian Volcano Observatory on the Island of Hawaii, where the most recent eruption of Kilauea Volcano, which began in 1983, still continues unabated.
- 2) The Cascades Volcano Observatory in Vancouver, Washington, near Mt. St. Helens.
- 3) The Alaska Volcano Observatory (AVO), a cooperative effort of the USGS Volcano Hazards Program, the University of Alaska Fairbanks, and the State of Alaska Division of Geological and Geophysical Surveys. AVO monitors the volcanoes of Alaska, which threaten not only

local populations but also aircraft and travelers using the major air routes across the North Pacific. AVO also is responsible for disseminating warnings about dangerous eruptions and ash clouds from Kamchatkan volcanoes that may affect U.S.-controlled airspace.

- 4) (4) The Long Valley Volcano Observatory in California, which focuses on the large Long Valley volcanic center where volcanic unrest has recurred episodically since 1980. Current program emphasis is on enhancing monitoring capabilities with improvements to equipment, software, and telemetry so that data from all restless, active, or potentially hazardous U.S. volcanoes can be acquired, processed, analyzed, and disseminated very rapidly.

Through a joint effort with the U.S. Agency for International Development (USAID), the USGS operates a mobile volcano-monitoring observatory to respond to selected volcanic crises around the world. At the request of other countries and working through USAID and the State Department, USGS scientists provide rapid-response volcano monitoring to determine nature of volcanic unrest and assess possible consequences of eruptive activity. The USGS benefits from this activity abroad by refining monitoring methods for use in domestic volcanic crises (such as at Redoubt Volcano and Mt. Spurr in Alaska in 1989 and 1992). A stunningly successful emergency response occurred in 1991 at Mt. Pinatubo in the Philippines where USGS and Philippine scientists predicted the volcano's explosive eruption, saving tens of thousands of lives of the people living around the volcano and providing critical advice to the U.S. Air Force at Clark Air Base and the U.S. Navy at Subic Bay Naval Station.

Assessing Volcanic Hazards -- USGS assessments of volcanic hazards are used to anticipate the effects of future eruptions and to identify the appropriate level of monitoring at specific volcanoes. Information obtained through geologic mapping, dating and analysis of eruptive deposits, hydrologic investigations, and geophysical analysis is combined in hazard-zonation maps, digital databases, and probabilistic recurrence and inundation models. Assessments are updated by the Volcano Hazards Program as new data become available and are critical input to emergency preparedness and land-use planning. Current program emphasis is on preparing new hazards assessments for volcanic centers in Hawaii (Hawaii Island, East Maui), California (Lassen Volcanic National Park), and Alaska (Aleutian Islands, Cook Inlet) and revised assessments for volcanoes in Washington (Mount Rainier, Mount Baker). New methods for probabilistic assessment are being developed for application along with more traditional means of describing hazard potential.

Studying Volcanic Processes -- USGS volcano-monitoring strategy and analysis of precursory unrest are founded on an understanding of magmatic processes and eruption dynamics. The Volcano Hazards Program uses many tools from seismology, geophysics, geochemistry, field geology, and hydrology to acquire that fundamental understanding. Topics of interest include the process of magma movement in relation to seismicity and ground deformation, mechanisms by which volcanic systems originate and change over time, the role of magmatic gases in eruption dynamics, interaction of magma and eruptive products with ground or surface water, and the dynamics of mudflows and debris avalanches at volcanoes.

Disseminating Information About Volcanoes -- The results of volcano-hazard studies must be effectively conveyed to the community they are intended to serve. Accordingly, the Volcano Hazard Program works closely with scientists in other institutions, public-safety officials at the Federal, State, and local levels, government-land managers, business leaders, the media, land developers and planners, educational institutions, and citizens groups. Information is disseminated through briefings, workshops, maps, scientific publications, videos, digital databases, web sites, newspaper articles and interviews with media. During volcanic crises, USGS personnel work directly with authorities responsible for public safety, and current

program emphasis is on preparation of interagency operational response plans. Information concerning volcano hazards can be obtained at the Volcano Hazards Program's (VHP) website at <http://volcanoes.usgs.gov>.

Recent Accomplishments

Eruption Response in Alaska -- On April 17, 1999, following more than three months of precursory seismic and thermal activity, Shishaldin volcano in the eastern Aleutian Islands began a brief but vigorous episode of explosive eruptions that sent volcanic-ash plumes to over 50,000 feet above sea level intermittently for about one month. This explosive activity from one of Alaska's most active volcanoes (28 eruptions since 1774) was successfully monitored by the Alaska Volcano Observatory using a newly installed real-time seismic network and improved techniques for rapidly examining meteorological satellite imagery. Volcanic ash from Shishaldin posed a threat to jet aircraft in the heavily traveled North Pacific air routes, but because of information provided by the USGS to the National Weather Service and the Federal Aviation Administration, aircraft were diverted and rerouted around potentially hazardous ash clouds. Volcanic ash erupted into the high atmosphere is highly hazardous to modern high-performance jet aircraft because it erodes compressor blades, melts onto critical engine parts, and causes loss of engine power. Hazardous concentrations of volcanic ash can drift at air-traffic altitudes for hundreds to thousands of miles downwind following a volcanic eruption. Worldwide, approximately 100 jet aircraft in the last 18 years have accidentally entered volcanic-ash clouds, putting many thousands of passengers at risk.

Sustained Vigilance in the Face of Long-lived Eruptions and Unrest -- The USGS Hawaiian Volcano Observatory continued to monitor the ongoing (since 1983) eruption of Kilauea volcano on Hawaii Island, helping the National Park Service and County Civil Defense to keep people out of harm's way while still allowing them to enjoy the island's natural beauty. In addition to scorching lava flows, Kilauea's hazards include sulfurous vog (volcanic smog) that has debilitating respiratory effects on people, explosive eruptions caused by mixing of magma and groundwater, sudden collapses into the ocean of oversteepened new lava benches, damaging earthquakes, and local tsunamis, all of which HVO helps to assess. At Long Valley caldera, adjacent to a popular recreational area in California and in the path of heavily traveled West Coast air-traffic routes, USGS scientists continued to monitor the latest signs of the area's two decades of recurring volcanic unrest. By providing objective interpretation of the significance of the unrest and by openly communicating with affected communities and agencies, the USGS is reducing uncertainties about potential volcanic activity there and contributing to informed decision-making by private individuals, businesses, and public officials. At Mount St. Helens in Washington, the USGS Cascades Volcano Observatory and its partner the University of Washington kept a vigilant eye on the volcano, monitoring the intermittent seismic swarms and small mudflows that still persist there long after the catastrophic eruption of 1980. With a heavily visited U.S. Forest Service visitor center now situated a few miles north of the summit crater excavated in the explosive 1980 eruption, continuing watchfulness is well warranted.

Volcano Monitoring Improvements -- In Hawaii, seismic monitoring was initiated for the Island of Maui, in response to recent geologic studies that identified Haleakala volcano as having had more frequent eruptions than previously recognized. On the Island of Hawaii, a network of borehole tiltmeters was established on Mauna Loa and Kilauea, providing the first reliable real-time deformation monitoring of the two volcanoes. In Alaska, the Alaska Volcano Observatory established a real-time seismic monitoring node on Adak Island, proving that it is possible to work in the remote western Aleutians and paving the way for eventual monitoring of all of

Alaska's potentially active volcanoes. Concurrent geologic field studies established that volcanoes on Adak have produced larger, more explosive eruptions than previously realized. At Long Valley, enhancements of the network to monitor ground deformation continued, and improvements in on-site computer processing and telemetry were initiated to improve availability to scientists of data from different types of sensors. In Yellowstone National Park, monitoring of the very large Yellowstone caldera was improved with additional continuously recording ground-deformation sensors used in combination with an innovative satellite radar technique.

International Volcanic Hazard Mitigation -- Through the joint USGS/USAID Volcano Disaster Assistance Program, during the past year USGS scientists responded to official requests to help interpret precursory unrest and eruptions at two volcanoes in Ecuador: Guagua Pichincha, adjacent to the capital city of Quito, and Tungurahua, near the popular tourist destination of Banos. Over a period of several months and working with host-country scientists, USGS volcanologists aided with monitoring-network upgrades, data interpretation, assessment of potential hazards, and development of a public-notification scheme. To minimize disruption of operations at Quito International Airport, USGS personnel provided information about the effects of ash falls to airport officials and American air carriers, and arranged for staff of Anchorage International Airport experienced with ash impacts to visit and advise Quito's airport managers. At the time of this writing, both Pinchincha and Tungurahua simultaneously were in eruptive phases, with ~25,000 people displaced from areas at greatest risk.

Emergency Preparedness -- Progress was made on interagency efforts to lay groundwork in advance of emergency operations during potential volcanic activity: An interagency plan to respond to volcanic hazards at Mount Rainier, Washington, was finalized among USGS, municipal, county, state, and other Federal agencies. The plan lays out responsibilities of the various entities during a volcanic crisis, including aspects of public education and information dissemination. For the Long Valley area in California, the USGS participated in an exercise that used a hypothetical eruption to test the emergency communication systems between about two dozen government agencies and private industry. Results from the communication exercise are being used by other agencies to improve the delivery of information during diverse future emergencies, not just volcanic ones. The Interagency Volcanic Ash Warning Plan for Alaska was updated and signed by the USGS, Federal Aviation Administration, National Weather Service, U.S. Air Force, and Alaska Department of Emergency Services. The plan establishes integrated and timely communications for air-traffic safety during volcanic eruptions in the North Pacific region.

Geologic Hazard Assessments Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Earthquake Hazards	43,893	+867	+2,600	47,360	+3,467
Volcano Hazards	17,181	+284	+250	17,715	+534
Landslide Hazards	2,580	+48	0	2,628	+48
Global Seismographic Network	3,464	+33	0	3,497	+33
Geomagnetism	1,993	+43	0	2,036	+43
Total Requirements \$000	69,111	+1,275	+2,850	73,236	+4,125

Landslide Hazards

Current Program Highlights

The Landslide Hazards Program helps reduce losses and casualties from landslide hazards through better understanding of the causes and mechanisms of ground failure. It is estimated that landslide-related fatalities average from 25 to 50 per year in the U.S. and that direct and indirect economic costs to the nation range up to \$2 billion per year. Although landslides occur in all regions and States, the Pacific Coast, the Rocky Mountains, and the Appalachian Mountains are particularly susceptible. Globally, landslides cause billions of dollars in damages and thousands of deaths and injuries each year.

USGS landslide hazards investigations focus on the urban environment, landslide hazards to infrastructure, and landslides that occur in association with other natural disasters such as earthquakes, volcanic eruptions, floods, and wildfires. These investigations are the essential first step in the development and implementation of strategies that reduce threats to life and property. They are conducted in partnership with Federal, State, and local land-management and emergency-response agencies.

Landslide hazard assessments provide the scientific basis for land use and emergency planning decisions, cost-benefit analyses of possible loss reduction measures, and determination of insurance risk. For example, studies of landslide susceptibility and hazard are providing much needed information to reduce landslide losses in three regions of the country that have significant landslide problems: the San Francisco Bay region, California, the Seattle/Puget Sound region, Washington, and the Blue-Ridge of central Virginia. The USGS is cooperating with local partners of the Federal Emergency Management Agency's (FEMA) Project Impact in Seattle, Washington, and Oakland, California.

Applied research concentrates on understanding landslide processes, development and deployment of instrumentation to monitor threatening landslides, forecasting the onset of catastrophic movement, and possible future landslides. Research into processes and forecasting methodologies is prioritized toward landslide types that produce enormous losses in the United States such as those landslides related to steep slopes, heavy rains, and vegetation loss due to wildfires or other mechanisms.

USGS scientists respond to landslide emergencies and disasters nationwide. Federal, State, and local agencies are assisted through landslide site evaluations and recommendations of strategies for reducing ongoing and future damages from landslides. For foreign disasters, the USGS works with the Agency for International Development's Office of Foreign Disaster Assistance (USAID/OFDA) in responding to appeals for technical assistance from affected countries.

The USGS provides timely information through the National Landslide Information Center (NLIC). This center communicates with the public and media about ongoing emergency responses and provides information to the external user-community through fact sheets, books, reports, and press releases. The NLIC maintains several databases: the Landslide Bibliography (more than 9,000 entries), the International Landslide Experts Roster of about 2,000 entries, and Major Landslide Events of the U.S. (part of the USGS National Atlas). The NLIC also has real-time measurements from ongoing landslide monitoring projects available for viewing via the Internet. They are used to forecast landslide movement or changes in an individual landslide's behavior.

The USGS is engaged in the preparation of a comprehensive plan to address landslide hazards in the U. S. in response to the following directive contained in the House Report which accompanied the FY 2000 Interior Appropriations bill:

“... the Survey is directed to develop by September 15, 2000, a comprehensive strategy, including the estimated costs associated with addressing the widespread landslide hazards facing the Nation. The preparation of this strategy should include the involvement of all parties having responsibility for dealing with the problems associated with landslides.”

Recent Accomplishments

Real-time landslide monitoring -- Quick response and continuing monitoring efforts by the USGS have served as a catalyst and model for the deployment of a permanent monitoring and warning system by the Colorado Department of Transportation as part of the mitigation efforts. Following the DeBeque Canyon, Colorado, landslide in April 1998, USGS monitoring has provided data essential to better understand and identify the potential significant hazards posed by this unique feature to Interstate-70, the Colorado River, and a major railroad corridor. A large study for mitigation of this hazard is being funded by the Federal Highway Administration, and includes cooperative efforts by the Colorado Department of Transportation, the Colorado Geological Survey, the USGS, and a private consultant.

Similarly, monitoring at Rio Nido, California, and US Highway 50 (east of Placerville, California) and at Woodway, Washington (near Seattle), is providing key information for dealing with landslide hazards in those areas. Using real-time data collected during landslide activity, USGS scientists have determined relations that distinguish slow movement from the onset of catastrophic failure of landslides along Highway 50, California. This represents a considerable advancement in the ability to provide short-term forecasts of hazardous landslide activity.

Regional assessments of landslide hazards -- In the San Francisco Bay region, California, USGS scientists are preparing a digital spatial database of the locations of about 90,000 existing landslides mapped in the ten-county San Francisco Bay region. Preliminary databases

for two counties, Santa Cruz and Alameda, have been released and a landslide susceptibility map based on these data is being prepared for the city of Oakland in conjunction with FEMA's Project Impact. USGS scientists have also compiled and analyzed inventory maps of debris flows resulting from the February 1998 El Nino storms for two parts of Alameda County, California.

In the Seattle, Washington, region, USGS scientists have developed a prototype susceptibility map for shallow landslides and are working with the city of Seattle to extend the map to the entire city. The USGS has also developed preliminary precipitation intensity-duration thresholds for occurrence of landslides in Seattle and a preliminary map of landslide probability calculated from Seattle's database of historic landslides. The maps will aid the city in its emergency response and landslide mitigation efforts. The thresholds can form the basis of a landslide warning system for the city.

In the Blue Ridge of central Virginia, USGS scientists developed digital mapping (GIS) techniques to depict debris-flow hazards based on detailed field examination, mapping, and analysis of debris flows triggered by the storm of June 27, 1995, in Madison County, Virginia. The USGS is now working in conjunction with several counties to develop maps that show potential debris-flow hazards in the Blue Ridge of central Virginia. Ongoing studies of prehistoric debris-flow deposits in the area are allowing the USGS to determine the average recurrence times of debris flows. The information on average recurrence will be utilized in preparing maps of debris-flow susceptibility in terms of likely probability of occurrence.

Response to landslides from Hurricane Mitch -- USGS scientists participated in post-Hurricane Mitch landslide reconnaissance in Honduras and neighboring countries and provided technical advice to USAID and Honduran government agencies concerning existing and future hazards from landslides. The information was used in making decisions about reconstruction and relocating populations in affected areas. A map of landslides in Tegucigalpa, Honduras, was completed and mapping of landslides in southern Honduras is underway. Technical advice and recommendations regarding mitigation of landslide hazards were provided to the World Bank. USGS also worked with the US Army Corps of Engineers in developing a plan for the excavation of a critical channel at the toe of the El Berrinche landslide in Tegucigalpa.

Geologic Hazard Assessments Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Earthquake Hazards	43,893	+867	+2,600	47,360	+3,467
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Total Requirements \$000	69,111	+1,275	+2,850	73,236	+4,125

Global Seismographic Network

Current Program Highlights

The Global Seismographic Network (GSN) is a worldwide network currently consisting of 117 modern seismographic stations. The GSN has a goal of 150 stations providing high-quality data used to address problems related to disaster management, hazards assessment, national security, loss reduction, and the structure and dynamics of the Earth. GSN is a joint effort involving the USGS, the Incorporated Research Institutions for Seismology (IRIS, a consortium of universities supported by the National Science Foundation), and the Institute for Geophysics and Planetary Physics (IGPP) at the University of California. The network is maintained in cooperation with many international partners who, in most cases, provide facilities to house the instruments and personnel to oversee the security of each station. The majority of GSN stations are operated within the framework of agreements between a host organization (academic institution or foreign government agency) and either the USGS, IRIS, or IGPP.

Funds for the purchase and installation of new GSN stations are provided to IRIS by NSF; the USGS and IGPP install new GSN stations on behalf of IRIS. Once installed, the USGS is responsible for maintenance, data collection, and quality control of about two-thirds of the GSN stations. The minor and routine maintenance at most foreign GSN stations is carried out by host organization personnel who are trained by the USGS. USGS tasks include training station operators, providing major repairs, conducting routine service visits to network stations, and providing direct financial aid in support of station operations at those sites lacking an indigenous host organization (most of these stations reside within the former Soviet Union).

The USGS and IRIS also evaluate, develop, and exploit new technologies in data acquisition and data management and improve station performance by relocating unusually noisy stations to quieter sites or configurations (e.g., placing sensors in boreholes) so that smaller events (earthquakes or explosions) may be detected. Siting, permitting, and installation of GSN stations are nearing completion. Currently, GSN is making the transition from development and deployment to operation and maintenance. The planned lifetime of the completed network is 30 years. However, with proper maintenance and gradual upgrades of data system components, GSN will produce data indefinitely and its performance will improve year by year.

Principal end-users of GSN data include the USGS National Earthquake Information Center in Golden, Colorado; the Center for (Nuclear) Monitoring Research in Arlington, Virginia; a broad assembly of government and academic researchers both domestic and international. Copies of all the data from USGS GSN stations are sent to the IRIS Data Management Center in Seattle, Washington. The IRIS data center is the distribution point for GSN data to users (such as scientists, engineers, and government agencies) throughout the world; every year it responds to over ten thousand requests for GSN data. In addition, data from over 50 GSN stations are currently available within hours of large earthquakes to the worldwide user community via telephone dial-up and (or) Internet connections.

GSN data are used daily in the routine operations of the USGS National Earthquake Information Center (NEIC). Real-time data are transmitted continuously to the NEIC where they are used, with other data, to determine the locations, depths, magnitudes, and other parameters of earthquakes worldwide. When appropriate, GSN data and parametric reports are provided to the Pacific and Alaskan tsunami warning centers. A unique feature of the GSN data is that they can be used to determine, within an hour, the geometric orientation of the fault that caused the earthquake, and provide an estimate of the length of the fault that ruptured during the earthquake. A damaging earthquake near a populated region generates great demand for such information by government officials and scientists responsible for assessing and responding to an earthquake disaster. Such information about significant domestic earthquakes is immediately sent to Federal and State emergency management and public safety agencies, operators of transportation facilities and public utilities, and national news media. Information about potentially damaging foreign earthquakes is immediately sent to the Department of State, embassies and consulates in the affected region, the Office of Foreign Disaster Assistance, the Red Cross, and the United Nations as well as national and international news media.

Recent Accomplishments

Network Status -- The USGS maintained 73 GSN stations at the end of FY1999. During FY1999 new stations were installed in Gabon and Brazil and on Midway Island and the Island of Hawaii. Plans called for eight new stations to be installed in FY1999; however, a major effort was required to ensure that the GSN was Y2K compatible. This involved replacing software for GSN operating systems that had 22 hardware variations and replacing non-compliant GPS clocks at 31 stations. Y2K compliancy for the GSN presented significant problems because of the diversity of system configurations and the wide geographical distribution of stations. These problems were overcome and the GSN was fully ready for Y2K and experienced no operational failures.

New Stations -- During FY2000 seven new GSN stations will be installed with funding from NSF. These stations will be at Ellice Island, Tarawa Island, Ecuador, Tristian Da Cunha, Raoul Island, Argentina, and Brazil. Five new GSN stations are planned for FY2001.

International Monitoring System -- U.S. national security interests continue to require seismic data from worldwide sources to monitor underground testing of nuclear weapons by foreign countries. Thirty-four GSN stations are part of the auxiliary seismic network of the International Monitoring System.

Research Support -- Data from the GSN are used extensively in basic and applied research on earthquakes, Earth structure, and seismic monitoring. Since the development of the GSN over

400 articles in scientific journals have acknowledged the use of GSN data in the reported research.

Real-Time Data Distribution -- Approximately 1.5 giga bytes (10^9) of data are recorded each day by USGS GSN stations. Data from 35 stations are now acquired in real-time and made available for monitoring and research through a Live Internet Seismic Server (LISS) developed for the GSN by USGS personnel. The LISS approach is much less expensive and more reliable than telephone dial up. The LISS is being adopted by other groups as an effective, low-cost means to collect large volumes of data from worldwide sites. The LISS approach provides seismic data immediately to the USGS National Earthquake Information Center for improved location and characterization of earthquakes worldwide. LISS also provides the schools and the general public with immediate access to GSN data.

Geologic Hazard Assessments Subactivity

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Earthquake Hazards	43,893	+867	+2,600	47,360	+3,467
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Geomagnetism	1,993	+43	0	2,036	+43
Total Requirements \$000	69,111	+1,275	+2,850	73,236	+4,125

Geomagnetism

Current Program Highlights

Magnetic Observatories -- Geomagnetic storms, induced by solar activity, pose significant hazards to satellites, electrical power distribution systems, radio communications, navigation, and geophysical surveys. Strong storms can also expose astronauts and crews of high-flying aircraft to dangerous levels of radiation. Over the past few years, such space weather hazards have caused crippling damage to communication satellites and power utility grids around the world. Economic losses from recent geomagnetic storms have run into hundreds of millions of dollars. The USGS Geomagnetism Program operates a network of geomagnetic observatories, which monitor the onset of solar-induced storms and give warnings that help diminish losses to military and commercial operations and facilities. The USGS maintains a network of 13 magnetic observatories in the conterminous United States, Alaska, Guam, Puerto Rico, and Hawaii. These observatories provide nationwide coverage, continuously measure the Earth's magnetic field, and carry out periodic observations for precise determination of the geomagnetic field to calibrate the continuous measurements. The data gathered by these observatories form the backbone of the program. Magnetic field variations are tracked continuously, and the data are made available to clients in a variety of time frames ranging from near real-time to five-year summary information, depending on clients' needs and requirements. Most of these observatories are fully instrumented (no onsite personnel) and the last few staffed observatories are in the process of being converted to unmanned operations. A program objective is to have all observatories in full, automatic operation during the next maximum of solar activity expected during 2000-2001.

Data Management and Satellite Operations -- USGS geomagnetic observatories use satellite transmission links to send data at 12-minute intervals to the USGS Geomagnetic Data Management Center in Golden, Colorado. This Center also operates as an international geomagnetic information node, which is connected with similar installations worldwide for the distribution of geomagnetic data via satellite. These near real-time data are used by the U.S. Air Force and NOAA's Space Environment Center (SEC) for hazard mitigation by warning of potential satellite failures, communication disruptions, power grid failures, and other problems caused by intense geomagnetic storms.

National Geomagnetic Information Center -- This center serves as the U.S. clearinghouse and information hub for products and services related to the Earth's magnetic field. The center produces CD-ROM's that contain definitive data from the USGS magnetic observatories, operates an online dial-up and WWW service (<http://geomag.usgs.gov/>) that allows users to obtain values of the Earth's magnetic field for any date, location, and elevation, and provides educational materials for teachers and the general public.

Modeling and Charting – Because of gradual but significant changes in the Earth's magnetic field, the USGS produces new magnetic field charts every five years and disseminates these charts to the user community worldwide. This user community includes all branches of the Armed Forces and other DOD agencies, the navigation and transportation infrastructure, and mineral and oil exploration industries. The charts graphically show the values of the magnetic field and its projected changes over time. The sophisticated mathematical models used to create the charts take into consideration all of the components of the Earth's magnetic field and their actual and forecast variations. The final models are used to calculate the Earth's complete magnetic field at any time and location.

Applications Research -- The USGS conducts geomagnetic research to achieve a better understanding of basic geomagnetic processes and their effects on our physical and social environments. For example, developing new models of the behavior of the ionosphere and magnetosphere enables us to make better predictions of the duration and end times of geomagnetic storms.

Recent Accomplishments

2000 Epoch World Magnetic Model -- A new World Magnetic Model (WMM) for the epoch 2000-2005 was completed in FY2000. This mathematical model of the Earth's magnetic field depicts the current field strength and direction and predicts the secular variation of the field five years into the future. The model was based on data from USGS geomagnetic observatories and satellite observations. The new model has many applications in navigation, spatial orientation, surveying, and research. The model has been provided to the National Imagery and Mapping Agency (NIMA) for Department of Defense purposes. NIMA will redistribute the model to NATO countries. The model has also been provided to the GPS-NAVSTAR Program Office for distribution to government and private GPS interests. This magnetic field model is incorporated in every GPS receiver used by the Department of Defense.

Improvements in Real-time Geomagnetic Data Capability -- The USGS is in the process of upgrading its geomagnetic data collection, communications, and data management capability. Rapid access to data from geomagnetic observatories is necessary for timely warnings of magnetic storms. A new generation of data collection platforms (DCPs) is being installed at each of the observatories to replace 15-year old equipment. The new DCPs will be based on personal computer technology and have the ability for: recording one-second data samples, perform numerical filtering, synchronization to GPS time, satellite data transmission, on site data display, and remote system administration. The new DCP systems are improving the quality, quantity, and reliability of data collected from the observatories, thereby reducing labor-intensive efforts required for data processing and management.

Geologic Landscape and Coastal Assessments Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Earth Surface Dynamics	12,327	+745	⁽¹⁾ +2,450	15,522	+3,195
National Cooperative Geologic Mapping	19,781	+457	+7,500	27,738	+7,957
Coastal and Marine Geology	33,327	+602	0	33,929	+602
Total Requirements \$000	65,435	+1,804	+9,950	77,189	+11,754

¹ See Program Change section for details on Place-based Studies (+\$500), DOI Science Priorities (+\$1,950)

Earth Surface Dynamics

Current Program Highlights

Global Change

The USGS Earth Surface Dynamics Program helps scientists to understand, model, and forecast on sub-continental and regional scales the response of the land surface and ecosystems to climate and land use changes. The landforms and ecosystems of the earth's surface undergo constant and profound changes. The pace and direction of these changes are determined by complex interactions among climate change, natural disturbances, and human activities (such as deforestation, agriculture, and urban sprawl). The earth's surface does not exist in a static, unchanging condition interrupted only by the actions of humans, but instead is a dynamic system of which humans are a part.

The USGS provides scientific support for the land stewardship responsibilities of the Nation by addressing resource management issues related to the impacts of climate variability and land use on ecosystems, the landscape, and resources. Priority is given to improving the utility of global change research to natural resource managers, through an increased emphasis on monitoring, modeling and forecasting the impacts of change on landscapes and ecosystems. Support for research on long-term climate history is decreasing accordingly.

The USGS works closely with other participating federal agencies to coordinate research under the auspices of the U.S. Global Change Research Program. There is an increasing emphasis on the human dimensions of environmental change, including understanding the sensitivity of regional systems to human activities and land use and the impacts of global and regional environmental change on human health. Emphasis is also placed on understanding the impact of climate change and land use on the carbon cycle and carbon sequestration in soils and sediments. In the lower Mississippi Basin, field-based measurements and modeling research will be enhanced to better describe the role of land-use change and associated erosion, sedimentation and biological processes on carbon storage and nutrient cycles in wetlands and riparian areas.

Great Lakes Mapping Coalition Project

In FY 2000 the USGS and the State Geological Surveys of Illinois, Indiana, Michigan, and Ohio began the pilot phase of a new partnership project to meet the increasing need for three-dimensional geologic maps of the extensive glacial deposits that blanket the upper Midwest. These maps will provide a foundation for making economic and environmental decisions related to water, land, and other natural resources. Pilot studies focus on a rapidly urbanizing area northwest of Chicago, a geologically complex region in southwestern Michigan, a region of coastal lake Erie affected by erosion in Ohio, and ground water protection issues in northeastern Indiana.

Studies Conducted Within A Specific Geographic Area

Sound restoration and management decisions depend on the availability of objective, high quality information that integrates science from a broad range of disciplines. These place-based studies investigations bring together scientific teams of geologists, hydrologists, biologists, and cartographers to solve the complex, multifaceted environmental. Results of the work helps resource and environmental managers understand historical ecosystem changes, design monitoring programs for restoration and management, and elucidate the relations between parts of the environment.

This integrated information is critically important to reduce the ultimate costs of restoration and resource management. The costs of physical environmental alterations are large, but not compared to the costs of ill-planned, misinformed actions that are ineffective. The scientific information provided helps to ensure that future plans have realistic expectations for restoration, water control structures are optimally designed and managed, and managers have the tools to predict outcomes of possible restoration actions.

Extensive restoration and management actions are underway in several nationally-important regions of the country. The south Florida restoration is expected to cost \$11 billion to \$15 billion, and will be based in part on predictions from models that were funded in part through work by USGS. In San Francisco Bay, multimillion-dollar modifications of wetlands and the water management system require multidisciplinary scientific information that has been developed over the years by USGS. In Chesapeake Bay, USGS information on nutrient and sediment loading into Chesapeake Bay has helped the Bay Program better plan restoration goals and actions related to land use management. In Platte River, scientific information will help determine the most effective means of restoring the habitats of millions of migratory birds that rely on the river environment. In the Salton Sea, greater Yellowstone and Mojave Desert, management and restoration also require a targeted scientific base to avoid costly mistakes as management changes are implemented.

Recent Accomplishments

Geologic controls on invasive species -- USGS scientists are working to understand the conditions of cheatgrass (*Bromus tectorum*) invasion into native shrublands and grasslands on the central Colorado Plateau, Utah. Recent discoveries have revealed landscape-scale links between cheatgrass footholds and climate, soil texture, soil composition, and geomorphic features. Combined with new theories about plant-nutrient requirements and uptake mechanisms for native and non-native species in the region, these discoveries support new understanding about how geologic processes influence ecosystem processes and health.

Continued monitoring of climate and nutrient inputs from wind-blown dust derived from distant sources will help achieve goals of alerting land managers to potential future invasion and ultimately identifying possible ways to halt continued damage to the ecosystem.

Understanding Interactions between Climatic and Vegetation Changes -- USGS scientists, working with academic colleagues, published quantitative data and illustrations on the relations between present-day climate and the geographic distributions of more than 400 major native trees and shrubs in North America. These data are being used by U.S. and international scientists to model potential future changes in vegetation patterns, including the potential roles of invasive species in future ecosystems of North America. The USGS data on modern climate-vegetation relations are also being used: 1) with paleobotanical data to provide detailed quantitative reconstructions of past climate fluctuations in North America, 2) to improve the depiction of vegetation surface models, and 3) to 'validate' modeled simulations of past climatic conditions by comparing simulated past vegetation patterns with the observed paleobotanical record.

Temperature History of Greenland and Antarctica -- USGS scientists, working with academic and international cooperators and the National Science Foundation, have obtained highly-precise temperature profiles of ice-sheets in Greenland and Antarctica (bore-hole paleothermometry). These data are being used to revise estimates of temperature changes on these ice sheets over the past few tens of thousands of years. The USGS studies indicate that polar ice sheet temperatures during the last glacial period were much colder than previously thought, and that polar climates changed synchronously between Greenland and parts of Antarctica. These results have strong implications for understanding past global climates and our ability to accurately model patterns of future climate change.

Improved Access to Information Aids Florida Resource Managers -- The South Florida Information Access (SOFIA) Internet site has made significant enhancements to the accessibility of USGS information in South Florida. The site enables managers and the general public to find data, metadata, descriptions of research, fact sheets, and information contacts. The site hosts the interagency presentations made at the South Florida Restoration Science Forum. Viewers can search for information by topic, investigator, title or click on a map to see all of the activities in a given area. Descriptions of synthesis projects provide an overview of specific topics, such as sediment and salinity in Florida Bay, and aquatic cycling of mercury. An automated demonstration steps through the components of the database. The Internet address is <http://sofia.usgs.gov>.

Models Aid Restoration Planning -- The successful restoration of south Florida rests on the availability of tools to predict accurately the effects of water management. Key predictive capability will be provided by USGS ecological and hydrological models. These models are also supported by the National Park Service (Critical Ecosystem Studies Initiative) and the Corps of Engineers.

Hydrologic Modeling -- Results from the Southern Inland Coastal Systems (SICS) Model are causing major changes in hydrologists' understanding of how water flow through the mangrove zone north of Florida Bay. Understanding the flowpaths of water entering coastal bays is important because US Army Corps of Engineers (COE) and other members of the Ecosystem Restoration Task Force are attempting to reconstruct the historical conditions by rectifying water flow through the Everglades into Florida Bay. Drainage in the southern Everglades, a vast network of interconnecting sloughs, has never been well documented. When planning began, vegetation patterns appeared to indicate that water flowed predominantly through Taylor Slough

and into Florida Bay at Taylor Creek. USGS modeling and data indicate that much of the water entering Taylor Slough actually flows southeast into Joe Bay then into Trout Creek, which empties into a different part of Florida Bay than Taylor Creek. The USGS model uses an integrated suite of scientific information including highly accurate elevation data, complex tidal stream flow measurements, studies of the effects of wind vegetation and evapotranspiration, and relations between surfacewater and groundwater. This information will help the COE accurately target its flow structures and management of water to maintain the appropriate distribution of salinity in Florida Bay.

Ecological Modeling -- The Corps of Engineers used the set of ecological models known as ATLSS, (Across Trophic Level System Simulation) in the Restudy to evaluate hydrologic scenarios for their effects on critical species. ATLSS is one of the most sophisticated ecological models of its kind that incorporates an unusually high degree of realism. Working models for wading birds (based on white ibis), white tailed deer, fish, American alligators, hydrology, and endangered species such as the Florida panther, wood stork, Cape Sable Seaside Sparrow and Snail Kite have been developed and are being refined for more detailed analysis. These models and links with predictive hydrologic models will be completed by FY2000. Additional components on estuarine species such as fish (underway), mangrove vegetation (planned), will be completed by FY 2001-2. ATLSS will continue to be used to aid monitoring, planning and ongoing management of the system <http://atlss.org/>.

Mercury Studies Provide Key Information For Predictive Models -- Resource managers of South Florida have long known that they had severe problems with methylmercury contamination of fish and wildlife. The State has issued many fish consumption advisories. They also knew that methyl mercury problems were particularly acute in certain parts of the Everglades and that changing the geochemical characteristics of the wetland was likely to influence methylmercury production. What they did not know was whether it would increase or decrease the risk. A team of scientists from USGS, state government, and academia, have provided the research findings that have enabled the EPA to model mercury dynamics in this complex system. The results of the model has allowed the South Florida Water Management District to move forward with its plans to purchase lands to construct Stormwater Treatment Areas without fear of creating "methylmercury factories."

Evaluating The Threat Of Mercury Contamination From Hydraulic Mining Debris -- More than a billion cubic meters of contaminated riverine sediment has flowed out of the foothills of the Sierra Nevada since the hydraulic gold mining days of the 1800s. As much as 10,000 tons of mercury, used to extract gold, was released to rivers during extraction of gold. Much of the contaminated sediment was initially covered over with cleaner sediments, but those sediments are now slowly eroding away. A USGS 3-D model of the distribution of mercury-contaminated hydraulic mining debris for the entire North Bay reveals that more than 400 million cubic meters, approximately one-third of the total volume of hydraulic mining debris, was deposited in North San Francisco Bay during the hydraulic mining period. Sediment coring has revealed mercury concentrations greater than 0.3 mg/g, significantly more than the reported background level of 0.1 mg/g. This model predicts that, more than 100 years later, about half of the hydraulic mining debris originally deposited in the North San Francisco Bay still remains there. Because of ongoing natural erosion of bottom sediments, much of the mercury-contaminated debris is presently at or near the surface of the bay floor, thus facilitating the transfer of mercury to overlying water and biota.

Geologic Landscape and Coastal Assessments Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Earth Surface Dynamics	12,327	+745	+2,450	15,522	+3,195
National Cooperative Geologic Mapping	19,781	+457	⁽¹⁾ +7,500	27,738	+7,957
Coastal and Marine Geology	33,327	+602	0	33,929	+602
Total Requirements \$000	65,435	+1,804	+9,950	77,189	+11,754

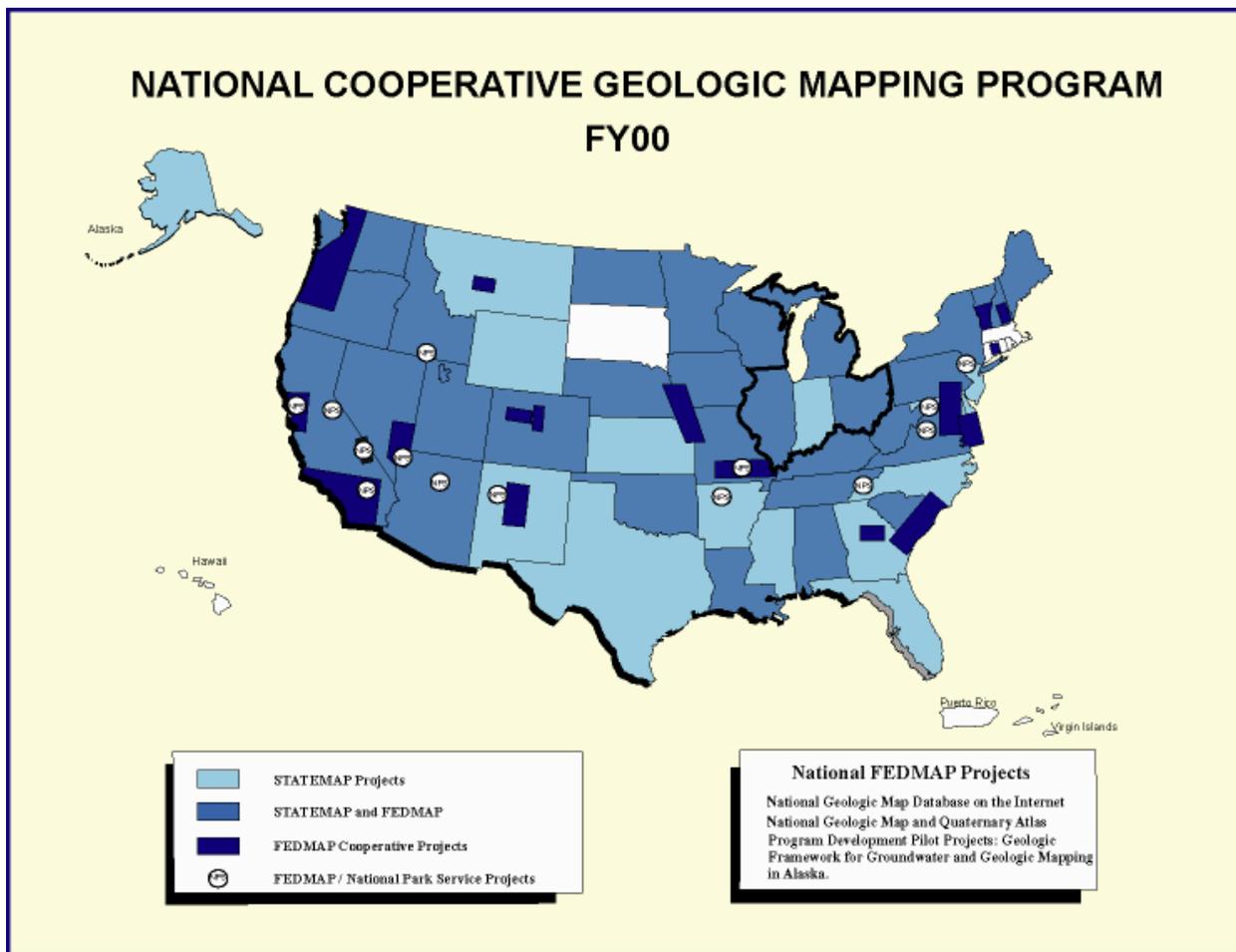
¹ See Program Change section for details on C/FIP (+\$7,500)

National Cooperative Geologic Mapping

Current Program Highlights

The National Cooperative Geologic Mapping Program (NCGMP) was created following the passage of the National Geologic Mapping Act of 1992, and reauthorized in 1997 and 1999 as Public Law 106-148. The Program is the primary source of multiple-purpose geologic maps that depict the distribution of the Nations' sediment and rocks and the resources they provide. Geologic maps are vital in the exploration and development of mineral, energy, and water resources, evaluating and planning for environmental protection, reducing losses from landslides and other ground failures, mitigating effects of coastal and stream erosion, siting of critical facilities, and planning for basic earth science research. The Program provides state-of-the-art digital geologic maps to the Nation in a cost-effective timely manner through cooperation among Federal, State, Academic, and private-sector earth-science organizations. Priorities and execution of the NCGMP are guided by a Federal Advisory Committee, which meets annually and consists of representatives from Federal and State governments, Academia, and from the private sector. Progress and status reports on the Program were prepared for the Secretary of the Department of the Interior and for the Committee on Resources of the House of Representatives and the Committee on Energy and Natural Resources of the Senate.

The NCGMP supports the Mapping Act through three main program components FEDMAP, STATEMAP, and EDMAP. FEDMAP, the Federal component consists of regional geologic mapping and synthesis projects. Government and private-sector clients and cooperators are not only users of program products, but also are involved in program planning. STATEMAP supports geologic mapping studies by state geological surveys through a competitive grant program that matches every federal dollar with a state dollar. Mapping priorities are determined with the help of State Mapping Advisory Committees in each state that include representatives from all levels of government, the private sector, academia, and industry. In 1999, 45 states received funds to accomplish more than 150 geologic mapping projects across the Nation. EDMAP supports the training of a new generation of geologic mappers in universities and colleges across the Nation through a competitive grant program that matches every federal dollar with a dollar from academic institutions. Both graduate and undergraduate students are encouraged to coordinate their mapping closely with our partners in the state geological surveys and scientists from the USGS. In 1999, 60 students from 41 universities in 29 states were funded to carry out well-mentored geologic mapping projects.



Recent Accomplishments

National Mapping Efforts

The National Geologic Map Database is mandated by the National Geologic Mapping Act, as a national archive of spatial geologic, geophysical, geochemical, geochronologic, and paleontologic information. The project is designed to build the database as a distributed system with a primary entry point on the World Wide Web for search and retrieval of information. The database consists of metadata for all published paper geoscience maps and book publications that contain maps; metadata for published digital map data; coherent nationwide geologic map coverage at intermediate and small scales; a distributed data management system for access to digital data held by a wide variety of data producers nationwide; a Web-based mechanism for searching and retrieving information from the database; and instructional and general-interest material detailing uses of geologic information and the value to society. Currently, the Database contains 95% of all USGS geologic map publications and 6% of State Geological Survey geologic map publications. A Digital Mapping Techniques workshops was held in Madison, Wisconsin, in cooperation with the American Association of State Geologists and the Geological Survey of Canada to help move the state surveys and the USGS toward development of more cost-effective, flexible, and useful systems for digital mapping and GIS analysis.

The Science in the Parks initiative is an ongoing priority of the Department of Interior aimed towards maintaining and protecting our National Parks. Recent rockfalls in Yosemite and Grand Canyon National Parks remind us of the growing need for geologic information to guide land management decisions, provide a safe environment for visitors, and enhance the interpretation of National Park lands. The NCGMP is the principal USGS partner involved with coordinating and prioritizing geologic studies in cooperation with the National Parks Service. The projects provide geologic maps and unbiased science on issues that range from geologic controls on water quality in the Ozarks and Buffalo River National Scenic Waterways to habitat preservation in Death Valley. Scientific information is provided in digital and standard formats that contribute to land-use management, educational outreach, inventories, and monitoring of natural resources to meet national and regional earth science needs.

The Quaternary Atlas of the eastern two thirds of the United States at 1:2.5 million scale has been completed as a product for the USGS National Atlas. The map is the premier product from more than twenty-years of collaboration between State and Canadian Provincial geological surveys, universities, the Geological Survey of Canada, and the U.S. Geological Survey. The Quaternary Period includes the time of all activities of man. The rocks, deposits, and materials depicted on the map include the soils and surface mantle of the earth, in which man's activities are concentrated. The map units are distinguished in part on the basis of physical, chemical, sedimentologic, and engineering properties. The map provides a national-scale database for all concerned with shallow groundwater aquifers, sand and gravel construction materials, soil and groundwater contamination and pollution, and toxic and other shallow waste disposal.

Regional Mapping Efforts

The Las Vegas Urban Corridor Project completed 1:100,000 scale geologic mapping of the Las Vegas and Lake Mead 1-degree quadrangles. The map areas include most of the city and suburbs of Las Vegas, Nevada as well as Lake Mead National Recreation Area. Mapping has identified the distribution of permeable strata and fracture zones (which are the pathways for water resources and pollution plumes) and delineated expansive soils, potential flood-hazard areas, subsidence due to ground-water withdrawal, landslides, and seismic faults and will contribute to planning and zoning efforts by local and state officials. Additionally, the maps aid local water districts in locating ground-water resources and areas for artificial ground-water recharge.

The San Francisco Bay Mapping Project is constructing digital databases of surficial and bedrock geology for ten San Francisco Bay area counties. The Regional Geologic Data Library will provide customers with on-line access to topical and geographically indexed data. Additionally, a variety of research efforts are continuing to understand and help characterize the hazard potential in the Bay region, in particular hazards associated with different types of landslides and earthquake hazards associated with strike-slip faults. Detailed, large-scale mapping in regions of fault segmentation will help in understanding the where, when and how great earthquakes are initiated.

The Appalachian Regional Geology Hydrology project completed geologic mapping of six quadrangles covering the Washington-Baltimore urban area. Collectively, these geologic maps provide a framework for environmental assessments, urban planning, and future resource and hazard investigations in an area of the Chesapeake Bay watershed that has sustained 3 centuries of urban development. The area was chosen based on input from a public forum and considered several factors, including societal relevance, customer needs, interagency

agreements and partnerships, available staff, and contribution to USGS initiatives. The forum was a significant step in ongoing efforts to promote communication between users and providers of geologic map information and to encourage user input and partnerships in the design of geologic mapping activities and products.

The central Death Valley region of California and Nevada is the area of principal discharge for regional groundwater flow from an extensive system encompassing 15,000 square miles of southern and central Nevada. A new FEDMAP project will provide the three-dimensional structural and stratigraphic framework for the area to support regional groundwater flow-model studies. The project coordinates with Department of Energy efforts to develop integrated steady state and transient flow models for the nearby Nevada Test Site and Yucca Mountain nuclear repository. Products will include digital geologic maps and GIS databases at 1:24,000 and 1:100,000 scales. Additionally, the project will assist the National Park Service in assessing environmental issues related to geology, geologic hazards and groundwater discharge in Death Valley National Park. The Park Service has significant concerns related to impacts of earthquake and mass wasting hazards on current and future Park development that lie astride the active Death Valley-Furnace Creek fault systems. Potentially large-scale offsets on the fault system is only rivaled by the San Andreas Fault.

Urban Mapping Efforts

Growing urban areas around Seattle and other lowland Washington cities are prone to seismic shaking, ground failure, and damage from earthquakes. In an effort to understand the earthquake hazard posed by the Seattle fault, the USGS has undertaken detailed geologic mapping and high-resolution geophysical surveys of the fault zone in the central Puget Lowland. The geologic mapping is a cooperative effort between the USGS, the University of Washington, and the City of Seattle. Field investigations guided by airborne laser terrain mapping (ALTM) have revealed that previously unknown active surface ruptures have occurred along a strand of the Seattle fault. The combination of geologic field mapping and ALTM mapping shows great promise for accurately mapping active fault structures, landslides, surficial deposits, and watercourses throughout the Puget Lowland. At the Seattle Urban Geologic Hazards Workshop held in February 1999 - sponsored by the USGS, University of Washington and FEMA's Project Impact - local cooperators noted that in addition to improving hazard assessments, integrated ALTM/geologic mapping also provides important information for surface-groundwater interactions and assessment of salmon habitat.

Geologic and hydrologic framework studies along the southeastern coastal plain of the United States produced maps defining the three-dimensional structure and continuity of aquifers that supply drinking water in the area. These FEDMAP maps will also help to resolve multi-state issues of ground-water quality and salt-water contamination issues. Partners include the USGS South Carolina Water District office, the Department of Energy, and the South Carolina Department of Natural Resources. Geologic mapping, supported by STATEMAP funds and the South Carolina Geological Survey, is concentrated in the fastest growing recreational and retirement area of the state along the coast. As man's activities come in contact with the fragile estuary ecosystem, the need for geologic mapping increases.

Geologic mapping in southern California is defining the structure and history of the San Andreas Fault system and its relation to earthquake hazards. This is a cooperative FEDMAP project with the California Division of Mines and Geology (CDMG), the USGS Water Resources District Office, the Mojave Water Agency, the USGS Earthquakes and Landslides programs, and a long list of additional cooperators. The project also maps ground-water basins in three-

dimensions to support the water resource needs of the populous desert region from the Mexico border through the Los Angeles basin, and eastward into the Mojave Desert. Closely coordinated geologic mapping supported by STATEMAP funds and CDMG is producing detailed maps in Orange and San Diego Counties for the Seismic Hazards Zoning Program. These maps are required by state law to be used for planning and development purposes at the county and municipal level. University students supported by EDMAP have been involved in both the FEDMAP and STATEMAP geologic mapping efforts underway in California.

Recent geophysical surveys and geologic mapping provides important information about detailed patterns of buried faults that offset the Santa Fe Group aquifers in the Middle Rio Grande Basin. The organization of this effort dovetails geologic mapping supported by all three components of the program, FEDMAP, STATEMAP, and EDMAP. Students supported under EDMAP work closely with geologists from both the USGS and the New Mexico Bureau of Mines and Mineral Resources. The new surface and subsurface data contributes to a three-dimensional model of the basin structure. The model will allow water allocation policies to be formulated on a more factual and technically rigorous basis and will facilitate more credible forecasts of the possible impacts of various water-use projections for the City of Albuquerque.

Geologic Landscape and Coastal Assessments Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
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Total Requirements \$000	65,435	+1,804	+9,950	77,189	+11,754

Coastal and Marine Geology

Current Program Highlights

The USGS Coastal and Marine Geology Program (CMGP) provides geologic information critical to the management of the Nation's coastal and marine environments. Research in CMGP currently addresses four main themes: 1) environmental quality and human health, 2) natural hazards and public safety, 3) natural resources, and 4) technology and information. Dealing with and resolving national issues, such as coastal erosion, coastal pollution, loss of wetlands, and sea level rise, requires the credible and objective science data, information, and understanding being provided by the USGS. The CMGP follows a 5-year plan of research based on prioritization of national issues and meeting customer needs. This plan is flexible and includes interdisciplinary studies that are producing information and products used by Federal, State, and local agencies and the public. Such products provide the authoritative, credible, objective scientific basis for regulating, managing, and protecting the Nation's coastal and marine resources.

In FY 2001 as several current coastal and marine geology studies come to completion and results are disseminated to user groups, funds will be used to begin or augment high priority studies in three topics: Effects of Coastal Storms, Sediment-hosted Pollution in the Lower Mississippi River, and Coral Reefs. All three of these issues are vitally important to the Nation and reliable scientific data and information from USGS studies are needed to address these issues.

Environmental Quality and Human Health -- These studies address topics such as pollution and waste disposal, wetlands loss, characterization of coastal and offshore biological habitats and marine sanctuaries and reserves, and environmental change. Results from these efforts provide an understanding of geologic processes needed to predict natural and human-related variability and to evaluate the influence of human activities on coastal regions, estuaries and offshore regions. Federal and state agencies and private groups routinely use the regional broad-based and long-term science information produced by this USGS work to make land-management decisions.

Natural Hazards and Public Safety -- These studies provide geologic information for understanding and predicting coastal erosion and other storm effects on the shoreline, for identifying and evaluating offshore earthquake and tsunami hazard potentials, and for evaluating submarine landslide hazards.

Natural Resources -- These studies provide information on the location, distribution, quantity, and quality of fresh water, minerals, and energy resources in coastal and marine environments, and the potential impacts of extraction. Understanding the geologic conditions and processes which form energy and mineral deposits is important because modern marine environments are the analog for older deposits being recovered on land. Such information can increase production and safeguard the environment.

Technology and Information -- These studies provide base-line products characterizing the form and composition of the Nation's coasts and seafloor through systematic reconnaissance-level surveys and production of maps of the U.S. coast and offshore Exclusive Economic Zone. These scientific maps and information are used for assessment and management of the sea floor and provide a foundation for investigations of environmental-, hazard-, and resource-related issues in coastal and offshore areas. The USGS also addresses the management and transfer of marine geologic information and products.

Recent Accomplishments

Geologic Framework and Processes of Coral Reef Systems -- Coral reefs, critical ecosystems in the U.S., island territories, and in many tropical developing-nations, are in dramatic decline because of a combination of natural and man-made factors. The USGS, in cooperation with other Federal agencies, has begun studies to assess changes caused by natural and man-made factors by mapping the location and evaluating the health of coral reefs, discerning the impact of sedimentation, including airborne dust and diseases, and wave energy on reef processes. In April 1999 USGS scientists began field studies of coral reefs along the south coast of Molokai'i in the Hawaiian Islands. These studies are mapping the complex reef system around the Hawaiian Islands to determine how land-derived sediment and other factors affect the health of the reefs. The project is employing both traditional and innovative data-collection and mapping methods such as state-of-the-art laser imaging.

Additional studies are being conducted, using satellite imagery and salinity surveys, from Florida Bay and the Florida Keys on reefs in several DOI and NOAA parks: Biscayne National Park, the Florida Keys National Marine Sanctuary, and Dry Tortugas National Park. Results are showing that net ground-water flow and contaminants are being transported from Florida Bay toward the reefs at higher rates than previously thought.

These projects are providing reef managers a better understanding of the controls and processes that influence coral reefs, regional diversity, distribution and productivity.

The USGS is also contributing to the newly formed Coral Reef Task Force by taking a lead in preparing action plans detailing the additional scientific studies and mapping necessary to protect and preserve coral reefs.

Geology and Processes of the Lake Pontchartrain Basin, Louisiana -- One of the largest and most important estuaries of the Gulf Coast region, the Lake Pontchartrain Basin, is adjacent to New Orleans, a city of 1.5 million people. The effects of the area's rapid development over the past 50 years, combined with natural processes, have resulted in significant loss of critical wetland habitats and environmental degradation. To better understand the Basin's origin and the processes driving its evolutionary development and degradation, a multidisciplinary study is underway, in close collaboration with Louisiana state institutions and other Federal agencies.

Six primary tasks are being addressed: geologic framework, historic shoreline and wetland change, lakebed sediment characterization, critical processes, circulation modeling, and information transfer/education outreach. Such baseline information is being used by state and local managers to protect and restore the Lake Pontchartrain Basin.

Sediment and Pollutant Movement Offshore Los Angeles -- The coastal ocean off the Los Angeles metropolitan area, like many regions of the US, receives surface runoff, sewage, and industrial waste drainage. Recent surveys have shown that more than 95 percent of Santa Monica Bay, west of Los Angeles, has contaminants at concentrations exceeding levels at which biological effects begin to occur. The USGS, in collaboration with the City of Los Angeles and the Southern California Coastal Water Research Project, is conducting a study of the sediments on the floor of Santa Monica Bay to determine the severity of present contamination conditions and how levels of contamination have changed in recent times.

The USGS obtained a set of sediment samples going back over the last 100 years. These samples were tested for geologic properties, pesticides, toxicity, and other contaminants. Analyses show that, although surface sediment in the Bay is still contaminated, contamination levels have decreased over the past 50 years. Overall, conditions of sediment contamination in the Bay seem to be improving. In addition, sediment data are being combined with monitoring of ocean currents to better understand how sediment and contaminants move around the Bay. This information is having immediate benefits to state and local agencies involved with cleaning up and managing the southern California coastal region.

Long Island Sound Contamination and Habitats -- USGS studies, conducted in cooperation with the Connecticut Department of Environmental Protection, have defined the seafloor processes, ocean circulation patterns, and contaminated sediment distributions in the large, urbanized Long Island Sound estuary. This data provides a comprehensive regional understanding of the long-term fate and transport pathways of human toxins and wastes introduced into Long Island Sound. Results show that contaminants are widely dispersed across the Sound. Seafloor environments, the proximity to pollutant sources, and the type and mixing of bottom sediments influence the contaminant distribution. Knowledge of the variability of contaminants and seafloor conditions is essential to Federal, State, and local environmental managers for predicting where contaminants and wastes affect the seafloor biologic habitats and determining where additional studies are needed.

Understanding the Chesapeake Bay Ecosystem -- USGS scientists are working with EPA, state agencies, universities, and marine laboratories in the Chesapeake region to put an understanding of the Bay's ecosystem into a historical context. Studying written records and working back in time with information from sediment cores, investigators are starting to see how the Bay has responded to rising sea level and changing climate over past decades and centuries. These data are being matched and compared with other archived information of the past including tree ring records and sediment cores from East coast lakes and the Atlantic Ocean.

USGS studies have also confirmed that an asteroid impact in the geologic past is largely responsible for the origin of the Bay and the buried crater continues to affect ground water flow conditions in the Norfolk region around the mouth of the Bay. USGS studies of geologic conditions and processes is providing critical understanding of pollution in Chesapeake Bay and other estuaries.

This information on the history and evolution of Chesapeake Bay is being used to assess scenarios for the future of the ecosystem and to optimize management strategies of Chesapeake Bay Program partners to reduce negative human impacts to the ecosystem. In 1999, field investigations were performed including imaging of underwater sediment layers and sediment coring in the main Bay, tributaries, and marshes. Analyses of the sea-level change record are underway. Preliminary results show that sea level is rising much faster than the world-wide average, which has grave implications for increasing coastal erosion along developed coastal regions around the Bay.

Mapping the Effects of El Niño Storms Along the Pacific Coast -- As part of its response to El Niño generated storms and coastal response, the USGS and its Federal partners collected airborne laser baseline topographic survey data (LIDAR) along 1200 km of the U.S. Pacific coast. The primary purpose of these investigations is to document beach and coastal bluff changes as a result of severe El Niño induced winter storms.

Additional studies, in cooperation with State, local, and university researchers, further established the timing and process mechanisms of coastal change at a number of detailed study sites along the West Coast. Coastal monitoring data, which includes oceanographic measurements, beach profiling and aerial photography, is being used by state and local agencies to plan ahead for future storm events in order to reduce the costs and threats posed by extreme climate events.

Earthquake and Tsunami Hazards of the Pacific Northwest Coastal Region -- A complementary mix of geologic investigations by the USGS is being used to improve the scientific understanding of onshore and offshore earthquake fault structures and potential slope instabilities associated with the tectonic deformation of coastal Washington. The results of these USGS studies are being used to update regional fault maps of the Puget Sound region and the Washington-Oregon coastal zone. Additionally, the data provide new and useful information to FEMA and state agencies on the potential magnitude and reoccurrence rates of local earthquakes and tsunamis and the impact of these events on human activities in the Seattle-Tacoma urban corridor.

Coastal Landslides in the Great Lakes Region -- Coastal and offshore geological studies conducted by the USGS, in cooperation with the National Park Service, have shown that major landslides along the floor of Lake Michigan have caused rapid and catastrophic shoreline loss in historic times at Sleeping Bear Dunes National Lakeshore that threaten life and property. These slides, over a period of centuries, have disrupted the beach and parts of the lakefloor. Onshore studies discovered underlying geology that predisposes the area to landslides, and documented beach loss and ground pressures. Interpretations of these findings are helping to understand the cause of repeated slides. Results of underwater surveys and onshore monitoring are helping the USGS and the NPS evaluate the landslide hazard potential in the Park and may have application to other coastal cliff regions.

Southwest Washington Coastal Erosion -- For the past several thousand years, the beaches of southwest Washington and northwest Oregon accumulated sand, growing seaward and creating broad coastal plains and sand dune fields. During the last century, accelerated accretion of the beaches, associated with jetty construction at tidal inlets, has led to the belief that the coast was stable and favorable for development. In the past few decades, however, beach growth has slowed, and in several areas has reversed to erosion, causing loss of land and property damage. Scientists from the USGS, the state of Washington, local agencies, and

the university community are conducting a comprehensive, regional study of sediment supply, coastal processes, and shoreline change in the Columbia River coastal region.

Scientists are learning that the position of the shoreline changes over many time scales, caused by many complex factors, including seasonal fluctuations of up to 100 m during winter, reorientation of the shoreline during El Niño storm events, and infrequent but catastrophic tsunami waves following earthquakes. All of these shoreline events are superimposed on longer-term trends of either accretion or erosion. This information, provided in reports and at workshops, is aiding State and Federal agencies that are responsible for managing coastal activities, as well as local government officials responsible for long-term planning of coastal development and protection.

Sand Resources Offshore Long Island to Mitigate Coastal Erosion -- Significant and widespread coastal erosion from storms is occurring along the barrier-islands of the south shore of Long Island, New York. The economic importance of this area is substantial. Approximately \$2.8 billion worth of real estate, coupled with a \$1.5 billion annual tourist industry, is dependent on the region's recreational beaches that are undergoing rapid erosion. The USGS, in cooperation with the U.S. Army Corps of Engineers, is producing geologic maps of the sea floor along the south shore of Long Island that are being used in efforts to mitigate the erosion.

This project is determining regional-scale sand resource availability for planned beach-nourishment programs and investigating the role that inner-shelf morphology and geologic framework play in the evolution of this coastal region. Information collected is being used by the Corps of Engineers to assess sand resource potential and evaluate the possible impact that extraction of this resource might have on adjacent beaches.

Geologic Framework and Processes Shaping the Deep-water Gulf of Mexico -- The continental slope offshore Texas and Louisiana is one of the few remaining regions for oil and gas exploration within the U. S. Exclusive Economic Zone. The USGS is conducting research in cooperation with academic institutions to map the near-surface geology to better understand the processes that have shaped this geologically dynamic area. A regional mapping effort is providing information on the geometry and sediment composition of modern slope deposits and the distribution and timing of submarine landslides.

These studies are providing Federal agencies and the oil and gas industry with critical information on the impacts of oil and gas extraction in the deep Gulf of Mexico. The hazards being identified and mapped influence the siting of oil and gas platforms and pipeline routes. The detailed understanding of the geometry and composition of modern sedimentary deposits provides industry with analogs to more deeply buried ancient deposits that presently are drilling targets; information needed for oil and gas exploration and recovery studies.

Geologic Mapping of Coastal and Near shore Seafloor Habitats -- Accurate base maps are a prerequisite for every geographically based scientific study. Detailed knowledge about seabed habitats does not exist for much of the Nation's coastal regions, yet seabed geology is the basic framework for the development of habitats and associated biological resources. The USGS, in cooperation with the University of New Brunswick and using private sector ocean-surveying firms, has begun the systematic mapping of large portions of the near shore U.S. continental margin. This effort is producing accurate, high-resolution base maps and imagery for geologic and biologic studies by the USGS and other agencies. The EPA, U.S. Army Corps of Engineers, and NOAA, among others have joined with the USGS to support this mapping. The data is being used for activities as diverse as regulating marine disposal sites,

decisions concerning the removal of navigation hazards, and management of the Nation's Marine Sanctuaries.

In 1998 and 1999, the USGS mapped parts of the continental margin off South Carolina, greater Los Angeles and San Diego, selected areas around the Hawaiian Islands, including the Humpback Whale Marine Sanctuary; Flower Garden Bank; Stellwagen Bank; parts of Monterey National Marine Sanctuary; parts of the New York Bight, including the Hudson Shelf Valley; Gulf of Maine; and central San Francisco Bay. In addition, the USGS brought marine mapping technology onto the continent, successfully mapping the complex bottom of Lake Tahoe to address a variety of environmental issues associated with the Lake. The coastal maps and related research on biological habitats have identified bottom types that are deemed essential for the successful reproduction and survival of important fishery species and have documented the alteration of "essential fish habitat" by fishing practices. Maps of both active and historical disposal sites have documented the dispersal patterns and the effects of the materials on the environment, and the status of toxic sites that have been capped in an effort to prevent further contamination of the seabed.

These results are providing a basis for further research and for the development of regulatory policies by State and Federal managers. For instance, the maps are used by the EPA and the USACE to manage offshore disposal sites; and by NOAA, the regional Fisheries Management Councils, and the fishing industry to identify "essential fish habitat" and to regulate fishing grounds. Future marine mapping will continue adjacent to the major population centers on the East and West coasts and possibly the Great Lakes.

Geologic Resource Assessments Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Mineral Resources	53,893	+1,193	⁽¹⁾ -2,000	53,086	-807
Energy Resources	22,783	+524	-2,009	21,298	-1,485
Total Requirements \$000	76,676	+1,717	-4,009	74,384	-2,292

¹ See Program Change section for details on Decision Support/Resource Management (+\$1,200) and program decreases (-\$3,200)

Mineral Resources

Current Program Highlights

Minerals and mineral products are important to the U.S. economy; processed materials of mineral origin accounted for an estimated \$415 billion (5 percent) of the gross domestic product in 1998. The USGS Mineral Resources Program (MRP) is the sole Federal provider of scientific information for objective resource assessments and unbiased research results on mineral potential, production, consumption, and environmental behavior. This information is used to characterize the life cycles of mineral commodities from deposit formation and discovery to mineral recycling. The MRP continues to increase the availability and usefulness of its data resources by designing and implementing methods for integrating and delivering spatially referenced digital data via the Internet using standard World Wide Web technology and software. Analyses based on these data are critical to the formulation of economic and environmental policy and also provide land managers with decision options when there are conflicting demands for resources.

Environment and Public Health -- Environmental effects of mineral deposits that result from natural processes, mining, and mineral processing are key issues in national and global mineral-resource development. The abundance, compositions, and environmental availability of minerals or their contained elements in rocks and soils define the geochemical landscape and directly influence nutrient availability, toxic element concentration, vegetation distribution, and the general health of ecosystems. The MRP conducts geologic, environmental, and public health studies in cooperation with land-management agencies, biologists, medical professionals, States, universities, and industry. MRP supplies objective information, research, and assessments that are used for prioritizing mitigation and restoration projects, developing mitigation and restoration strategies, and formulating regulatory policy. Current MRP activities include examining how minerals affect ecosystem health; assessing abandoned mine lands; characterizing the source, transport, and fate of toxic elements, particularly mercury and arsenic; and developing regional and national geologic, geochemical, and geophysical baseline and background maps and databases. Through the use of remote-sensing technologies such as imaging spectroscopy, developed by MRP with NASA, program scientists can map environmentally significant characteristics such as mineral alteration, mineral distribution, and vegetation health.

Sustainability and Societal Need -- As world population increases and the world economy expands, so does the demand for natural resources. As described by the National Research Council, Sustainability represents a growing concern about the adequacy of mineral resources to meet future demands and to do so without unacceptable environmental degradation. The MRP maintains national databases, develops assessment and analysis methods, and conducts applied research that provides the objective scientific tools for decision-making related to sustainability. The USGS is a world leader in understanding mineral occurrences and developing methodologies for quantitative and qualitative mineral and environmental assessments. Mineral-deposit research provides the fundamental knowledge used to understand where minerals occur and how they interact with the environment. Understanding the origin of mineral deposits and developing genetic components of mineral-deposit life cycle models are fundamental requirements for construction of accurate deposit models and for adequate assessment of the Nation's mineral resources. Concepts of ore genesis evolve over time as our understanding of geologic and ore-forming processes increases, as new deposit types are recognized, and as technology advances. USGS assessments of the distribution, economic significance, and environmental impact of development of the Nation's mineral resources are conducted on regional, national, and global scales to meet the needs of land-management agencies and national policy makers. In response to the need to update and maintain urban infrastructure, the MRP is increasing its emphasis on assessments of aggregate resources, such as sand, gravel, and crushed stone. Current program activities include development of environmental models, economic filters, materials flow models, and assessment techniques for selected industrial minerals. In the last four years, MRP has focused on electronically disseminating the national and regional databases of geochemistry, geophysics, mineral and mine localities, and lithology, as well as the extensive science applications developed using these data. We are actively working with our partners on developing an interactive geospatial information system that will be made available on the World Wide Web.

Economy and Public Policy -- The MRP responds to the economic and public policy needs of the Nation by providing long-term national and regional data on mineral potential, production, use, and recycling to land-management agencies, regulatory agencies, industry, academia, and the public. MRP collects, analyzes, and disseminates information on the production and consumption of about 100 mineral commodities, both domestically and internationally for approximately 190 countries. Information on strategic minerals is provided to the Department of Defense for managing the National Defense Stockpile. By monitoring the flow of materials through society, MRP provides information and analyses essential for sustainability indicators, as well as for mineral conservation and recycling, land stewardship, and environmental policy for governments, industry, and the public. Government agencies, financial institutions, and many types of industries use MRP's monthly metal industry indicators to monitor the health of the U.S. metal industries. Current activities include projects in National Parks, National Forests, and BLM Resource Areas that provide geospatial minerals, geologic, geochemical, and geophysical information for land stewardship and management plans; national geospatial databases that allow rapid response to land management concerns; materials flow analyses of key minerals in the economy and environment; and minerals information on over 100 commodities on a monthly, quarterly, semi-annual, and annual basis. In the last four years, the program has focused on electronically disseminating national and regional databases of geochemistry, geophysics, mineral and mine localities, and lithology, as well as the extensive science applications developed using these data. The USGS is actively working with partners to develop an interactive geospatial information system that can be served on the World Wide Web, and will assist land managers and policymakers with analysis of natural resources and the potential environmental effects of resource utilization.

Technology and Information Dissemination -- USGS minerals research results are available to users in easily accessible, accurate, and timely products. Information is disseminated through traditional paper products, in digital form, over the Internet (<http://minerals.usgs.gov/>), by FAXBACK (703-648-4999), through interagency collaborations, and in technical and non-technical public presentations. Geospatial data are a major component of this theme, as is dissemination of timely information about MRP activities and accomplishments. Other components include development of new geophysical and geochemical techniques for mineral-resource studies and the application of mineral-resource expertise and techniques to other societally relevant issues such as mapping earthquake and volcanic hazards, location and evaluation of energy resources, characterization of hydrology, or location of buried ordnance.

Partners -- All projects in the program are enhanced by working with partners in other Federal, State, and local agencies, universities, or industry. Over half of the studies conducted have an environmental component and over half of the projects are providing direct scientific support to land management and regulatory agencies. Collaboration with other Federal and State agencies focuses on meeting information needs concerning the lands they administer, including a wide range of topics from land management plans to characterizing Superfund sites. Through university cooperative agreements, the program partners with academia and industry to conduct basic research on ore forming processes and surficial geochemical processes in order to understand the environmental consequences of deposit weathering, extraction, and use. Through an extensive network of over 18,000 industry and State collaborators, the program synthesizes and disseminates high quality national and international production data that are useful to policymakers, land managers, industry, environmental community, regulators, economists, and educators.

Recent Accomplishments

Land management decisions and economic development in southeast Alaska -- USGS research has provided a basis for interpretation of geophysical surveys in Tongass National Forest, southeast Alaska, which were supported by federally appropriated funds to Bureau of Land Management (BLM) and the City of Wrangell. Field and laboratory studies conducted in cooperation with the BLM, USDA-Forest Service, Alaska Division of Geological and Geophysical Surveys, and City of Wrangell improved the basis for mineral assessment of these Federal lands, provided information to the Forest Service for updating their land management plans, and provided a foundation for industry to undertake efficient and competitive mineral exploration in the area. USGS identified a larger area prospective for mineralization than previously known, as rock units that host numerous mines and mineral deposits in the southeastern Alaska, including the Greens Creek mine and the Windy Craggy prospect, are exposed over a broader area than previously thought. Results of this project include digital versions of the updated geologic map and resource assessment of the project area; new geophysical, geochemical, structural, and isotopic data compilations; and interpretive reports released on CD-ROM and via the World Wide Web. Results were presented to the annual meeting of the Alaska Miners Association.

Understanding basin formation in the arid southwest -- USGS scientists are integrating new and existing geologic, geophysical and geochemical data and imagery to provide three-dimensional visualizations of the upper Santa Cruz River, Tucson, and San Pedro River basins, southeastern Arizona. The result of this is an integrated model of basin formation in the arid southwest which provides information for land and water utilization strategies in these basins

and can be used as a starting point for detailed study of other basins. Analysis of the geologic and geophysical logs of two deep wells, one in the San Pedro and one in the Tucson basin, has provided a record of the basin-filling events which can be directly related to the detachment-tectonic events forming the basins. Using gravity and aeromagnetic data, the shape and probable composition of subbasins have been defined and a map of estimated thickness of the best aquifer in the basins produced. Analyses of data from airborne electromagnetic surveys are being used to model porosity and permeability in three dimensions, permitting construction of water quality and quantity models of unprecedented resolution. Further studies of the electromagnetic data have shown extensions of known mineral districts beneath the edges of the basins; providing information valuable both for predicting water quality and for mineral resource exploration. As rapid urban development continues in the arid southwest, understanding how the landscape formed and where good quality waters is likely to be available will be increasingly important for effective planning.

U.S. aggregates and clay operations map -- USGS scientists have prepared a map showing accurate locations of most active commercial sand and gravel, crushed stone, and clay operations in the United States—about 8,600 locations. USGS coordinated the participation of the State geological surveys to verify the data and ensure the highest quality of information possible. The final USGS aggregates and common clay databases, including recent updates, are being incorporated in the National Atlas of the United States. The preliminary map, *Natural Aggregate Operations, Commercial Producers*, has been displayed several national aggregates industry trade shows. The popularity and value of the aggregates information is reflected in the fact that the four-page USGS fact sheet on aggregates was updated and reprinted at the request of the Federal Government, State governments, and industry. These reprints were completed in cooperation with the Missouri Limestone Producers Association and fourteen other State Trade Associations.

Environmental consequences of mining in Fortymile River, Alaska -- A systematic water-quality study of the Fortymile River and many of its major tributaries in eastern Alaska was recently completed. This effort, in cooperation with the Alaska Department of Natural Resources and the U.S. EPA, sought to establish regional baseline geochemistry values for water, soil, and vegetation and to evaluate the possible environmental effects of suction dredge placer gold mining and of bulldozer-operated placer gold mining (commonly referred to as “cat mining”). In general, the water quality of the Fortymile River is very good, with low total dissolved solids and only two cases in which the concentration of any element exceeded primary or secondary drinking-water quality standards. In both cases, iron exceeded secondary drinking-water limits. At the time this work was conducted, only a handful of suction dredges were operating on the lower Fortymile River, and cat mining was being conducted along Uhler Creek and Canyon Creek, two major tributaries to the river. Based on the water-quality and turbidity data, the suction dredges have no apparent impact on the Fortymile River system, although effects on biota were not evaluated in this study. In contrast, the cat-mining operations in Canyon Creek appear to have a dramatic impact on water quality and streambed morphology, based on the field water-quality and turbidity measurements, on comparisons to adjacent unmined drainages, and on field observations of streambed morphology. The cat mining in Uhler Creek appears to have had less impact, perhaps because the main stream channel was not as heavily disrupted by the bulldozers, and the stability of the channel was mostly preserved.

Price Book -- In response to requests by the Bureau of the Census, the Bureau of Economic Analysis, and other Government agencies, as well as academia and others, USGS mineral commodity specialists have authored and published a special report, *Metal Prices in the United*

States through 1998. This publication tracks long-term price trends for over 60 metals in current and constant dollars (deflated in relation to the Consumer Price Index) and discusses significant events that influenced price changes. This information is used by Government agencies and others to analyze the contribution of the metals sector to the U.S. economy. The publication, available in printed and electronic form, updates a publication released by the U.S. Bureau of Mines in 1991.

USGS responds to mineral information needs in Alaska -- In response to a request from Congress, the USGS organized a diverse group of stake holders including other Federal Agencies, the Alaska Division of Geologic and Geophysical Surveys (ADGGS), the University of Alaska, Native Corporations, and the geologic community as a whole to improve the quality and accessibility of minerals information in Alaska. The results of this effort, started in FY 1998, are: digital cataloging of the 18,000-volume USGS Alaska library, historic holdings of the USGS Alaska Technical Data Unit, and BLM's Juneau Minerals Information Center; updating and posting mineral occurrence records for 50 1:250,000-scale quadrangles; correcting errors in records for 30,000 geochemical samples and posting the data on the Internet; completion of an 11,000 record geospatially referenced bibliography of maps and papers on Alaska; and providing support for publication of a Guide to Alaska Geologic and Mineral Information as ADGGS Information Circular 44. The guidebook contains information about the collections of seven libraries and archives in Alaska, as well as information about many other minerals-related subjects, and was featured at the Alaska Miners Association Convention and at an open meeting of the Alaska Land Manager's Forum. All of this information is available on the Internet at: <http://imcg.wr.usgs.gov>.

National Geochemical Database -- The USGS National Geochemical Database is a digital repository of about 70 million analytical determinations made on approximately two million samples of geologic material such as rocks, stream sediments, and soils. These data provide a varying degree of geochemical information for approximately two-thirds of the land area of the US. During FY 1999 and FY 2000 USGS scientists and data managers have made major improvements in the reliability and accessibility of this critical database. Original paper records have been scanned and organized into an historical archive, safeguarding against loss due to fire, theft, or other disasters. By mid FY 2000 all samples from Alaska that were analyzed in USGS labs (about 160,000 samples) will have been reviewed, corrected, and made available in the World Wide Web. An additional 92,000 samples from the Montana and Idaho have also been reviewed and updated. Samples collected by the National Uranium Resource Evaluation program in the late 1970s and early 1908s have been made available on the World Wide Web for all of 17 states and parts of four others.

Zinc-lead-silver potential in Alaska -- USGS scientists have produced a wealth of new data crucial for understanding the processes responsible for syngenetic massive sulfide deposits formation in three important metallogenic belts in Alaska: the northern Alaskan belt, including Red Dog, the world's largest zinc deposit, which accounts for almost half of the total annual value of Alaska's \$1 billion minerals industry; the southeastern Alaskan belt, including the Greens Creek deposit, the largest US producer of silver in 1997 and 1998; and east-central Alaska and western Canada, where new discoveries in Canada bring to light new potential in Alaska. Multidisciplinary studies in these three areas demonstrate that the deposits, while similar in gross characteristics, likely formed through substantially different combinations of geologic events. Delineating the critical events leading to zinc-lead-silver ore formation in these basins in Alaska should lead to better assessments of resource potential in Alaska, elsewhere in the US, and ultimately on a global scale, improving our understanding of the global resource base for zinc, lead, and silver.

New discoveries from the floor of Yellowstone Lake -- Recently completed high-resolution sonar imaging, seismic reflection, and magnetic surveys of the northern part of Yellowstone Lake show a bottom covered with dozens of circular depressions and hundreds of spires and pinnacles protruding from the floor. The circular depressions are 25-800 meters in diameter, have steep inner walls, and may be the remnants of explosive events similar to explosion craters exposed on land nearby. The spires are composed primarily of silica, are up to 35 meters high and 50 meters in diameter. These linear features may sit astride fissures on the lake floor. Formation of both spires and circular depressions is related to deep-seated fluid circulation in the Earth's crust and has occurred over the past 12,000 years. The spires in Yellowstone Lake are formed by venting processes similar to those that form black smoker chimneys on the ocean floor. Other features recognized in the survey conducted jointly by USGS, Eastern Oceanics, and the University of Wisconsin at Milwaukee include vents through which deep circulating fluids exhaust onto the lake bottom, recent faults, and submerged former shorelines. Further analysis of the data and additional investigations using a submersible, remotely operated vehicle may define the relationships between fluid circulating features and fish and other lake-dwelling fauna. Objectives of this work include understanding the geologic processes that shape the lake and how they affect present-day lake populations, as well as examining a modern analog for the deep-fluid circulation systems responsible for many important types of mineral deposits.

USGS scientists make major contributions to a new textbook on the environmental effects of mining -- Cleaning up the environmental impacts of past mining operations, as well as predicting and mitigating the potential environmental impacts of future mining operations, are high priorities of societies worldwide. Over 20 USGS scientists have played major roles (as lead editor and chapter authors) in the development of a new two-volume textbook, recently published by the Society of Economic Geologists, that will help improve mining-environmental prediction, mitigation, and remediation. The textbook, *The Environmental Geochemistry of Mineral Deposits*, uses a unique mixture of overview papers and case studies to provide a process-oriented, interdisciplinary understanding of the environmental and health effects of mineral resource development, as well as of the scientific methods used to assess these effects. The text is geared toward geologists, mining engineers, environmental regulators, environmental scientists, land managers, students, and others who need to understand the scientific processes behind mining-environmental issues.

Arsenic in the Southern Appalachian Basin -- The highest reported arsenic and fluorine concentrations for all US coals, as well as elevated levels of mercury, copper, molybdenum, thallium, and antimony and gold, are found in coals from the Warrior Basin, Cahaba and Coosa basins, northern Alabama. Arsenic ranges up to 2300 parts per million (ppm whole coal). On average, arsenic in Alabama coals is three times higher than other U.S. Coals. These conclusions are based on nearly 1000 coal analyses contained in the USGS National Coal Resources Database, and on additional new data now being obtained by USGS scientists. These ongoing studies have revealed that the arsenic, copper, molybdenum and thallium and gold are contained in the mineral pyrite. Arsenic is also enriched in other portions of northern Alabama. Arsenic, antimony, and copper are common in small gold deposits in metamorphic rocks located east and southeast of the Warrior coal basin. The arsenic and associated elements were likely introduced into the coal by the same fluids that formed the gold deposits further east. The presence in northern Alabama of elevated arsenic concentrations in multiple geologic settings raises the possibility of widespread dispersion of arsenic into the environment. Stream sediments from the coal mining area are elevated in arsenic compared to adjacent areas and arsenic concentrations as high as 200 ppm have been measured in streams

receiving coal acid mine drainage. Stream sediments near arsenic-enriched gold mines have elevated arsenic concentrations compared to non-mineralized areas. Follow-up studies are planned to establish the extent and environmental impact of this seemingly widespread arsenic enrichment.

Geologic Resource Assessments Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Mineral Resources	53,893	+1,193	-2,000	53,086	-807
Energy Resources	22,783	+524	⁽¹⁾ -2,009	21,298	-1,485
Total Requirements \$000	76,676	+1,717	-4,009	74,384	-2,292

¹ See Program Change section for details on C/FIP (+\$500) and program decreases (-\$2,509)

Energy Resources

Current Program Highlights

Our Nation faces the simultaneous challenges of an expanding energy appetite, an increasing dependence on imported oil, and an increasing demand for energy that produces minimal environmental effects. The USGS Energy Resources Program (ERP) addresses these challenges by conducting basic and applied research on geologic energy resources and on the environmental and economic impacts of their extraction and use. The program provides reliable, impartial, scientific information and comprehensive analyses of oil, natural gas, and coal resources of the Nation and the World. Major consumers of our products are the land and resource management bureaus of the Department of the Interior, federal environmental and national security agencies, State geological surveys, the energy industry, and the environmental community.

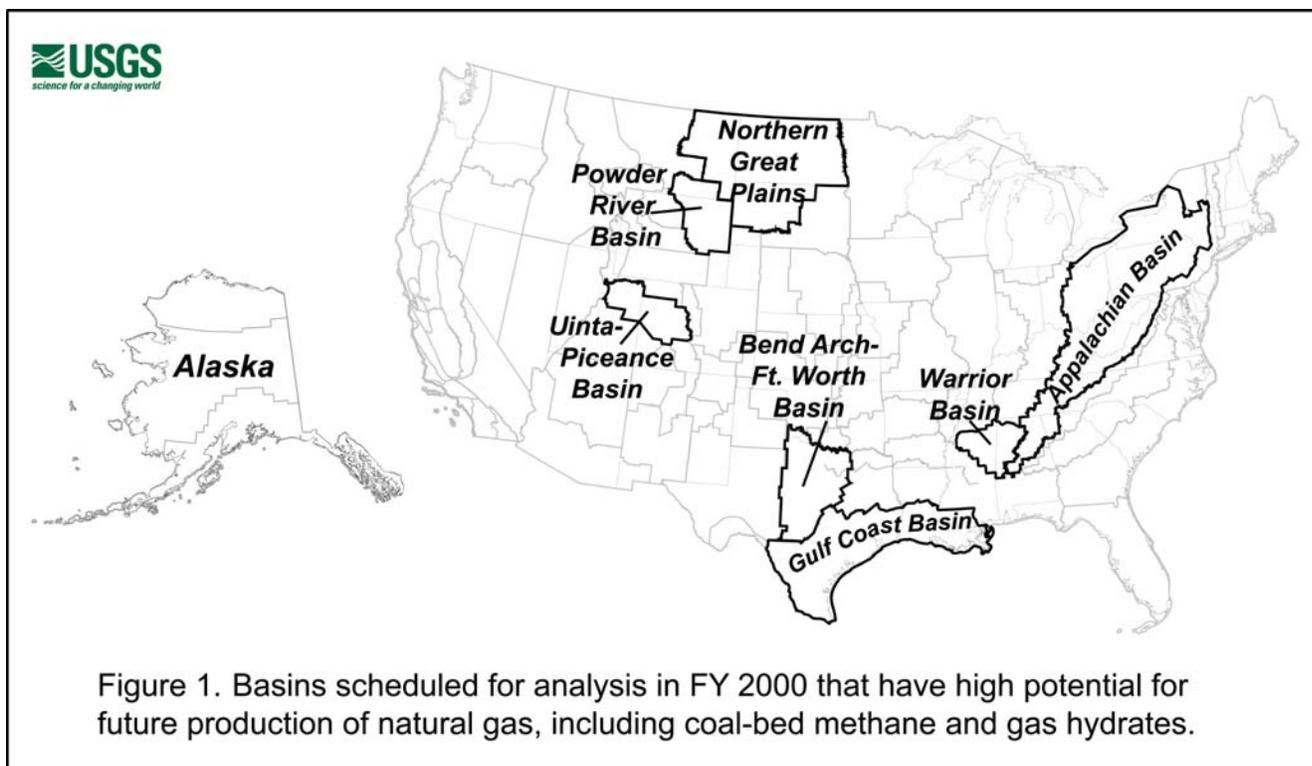
Future Energy Resource Availability -- The Energy Information Administration (EIA) Annual Energy Outlook 2000 forecasts that worldwide energy consumption will increase 27% between 1998 and 2020 due to growth of the world economy. In the United States, forecasts indicate that natural gas consumption will increase 40%, coal consumption will increase 20%, and petroleum demand will grow 29%, in part, due to a predicted 60% decline in nuclear electricity generation capacity.

The Energy Resources Program conducts periodic assessments of all major energy resources. The National Coal Resource Assessment (to be released in FY2000) will report on the quantity, the availability, and the recoverability of coal that will provide the bulk of the Nation's supply for the next two or three decades. The National Oil and Gas Assessment (to be released in FY2004) will focus on those regions of the Nation that have the greatest potential for undiscovered gas resources vital to meet the increasing demand for natural gas as a substitute for oil and coal. The World Energy Assessment (to be released in FY2000) will assess the 76 most productive oil and gas provinces of the world that contain about 95% of the world's oil and gas resources. A challenge in oil and gas assessment activities is a better understanding of the geologic, technologic, and societal controls on reserve growth, the primary source of future oil supplies in this country.

National Oil and Gas Resources -- The 1995 USGS National Oil and Gas Assessment concluded that the probability is low that many more significant oil reservoirs will be discovered

in the onshore areas and state waters of the United States. Instead, our remaining energy supply will come from natural gas deposits, from existing oil and gas fields, and from imports. Additionally, the 1990 Clean Air Act Amendments, and concern about greenhouse gas emissions to the atmosphere, have introduced a sense of urgency to identify the Nation's remaining deposits of natural gas, the cleanest burning fossil fuel. Consequently, the USGS has initiated a new national assessment that focuses on the Nation's natural gas endowment and the potential of additional reserves of oil and gas from existing fields in the United States, exclusive of Federal waters.

Research starting in FY00 and continuing to FY04 will focus on regions of the Nation that have high potential for future production of natural gas, including coal-bed methane and gas hydrates, and on the scientific challenge of improving the accuracy of natural gas resource assessments. This effort begins in the Uinta-Piceance region of Colorado and Utah; the Northern Great Plains region encompassing parts of Montana, North Dakota, and South Dakota; the Powder River Basin of Wyoming and Montana; the Bend-Arch/Fort Worth Basin of Texas; the Black Warrior Basin of Alabama; the Appalachian region, primarily in Ohio and Pennsylvania; the onshore Gulf Coast region, specifically in Texas and Louisiana; and Central Alaska (figure 1). Additional basins will be included based on regional priorities identified during the assessment. The North Slope of Alaska and the Gulf Coast region hold the most promise for new oil and gas discoveries in this country.



Alaska -- The North Slope of Alaska is thought to have the greatest remaining oil potential of any onshore area in the United States; the USGS is conducting an intensive examination of its geology and petroleum potential. The current research focus is the National Petroleum Reserve – Alaska (NPRA) on the western portion of the North Slope (figure 2). Activities in Alaska include petroleum geologic framework of the NPRA; evaluation of the resource potential of gas hydrates in northern Alaska; evaluation of coal-bed methane as a local energy source for

the native villages of Chignik, Fort Yukon, and Wainwright; and Cook Inlet petroleum reservoir and coal studies. These studies are collaborative efforts with the Alaska Division of Geologic and Geophysical Surveys.

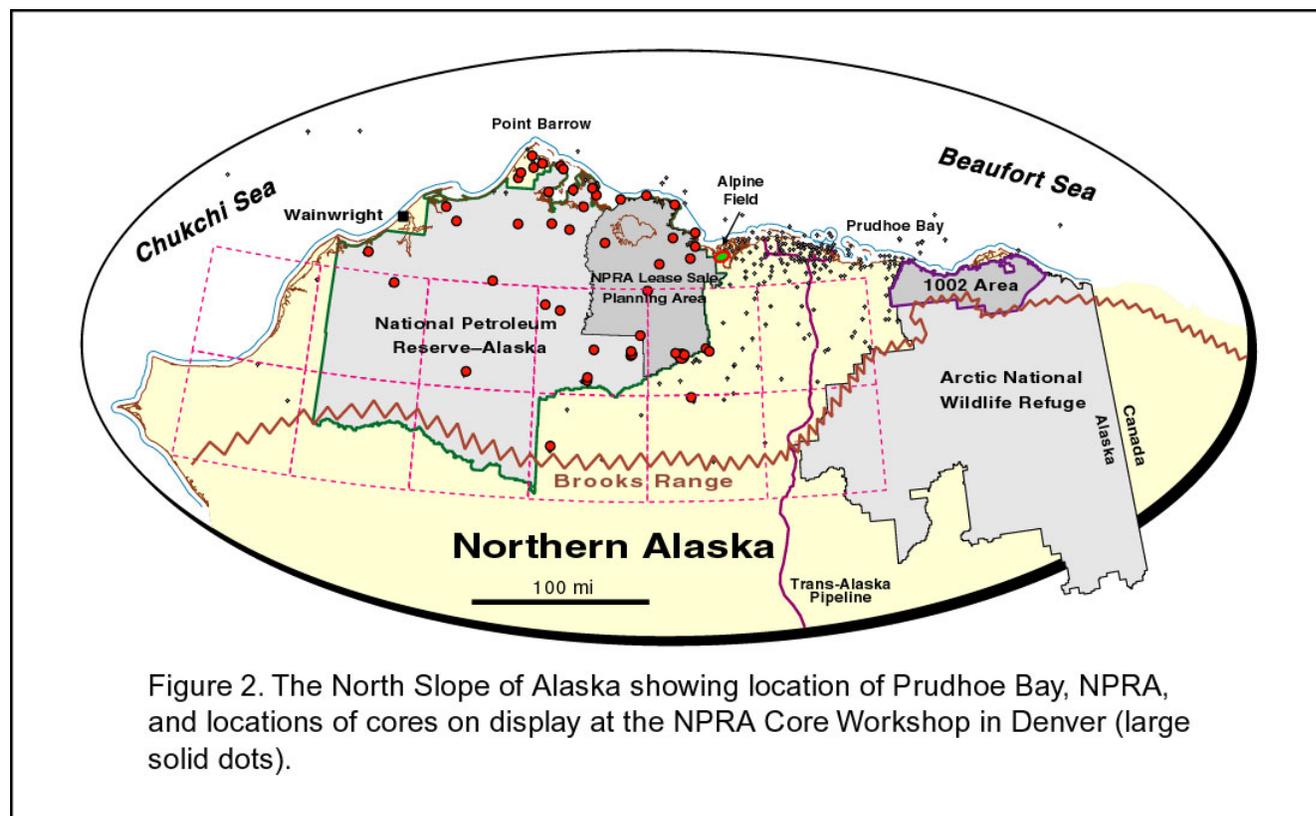


Figure 2. The North Slope of Alaska showing location of Prudhoe Bay, NPRA, and locations of cores on display at the NPRA Core Workshop in Denver (large solid dots).

The Energy Resources Program is preserving and archiving Alaskan oil and gas datasets compiled during two government oil and gas exploration programs in the NPRA; one by the U.S. Navy in the 1940s and 1950s and the other by the Navy and the USGS in the 1970s and 1980s. More than 14,000 miles of seismic and related geophysical data, logs and other records from 126 drill holes, and special studies of geochemistry, paleontology, and reservoir rocks are being transferred to more durable and accessible digital formats from aging tape media. The USGS is working cooperatively with the Bureau of Land Management, USDA Forest Service, and Alaska Division of Geological and Geophysical Surveys in this effort.

Gulf Coast Region -- In the Gulf Coast region, the USGS is developing a geologic framework of the oil- and gas-bearing rocks of Texas and Louisiana using seismic data. This framework will allow USGS scientists to better assess the potential for undiscovered resources and to define potential assessment plays that are onshore extensions of plays identified by the Minerals Management Service for offshore Federal resources. The USGS is examining the petroleum potential of the Austin Chalk trend, our Nation's largest onshore domestic unconventional oil resource; the deep gas reservoirs of the Tuscaloosa Formation, one of the major gas producing formations in the Gulf Coast Region; and the coal-bed methane producing potential of the extensive lignites of Texas, Louisiana, Mississippi, and Alabama (figure 3).

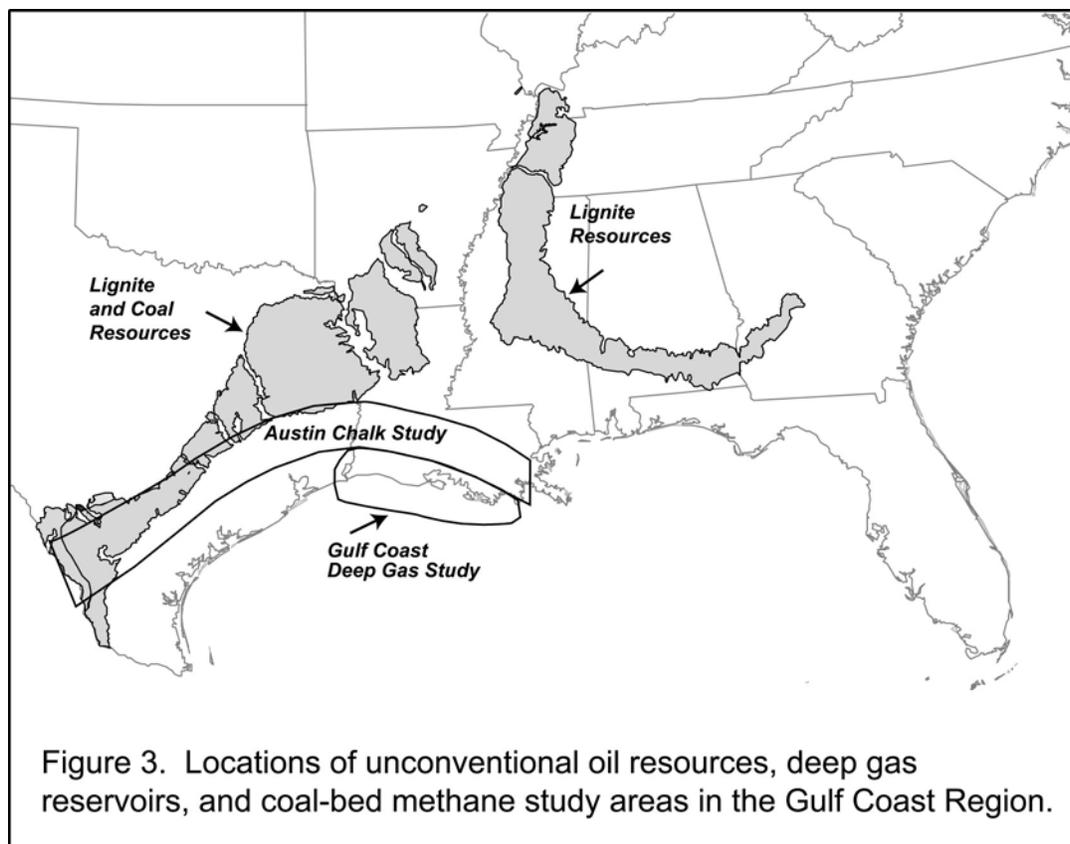


Figure 3. Locations of unconventional oil resources, deep gas reservoirs, and coal-bed methane study areas in the Gulf Coast Region.

National Coal Resources -- The USGS is assessing coal resources for use in the first quarter of the 21st century. This intensive, multi-year assessment of the quantity, quality, availability, and recoverability of coal involves the generation of digital databases and use of geographic information system (GIS) technology to facilitate quantitative estimation of coal resources. The results will be used by Federal and State land managers to support land-use decision-making, by environmental regulators to evaluate compliance with regulations stemming from the 1990 Amendments to the Clean Air Act, and by economists to forecast economic trends at regional and national scales. Electric utilities, coal producers, and coal consumers also will use these results and products for evaluating the availability and quality of coal feedstock to electricity generating power plants and to achieve compliance with emission standards and other environmental regulations. The comprehensive summary of coal resources is scheduled for release in FY 2000, although reports on individual regions are being released as they are completed.

This study will form the basis for addressing the challenge of future changes in the energy mix as the Nation responds to increasing demands for cleaner burning coal. Upon completion of the national assessment, the USGS will focus on integrating this new digital resource information with national and global digital inventories of coal quality. The resulting integrated database will allow the USGS to provide critical information to land and resource managers who will manage the Nation's ever increasing need for energy while protecting the environment and human health.

World Oil and Gas Resources -- Worldwide petroleum demand is predicted to increase 27% over the next 20 years, with 70% of that increase due to transportation demands. In the United

States, despite advances in oil exploration and production technology, oil production is predicted to decline about 0.8% per year over the next 20 years. Falling production and rising demand will necessitate an increase in petroleum imports. Currently, net imports account for more than 50% of the U.S. petroleum consumption and are predicted to increase to 64% in 20 years. Consequently, it is in the Nation's interest to know the distribution and quantity of the remaining oil, natural gas and natural gas liquids remaining in the petroleum provinces of the world.

The USGS is assessing undiscovered oil and gas in the most productive petroleum provinces of the world. This current assessment will be the first of its kind to include a rigorous geologic foundation for remaining resource volumes, and the first to make those data available to the entire geoscience, business, and research community. Assisting us in this effort are the U.S. Departments of Energy, Defense, and State; U.S. Agency for International Development; Energy Information Administration; International Energy Agency; the intelligence community; and over two dozen industry partners.

To-date, seven CD-ROM's have been released that describe and rank selected petroleum provinces and contain digital geologic maps for those provinces. More than 25,000 copies have been distributed in response to requests received at professional meetings, by mail, and via the WEB. The complete assessment will be released at the World Petroleum Congress in June 2000 in Calgary, Alberta. The next phase of the World Assessment will focus on global unconventional gas resources in anticipation of advances in gas-to-liquids technology and the future availability of those liquids for export.

Energy Resources and the Environment -- Carbon emissions (primarily as carbon dioxide) from energy use are projected to increase 20% by 2020. Eighty-two percent of carbon emissions associated with the use of petroleum products result from the transportation sector. Electricity generation will account for 38% of all carbon emissions. Coal is the predominant fuel source for electricity generation and is the second leading fuel source of carbon emissions, due to its high carbon content. Use of natural gas, with just half the carbon content of coal, should outpace all of the fossil fuels.

Additional environmental challenges addressed by the Energy Resources Program are the disposal of hazardous oilfield waters that are co-produced with oil and gas, coastal subsidence due to reservoir depletion, and the introduction of sulfuric acid into surface and groundwater from leaching of sulfur-bearing minerals in the overburden produced in coal mining.

Coal Quality and Human Health -- Currently, over half of the Nation's electricity is generated by burning coal and the demand for electricity will continue to increase. Coal combustion produces a wide range of potentially hazardous substances that impact the environment. The Energy Resources Program supports research to understand the natural variability of coal quality and the environmental and human health impacts of mining and utilization of coal as an energy source. This research provides objective scientific information to guide private industry and federal and state policy-makers.

The USGS National Coal Quality Inventory (NaCQI), a database of the chemistry of coals used in power plants, has recently been established and will expand through collaboration with State geological surveys and the Electric Power Research Institute. The database will continue to grow by adding new data about the coal that we anticipate will be mined in each region of the United States during the coming decade. These digital data will enable Federal and State regulatory agencies, electric power utilities, and the coal industry to quickly access and display

detailed coal quality information to address air quality issues and to maintain compliance with the 1990 Amendments to the Clean Air Act. NaCQI also will be a valuable scientific tool for evaluating the feasibility of achieving CO₂ and other greenhouse gases emission targets.

Through its coal quality research effort, the Energy Resources Program provides EPA and DOE with reliable estimates of amount and behavior of hazardous elements, such as mercury and arsenic, in the coal mined in this country. Additionally, the USGS is compiling a database of coal quality from around the world, the World Coal Quality Inventory (WoCQI), to provide information for policy makers to evaluate the environmental impacts of global coal use.

CO₂ Sequestration -- The USGS is assessing the capability of depleted oil and gas reservoirs and unmineable coal beds to accept and sequester carbon dioxide produced by power plants. This research effort will provide forecasts of the amount of carbon dioxide, other greenhouse gases, and hazardous chemical atmospheric emissions based on current and projected energy consumption of the Nation and the World. Additionally, the research will include evaluations of energy supply reliability and economic impacts of various mitigation scenarios for reducing carbon dioxide and other greenhouse gas emissions. Assessment results will provide policy makers with a basis for evaluating technologies that reduce carbon dioxide emissions to the atmosphere.

This effort will provide fundamentally new information on the capacity of geologic reservoirs to serve as long-term repositories for carbon dioxide. If the methodology for quantitative assessment of total repository capacity is successful, it will be applied on a worldwide scale, allowing international assessment of carbon sequestration capacity.

Disseminating Energy Resource Information

Geo-Data Explorer – GEODE -- The wise stewardship of federally managed lands requires detailed knowledge of domestic energy-resource availability, quality, and distribution. The ability to integrate that resource knowledge with other environmental or land-use information is becoming increasingly important. Because Federally managed lands contain a large proportion of the remaining energy resources of the U.S., it is important that land-use decisions concerning energy-resource development be made within the context of the energy-resource endowment and energy-mix goals of the Nation.

Consequently, the Energy Resources Program has developed an energy resource decision support system, called Geo-Data Explorer, or GEODE. This unique software is a GIS-based, WEB-accessed, interactive data delivery system of energy, cultural, and environmental information that is specifically designed to assist land and resource managers and to facilitate integrated energy research within the USGS. The system can be accessed at <http://geode.usgs.gov/>. In addition, energy databases are maintained and available from the USGS at: <http://energy.usgs.gov>.

Recent Accomplishments

The USGS, through its Energy Resources Program, conducts energy resource assessments of coal, oil, and natural gas throughout the Nation and the world. Major products are expected in FY2000 from the National Coal Resource Assessment and the World Energy Resource Assessment projects. The USGS assisted the Department of Interior in its recent lease sale in

Alaska, progress has been made in understanding the natural variability of coal used in power plants and in the resource potential of permafrost gas hydrates, and we have made significant advances in our ability to deliver our digital data over the internet.

National Oil and Gas Assessment

National Petroleum Reserve-Alaska – The USGS is focusing on the National Petroleum Reserve-Alaska (NPRA) to conduct an assessment similar to the oil and gas assessment of the 1002 area of the Arctic National Wildlife Refuge. In May of 1999, the Department of the Interior conducted a lease sale in the NPRA, which was the first Federal petroleum lease sale on the North Slope of Alaska since 1984. In support of that lease sale, the USGS held a Core Workshop in March 1999 to allow various stakeholders and representatives of industry to examine rock samples from the NPRA at the USGS Core Research Center in Denver, Colorado (see figure 2). The workshop attracted scientists from industry and state and federal agencies, and was co-sponsored by the Petroleum Technology Transfer Council (PTTC). A CD-ROM (Open-File Report 99-015) was produced as a result of the workshop and provides geologic data and core photographs from 11 NPRA wells. Additionally, USGS scientists working in the eastern NPRA in FY1999 discovered a surface outcrop of an oil-stained formation, which has been interpreted as an exhumed oil accumulation that may have originally held more than one billion barrels of oil. This discovery will assist scientists in estimating the volume of undiscovered oil and gas yet to be found on the North Slope.

Gas hydrates-North Slope -- There is significant potential that large volumes of methane gas are stored within the permafrost of the North Slope in ice-like structures known as gas hydrates. Gas hydrates may prove to be a major source of clean-burning methane for the Nation. However, there has been little success in producing this resource due to technological challenges. The USGS is working to assess the recoverability, resource potential, environmental effects, and production characteristics of permafrost-associated natural gas hydrates with support from the U.S. Department of Energy (DOE) and industry operators in Alaska.

In 1998, researchers from Japan, Canada, and the USGS undertook the first extensive investigation of a natural gas hydrate accumulation in an Arctic Basin by drilling the Mallik 2L-38 gas hydrate research well in the Mackenzie Delta of Canada. The results of that study have recently been released in the Geological Survey of Canada Bulletin 544. This international report provides a multi-disciplinary overview of the nature and occurrence of gas hydrate in the Mallik well. The results of this research effort in Canada have provided the critical foundation for the next phase of USGS research into gas hydrates in permafrost near Prudhoe Bay on the North Slope of Alaska (see figure 2). USGS scientists are collaborating with scientists from DOE and private industry.

National Coal Resource Assessment -- The National Coal Resource Assessment of the top five coal-producing regions of the Nation will be released in FY 2000. These regions include the Appalachians, the Gulf Coast, the Illinois Basin, the Northern Rocky Mountains and Great Plains, and the Colorado Plateau. The assessment of coal resources of the Northern Rocky Mountains and Great Plains Region is now available on CD-ROM as USGS Professional Paper 1625-A and Open-File Report 99-376. Coal resource assessments of the other four regions will be released during FY2000. This five-year study is the first to use digital techniques for estimating the coal resources that this nation will need for power generation over the next 30 years; the assessment includes information about coal quantity, quality, availability, and recoverability. The National Coal Resource Assessment will form the essential framework for

the first USGS National Coal Quality Assessment, to be initiated in FY 2002, which will provide the Nation with crucial information on the availability and recoverability of Phase II compliant coals, in accordance with the 1990 Clean Air Act Amendments.

World Oil and Gas Assessment -- The USGS World Energy Assessment Project released five interim CD-ROM publications in 1999 that contain geologic maps and petroleum provinces for five oil and gas regions of the world: the Arabian Peninsula, South Asia, the Former Soviet Union, the Asia Pacific Region, and a proprietary study for the intelligence community. Two CD-ROMs were released in 1998, a ranking of the petroleum provinces of the world and the petroleum provinces of Sub-Saharan Africa. Each of these products has been well received by domestic and international stakeholders with more than 25,000 copies requested and distributed thus far. USGS scientists have developed a sophisticated probabilistic assessment method that has been endorsed by the American Association of Petroleum Geologists. This USGS effort has been profiled in a nationally distributed video prepared by the American Geological Institute and the USGS, and project scientists have made presentations in numerous public forums concerned with the potential of an impending global oil crisis. The preliminary results of this study are being used by Department of State, Department of Defense, and the intelligence community as fundamental input for analysis and development of foreign policy and domestic energy policy. Additionally, a cooperative agreement is being established between the USGS and the International Energy Agency, Paris, to conduct collaborative research with scientists working on this World Assessment.

Hazardous Elements in Coal -- The focus of USGS coal quality research is in coal-producing regions that have reported potentially toxic concentrations of hazardous elements in coal. Recent analyses of coal samples collected from active and abandoned mines in the Warrior Basin, Alabama, indicate elevated concentrations of as much as 4800 ppm of arsenic, 20 ppm of mercury, and 100 ppm of thallium. These findings will be used in an engineering model to predict toxic element emissions from coal-fired power plants. If this model gains wide acceptance, it will have important ramifications for the electric power industry in the next century.

The EPA continues to use the NaCQI coal quality database for guidance to establish realistic compliance standards mandated by the 1990 Clean Air Act Amendments. In particular, EPA has used USGS data on mercury in coal to estimate the total load of mercury contributed per year by the combustion of coal in the U.S. and to review a recent Information Collection Request (ICR) for mercury and chlorine in U.S. coals.

Energy Decision Support: Geo-Data Explorer -- In FY99, the Energy Resources Program introduced its energy resource data delivery system, Geo-Data Explorer (GEODE), to the public via the Internet at <http://geode.usgs.gov/>. This web site is designed to provide both non-technical and scientific users quick access to the scientifically sound, unbiased energy resource data produced by the USGS, by providing them with real GIS tools over the Internet, an unprecedented capability that previously had been unavailable. Users can access complex energy datasets in a map format, make queries of data details, and superimpose energy and environmental data layers to create their own unique maps, for their specific needs, using just their web browsers. This new tool will enable Federal and State land managers to conduct sophisticated analyses at their desktops without requiring complex software or GIS expertise.

NRC Review of the USGS Energy Resources Program -- The National Research Council (NRC) of the National Academy of Sciences reviewed the Energy Resources Program in 1999. In their report, *Meeting U.S. Energy Resource Needs, The Energy Resources Program of the*

Geologic Resource Assessments Subactivity

U.S. Geological Survey, the NRC acknowledges the unique and critical role that the Energy Resources Program plays in providing up-to-date and impartial assessments of geologically based energy resources of the Nation and the World. The NRC panel encourages the USGS, through its Energy Resources Program to continue supporting a strong research and knowledge base to understand the origin and recoverability of fossil energy resources and to assess the future availability and environmental consequences of developing energy resources.

Water Resources Assessments and Research Subactivity

Program	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Ground-Water Resources	2,800	+87	0	2,887	+87
National Water-Quality Assessment	61,883	+1,263	0	63,146	+1,263
Toxic Substances Hydrology	13,306	+331	-1,240	12,397	-909
Hydrologic Research & Development	13,048	+331	-1,454	11,925	-1,123
Total Requirements \$000	91,037	+2,012	-2,694	90,355	-682

Ground-Water Resources Program

Current Program Highlights

Ground water is one of the Nation's most important natural resources. Aquifers supply drinking water to about 130 million U.S. residents (about 50 percent of the population), and ground water is used in all 50 States. Much of the water used for irrigation by the Nation's important agricultural sector is provided by ground water. Ground water also plays a crucial role in sustaining streamflow and helping to maintain healthy lakes and wetlands, especially during low-flow periods. The Ground-Water Resources Program addresses ground water at risk from development by evaluating the availability and sustainability of ground water in the Nation's major aquifer systems, especially during drought periods. By conducting regional assessments, the Ground-Water Resources Program complements the USGS Federal-State Cooperative Water Program, which evaluates water resources on a more local scale in response to concerns raised by State and local water managers. The Program comprises three components: Investigations of Critical Regional Aquifer Systems, Regional Assessments of Key Ground-Water Issues, and Development of a National Aquifer Database.

Investigations of Critical Regional Aquifer Systems

Middle Rio Grande Basin, New Mexico -- Studies by the New Mexico Bureau of Mines and Mineral Resources and the USGS in cooperation with the City of Albuquerque have shown that ground water is not as plentiful as once thought. The USGS is working to more accurately estimate the amount and timing of ground-water flow into and through the ground-water system of the entire Middle Rio Grande Basin where population and corresponding demands for water are rapidly increasing. More information on the Middle Rio Grande Basin Study can be found on the USGS Web site at <http://rmmcweb.cr.usgs.gov/public/mrgb/mrgbhome.html/>.

South Florida -- The Everglades flow system and inputs to Florida Bay are as much a matter of ground-water flow as they are of surface water. Analysis of options for restoring the system depends on improved understanding of ground water and its interactions with surface water. The U.S. Army Corps of Engineers, National Park Service, and South Florida Water Management District are using this information to develop restoration plans for the Everglades.

Regional Assessments of Key Ground-Water Issues

Southwestern United States -- Surface water in the southwestern United States is generally fully appropriated, and considerable ground-water development has taken place. New water supplies increasingly rely on conjunctive use of surface water and ground water. The dependence of sensitive ecosystems on ground water creates additional competition for scarce water resources. To address these concerns, the USGS is conducting the second year of a 5-year study of the interaction of ground water and surface water in the alluvial basins of the Southwest.

Atlantic coast -- Development of ground-water resources along the Atlantic coast has caused saltwater to intrude many highly productive aquifers. Development can also affect the discharge of ground water to coastal ecosystems. A project to review what is known about these freshwater-saltwater issues along the Atlantic coast is nearing completion. A USGS Circular on saltwater intrusion and related coastal zone issues is being written. More information on the Atlantic Coastal Zone Assessment can be found on the USGS Web site at <http://water.usgs.gov/ogw/saltwater/>.

National Aquifer Database

One of the long-term goals of this program is to build a database that contains up-to-date information on major features of all of the Nation's regional aquifer systems. Features such as aquifer extent, water-level maps, aquifer thickness, hydraulic properties, and major geochemical characteristics would be available as digital files over the Internet. Preliminary planning is underway for the database.

Recent Accomplishments

Ground Water Atlas of the United States -- The USGS has completed an atlas of the Nation's major aquifers. The atlas comprises a series of printed publications that describe the location and extent of important aquifers in the United States as well as their geologic and hydrologic characteristics. The series consists of 13 chapters that describe the ground-water resources of regions that, collectively, cover the 50 states, Puerto Rico, and the U.S. Virgin Islands. More information on the Ground Water Atlas can be found on the USGS Web site at <http://wwwcapp.er.usgs.gov/publicdocs/gwa/>.

Ground-Water Model Development -- Ground-water models have recently become a more vital component of many ground-water studies; they help scientists and resource managers to better understand the movement of ground water, the transport of contaminants in ground water, and the effects of human activities (such as pumping) on water availability and quality. Improvements in computer codes for models are needed to keep pace with changing needs of hydrologists who evaluate ground-water flow and transport of contaminants in ground water. Several updates for MODFLOW, the most widely used ground-water-flow code in the world, are nearly complete. These updates include more efficient solutions for estimating model parameters, new interfaces to make the models more "user friendly," and new modules for solving specific problems such as ground-water flow near lakes. More information on ground-water model codes can be found on the USGS Web site at http://water.usgs.gov/software/ground_water.html/.

Water Resources Assessments and Research Subactivity

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Total Requirements \$000	91,037	+2,012	-2,694	90,355	-682

National Water-Quality Assessment Program

Current Program Highlights

The USGS National Water-Quality Assessment (NAWQA) Program continues to address long-term goals:

- Describe the status and trends in the quality of a large, representative part of the Nation's surface water and ground water resources;
- Provide an improved understanding of the primary natural factors and human activities affecting these conditions; and
- Provide information that supports development and evaluation of management, regulatory, and monitoring decisions by other Federal, State, and local agencies.

The USGS approaches these goals using four major program elements:

- Study unit investigations of major river basins and aquifer systems -- Study unit investigations follow consistent practices from data collection through interpretation, to facilitate comparability of findings over time and across the Nation.
- National syntheses of key findings related to important water-quality topics from investigations in the study units and from other water-quality investigations -- National synthesis projects compare findings across the country and identify relationships between land use, geology, soils, climate, and water-quality conditions. The current national synthesis topics are pesticides, nutrients, volatile organic compounds, trace elements, and aquatic ecology.
- Supporting research and methods development -- To ensure NAWQA data collection and analyses are relevant to emerging issues, about 10 percent of program resources are devoted to developing new methods of sample collection and analysis, and to continuously improving assessment techniques.

- Coordination with others at local, State, regional, and national levels with environmental and natural resources managers and other users of water-quality information -- Nationally, over the past year NAWQA coordination has increased significantly with both the USEPA and the National Park Service. NAWQA has provided direct service to the USEPA Office of Pesticide Programs, assisting in the timely and relevant application of NAWQA data to that Office's decision-making process. This association has made millions of dollars of field pesticide data available in a useful form for USEPA decision-making.

NAWQA has been designed as an efficient program, taking advantage of other USGS programs and the existing USGS infrastructure. Despite these efficiencies, over the past 9 years, inflation has had an impact on the Program. Instead of operating all 59 of the planned study units by 1998, the USGS had only begun work in 49. In 1998, the USGS began a study that focuses on the High Plains aquifer--an area of the country encompassing 7 study units where work had been postponed. Also, in 1999 data collection began for the second time in two of the original NAWQA pilot study units (Delmarva Peninsula and the Yakima River Basin). Although adding these two new study units was important, even with their addition, program activities still do not meet the planned operational level of about 20 study units per cycle. Also, decreased activity in other programs supporting NAWQA, resulting from uncontrollable costs and budget decreases, have required the NAWQA Program to redirect resources to ensure that crucial supporting activities are maintained. As a result, NAWQA must continually adjust program resources, and beginning in FY 2000, the number of study units the program continues to operate must be evaluated annually.

The NAWQA Program is nearing the completion of Cycle I studies that began in 1991 and focused on the occurrence and distribution of contaminants. Cycle II studies will begin in 2001 and will focus on explaining the environmental conditions that influenced the distribution of contaminants.

As the NAWQA Program moves into Cycle II, studies will be underway in 42 study units (see Figure W-1). A science panel spent several months selecting the Cycle II study units. Drinking water use, diverse hydrologic settings, contaminant source areas, important aquifers, and biological diversity were considered in selecting the Cycle II study units. Those study units will compare previous findings with new findings to further enhance the understanding of water quality conditions in those areas and the factors affecting those conditions. The Cycle II study units are distributed throughout the Nation and will provide substantive information for all regions to assess the quality of water resources. That assessment will significantly supplement the knowledge base of local, State, and regional water providers and users. Additionally, the USGS will provide industrial and agricultural users with a database to address their interests in water quality.

Program Coordination

At the study unit level and nationally, NAWQA Program personnel continue to meet with environmental and resource managers, and other water information users at all levels of government. Through liaison committees at the national and study unit level, nearly 1,500 individuals represent their agencies or constituents in discussions on the program's progress, data, and products. These interactions have provided public and private sector groups with protocols for designing sampling and monitoring programs, with guidance in use of data for decision-making, and with opportunities for cost-sharing in water-quality investigations.

The USGS has established a NAWQA Home Page on the World Wide Web (http://www.rvares.er.usgs.gov/nawqa/nawqa_home.html) to provide rapid access to NAWQA data, reports, and methods documents. Also available is an

Water Resources Assessments & Research Subactivity

up-to-date listing of current developments that allows interested parties to get new information in a timely fashion.

To share program knowledge, NAWQA managers have developed an aggressive program of coordination with Federal agencies such as the USEPA, State and local agencies, and the private sector. For example, NAWQA staff have been assigned office space in selected USEPA offices to ensure that technical information and resources are shared, so that duplication can be avoided and Federal dollars can be saved. Numerous liaison meetings are held each year by each active NAWQA study unit, informing interested parties from the public and private sectors of program findings and plans. Input from these same groups is sought and incorporated in program activities. For example, these groups influence the selection of sampling sites and the selection of chemicals analyzed, and assist USGS in gaining access to sampling locations.

To ensure relevance and objectivity, the NAWQA Program will support an outside review by the National Academy of Science (NAS) that will be completed in 2001. The NAS committee will consider selected topics for an in-depth review and will provide findings and recommendations. The NAS review will be used to plan, direct, and reinforce program activities. The review follows an in-depth internal USGS review of the NAWQA Program that provided the template for Cycle II.

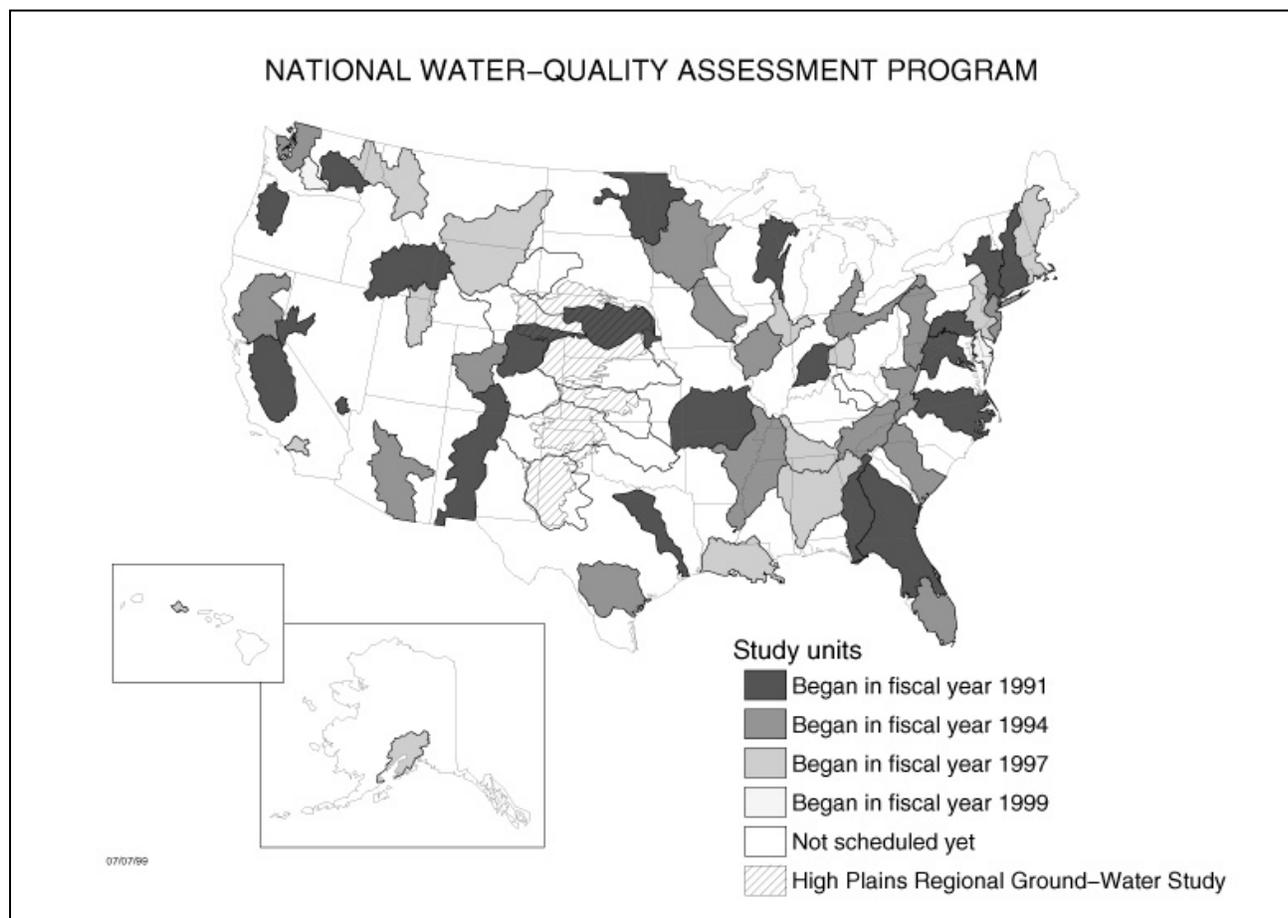


Figure W-1

Recent Accomplishments

Monitoring Networks -- Regional and local-scale ground-water sampling results from the NAWQA project on the Delmarva Peninsula have been incorporated into the Delaware Department of Natural Resources and Environmental Control Geographic Information System. These data are being used in the design of a sampling network to study contamination of ground water used by small community water systems throughout Delaware.

Volatile Organic Compounds -- The USEPA is concerned about impacts to water resources and drinking water from the gasoline oxygenate methyl tert-butyl ether (MTBE). Knowledge from NAWQA's broad-scale monitoring of ground water and compilation of MTBE drinking-water analyses has provided key information to the USEPA's Blue Ribbon Panel on Gasoline Oxygenates. Field testimony to the Blue Ribbon Panel on key NAWQA findings was given by the USGS in January and April 1999 and this testimony was partly responsible for the panel's recommendation that the use of MTBE in gasoline be significantly reduced to minimize additional degradation of water quality.

Environmental Management -- A surprising number of MTBE detections in ground water from monitoring wells installed in eastern Iowa urban land-use studies resulted in State legislation that limits the amount of MTBE in motor vehicle fuels to less than two percent by volume and requires that samples for the analysis of MTBE in water and soil be included as part of monitoring at leaking underground storage tanks sites.

Pesticides -- A study of pesticides in urban streams published jointly by NAWQA, the Washington State Department of Ecology, and King County, Washington, has caused State and local managers concern. Study results, showing levels of some insecticides in urban streams at concentrations violating criteria for the protection of aquatic life, have played a part in decisions by these managers to implement procedures to reduce the use of pesticides on public lands. Additional work in the area of pesticides involves two new methods developed at the USGS National Water Quality Laboratory for analyzing low levels of pesticides (herbicides and insecticides) and their degradation products in water samples. In combination with another method developed by NAWQA scientists, these two new methods will provide nearly complete coverage of the top 100 agricultural pesticides of national importance and will account for more than 90 percent (by weight) of pesticides applied each year.

Database Enhancements

To meet program synthesis goals it is critical to have a user-friendly database where chemical, biological, ancillary site/basin characteristics, and quality-control data are all linked. The database development team is staffed with USGS experts from throughout the Nation and consultants from the private sector. The team is using state-of-the-art software. By using commercially available software, development time and cost is reduced and the functionality is enhanced. Considerable success has been attained, and after less than a year a useful product is already in use. When this effort is complete, the USGS will have an easily accessible, comprehensive, and functional hydrologic database populated from diverse locations across the Nation. This will be of great benefit to NAWQA staff as well as all parties interested in these data.

Drinking-Water Studies -- The USEPA is revising national primary drinking water regulation for arsenic. NAWQA has provided USEPA's Office of Ground Water and Drinking Water with estimates of the arsenic concentrations in ground waters used as source waters by public purveyors across the U.S. This information allows estimation of the changes in treatment costs

associated with adoption of standards at differing arsenic levels. Also, the National Cancer Institute has incorporated NAWQA results from a review of arsenic in bedrock public supply wells into regional studies of cancer rates in the U.S. Arsenic is a known carcinogen. Information on both the sources of drinking waters and geologic and hydrologic variables that may relate to cancer mortality will also be included in the study.

Environmental Management -- The Edwards Aquifer Authority, charged with managing and protecting the Edwards aquifer in south-central Texas, will begin assessing water-quality conditions and long-term trends in an urbanized part of the Edwards aquifer recharge zone on the basis of data collected from 30 monitoring wells installed cooperatively with the NAWQA program.

Tribal Assistance -- After exposure to NAWQA field sampling protocols for surface water and ground water, the Gila River Indian Community's Department of Environmental Quality has been training staff and using these state-of-the-art protocols for their water-quality sampling programs.

Environmental Monitoring -- The Missouri Department of Natural Resources and the Missouri Department of Conservation have signed an MOU agreeing to enter into a joint statewide aquatic resource-monitoring program that will assess fish, invertebrates, and habitat at 100 stream sites in Missouri. The NAWQA fish, invertebrate, and habitat methods protocols are being used for the development of their sampling protocols.

Water Resources Assessments and Research Subactivity

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Toxic Substances Hydrology	13,306	+331	⁽¹⁾ -1,240	12,397	-909
Hydrologic Research & Development	13,048	+331	-1,454	11,925	-1,123
Total Requirements \$000	91,037	+2,012	-2,694	90,355	-682

¹ See Program Change section for details on Amphibian Research and Monitoring (+\$500) and programmatic decrease (-\$1,740).

Toxic Substances Hydrology

Current Program Highlights

The USGS Toxic Substances Hydrology (Toxics) Program conducts research on the behavior of toxic substances in hydrologic environments. The information developed from this research is used by water resource managers, regulators, and industry to develop policies and action plans that help avoid exposure to toxic substances, provide cost-effective clean-up strategies, and reduce the risk of future contamination.

The contamination problems investigated by the Toxics Program are widespread and pose significant risk to human health and the environment. Field-based investigations are conducted at representative sites that focus on subsurface, point-source contamination or on watershed-scale and regional-scale contamination problems. As part of these investigations, new methods are developed to make environmental measurements (including methods to measure emerging contaminants in environmental samples), and new models are developed to predict the persistence and fate of contamination and to design waste-disposal and remediation strategies.

Information about the Toxics Program is available on the World Wide Web (WWW) at:
<http://toxics.usgs.gov/toxics/>

The Toxics Program works in partnership with the U.S. Environmental Protection Agency (USEPA), the U.S. Department of Agriculture (USDA), Federal land management agencies, the Departments of Defense and Energy, and the Nuclear Regulatory Commission to ensure that research priorities are coordinated. Scientists from universities, other Federal agencies, and industry collaborate with USGS scientists in program activities. The results of studies are distributed at briefings for regulatory agencies and industry groups, at workshops, at national scientific meetings, in USGS reports, and in scientific journals and books.

Investigations of Subsurface, Point-Source Contamination -- Interdisciplinary USGS research teams conduct long-term intensive field investigations of common types of subsurface contamination in a variety of natural environments. The investigations at these "field laboratories" provide fundamental knowledge of the processes that control contamination. This

fundamental knowledge is generalized by testing at other sites so that lessons learned through these studies can be applied across the Nation.

- A "Tool Box" for Characterizing Contamination in Fractured-Rock Aquifers — Toxics Program scientists are developing a "tool box" of methods for characterizing contamination in fractured rock. Uncertainty in assessing the movement and transformation of contamination in fractured-rock aquifers makes this one of the toughest problems facing environmental professionals today. The "tool box" approach combines elements of chemistry, geology, geophysics, and hydrology to provide tools to characterize, monitor, and clean up contaminated fractured-rock sites.

Tools developed at the program's uncontaminated field laboratory in Mirror Lake, New Hampshire, have been applied at numerous contaminated sites across the Nation. Currently, program activities are being extended to a contaminated fractured-rock site where a major emphasis will be to investigate how chemical reactions and biodegradation affect dispersal of contaminants differently in fractured-rock than in unconsolidated (granular) aquifers.

- Migration of Radionuclides and Mixed Wastes in Arid Environments, the Amargosa Desert Research Site, Nevada — USGS investigations have documented subsurface movement of radionuclides (radioactive carbon and hydrogen) and mixed wastes near a waste-isolation facility near Beatty, Nevada. The site was chosen because it was believed to provide ideal hydrologic conditions for waste isolation. Similar sites in the arid and semi-arid West increasingly are being sought for isolation of radioactive and other hazardous wastes. This investigation has improved understanding of movement of water, gas, and the associated contamination through thick arid unsaturated zones, including the effects of facility design features. Information gained from studies at this site is important to the design of waste-isolation facilities, their monitoring systems, and remedial strategies.

Additional subsurface point-source investigations and associated field laboratory

- Treated sewage-effluent releases - Cape Cod, Massachusetts
- Regular-gasoline spills - Galloway, New Jersey
- Oxygenated gasoline spills - Laurel Bay, South Carolina
- Landfill leachate - the Norman municipal landfill, Oklahoma
- Chlorinated solvents - Picatinny Arsenal, New Jersey
- Crude oil releases - a pipeline rupture near Bemidji, Minnesota

Investigations of Watershed-Scale and Regional-Scale Contamination -- Watershed-scale and regional-scale investigations address contamination problems typical of widespread land uses or human activities that may pose a threat to human and environmental health throughout a significant portion of the Nation. These investigations involve characterizing contaminant sources, the mechanisms by which non-point source contamination affects aquatic ecosystems, and the processes that transform contaminants into different and possibly more toxic forms.

- Mercury in Aquatic Ecosystems — Industrial activities have significantly increased mercury transport through the atmosphere, resulting in accumulation of a toxic form of mercury (methylmercury) even in remote wetlands, lakes, and streams. In some ecosystems, mercury is converted readily to methylmercury, which accumulates to dangerous levels in the food chain and threatens the health of fish-eating wildlife and humans. The USEPA and Department of Energy estimate that emission controls for mercury would cost about \$2 billion a year, yet current scientific understanding cannot provide reasonable assurance that significant environmental improvements would result from the decreased emissions. USGS is participating in two investigations that will provide the best scientific basis for

answering this difficult and relevant question. USGS scientists in the Toxics Program are conducting the first systematic national assessment of the different forms of mercury in water, sediment, and fish. This assessment will provide information needed to understand whether specific ecosystem types or specific regions of the Nation are more susceptible to mercury contamination. In addition, the USGS is participating in a new international study designed to address global-scale land management and regulatory issues. This study will define the response, in terms of reduced human and wildlife exposure, that could be expected if we reduce mercury emissions. More information on this international study is available at <http://www.biology.ualberta.ca/metaallicus/metaallicus.htm>.

- Amphibian Research and Monitoring – Scientists from the Toxics Program, together with USGS biologists and other DOI agencies, are undertaking a study to assess the scope and severity of amphibian declines across the U.S. This study intends to quantify changes in amphibian communities in priority ecosystems throughout the Nation, and to identify causes of declines. The USGS will conduct water-quality investigations and monitoring activities that focus on contaminants that cause and/or contribute to amphibian declines. Information from this national effort will assist in formulation of effective actions to arrest or reverse the declines.

Other regional investigations

- Agricultural chemicals in cotton-growing areas across the South
- The occurrence of herbicides in the Midwest (the corn-belt)
- Emerging contaminants (pharmaceuticals, hormones, new industrial chemicals) in the Nation's surface waters
- Mine drainage in arid southwest basins (Pinal Creek, Arizona), and Rocky Mountain watersheds (Upper Arkansas River, Colorado)

In addition to all the activities outlined above, the Toxics Program is a partner in the USGS Abandoned Mine Lands Initiative, where new methods to characterize and remediate mining contamination are being transferred to Federal land managers in two pilot watersheds--the Boulder River in Montana, and the Upper Animas River in Colorado. For more information on this initiative, see <http://amli.usgs.gov/amli>.

Recent Accomplishments

USGS Studies Form the Basis for Regulatory Guidance on Clean-up Options -- Toxics Program studies have helped form regulatory policy on the use of natural attenuation to clean up contaminated sites. Natural attenuation occurs when natural processes mitigate the harmful effects of subsurface contamination. USGS investigations of subsurface point-source contamination quantify natural processes and evaluate the long-term potential to maintain natural attenuation. Toxics Program scientists working at Laurel Bay, South Carolina, have developed a methodology to assess natural attenuation of MTBE at gasoline spill sites. The methodology developed by the USGS is being adopted by the South Carolina Department of Health and Environmental Control to integrate consideration of fuel oxygenates (such as MTBE) into the State Underground Petroleum Emergency Response Bank program. The USGS and USEPA scientists have offered a series of workshops on natural attenuation at 10 locations across the Nation. The workshops provided environmental scientists and engineers with guidance and methods for implementing monitored natural attenuation for cleaning up contaminated ground-water sites. Results from Toxics Program study sites on petroleum hydrocarbons, fuel oxygenates, and chlorinated solvents were used as a basis of current

knowledge. More information on the seminar can be found on the World Wide Web at <http://www.erg.com/erg/atten-info.htm>.

Silver Toxicity and Fish Reproduction -- Toxics Program scientists are studying the effects of silver on reproduction in marine life in the San Francisco Bay. Traditional lab-based assessments have shown little adverse effect from silver, especially on fish, at environmentally relevant levels. Field studies, however, indicate significant reproductive damage associated with silver exposure. These results raise a cautionary flag for traditional decision-making. The City of Palo Alto, California, is using these and other USGS results to encourage local dischargers of wastewater containing silver to maintain discharge-reduction efforts. The City of Palo Alto has received national awards for its source control program, part of which involves use of USGS data. Results also have been shared with the Silver Coalition, a coalition of silver users, and will assist industry decisions related to silver discharge reductions.

Hypoxia in the Gulf of Mexico -- Hypoxia is a condition whereby water becomes so low in dissolved oxygen that organisms (including fish and shrimp) flee the affected area or perish. Hypoxia is exacerbated by the flow of large quantities of nutrient-rich freshwater into the Gulf each year from the Mississippi River. At the request of the White House Office of Science and Technology Policy (Committee on Environment and Natural Resources), the USGS led a multi-agency team and prepared a report on the sources and discharge of nutrients to the Gulf of Mexico (<http://www.rcolka.cr.usgs.gov/midconherb/hypoxia.html>). Results indicate that on average about 1.6 million metric tons of nitrogen (a nutrient) enter the Gulf of Mexico from the Mississippi River each year. The largest sources of nitrogen to the Mississippi River are from streams draining the Midwest corn-growing States. The report documents the source areas for nutrients, such as nitrogen and phosphorus, and provides information on the human activities most responsible for these nutrients. The Mississippi River/Gulf of Mexico Watershed Nutrients Task Force will use this report to develop an action plan to improve water-quality conditions in the Mississippi River Basin and the Gulf of Mexico. (Note: the Hydrologic Research and Development Program also funds some work related to the hypoxia issue, and the National Stream Quality Accounting Network, which is funded by the Hydrologic Networks and Analysis Program, contributes to the hypoxia effort through nutrient monitoring in the Mississippi River.)

Water Resources Assessments and Research Subactivity

Program	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Ground-Water Resources	2,800	+87	0	2,887	+87
National Water-Quality Assessment	61,883	+1,263	0	63,146	+1,263
Toxic Substances Hydrology	13,306	+331	-1,240	12,397	-909
Hydrologic Research & Development	13,048	+331	⁽¹⁾ -1,454	11,925	-1,123
Total Requirements \$000	91,037	+2,012	-2,694	90,355	-682

¹ See Program Change section for details on Columbia River Aquatic Resources (+\$1,000) and programmatic decrease (-\$2,454).

Hydrologic Research and Development

Current Program Highlights

The Hydrologic Research and Development Program focuses on long-term investigations that integrate hydrological, geological, chemical, climatic, and biological information related to water resources issues. The program develops new fundamental knowledge about the processes affecting water and develops new methods and interpretive techniques to aid in data collection, understanding, and prediction. Its long-term interdisciplinary approach allows work on large, difficult hydrologic problems, and the direct linkage of the program with other USGS water-resources programs ensures that the research remains relevant to water-resources needs. The USGS scientists supported by this program provide training, workshops, reviews, and advice to USGS staff working on all water programs to enhance their capabilities. Thus, through its research, development, and information transfer, this program provides the foundation for the technologies and conceptual approaches used in all USGS water programs for the future. The new knowledge, tools, and insight needed to solve hydrologic problems are gained through three approaches: Individual Studies, Large Interdisciplinary Studies, and the Development of Tools and Methods.

Small Individual Studies -- Those receiving current emphasis include studies directed towards gaining an understanding of the:

- processes related to the transport of viruses, bacteria, and protozoa in water and their role in ground water remediation,
- shape of river channels and the erosional processes governing the source, mobility, and deposition of sediment,
- microbial and chemical reactions in the zone of a stream bank where recharge or discharge occurs, causing mixing of the stream and ground water,
- movement of water, solutes, and gases through various environments and materials,
- chemical and biochemical reactions affecting natural and contaminated water,
- interaction of ground water and surface water in key areas such as wetlands,

Water Resources Assessments & Research Subactivity

- processes and factors (such as land use) that govern the sources, sinks, and transport of carbon and nitrogen, and
- effect of subsidence on wetland habitat loss and as a threat to low-lying population centers.

A new focus of work in FY 2001 relates to sediment mobilization and carbon sequestration in the Lower Mississippi River Basin, where the loss of riparian forests and wetlands from ground-water withdrawals, subsidence, surface-water flow, and land-use practices is of concern. The amount of sediment mobilized by these phenomena affects the sequestration of carbon in channels, reservoirs, and wetlands. The USGS will investigate the relationships between water and sediment transport and its effect on carbon storage to provide better information for resource managers.

Large Interdisciplinary Studies -- The following are selected examples of research that is conducted primarily through large interdisciplinary studies:

- Hypoxia causes -- Hypoxia, a low oxygen condition in water, is known to be related to high levels of nitrogen and its associated algal blooms. Although scientists believe hypoxia in the Gulf of Mexico is related to nitrogen from the Mississippi River and its tributaries, it is unclear to what extent various sources of nitrogen contribute to the hypoxia problem. A USGS research study is considering geochemistry, microbiology, and transport of nitrogen species and is examining denitrification and its impact on nitrogen transport. Denitrification is a natural reaction that transforms nitrate, a harmful form of nitrogen, into nitrogen gas, which is environmentally benign. Research efforts are currently focused at a NAWQA site with high agricultural input of nitrogen in the Illinois River basin and at a Mississippi River pool near La Crosse, Wisconsin. (Note: the Toxic Substances Hydrology Program also funds some work related to the hypoxia issue, and the National Stream Quality Accounting Network, which is funded by the Hydrologic Networks and Analysis Program, contributes to the hypoxia effort through nutrient monitoring in the Mississippi River.)
- Regional and global biogeochemical cycles (such as the carbon and nitrogen cycles) in rivers, lakes and reservoirs -- Five water, energy, and biogeochemical budgets (WEBB) sites in Colorado, Wisconsin, Vermont, Georgia, and Puerto Rico, representing a range of hydrologic and climatic conditions, are providing a focal point for research into processes that control the exchange of water, energy, and carbon between the atmosphere and the land surface. Understanding these processes is critical to such important environmental policy issues as greenhouse gases, atmospheric deposition, nutrient enrichment, and biodiversity. A watershed modeling effort that has been started at all sites is expected to lead to a better understanding of the chemical and hydrologic processes in the watersheds and to lead to approaches for scaling up to larger watersheds. Such efforts are critical to understanding how better to manage the Nation's waters.
- Basins and watersheds, where interactions occur among a variety of processes associated with carbon budgets, nutrient transport, land-water interactions, atmospheric chemistry, botany, and geochemistry -- Lake studies, which examine how lakes integrate these and other hydrologic processes and preserve a record of past environmental change in their sediments, are centered on two lake watersheds in Minnesota: Williams Lake and Shingobee Lake. In addition, a Mississippi River basin study is examining nutrient, carbon, and sediment storage in lakes, reservoirs, and wetlands. This study will lead to a better understanding of how changes in land use affect erosion and sedimentation, and the consequences of these changes on the global carbon cycle.

Tools and Methods -- Studies of water resources require the development and enhancement of new tools and methods such as:

- Developing new and refined hydrologic computer models that are used throughout the world, and enhancing existing models by making them more flexible and user friendly. Currently, an increased emphasis is being given to models that are directed towards improving estimates of parameter uncertainty, adding model components that describe microbiological reactions, and coupling water movement, chemical transport, and geochemical reactions.
- Developing and refining methods for determining the age of relatively recent ground water in order to identify and trace the movement of recently recharged ground water. These techniques help delineate source-water protection areas and predict future improvement or degradation of ground water resources.
- Refining methods used in determining the nature of dissolved organic matter so that the techniques can be applied to assessing the potential risks of using reclaimed wastewater to recharge potable-water aquifers.
- Developing a database of nutrient concentrations by compiling water quality data from estuaries around the U.S. and other countries. The database is expected to be used to assess the global status of nutrients in nearshore coastal ecosystems and to compare the susceptibility of different coastal ecosystems to the harmful effects of nutrient enrichment.

Recent Accomplishments

Nutrients Index for Estuaries -- The development of large phytoplankton blooms in estuaries is generally blamed on excessive input of nutrients from human activities, but this does not explain why nutrient-rich San Francisco Bay does not exhibit the same symptoms of eutrophication as the Chesapeake Bay. USGS scientists have developed an index that can be used to determine whether light or nutrient input will be the limiting factor for phytoplankton growth rate in a particular estuary. This index can be used as an objective basis for determining the susceptibility of aquatic ecosystems to the harmful effects of nutrient enrichment and for comparing the potential for harmful-bloom development among ecosystems.

Permeable Reactive Barriers -- At Fry Canyon, Utah, a USEPA Superfund site, the use of permeable reactive chemical barriers (PRB) to control uranium concentrations in contaminated ground water has been tested in collaboration with DOE, BLM, and USEPA. Although tests are continuing, the data show that after 1.5 years, uranium concentrations in the water have been decreased 70-95 percent, depending upon the type of PRB used.

Iron Toxicity in Keswick Reservoir -- Acid mine drainage from the Iron Mountain Superfund site in California has resulted in the accumulation of metal-rich sediments in the Sacramento River's Keswick Reservoir. In cooperative studies with USEPA and BOR, the sediments and their pore waters were analyzed and, via a USEPA contract with Pacific Eco-Risk Laboratories, used in toxicity tests. Results from this cooperative study indicate that iron appears to be the main toxic constituent for aquatic life, rather than copper or zinc as had been previously

assumed. This finding may have a major impact on regulatory requirements for the safety of aquatic life since iron is not currently a regulated element.

Sediment Contamination in San Francisco Bay -- In a special issue of the journal *Marine Chemistry*, published in February 1999, USGS and university scientists documented the impact of human activities on sediment contamination in the San Francisco Bay. This interdisciplinary study was jointly funded by the USGS and NOAA, and was based on analysis of sediment cores from the Bay. The findings indicate that a large estuary contaminated by human activities can take decades to recover even if sources of contamination have been eliminated, but also illustrate the effectiveness of regulation, documenting the decline in concentration of some regulated contaminants despite continued economic growth.

Water Data Collection and Management Subactivity

Program	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Hydrologic Networks and Analysis	25,428	+827	⁽¹⁾ +4,459	30,714	+5,286
Water Information Delivery	3,739	+122	+4,700	8,561	+4,822
Total Requirements \$000	29,167	+949	+9,159	39,275	+10,108

¹ See Program Change section for details on Real-Time Hazards (+\$4,000), DOI Science (+\$3,250), and programmatic decrease (-\$2,791).

Hydrologic Networks and Analysis

Current Program Highlights

Data on the quantity and quality of water in the Nation's streams, lakes, and aquifers, as well as analytical studies, are necessary for the wise planning, development, utilization, and protection of our water resources. As the Federal Government's primary water resource agency, the USGS maintains national networks for collecting long-term, comprehensive data on water quantity and quality, and atmospheric deposition (such as rain and snow). Much of this work is accomplished with funding from State and local government agencies, and from other Federal agencies; nearly half of the water resources operating budget comes from these non-appropriated sources. The Federal funds appropriated through the Hydrologic Networks and Analysis Program support the parts of the national streamgaging network that are not funded by the other agencies for a specific purpose.

The data and analytical information which the USGS provides through this program are used to:

- respond to decrees of Federal courts, river basin compacts, and international treaties regarding water rights and allocation
- resolve land and resource management issues in which a strong Federal interest is evident, for example, on lands owned and managed by the Federal government
- describe short-term or severe changes in water resources, such as flooding, droughts, and widespread contamination
- monitor long-term changes in the availability and quality of selected rivers, lakes, reservoirs, and ground water to document the current conditions and changes in these systems over time
- measure the quantity and quality of small streams in pristine environments to document current conditions and changes over time in natural watersheds

Hydrologic Networks

Water Quantity -- The USGS operates nationwide hydrologic networks for the collection of surface-water, ground-water, and water-quality data. The shared funding and single-agency operation of the USGS networks provide high-quality information to all potential users, for a wide variety of uses at low cost to the Federal Government. Because a single agency operates the networks, data are collected using nationally-consistent methods, which enables comparability of data across jurisdictional boundaries and acceptance of results by water management agencies and courts at all levels of government. The USGS uses the Federal funds appropriated through this program to support the parts of the national data collection infrastructure that are not funded by the other agencies for a specific purpose. This includes the National Streamflow Information Program, which provides data that enable the National Weather Service to issue flood forecasts and warnings.

Water Quality -- The USGS operates three major water quality monitoring networks:

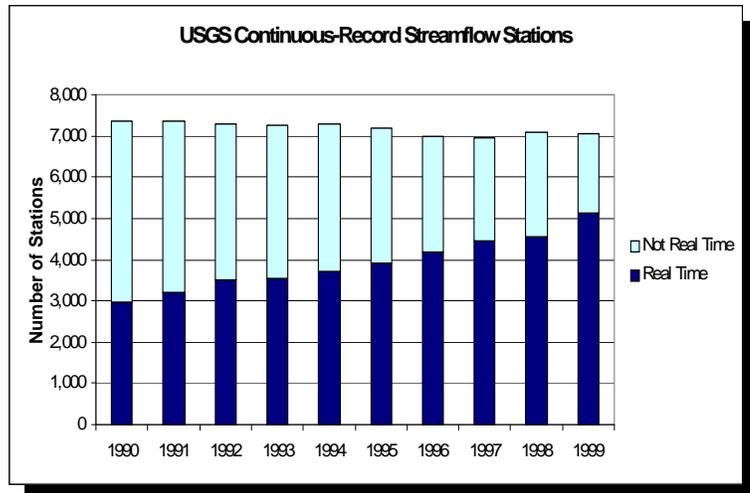
- The National Stream Quality Accounting Network (NASQAN) operates 40 stations to measure water quality and to calculate the loading of sediments and chemicals in four of the Nation's largest rivers (Mississippi, Columbia, Colorado, and Rio Grande) and their major tributaries; data from these stations aid in the planning, utilization, and protection of these major rivers that flow across interstate and international boundaries and are the subject of complex regulatory requirements. Although monitoring these four rivers continues to be a high priority for the program, planning is underway to develop a baseline characterization of water quality in the Yukon River basin. Important issues in this large Alaskan basin include melting of the permafrost (and the associated hydrologic and chemical changes) and atmospheric deposition of manmade organic pollutants. Sampling in the Yukon would begin in FY 2001 at the earliest.
- The Hydrologic Benchmark Network presently comprises 50 surface-water sites located in natural basins that are minimally altered by human influences; data collected at these sites fill a unique national function in discerning effects of long-term climatic trends on hydrologic systems and separating natural variability from human-induced change in surface-water systems.
- As the lead Federal agency for monitoring wet atmospheric deposition (chemical constituents deposited from the atmosphere via rain, sleet, and snow) in the U.S., the USGS supports 72 sites in the National Trends Network. This network provides a national scorecard with which to evaluate the effectiveness of ongoing and future regulations intended to reduce atmospheric emissions and subsequent impacts to our terrestrial and aquatic ecosystems.

National Streamgaging Program Evaluation

In 1999 the USGS completed an evaluation of the ability of the streamgaging network to meet Federal needs for streamflow information. The evaluation found that the network's ability to meet long-standing Federal needs has declined because of an absolute loss of critical stations and the declining ability of the USGS to continue to operate high-priority stations when partners decide to discontinue funding. A subsequent report, "Streamflow Information for the Next Century -- A Plan for the National Streamflow Information Program of the U.S. Geological Survey," provides a vision for meeting the Nation's streamflow information needs. It includes enhancements to the streamgaging infrastructure, a new funding mechanism, supplemental measurements of floods and droughts, ongoing assessments of streamflow characteristics and trends, improved systems for disseminating streamflow information and enhancing the reliability of the delivery system, and research on new technology for measuring the Nation's rivers and streams.

Real-Time Flood Warning for Safer Communities

In FY 2000 the USGS received an increase of \$2 million to augment and upgrade the existing streamgaging network. These additional funds are being used to build new streamgaging stations, reactivate some stations which were previously discontinued due to funding constraints, upgrade instrumentation at some stations to make them capable of real-time reporting, and strengthen or "flood harden" some stations which are vulnerable to being damaged or destroyed during large-scale floods. In addition, some funds will be used to develop alternative methods of measuring streamflow, and to strengthen data delivery systems so that power failures or computer malfunctions will not inhibit the flow of data to USGS customers during times of crisis.



Hydrologic Analysis

Studies of Climate Variability and Change -- The USGS is working to identify what atmospheric and oceanic patterns are most responsible for variations in hydrologic conditions (streamflow, lake levels, snowpack, and glacier mass), particularly extreme events such as the flooding which affected the eastern seaboard after Hurricane Floyd and the drought which affected the eastern States during 1999. These investigations depend upon the primary surface water databases collected by the USGS, as well as on modeling studies conducted in conjunction with climate modeling centers. The studies are aimed at developing improved planning and management information for operators of water resource systems, as well as providing for more efficient USGS data collection operations. Work also includes paleoclimate studies that differentiate the effect of human activities from effects caused by natural climate variations; these studies are leading to a better understanding of the causes, intensity, duration, and timing of ice ages.

Watershed Modeling -- Competition among water-resource users in many basins in the western U.S. has resulted in a need for near-real-time assessments of water availability and use. The use of coupled hydrologic and water-management models can provide these assessments with substantial benefits for water-resource planning and operation. Advancements in computer hardware and modeling software have enabled the development of such water-resource models. The USGS and the Bureau of Reclamation have been working collaboratively since 1995 on a project called the Watershed and River Systems Management Program (WARSMP). The goal of the program is to first couple watershed and river-reach models that simulate the physical hydrologic setting with routing and reservoir management models that account for water availability and use. The coupled models are then to be applied to Reclamation projects in the western U.S. The coupling provides a database-centered decision support system for use by WARSMP and other projects. In FY 2000 WARSMP is wrapping up final model documentation in Washington's Yakima River basin, and beginning a new study of the Rio

Grande basin to provide planning tools for the Federal and State agencies which manage water resources for the cities of Albuquerque, Santa Fe, and El Paso.

USGS Science to Aid National Park Service -- In FY 1999 the USGS began water-quality studies in the National Parks as part of the Clean Water Action Plan. A National Park Superintendent, in a letter to the USGS Director, eloquently stated the potential for this type of collaboration. "USGS scientists' abilities are essential to develop, integrate and interpret scientific information and provide professional interdisciplinary opinions regarding potential effects to water quantity and quality and associated biologic resources. The USGS brings a reputation for trustworthy and unbiased science and professional advice that is essential for the credibility of our often controversial resource management decisions The USGS work . . . provides concrete examples of multidisciplinary science the USGS can provide the National Park Service in park management planning, interpretation, public education and day-to-day resource management decisions."

Other activities funded by the Hydrologic Analysis component of this program include:

- a portion of USGS place-based studies such as those in Chesapeake Bay, Mojave Desert, San Francisco Bay, South Florida, and the Platte River basin
- an interdisciplinary study of multiple natural hazards in urban areas, focusing on earthquakes, floods, and volcanoes in the Seattle-Tacoma area

Recent Accomplishments

Response to Hurricane Floyd -- The USGS provides streamflow data which Federal and local emergency management agencies use for making decisions about when to issue flood warnings or evacuation orders. Advance warning of even an hour can result in significant savings when property is moved. For example, the Somerville, New Jersey, Police Department has indicated that lives and property were saved during Hurricane Floyd, in part because of information from a streamgauge that USGS operates in cooperation with Somerset County as part of the County's Flood Information System. As a result of the flood warning 500-600 people were evacuated from the area. Many vehicles were moved before they were flooded. Potential property damage was reduced by residents and businesses moving contents to a higher level. In addition, flood forecasts can lead to community or individual decisions to evacuate. These decisions can literally save lives. During Hurricane Floyd, the North Carolina Department of Corrections used data from a newly re-activated USGS gaging station to help make decisions pertaining to evacuation of prisons, some of which were in danger of being flooded.

Water quality concerns in the hurricane's wake -- There was much concern about the effects of high rainfall and runoff on the water quality and aquatic habitat of the streams flooded by Hurricane Floyd. Concentrations of sediment, nutrients, bacteria, and pesticides were measured at numerous streams in Maryland, New Jersey, North Carolina, Pennsylvania, and Virginia. Flooding of swamps in coastal areas can reduce dissolved oxygen levels for some distance downstream over many days, harming aquatic organisms. Increased nutrients can cause nuisance algal growth and contribute to low oxygen levels in streams and lakes. High sediment loads can damage aquatic habitats and fill navigation channels, lakes and reservoirs. Bacteria was of particular concern, especially in North Carolina, where many animals drowned and remained in waterlogged areas for days before they could be removed.

USGS hydrologic networks support science education -- Data from the USGS networks of water quantity, water quality, and atmospheric deposition are now available on the Internet. For example, in 1999 customers downloaded 16,000 data-sets from the USGS acid rain web site in support of their research. Customer surveys indicate that a significant portion of the users are students and educators who are incorporating the data into their classroom projects and reports. Students using the data range from grade-schoolers preparing science fair projects to PhD candidates using the data for their dissertations.

USGS networks provide critical data for Gulf of Mexico hypoxia assessment -- Data on nutrients and streamflow collected by the USGS over the past four decades in the Mississippi River basin played a central role in determining the sources of nitrogen and in identifying trends in nitrogen loading from the 1950's through the 1990's. Nitrogen loading is thought to be an important factor in causing hypoxia (a zone of low oxygen) in the Gulf of Mexico which may be harming fisheries in that region. The long-term, nationally consistent data provided by this program enabled USGS scientists to quickly respond to a request from CENR for this assessment. NASQAN currently operates 18 stations in the Mississippi River basin to determine the annual flux of nutrients and pesticides along major rivers in the basin. (Note: the Toxic Substances Hydrology Program and the Hydrologic Research and Development Program fund research related to the hypoxia issue; activities in the Hydrologic Networks and Analysis Program are primarily basic data collection.)

USGS acid rain program unites atmospheric deposition monitoring networks worldwide -- For the first time, all of the major global atmospheric deposition monitoring networks have been united in a USGS program designed to measure laboratory data quality. On June 21, 1999, USGS began measuring analytical data quality from wet deposition chemistry laboratories in Europe and Southeast Asia. These laboratories will join those representing the major North American deposition monitoring networks which are already in the program. Now it will be possible to directly compare data from all of the deposition monitoring networks in the world. As a result, the ability to compare deposition levels occurring worldwide will be improved. In addition to monitoring trends in acid rain, nitrogen deposition data from these networks are being combined as input to global circulation models to estimate the role that nitrogen deposition plays in affecting the global cycling of carbon dioxide.

Research from several studies provides a better understanding of the relationship between hydrology and climate in the West -- In the Southwestern U.S., the Pacific warm-water phenomenon known as El Niño has been found to be linked to more frequent high streamflow events. For example, in the Spring Mountains, Nevada, although high-intensity/short-duration summer storms contribute about one-third of the annual precipitation, the principal means of upland recharge was found to be from late spring snowmelt, and El Niño was found to enhance both the snowpack and recharge. Information being provided by these studies can greatly aid water-management decisions in western States.

Water Data Collection and Management Subactivity

Program	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Hydrologic Networks and Analysis	25,428	+827	+4,459	30,714	+5,286
Water Information Delivery	3,739	+122	⁽¹⁾ +4,700	8,561	+4,822
Total Requirements \$000	29,167	+949	+9,159	39,275	+10,108

¹ See Program Change section for details on Community/Federal Information Partnerships (+\$2,000) and Resource Management Decision Support (+\$2,700).

Water Information Delivery

Current Program Highlights

The Water Information Delivery program funds a small but vital portion of the overall information delivery activity of the USGS water resources programs. Delivery of basic hydrologic data is funded directly as a part of the overall cost of the data collection activity (funded by the Federal or State portions of the Federal-State Cooperative Water Program, by other Federal agencies, or by the Hydrologic Networks and Analysis Program). Also, publication of project-specific findings is funded within the cost of each project. The purpose of the Water Information Delivery program is to assure adequate delivery of results beyond the immediate needs of funding agencies or programs. In particular, it funds the extra costs (beyond the costs of producing a product required for immediate local needs) of preparing and printing USGS professional papers, hydrologic atlases, and circulars.

Scientific and technical information products are central to the accomplishment of the USGS mission and provide the most important vehicle by which the results of research and investigations are made available for use by other governmental agencies, the private sector, and the general public. For over a century, the USGS has been collecting, compiling, and archiving basic information on the water resources of the United States in national databases. The USGS and others use these data to create products that address significant and emerging regional and national water resource issues. In addition to these synthesis activities, advances in technology have made it possible to put the USGS national databases at the fingertips of every American via the World Wide Web (WWW). The USGS makes data that are collected in real time available to all within a few minutes or hours. During times of crisis, managers and emergency management agencies can now make critical decisions for saving lives and property based on up-to-date information. And because some users require timely data in critical situations, USGS is planning system enhancements to improve the reliability of WWW service.

Regional and National Synthesis Activities -- Scientific data and interpretations from USGS water resources programs are synthesized to create products that address significant regional and national water resources topics. These products will present regional or national perspectives and describe the current thinking on specific and relevant water resources issues. Products are customized to convey the appropriate information to targeted audiences. Target

audiences for synthesis products range from technical to general audiences. Products resulting from this synthesis effort include specialized databases, maps, and brief reports.

Reports Process Streamlining -- USGS publications such as professional papers, hydrologic atlases, and circulars remain important vehicles for releasing the results of water resources investigations. These products are a critical link to many USGS customers. The USGS Water Resources Investigations Activity is continually evaluating and improving its publications process to reduce costs and provide greater efficiencies in the approval and preparation process. The effort is resulting in decentralized publication procedures and greater use of new technologies such as desktop publishing. As part of this ongoing streamlining effort, customers are systematically queried for their opinions about USGS water resources products. The results from these customer surveys are being used to improve the delivery and quality of USGS information products.

Data System Enhancement -- In the past, requests for USGS hydrologic data came in a variety of forms: telephone, mail, e-mail, and walk-in. Virtually all of these requests required individual attention, with USGS staff retrieving data from our databases and tailoring a product to user needs. These products took many forms: paper, magnetic tape, floppy disks, or files delivered electronically. The data delivery systems for USGS hydrologic data are being reengineered so that in many cases customer needs can be filled without any direct intervention by USGS staff. This is accomplished by using the WWW as the retrieval mechanism. Use of the WWW to provide hydrologic data is beneficial for two reasons. The timeliness of data delivery is greatly enhanced. Response is now virtually instantaneous. It also results in great cost savings for the USGS, because USGS staff time is not consumed with filling and tailoring individual requests. At the present time, data sets accessible on the WWW include almost all USGS historical streamflow daily values, water use data, and continuous records of the past 7 days for many streamflow stations. The capability does not yet exist for such automatic delivery of water quality data or data on wells and springs, but initial capabilities for WWW delivery of water quality data and data on wells have been planned and developed, and are under review and testing.

Feedback from USGS WWW customer

"... your work continues to be of extraordinary value as a tool in managing and helping others understand the state of our watershed. By making real time data available and understandable you have awakened interest and concern at the very grass roots level where progress is being made in leaps and bounds toward the goals of swimmable and fishable waters. ... In my work, whether as a real estate broker in the Berkshire Hills of western Massachusetts, as a Conservation Commissioner for my town of Stockbridge, or as a local watershed project coordinator for the Housatonic Valley Association, USGS map products and on-line web sites provide exceptional value for my tax dollar because they empower all of us to do far better work than we could do on our own. That's what I have always thought government was supposed to do, and you-all have hit the mark dead center."

*Shepley W. Evans
Stockbridge, MA*

Recent Accomplishments

Water Resources Applications Software -- The USGS provides water resource application software across the WWW to a multitude of users who need tools for modeling ground water flow, analyzing stream channel geometry, computing sediment discharge, modeling precipitation runoff, analyzing flood frequency, modeling solute transport and biodegradation, and a myriad other purposes. Topical areas include software for geochemistry, ground-water, surface-water,

water-quality, and general use applications. On-line requests for software have averaged about 7,100 per month with approximately 95 percent from sources external to the USGS. To respond to the growing interest in available software, the USGS is now providing information on updates and enhancements of specific software applications to those who register for automatic notification. (http://water.usgs.gov/software/software_registration.html)

Online National Map of Daily Streamflow Color Codes What's Up or Down -- As a further enhancement to its online availability of real-time streamflow information, the USGS announced in June 1999 that this crucial information, which is used by emergency officials, water managers, and recreationists, is now available for the first time as a daily national map that shows at a glance what streams are up or down across the Nation. The map, which is updated at intervals throughout the day, was especially useful for checking on drought conditions in the Mid-Atlantic during the dry summer of 1999, and for checking on water-resources conditions around the country. In addition to the national map, users can also access tables of regional streamflow data. As a quick snapshot of streamflow activity in recent days, an animation feature on the pages shows 5 days of streamflow in sequence. The daily streamflow conditions map can be viewed at <http://water.usgs.gov/public/dwc/national_map.html>

USGS Cuts Costs by Publishing Reports on CD-ROM -- The USGS now offers many of its reports on CD-ROM, instead of the traditional paper format. Thus far this has resulted in substantial cost savings. For one annual data report which was released during the summer of 1999, this practice cut publication costs from \$16.35 per copy to \$1.13 per copy and allowed the USGS to produce 2,000 copies, compared to only 425 copies of the previous year's report. This practice makes it possible to distribute USGS scientific data and results to a much broader audience than was previously possible, and saves valuable resources so that more funding is available to support research and monitoring activities.

Federal-State Cooperative Water Program Subactivity

Program	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Federal-State Cooperative Water Program	60,553	+2,326	0	62,879	+2,326
Total Requirements \$000	60,553	+2,326	0	62,879	+2,326

Current Program Highlights

A vital cornerstone of the USGS mission is the continuous assessment of the Nation's water resources. This is a huge and expensive task. Throughout its history, the Federal-State Cooperative Water Program (Coop Program) has enabled the USGS to partner with State and local water resource agencies in carrying out this important part of its mission. The Coop Program also provides technical assistance to State and local water management agencies (including Indian Tribes) in seeking solutions to water-resource issues of national concern through a matched funding arrangement. The cooperating agencies provide at least half the funding; USGS does most of the work. These provisions result in an effective cost sharing arrangement and ensure that data collection, archiving, and analysis are conducted with consistent techniques that allow a truly national resource assessment.

The Coop Program has been highly successful for several reasons. From a Federal perspective, the Coop Program combines Federal and non-Federal resources in addressing many of the Nation's most pressing water resource issues. Coop studies are conducted in each of 50 States; the knowledge gained from these studies contributes significantly to understanding the hydrology in all parts of the country. By bringing together and synthesizing the results of studies on common topics in various hydrogeologic and climatic settings, the Coop Program enables the USGS to form a national picture of important water-resource issues and potential solutions at great cost savings to the Federal Government.

From a State and local perspective, having an objective Federal science agency provide high-quality data and information on issues of importance to them is a vital service for which they are willing to share the cost. By using standardized methods of data collection and analysis across the country, the USGS ensures that its information and results are comparable from one State to another. Rivers and aquifers cross jurisdictional lines; studies and data collected in one county or State have great value to adjoining counties and States. Therefore, water managers at all levels appreciate that information developed by the USGS is provided to all potential users, public and private, on an equal basis. Also, cooperators understand that USGS staff have ready access to a wide variety of expertise across the country in such areas as database management, quality assurance, and research in all areas of hydrology.

Within the Coop Program, about half of the funds are used to support Data-Collection Activities; the remaining funds are used for Interpretive Studies. In an effort to maximize the usefulness of hydrologic data and the results of interpretive studies, the USGS continues to compile and analyze information resulting from these activities in various States into Regional and National Synthesis products using modest amounts of funding from other USGS programs.

Data-Collection Activities

Cooperatively funded hydrologic data collection activities are underway in every State, Guam, Puerto Rico, and the U.S. Virgin Islands. Over the past few years the Coop Program has provide sole support or partial support for well over half of the sites where USGS collects data on surface-water levels and flow, ground-water levels, and ground-water quality. In addition, the Coop Program supports collection of data on surface-water quality, which is becoming increasingly important to the States as they monitor total maximum daily loads (TMDLs), in order to comply with the requirements of the Clean Water Act. All these data provide resource managers with the information they need to determine the suitability of water for various uses, identify trends in water quality, and evaluate the effects of stresses on the Nation's ground-water and surface-water resources. Much of the data collected at USGS monitoring sites is provided free of charge on the World Wide Web to all interested parties. This includes historical data, as well as real-time data which are generally less than 4 hours old. The real-time data are used routinely by emergency management agencies, State and municipal agencies, businesses, and recreational boaters and fishers.

In addition to providing information responsive to State or local needs, the Coop Program provides information that satisfies the needs of many Federal agencies. Some of these needs are:

- Forecasting floods
- Managing surface-water supplies
- Monitoring hydroelectric power production
- Setting waste disposal limitations
- Regulating industrial discharges
- Designing highway structures
- Measuring the downstream transport of pollutants or nutrients
- Determining total maximum daily loads
- Evaluating mine permits
- Planning and evaluating land reclamation
- Evaluating fish habitat
- Quantifying Indian water rights
- Quantifying Federal reserved water rights

Most of the USGS data-collection stations serve multiple purposes and many are funded, wholly or in part, through cooperative agreements. Normally these stations, though funded by various organizations, are operated as part of an integrated network rather than as stand-alone entities. For this reason cooperating organizations are billed on the basis of AVERAGE station cost, rather than ACTUAL cost, which rarely can be precisely known. For instance, the annual cost of a streamflow gaging station usually is the same for all such stations operated by a particular USGS office. This procedure benefits these organizations and the USGS in at least two ways. Administrative costs are reduced because financial transactions are simplified, and definitive cost information is available to all parties for planning purposes at the beginning of the fiscal year. This arrangement also assures that data collection in remote areas or which may be otherwise problematic during a given period of time (vandals, extreme flooding, lightning strikes, etc.) do not become prohibitively expensive and as a result exclude these important hydrologic stations from the network.

Interpretive Studies

In addition to data collection activities, the Coop Program supports about 500 hydrologic studies and investigations each year. Water resource appraisals define, characterize, and evaluate the extent, quality, and availability of water resources. Since the early 1970's these investigations have increasingly emphasized water-quality issues, such as aquifer contamination, land application and injection of reclaimed water, river quality, storm-runoff quality, and the effects of acid rain, urbanization, mining, and agricultural chemicals and practices on water resources. The results of these investigations are published and provided to State agencies, who use them as the basis for managing the water resources for which they are responsible. Also, these

investigations provide information that can be synthesized and applied to a variety of hydrogeologic and climatic settings across the country, greatly expanding the usefulness and transferability of USGS study results nationwide.

External Review of the Coop Program

During FY 1999, the Coop Program had an extensive review by stakeholders external to the USGS--the first such review in the program's history. The External Review Committee comprised representatives from cooperating agencies and Tribes, Federal agencies, national water resources organizations, and the private sector. The Review Committee, under the aegis of the Advisory Committee on Water Data (established under FACA guidelines) was charged with evaluating the program in four major areas: mission, prioritization and funding of work, conduct of work, and products.

The Review Committee provided many insightful observations and recommendations about the program that will maintain the program's core strengths while leading to significant improvements. In accordance with FACA guidelines, the Committee's report is now available for public comment. An excerpt from the Committee's report follows:

"The Cooperative Water Program is critical to improving the management of the Nation's water resources. It is important to the Nation in that it acknowledges the keen shared-interest of Federal, State, Tribal, and other government agencies in appraising the Nation's water resources and seeking solutions to water-related problems. In today's climate of growing demands on, and increasing competition for, the Nation's water resources, there can only be an increased need for all types of water-related data and analyses in the future. The Cooperative Water Program offers the highest level of scientific knowledge, objectivity, and technical expertise. The Cooperative Water Program is integral to providing long-term data collection and analysis of water quantity, quality, and use on a national basis. Without the Cooperative Water Program, the nation would not have information vital to the routine management of the nation's water resources and critical in the management of water-related emergencies."

Recent Accomplishments

Innovations in Water Data Collection -- The USGS developed an unmanned platform used to make river discharge measurements with an acoustic Doppler current profiler. This work is described in a paper which was presented to the Institute of Electrical and Electronic Engineers Sixth Working Conference on Current Measurement in San Diego, in March 1999. The paper, titled "Overview of Hydro-acoustic applications by the U.S. Geological Survey in Indiana," presents an overview of the work, including in-situ applications and mobile applications. For in-situ applications, hydro-acoustic instrumentation is installed and operated at streamflow-gaging stations to produce accurate records of river discharge. Such applications are particularly well suited to presenting data in real-time on the Internet. The paper explains the benefits in precision, efficiency, and safety obtained by the use of hydro-acoustic instruments in the streamflow-gaging program.

Flood Tracking Chart -- The USGS Mississippi and Louisiana Districts recently completed a year-long effort to develop a flood tracking system for the Pearl River Basin in Mississippi and Louisiana. The flood tracking system includes two components, a printed report, "The Flood Tracking Chart for the Pearl River Basin," and the Flood Tracking Web Page. The report, released as USGS Open-File Report 99-53, is a color poster that shows a map of the Pearl

River Basin, the location of real-time streamgaging stations in the basin, and the five highest recorded peak stages at selected stations. The Flood Tracking Web Page (<http://ms.water.usgs.gov>) provides an interactive version of the Flood Tracking Chart that allows users to simultaneously monitor data at several streamgaging stations. The information shown for each selected site includes a plot of the river stage for the previous 3 days and, where available, the National Weather Service (NWS) river stage forecast for the next 3 days. In addition, during flood conditions, the information shown for each site may include the NWS flood-crest forecast and, for comparison purposes, the recorded crests of five previous floods.

InSAR to Monitor Land Subsidence -- The Santa Clara Valley of California was the first area in the U.S. where land subsidence due to ground-water withdrawal was recognized. It is also the first area where organized remedial action was undertaken, and subsidence was effectively halted by about 1969, through a combination of reduced ground-water pumpage and extensive recharge of imported surface water. With the recovery of water levels in the valley, the Santa Clara Valley Water District has proposed to increase ground-water withdrawals during periods of drought, to reduce the extreme reliance on expensive imported water. They set a concurrent goal, however, to limit land subsidence to 0.3 centimeters per year. USGS cooperated with the Santa Clara Valley Water District to test the viability of using InSAR (Interferometric Synthetic Aperture Radar) as a tool to monitor surface displacements associated with land subsidence. InSAR images were produced by USGS from satellite-borne radar data for a short (8 month) period and a longer (5 year) period. Subsidence of about 3 cm was noted for the January to August period in an area centered around San Jose. For the 5-year period between 1992-97, however, the land surface in Santa Clara Valley as a whole rebounded about 3 cm. InSAR has been proven to be an excellent tool for evaluation of land-surface subsidence, with applications to many areas and many problems.

Snyderville/Park City Hydrology -- The Snyderville basin-Park City area, located east of Salt Lake City in the Wasatch Range, is one of the fastest growing residential and recreational areas in Utah. A major constraint to planned development in the area is the availability of water. Water resources of the area are considered to be fully appropriated and the Utah Division of Water Rights needed to know the effects of exchanging existing surface-water rights for ground-water rights to meet future municipal and residential needs. The USGS conducted a study to define the geometry and character of the principal sources for ground-water development, define the principal mechanisms and processes within the hydrologic system, assess the existing quality of water and the potential for degradation, and provide data and analyses from which the effects of future water development could be estimated. The Utah Division of Water Rights has used the conclusions of this study as a basis to form the policy for future ground-water development.

Urban Hazards Initiative -- This USGS multi-divisional program has resulted in development of geographic information system (GIS) methods to efficiently map areas of flood inundation in flood plains. The GIS methods, although not quite as accurate as traditional "on-the-ground" methods, are much less expensive and faster, and produce results that more accurately reflect current conditions than do many existing flood-plain maps, that are outdated due to better estimates of the 100-year flood level. Thus, in the trade off between method accuracy and 100-year flood-level accuracy, the new method finds utility. This new flood-plain mapping method is currently being further developed to allow real-time inundation mapping based on predicted flooding conditions. This real-time method requires coupling the GIS technique with a two-dimensional surface water model, which is being refined and documented under the Urban Hazards Initiative.

Drinking Water Sources in Kansas -- In partnership with the City of Wichita and the Bureau of Reclamation, the USGS is conducting two studies to describe nearly all of the source-water supplies for 350,000 customers in the City of Wichita, Kansas. Current supplies are completely allocated, and the City has adopted a water-supply plan for recharging these sources with excess streamflow from the Little Arkansas River to meet future water demand. The primary role of the USGS study focuses on describing the current water-quality and quantity conditions in the Little Arkansas River and adjacent aquifer, quantifying the effects of demonstration-scale recharge activities, evaluating the effects of agricultural chemicals and sediment on Cheney Reservoir, and providing a baseline of current water-quality conditions to measure the effectiveness of any implemented land-management strategies to maintain future reservoir water quality. Results from these studies help the City to ensure their future water-quantity and quality needs and provide agricultural producers with information about preserving water resources for the future. The recharge demonstration project has received nationwide recognition from water-supply communities, and the watershed study will have national relevance for relating water-quality constituent concentrations and transport to land-use, climatic, hydrologic, or geologic characteristics.

New Bridge-Scour Prediction Equations Improve Estimates of Scour Depths -- Scour is the hole left behind when sediment (sand and rocks) is washed away from the bottom of a river. Although scour may occur at any time, scour action is especially strong during floods, and can pose a threat to the stability and safety of highway bridges, culverts, and other structures that span or are adjacent to rivers and streams. Until recently, the mathematical equations used to predict the scour at bridges overestimated scour depths when compared to actual field observations. Further complicating this issue was the lack of guidelines or supportive field data by which an engineer could modify the theoretical values of scour. As a result, the USGS and the South Carolina Department of Transportation collected both clear-water abutment and contraction scour data at nearly 130 bridges throughout the State. When the field-collected data were analyzed and compared with theoretical scour depths, scientists were able to derive new scour-prediction equations from regression analyses and envelope curves that delineated maximum-observed scour depths at South Carolina bridges. The concepts and tools developed in the South Carolina study may be applicable for use at bridges across the United States. Scientists are planning to take the study one step further by developing a flow model to predict the acceleration of flood flows around bridge abutments.

Water Resources Research Act Program Subactivity

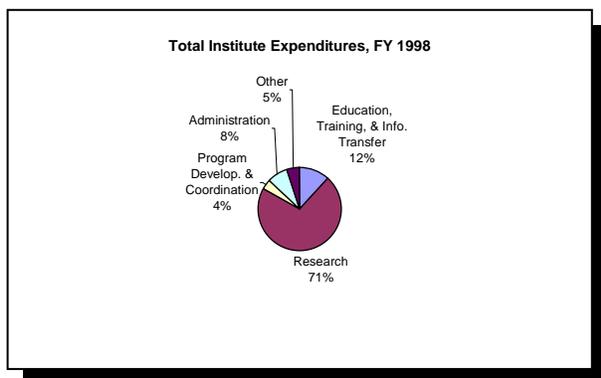
Program	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Water Resources Research Act Program	5,062	+5	0	5,067	+5
Total Requirements \$000	5,062	+5	0	5,067	+5

Current Program Highlights

Section 104 of the Water Resources Research Act of 1984 (P.L. 98-242), as amended by P.L. 104-147, establishes a Federal-State partnership in water resources research, education, and information transfer through a matching grant program that authorizes State Water Resources Research Institutes at land grant universities across the Nation. This program provides an institutional mechanism for promoting State, regional, and national coordination of water resources research and training, and a network of Institutes to facilitate research coordination and information and technology transfer. With its matching requirements, it is also a key mechanism for promoting State investments in such research and training.

Section 104 authorizes a maximum of 57 Water Resources Research Institutes. There are currently 54 Institutes: one in each State, the District of Columbia, Puerto Rico, the Virgin Islands, and Guam, which also serves the Federated States of Micronesia and the Commonwealth of the Northern Mariana Islands. The law requires a non-Federal to Federal cost sharing ratio of 2:1 and specifies that the Federal funds are not to be used to pay the indirect costs of the Institutes. In fact, the Institutes have developed a constituency and a program that far exceeds that supported by their direct Federal appropriation. According to a 1999 report of the National Institutes for Water Resources, in 1998 the Institutes collectively generated over \$14 in support for each dollar appropriated to them through this program, with \$6 coming from other Federal funds and \$8 from non-Federal sources.

Each Institute operates a program of multi-year research, education, and information transfer



projects focused on State and regional water resource priorities. In FY 1998, the Institutes supported more than 800 research projects nationwide, at an average cost of about \$41,000 per project. Though the emphasis varies across the Nation, depending upon State and regional priorities, the most common topics were concerned with surface-water and ground-water quality, toxic substances, and non-point source pollution. The Institutes collaborated with 101 other universities, 192 State agencies, and over 400 private sector or

local government entities. In addition, the Institutes cooperated with over 150 Federal agency contacts. Each Institute, on average, worked with about 14 State and Federal agencies, or other organizations, on research projects.

The Institute program is a primary source of training for water scientists and engineers. In FY 1997, nearly 1,000 students received training by participation in Institute-supported research and information transfer projects. Students trained under this program provide the talent needed to meet the mandates of the many new programs for water resources protection that have come into existence in recent years, and to support the water management initiatives of Federal, State, and local agencies.

Institute Evaluations -- The Water Resources Research Act, as amended, requires that each Institute be evaluated at least every 5 years. Detailed evaluations of all 54 Institutes were conducted in 1999 to determine their eligibility to receive grants. The independent panel which conducted the evaluations concluded that: "the institute program, with its federal-state matching requirements, is an important and significant component of the nation's water resources research infrastructure" and that "the program as a whole is vigorous and surprisingly productive, especially in light of the very limited federal support that it receives." The panel noted, "There are few federal programs that leverage federal dollars with non-federal dollars to the extent that the Water Resources Research Institute program does."

Grant Process for FY 2000 and Beyond -- In conformance with Congressional direction, \$3.8 million of the funds appropriated in FY 2000 will be used to support in each State a program in research, education, and information and technology transfer that has been developed in collaboration with each Institute's State advisory panel. These funds will be allocated equally among the Institutes, with the Institute in Guam receiving grant shares for itself, Micronesia, and the Northern Mariana Islands. The remainder of the funds will be competitively allocated among the Institutes under the provisions of section 104(g) of the Water Resources Research Act, which require that research priorities be developed jointly by the Institutes and the USGS and that the funds be matched on a 1:1 basis. The FY 2001 program will be operated in the same manner.

A lead institute will work with the USGS to solicit, review, and convene a panel to select research projects to be funded nationwide. Proposals seeking up to \$250,000 in Federal funds will be solicited for research addressing problems in non-point source pollution, aquatic habitat, and water management and use. Specific research priorities will be set jointly by the Institutes and the USGS. Proposal selection criteria will favor projects involving collaboration between the USGS and university scientists. Any university or college can apply for a grant through an Institute. The USGS will award the grants, which can be for work over a period of up to 3 years.

Descriptions of the research projects funded under the State Water Resources Research Institute program in FY 1999 are provided on the Internet at:

<http://water.usgs.gov/wrri/projects.html>

Abstracts of the projects funded in FY 2000 and FY 2001 will also be included at that site.

Program Administration -- USGS administration of the program is funded at \$244,000 in FY 2000, and requires two FTEs. The USGS provides \$25,000 to a lead Institute assisting in the administration of the Competitive Grant Program conducted under the provisions of section 104(g) of the Water Resources Research Act.

Recent Accomplishments

State Water Resources Research Institutes -- The Institutes support several hundred projects each year, involving over 1,000 students. The results of this work appears initially in Institute reports and scientific journals. Much of this work results eventually in changes in water management practices. The following are examples of some recent accomplishments which have had, or may soon have, management applications.

- The West Virginia Water Resources Research Institute worked closely with the West Virginia Department of Environmental Protection to develop the State's policy pertaining to disposal in coal mines of fly ash from coal-burning plants. The policy addresses criteria for classification as a beneficial use and identifies application rates for neutralization of acid mine drainage in coal mines. The policy, adopted in 1998, was guided by research conducted by the West Virginia Water Resources Research Institute.
- The current and former Directors of the Water Research Institute at the University of Maine were lead-author and co-author of the 1999 Water Resource Management Plan for Acadia National Park, the first such plan for the Park. The plan will guide management and research at Acadia National Park for the next decade.
- The Louisiana Water Resources Research Institute has implemented a real-time hurricane flood forecasting system. Data are acquired from the National Weather Service and the USGS and incorporated into a version of the Federal Emergency Management Agency's overland hurricane flood prediction model. The resulting forecasts give State and parish emergency managers information as to the area of flooding and the elevation and depth of flooding as much as 72 hours before landfall.
- The Virginia Water Resources Research Center convened and chaired the Virginia Water Quality Academic Advisory Committee. The Committee's report led to an agreement between the State and the USEPA on the proper analysis of limited data for listing impaired waters under section 303(d) of the Clean Water Act. The analytical approach, to be reviewed for national application, seeks to assure that limited funds for total-maximum-daily-load (TMDL) plans are directed to the most threatened waters.
- The Utah Water Resources Research Institute, working with the USEPA and the Lawrence Berkeley National Laboratory, developed a new method for the analysis and assessment of bioremediation at waste sites in Utah and across the Nation. The method uses synchrotron microscopy to measure biological reactions at 10 micron distances in real time. Using this method, researchers have been able to observe real-time degradation of the hazardous chemical pyrene on soil particles.

Under their information and technology programs, the Institutes sponsor seminars, conferences, and workshops, publish newsletters, reports, books, and articles in scientific refereed journals, and produce videos on water related topics. Since 1983, the Institutes have published nearly 1,000 reports of various types each year. Information on 10,000 of these publications is available on computer disk and on the Internet through the National Institutes for Water Resources (NIWR). In 1998, over 20,000 people participated in water conferences sponsored or cosponsored by the Institutes, and the Institutes collectively distributed over 40 newsletters and other non-technical publications to more than 250,000 subscribers.

- Research supported by the Water Resources Research Institute at New Mexico State University has demonstrated the utility of a new assay (test) for toxic chemicals using the bacterium *Rhizobium meliloti* as an indicator organism. The assay can be used to determine the toxicity of herbicides and to follow the fate of herbicides in soil. The procedure, which has been patented, is inexpensive (approximately one-tenth the cost of traditional lab tests) and does not require the use of laboratory animals.
- Research sponsored by the Montana Water Resources Research Center indicates that grazing rough fescue grasslands to a 3 inch stubble height significantly reduces sediment production during the summer months. This level of stubble was better at controlling sedimentation than, for example, very short or very high stubble, and even ungrazed vegetation.
- A three-dimensional numerical simulation model for both ground-water flow and land subsidence developed by University of California scientists with support from the Center for Water and Wildland Resources at the University of California projects the effect of various water management practices on land subsidence in the San Joaquin Valley. The model indicates that maintaining the present combination of surface-water and ground-water withdrawals virtually eliminates unrecoverable land subsidence, but that a transition to combination of less surface water withdrawals and increased ground-water pumping would result in increased land subsidence.

Biological Research

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes ¹	FY 2001 Budget Request	Change from FY 2000
Biological Research and Monitoring	113,232	+1,690	+8,508	123,430	+10,198
Biological Information Management and Delivery	10,484	+259	+10,500	21,243	+10,759
Cooperative Research Units	13,180	+228	+700	14,108	+928
Total Requirements \$000	136,896	+2,177	+19,708	158,781	+21,885

¹ See Program Change Section for details.

Activity Summary

Introduction

The USGS Biological Research Activity generates and distributes information needed in the conservation and management of the Nation's biological resources. This program serves as the Department of the Interior's (DOI) biological research arm and continues the strong traditions for management-oriented research developed within the Department's land management bureaus. Core biological research capability in 16 research centers and associated field stations and 39 Cooperative Research Units supports research on fish, wildlife, and habitats that is used by Federal and State Government and non-governmental organizations. A list of science centers appears at the end of the discussion of the information component. A list of cooperative research units appears in the discussion of that activity.

Information generated by the Biological Research program also contributes to achieving bureau goals for improved management of the Nation's water resources; availability of maps and map data; and improved decisionmaking regarding land and water use. These goals are supported by the efforts conducted in three subactivities: Research and Monitoring, Information Management and Delivery, and Cooperative Research Units.

Research and Monitoring — The USGS serves the needs of DOI bureaus by providing scientific information through research, inventory and monitoring investigations. Biological studies develop new methods and techniques to identify, observe, and manage fish and wildlife and their habitats; inventory populations of animals, plants and their habitats; and monitor changes in abundance, distribution, and health of biological resources through time and in direct relation to their causes. Scientists work to maintain the health, diversity, and ecological balances of biological resources while meeting public needs such as game harvests and the use of public lands and waters.

USGS biologists work toward these goals in collaboration with other scientists, customers, and partners. Biologists combine their expertise with that of the other USGS disciplines in interagency ecosystem initiatives from South Florida to the Pacific Northwest where scientists are working together to understand, evaluate, and provide options for restoring fish and wildlife habitats and better resource management decisions. In a collaborative process, USGS involves

Biological Research

the users of scientific results by engaging them in the identification and prioritization of their information needs as research is planned. DOI bureaus and other customers and partners are involved in this process, and where appropriate, are involved in an adaptive process to find solutions and develop new methods by testing research results in the field.

Information Management and Delivery — The USGS strives to enhance the flow of scientific and technical information and the utility of that information among its partners. Through the development of a National Biological Information Infrastructure (NBII), this program strives to make information from current and previous research accessible to all users. The NBII is linked to the Internet, and will link government and private information sources nationwide to facilitate the rapid sharing of information among researchers and users. Further, the NBII will greatly expand the exposure and usefulness of biological information.

Cooperative Research Units — This cooperative program allows government and non-government entities with common interests and responsibilities for natural resource management to cooperatively address biological resources issues. Through this unique program, biologists from Federal and State Governments and academia are able to work as a team and focus their expertise and creativity on resolution of biological resources issues. Federal support of the Cooperative Research Units program is matched with State and university contributions of expertise, equipment, facilities, and project funding. Through university affiliations, Federal scientists train future natural resource professionals.

Federal Role

The USGS biologists work with others to provide the scientific understanding and technologies needed to support the sound management and conservation of our Nation's biological resources. The USGS works to meet the needs of all DOI bureaus for scientific and technological information concerning biological resources. In addition, other Federal agencies, States, and even private entities are looking to USGS as the premiere source of biological information. The USGS contains one of the Nation's largest collections of expert scientists and technicians in the field of biology. Many outside interests look to the USGS to produce the highest quality biological information available.

Customers and Partners

The USGS is creating a culture in which customers are considered close partners in our research. This focus on knowing and meeting partners' needs, establishing a goal for partner satisfaction and measuring our performance toward reaching that goal has improved the quality of our products and services. The partner Service Plan, revised and published annually, establishes a partner satisfaction goal against which performance is measured.

The biological resources program of the USGS established a goal to provide products to customers that would result in more than 80 percent of them rating their satisfaction with those products as satisfied or very satisfied. A customer survey of the users of the biological products in the 1998 GPR report found that 96% ($\pm 2\%$) were satisfied (46%) or very satisfied (50%), with 350 out of 772 customers responding. Satisfaction with Long-term Data Collections and Management Efforts was 96% ($\pm 3\%$), satisfaction with Systematic Analyses And Investigations Delivered To Customers 97% ($\pm 3\%$), and satisfaction with Decision Support Systems/Predictive

Models was 90% ($\pm 14\%$). All respondents were satisfied with USGS courtesy, 97% ($\pm 2\%$) were satisfied with the product's currentness, 96% ($\pm 2\%$) with the relevance, 94% ($\pm 3\%$) with the completeness, and 93% ($\pm 3\%$) with the timeliness of delivery. In addition to measuring customer satisfaction with different aspects of our products, the survey provided very helpful comments and suggestions from our customers. For example, customers praised the new procedures for electronic reporting of bird banding data, which reduced the reporting burden on banders and facilitated their record keeping, but some found the instructions to be incomprehensible. The feedback verifies successes and identifies features that should be improved.

Biological Research and Monitoring Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes ¹	FY 2001 Budget Request	Change from FY 2000
Biological Research and Monitoring	113,232	+1,690	+8,508	123,430	+10,198
Total Requirements \$000	113,232	+1,690	+8,508	123,430	+10,198

¹ See Program Change Section for details on programmatic decreases (-\$3,992), Decision Support-Resource Management (+\$1,200), Columbia River Aquatic Resources (+\$2,000), Place-based Studies - Yellowstone (+400), DOI Science Priorities Initiative (+\$6,500), Amphibians (+\$1,400), Fish and Wildlife Disease (+\$1,000).

Current Program Highlights

The Biological Research and Monitoring subactivity generates specialized biological research and monitoring information needed to effectively manage and conserve biological resources. Our Nation's biological resources are an invaluable and increasingly vulnerable part of our country's heritage and economy. These resources are varied, widely distributed, and complex. They extend from the polar bear habitats of the Arctic to the seagrass beds of the Florida coast and encompass the aquatic treasures of the Great Lakes and the beauty and extreme conditions of the Southwest deserts. These resources include isolated islands of incredible diversity such as Hawaii and large interconnected waters like the Mississippi River. The types of habitats that we live alongside include mountains, forests, rangelands, wetlands, coasts, and open waters. The products of these habitats provide us with food, energy, medicine, transportation, and enjoyment. These habitats are vulnerable to the adverse effects of many natural and human-induced changes.

Research is needed to reduce and avoid the costs of controlling and eradicating invasive species. These costs may reach \$100 billion annually over the next 50 years. Investigations conducted to evaluate the threats posed by toxic substances can aid in determining the most effective regulations. Studies are required to help contain and eradicate diseases that can devastate regional wildlife populations. Single disease outbreaks have killed 300,000 or more waterfowl and outbreaks resulting in 10,000 or more deaths occur almost every year. Monitoring of environmental conditions and populations is critical to providing the yardstick by which the success of management strategies and resource policies is measured.

Management responsibility for biological resources falls on a number of State and Federal government agencies. The Department of the Interior (DOI) primarily manages Federal lands and biological resources. DOI land and resource management bureaus need the scientific understanding and the technical tools to be able to wisely manage lands and resources on a sustainable basis.

To develop the biologic information needed by land and resource managers, the USGS Biological Research and Monitoring subactivity is organized to include the eight program elements shown in the table below. Grouping science within these program areas provides an opportunity to plan and promote integration and cohesion among individual science projects and allows for periodic evaluations of accomplishments.

The following table displays the Biological Research and Monitoring subactivity funding:

Biological Research and Monitoring Program Areas (\$000)

Program	FY 2000 Enacted	FY 2001 Request
Status & Trends	21,746	21,544
Contaminants	10,970	10,821
Fisheries & Aquatic Resources	14,784	15,409
Wildlife	17,070	19,021
Ecosystems	26,528	26,687
Application of Science Information to Management	3,114	4,286
Endangered & At-Risk Species	13,836	13,353
Invasive Species	5,184	5,803
DOI Science Priorities Initiative	N/A	6,500
Total Biological Research & Monitoring	113,232	123,430

Science Information System

The Science Information System (SIS), an automated query system, has been developed to make biological science activities readily available to all interested parties. The SIS is designed to meet the information needs of scientists and resource managers both within the USGS and Department of the Interior and in partner organizations, client agencies, and special interest groups. Its purpose is to provide a comprehensive scientific information database containing summary descriptions of the objectives, location, funding sources, general approach, and anticipated applications of results of USGS scientific efforts. The SIS database includes metadata on projects that contribute to Biological Research and Monitoring program areas. The SIS (which is component of the National Biological Information Infrastructure, or NBII) may be accessed and queried on the world wide web at <http://cristel.nal.usda.gov:8080/star/brd.html>.

The following describes the Biological Research and Monitoring subactivity by program element:

Status and Trends

Biological status and trends science integrates inventory and monitoring efforts and current historical data sets with a focus on DOI trust resources and lands. This program area seeks to provide an integrated monitoring approach that describes and tracks the abundance, distribution, productivity, and health of the Nation's plants, animals, and ecosystems.

Biological Research & Monitoring Subactivity

It encompasses activities at the landscape, community, population, and genetic levels and develops inventory and monitoring techniques and statistical methods specifically applicable to DOI land and resource management needs. While focused on Department lands, information is also useful to other public and private organizations. Regular assessments and analyses of biological resources help policymakers and the public make informed decisions about their management, while maintaining the health, diversity, and ecological balance of biological resources. The work involves extensive cooperation with Federal, State, and private agencies and organizations.

National Park Monitoring – To deal with natural resource management concerns, a long-term monitoring program evaluates status and trends of representative ecological communities. In national parks in 7 biogeographical regions, USGS scientists assist in the development of the prototype monitoring framework, statistical design and methodology. A goal of the prototype program is to provide high quality methods and tools that can be used in other parks, refuges, or on DOI lands within similar ecological areas.

Bird Monitoring -- Monitoring bird populations is a special emphasis for USGS because of the federal role in conservation of migratory birds. Migratory bird populations surveys provide data for establishing waterfowl hunting regulations and tracking changes in populations of songbirds and seabirds. The USGS maintains the national Bird Banding Laboratory, and the most important bird monitoring database in North America, the Breeding Bird Survey.

Mammal Monitoring -- USGS scientists have partnership efforts to monitor the status and trends of wildlife populations that extend from the Arctic to Yellowstone to the Everglades of Florida. Focal species include polar bears, moose, elk, and manatees.

Amphibian Monitoring – In the face of growing recognition that many species of frogs, toads, and salamanders are experiencing alarming population declines, USGS is stepping up its amphibian monitoring efforts. USGS coordinates the national North American Amphibian Monitoring Program with Federal and State agency partners. (See program change section for more information,)

Fish Monitoring – In cooperation with States, Tribes and other Federal agencies, the USGS collects, analyzes and interprets data on Great Lakes fishery resources and on anadromous and interjurisdictional species on the Atlantic, Pacific and Gulf Coasts. This information is critical to effective regulation of fisheries harvests.

Offshore Environmental Studies (Monitoring) – Offshore environmental studies conducted by the USGS provide environmental monitoring information to the Department's Minerals Management Service (MMS) for use in offshore oil and gas exploration development and production decision making. These data can be used to develop mitigating measures for offshore operations.

Standards and Protocols – USGS scientists are continuing to develop standards and protocols to implement many different inventory and monitoring projects. The protocols include statistical sampling that is important for tracking trends in biodiversity, effects of contaminants, ecological restoration, and many other activities.

Taxonomy, Systematics, and Museum Studies – At the National Museum of Natural History, a major repository of information important in the conservation of species, USGS scientists study variation in natural communities of animals. Curation of North American vertebrate

collections at the Smithsonian Institution provides stewardship of an important scientific database available to scientists from around the world.

Recent Accomplishments

Report on the Status and Trends of the Nation's Biological Resources – In FY 1999, USGS completed a comprehensive report on the Status and Trends of the Nation's Biological Resources. This 4-year project resulted in a two-volume report of 1,000 pages, covering terrestrial and marine biological resources; factors such as natural processes and land use that affect those resources; and regional trends in different areas of the country. This report is a major publication that synthesizes and integrates important natural resource information and makes it available to the public. It is being widely distributed to federal and state agencies, nongovernment organizations, schools, and public organizations.

Quantitative Analysis of Shorebird Monitoring Programs – In FY 1999, USGS scientists completed an analysis and reporting of data from the International Shorebird Survey to estimate the reliability of shorebird monitoring programs conducted during non-breeding periods. The report is playing a central role in development of the National Shorebird Conservation Plan.

Improvements in the North American Breeding Bird Survey (BBS) – The BBS is a long-term continental bird-monitoring program that tracks the status and trends of North American bird populations. The U.S. Fish and Wildlife Service and Partners-in-Flight use this information to make meaningful bird conservation plans and for population data on certain game birds, like band-tailed pigeons, which are not monitored effectively by other surveys. To meet the needs of these agencies the USGS has developed a BBS Internet retrieval site (<http://www.mp2?pwrc.usgs/bbs/retrieval/>) that allows access to BBS data and can process a wide variety of customized data requests.

Contaminants

Fish and wildlife populations are increasingly threatened and imperiled by a wide array of environmental toxins and contaminants. A growing global concern is the effect from exposures to chemical mixtures such as those commonly encountered with industrial development, mining activities, farm irrigation practices, treatment of domestic sewage, and animal feedlot operations.

A critical gap exists in our scientific knowledge concerning the response of fish and wildlife to contaminant mixtures, as well as the effects of contaminants acting in concert with disease. Resource managers in DOI and other Federal, State, and local agencies are faced with increasing fish and wildlife mortality events. The managers need timely and accurate information about the causes and magnitude of mortality and methods to reduce contaminant related impacts and prevent devastating mortalities in the fish and wildlife resources they protect and manage. The US Fish and Wildlife Service, National Park Service, Bureau of Reclamation, and Office of Surface Mining have all expressed a critical need for information on the effects of contaminant mixtures and population-level effects on fish and wildlife resources.

Contaminant research and monitoring is directed at understanding how contaminants affect organisms, populations, and ecosystems. Concurrent long-term biomonitoring is used to assess the effects of contaminants and biological agents on the Nation's biological resources, especially those under DOI stewardship. This work is also dependent on work of Water

Biological Research & Monitoring Subactivity

Resources Toxics programs. Scientists from these divisions work cooperatively to incorporate biological endpoints into the NAWQA program and to use hydrologic expertise to solve water resource problems on DOI lands.

Environmental Toxicological Research – Research includes controlled laboratory and field studies and is directed at understanding environmental contaminants; describing the relative toxicities of individual and mixtures of chemicals to a variety of species; and evaluating cause-and-effect linkages between contaminant stressors and observed impact. Toxicological research involves:

- Evaluating the population-level effects on important species of fish and wildlife caused by exposure to contaminants. This research focuses on DOI trust species and DOI lands.
- Determining the physiological mechanisms through which contaminants affect critical life processes such as growth, reproduction, immunity and the stress response.
- Providing DOI agencies with technical information on the management and prevention of fish and wildlife contaminant mortalities as well as technical assistance, models and technology transfer of novel tools and approaches to mitigate their effects.
- Providing the technical information and assistance for a better understanding of how to restore contaminated and polluted DOI lands.

Biomonitoring of Environmental Status and Trends (BEST) – The BEST Program monitors, identifies, and assesses the effects of environmental contaminants on the Nation’s biological resources, particularly those under the stewardship of the DOI, in order to provide scientific information to guide management actions. Long-term database information provides resource managers with comparisons of broad geographic areas, benchmarks for interpreting results of site-specific investigations, and assessments of temporal changes in exposure and affect.

Recent Accomplishments

Great Lakes Diving Ducks – USGS scientists have identified high selenium concentrations in livers of diving ducks that winter in and migrate through western Lake Erie, Lake St. Clair, and southern Lake Michigan. Selenium concentrations found in livers of over 70% of lesser scaup, bufflehead, and common goldeneye, were either elevated or were above a value considered harmful. Reproductive effects in farm mallards were observed when selenium concentrations exceeded an elevated level in livers. These results may have implications for the nationwide decline of North American lesser scaup populations, which in 1998 were at the lowest recorded levels since breeding waterfowl surveys began in 1955. These data may be used by management agencies, both State and Federal, to aid in the recovery of these species.

Western Reservoir Ecology – USGS, in partnership with the Bureau of Reclamation (BOR), has completed one year of research at western reservoirs located at Elephant Butte, NM; Angostura Unit, SD; and San Pedro River, AZ. Researchers investigated water quality concerns as a part of the Clean Water Action Plan. High concentrations of sulfides in the tailrace of the Elephant Butte Dam have adversely affected the downstream trout fishery and pose potential hazards to the Dam workers. At the Angostura Reservoir and Dam, and the San Pedro River, there are increased concerns about the quality of irrigation drainage into these

reservoirs and its potential harmful effects on fish, wildlife and human health. USGS scientists have collected field data, synthesized available literature, and are analyzing physical and biological samples for contaminants. These data and findings will be used by the management agencies in the restoration of these western reservoirs and downstream waters.

Restoration of Stream Waters Degraded by Acid Mine Drainage – Acid mine drainage (AMD) in the Appalachian coal region has degraded more than 8,000 miles of streams and has left some aquatic habitats virtually lifeless. USGS scientists have developed and received two U.S. Patents for a new process that reduces the risk and cost of restoring AMD degraded waters. Field tests conducted at the Toby Creek Mine Drainage Treatment Plan (Pennsylvania) demonstrated the ability of the process to work effectively under a wide range of operating conditions. Additional field tests are under development in cooperation with The Conservation Fund's Freshwater Institute in Pennsylvania and Maryland as part of a Cooperative Research and Development Agreement with USGS. Results will be most useful in the development of AMD restoration technology for the Appalachian coal mining region.

Biomonitoring of Environmental Status and Trends (BEST) – In FY 1999, the BEST program provided DOI bureaus with a number of products to assess contaminant effects on natural resources. A user guide for the Contaminant Assessment Process was tailored to meet the needs of the U.S. Fish and Wildlife Service and has become part of the Service's standardized process to assess contaminant threats on national wildlife refuges. Summaries of biological characteristics of birds and other species found in coastal habitat (including data on contaminant exposure and effects on these species) are accessible at www.pwrc.usgs.gov/bioeco/. Scientists and natural resource managers regularly use these data to plan assessments and interpret results from their investigations. A comprehensive database of ecotoxicological data for species in Atlantic coastal habitats is accessible at www.pwrc.usgs.gov/ceetv/. This database has been used to identify information gaps, focus biomonitoring efforts, and identify areas for mitigation and restoration. Users of these web sites are from DOI bureaus, other federal agencies, State and local governments, industry, environmental organizations and the public.

Fisheries and Aquatic Resources

Research conducted in the Fisheries and Aquatic Resources program area centers on determination of factors affecting the reproduction, survival and health of fish and other native aquatic fauna including their physiology, behavior, genetics and habitat requirements. The USGS develops and evaluates methods for restoring and managing populations and communities through culture techniques, artificial propagation, and the diagnosis and treatment of disease. Scientists determine the systematics, taxonomy and distribution of species of concern, including identification of populations and their taxonomic relationships, habitat characteristics, resource needs, and the biological integrity of multi-jurisdictional aquatic systems, including the effects and mitigation of habitat alterations on riverine species.

Fish Passage – The USGS maintains a unique environmental laboratory designed to test structures that allow fish to by-pass dams or other obstructions that limit access to spawning grounds affecting the long-term survival of migratory species. Information is developed on physiological, behavioral, and hydraulic phenomena that determine the success of artificial structures intended to allow fish to pass around river obstacles.

Coastal Fisheries – Coastal fishery studies encompass important species on all coasts. Important fishes in San Francisco Bay and small California estuaries, and in Glacier Bay are

being studied on the West coast. On the East coast, work on striped bass restoration includes improving marking methods and developing cost-effective culture techniques. Efforts are underway to better understand food sources of native fishes.

Fish Biology – The USGS fishery research program examines all phases of the life cycles of fish and their habitat requirements. The goal is to relate the research findings to management techniques in order to restore the fish populations. Research on imperiled fishes focuses on interactions with nonnative species while limnological studies examine changes in water quality associated with land-use and diversion and impoundment of streams.

Fish Genetics — Studies in fish genetics characterize variability and taxonomic status of individuals, stocks, races, and populations. Assessed information is used to help manage harvest and determine restoration strategies. Efforts underway include identifying genetic traits for restoration of Atlantic and Pacific salmon and lake trout, cataloguing genetic attributes of fish hatchery stock, and genetic identification of salmon in Alaska to improve stock management.

Fish Disease — Fish disease research focuses on development of better methods for detection of causative agents, fish species resistance to disease, the role of environmental contaminants upon the disease cycle, improved diagnosis of disease, and development of new vaccines. The results are used to understand the factors that control the distribution and transmission of fish diseases and the effects on fish restoration efforts.

Native Mussels — The USGS is a nationwide leader in research and monitoring of native freshwater mussels. Freshwater mussels are an important, but a threatened, component of aquatic ecosystems. The factors that make freshwater mussels excellent indicators of water quality also make them vulnerable to water pollution, sedimentation from upland sources, and habitat destruction. USGS research and monitoring activities identify how invasive species and environmental degradation of streams, rivers and lakes are affecting mussel populations and how remaining populations can be protected. Techniques developed by USGS biologists are being used to hold, propagate, relocate, and reintroduce native mussels, and new methods are being developed to determine their distribution and abundance.

Large Rivers — USGS research related to the unique resources and conditions found in America's large rivers, such as the Missouri, Mississippi, and Columbia, is developing vital information on fish community structure and function, habitat restoration, migratory bird habitat, hydrology and hydraulics of the rivers, degree of sediment contamination, and water quality. This information will be used by water managers to respond to increasing demands and legal mandates for high quality water with reliable and integrated scientific information.

Great Lakes — USGS scientists conduct a regional program of research to develop the knowledge and technical basis for assessing, protecting, and rehabilitating the valuable fishery resources and aquatic habitats in the Great Lakes. The research program includes studies of the biology and dynamics of important sport, food, and forage fish populations, and evaluation of habitat limitations that inhibit successful survival, reproduction, and recruitment of these populations.

Recent Accomplishments

Fish Passage at the Little Falls Dam – Scientists at the Leetown Science Center, working with the Fish and Wildlife Service, Army Corps of Engineers, and State agencies, designed a unique fish

passageway that will allow American shad and other species to pass over the Little Falls Dam on the Potomac River near Washington, D.C. The dam currently prevents fish from reaching their historic spawning grounds. The passageway, developed at the Center's Conte Anadromous Fish Research Laboratory in Turners Falls, MA, includes wedge-shaped weirs designed to slow water velocity for upstream fish migration and to be self-maintained. When construction is completed, the passageway will open a 10-mile stretch of the river for fish spawning.

Whirling disease: research advance – USGS scientists, in their ongoing efforts to assist in the control and management of Whirling Disease in salmonids, have developed a quantitative polymerase chain reaction (QPCR), a molecular technique that amplifies DNA, to enhance our understanding of the life cycle of the causative agent's development. The development of the QPCR opens new doors for in-depth studies of the parasite in the aquatic environment.

Research to determine levels of bacteria shed from fish with Bacterial Kidney

Disease (BKD) – Research on BKD has been hampered by the slow growth rate of the causative agent, *Renibacterium salmoninarum*, by the lack of artificial challenge systems that mimic natural routes of infection, and by a lack of information on the levels of *R. salmoninarum* shed during infection. Scientists at the Western Fisheries Research Center (WFRC) developed reproducible waterborne and cohabitation challenge systems to infect fish and tested levels of bacteria produced during infection that resulted in transmission of the disease to other susceptible fish. Results showed that infections result from exposure to very low concentrations of the bacterium and that the progression of the disease was similar to that observed in hatcheries and nature. The levels of bacteria shed during infection were monitored over time to give scientists a better idea of the period in which the risk to other fish is greatest.

Wildlife

Research conducted in the Wildlife program area focuses on investigations of factors regulating the distribution, abundance, and condition of wildlife populations and communities including their behavior, genetics, and habitat requirements. Studies also evaluate the effects of disease on wildlife populations and communities and the prevention and management of disease in free-ranging biota.

Migratory Game Birds — USGS research on migratory game birds supports the Interior Department's stewardship responsibilities. Much of this work is in cooperation with the FWS and state fish and wildlife departments that have direct responsibility for managing populations and harvests. The USGS provides information needed to protect and enhance waterfowl and other game bird populations on national wildlife refuges waterfowl production areas, and other wildlife management units.

Non-Game Birds — USGS research focuses on environmental factors and human influences on productivity and survival in non-game species. Because of increasing urbanization, as well as agricultural and logging practices, many bird populations are threatened and degraded due to fragmenting and degrading habitats. USGS biologists investigate specific habitat requirements of songbirds, seabirds, shore birds, and eagles.

Large Mammals — Large mammals inhabiting Federal lands are a major concern of land managers, particularly when there are conflicts between populations of these animals and humans or human activities. USGS scientists conduct studies to seek a better understanding of habitat needs and management practices that will reduce conflicts between animals and humans or livestock and reduce damage to vegetation.

Arctic Studies — USGS conducts research in the Arctic to help DOI agencies in Alaska meet their resource management responsibilities.

Wildlife Disease — USGS supports a unique national program dealing with all aspects of wildlife health issues providing research and technical support to the FWS, other Federal agencies, and state fish and wildlife agencies.

Population Modeling — Computer simulation models help wildlife and land managers make difficult decisions when dealing with uncertainty such as arrival of migrants in the spring, selection of nest sites, and survival of nests and broods.

Amphibian Monitoring — USGS scientists are developing quantitative methods for assessing amphibian populations at several geographic scales across the continent. These methods are field tested by resource managers and provide techniques to readily gather information on amphibian changes at local, regional and national scales.

Recent Accomplishments

Population dynamics of white-faced ibis – USGS scientists analyzed population trends and colony dynamics of white-faced ibis breeding in the Great Basin during 1985-1997. The synthesis included all known colonies in six states and incorporated data from state agencies, several U.S. Fish and Wildlife Service Refuges, and others. Results indicate that this Species of Management Concern has nearly tripled in size since 1985. The increase is present in all parts of the range. Colony dynamics indicate the ability of this highly nomadic species to compensate for poor conditions at traditional sites by moving among colonies and rapidly colonizing newly available wetlands. This tendency has major implications for how ibis habitat can best be maintained and how ibis populations can best be monitored. The final product was published as a scientific article in the journal *Colonial Waterbirds*.

Migratory Bird Monitoring – During FY 1999, USGS scientists established migratory bird monitoring sites along the Colorado River corridor between Yuma, Arizona and Moab, Utah, as well as one site at Zion National Park, Utah. Forty-two individuals of six different bird species were equipped with transmitters and were tracked during spring and fall migrations throughout the Colorado River corridor to determine habitat use and availability.

Contaminant analysis of birds on the Salton Sea – Fieldwork began in April 1999 to monitor the nests of a small colony of Great blue herons (GBH) and Great egrets (GREG). These were selected for intensive nest monitoring to determine the effects of contaminants on offspring. Forty-five nests were established during this period, predominantly by GBH. Less than 10 GREG nests were established and contained eggs. Only four GREG nest survived to the point of producing hatchlings, and no GREG nest survived to fledging. Seven GBH nests remained intact and produced fledglings. The Salton Sea routinely experiences severe windstorms during the spring and summer, and the particular area of the Ibis Road colony seems to be especially prone to severe, prolonged high wind events. These extreme winds rip apart fragile nesting structures and the nest themselves.

Brown bear populations on Kodiak Island, Alaska – The brown bear (*Ursus arctos middendorffi*) population of Kodiak Island is significant as a wildlife resource and of management concern because of increasing public. USGS undertook a study to determine the

status of bear populations in representative habitats, investigate ecological factors that influence the bear population, and evaluate interactions between bears and humans. The habitat data and information on interactions between bears and people provide guidance for education programs and commercial operators. Density and population information will provide the foundation of assessing population change and sport harvest.

Public Use and Its Effect on Florida Panthers in Big Cypress National Preserve – Big Cypress National Preserve in Florida comprises approximately one-third of the land where the endangered Florida panther (*Felis concolor coryi*) lives. As a National Preserve, deer and hog hunting are allowed. The National Park Service requested that USGS wildlife biologists evaluate the potential effects of this human activity on the behavior of panthers on the newly acquired lands in the northeast corner of the Preserve. Between 1995 -1998, USGS scientists examined these potential impacts and produced a final report in FY 1999. The study documented a minimum impact by hunting. In addition, it appears the panthers learned to use adjacent lands or in-holdings as refugia during the hunting season.

Ecosystems

Ecosystems program area studies improve knowledge about the complex interactions among the living and abiotic components of the earth's ecosystems. Such interactions include the biogeochemical processes, energy pathways, and the interchanges between and among ecosystems. An important focus is to explain why the observed heterogeneity of biological communities develops across landscapes and to understand the ecological processes involved. Investigations identify, explain, and predict the consequences of short- and long-term environmental changes. Activities include assessing ecosystem vulnerability to adverse effects of environmental change and providing information needed to adapt to and mitigate these effects. Topical areas for Ecosystems research include the ecology of wetlands, forests, and grasslands; landscape ecology; modeling ecological systems; ecosystem restoration; fire ecology; and global change.

The USGS is a leader in research and understanding of the role of land-use change and associated erosion and sedimentation processes on carbon sequestration in sediments. Carbon sequestration is the capture and storage of carbon that would otherwise be emitted to or remain in the atmosphere. Wetlands, shallow estuaries, peatlands, bottomland forests, and arctic tundra and tiaga occupy large areas and have the potential to process large quantities of carbon over short and long time scales. Land use change in the lower 49 States and Alaska is emerging as a major influence on carbon cycling and sequestration. In FY 2001 the USGS plans to refocus some of its work on climate change and wetland processes associated with carbon storage. New work will focus on field based measurements and modeling of the effects of climate and hydrologic change on carbon and nutrient cycling and carbon sequestration, and biological processes in wetlands and riparian areas. Primary focus will be in the lower Mississippi basin region.

Coastal Wetlands/Habitats — Important coastal wetlands and adjacent shallow waters have suffered significant losses this century. USGS biologists investigate coastal wetland structure and function (including Great Lakes habitats) to assess and predict the effects of human activities and environmental change and to measure the effects of management actions. Studies examine the ecological responses of coastal wetlands to stressors, including sea-level rise, carbon dioxide enrichment, and nutrient and contaminant inputs. Research into non-native species effects, the effects of physical disturbances such as canal dredging and filling, hurricanes, and floods are ongoing. Methods and standards for restoring coastal wetlands are

under development, adaptive management evaluations are being conducted, and computer ecological modeling is being conducted to emphasize future predictability and to design restoration and management tools

Outer Continental Shelf Environmental Studies — Information on long-term effects of offshore oil and gas exploration and production activities, including effects of production platforms on fish assemblages and changes to existing biological conditions in areas of potential or new production, is needed. USGS scientists collaborate with the MMS to determine the health and appraise the vulnerability of marine biological communities that could be affected by offshore oil and gas exploration and production.

Coral Reefs — Among the most diverse and biologically complex ecosystems on earth, coral reefs and associated marine habitats appear to be in worldwide decline and the causes are poorly understood. Issues of major concern include coral diseases, water quality and algal blooms, interactions with sea grass beds and mangrove communities, and coral reef fish population dynamics. USGS biologists conduct long-term, integrated research on coral reefs and related ecosystems in Florida, the Caribbean, and Hawaii.

Range and Grasslands — Studies at various scales on native grasslands and managed rangelands are conducted to evaluate range conditions, determine rare plant patterns, appraise species richness, and identify concentrations of native plant diversity. These studies provide managers with baseline information and are the basis for techniques to detect human-induced stress in natural biological communities and for developing management actions for restoring and maintaining the productivity of rangeland ecosystems.

Deserts and Arid Lands — Over the past century in the southwestern U.S., an invasion of shrubs such as creosote bush and mesquite have impacted large expanses of semi-arid grasslands that naturally support a complex mix of plant and animal communities. Livestock and native animal grazing, recreational activities, agricultural use, and other management practices have also affected these communities so land managers need information to protect and restore productive ecosystems. Studies are being conducted into effects such as decreased nutritional content of plants, lower diversity of native species or decreased productivity, decreased water availability, diminished soil microbial populations, and accelerated rates of soil surface erosion.

Prairie Wetlands — The northern prairie pothole region in the Great Plains is the principal breeding ground for waterfowl and other waterbirds and serves as the key staging area for migratory sandhill cranes, shorebirds, and arctic and subarctic-nesting waterfowl. USGS scientists are evaluating the current status of prairie wetland ecosystems, investigating factors influencing wetland use by birds, amphibians, and aquatic macroinvertebrates, and quantifying characteristics of restored wetlands. Research on landscape patterns and the interactions of wetland biota with hydrology, geochemistry, and sediments is focused at basin and landscape scales because prairie pothole wetlands are in fragmented grassland habitats.

Forested Wetlands — Forested wetlands are the most rapidly declining wetland type in North America. USGS scientists are providing technical information needed to manage forested wetlands and their flora and fauna, including both economically valuable species and species at risk. Research focuses on multiple aspects of wetland regeneration and restoration in the Southeastern United States including site selection and preparation; seeds, seedlings, and biodiversity enhancements; planting and management procedures, and monitoring. Scientists

are seeking to quantify the role forested wetlands play in nutrient cycling, the retention of nutrients, and the regulation of nutrients entering waterways.

Global Change — Biologists in the U.S. Global Change Research Program do research in six topical areas to address global climate change effects on: coastal and interior wetlands, western mountains, arid lands, sensitive species and island ecosystems, bird/habitat interactions, and watershed biogeochemistry. Specific projects include the effects of climate change on Great Lakes wetlands, the response of desert vegetation to climate change in the southwest, sea-level rise and impacts on Atlantic Coast migratory birds, and the effects of climate change on carbon and nitrogen biogeochemistry in national parks. Research goals are to: (1) determine sensitivity and response of ecosystems to climate and environmental factors at local, landscape, and regional levels; (2) predict future global change impacts on the structure, function, and viability of natural systems; and (3) assess implications of change for resource management.

Recent Accomplishments

Wood Recruitment and Redistribution in a Coast Range Stream – Trees and large pieces of wood are critical to the structure and function of coastal streams because they affect channel shape, routing and storage of water and sediment, and provide habitat for aquatic and terrestrial organisms. USGS studies demonstrated that processes on local hill slopes and in riparian areas contribute more wood to the channel than do fluvial processes. In smaller streams that drain steep hill slopes, slope instability is the major factor in large wood recruitment while in slightly larger, moderate gradient streams with wider valley floors, wind throw is the primary recruitment process for large woody debris. The results will guide forest management practices.

Wind Erosion of Desert Landscapes – USGS researchers used a portable wind tunnel to measure susceptibility to wind erosion and sediment production in undisturbed and vehicle-disturbed soils in the Chihuahuan, Mojave and Colorado Plateau deserts. Undisturbed desert soil surfaces, protected from wind erosion by surface crusts, produced little sediment but soils experimentally disturbed with vehicles, horses and foot traffic produced up to 36 times the sediment loss of undisturbed surfaces at wind velocities below commonly-occurring wind speeds. This potentially leads to reductions in soil flora that contribute to desert soil stability and to reduced fertility, important factors in desert management and restoration activities.

Fire Effects in California Brushland Ecosystems – USGS scientists have determined that fire suppression in southern and central coastal California shrublands has not altered the frequency and intensity of large wildfires or the natural fire regime. In contrast to coniferous forests, no evidence was found to support the notion that suppression has reduced acreage burned or caused increased fuel accumulation leading to greater fire intensities. Large fires in these shrublands usually occur during Santa Ana winds and burn through all fuel age classes. Prescribed burning to achieve large-scale age class modification are not likely to be effective in altering fire behavior under Santa Ana conditions. Urban sprawl, not fire suppression, may be most responsible for loss of property and lives from brushland fires and resource managers may reexamine prescribed burning programs in California shrublands.

Application of Science Information to Management

The scientific knowledge gained by USGS and other researchers is often made useful to natural resource managers through development of decision support systems that harness vast amounts of scientific data and present it to decision makers in an understandable form. The

"Applications" program works in close collaboration with natural resources agencies to develop the scientific tools that combine advanced technologies with scientific information to assist land managers in making wise management decisions. Development of models and decision support tools assists decision making in such areas as land-use planning, land and water management, timber harvest, wetland management, fish and wildlife management, endangered species policies, invasive species prevention and control, urban development, and other areas involving human interactions with biological resources. These tools incorporate the best available economic, social, and ecological science information to offer alternative ways to balance social and economic needs with natural resource management and conservation. Examples of these efforts include the Upper Mississippi River Decision Support System, VegSpec-Revegetation Tool, Socioeconomic Evaluation of the Conservation Reserve Program, and the Across Trophic Level System Simulation System for decision making in South Florida.

Predictive Population Modeling — Through development of predictive population models, this program assists resource managers in making difficult decisions by reducing the uncertainty associated with population responses to habitat and environmental change. In essence, these models allow managers to project the likely outcome of various management alternatives on populations of plants and animals.

Science for Decision Support Systems — Land and other natural resource managers require strong scientific, social, and economic information to make justifiable management decisions. However, the gap between quality information and management decision making is often pronounced. Decision support systems are computer-based tools that bridge that gap by bringing the best scientific and human dimensions information to bear on specific natural resource issues. This program develops and advances the science associated with decision support systems, thereby ensuring that results from scientific research are directly funneled back into the decision making process of natural resources agencies. This program will be expanded in FY 2001 (see program change section for more information).

State and Tribal Conservation Management — Projects promoted through State partnerships between State and Tribal institutions and USGS field units address high priority conservation and management issues. Projects focus on providing scientific information needed to develop habitat and ecosystem restoration plans, and on enhancing the accessibility of scientific data and information products to State and Tribal land managers.

Adaptive Management — As more and more scientific data accumulate, and natural resource managers learn from their previous management actions, there needs to be a process of integrating that knowledge into future decision making. Adaptive management provides the conceptual foundation upon which future management issues can be successfully addressed. It is a process of evaluating a management problem, determining project objectives, implementing a remedial strategy, monitoring the outcome, and then revising the strategy, if necessary, to achieve stated objectives. This program area forms the foundation for a new era of partnerships, investigation, and management between the science arm of private and public entities and that arm responsible for management and conservation of the Nation's natural resources. Its aim is to close the gap between scientific knowledge and application of that knowledge through strong, on-the-ground collaboration between scientists and state, federal, and private natural resource managers.

Human Dimensions and Socioeconomics — Natural resources management requires a firm understanding of biological, as well as economic and social, issues and processes. Interaction between human communities and their natural surroundings through consumptive and non-

consumptive activities can introduce various changes to ecosystems. Human dimensions studies are used to better understand those human-induced changes, determine the environmental conditions desired by local communities and users of natural resources, and develop information that assists decision-makers in sustaining or restoring healthy ecosystems.

Pacific Northwest Forest Plan — The Pacific Northwest Forest Plan calls for major changes in the management of Pacific Northwest forests on Federal lands to ensure that species associated with old-growth and riparian areas have suitable habitat throughout their ranges. USGS research is identifying the essential habitats and specific life history requirements of sensitive species required to implement the Plan.

Recent Accomplishments

Integrated teams of scientists used novel approaches to provide management alternatives for restoration and conservation of aquatic habitats and wetland ecosystems – New decision support systems and predictive models were developed, including a tool that allows biologists in Louisiana’s Jean Lafitte National and Historical Park and Preserve to predict the outcome of water management alternatives on the health of forested wetlands. Along the Lower Missouri River, application of a new technology (airborne topographic mapping) is providing a new look at the underwater environment, which will offer managers of the Big Muddy National Wildlife Refuge more informed alternatives for restoring migratory bird and fish habitats that were lost during the severe flooding of the mid-1990s. In the upper reaches of the Missouri River, a decision support system was built for the Bureau of Reclamation that forecasts the effects of various reservoir operations on recreational activity, fish populations, riparian tree regeneration, power production, and other environmental, economic, and social considerations. In smaller watersheds, such as that containing Redwood National and State parks in California, scientists continued to refine models that will allow prediction of the impact of erosion and sedimentation from timber harvesting on the integrity of downstream watercourses and riparian habitats.

USGS scientists made major strides in developing and refining management tools and techniques that bolster the probability of successful recovery of high risk species – In response to the widespread concern over the loss of native mussels, biologists worked with the Pennsylvania Department of Transportation to evaluate a means of translocating individual mussels away from bridge and road construction sites, thereby mitigating impacts to those populations. This technique may have broad application in other river systems that have suffered severe declines in mussel populations. In high elevation habitats, predictive models and computer simulations were developed that provide the National Park Service a means of assessing the most effective ways to restore small, isolated populations of bighorn sheep throughout the western United States. In the low elevation Mojave Desert, development of predictive vegetation models and detailed synthesis of a diverse set of scientific information are providing federal, state, and tribal land managers guidance for conservation of endangered and high risk species, such as the desert tortoise.

Endangered and At-Risk Species

Reversing the rapid loss of biological diversity remains the greatest challenge to natural resource managers. Reasons for species' decline include habitat loss from development, agriculture, road building, reservoirs, and mining operations; habitat degradation from fire suppression, livestock grazing, damming and other changes in the amount and quality of water,

and invasions of invasive species; and health effects such as disease and contaminants. Restoring declining populations thus depends on an integrated program of research to develop critical information on the biology of individual species and the ecological relationships between those species and their habitats. Through improved data collection and analysis focused on linking physical, chemical and biological factors with others contributing to alterations in species composition and health, the USGS is providing land and resource managers with additional tools for addressing these issues.

Endangered and At Risk Species research focuses on determining the status and trends of rare species; detecting the point at which species fall into the status of being at risk; identifying factors responsible for the decline of threatened and endangered species; and assisting in the development of management plans and methods to restore depleted populations and to prevent further declines. Most USGS endangered species research supports recovery of species already having legal status under the Endangered Species Act of 1973, as amended. To help managers achieve the goals of recovery plans, USGS scientists investigate the life requirements of listed species and factors limiting their populations. Better knowledge of both requirements and limitations is needed for managers to act effectively to promote restoration of populations.

Endangered Species — USGS endangered species research provides biological information needed to restore currently listed populations, to support de-listing wherever possible, or to preclude future listings by clarifying species' status or suggesting timely preventative actions. Ongoing research provides Federal, State, and private-sector managers more effective tools to restore populations. The key to protecting both species and preventing the listing of additional species occupying the same habitats is habitat conservation planning. In partnership with DOI resource management bureaus and with State and local governments, USGS scientists are providing the kinds of sophisticated technical knowledge required to develop and implement effective habitat conservation plans.

Species at Risk — USGS scientists are also involved in efforts to conserve species before they become listed, thereby avoiding associated constraints and conflicts. Species at Risk projects lead to conservation options and actions that reduce the need for listing species as threatened or endangered. Projects focus on species for which there is concern over possible endangerment, but for which either viable option still exists for long-term protection or additional field evidence is needed to assess the risk. Projects involving population viability analyses and investigations of factors causing the decline of species generate new information to support species protection and restoration efforts.

Recent Accomplishments

Southern California Habitat Conservation Plan – In support of the Coastal Sage Scrub Natural Community Conservation Planning (NCCP) Program in Southern California, USGS scientists at the Western Ecological Research Center are conducting an analysis of existing monitoring efforts and developing a comprehensive ecological monitoring strategy. This effort will help to determine if the ecological system within the 6,000 square mile NCCP planning area is functioning effectively and is self-sustaining. While the research work is still ongoing, major accomplishments include the development of necessary conceptual models for the program at a workshop involving our partner agencies, the expansion of the herpetofaunal monitoring program to include six new sites and initiation of amphibian monitoring sites within the

Cleveland National Forest. Products to date include four reports to client agencies, two book chapters, and a presentation. Details follow:

- The clients are: U.S. Fish and Wildlife Service
National Park Service
California State Parks
California Department of Fish and Game
The Nature Conservancy
U.S. Marine Corps
- Reports: Neotropical migratory bird monitoring study at Marine Corps Base, Camp Pendleton, CA. Fourth Annual Progress Report. Prepared for the U.S. Marine Corps, Environmental and Natural Resources Office, Camp Pendleton, CA, 45 pp.
- Recovery plan for the least Bell's vireo and its riparian habitat (draft). Prepared for the U.S. Fish and Wildlife Service, Carlsbad, CA Field Office.
- Pilgrim Creek Restoration Project: Bird Community and Vegetation Structure. Prepared for the CA Dept. of Transportation, District 11, 34 pp.
- Radio-telemetry study of *Bufo californicus*, arroyo toad movement patterns and habitat preferences. Contract Report for the California Department of Transportation Southern Biology Pool. 66 pp.
- Book Chapters: Case, T.J. and R.N. Fisher. In press. Measuring and Predicting Species Presence: Coastal Sage Scrub Case Study. (for Spatial Modeling Book--product of NCEAS).
- Ver Hoef, J.M. Cressie, N., Fisher, R.N., and T. J. Case. In press. Uncertainty and spatial linear models in ecology. (for Spatial Modeling Book--product of NCEAS).
- Fisher, R.N. and T.J. Case. In press. Distribution of the herpetofauna of southern California with reference to elevation effects. For symposium volume: 2nd Interface between ecology and land development in California.
- Presentation: Research support for urban-wildland planning in Southern California (poster).

Effects of Roads on Desert Tortoise Populations in the Mojave and Colorado Deserts of California – Department of the Interior agencies that manage desert tortoise critical habitat have increasingly more complex questions about effects of roads on tortoise populations—by traffic volume, by effects of potential toxicants and by invasion of alien plants that alter composition of vegetation. USGS geologists and biologists have retrospectively analyzed the effects of roads on distribution of desert tortoises within 1.6 km of the road edge and evaluated the impacts by size and gender. Results will help to determine which roads should have tortoise-proof fencing and whether populations living immediately adjacent to roads are deleteriously affected by toxicants. Alien plant information will be used to develop mitigation measures to reduce invasions via roads. DOI land managers will use these findings as they prepare land-use plans for the Mojave and Colorado deserts.

Restoration of Imperiled Fishes in Southwest Arid Ecosystems – USGS scientists at the Western Fisheries Research Center have developed a quantitative assay for detection of heat-shock proteins that can be used as biomarkers of thermal stress in fish. The assay is being tested in the desert Southwest to assess exposure of fish to thermal stress, a condition to which they may be chronically exposed when water flows are low, as part of a decision support system for use by FWS, NPS, BLM, and State resource agencies for management of desert fishes. This technology has been selected for a patent application by DOI.

Invasive Species

Non-indigenous invasive plants, animals, and disease organisms cause increasing harm to native species and significant economic losses by reducing productivity and foreclosing opportunities for beneficial uses of forests, croplands, rangelands, and aquatic resources. In recent years, many species introduced decades ago have begun to spread rapidly in U.S. ecosystems and pose increasing threats to lands and waters managed by the Department of the Interior. USGS research fills an important niche in Federal efforts to combat invasive species in natural and semi-natural areas through early detection and assessment of newly established invaders, monitoring of invading populations, improving understanding of the ecology of invaders and factors in the resistance of habitats to invasion, development and testing of alternative management and control approaches, and facilitating the availability and integration of information on invasive species. USGS research on invasive species includes all significant groups of invasive organisms in terrestrial and aquatic ecosystems. However, available resources have enabled USGS to intensively study only a small number of the rapidly spreading invaders identified as priority concerns on DOI lands and waters.

A new focus of work in FY 2001 relates to the growing threats from invasive plants, animals, and pathogens to ecosystems, native species, resource-based economic activities, and public recreation. These threats have emerged as a major management issue affecting all regions of the U.S. USGS plays a major role in Federal efforts to combat invasive species under the new Executive Order on Invasive Species. New work will focus on supporting research in ecosystems and ecoregions such as Hawaii, California, and eastern waterways on the ecology of invaders and factors in the resistance of habitats to invasion, modeling to predict probabilities and locations of future invasions, and development of integrated approaches for control of invasive species.

Hawaiian Invaders — Hawaii's flora and fauna, which evolved in a high degree of isolation, are unusually susceptible to selective pressures from invasive species. Hawaii has the largest proportion of non-indigenous species of any state. Its ecosystems are especially vulnerable to the introduction and spread of invasive species due to increasing human travel and trade. USGS research focuses on the ecology and control of highly invasive plants (e.g., miconia, faya tree, strawberry guava, Kahili ginger), including exploration and testing for biological control agents; animals (e.g., Argentine ant, yellow jackets, brown tree snake on Guam); and wildlife disease organisms, and methods for reducing the impacts of invasive species on the region's unique native flora and fauna.

Weeds in the West — The USGS is conducting a multi-scale, integrative program for mapping infestations and accurately monitoring the spread of invasive plants (i.e., weeds) in western forests and rangelands, improving methods for predicting areas most vulnerable to invasions, assessing the effects of management practices and natural disturbances on invasions, and providing improved methods for reducing the impacts of invasive weeds on native species and for restoring public range lands affected by weed invasions.

Invasives in the East — The USGS conducts research on invasive species that are threatening ecosystems and on native species in the eastern states. These efforts include surveys of non-indigenous species in eastern parks and wildlife refuges, studies of pathways for establishment and spread of invasive species, research on the impacts of invasive species and factors in invasions (e.g., management history, natural and human caused disturbances), and

development of methods to control or eliminate invasive species and promote healthy native communities that are resistant to invasion.

Great Lakes Invaders — USGS research supports cooperative efforts in the Great Lakes region to prevent and control the spread of invasive fish, such as the round goby and sea lamprey, reduce the pervasive impacts of zebra mussels on U.S. waterways, and manage or mitigate the adverse ecological and economic impacts of the invaders.

Recent Accomplishments

Control Barriers for Invasive Fish – Scientists at the USGS Great Lakes Science Center helped design, and oversaw construction of a new sea lamprey (*Petromyzon marinus*) barrier on the Ocqueoc River, Michigan. The barrier, which combines two proven technologies of a low-head, and a pulsed electrical barrier, will more consistently block sea lamprey spawning migrations in Great Lakes tributaries. Under normal flow conditions, the low-head barrier blocks spawning-phase sea lampreys, but does not block jumping fishes such as migratory rainbow trout (*Oncorhynchus mykiss*). During spring floods, which generally last less than 3 days but are up to 8 ft deep on the Ocqueoc River, the electrical barrier automatically activates to block all fish passage. Traps incorporated in the new barrier caught about 70% of the sea lamprey spawning migration in 1999, compared to an average catch of about 50% in prior years. The new design will allow the Great Lakes Fishery Commission, in cooperation with the US Fish and Wildlife Service, Canadian Department of Fisheries and Oceans, the eight Great Lakes States, and the Province of Ontario, to expand its sea lamprey barrier program to streams where flooding makes low-head barriers ineffective. Expansion of the barrier program will reduce the number of stream miles treated with chemical lampricides, the only other currently effective method of sea lamprey control.

Techniques for the Control of the Noxious Pepperweed – Non-native vegetation threatens many areas in the U.S., both economically and ecologically. Perennial pepperweed (*Lepidium latifolium*) is an invasive invader throughout western North America that is listed as a noxious weed in 10 states, mostly in the western U.S. The USGS conducted studies at the Malheur National Wildlife Refuge, where this weed has invaded about 10% of meadow habitats and displaced native vegetation. The studies were conducted to determine the most effective and least environmentally harmful treatment to control this weed and to restore native vegetation using integrated pest management techniques. Two herbicides were found to be the most effective treatment, with greater than 90% reduction in pepperweed stems following application. Sheep grazing also was effective and almost completely restricted flower production. Managers at the refuge have taken recommendations from our research and begun applying them in order to control this nonnative weed.

The Impact of Aquatic Mammal Invasions: Nutria – Based on fieldwork in Louisiana, USGS developed a model describing the effects of nutria has on loss of coastal marshes. Analysis of the model indicates that nutria populations remain healthy until their foraging has nearly or completely destroyed the marsh habitat. The research showed that damage from nutria could only be assessed prior to the winter aging of marsh vegetation, and that nutria populations should be controlled in the fall. In a separate study, USGS scientists assisted the State of Louisiana in completing a coastwide survey of nutria damage that documented roughly 100,000 acres damaged by nutria. If damaged areas are not rapidly revegetated, they will convert to open water and will be very difficult and costly to restore.

Impacts of Introduced Avian Diseases on Native Honeycreepers – The introduction to Hawaii of avian pox and avian malaria, along with *Culex* mosquitoes which spread these diseases, has had a heavy impact on native forest bird communities. USGS scientists have taken a leading role in evaluating the effects of these diseases on highly susceptible Hawaiian honeycreepers, one of the most unique and diverse groups of native Hawaiian birds. USGS researchers have developed new diagnostic tools for detecting the diseases, conducted surveys to determine the extent of disease and vector distribution, and tested habitat management strategies for controlling mosquito populations. Ongoing investigations focus on achieving a better understanding of disease and vector ecology, and on the natural evolution of disease resistance in some honeycreeper species.

New Pesticide Application Shows Promise for Reducing Insect Threat to Native Pollinators and Endangered Plants in Hawaii – USGS research at Haleakala National Park continued to refine the use of a strategy for preventing the spread of the invasive and ecosystem-modifying Argentine ant, using aerial application of hydramethylnon (an insect growth-regulator) in a protein bait to the expanding margins of the ant's range. The ant, which has the potential to eliminate native pollinators of the threatened Haleakala silversword, covers 5% of the Park, but has the potential to occupy 50%. Progress during the year included identifying a promising remedy for weaknesses in the current application method.

USGS Completes National Book on Nonindigenous Fishes – In FY 1999, USGS completed a new book that provides detailed information on more than 500 non-native fish species, including methods of introduction, ecological and economic impacts, range maps and identification aids. It represents the state of current knowledge of nonindigenous fishes, and fills a large void by consolidating previously scattered information.

Biological Information Management and Delivery Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes ¹	FY 2001 Budget Request	Change from FY 2000
Biological Information Management and Delivery	10,484	+259	+10,500	21,243	+10,759
Total Requirements \$000	10,484	+259	+10,500	21,243	+10,759

¹ See Program Change Section for details on Decision Support-Resource Management (+\$2,500), Community/Federal Information Partnerships (+\$8,000).

Current Program Highlights

Information and data are critical to scientific discovery and application. Researchers need to know what has been done previously and what is currently being done by other organizations to help guide studies and prevent unnecessary duplication of research and monitoring. Land managers rely on information and data related to biological resources to make informed land management decisions. Databases, maps, and publications are vital sources of this information. Electronic networks enable identification and distribution of this data and information faster than traditional methods and in formats that are easily adaptable for various uses. Rapid access to information will help guide decisions and influence management practices resulting in improved stewardship of the Nation's natural resources.

Research information support is developed and maintained through sound management of the organization's information resources. The infrastructure is comprised of networks, data (spatial and non-spatial), publications (print and electronic), libraries, records management, and standards. Attention must also be directed to planning for requirements of the future as the need to stay current intensifies and new technologies emerge to facilitate the exchange of information among partners and customers. This is accomplished by developing, adapting, and distributing tools and technologies that enhance managers' abilities to use scientific information to answer resource questions, and to share and exchange data and information with others. The goal is to make the broadest possible use of the biological data collected through research and monitoring.

National Biological Information Infrastructure (NBII) — Fundamental to the USGS mission is making biological data, information, and associated technologies more accessible for customers and partners to use in making natural resource management decisions. USGS is leading the cooperative development of the NBII as a "national partnership" for sharing biological information to accomplish this goal.

The NBII uses the capabilities of the World Wide Web and other advanced technologies to establish a distributed "federation" of biological data and information sources through which people can find specific information, retrieve it electronically, and apply it to resource management questions. Partners and customers in this ongoing effort include government agencies at all levels, private sector organizations, natural history museums, libraries, educational institutions, international scientific organizations, and the public.

The USGS continues to work with its partners on four major fronts in implementing the NBII: (1) make the data and information products resulting from USGS biological research and monitoring activities electronically accessible; (2) collaborate with public and private partners to help them make the significant biological data and information they produce more accessible to others; (3) work cooperatively with other agencies and organizations to develop, refine, and provide training on new tools, standards, and technologies that provide the necessary infrastructure components of the NBII federation; and (4) begin development of regional nodes in collaboration with other government agencies and educational institutions.

Gap Analysis — Gap analysis is a scientific method of identifying the degree to which native animal and plant species are represented in our present day mix of conservation lands (those species not adequately represented constitute conservation "gaps"). The Gap Analysis Program (GAP) provides broad geographic information on the status of species and their habitats. From GAP's inception in FY 1988 and through FY 1999, the program has expended approximately \$23 million. The FY 2000 funding level is \$3.4 million. Research and development dominated the GAP agenda through its first decade resulting in ground breaking technical methodologies and standards for conducting projects nationwide. Recent innovations that expand the application of GAP analysis include decision support prototypes for determining impacts of development on biodiversity and providing assessments of key habitats associated with refuges. In addition, digital databases describing statewide land cover assemblages, vertebrate distributions, and characterizations of land stewardship have been created for most of the country.

Standards Development — Standards are developed, adapted, and refined to facilitate the exchange and use of biological data and information among diverse communities using multiple computer platforms and formats. The USGS works with Federal and non-Federal partners to develop and support needed biological data and information standards as part of the NBII program. These include a national standard for scientific names of U.S. plant and animal species, development of biological nomenclature, and a new Federal standard for describing and documenting biological data sets that is based on the Federal Geographic Data Committee's Content Standard for Digital Geospatial Metadata.

Information Resources Management — The Information Resources Management infrastructure includes telecommunications, networking, office automation, records management, computer security, electronic-mail, distributed data systems, applications technologies, and the training, procurement, and technology research necessary to support each of these activities.

Technology Transfer — Technologies are identified, adapted, developed, and distributed to enhance the collection and usability of biological data and information in a variety of formats for various purposes. Included are geographic information systems, remote sensing technologies, global positioning systems, decision support systems, scientific visualization, and computer modeling and simulation tools.

Information Transfer — Information transfer activities are an integral part of all USGS research activities. Information is distributed electronically (through the NBII and through special services such as "Fax-on-Demand"), via print media through the libraries and publications programs, and through other outreach activities (conference exhibits, fact sheets, etc.).

Publications Program — The Publications Program responds to the information needs of customers and partners at local, regional, and national levels. In addition, the program is

actively involved in shaping the field of scientific literature published in peer-reviewed journals through partnerships with publishers and participation in professional scientific information societies. The publications program is linked to the NBII program through joint initiatives designed to promote the creation and collection of citations for scientific information products. The focus of this project is to create tools that assist USGS researchers and publishers in producing information products that document their research and inventory activities. The system will provide a searchable database of USGS information products.

Science Information System — The Science Information System, currently under development, is a web-based database that includes information such as project title, purpose, objectives, investigators, science programs, clients, and partners for all biological research and monitoring activities that are being conducted at the USGS.

Geospatial Initiatives — Geospatial initiatives address the use and application of geographic information systems, remote sensing technologies, global positioning systems, image processing, and telemetry. The initiatives provide strategies and methodologies to meet national goals and plans relating to geospatial data development and management. They also provide guidance for sharing expertise and information. The ability of the USGS to use and apply geospatial technology across all disciplines depends upon its success in transferring this technology to field biologists and researchers as well as offering assistance to partners. Geospatial assistance is provided to a variety of users through the provision of guidance, technical assistance, tools, and training to improve and analyze their natural resources data and information and make it easily accessible.

Recent Accomplishments

National Biological Information Infrastructure — The NBII program (<http://www.nbii.gov>) continues to make significant biological databases and information products broadly accessible over the Internet. This includes biological data and information resulting from USGS research and monitoring, as well as data and information collected and maintained by other agencies and organizations. The USGS worked with partner agencies and organizations to significantly expand the NBII in 1999 by:

Increasing the content in the NBII clearinghouse (<http://www.nbii.gov/clearinghouse.html>), a free, online “catalog” containing complete, accurate descriptions of many hundreds of biological databases and information products.

Developing new Internet-based search and indexing tools specifically designed for biological data. These tools have made it easier for resource managers, researchers, students, and the interested public to use the NBII to find existing data on a given biological resources subject, a certain species, or a certain geographic location.

Assisting partner agencies and organizations in establishing eight new distributed clearinghouse “nodes” of the NBII gateway. New nodes have been established for the USGS National Wetlands Research Center, Environment Canada (Ottawa), Texas/Mexico borderlands area, Eastern Sierras, Wyoming, Texas, New Mexico, and the Olympic Peninsula.

Developing a new standard format for effectively describing biological data sets. The “biological metadata standard” was officially endorsed as a government-wide standard by the Federal Geographic Data Committee.

Providing training on how to use this standard to more than 200 USGS scientists, resource managers and scientists from National Park Service, Fish and Wildlife Service, National Oceanic and Atmospheric Administration, Bureau of Reclamation, Corp of Engineers, and state fish and game agencies and many others.

As a result of these innovations and accomplishments, the NBII was awarded a 1999 “Government Technology Leadership Award” by the *Government Executive* Magazine and was one of only 16 programs across the Federal Government selected as 1999 “Best Feds on the Web.”

Integrated Taxonomic Information System (ITIS) — The USGS works with several other Federal agencies and with taxonomic specialists across the U.S. to continue to enhance and support the only comprehensive national database that provides free access (directly over the Internet) to standard scientific names for all United States plant and animal species.

The ITIS has joined with Canada and Mexico to begin to build a North American base of data and is cooperating with Species 2000 to be part of the global base of data. The ITIS is accessible as part of the NBII and can be used by any customer as a standard reference on plant and animal species names and synonyms, thus making exchange of biological data between two different data sources possible, even when they may have each applied a different scientific name to the same species.

Center for Biological Informatics (CBI) — By facilitating Internet access to a broad array of biological data collections and supporting unique data development activities, CBI helps decisionmakers obtain the information needed to support the sound management and conservation of our Nation’s biological resources. Public and private interests—including university researchers, students, private landowners, and the general public—are also served through these activities. Specific 1999 accomplishments include: *Data development:* This year, in cooperation with Federal, State, university, and local organizations, CBI led or supported biological data collection in 49 States and 20 National Park Service units. Through mapping of vegetation, selected vertebrate species, and current and historical land use patterns, CBI has helped to better characterize our Nation’s environment. To aid in improving *Internet access*, CBI collaborated with State Heritage Programs and Data Centers to provide Internet access to State-developed data.

Accessing Data from Natural History Collections — The USGS is collaborating with other Federal agencies, including the Department of Agriculture, Environmental Protection Agency, and the National Science Foundation, as well as many non-Federal partners in natural history museums and universities around the U.S., in developing new approaches to provide broad electronic access to data on biological specimens of the Nation’s numerous natural history collections. These efforts will result in new NBII Internet-based tools to help customers access, learn from, and use biological specimen information from collections without having to physically visit each museum.

Data from State Fish and Wildlife Agencies and State Heritage Programs — The USGS is working with State fish and wildlife agencies around the U.S. and with the Association for Biodiversity Information, the Nature Conservancy and the network of State natural heritage

programs, in efforts to increase access to the biological data they collect and maintain by these through the NBII. This partnership data important to major USGS programs such as Gap analysis. Furthermore, state and county planners use decision support systems and other technologies developed through the Gap Analysis Program to protect and manage resources.

Habitat Information System — The USGS is currently supporting the development of information and technology transfer activities for habitat management research projects. Projects include the development of tools and decision and information systems for wetlands management, economic and ecological sustainability of the Colorado Plateau, ecology of western reservoirs, and the restoration of soils and plants in disturbed, arid lands.

Expertise Database — The expertise database provides users with access to information about subject matter available within USGS biological science and technology centers. The expertise listing includes a search engine capability so that records may be retrieved using keywords. Users may search the entire database by keyword, browse the entire database for suggestions, or print the expertise list for each USGS science and technology center. The database was established in the summer of 1997.

Publishing Utilities for the Biological Sciences (PUBS) — The PUBS system is a suite of web-based software tools and databases designed to assist in the production, access, and distribution of electronic publications that document biological research activities. The system coordinates the distributed publishing capabilities of the USGS biological science and technology centers and maximizes the visibility and benefits of electronic publishing.

During 1998, the PUBS team developed a database structure and input screens, and began populating a User Profile Database which serves as a searchable directory of users of USGS biological information products, with web-based input screens that permit registration of new users. This database allows biologists and other personnel involved in creating information products the ability to target distribution of the product to the appropriate audience based on self-selected interested areas.

In addition, it provides up-to-date address information to facilitate distribution. In 1998 the team also worked to refine a web-based software tool that speeds the creation and collection of citations about biological information products. Prototyped in 1997, MetaWebber as the tool is called, is now in use throughout USGS biological libraries and programs involved in creating metadata for information products. Metadata created using MetaWebber are being added to the NBII Clearinghouse. Existing publications databases from the science centers are also being converted to MetaWebber records and added to the Clearinghouse.

Providing rapid dissemination and online access to USGS biological science reports and publications is one key component of the overall National Biological Information Infrastructure (NBII) program.

Science Centers

Center Name	Location	FY 2000 Budget (\$000)
Center for Biological Informatics	Lakewood, CO	\$6,044
Program Description: The Center facilitates access to and use of biological data and information through leadership in establishing standards, developing information products, and using information technologies. The Center supports such programs as Gap Analysis, the USGS/National Park Service Vegetation Mapping, and the National Biological Information Infrastructure.		
Upper Midwest Environmental Sciences Center	LaCrosse, WI	\$3,205
Program Description: The Center provides natural resource managers with scientific information needed for effective conservation. The Center's core scientific programs focus on migratory birds, aquatic ecology, environmental contaminants, declining and endangered species, and fishery drug research and development.		
Leetown Science Center	Leetown, WV	\$7,221
Program Description: The Center conducts research to provide information needed to restore, enhance, maintain, and protect fish and other important aquatic and terrestrial organisms and their supporting ecosystems.		
National Wildlife Health Center	Madison, WI	\$4,023
Program Description: The Center provides national and international leadership for addressing health issues involving wildlife resources under Interior's stewardship and to foster partnerships with others to address wildlife health as a component of ecosystem health.		
Patuxent Wildlife Research Center	Laural, MD	\$11,568
Program Description: The Center's activities cover a wide range of approaches to managing the Nation's biological resources including identifying resource issues, establishing monitoring programs, conducting laboratory and field research, managing national databases, and transferring research results to other scientists and resource managers.		
Florida Caribbean Science Center	Gainesville, FL	\$3,608
Program Description: The Center provides natural resource managers with scientific information needed for effective conservation with emphasis on biological resources of the Florida peninsula, the southeastern states, and the Caribbean region. The Center focuses on coastal and marine ecology, restoration ecology, invasive species, and biological diversity.		
Great Lakes Science Center	Ann Arbor, MI	\$6,596
Program Description: The Center provides DOI and other natural resource managers with scientific information needed for restoring, enhancing, managing, and protecting living resources and their habitat in the Great Lakes basin ecosystem. The Center focuses on fish population research, invasive species, terrestrial ecology, and coastal and wetland habitat ecology.		
Midcontinent Ecological Science Center	Fort Collins, CO	\$8,550
Program Description: The Center provides information necessary to understand the causes and predict the consequences of change, including loss of wildlife habitat, threatened and endangered species, contaminated water systems, and global change, in order to improve the conservation and management of natural resources in interior western landscapes.		
Northern Prairie Wildlife Research Center	Jamestown, ND	\$3,576
Program Description: The Center studies biological resources of the Nation's interior grasslands and provides information to DOI and other natural resources managers. The Center focuses on, among other areas, waterfowl ecology, grassland birds, wetlands, grassland and vegetation analysis, amphibian and reptilian taxonomy, and control of invasive plants.		

Center Name	Location	FY 2000 Budget (\$000)
Columbia Environmental Research Center	Columbia, MO	\$5,622
Program Description: The Center provides scientific information in addressing national and international environmental contaminant issues and impacts of habitat alterations on aquatic and terrestrial ecosystems including large river floodplains, coastal habitats, wetlands, and lakes.		
National Wetlands Research Center	Lafayette, LA	\$5,152
Program Description: The Center develops and disseminates scientific information needed for understanding the ecology and values of our Nation's wetlands and for managing and restoring wetland habitats and associated plant and animal communities.		
Northern Rocky Mountain Science Center	Bozeman, MT	\$1,818
Program Description: The Center, the newest in USGS, conducts research and provides scientific assistance to the Greater Yellowstone Ecosystem and other public land managers in the Northern Rockies. The Center's research focuses on Grizzly bears and their ecology, bison, amphibians, trumpeter swans and ecological studies related to fire and climate change.		
Western Fisheries Research Center	Seattle, WA	\$2,351
Program Description: The Center conducts research and provide technical assistance to support the stewardship of the Nation's natural resources, emphasizing fish populations, and aquatic ecosystems of the West. The Center focuses on fish health, fish ecology, and aquatic ecosystems.		
Alaska Biological Science Center	Anchorage, AK	\$6,416
Program Description: The Center provides biological information and research findings to resource managers, policy makers, and the public to support sound management of biological resources and ecosystems in Alaska. The Center's research focuses on arctic and subarctic ecosystems, marine mammal ecology, migratory birds, and terrestrial mammals ecology.		
Pacific Islands Ecosystem Research Center	Honolulu, HI	\$2,550
Program Description: The Center conducts research and provides information and technical assistance relating to conservation of indigenous biological resources of the State of Hawaii and island territories of Guam, Truk, Commonwealth of the Northern Mariana Islands, American Samoa, and others under U.S. jurisdiction in the Pacific basin.		
Western Ecological Research Center	Davis, CA	\$5,791
Program Description: The Center provides biological information and research findings to resource managers, policy makers, and the public to support sound management of biological resources and ecosystems in California, Nevada, Arizona, and Utah. The Center's research focuses on work related to endangered species, waterfowl, amphibians, fire ecology, global change, and others.		
Forest and Rangeland Ecosystem Science Center	Corvallis, OR	\$7,268
Program Description: The Center provides the scientific understanding and technology needed to support sound management and conservation of our Nation's natural resources, with an emphasis on western ecosystems. The Center's programs focus on forest, aquatic, and arid and semi-arid ecosystems; wildlife ecology; landscape dynamics; population viability; restoration; and contaminants.		

Cooperative Research Units Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes ¹	FY 2001 Budget Request	Change from FY 2000
Cooperative Research Units	13,180	+228	+700	14,108	+928
Total Requirements \$000	13,180	+228	+700	14,108	+928

¹ See Program Change Section for details on Cooperative Research Units.

Current Program Highlights

The Cooperative Research Units program is a unique cooperative partnership among Federal and State Governments and academia, and is one of USGS' strongest links to Federal and State management agencies. The program provides the natural resource management community with scientific information and trained personnel to implement sound resource management. Federal scientists stationed at universities:

- X coordinate and implement research programs to meet the information needs of Unit Cooperators and partners;
- X provide access to scientific expertise among Unit scientists, university faculty, and other Unit Cooperators, especially where the required expertise is not readily available within Federal resource agencies; and
- X provide State, Federal and other natural resource managers access to a geographically dispersed science organization of Units to meet information needs that transcend State and regional boundaries.

Federal support of the Cooperative Research Units is augmented by State and university Cooperator contributions of expertise, equipment, facilities, and project funding, thereby enhancing the program's cost-effectiveness. Local guidance of individual Units by Unit Cooperators ensures that projects addressed by the Units are of high priority. Through university affiliations, Unit scientists train future natural resource professionals, and provide opportunities through graduate education to diversify the Federal workforce.

**Cooperative Research Unit Locations
Cooperative Fish and Wildlife Research Units**

Alabama	Auburn University
Alaska	University of Alaska
Arizona	University of Arizona
Arkansas	University of Arkansas, Fayetteville
California	Humboldt State University
Colorado	Colorado State University
Florida	University of Florida
Georgia	University of Georgia
Hawaii	University of Hawaii
Idaho	University of Idaho
Iowa	Iowa State University
Kansas	Kansas State University
Louisiana	Louisiana State University
Maine	University of Maine
Maryland	University of Maryland, Eastern Shore
Massachusetts	University of Massachusetts
Minnesota	University of Minnesota
Mississippi	Mississippi State University
Missouri	University of Missouri
Montana	Montana State University (Fish Unit) University of Montana (Wildlife Unit)
New Mexico	New Mexico State University
New York	Cornell University
North Carolina	North Carolina State University
Oklahoma	Oklahoma State University
Oregon	Oregon State University
Pennsylvania	Pennsylvania State University
South Carolina	Clemson University
South Dakota	South Dakota State University
Tennessee	Tennessee Tech University
Texas	Texas Tech University
Utah	Utah State University
Vermont	University of Vermont
Virginia	Virginia Polytechnic University
Washington	University of Washington
West Virginia	West Virginia University
Wisconsin	University of Wisconsin, Stevens Point (Fish Unit) University of Wisconsin, Madison (Wildlife Unit)
Wyoming	University of Wyoming

Training Projects with Historically Black Colleges and Universities

Arkansas	University of Arkansas, Pine Bluff
Louisiana	Grambling State University

The Unit program consists of 39 Cooperative Fish and Wildlife Research Units located in 37 States, and two undergraduate education programs at Historically Black Colleges and Universities. The Federal Government is responsible for staffing each Unit with two to four

Cooperative Research Units Subactivity

scientists. During FY 99 the Cooperative Research Units program, as directed by Congress, aggressively worked to fill existing science vacancies in Alabama, Alaska, Arizona, Arkansas, California, Georgia, Hawaii, Louisiana, Maine, Massachusetts, New Mexico, Pennsylvania, South Dakota, Tennessee, Vermont, Washington, West Virginia, and Wisconsin. In FY 2000 science vacancies in Arkansas, Louisiana, and Maryland were staffed. Operating support for individual units was increased for the first time in ten years providing units with greater opportunities to partner with their State and university cooperators to address local program needs.

During FY 1999, Unit scientists published more than 380 scientific papers, submitted more than 280 reports to management agencies, and presented more than 750 papers and workshops to natural resource professional societies and agencies. In total, over 1,100 research projects were active in FY 1999, with 200+ projects completed and 200+ new or expanded projects initiated in response to State and Federal agency needs. Unit projects covered a wide range of disciplines, including fisheries and wildlife management, ecosystem management, population biology and genetics, conservation biology, restoration ecology, environmental contaminants and diseases, and aquaculture and fish propagation.

Through affiliations with host universities, Unit scientists advise and mentor more than 600 graduate students. More than 100 of these students received graduate degrees in FY 1999. Activities also involve Unit sponsorship of undergraduate and graduate education programs for minorities that are underrepresented in the Federal workforce. These efforts focus on minority student recruitment and career training in natural resources and include USGS programs for minority students at Grambling University, University of Arkansas-Pine Bluff, and University of Arizona.

Unit research programs will continue to coordinate and address the research needs of multiple agencies at the local, State, regional, and national level. During FY 2000, research and technical services were provided to land and resource managers from the Fish and Wildlife Service, Bureau of Land Management, National Park Service, Bureau of Reclamation, Department of Defense, National Atmospheric and Oceanographic Administration, Department of Agriculture, Environmental Protection Agency, other Federal and state agencies from 37+ states and Puerto Rico.

Recent Accomplishments

Environmental Contaminants - The Texas Cooperative Fish and Wildlife Research Unit determined the sequence of an estrogen receptor-beta in frogs, enhancing the basic knowledge of estrogen receptors in amphibians. This information will be used in investigations of amphibian populations declines by providing techniques to study the effects of environmental contaminants on sex hormone disruption.

The South Dakota Cooperative Fish and Wildlife Research Unit assessed the status of the aquatic biota in Whitewood Creek where mine wastes have accumulated for many years. The study provided information to the U.S. Fish and Wildlife Service for use in a Natural Resource Damage Assessment of the area.

For the Missouri Department of Conservation, U.S. Fish and Wildlife Service, and the Columbia Environmental Research Center, the Missouri Cooperative Fish and Wildlife Research Unit studied the potential impact of environmental contaminants on the endangered Indiana bat. The findings will be incorporated into recovery strategies for this species.

Non-Game Species - For the USGS, the Alaska Cooperative Fish and Wildlife Research Unit conducted a study of Pacific walrus body condition that will assist federal resource managers from several agencies assess the status and health of the Pacific walrus population.

For the National Marine Fisheries Service, the Florida Cooperative Fish and Wildlife Research Unit prepared a manual of research and management techniques for the conservation of sea turtles. More than 60 authors collaborated to present in a single document the latest techniques applicable to sea turtle research. This document will serve to guide global research and management of sea turtles into the 21st century.

For a regional Fishery Bureau in China, the New York Cooperative Fish and Wildlife Research Unit identified information needs, study tasks, and options for restoring a critically endangered fish native to some large rivers of inner Asia. The U.S. Fish and Wildlife Service program to recover endangered fishes of the Colorado River will be used as a model for a recovery effort in China.

Imperiled Species - For the U.S. Fish and Wildlife Service, the Wyoming Cooperative Fish and Wildlife Research Unit developed and tested protocols to enhance the survival of captive-reared black-footed ferrets released into the wild.

For the White Mountain Apache Tribe and the U. S. Fish and Wildlife Service – Arizona Fisheries Resources Office, the Arizona Cooperative Fish and Wildlife Research Unit completed a study on growth and survival of juvenile Apache trout restocked into streams. Apache trout are a threatened species where several existing populations have hybridized with rainbow trout. Project sponsors will use this information to better management of Apache trout.

For the U.S. Fish and Wildlife Service, scientists at the North Carolina Cooperative Fish and Wildlife Research Unit released 49 captive-reared Hispaniolan Parrots in the Dominican Republic and monitored their survival and use of habitat. Survival rates and factors limiting the success of release efforts were identified and are being incorporated into management strategies for the release of the endangered Puerto Rican Parrot into native habitats in Puerto Rico.

Game Management - For the Arkansas Game and Fish Commission and the Rocky Mountain Elk Foundation, the Arkansas Cooperative Fish and Wildlife Research Unit determined habitat use and movement of female elk, landowners' attitudes towards elk on private lands, and prevalence of meningeal worm. Results will be used to understand successes and failures of reintroduced populations of elk in the East and will help Arkansas Game and Fish Commission biologists to better manage elk in Arkansas.

For the Canadian Wildlife Service, Delta Waterfowl and Wetlands Research Station, and the Edward K. Love Foundation, the Missouri Cooperative Fish and Wildlife Research Unit studied the interaction of black ducks and mallards and reaffirmed that competition from mallards has contributed to the decline of the black duck. These findings have important ramifications in developing habitat management programs and establishing hunting regulations for these species by both the Canadian Wildlife Service and the U.S. Fish and Wildlife Service.

For the U. S. Fish and Wildlife Service, the South Dakota Cooperative Fish and Wildlife Research Unit evaluated the effect of the over abundant population of snow geese on shorebirds near Hudson Bay. These findings help understand secondary and tertiary effects of

the over abundant snow goose population and will assist management agencies in developing a justification and strategy for management actions.

Fisheries Management - With funding from the U.S. Fish and Wildlife Service, the Colorado Cooperative Fish and Wildlife Research Unit assimilated from state submissions, all historical information on the occurrence and distribution of fish pathogens and parasites in wild fish. The information gathered has been incorporated into the USFWS National Wild Fish Health database and is being made available to state and federal agencies in their quest to improve the health of the nation's fish populations.

For the National Partnership on the Management of Wild and Native Coldwater Fisheries, the Colorado Cooperative Fish and Wildlife Research Unit determined that hatchery-infected fish are a primary source of whirling disease in salmonids in some Colorado trout waters. These findings helped to further understand how the disease manifests itself in a typical Rocky Mountain trout stream and will aid in the development of management techniques to combat the disease.

For Georgia Department of Natural Resources, the Georgia Cooperative Fish and Wildlife Research Unit completed an assessment of the reproductive success of striped bass in the Chattahoochee River above West Point Lake, Georgia. Results will help Georgia Department of Natural Resources manage the fishery for striped bass in West Point Reservoir and the fishery for stocked brown and rainbow trout in the upper reaches of the river.

Ecosystem Management - For the U.S. Forest Service, the Alaska Cooperative Fish and Wildlife Research Unit evaluated the regional economic responses of the global forest habitats to a range of climate change scenarios associated with different trajectories of global emission controls. The Forest Service now has the capability to assess how international protocols to control the growth of atmospheric carbon dioxide may influence the world's timber trade and to evaluate the potential economic consequences for the U.S. timber sector.

For the National Marine Fisheries Service, the Florida Cooperative Fish and Wildlife Research Unit determined movement and distribution patterns, habitat use, growth rates, and carrying capacity for sea turtles in the Bahamas. Results from this project will be used by the Bahamian government to assess habitats and designate foraging locations for protected area status for the conservation and management of sea turtles.

For the Maryland Department of Natural Resources and Coastal Zone Management, the Maryland Cooperative Fish and Wildlife Research Unit conducted an ecological evaluation of Maryland's coastal bays and facilitated the development of biological protocol for site selection of spoil disposal areas. The biological criteria will be available to evaluate the impact of future projects on the natural resources within Maryland's coastal bays.

Animal Biodiversity, Surveys, and Monitoring - For the National Park Service, the Sonoran Desert Field Station and the Arizona Cooperative Fish and Wildlife Research Unit completed a study on inventory techniques for small mammals and herps on Tonto National Monument. Techniques and information is of interest to management agencies that need to inventory wildlife populations.

For the USGS/BRD, the Colorado Cooperative Fish and Wildlife Research Unit assembled a national database for bat population monitoring data for use by research and management people in North America. The project terminated with a conference on bat monitoring held in

September 1999 in Estes Park, Colorado.

For the U.S. Fish and Wildlife Service, the Colorado Cooperative Fish and Wildlife Research Unit examined banding and recovery data for all species of birds where >30 years of continuous data were available. From these data, we estimated long-term trends in survival probability and estimated components of variance. These results are being used by use by several federal and state management agencies and research groups.

Habitat Management and Restoration Ecology - For the Arizona Game and Fish Department, the Arizona Cooperative Fish and Wildlife Research Unit completed a study on effects of desert waterholes (both natural and man made) on the distribution of small mammals, reptiles, and birds. This information should be used by state and federal management agencies determining whether to develop or maintain waterholes in desert areas.

For the Panther National Wildlife Refuge, the Florida Cooperative Fish and Wildlife Research Unit conducted studies on the effects of fire management on forage at the refuge. The fire management plans of the refuge will be altered to accommodate the finding of this study, providing improved habitat conditions for white-tailed deer, a key prey for the endangered Florida panther.

For the U.S. Geological Survey, the Iowa Cooperative Fish and Wildlife Research Unit examined the effects of field size on population density and nest success of birds nesting in Conservation Reserve Program (CRP) fields in west-central Minnesota. Managers will use these findings to evaluate conservation benefits of the CRP and similar federal programs.

Biometrics and Modeling - For the USGS/BRD, the Colorado Cooperative Fish and Wildlife Research Unit analyzed the extensive striped bass tag recovery and recapture data on the eastern U.S. coast and provided advice to the U.S. Fish and Wildlife Service on improving sampling strategies to optimize use of the data for science-based management of striped bass populations.

For the Iowa Department of Natural Resources and the Iowa Department of Transportation (IDOT), the Iowa Cooperative Fish and Wildlife Research Unit investigated deer-vehicle accidents on Iowa roadways. Data were incorporated into a geographic information system and combined with other USGS data to develop a model using landscape factors to predict where and when the most likely deer-vehicle collisions might occur. Results of this study have been provided to the State of Iowa for deer management and road planning.

For the Pacific Flyway Waterfowl Council, U.S. Fish and Wildlife Service Office of Migratory Bird Management, Ducks Unlimited, Inc., and the California Waterfowl Association, the New York Cooperative Fish and Wildlife Research Unit completed quantitative models for the adaptive harvest management of North American pintail ducks and western mallards. Model sets were then developed that provide a framework for making objective decisions about future management actions for these species.

For the U.S. Fish and Wildlife Service, the North Carolina Cooperative Fish and Wildlife Research Unit developed a deterministic and stochastic version of a wild turkey population model. This was placed on the World Wide Web to make it accessible to any turkey biologist with a PC, internet connection, and web browser. The model is very user friendly, and will be useful to states in establishing hunting regulations.

Cooperative Research Units Subactivity

Other - For the U.S. Geological Survey, the Idaho Cooperative Fish and Wildlife Research Unit used geographic information systems to correlate fire ignition patterns from 1980-1996 with vegetation cover-types, precipitation, and topography within portions of five semi-arid ecoregions in the western U.S. The methods used in this study provide fire managers with a procedure that can be applied at a variety of spatial scales and may be important in evaluating fire danger on the local scale. A large number of municipalities were identified as priorities for fire danger planning, especially in the suburban areas surrounding the major western population centers.

For the U. S. Fish and Wildlife Service – Conte National Fish and Wildlife Refuge, the Massachusetts Cooperative Fish and Wildlife Research Unit compared two wetlands rapid assessment methods to help the refuges in the Connecticut River watershed evaluate wetlands for acquisition or protection.

For the Government of Brazil, the Arizona Cooperative Fish and Wildlife Research Unit found that plants were very efficient at extracting inorganic nitrogen from effluent from fish culture facilities, but that there was insufficient nitrogen in the effluent to provide for optimum plant growth. This information will assist fish culturist to optimize the use of nitrogen from aquaculture effluent, for upland crop production.

For the U.S. Geological Survey and the National Park Service, the Idaho Cooperative Fish and Wildlife Research Unit determined that as presently managed, traffic volume and disturbance did not have an effect on the moose, caribou or grizzly bears along the road corridors in Denali National Park. Wildlife distribution along the road corridor was more keyed to habitat characteristics than any other factor. This information will be incorporated into park management programs.

Science Support

Activity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Change	FY 2001 Budget Request	Change from FY 2000
Science Support	67,104	1,791	2,000	70,895	3,791
Total Requirements \$000	67,104	1,791	2,000	70,895	3,791

Activity Summary

The Science Support Activity provides executive and managerial direction for the bureau and support services to all USGS programs. The Office of the Director provides policy direction, program guidance, and support to the programs and administrative activities of the USGS. Functions also include strategic planning and program coordination, outreach and education, congressional liaison, budget development and execution. The Science Support Activity includes funding for the three USGS regional executive staffs, and a portion of the executive and managerial direction of each of the four major programs of the USGS.

Science Support	
	FY 2001 Request
Bureau Operations	69,919
Payments to the National Business Center	<u>976</u>
Total	70,895

The Office of Program Support provides bureau-level support services that include human resources management; equal opportunity programs; safety and occupational health; financial management; acquisition and grant activities; security; property, supply, mail, and transportation management; and information systems management.

Bureauwide costs are funded in the Science Support Activity. Due to the nature of the organization and billing arrangements, certain essential program support costs are relatively uncontrollable by USGS; therefore, bureauwide costs are budgeted centrally. This includes payments to DOI for services provided through the Departmental Working Capital Fund, unemployment compensation payments to the Department of Labor, and injury compensation payments to the Department of Labor that are unidentifiable to a current program.

FY 2000 Program Highlights

USGS supports initiatives that are part of ongoing Department-wide and Government-wide efforts to implement innovative Federal programs that promote improved Federal management, return appropriate functions to the private sector, and maximize the Federal investment in research by partnering with state, local, private industry, and academia. Highlights of USGS progress on specific initiatives follows.

Reorganization of the Management Structure of the USGS — To increase the efficiency and accountability of USGS decision-making processes, the Director reorganized the bureau's management structure. The Executive Leadership Team (ELT) was established and includes

Science Support

the associate directors of operations, geology, water, geography and biology, three regional directors, and six office chiefs. The office chiefs are the Chief, Office of External Affairs; the Chief, Office of Strategic Plans and Analysis; the Chief, Office of Budget and Organization Analysis; the Chief, Office of Program Support, the Geographic Information Officer, and Chief, Office of Human Resources Management. To improve interaction with USGS customers and facilitate program management by those closest to USGS customers and cooperators, line and administrative authority over programs, budgets, and personnel is in the process of being transferred to the regional directors. To enhance the effectiveness of communications with USGS constituent groups and the public, the Office of the Director was reorganized by combining the congressional and public affairs functions and personnel into an Office of External Affairs.

Financial Management Improvements

USGS received an unqualified audit opinion on its FY 1998 financial statements and anticipates the same for its FY 1999 statements.

USGS increased its use of electronic commerce by:

- Partnering with DOI to develop and test electronic purchasing and invoicing,
- Making over 75% of commercial payments via electronic funds transfer,
- Making practically 100% of salary payments via electronic funds transfer, and
- Delivering on-time payments at a rate of 98.5%.

Collaborative Communication and Office Automation — The USGS has implemented a consistent personal computing desktop throughout all its offices to improve communications and collaboration across the bureau. This system is designed to be state-of-the-art, reliable, and easy to use; and provide consistent service across the entire enterprise. The USGS Collaborative Communication System is composed of a nationwide network of computers running Microsoft Office and Lotus Notes email and electronic calendaring/scheduling. Building on these shared desktop tools, the USGS is in the process of automating manual business practices including document management, workflow automation, electronic meetings and business process automation. The goal is improved internal efficiencies and more responsive service to our customers. USGS has reduced 234 electronic mail server sites to 35 sites that will result in long-term savings in staffing and equipment.

Personnel Automation Initiatives

Online Automated Recruitment System (OARS) is an automated personnel staffing and examining system that replaces manual processes with a fully automated capability to recruit applicants, accept applications, rate candidates' qualifications, and refer high quality candidates for employment consideration. The system was developed and tested, and employees were trained. The system became fully operational for both internal and external applicants during FY 2000.

Student Recruitment System (SRS) is a first-of-its-kind system that allows students using the Internet to learn about the USGS, explore the benefits of working for the USGS and the Federal Government, view student vacancies, and apply for positions on-line. SRS brings employment information directly to students, and it brings an automated and streamlined process of hiring students directly to managers.

Student Placement Assistance System (SPA) is an interactive and database Internet site that allows managers to monitor and track student appointments throughout the USGS to facilitate timely placement of students in permanent positions when they become available.

Implementation of Interior-wide Bank Card — In FY 2000, there was increased card usage in volume and numbers of transactions, reduced number of delinquent accounts, and successful implementation of the Department's daily receipt and payment of the invoices electronically.

Bureau Operations

Science Support	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Bureau Operations	66,128	+1,791	⁽¹⁾ +2,000	69,919	+3,791

¹ See Program Change Section for details on Accessible Data Transfer increase.

Current Program Highlights

Bureau Operations promotes the orderly and efficient conduct of all USGS programs through shared administrative support services, organizational leadership, and promotion of common business practices.

Office of Program Support - Corporate-level support services include the essential functions of financial management, general services and office support, security, safety and occupational health, contract negotiation and administration, grant administration, property management, and information systems management. The Office of Program Support (OPS) provides these support services from three regional locations: the USGS National Center in Reston, Virginia; Denver, Colorado; Menlo Park, California; and one field office in Flagstaff, Arizona.

Bureau Operations	FY 2000 Estimates
Office of Program Support	35,304
Office of Human Resources	9,625
Office of Geographic Information	775
Office of the Director	10,835
Bureauwide Costs	<u>13,380</u>
Total	69,919

Office of Financial Management - The Office administers a Bureauwide financial management program to meet the financial processing, accounting, and fiscal information needs of bureau program managers in support of their scientific mission. The Office also supports the financial management initiatives and fiscal reporting requirements of the Department of the Interior, the Department of the Treasury, and other agencies. The Office

- \$ operates and maintains the USGS financial management system;
- \$ supports USGS headquarters and regional managers with financial management services in support of their scientific activities;
- \$ maintains the Bureau's general ledger;
- \$ processes and categorizes all accounting transactions;
- \$ ensures the integrity of accounting data;
- \$ reconciles data with other Federal agencies;
- \$ summarizes accounting transactions and reports results of operations both internally and externally such as to Dept. of Treasury; and
- \$ provides policies and procedures for USGS financial management operations.

Office of Management Services - The Office is responsible for administering bureauwide programs and providing advice, direction, and guidance in the areas of space, facilities, security, property, energy management, safety, supply, and other general administrative programs. The Office also provides direct services to USGS employees at headquarters and eastern region field locations. Critically important to the support of science mission activities are the Office's

space and facilities services. These include assisting in the development of detailed space requirements and working with the General Services Administration (GSA) on leasing efforts or, for small assignments, leasing directly. During the lease occupancy period, the Office provides lease administration services, from facilitating workplace construction changes to resolving lessor services issues. The Office also assists science managers at field sites with issues of workplace safety and security, and services for mail and printing, transportation, and USGS-unique supplies. One of the most specialized services provided by the Office is the promotion and coordination of technology transfer efforts, including processing patent applications and license agreements, and developing Cooperative Research and Development Agreements (CRADAs).

Office of Acquisition and Federal Assistance - The Office has bureauwide responsibility for the procurement of goods and services from the private sector used in USGS scientific programs and research; the development and dissemination of acquisition and Federal assistance policy and procedures; the development of business strategies for procurement and Federal assistance programs in cooperation with USGS program divisions, and private and public sources; the award and administration of grants and cooperative agreements with educational institutions, state and local governments, and non-profit organizations collaborating with the USGS in various mutually beneficial programs and projects related to the natural sciences; and administration of the bureau-wide charge card program.

Office of Information Services - The Office manages and operates the comprehensive information management services to support the computing, communications, and information technology requirements of the bureau's science mission. The Office provides a variety of information systems support services, including operation of bureau-level administrative systems, Internet and Intranet services, and support for bureauwide computer and telecommunications networks, including management of the Department's network, DOINET. This Office establishes procedures, policies and leadership for bureauwide records management, information architecture infrastructure, and computer security. Through the work of this Office, an efficient and effective information framework forms the foundation on which the science work of the organization can depend.

Field Organization - The Regional Service Centers of the Office of Program Support are located in Menlo Park, California, and Denver, Colorado. A field office is located in Flagstaff, Arizona that reports to the regional office in Menlo Park. These offices work closely with science program managers in their regions/locations to support the technical work of the USGS through acquisition, information technology, facilities, property, and general services. They advise field managers on efficient science support options while remaining in close two-way communication with their functional counterparts in headquarters. Thus, they ensure that bureau science support policy reflects the needs of scientists in the field and that support is provided to the science programs in accordance with that policy.

Office of Human Resources - The Office provides leadership, program direction, and staff support for the corporate-level support services for the essential functions of personnel management and equal opportunity programs of the USGS. These services are provided from three regional locations: the USGS National Center in Reston, Virginia; Denver, Colorado; Menlo Park, California; and from one field office in Norcross, Georgia.

The Personnel Office develops and implements innovative human resources programs that enable the USGS to attract, develop, and retain the best and brightest scientific, technical, and support talent on behalf of the USGS science mission. As a strategic partner with management,

Science Support Activity

the Personnel Office develops creative recruitment plans to attract a diverse, highly-qualified pool of candidates for student, temporary, and permanent employment opportunities; recommends unique approaches to compensation issues, including pay flexibilities, in order to attract and retain candidates of choice; provides employee development, leadership, and mentoring programs to help employees retain state-of-the art scientific and technical skills; and implements quality of life initiatives that provide increased flexibility for managers and employees and allow the USGS to compete for and retain the highly-skilled employees who will help the USGS remain a world leader in the natural sciences. The Office has taken an aggressive leadership position in developing innovative, streamlined, and automated human resources programs to help managers recruit, develop, reward, and retain diverse and highly skilled employees. In addition, the Personnel Office has created new programs that help employees hone their skills, develop their leadership potential, and balance their work and family responsibilities.

The Office of Equal Opportunity enforces and monitors the implementation of all equal opportunity and civil rights laws, regulations, and court decisions through the development, oversight, and evaluation of USGS policies, principles and practices without being an advocate for either management or employees. The Office has taken a proactive leadership approach to increase the effectiveness of the equal opportunity complaints process, and to develop innovative approaches to diversity management, in order to position USGS to meet the challenges of the next century. Significant demographic shifts are expected in the next century that will change the labor pool from which the USGS future workforce will be drawn. A representative workforce will help the USGS interact more effectively with increasingly diverse customers and cooperators.

The Office enhances the scientific mission of USGS and ensures that the bureau continues to provide world-class science by recommending new, and evaluating existing, policies, principles and practices that promote equal opportunity in all activities and programs. These result in the recruitment, development, and retention of a diverse workforce, and create a work environment that values and supports its human resources. Neutral guidance, advice and techniques are provided to help managers and employees understand and value differences. The Office ensures that all USGS employees are provided every opportunity to perform and advance in their careers without discrimination; acts quickly on allegations of discrimination; resolves informal complaints at the lowest possible stage whenever practical; processes formal complaints quickly and resolves them when possible; monitors the accessibility of all facilities and programs for use by individuals with disabilities; and reviews programs or activities receiving Federal Financial Assistance for compliance with non-discrimination laws.

Geographic Information Office (GIO) – The Office provides leadership for bureauwide information technology management through the formulation and evaluation of plans, policies, and strategies to improve the value and reliability of the USGS information technology infrastructure. The infrastructure consists of a framework of hardware, software, data, policies, procedures and people that support the collecting, sharing, serving, delivery, and archiving of information across the bureau. The basis for a common infrastructure is a set of core capabilities that have common application and transparent data formatting across the USGS. The GIO also provides Information Resources Management (IRM) policy guidance throughout the bureau. The office:

- § establish bureau information technology programs, directives, initiatives, standards, technologies, and techniques;

- § formulate technological approaches needed to meet Department IRM initiatives and priorities;
- § guide the development of strategic planning for IRM functions;
- § stimulate the use of innovative information technology solutions by shaping strategic objectives during program planning processes;
- § direct periodic project assessments to determine progress toward completion and realizations of benefits;
- § establish and maintain appropriate working relationships with external organizations to ensure proper coordination of bureau IRM activities with other federal, state, and private sector organizations.

Office of the Director – The Director of the USGS, under the supervision of the Assistant Secretary for Water and Science, formulates USGS policy delegated by the Assistant Secretary and directs all activities of the USGS. The Deputy Director shares the responsibility for direction and coordination of all USGS programs and activities. The Director and Deputy Director are assisted in the management and leadership of the science programs and support activities by the Regional Directors and Associate Directors, who report through the Deputy Director to the Director.

Regional Directors have line authority and are responsible for managing all integrated and place-based science programs and related support activities within their Region. The Regional Directors represent the USGS in all contacts with customers, partners, and stakeholders in their Region.

Associate Directors for Biology, Geology, Geography, and Water share in the planning, direction, and management of the interdisciplinary and integrated programs that contribute to the hazards, environmental, and natural science mission of the USGS. The Associate Directors provide broad oversight to their program divisions to ensure the prevalence and advancement of their respective scientific disciplines. The Associate Directors are responsible for providing management direction and the coordination of scientific and technical resources necessary to carry out the planning, development and accomplishment of the interdisciplinary and integrated science programs of the USGS.

Associate Director for Operations is responsible for planning and managing the development and implementation of policies and strategic and operational plans related to scientific and administrative information systems and information resources management; financial management; acquisition and Federal assistance; facilities, property, space management, and other administrative services; equal employment opportunity and human resources management. The Associate Director for Operations also serves as Chief Financial Officer for the USGS and represents the USGS on Federal level activities related to information resources management through the Geographic Information Officer.

Staff Offices – The staff offices below report to the Director and provide bureau level advice and assistance to the Director and Deputy Director.

- **Budget and Organization Analysis Office** provides bureauwide policy, guidance, and direction for budget formulation, execution, presentation, and advocacy. The Chief serves as Deputy Chief Financial Officer for the USGS.
- **External Affairs Office** is responsible for agency-wide policy, guidance and direction for communicating information about USGS research, programs, activities and products

Science Support Activity

to a broad range of customers and stakeholders including Congress, the news media, other Federal, State and local governments, and the general public. The Office is responsible for liaison and close coordination between the USGS and the Congress, the Department, and other bureaus for congressional and public affairs matters. The Staff serves as a central source of information for congressional inquiries and furnishes information materials and assistance to Congress. In other public outreach activities, the Office coordinates the open houses and other special-event programs and activities. The Office maintains a 7-day-a-week, around-the-clock alert with technical divisions to provide information to news media as quickly as possible about earth hazards and anomalous events such as earthquakes, volcanic eruptions and floods

- **Strategic Planning and Analysis Office** is responsible for advising the Director on science planning and for developing strategies for the formulation and implementation of policies, objectives, programs, and plans that will result in an integrated and interdisciplinary approach to achieving the USGS mission. In addition, the office is responsible for implementation of bureau wide marketing and customer related activities.

Bureauwide Costs – Bureauwide costs are budgeted centrally. Certain essential program support costs are relatively uncontrollable by USGS, and due to the nature of the organization and billing arrangements, are more effectively and efficiently managed centrally. Bureauwide costs include payments to DOI for services provided through the Departmental Working Capital Fund and other charges such as NPR costs, Federal Lab Consortium, Ecosystem Report Card support, Property Management Disposal System, and Coral Reef Task Force. Other bureau level costs include payments for the Federal Personnel/Payroll System; unemployment compensation payments to the Department of Labor, and injury compensation payments to the Department of Labor that cannot be identified to a current program; bureau wide computer system charges; human resources initiatives, and other bureau level administrative initiatives.

Bureauwide Costs	FY 2001 Estimate
DOI Charges	3,322
FPPS	1,836
Reimbursements to the DOL	904
HRI	2,270
Computer Systems Charges	2,356
Other Bureauwide Charges	<u>2,692</u>
Total	13,380

Recent Accomplishments

Strategic Planning –The Strategic and Annual plans were refocused with a Balanced Scorecard approach to unify and align strategy throughout the organization and to reduce Mission goals from 8 to 2 and performance measures from 112 to 10 in FY 2000. The FY 1999 Annual Plan was retrofitted to gain immediate benefit of streamlining, begin trend setting and avoid carrying excess baggage of both sets of measures.

Customer Surveys – In February 1999, the Office of Management and Budget approved a plan developed by the USGS to conduct information collection activities under a three-year generic clearance package. Among the activities conducted in 1999 were a survey of visitors to USGS' web pages that enabled the USGS to find out what customers think of these pages and whether there are opportunities for improvement. Additionally, one of the USGS' major product distribution centers in Denver, CO, has used the approval to obtain feedback from customers by using comment cards that are shipped with every order that this office fills. The USGS will analyze customer data obtained through these information collection activities to improve

service to customers, identify their needs, and to ensure the highest levels of customer satisfaction.

Y2K Supplemental Funding – Supplemental Funding in the amount of \$26.5 million was received to solve potential Y2K problems. The Director's Office provided advice and managed these funds for the Bureau.

Support for Tribal Governments – The FY 1999 Omnibus Appropriations Act and the Water Resources Development Act of 1999 directed the Secretary of the Army to arrange for the USGS to conduct a study of the potential impacts of the transfer of certain lands to Indian Tribes and to an agency of the State of South Dakota. The USGS completed that study and transmitted the results to the Army. The USGS continues to provide technical and educational activities involving more than 140 Tribes, Tribal governments, and Tribal/Native organizations.

Hurricane Mitch -- In the immediate aftermath of Hurricane Mitch, USGS marshaled its scientific capabilities to assess the physical impacts, to help plan actions to be taken in the reconstruction that would mitigate, in short- and long-term, both human and economic impacts of future natural disasters, and took the U.S. Government lead for the development and coordination of data and information needs for the many participating entities.

The USGS partnered with and utilized information from many Federal agencies such as USAID, USACE, USAF, DOD, NOAA, Department of State, HUD, Agriculture as well as non-governmental and humanitarian organizations (World Bank, IDB, PAHO, Red Cross, and others). USGS, through its Center for Integrated Natural Disaster Information (CINDI), compiled all available information into a Hurricane Mitch Central American GIS Disaster Atlas and established an "information central" that provided and coordinated the information needs for all agencies and entities involved.

Once the lifesaving efforts were completed, the USGS sent a series of scientific teams into the region to assess the floods and associated mudflows, the major sources of the death and destruction; to initiate studies to develop an understanding of the geomorphic and hydrologic processes that created the hazards; and undertook a preliminary ecological assessment, including agricultural and livestock resources, to quantify the extent of damage to the ecosystems. Results of these efforts were developed "on the fly" and were provided to disaster planning and humanitarian relief teams, to ensure that relocation and reconstruction would be accomplished out of harms way. Documenting and monitoring these processes and events, and providing the information linkages, were essential contributions to providing a sound, defensible, scientific blueprint for reconstruction that included resettlement, re-establishment of infrastructure, and future hazard mitigation.

Under the Hurricane Mitch Supplemental Appropriation, the USGS science and monitoring efforts in Central America have continued. USGS is now conducting a broad array of investigations that include assessments of geologic, hydrologic, and biological impacts, identification of natural hazards, and the continuing development and maintenance of the information network needed to provide the data that is critical to the successful reconstruction of the disaster area.

Bureau Communications –The Bureau Communications Strategic Plan covering FY 1999-2004 was prepared by the Bureau Outreach Committee to address the bureau strategic plan's long-term goals. The primary intent of the plan was to establish a strong bureau communication infrastructure on which annual program-based communication planning can be

done. Four strategic goals form the core of the plan. The overall intent of these goals is to establish a solid foundation for executing effective communications from all levels of the bureau to targeted audiences with well-defined messages. The four goals are:

- Establishment of a bureau-wide outreach infrastructure;
- Definition of outreach roles and responsibilities of organizational units and employees and the necessary bureau skills to conduct effective outreach;
- Simplification and standardization of Outreach, and
- Inclusion of a communications element in each program element's annual plan.

Natural Disaster Information –From floods in the Pacific Northwest and droughts in the Mid-Atlantic region to earthquakes at home and abroad and hurricanes along the East coast, it's been a busy year of communicating natural disaster information for the Office of External Affairs. During the year the Office arranged for and provided information to numerous national news media outlets. During the interviews, USGS scientists explained the status of hydrologic conditions and the purposes of streamflow gaging stations and the streamflow network and reported earthquake probabilities for the San Francisco Bay and other areas.

Landsat 7 – The Landsat 7, which was launched in April 1999, is collecting and archiving an unprecedented quantity of multi-spectral data each day. These data provide a global view of both seasonal and annual changes in the Earth's environment. The USGS has primary responsibility for capture, processing, and distribution of the data; mission management and maintaining an archive of Landsat and other remotely sensed data. The Office of External Affairs worked closely with the NASA in coordinating the media events related to the launch of Landsat 7, including press briefings prior to, during and after the launch and news releases distributed to national news media.

Payments to the National Business Center

Science Support	2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Payments to the National Business Center	7,483	⁽¹⁾ -6,507	0	976	-6,507

¹ These funds were transferred during FY 2000 by the requirements of Secretary Order establishing the National Business Center.

Current Program Highlights

The Department's National Business Center (NBC) provides efficient and cost effective standardized electronic-based administrative systems and ADP services to USGS. The funds provide management and support services related to the Federal Financial System (FFS), Fixed Assets and Inventory Subsystem, Interior Department Electronic Acquisition System (IDEAS), and the Procurement Data Reporting System.

Facilities

Activity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Facilities	85,618	+2,418	0	88,036	+2,418
Total Requirements \$000	85,618	+2,418	0	88,036	+2,418

Activity Summary

Funds for this activity are used to provide safe and functional workspace and facilities for accomplishing the bureau=s mission. It includes rental payment to the General Services Administration (GSA) and to private lessors for space holdings nationwide; operations and maintenance of USGS real property holdings; and deferred maintenance and capital improvement needs.

Facilities	
	FY 2001 Request
Rental Payments	55,714
Operations & Maintenance	29,332
Deferred Maintenance and Capital Improvement	<u>2,990</u>
Total	88,036

Approximately 60 percent of the requested funds are directed toward the rental payments to the General Services Administration (GSA) and to private lessors for space holdings nationwide. Under the President=s Family Friendly Workplace Initiative, the rental payment are also provided for two day care facilities: one located near the USGS National Center in Reston, Virginia, and the other at the USGS Menlo Park, California, regional center.

The operations and maintenance of USGS real property holdings includes major science centers, research stations, and geomagnetic and seismological observatories. Facilities support services are provided for the National Center and major field centers. The activity provides funding for the USGS= library system that consists of three large regional libraries with multidisciplinary collections (geology, hydrology, cartography, and biology), as well as several smaller libraries with more specialized collections in earth and biological sciences.

Deferred maintenance and capital improvement addresses the USGS= highest priority needs to bring facilities and equipment to meet safety and environmental standards within available resources. The funding will help USGS to maintain and invest capital for its facilities and other mission infrastructure, including the science centers, river cableway structures, and extensive seismic warning networks.

Rental Payments

Facilities	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Rental Payments	54,355	1,359	0	55,714	1,359

Current Program Highlights

Rental Payments funds payments to GSA and to private lessors space occupied by the USGS nationwide. The FY 2001 request funds the appropriated portion of these facilities costs. Rental costs related to reimbursable activities are recovered from reimbursable customers. Although the USGS has unique facility requirements necessary to support its science, it relies heavily on GSA to meet these needs. GSA has been an active partner in providing modern laboratory and other support space, which are key to the efficient and effective performance of USGS research and analysis on a host of critical environmental, natural resources, and hazards concerns.

Recent Accomplishments

The USGS has closely monitored GSA's implementation of new billing policies for Government-owned buildings. Based on occupancy agreements typically covering 10 years, the USGS and GSA have entered into a leveled-rent arrangement for USGS space at Menlo Park, California. At the John Wesley Powell Federal Building in Reston, Virginia, the proposed agreement would change dramatically the traditional funding approach for the USGS share of the costs for the GSA renovation of laboratories. As the latter agreement sets precedents that may apply to future renovations of other USGS-occupied space in GSA-owned buildings, coordination continues to bridge from the old to new pricing policies.

Operations and Maintenance

Facilities	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Operations & Maintenance	29,273	59	0	29,332	59

Current Program Highlights

Facilities Operations and Maintenance funding provides for the routine, daily work necessary for the basic upkeep of facilities, to ensure that facilities are in compliance with Federal, State, and local standards and to ensure that facilities remain safe. Operations and Maintenance includes three program components: Facilities Operation and Maintenance, Facilities Support Services, and Library. The FY 2001 request funds the operations and maintenance costs associated with appropriated work; operations and maintenance costs associated with reimbursable activities are recovered from reimbursable customers.

	FY 2001 Estimate
Operation & Maintenance	16,332
Support Services	6,100
Library	<u>6,900</u>
Total	29,332

USGS owns 37 real property installations that include major Science Centers with complex facilities such as laboratories and chemical storage buildings, and smaller facilities such as research stations, geomagnetic and seismological observatories, and warehouses.

Facilities Operation and Maintenance. Operations and maintenance functions include ongoing facility and equipment support that sustain day-to-day USGS scientific activities at its owned installations. Associated costs are for utilities, fuel, janitorial services, grounds upkeep, waste management, security and safety, hazardous materials pre-disposal storage and removal, preventive and other maintenance to realize the originally anticipated useful life of an asset, salaries, contracts, repairs, rehabilitation, parts replacement, inspections, and similar services and items.

Facilities Support Services. Support Services at each of the three regional centers for USGS program operations include mail and transportation operations; conference/training facility service; moving services; property management; work space layout, assignment, and control; systems furniture design, ordering, and installation; parking; duplicating and printing services; facility safety, industrial hygiene and hazardous materials management; and central receiving, delivery, and warehousing operations.

Recent Accomplishments

Working closely with scientists, GSA, and designers, the construction contract to modernize laboratory space at the National Center was awarded. This \$31 million renovation project with shared cost made up of \$28.1 million from GSA and \$2.9 million from USGS began in August 1999. Construction is anticipated to continue until FY 2004.

Facilities Activity

The USGS and GSA have worked together to initiate a design project to replace four 1,500-ton chillers at the National Center during FY 2000 and FY 2001. This capital improvement is anticipated to cost \$2.5 million and GSA will provide the funding.

A Building Security Committee was established at each USGS-owned facility to facilitate implementation of the Department of Justice minimum-security standards, with a goal of minimizing danger to life and protecting USGS owned facilities. The EROS Data Center and many of the Biological Science Centers have included security upgrades in the Maintenance and Construction Plan FY 2001-2005. GSA and DOI requirements for meeting the Department of Justice minimum-security standards remain to be met and continue to require monitoring to assure eventual compliance.

To assist the programs with establishing classified programs and projects, USGS security managers and staff certified and accredited several special-use facilities and systems. This included the certification of a classified Automated Information System (AIS) for Eastern Region, Geologic Division at the National Center; certification of the Mid-Continent Mapping Center classified AIS Rapid Exploitation System; accreditation of a closed-storage Secret collateral facility for the Northern Prairie Wildlife Research Center; and the review of the architectural drawings and security requirements for a Secret collateral facility to be built in Menlo Park, California.

Deferred Maintenance and Capital Improvement

Facilities	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Deferred Maintenance & Capital Improvement	1,990	1,000	0	2,990	1,000

Current Program Highlights

The USGS participates in the Department of the Interior's Safe Visits to Public Lands initiative and is committed to improving the maintenance of existing facilities and equipment to ensure the health and safety of the public and employees, cultural and natural resource protection, and building codes and standards compliance.

The USGS conducted a detailed inventory of its facilities and equipment needs based on the Department of the Interior's standards and definitions, and developed a plan to address the most critical maintenance and capital improvement projects. The FY 2001 Budget reflects year two of a proposed Five-Year Plan for deferred maintenance and capital improvement. This Plan is subject to adjustments in outyears based on funding levels.

The focus of the Five-Year Plan is addressing critical health and safety needs of USGS installations, streamgaging, and hazards monitoring networks. The identified facility projects include such activities as replacing unsafe laboratories fume hoods to ensure safe ventilation of toxic fumes; repairing buildings; and repairing or replacing building systems such as fire suppression and alarm systems. The plan also includes, as a high priority to the USGS, the repair/replacement of unsafe river cableways used by employees to measure rivers, including flooding rivers. Maintenance and, where required, replacement of the USGS hazards monitoring infrastructure components are high priorities as they are critical to safeguarding the health and safety of people throughout the Nation. Components of some earthquake monitoring networks, for example, were installed over 20-30 years ago so the need exists to replace these infrastructure components before they become unreliable.

The USGS will continue to refine the scope of its project backlog and prioritize our critical projects. In concert with this effort, the USGS is working with the Department and with other bureaus in formulating a strategy for maintenance system automation and developing a condition assessment program. Through the implementation of a condition assessment program, the USGS will establish a cyclic/recurring process for on-site inspections to document deferred maintenance and to measure asset condition.

Recent Accomplishments

Of the total \$1,990,000 funded in FY 2000, the first year of the 5-Year Deferred Maintenance Plan, about \$700,000 is for much-needed repairs at USGS facilities nationwide. The largest project will be the replacement of the fire curtains at the EROS Data Center in Sioux Falls, South Dakota. An example of the significant opportunity that funding provided to address overdue repairs, the project will help overcome a longstanding design deficiency that essentially failed to provide fire protection in the plenum above the ceiling.

The USGS targeted \$341,000 of the deferred maintenance funds to the repair, renovation, or replacement of unsafe river cableways as an initial step in the much larger initiative applying new design and load-testing criteria that will make the structures safer for field technicians. Cableways have been erected across rivers since the early 1900s to allow USGS technicians to directly measure river depths and velocities. Deteriorating cableways crossing rivers pose a significant hazard to employees who use them. Recently, USGS updated the design and load-testing criteria for all cableways. In addition, new technologies are being investigated to develop alternative methods of direct measurement of streamflow to reduce or eliminate the need for field technicians to work directly over rivers suspended from cableways. The cableways at these sites are not able to meet the new design and load-testing criteria. In FY 2000, to ensure employee safety and the collection of required scientific data, \$341,000 will be used to begin to bring these cableways up to the new safety standards, or (where possible) to initiate the redesign of the installation to allow use of a bank-operated system or a modified acoustic doppler current profiler streamflow measurement instrument.

As the USGS has just established a program to eliminate the backlog of deferred maintenance at its facilities and other mission infrastructure, the balance of the funds was tapped to initiate the first standardized assessments of the condition of its assets and establishing priorities, and to develop a maintenance management system. The USGS will work in collaboration with the National Park Service to identify and implement a maintenance system and also to explore system alternatives that would be responsive to the needs of smaller installations.

FY 2001 Maintenance and Construction Plan

FY 2001 Facility Projects	
1	Restoration of research vessel, R/V Sturgeon. Facility -- Great lakes Science Center; State MI; Congressional District - 13. The vessel is an empty hull, therefore the retrofit will include: installation of electrical and plumbing systems; building interior walls/infrastructure, the pilot house; installing a navigation system, hydraulic and steering mechanisms, hydraulics for the science system components, and other components. Project Cost \$504,000.
2	Replace unsafe HVAC and roof. Facility -- Leetown Science Center; State WV; Congressional District - 2; Project number B19980061D. The HVAC is operating in an unsafe and inefficient manner. The operating controls for the boiler have failed and a dangerous condition exists because only the built-in boiler safety systems keep the boiler going. The cooling system is no longer functional. The system air handlers and cooling tower are seriously corroding. The roof is leaking extensively. The water damage will cause masonry unit wall damage. Project Cost \$550,000.
3	Replace Exhaust Fans with Velocity Stacked Exhaust Fans: Facility --EROS Data Center; State SD; Congressional District - 1; Project number M1998EDC003. The existing chemical exhaust fans do not meet code and do not adequately exhaust potentially hazardous fumes from the building intakes. Project Cost \$75,000
4	Replace Hazardous HVAC Distribution System and motor control center: Facility --Upper Midwest Environmental Science Center; State WI; Congressional District - 3; Project number B19990002&12B. The existing air distribution system is constructed of fiberglass ductboard that is deteriorating and is a health hazard. The air distribution system is not capable of meeting OSHA requirements to provide acceptable air quality in work areas (insufficient fresh air and insufficient air volume to dissipate heat). The existing control system is 20 years old and has pneumatic type controls, resulting in unacceptable air quality from airborne fiberglass, excessive temperature and excessive humidity. Replace unsafe motor control center violating OSHA requirement for lockout/tagout provisions and poses electrical shock risk to staff. Project Cost \$235,000
5	Repair unsafe vessel (Kaho) steering mechanism: Facility --Great Lakes Science Center; State MI; Congressional District - 13; Project number B19990001G. Repair critical steering mechanisms & hydraulic systems for vessels. Critical to ensure safe passage by vessel crew. Project Cost, \$50,000.
6	Chemical - Formalin: Facility --Great lakes Science Center; State MI; Congressional District - 13; Project number B19980006G. The present Formalin storage facility is dangerously insufficient. There is no air ventilation or circulation to dissipate toxic and corrosive fumes, and no spill containment for accidents. Shelving does not meet OSHA requirements for chemical storage. Project Cost \$50,000,
7	Replace Unsafe Tractor: Facility -Leetown Science Center; State WV; Congressional District - 2; Project number B19980061. During a safety inspection, the mower was considered unsafe due to no manufactured roll bar. Project Cost \$30,000
8	Remove unsafe buildings: Facility -- Leetown Science Center FM; State WV; Congressional District - 2; Project number B19980028D. Two buildings identified as fire and/or safety hazards by local Fire and Security personnel need to be removed. Project includes removing asbestos and then the local Fire Department will perform a controlled burn for destruction of the buildings. Project Cost \$40,000.
9	Replace boiler exhaust stack: Facility Natural Wildlife Health Center; State WI; Congressional District - 2; Project number B19960010C. The stack is corroding and condensation is leaking into the incinerator room in the Diagnostic Building. The stack transmits combustion gas from the boiler to the outside and if it is not replaced, deterioration will allow combustion gas, carbon monoxide, to eventually leak into the building. The project requires replacing approximately 100 feet of 18" insulated boiler flue which is in our biological containment section of the building. Project Cost \$44,000

Facilities Activity

10	<p>Repairs to 50ft research vessel (Tamnick): Facility -- Alaska Biological Science Center; State AK; Congressional District - 0; Project number B199800980. The research vessel is to be used as a research platform for conducting specialized sampling inherent to the numerous marine-related research projects conducted by staff. Replacement of the global positioning system and life raft with a new Emergency Position Identification Beacon (EPIRB), as well as other structural modifications (safe ladder/dive platform) and a cascade system for storing compressed air will resolve critical safety deficiencies and make the vessel a safer environment for research scientists working at sea. Project Cost \$77,000.</p>
11	<p>Seal Shock Hazard electrical vaults: Facility -- West Fisheries Research Center; State WA; Congressional District - 7; Project number B19970013N. Twelve electrical vaults that house telephone/electrical equipment are unsealed and fill w/rain water. Pumping is required to drain, creating a hazard of shock to employees. Project Cost \$80,000</p>
12	<p>Relocate & Replace existing generator & transfer switch: Facility -- Upper Midwest Environmental Science Center; State WI; Congressional District - 3; Project number B19940001B. The existing generator violates OSHA/NEC regulations & poses a significant health risk to Center staff. Current location of generator results in damage to research specimens due to the transmission of noise and vibration. The existing generator capacity is insufficient to continue electric service in support of critical research needs during an electric utility outage and electrical power for ventilation needs resulting in exposure of laboratory personnel to chemical fumes. This project will permit generator operation and cooperation with utility company yielding significant utility savings. Project Costs \$315,000.</p>

FY 2001 Equipment Projects

1	<p>Microwave Replacement - Facility -- Northern California Seismic Network; State CA; Project number G987160001. Replace earthquake network stations which provide seismic monitoring/warning for large metropolitan areas. The requested funds would be used to replace existing equipment that has exceeded its expected life and that cannot be expected to operate continuously without increased failure rates. The current equipment that supports the network may fail during an emergency, which would limit or possibly prevent adequate response to other Federal agencies, local governments, the private sector, and public needs. Project Cost for FY 2001 \$242,000. (Total need = \$2.0M.)</p>
2	<p>Renovate/Replace active cableways - Facility --139 Sites Nationwide; Project number W1998A10000. Cableways have been erected across rivers since the early 1900s to allow USGS technicians to directly measure river depths and velocities. Deteriorating cableways pose a significant hazard to employees who use them. Recently, WRD updated the design and load-testing criteria for all cableways. In addition, new technologies are being investigated to develop alternative methods of direct measurement of streamflow to reduce or eliminate the need for employees to work directly over rivers suspended from cableways. The cableways at these sites are not able to meet the new design and load-testing criteria. To ensure employee safety and the collection of required scientific data, it is critical to bring these cableways up to the new safety standards, or to redesign the installation to allow use of a bank-operated system or a modified acoustic doppler current profiler streamflow measurement instrument. Total need = \$3,436; remaining costs will be funded in the outyears. Project Cost for FY 2001 \$243,000.</p>

Summary of Requirements by Object Class

(Dollar amounts in millions)

Appropriation: Survey, Investigations, & Research		2000 Estimate		Uncontrollable & related changes		Program Changes		2001 Request	
		FTE	Amount	FTE	Amount	FTE	Amount	FTE	Amount
Object Class:									
11.0	Personnel compensation:								
11.1	Full-time permanent		322		13		2		336
11.3	Other than full-time permanent		26		1		0		27
11.5	Other personnel compensation		8		0		0		8
	Total personnel compensation	6,438	356		14	26	2	6,464	371
12.1	Personnel benefits		80		2		1		83
13.0	Benefits for former personnel		1		0		0		1
21.0	Travel & transportation of persons		24		0		1		25
22.0	Transportation of things		6		0		1		7
23.1	Rental payment to GSA		53		1		0		54
23.2	Rental payments to others		2		0		0		2
23.3	Comm., utilities & misc. charges		14		0		1		15
24.0	Printing and reproduction		3		0		1		4
25.1	Advisory & assistance services		1		0		0		1
25.2	Other services		76		1		15		92
25.3	Purchase of goods & services from Government accounts		38		0		3		41
25.4	Operation & maintenance of facilities		3		0		1		4
25.5	Research & development contracts		4		0		0		4
25.7	Operation & maintenance of equipment		10		0		1		11
26.0	Supplies & materials		28		0		4		32
31.0	Equipment		51		0		8		59
41.0	Grants, subsidies, & contributions		63		0		25		88
42.0	Insurance claims and indemnities		1		0		0		1
	Total Requirements		814		18		64		895

Note: This information is displayed in budget authority, not obligations, by object class.

Summary of Requirements by Object Class

(Dollar amounts in millions)

Appropriation: Survey, Investigations, & Research		2000 Estimate		2001 Request		Increase or Decrease	
Reimbursable Obligations	FTE	Amount	FTE	Amount	FTE	Amount	
11.0	Personnel compensation:						
11.1	Full-time permanent		129	132			3
11.3	Other than full-time permanent		14	14			0
11.5	Other personnel compensation		3	4			1
		<u>146</u>		<u>150</u>			<u>4</u>
	Total personnel compensation	2,797	2,797		0		
12.1	Personnel benefits		32	33			1
21.0	Travel & transportation of persons		10	10			0
22.0	Transportation of things		2	2			0
23.1	Rental payments to GSA		17	17			0
23.2	Rental payments to others		0	0			0
23.3	Comm., utilities & miscellaneous charges		7	7			0
24.0	Printing and reproduction		1	1			0
25.2	Other services		65	59			-6
25.3	Purchase of goods & services from Government accounts		16	13			-3
25.4	Operation & maintenance of facilities		1	1			0
25.5	Research & development contracts		1	1			0
25.7	Operation & maintenance of equipment		3	3			0
26.0	Supplies & materials		13	11			-2
31.0	Equipment		24	21			-3
41.0	Grants, subsidies, & contributions		18	18			0
	Total Requirements	356	347			-9	

United States Geological Survey

Federal Funds

General and special funds:

SURVEYS, INVESTIGATIONS, AND RESEARCH

Program and Financing (in millions of dollars)

Identification Code 14-0804-0-1-300		1999 Actual	2000 Estimate	2001 Estimate
Obligations by program activity:				
Direct Program				
00.01	National mapping program	135	127	155
00.02	Geologic hazards, resources, and processes	230	212	225
00.03	Water resources investigations	209	186	197
00.04	Biological research	155	142	159
00.05	Science support	24	67	71
00.06	Facilities	22	86	88
09.01	Reimbursable program	369	356	347
10.00	Total new obligations	1,144	1,176	1,242
Budgetary resources available for obligation:				
21.40	Unobligated balance available, start of year	12	21	13
22.00	New budget authority (gross)	1,156	1,167	1,242
23.90	Total budgetary resources available for obligation	1,168	1,188	1,255
23.95	Total new obligations	-1,144	-1,176	-1,242
23.98	Unobligated balance expiring	-3	0	0
24.40	Unobligated balance available, end of year	21	13	13
New budget authority (gross), detail:				
Discretionary				
40.00	Appropriation	798	823	895
40.15	Appropriation (emergency)	1	0	0
40.75	Reduction pursuant to P.L. 106-51	-2	0	0
40.76	Reduction pursuant to P.L. 106-113	0	-4	0
41.00	Transferred to other accounts (14-0680)	0	-1	0
41.00	Transferred to other accounts (14-1036)	0	-2	0
41.00	Transferred to other accounts (14-1109)	0	-1	0
41.00	Transferred to other accounts (14-1611)	0	-1	0
41.00	Transferred to other accounts (14-2100)	0	-1	0
43.00	Appropriation (total discretionary)	797	813	895
Spending authority from offsetting collections:				
68.00	Offsetting collections (cash)	371	347	340
68.10	From Federal sources: Change in receivables and unpaid, unfilled orders	-12	7	7
68.90	Spending authority from offsetting collections (total discretionary)	359	354	347
70.00	Total new budget authority (gross)	1,156	1,167	1,242

Surveys, Investigations, and Research Exhibits

United States Geological Survey

Federal Funds

General and special funds:

SURVEYS, INVESTIGATIONS, AND RESEARCH

Program and Financing (in millions of dollars)

Identification Code 14-0804-0-1-300		1999 Actual	2000 Estimate	2001 Estimate
	Change in unpaid obligations:			
	Unpaid obligations, start of year:			
72.40	Obligated balance: start of year	134	113	140
72.95	From Federal sources: Receivables and unpaid, unfilled orders	198	186	193
72.99	Total unpaid obligations, start of year	332	299	333
73.10	Total new obligations	1,144	1,176	1,242
73.20	Total outlays (gross)	-1,166	-1,142	-1,197
73.40	Adjustments in expired accounts (net)	-11	0	0
	Unpaid obligations, end of year:			
74.40	Obligated balance, end of year	113	140	178
74.95	From Federal sources: Receivables and unpaid, unfilled orders	186	193	200
74.99	Total unpaid obligations, end of year	299	333	378
	Outlays (gross), detail:			
86.90	Outlays from new discretionary authority	934	956	1,015
86.93	Outlays from discretionary balances	232	186	182
87.00	Total outlays (gross)	1,166	1,142	1,197
	Offsets:			
	Against gross budget authority and outlays:			
	Offsetting collections (cash) from:			
88.00	Federal sources	-344	-322	-311
88.40	Non-Federal sources	-27	-25	-29
88.90	Total, offsetting collections (cash)	-371	-347	-340
	Against gross budget authority and outlays:			
88.95	From Federal sources: Change in receivables and unpaid, unfilled orders	12	-7	-7
	Net budget authority and outlays:			
89.00	Budget authority	797	813	895
90.00	Outlays	795	795	857

Object Classification

(in millions of dollars)

Identification Code		1999 Actual	2000 Estimate	2001 Estimate
14-0804-0-1-300				
	Reimbursable obligations:			
11.0	Personnel compensation:			
11.1	Full-time permanent	124	129	132
11.3	Other than full-time permanent	14	14	14
11.5	Other personnel compensation	3	3	4
11.9	Total personnel compensation	141	146	150
12.9	Civilian personnel benefits	31	32	33
21.0	Travel & transportation of persons	10	10	10
22.0	Transportation of things	2	2	2
23.1	Rental payments to GSA	17	17	17
23.3	Comm., utilities, and miscellaneous charges	7	7	7
24.0	Printing and reproduction	1	1	1
25.3	Other services	87	65	59
25.3	Purchases of goods & services from Government accounts	15	16	13
25.4	Operation & maintenance of facilities	1	1	1
25.5	Research & development contracts	1	1	1
25.7	Operation & maintenance of equipment	3	3	3
26.0	Supplies & materials	12	13	11
31.0	Equipment	23	24	21
41.0	Grants, subsidies, & contributions	18	18	18
99.0	Subtotal, reimbursable obligations	369	356	347
99.0	Total new obligations	1,144	1,176	1,242

Personnel Summary

Identification Code		1999	2000	2001
14-0804-0-1-300		Actual	Estimate	Estimate
	Direct:			
1001	Total compensable work years: Full-time equivalent employment	6,442	6,438	6,464
	Reimbursable:			
2001	Total compensable work years: Full-time equivalent employment	2,799	2,797	2,797

Working Capital Fund Overview

The USGS Working Capital Fund (WCF) was established to allow for the efficient financial management of the components listed below. The WCF was made available for expenses necessary for furnishing materials, supplies, equipment, work, and services in support of USGS programs, and as authorized by law, to agencies of the Federal Government and others. The WCF consists of both investment components and fee-for-service components, as follows:

Mainframe Computer Investment ◻ This component is used for the acquisition, augmentation, and replacement of the USGS mainframe computer, related peripheral equipment (data storage devices, printers, processors, etc.), software, and necessary environmental and facilities replacement and renovation.

Telecommunications Investment ◻ This component is used for telecommunication hardware, software, facilities, and services. Examples include replacement or expansion of automatic exchange systems and computerized network equipment such as switches, routers, and monitoring systems.

Equipment Investment ◻ This component is used for the acquisition, replacement, and augmentation of equipment for USGS programs. Equipment may include, but is not limited to, hydrologic, geologic, cartographic instruments, laboratory equipment, and computer hardware and software.

Facilities Investment ◻ This component supports facility and space management investment expenses for USGS real property, including owned and leased space. Authorized investment expenses include nonrecurring and emergency repair, relocating of a facility, and facility modernization. The component does not include annual expenses such as rent, day-to-day operating expenses, recurring maintenance, or utilities. The investment component is not used to fund construction of buildings.

National Water Quality Laboratory (NWQL) ◻ The NWQL is a fee-for-services component conducting chemical analysis of water, sediments, and aquatic tissue for all USGS water district offices and other customers including other USGS divisions, other DOI bureaus, and other government agencies. The NWQL also does biological classification for these customers. NWQL analyses services are provided on a reimbursable basis, with the price of services calculated to cover direct and indirect costs.

USGS Hydrologic Instrumentation Facility (HIF) ◻ The HIF provides hydrologic instrumentation on a fee-for-service basis. The facility provides its customers with hydrologic instruments which can be rented or purchased, maintains a technical expertise on instrumentation, and tests and evaluates instruments as they become available in the marketplace.

Publications ◻ This component provides a fee-for-service and investment mechanism for funding the production of publications, which often spans fiscal year boundaries. It is used by internal and external customers to pay costs for the publishing of technical and scientific reports as well as general interest and other publications deemed to be for the public good.

Working Capital Fund

Eastern Region Research Laboratories (ERR) ☐ This component includes two laboratories. The ERR Laboratories perform gaseous dissolved chlorofluorocarbon measurements and isotope-ratio measurements of water, sediments, rocks, and gases for all WRD district offices, other USGS divisions, and OFA=s.

National Training Center ☐ This component conducts fee-for-service USGS training programs. These programs include but are not limited to specialized training for USGS employees, cooperators, and international participants in many facets of hydrology, hydraulics, and water resources investigations, as well as computer applications, management seminars, and various workshops.

Drilling – This component provides drilling services to conduct exploratory drilling for obtaining geologic samples and cores in difficult hydrogeologic environments and the emplacement of sampling devices and sub-surface sensors for hydrologic investigations.

The WCF Components provide a mechanism to assist USGS managers in planning and acquiring goods and services which are too costly to acquire in a single fiscal year or which, due to the nature of services provided, must operate in a multi as opposed to single year basis of funding. Investments are supported by documented investment plans which include estimated acquisition/replacement costs, a schedule of deposits, and approval of the plans, deposits and expenditures by designated USGS officials. WCF Service Components provide a continuous cycle of client services for fees established in a rate setting process and, in some cases, with funding provided by appropriated funds. Fees are predicated upon both direct and indirect costs associated with providing the services, including amortization of equipment required to provide the services.

Appropriation Language and Citations

Permanent authority:

1. Provided further, That in fiscal year 1986 and thereafter, all amortization fees resulting from the Geological Survey providing telecommunications services shall be deposited in a special fund to be established on the books of the Treasury and be immediately available for payment of replacement or expansion of telecommunications services, to remain available until expended.

X **43 U.S.C.50a** This authority established the Telecommunications Amortization Fund which was displayed as part of the Surveys, Investigations and Research appropriation from FY 1986 through FY 1990. After FY 1991, the Telecommunications Amortization Fund was merged into the Working Capital Fund (WCF) described in the next citation.

2. There is hereby established in the Treasury of the United States a working capital fund to assist in the management of certain support activities of the United States Geological Survey (hereafter referred to as the ASurvey@), Department of the Interior. The fund shall be available on and after November 5, 1990 without fiscal year limitation for expenses necessary for furnishing materials, supplies, equipment, work, facilities, and services in support of Survey programs, and, as authorized by law, to agencies of the Federal Government and others. Such expenses may include laboratory modernization and equipment replacement, computer operations, maintenance, and telecommunications services; requirements definition, systems analysis, and design services; acquisition or development of software; systems support services such as implementation assistance, training, and maintenance; acquisition and replacement of computer, publications and scientific instrumentation, telecommunications, and related automatic data processing equipment; and, such other activities as may be approved by the Secretary of the Interior.

There are authorized to be transferred to the fund, at fair and reasonable values at the time of transfer, inventories, equipment, receivables, and other assets, less liabilities, related to the functions to be financed by the fund as determined by the Secretary of the Interior. Provided, That the fund shall be credited with appropriations and other funds of the Survey, and other agencies of the Department of the Interior, other Federal agencies, and other sources, for providing materials, supplies, equipment, work, and other services as authorized by law and such payments may be made in advance or upon performance: Provided further, That charges to users will be at rates approximately equal to the costs of furnishing the materials, supplies, equipment, facilities, and services, including such items as depreciation of equipment and facilities, and accrued annual leave: Provided further, That all existing balances as of November 5, 1990, from amortization fees resulting from the Survey providing telecommunications services and deposited in a special fund established on the books of the Treasury and available for payment of replacement or expansion of telecommunications services as authorized by Public Law 99-190, are hereby transferred to and merged with the working capital fund, to be used for the same purposes as originally authorized. Provided further, That funds that are not necessary to carry out the activities to be financed by the fund, as determined by the Secretary, shall be covered into miscellaneous receipts of the Treasury.

Working Capital Fund

- X **P.L. 101-512 Department of the Interior and Related Agencies Appropriations Act, 1991** This authority established a Working Capital Fund account in FY 1991. The Telecommunications Amortization Fund was included as part of the WCF and all balances of the Telecommunications Amortization Fund existing at the end of FY 1990 were transferred to the WCF. These balances were to be used for the same purposes as originally authorized.

- X **P.L. 103-332 Department of the Interior and Related Agencies Appropriations Act, 1995** The amendments that were made in this Appropriations Act are shown in underline. This authority expanded the use of the Working Capital Fund to partially fund laboratory operations and facilities improvements and to acquire and replace publication and scientific instrumentation and laboratory equipment.

United States Geological Survey

Federal Funds

General and special funds:

WORKING CAPITAL FUND

Program and Financing (in millions of dollars)

Identification Code 14-4556-0-4-306		1999 Actual	2000 Estimate	2001 Estimate
	Obligations by program activity:			
10.00	Total new obligations	42	42	37
	Budgetary resources available for obligation:			
21.40	Unobligated balance available, start of year	21	44	33
22.00	New budget authority (gross)	54	31	36
22.10	Resources available from recoveries of prior year obligations	11		
23.90	Total budgetary resources available for obligation	86	75	69
23.95	Total new obligations	-42	-42	-37
24.40	Unobligated balance available, end of year	44	33	32
	New budget authority (gross), detail			
	Mandatory:			
68.00	Offsetting collections (cash)	56	31	36
68.10	From Federal sources: Change in receivables and unpaid, unfilled orders	-2	0	0
68.90	Spending authority from offsetting collections (total mandatory)	54	31	36
	Change in unpaid obligations:			
	Unpaid obligations, start of year:			
72.40	Obligated balance: start of year	30	2	2
	From Federal sources: Receivables and unpaid, unfilled orders	10	8	8
72.99	Total unpaid obligations, start of year	40	10	10
73.10	Total new obligations	42	42	37
73.20	Total outlays (gross)	-60	-42	-37
73.45	Adjustments in unexpired accounts	-11	0	0
	Unpaid obligations, end of year:			
74.40	Obligated balance, end of year	2	2	2
74.95	From Federal sources: Receivables and unpaid, unfilled orders	8	8	8
74.99	Total unpaid obligations, end of year	10	10	10

Surveys, Investigations, and Research Exhibits

United States Geological Survey

Federal Funds

General and special funds:

WORKING CAPITAL FUND

Program and Financing (in millions of dollars)

Identification Code 14-4556-0-4-306		1999 Actual	2000 Estimate	2001 Estimate
	Outlays (gross), detail:			
86.97	Outlays from new mandatory authority	48	29	30
86.98	Outlays from mandatory balances	12	13	7
87.00	Total outlays (gross)	60	42	37
	Offsets:			
	Against gross budget authority and outlays:			
88.00	Offsetting collections (cash) from:			
	Federal sources	-56	-31	-36
	Against gross budget authority only:			
88.95	From Federal sources: Change in receivables and unpaid, unfilled orders	2	0	0
	Net budget authority and outlays:			
89.00	Budget authority	0	0	0
90.00	Outlays	4	11	1

United States Geological Survey

Federal Funds

General and special funds:

WORKING CAPITAL FUND

Statement of Operations (in millions of dollars)

Identification Code		1998 Actual	1999 Actual	2000 Estimate	2001 Estimate
14-4556-0-4-306					
0101	Revenue	50	46	30	31
0102	Expense	-49	-45	-30	-31
0105	Net income or loss (-)	1	1		
0109	Comprehensive income	1	1	0	0

Surveys, Investigations, and Research Exhibits

United States Geological Survey

Federal Funds

General and special funds:

WORKING CAPITAL FUND

Balance Sheet (in millions of dollars)

Identification Code		1998 Actual	1999 Actual	2000 Estimate	2001 Estimate
14-4556-0-4-306					
	Assets:				
	Federal assets:				
1101	Fund balances with Treasury	50	46	22	25
	Investments in US securities:				
1106	Receivables, net	6	14	10	10
1803	Other Federal assets: Property, plant and equipment, net	1	3	1	1
1999	Total assets	57	63	33	36
	Liabilities:				
2101	Federal liabilities: Accounts payable	53	51	29	32
2201	Non-Federal liabilities: Accounts payable	2	10	2	2
2999	Total liabilities	55	61	31	34
	Net Position:				
3100	Unexpended appropriations	-2	1	1	1
3300	Cumulative results of operations	4	1	1	1
3999	Total net position	2	2	2	2
4999	Total liabilities and net position	57	63	33	36

Object Classification

(in millions of dollars)

Identification Code 14-4556-0-4-306		1999 Actual	2000 Estimate	2001 Estimate
Direct obligations				
11.0	Personnel compensation:			
11.1	Full-time permanent	9	9	10
11.3	Other than full-time permanent	1	1	1
11.9	Total personnel compensation	<u>10</u>	<u>10</u>	<u>11</u>
12.9	Civilian personnel benefits	3	3	3
21.0	Travel & transportation of persons			
23.1	Rental payments to GSA	3	3	3
23.2	Rental payment to others	0	1	1
24.0	Printing and reproduction	1	0	0
25.2	Other services	6	8	3
25.3	Purchases of goods & services from Government accounts	3	2	2
25.4	Operation & maintenance of facilities	0	2	1
25.7	Operation & maintenance of equipment	1	1	1
26.0	Supplies & materials	3	2	3
31.0	Equipment	9	9	8
99.0	Subtotal, reimbursable obligations	<u>39</u>	<u>41</u>	<u>36</u>
99.5	Below reporting threshold	3	1	1
99.9	Total new obligations	<u>42</u>	<u>42</u>	<u>37</u>

Personnel Summary

Identification Code 14-4556-0-4-306		1999 Actual	2000 Estimate	2001 Estimate
2001	Total compensable work years: Full-time equivalent employment	241	241	241

**Funding of U.S. Geological Survey Programs
(Obligations)**
(Dollars in Thousands)

	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate
Surveys, Investigations, and Research (SIR)			
National Mapping Program:			
Annual appropriation	135,000	126,171	155,282
<i>Non-Federal (Domestic) sources</i>			
Map receipts	8,856	7,000	7,000
Sale of photos, reproductions & digital products	5,874	5,800	5,800
Miscellaneous	583	600	600
Subtotal (non-Federal sources)	15,313	13,400	13,400
<i>State and local sources</i>			
Matched	4,925	5,000	5,000
Unmatched	1,890	700	700
Subtotal (state and local sources)	6,815	5,700	5,700
<i>Federal sources</i>			
Agency for International Development	1,931	1,900	1,900
Hurricane Mitch			
Department of Agriculture	12,450	12,000	8,000
Department of Commerce:			
National Oceanic & Atmospheric Administration	313	0	0
Technology Transfer	179	0	0
Department of Defense:			
Corps of Engineers	30	50	50
Other	3,213	5,000	3,400
Department of the Interior:			
Bureau of Land Management	292	300	300
U.S. Fish and Wildlife Service	278	200	200
National Park Service	1,676	1,700	1,700
Environmental Protection Agency	2,001	2,000	2,000
National Aeronautics & Space Administration	5,185	5,100	5,100
National Science Foundation	381	350	350
Sale of maps, photos, reproductions, & digital products	4,022	4,000	4,000
LandSat Affiliates	822	800	800
Miscellaneous agencies	1,053	279	168
Subtotal (Federal sources)	33,826	33,679	27,968
Total: National Mapping Program	190,954	178,950	202,350

Sundry Exhibits

	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate
Geologic Hazards, Resources, and Processes:			
Annual appropriation	230,000	212,000	206,409
No-Year appropriation	18,233	18,397	18,400
Subtotal (appropriation)	248,463	230,397	224,809
<i>Non-Federal (Domestic) sources</i>			
Miscellaneous	1,989	1,989	1,989
<i>Non-Federal (Foreign) sources</i>			
Saudi Arabia	3,547	3,547	3,547
Other	107	107	107
Subtotal (<i>Non-Federal Foreign</i>)	3,654	3,654	3,654
<i>State and local sources</i>			
Matched	364	364	364
Unmatched	1,777	177	177
Subtotal (<i>state and local sources</i>)	2,141	541	541
<i>Federal sources</i>			
Agency for International Development			
Hurricane Mitch	1,539	2,469	2,469
Department of Agriculture	48	48	48
Department of Commerce:			
National Oceanic & Atmospheric Administration	2,819	2,819	2,819
Technology Transfer	91	91	91
Department of Defense:			
Corps of Engineers	477	477	477
Other	2,626	2,626	2,626
Department of Energy	3,488	3,488	3,488
Department of the Interior			
Bureau of Land Management	60	60,000	60,000
Bureau of Reclamation	245	245	245
Minerals Management Service	100	100	100
National Park Service	408	408	408
Environmental Protection Agency	1,293	1,292	1,292
National Aeronautics and Space Administration	5,306	5,306	5,306
Nuclear Regulatory Commission	118	118	118
National Science Foundation	496	496	496
Miscellaneous agencies	657	748	543
Subtotal (<i>Federal sources</i>)	19,771	20,791	20,586
Total: Geologic Hazards, Resources, & Processes	276,019	257,372	251,579

Funding of U.S. Geological Survey Programs (Obligations)

	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate
Water Resources Investigations:			
Annual appropriation	209,000	185,819	197,576
No-Year appropriation	867	0	0
Subtotal (appropriation)	<u>209,867</u>	<u>185,819</u>	<u>197,576</u>
<i>Non-Federal (Domestic) sources</i>			
Permittees & licensees of the Federal Energy Regulatory Commission	3,212	3,200	3,200
Miscellaneous	157	150	150
Subtotal (<i>non-Federal domestic sources</i>)	<u>3,370</u>	<u>3,350</u>	<u>3,350</u>
<i>Non-Federal (Foreign) sources</i>			
Miscellaneous	731	700	700
<i>State and local sources</i>			
Matched	70,117	72,947	74,000
Unmatched	37,459	37,500	35,000
Subtotal (<i>state and local sources</i>)	<u>107,576</u>	<u>110,447</u>	<u>109,000</u>
<i>Federal sources</i>			
Agency for International Development			
Hurricane Mitch	1,168	1,100	1,100
Department of Agriculture	1,226	1,200	1,200
Department of Commerce:			
National Oceanic & Atmospheric Administration	732	700	700
Technology Transfer	695	880	880
Other			
Department of Defense:			
Military	25,023	18,730	18,730
Civilian	13,771	24,376	24,376
Department of Energy:			
Bonneville Power Administration	331	300	300
Other	19,539	19,500	19,500
Department of the Interior			
Bureau of Indian Affairs	773	700	700
Bureau of Land Management	802	800	800
Bureau of Reclamation	8,215	8,200	8,200
U.S. Fish & Wildlife Service	1,172	1,200	1,200
National Park Service	1,666	1,883	1,883
Office of the Secretary	845	0	0
Department of State	327	300	300
Department of Transportation	447	450	450
Environmental Protection Agency	10,158	9,000	9,000
Federal Emergency Management Agency	1,398	1,300	1,300
Tennessee Valley Authority	234	203	203
Miscellaneous agencies	1,694	934	934
Subtotal (<i>Federal sources</i>)	<u>90,216</u>	<u>91,756</u>	<u>91,756</u>
Total: Water Resources Investigations	411,760	392,072	402,382

Sundry Exhibits

	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate
Biological Research:			
Annual appropriation	1,200	0	0
Multi-Year appropriation	155,000	142,000	158,781
No-Year appropriation	16	76	0
Subtotal (appropriation)	156,216	142,076	158,781
<i>Non-Federal (Domestic) sources</i>			
State and local sources Unmatched	0	0	0
Miscellaneous	1,545	1,500	1,500
Subtotal (non-Federal Domestic sources)	1,545	1,500	1,500
<i>State and local sources</i>			
Matched	0	0	0
Unmatched	2,385	3,712	3,712
Subtotal (state and local sources)	2,385	3,712	3,712
<i>Federal sources</i>			
Agency for International Development	3	90	88
Hurricane Mitch			
Department of Agriculture	1,385	1,500	1,500
Department of Commerce:			
Other	52	50	50
National Oceanic and Atmospheric Administration	394	423	423
Technology Transfer	174	174	0
Department of Defense:			
Corps of Engineers	14,872	13,671	13,671
Other	2,269	2,088	2,088
Department of Energy:			
Bonneville Power Administration	3,085	2,197	2,197
Other	54	51	51
Department of the Interior:			
Bureau of Land Management	954	1,000	1,000
Bureau of Reclamation	1,335	1,250	1,250
U.S. Fish & Wildlife Service	9,420	9,500	9,500
Mineral Management Service	360	350	350
National Park Service	4,047	4,000	4,000
Office of the Secretary	673	600	600
Environmental Protection Agency	4,367	3,330	3,330
Miscellaneous agencies	352	382	307
Subtotal (<i>Federal sources</i>)	43,798	40,657	40,405
Total: Biological Research	203,944	187,945	204,398

Funding of U.S. Geological Survey Programs (Obligations)

	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate
Science Support:			
Annual appropriation	24,000	67,104	70,895
<i>Non-Federal (Domestic) sources</i>			
Miscellaneous	31	0	0
<i>Federal sources</i>			
Department of Commerce:			
Technology Transfer	1,432	2,226	1,100
Department of the Interior:			
Bureau of Indian Affairs	1,640	1,604	1,500
National Park Service	40	28	42
Office of the Secretary	33,347	7,173	7,173
Miscellaneous agencies	1,404	1,286	1,140
Subtotal (<i>Federal sources</i>)	37,862	12,357	10,995
Total: Science Support	61,893	79,461	81,850
Facilities:			
Annual appropriation	22,000	86,000	88,000
<i>Federal sources</i>			
General Services Administration	5,937	10,821	8,458
Total: Facilities	27,937	96,821	96,458
SIR Summary:			
Annual appropriation	621,200	677,094	718,162
Multi-Year appropriation	155,000	142,000	158,781
No-Year appropriation	19,116	18,473	18,400
<i>Non-Federal sources:</i>			
Map Receipts	8,856	7,000	7,000
Domestic	13,392	13,239	13,239
Foreign	4,385	4,354	4,354
State and local sources	118,916	120,400	118,953
Federal sources	230,566	210,061	200,168
Total: SIR	1,171,431	1,192,621	1,239,057

Sundry Exhibits

	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate
Contributed Funds:			
Permanent, indefinite appropriation:			
Geologic Hazards, Resources, & Processes	2,059	4,838	164
Biological Research	290	291	290
Total: Contributed Funds	2,349	5,129	454
Operation and Maintenance of Quarters:			
Permanent, indefinite appropriation:			
Geologic Hazards, Resources, & Processes	77	77	77
Biological Research	290	290	290
Total: Operation & Maintenance of Quarters	367	368	367
Working Capital Fund:			
National Water Quality Lab	20,894	19,147	19,606
Hydrologic Instrumentation Facility	9,323	9,291	9,795
Other	4,777	4,665	4,615
Total: Working Capital Fund	34,994	33,103	34,016
Allocations from other Federal Agencies:			
U.S. Fish & Wildlife Service			
Natural Resource Damage Assessment	1,571	260	260
Department of State	464	464	464
Total: Allocations	2,035	724	724

Trust Funds
DONATIONS AND CONTRIBUTED FUNDS
Program and Financing
(in millions of dollars)

Identification Code 14-8562-0-7-300		1999 Actual	2000 Estimate	2001 Estimate
	Obligations by program activity:			
10.00	Total new obligations	1	1	1
	Budgetary resources available for obligation:			
21.40	Unobligated balance available, start of year	1	1	1
22.00	New Budget authority (gross)	0	1	1
23.90	Total budgetary resources available for obligation	1	2	2
23.95	Total new obligations	-1	-1	-1
24.40	Unobligated balance available, end of year	1	1	1
	New budget authority (gross), detail:			
	Mandatory:			
60.25	Appropriation (special fund, indefinite)	0	1	1
	Change in unpaid obligations:			
72.40	Unpaid obligations, start of year:			
	Obligated balance: start of year	3	1	1
73.10	Total new obligations	1	1	1
73.20	Total outlays (gross)	-2	-1	-1
74.40	Unpaid obligations, end of year: Obligated balance, end of year	1	1	1
	Outlays (gross), detail:			
86.97	Outlays from mandatory balances	2	1	1
	New budget authority and outlays:			
89.00	Budget authority	0	1	1
90.00	Outlays	2	1	1

Object Classification
(in millions of dollars)

Identification Code 14-8356-0-7-300		1999 Actual	2000 Estimate	2001 Estimate
	Direct obligations:			
99.9	Other services	1	1	1

ADMINISTRATIVE PROVISIONS

The amount appropriated for the United States Geological Survey shall be available for the purchase of not to exceed 53 passenger motor vehicles, of which 48 are for replacement only; reimbursement to the General Services Administration for security guard services; *reimbursement to the United States Fish and Wildlife Service (FWS) for Refuse Revenue Sharing payments made by FWS to local entities for the FWS real property transferred to the Geological Survey*; contracting for the furnishing of topographic maps and for the making of geophysical or other specialized surveys when it is administratively determined that such procedures are in the public interest; construction and maintenance of necessary buildings and appurtenant facilities; acquisition of lands for gauging stations and observation wells; expenses of the United States National Committee on Geology; and payment of compensation and expenses of persons on the rolls of the Survey duly appointed to represent the United States in the negotiation and administration of interstate compacts: *Provided*, That activities funded by appropriations herein made may be accomplished through the use of contracts, grants, or cooperative agreements as defined in 31 U.S.C. 6302 et seq.[: *Provided further*, That the United States Geological Survey may hereafter contract directly with individuals or indirectly with institutions or nonprofit organizations, without regard to 41 U.S.C. 5, for the temporary or intermittent services of students or recent graduates, who shall be considered employees for the purposes of chapters 57 and 81 of title 5, United States Code, relating to compensation for travel and work injuries, and chapter 171 of title 28, United States Code, relating to tort claims, but shall not be considered to be Federal employees for any other purposes]. (*Department of the Interior and Related Agencies Appropriations Act, 2000, as enacted by section 1000(a)(3) of the Consolidated Appropriations Act, 2000 (P.L. 106-113).*)

Justification of Proposed Language Change

1. Insertion: *reimbursement to the United States Fish and Wildlife Service (FWS) for Refuse Revenue Sharing payments made by FWS to local entities for the FWS real property transferred to the Geological Survey*

This language will authorize the U.S. Geological Survey to reimburse the U.S. Fish and Wildlife Service (FWS) for impact funding the FWS disburses to local entities pursuant to Refuge Revenue sharing that is associated with Federal real property transferred to the USGS from the FWS. Despite the transfer of these properties to USGS, the FWS has continued to provide impact funding to local entities because USGS lacks the authority to make these payments. The proposed language takes advantage of existing administrative efficiencies by having FWS continue to make the disbursements directly to local entities.

2. Deletion: *Provided further, That the United States Geological Survey may hereafter contract directly with individuals or indirectly with institutions or nonprofit organizations, without regard to 41 U.S.C. 5, for the temporary or intermittent services of students or recent graduates, who shall be considered employees for the purposes of chapters 57 and 81 of title 5, United States Code, relating to compensation for travel and work injuries, and chapter 171 of title 28, United States Code, relating to tort claims, but shall not be considered to be Federal employees for any other purposes*

As part of the FY 2000 Congressional enactment of the Department of the Interior and Related Agencies Appropriations Act, this language was made permanent. This change requests the deletion of these words, because permanent language does not need to be repeated and made part of the appropriation process each year. However, this language can now be found in the Appropriation Language and Citations section that follows this page.

Appropriation Language and Citations

1. The amount appropriated for the Geological Survey shall be available for purchase of not to exceed 53 passenger motor vehicles, of which 48 are for replacement only;
 - **31 U.S.C. 638a(a)** provides that, "Unless specifically authorized by the appropriation concerned or other law, no appropriation shall be expended to purchase or hire passenger motor vehicles for any branch of the Government. ..."
 - **31 U.S.C. 638a(b)** provides that, "Excepting appropriations for the military and Naval Establishments, no appropriation shall be available for the purchase, maintenance, or operation of any aircraft unless specific authority for the purchase, maintenance, or operation thereof has been or is provided in such appropriation."
2. reimbursement to the General Services Administration for security guard services; contracting for the furnishing of topographic maps and for the making of geophysical or other specialized surveys when it is administratively determined that such procedures are in the public interest;
 - **No specific authority.** These provisions are required by reason of rulings of the Comptroller General that specific authority is required for reimbursing the General Services Administration for guard services (B-87255); and for contracting with private persons for the performance of duties with which the agency is specifically charged (15 Comp. Gen. 951).
3. construction and maintenance of necessary buildings and appurtenant facilities;
 - **No specific authority.** The Organic Act of 1879, establishing the Geological Survey and providing for "...examination of the geological structure, mineral resources, and products of the national domain" (43 U.S.C. 31) is general authorization for construction of special-purpose laboratory buildings. Specific authorization by the Congressional committees on public works is not needed because of the highly specialized purposes of the building. 40 U.S.C. 612: "The term 'public building' means any building ... which is generally suitable for office or storage space ... but shall not include any such buildings and construction projects: ... (E) on or used in connection with ... or for nuclear production, research, or development projects." 41 U.S.C. 12: "No contract shall be entered into for the erection, repair, or furnishing of any public building ... which shall bind the government to pay a larger sum of money than the amount in the Treasury appropriated for the specific purpose."
4. acquisition of lands for gauging stations and observation wells;
 - **43 U.S.C. 36(b)** provides that, "The Secretary of the Interior may, on behalf of the United States and for the use by the Geological Survey in gaging streams and underground water resources, acquire lands by donation or when funds have been appropriated by Congress by purchase or condemnation. ..."
5. expenses of the U.S. National Committee on Geology;
 - **43 U.S.C. 31** participation in and payment of expenses of the U.S. National Committee on Geology is a proper and necessary function of the Geological Survey, and so is authorized by the Survey's Organic Act of March 3, 1879, 43 U.S.C. 31. This Act provides that, "...The Director of the Geological Survey, which office is established, under the Interior Department, shall be appointed by the President by and with the advice and consent of the Senate. This officer shall have the direction of the Geological Survey, and

the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain. ..."

6. and payment of compensation and expenses of persons on the rolls of the Geological Survey appointed, as authorized by law, to represent the United States in the negotiation and administration of interstate compacts.
 - **66 Stat. 453.** The above language first appeared in the Appropriation Act for FY 1953, P.L. 82-470 (66 Stat. 453), and has been repeated in each Act since that date. Article I, Section 10, paragraph 3, of the United States Constitution provides that, No State shall, without the consent of Congress, lay any duty on tonnage, keep troops, or ships of war in time of peace, enter into any agreement or compact with another State, or with a foreign power, or engage in war, unless actually invaded, or in such imminent danger as will not admit or delay." (emphasis supplied)

Thus each interstate compact must be approved by the Congress and signed by the President. The Public Law approving each interstate compact represents the authorizing legislation.

7. Provided, That activities funded by appropriations herein may be accomplished through the use of contracts, grants, or cooperative agreements as defined in 31 U.S.C. 6302, et seq.
 - The above language appears in the Department of the Interior and Related Agencies Appropriations Act, 1988, as included in Public Law 100-202.

Permanent Authority:

8. *Provided*, That appropriations herein and hereafter made shall be available for paying costs incidental to the utilization of services contributed by individuals who serve without compensation as volunteers in aid of work of the Geological Survey, and that within appropriations herein and hereafter provided, Geological Survey officials may authorize either direct procurement of or reimbursement for expenses incidental to the effective use of volunteers such as, but not limited to, training, transportation, lodging, subsistence, equipment, and supplies.
 - **43 U.S.C. 50c**
9. *Provided further*, That provision for such expenses or services is in accord with volunteer or cooperative agreements made with such individuals, private organizations, educational institutions, or State or local government.
 - **43 U.S.C 31(a)**
10. *Provided further*, That the Geological Survey (43 U.S.C. 31(a)) shall hereafter be designated the United States Geological Survey.
 - **Department of the Interior and Related Agencies Appropriations Act, 1992, as included in Public Law 102-154.**

11. *Provided further*, That the United States Geological Survey may hereafter contract directly with individuals or indirectly with institutions or nonprofit organizations, without regard to 41 U.S.C. 5, for the temporary or intermittent services of students or recent graduates, who shall be considered employees for the purposes of chapters 57 and 81 of title 5, United States Code, relating to compensation for travel and work injuries, and chapter 171 of title 28, United States Code, relating to tort claims, but shall not be considered to be Federal employees for any other purposes.

- **Department of the Interior and Related Agencies Appropriations Act, 2000, as included in Public Law 106-113.**

Employee Count By Grade (Total Employment)

	1999 Actual	2000 Estimate	2001 Estimate
Executive Level V	1	1	1
ES-5	4	2	2
ES-4	11	10	11
ES-3	1	3	5
ES-2	9	14	14
ES-1	6	4	1
Subtotal	32	34	34
GS-15	548	549	550
GS-14	806	808	809
GS-13	1,332	1,332	1,334
GS-12	1,582	1,584	1,585
GS-11	1,400	1,400	1,400
GS-10	203	203	204
GS-9	1,205	1,204	1,205
GS-8	313	312	314
GS-7	884	882	885
GS-6	349	346	347
GS-5	478	476	479
GS-4	228	225	225
GS-3	140	138	140
GS-2	70	70	72
GS-1	37	37	39
Subtotal	9,575	9,566	9,588
Other Pay Schedule Systems	210	211	215
Total employment (actual/estimate)	9,817	9,811	9,837

**United States
Department of the Interior**

U.S. Geological Survey

**Government Performance and Results Act
(GPRA)
CONSOLIDATED REPORT**

FY 1999 Annual Performance Report

FY 2000 Operating Plan

FY 2001 Annual Performance Plan

February 2000

Message from the Director

I am pleased to present our first consolidated performance report and plans for the United States Geological Survey (USGS) for FY 1999-2001.

Capitalizing on our experience and actual accomplishments in FY 1999, we have developed annual performance plans that will advance us toward achieving our revised strategic plan for FY 2000 – 2005. Our plans build on our proud 120-year history of impartial scientific excellence. They reflect a renewed commitment to meeting the needs of our partners and customers, and they endeavor to deliver relevant and useable science in time to make a difference. To ensure this happens, we are cultivating an atmosphere of innovation and creativity — one that will foster and reward the broad-scale, integrated science I believe is needed by decisionmakers and the public.

We will also focus our organizational and management structure — and our use of time, people, and financial resources — on keeping science first. Streamlined business practices, enhanced regional leadership, insightful collaboration among disciplines, and an evolving culture of accountability are the foundation of those efforts. Together we will build a USGS that is well positioned for the future and better prepared to provide science for a changing world.

Charles Groat
Director
U.S. Geological Survey

USGS Commitment

The employees of the U.S. Geological Survey (USGS) support the goals and objectives of the Government Performance and Results Act (GPRA), and are committed to transforming USGS into a responsive and performance oriented agency. In accordance with GPRA, this Annual Plan has been prepared to advance the long-term goals of our revised Strategic Plan. We, the undersigned members of the USGS Executive Leadership Team, are responsible for successful implementation of our Strategic and Annual Plans:

Dr. Charles Groat
Director

Kathryn Clement
Deputy Director

Barbara Ryan
Associate Director for Operations

Amy Holley
Senior Advisor to the Director

Richard Witmer
Associate Director for Geography

Martin Eckes, Chief
Budget and Organization Analysis

Bonnie McGregor
Eastern Regional Director

Anne Kinsinger, Chief
Strategic Planning and Analysis

Thomas Casadevall
Central Regional Director

Barbara Wainman, Chief
External Affairs

John D. Buffington
Western Regional Director

Dennis Fenn
Associate Director for Biology

James Leupold, Chief
Office of Program Support

Robert Hirsch
Associate Director for Hydrology

Jeffrey Armbruster, Acting Chief
Human Resources

Patrick Leahy
Associate Director for Geology

Kenneth Lanfear
Acting Geographic Information Officer

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Executive Summary

Since joining the USGS in November 1998, Director Charles Groat has emphasized that integrating science is the key to its relevance in a changing world. As we seek to more completely integrate the research of our various disciplines, we will strive to respect the expertise from each discipline and present a balanced view of the issues involved. High quality, objective, credible research and information are our most important products, and our science must be communicated and widely used if we wish to be considered successful. The Director's theme — **ONE BUREAU, ONE MISSION** — looks to a more vibrant, more robust, and more relevant earth and life science agency. A Strategic Change team, co-chaired by the Director, and focus groups involving more than 200 employees worked together from September through December 1999 to define the actions needed to make USGS sleeker, stronger and more flexible. The Director is restructuring the bureau and redefining our business practices to ensure that USGS is positioned to be a world leader in the natural sciences. We will not only provide the discipline-based and integrated science on which people have come to depend, but also enhance our tradition of excellence by increasing our ability to work on large regional natural resource problems and more effectively draw on the full breadth of scientific capability available within the USGS.

We are ready to make the changes necessary as we begin this new century, with a revised Strategic Plan for FY 2000-2005 to guide our efforts. Modified to more clearly represent our goals and strategies and to reflect stakeholder feedback received through our consultation process, the revised Strategic Plan is vital to accomplishing change. Critical to monitoring our progress in achieving our strategic direction are the annual performance targets and measures presented in this annual plan. USGS is defining the roles and responsibilities of Regional and Associate Directors in ensuring that performance metrics are collected, evaluated, and achieved at appropriate levels in the bureau and that performance data are verified and validated.

Among the Director's highest priorities is making significant progress toward a real-time hazards warning system. For FY 1999, USGS met or exceeded all performance targets for achieving this end. Increased funding appropriated in FY 2000 and proposed for FY 2001 will accelerate achievement of the real-time components of the **Hazards** long-term goal. In addition, our experience in tracking and reporting performance data during the year, our commitment to using these data for management purposes, and our efforts to validate the measures have improved our ability to measure the delivery of real-time flood data. New performance measures will be in place for FY 2000 performance tracking.

Acting on the Director's message to more effectively communicate science and draw upon the full breadth of our scientific capability, we substantially exceeded our FY 1999 **Environment and Natural Resources** performance targets for analyses, decision support systems, and stakeholder meetings. In fact, we more than doubled our targets related to stakeholders by meeting with them to obtain program feedback, share current knowledge, and identify opportunities for partnerships. The information gathered and relationships fostered positioned us to better identify the science needs and form the plans to address the large regional natural resource problems we are proposing initiatives for in FY 2001. We are also planning to continue improving the communication of our science information in FY 2001, with several initiatives focused on integrating long-term databases and enhancing network speed, security and capacity to deliver the data. While aggregate performance targets are provided in this Plan, the increments associated with each initiative are provided in the FY 2001 President's Budget.

The single performance target that we failed to meet in FY 1999, our university-based partnerships, resulted from the nature of the work that was conducted and from effectively streamlining how we issued the research work orders by whole project rather than by individual phases. FY 2000 and 2001 targets reflect the new process. Performance measure validation efforts during FY 2000 will determine the appropriateness of this metric as well as others in providing an accurate view of the performance of our programs.

Quality science that is both relevant to a changing world and effectively communicated is our most important product. We will continue to measure its quality and relevance through peer reviews and program evaluations. By embarking on a systematic survey of customer satisfaction with our products and services, we will renew our commitment to accountability. We believe that our leadership and our plan will allow us to meet the challenges of the new century with renewed vigor and a clarified sense of purpose and mission.

About this Document

The Government Performance and Results Act (GPRA) requires agencies to submit annual performance plans to Congress with their fiscal year budget request, and to prepare an annual performance report at the end of each fiscal year (FY) on how well they met their goals. The FY 1999 Annual Performance Plan was the Department of the Interior's first official plan submitted to Congress, and the FY 1999 Annual Performance Report is Interior's first opportunity to report on our accomplishments.

Rather than preparing a separate FY 1999 Annual Performance Report (Report), the Department of the Interior (DOI) has combined the FY 1999 Report with the FY 2001 Annual Performance Plan (Plan). We believe this consolidated plan and report will be more useful to Congress and the appropriations process than submitting a FY 2001 Plan with the budget in February 2000, followed by a separate FY 1999 Report submitted at the end of March 2000. In this consolidated document we present our accomplishments for FY 1999, what we plan to accomplish in the current fiscal year, FY 2000, and what we propose to accomplish in FY 2001 with the budget resources we are requesting. In a single presentation, the reader can see the trends in our performance targets along with the trends in our results.

Section I - Introduction and Overview

1.1 Introduction

What we do

The United States Geological Survey (USGS) provides science for a changing world by delivering reliable and impartial information that describes the Earth, its natural processes, and its natural species. Emergency response organizations, resource managers, planners, and other customers use this information to: minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life. The USGS is at work in every State of the Nation and in dozens of foreign countries, cooperating with more than 2,000 organizations to provide information for resource managers in the public and private sectors. Our strengths, which rely on our reputation for objectivity and scientific excellence, as well as a strong heritage of collegial relationships and partnerships with the customers we serve, include a multidisciplinary workforce capable of working anywhere in the world; the ability to develop, design, and maintain long-term national and international databases; and the capability to conduct long-term, broad-scale, multidisciplinary, and interpretive studies.

Better Positioned to Deliver Science

USGS primary science disciplines include the following:

- Biological resources (information critical to biological species management, animal health, ecosystems, and invasive species);
- Geology (information relating to energy and mineral resources; natural hazards such as landslides, volcanoes, and earthquakes; and geologic processes that affect our Nation's land and coasts);
- Geography (geospatial data, topographic maps, and satellite images); and
- Water resources (real-time flood data and water quality and quantity information on surface and ground-water resources).

Our strategic and annual performance targets focus on the **provision** of science to customers in support of solving the Nation's complex land and resource management problems and minimizing the loss of life and property from natural disasters. Our division-centered, discipline-focused, culture hampers multidisciplinary efforts to integrate science and advance its relevance to societal needs. We are initiating strategic changes that focus on creating an organization with the infrastructure to enable integrated science in terms of operational processes and practices; communications; information technology; a common understanding of our customers and their needs; and investing in and rewarding our people. The most important changes that we are going to make relate to common business practices, leadership, program planning, and customers.

Common Business Practices: Our top short-term priority in streamlining USGS functions is to adopt and implement a bureau-wide infrastructure that will facilitate uniform administrative, program development, and science support systems across divisions, regions, and programs. We will remove barriers that hinder collaboration among our scientists across division lines and provide incentives for participation in collaborative and integrated programs at the bureau level.

Leadership: Our leadership structure will be altered somewhat to ensure better distribution of leadership in both the administrative and scientific arenas. The science

leaders of the bureau are the Associate Directors for Biology, Geography, Geology, and Hydrology. Empowering regional leadership is a top priority in strengthening the programs that meet local and regional customer needs. While Associate Directors will have oversight of national programs, the regional aspects of these programs will be overseen by the regional leadership to ensure specific needs are being met. We will institute a matrix management approach that gives Regional Directors and Regional Executives, in collaboration with Associate Directors, substantial authority over regional programs and funding for them. Regional Executives will be distributed to interact with customers and meet program and facilities oversight needs.

Program Planning: Associate Directors have the lead role in science program development and formulation of future science directions, participating in a consolidated and coordinated planning process at the bureau level. Regional Directors also participate in this critical function. Having both Regional and Associate Directors involved in the process is essential to meeting the science and customer goals in our Strategic Plan. This new process has already contributed to the formulation of the FY2001 budget proposal and will more fully influence the development of the FY2002 programs.

Customers: Our Strategic Plan places high priority on meeting our customers' needs. Therefore, each Associate Director will have added responsibilities for engaging customers at the national level, and Regional Directors will be responsible for meeting with customers on the regional level to ensure that needs are being met. As we enter into new partnerships, we will examine the dynamics of the relationship to continue to ensure that organizational and personal conflict of interest issues are considered, evaluated, and resolved. Honesty and integrity in all aspects of our scientific enterprise, maintaining our impartiality, and ensuring that our information and products are used to benefit the public as a whole will continue to be hallmarks of USGS science.

Science Performance Measurement and GPRA

USGS research is peer-reviewed and our programs are cyclically evaluated to ensure the quality and timeliness of our science. This approach is validated in the recommendations of the National Academy of Science report on *Research and the Government Performance and Results Act* that was released February 17, 1999, and is consistent with the September 1998 report by the House Science Committee *Toward a New Science Policy* that states...*in general, R&D in Federal agencies should be highly relevant to, and tightly focused on, agency or department missions.*

The Academy report endorses a three-pronged "expert review" of Federal science, addressing quality, relevance, and leadership. USGS engages in reviews and evaluations that meet these accountability criteria for the research we produce.

South Florida Restoration Science Forum May 1999, Primary hosts: USGS and the South Florida Water Management District

Highlighting the connection between science and resource management for the South Florida restoration effort, this forum also served as a model for similar landscape-scale restoration projects across the nation. "You could visit and learn about nearly every facet of scientific research – from Panther tracking to looking at Periphyton algae through a microscope," said Truman Eugene (Gene) Duncan, Director of Water Resources for the Miccosukee Tribe. "Actual researchers were on hand in each room to answer questions of the managers. In my opinion, the very fact that the researchers were able to talk one-on-one with the managers accomplished the goal of improving the linkage between science and resource management."

- Peer review has been the **quality** standard for USGS scientific publications and a documented component of USGS policy throughout our history.
- To assess the **relevance** of our products to their needs, USGS is collecting information from customers by survey, as described in the Customer Service section 3.1, and by periodic review of our programs with stakeholders, including user forums to which the public is invited. Further, a DOI-wide process is being implemented to ensure that the highest priority science needs of the DOI are being met by USGS programs — again ensuring the relevance of USGS science to support DOI land and resource management policy and decisionmaking.
- **Leadership** issues are addressed in formal, external, independent program evaluations such as
 - the National Academy of Public Administration’s studies which resulted in a 1998 report *Geographic Information for the 21st Century: Building a Strategy for the Nation*, and a 1999 report on *Human Resources Roles and Responsibilities*
 - the National Research Council’s reviews of the Energy Resources Program and Coastal and Marine Geology Program released in 1999, and
 - the current 18-month review by the National Research Council of USGS strategic direction.

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1.2 Mission Statement

Strategic Direction

The USGS will combine and enhance our diverse programs, capabilities, and talents and increase customer involvement to strengthen our science leadership and contribution to the resolution of complex issues.

Vision

The USGS is a world leader in the natural sciences through our scientific excellence and responsiveness to society’s needs.

Mission

The USGS serves the Nation by providing reliable scientific information to:

- describe and understand the Earth;
- minimize loss of life and property from natural disasters;
- manage water, biological, energy, and mineral resources; and
- enhance and protect our quality of life.

1.3 Linkage to Bureau Strategic Plan and Departmental Goals

The U.S. Geological Survey Strategic Plan has two mission goals —

- Hazards, and
- Environment and Natural Resources.

Each mission goal or GPRA Program Activity has an associated long-term goal that identifies target performance levels and time frames of performance for the Strategic Plan. Each of the Strategic Plan’s long-term goals has one associated annual goal that identifies

the annual performance increment necessary to achieve the long-term goal as well as any proposed changes resulting from program and budget initiatives. Each annual goal has five numeric performance measures — a total of ten for the entire Annual Plan.

“Stakeholder meetings” are identified as performance measures for each of the annual goals to capture follow-through on the strategic direction’s focus on “increased customer involvement to strengthen our science leadership and contribution to the resolution of complex issues.” Each annual goal also has a milestone to measure customer satisfaction with key USGS science product categories: establishing baseline in FY 2000 and defining improvement targets in the revised final FY 2001 plan. The new customer satisfaction measure will increase the number of numeric performance measures to twelve.

As the science bureau of the Department of the Interior, USGS provides information and technologies that are critical to the mission achievement of Department land and resource management bureaus. USGS and the resource management bureaus of DOI have formalized a process to provide USGS science support to the DOI bureaus that will eventually provide input to USGS for defining GPRA metrics and outcomes. USGS mission and long-term goals directly support the Department of the Interior Goal # 4, “Provide Science for a Changing World,” but contribute to all of the DOI goals by focusing on the provision of scientific information to support these efforts.

1.4 Linkage to Budget

The GPRA Program Activity concept captures the contribution of all program activities to a common mission requirement by applying a single set of annual goals and performance measures across four current Program and Finance (P&F) schedules — National Mapping Program (08040001), Geologic Hazards, Resources and Processes (08040002), Water Resources Investigations (08040003), and Biological Research (08040004). The USGS’s remaining two P&F schedules — Science Support (08040005) and Facilities (08040006) — support all programmatic activities and their funding has been distributed on a *prorata* basis to the two GPRA Program Activities (Hazards and Environment and Natural Resources).

The FY 2000 budget consolidated the appropriated facilities and general administration costs into bureau-wide accounts to improve accountability for all aspects of the organization and promote common business practices. The result is a much clearer view of the funding available for science. The approved FY 2000 budget structure does not include the proposed new Integrated Science activity, and FY 2000 revised final performance targets have been redistributed to reflect the restoration of funds to their former P&F line items.

Budget activities and subactivities linked to these GPRA Program Activities are identified in **Section II. GPRA PROGRAM ACTIVITIES AND GOALS**. Performance targets are aggregated as a total for the Bureau for each GPRA Program Activity. Performance targets are disaggregated by budget activity in the President’s Budget request.

Long-term goal performance targets assume continued funding at the FY 2000 level. Annual performance for FY 1999 shows actual achievements with the enacted funding level. Targets set for FY 2000 reflect the enacted funding level less the across-the-board reduction, and targets for FY 2001 reflect presidential priorities. The targets also include “completions” funded by prior-year monies because research often requires more than 1 year to deliver a product. Similarly, funding increases in a given year support some long-term efforts, the completion of which will not be achieved until outyears. Therefore, departures of FY 1999, FY 2000, and FY 2001 targets from the FY 1998 baseline represent not only the aggregate impact of funding increases and decreases in the given

year, but also the completion of long-term efforts from prior-year funding increases or decreases, and/or cyclic studies mandated by Congress.

1.5 Adjustments to Strategic Plan

In 1999 our Refocused Strategic Plan 1997-2005 underwent a formal consultation process, advertised in the Federal Register, that involved public and employee reviews, stakeholder meetings, written and on-line comments, briefings, and congressional consultations. We received approximately 35 written comments from bureaus within the Department of the Interior, other Federal agencies, employees of the USGS, private corporations, the university community, environmental organizations and other non-governmental organizations, and private individuals. Comments on our programs received during approximately 200 regular stakeholder meetings were also incorporated into the revised Plan. Within USGS, a 2-day meeting of 50+ senior managers included facilitated discussion sessions on the Plan. In general, these consultations supported the new simplified mission goals and the long-term goals of the refocused Plan. Adjustments that were made in response to comments and program evaluations, include a new customer satisfaction measurement for the two GPRA Program Activities and revised performance measurement for real-time hazards as further described in the Verification and Validation section for the Hazards goal. The new revised Strategic Plan for FY 2000-2005 that has emerged from this process is the basis for the current FY 2000 and 2001 Annual Plans.

1.6 FY 2001 Goals at-a-Glance

Departmental Goal 4. Provide Science for a Changing World						
USGS GPRA Program Activity	Long-term Goal	Annual Goal	Performance Measure	2000	2001	2005
Hazards Provide science for a changing world focusing efforts in response to present and anticipated needs to predict and monitor hazardous events in near-real and real-time and to conduct risk assessments to mitigate loss.	Ensure the continued transfer of hazards-related data, risk assessments, and disaster scenarios needed by our customers before, during, and after natural disasters, and by 2005, increase the delivery of real-time hazards information by increasing the quarterly average number of gages reporting real-time data on the Internet to 5,500 (thus reducing the time it takes to provide flood information at that site from 6 to 8 weeks to 4 hours) and installing 500 improved earthquake sensors (thus reducing delivery time of information on potentially damaging earthquakes from 40 to 20 minutes) to minimize the loss of life and property.	Develop, maintain and improve monitoring networks and techniques of risk assessment by: maintaining the baseline of data and risk assessments transferred to customers; increasing by 300 the quarterly average number of streamgages delivering real-time data on the Internet, and increasing by 150 improved earthquake sensors to deliver real-time information on potentially damaging earthquakes to minimize loss of life and property.	Hazards monitoring networks maintained	6	6	6
			Risk assessments delivered	10	9	9
			Real-time stream-gages on the Internet (quarterly avg.)	4,700	5,000	5,500
			Real-time earthquake sensors (cumulative)	200	350	700
			Stakeholder meetings	13	13	13
			Customer satisfaction	Base-line	Mea-sure	Mea-sure
Environment and Natural Resources Provide science for a changing world in response to present and anticipated needs to expand our understanding of environment and natural resource issues on regional, National, and global scales and enhance predictive/forecast modeling capabilities.	Ensure the continued availability of long-term environmental and natural resource information and systematic analysis and investigations needed by customers, and by 2005, develop 20 new decision support systems and predictive tools for informed decisionmaking about natural systems.	Provide and improve long-term environmental and natural resource information, systematic analysis and investigations, and predictive options for decisionmaking about natural systems by: providing essential information to address environmental and natural resources issues by maintaining 45 long-term data collection/data management efforts and supporting 2 large data infrastructures managed in partnership with others; delivering 1,077 new products from systematic analyses and investigations to our customers; improving and developing 9 new decision support systems and predictive tools for decisionmaking; and collaborating with university partners to understand natural systems and facilitate sound management practices through 258 external grants and contracts.	Long-term data collection & data management efforts maintained and improved, and large data infrastructures supported	46	47	46
			New products from systematic analyses and investigations delivered to customers	995	1,077	N/A
			Decision support systems or predictive models developed or improved and delivered to customers	6	9	20
			University-based partnerships for natural systems analysis	248	258	N/A
			Stakeholder meetings	438	459	N/A
			Customer satisfaction	Base-line	Mea-sure	Mea-sure

Section II - GPRA Program Activities and Goals

2.1 GPRA Program Activity: Hazards

Description

Provide science for a changing world in response to present and anticipated needs, focusing efforts to predict and monitor hazardous events in near-real and real time and to conduct risk assessments to mitigate loss.

Hazards are unpreventable natural events that, by their nature, may expose our Nation's population to the risk of death or injury; and may damage or destroy private property, infrastructure, and agricultural or other developed land. USGS hazards mission activities deal with describing, documenting, and understanding natural hazards and their risks. These activities include long-term monitoring and forecasting, short-term prediction, real-time monitoring, and communication with civil authorities and others during a crisis. Other significant activities are post-crisis analysis to develop strategies to mitigate the impact of future events, and coordinated risk assessments for regions vulnerable to natural hazards.

Keeping People Out of Harm's Way. Through the joint USGS/USAID Volcano Disaster Assistance Program, USGS volcanologists responded to official requests to help interpret precursory unrest and eruptions at two volcanoes in Ecuador – Guagua Pichincha, adjacent to the capital city of Quito, and Tungurahua, near the popular tourist destination of Banos. Over a period of several months, USGS volcanologists worked with host-country scientists, aiding with monitoring-network upgrades, data interpretation, assessment of potential hazards, and development of public-notification scheme. To minimize disruption of operations at Quito International Airport, USGS personnel provided information about the effects of ash falls to airport officials and American air carriers and arranged for staff of Anchorage International Airport that was experienced with ash impacts to visit and advise Quito's airport managers.

The USGS has the primary Federal responsibility for monitoring and issuing warnings for earthquakes, volcanoes, landslides, and geomagnetic (solar) storms. We work closely with the National Weather Service in providing the hydrologic information used to forecast floods; the National Oceanic and Atmospheric Administration in monitoring coastal erosion and tsunamis; the Interagency Fire Center to support wildland fire management activities; and the Fish and Wildlife Service and others in monitoring and reporting on wildlife disease outbreaks. The USGS has unique capabilities for integrating hazards information with a wealth of other geospatial data and imagery to rapidly assess the impact of natural hazards events.

FY 2001 Goal

Develop, maintain and improve monitoring networks and techniques of risk assessment by: maintaining the baseline of data and risk assessments transferred to customers; increasing by 300 (to 5,000) the average number of streamgages delivering real-time data on the Internet and increasing by 150 improved earthquake sensors to deliver real-time information on potentially damaging earthquakes to minimize loss of life and property.

Proposed Legislation

Performance goals are not contingent on enactment of legislation during the fiscal year covered by the annual plan.

GPRA Consolidated Performance Report and Plan

Budget Table

Budget Activity/Subactivity (\$000)	FY 1999 Enacted Appropriation less rescission		FY 2000 Enacted Appropriation less reductions		FY 2001 Pres Budget	
	Total	Hazards	Total	Hazards	Total	Hazards
National Mapping Program (<i>Budget Activity</i>)	138,148	6,015	126,717	7,950	155,282	7,950
Mapping Data Collection and Integration	63,691	0	56,330	5,250	67,327	5,250
Earth Science Info Management and Delivery	36,388	4,555	34,270	1,250	36,911	1,250
Geog Research and Applications	38,069	1,460	36,117	1,450	51,044	1,450
Geologic Hazards, Resources, and Processes	238,659	93,297	211,222	84,108	224,809	90,200
Geologic Hazard Assessments	76,237	76,237	69,111	69,111	73,236	73,236
Geologic Landscape and Coastal Assessments	73,935	17,060	65,435	14,997	77,189	16,964
Geologic Resource Assessments	88,487	0	76,676	0	74,384	0
Water Resources Investigations	208,542	12,764	185,819	14,764	197,576	18,764
Water Resources Assessment and Research	103,991	0	91,037	0	90,355	0
Water Data Collection and Management	29,359	2,190	29,167	4,190	39,275	8,190
Fed-State Coop Water Program	70,137	10,574	60,553	10,574	62,879	10,574
Water Resources Research Act Program	5,055	0	5,062	0	5,067	0
Biological Research	162,187	0	136,896	0	158,781	0
Biological Research and Monitoring	138,247	0	113,232	0	123,430	0
Bio Info Management and Delivery	11,443	0	10,484	0	21,243	0
Cooperative Research Units	12,497	0	13,180	0	14,108	0
Programmatic Total	747,536	112,076	660,654	106,822	736,448	116,914
General Administration/Science Support (prorated)	27,204	4,081	67,104	10,737	70,895	11,343
Facilities (prorated)	21,501	3,225	85,618	13,699	88,036	14,086
Appropriations Total (not including supplementals)	796,241	119,382	813,376	131,258	895,379	142,343

GPRA Program Activity: Hazards						
Long-Term Goal: Ensure the continued transfer of hazards-related data, risk assessments, and disaster scenarios needed by our customers before, during, and after natural disasters, and by 2005, increase the delivery of real-time hazards information by increasing the quarterly average number of gages reporting real-time data on the Internet to 5,500 (thus reducing the time it takes to provide flood information at that site from 6 to 8 weeks to 4 hours) and installing 500 improved earthquake sensors (thus reducing delivery time of information on potentially damaging earthquakes from 40 to 20 minutes) to minimize the loss of life and property.						
FY 2001 Annual Performance Goal: Develop, maintain and improve monitoring networks and techniques of risk assessment by: maintaining the baseline of data and risk assessments transferred to customers; increasing by 300 (to 5,000) the average number of streamgages delivering real-time data on the Internet and increasing by 150 improved earthquake sensors to deliver real-time information on potentially damaging earthquakes to minimize loss of life and property.						
Performance Measure	FY 97 Actual	FY 98 Actual	FY 99 Plan	FY 99 Actual	FY 00 Plan	FY 01 Proposed
Hazards monitoring networks maintained	6	6	6	6	6	6
Risk assessments delivered*	n/a	16	14	16	10	9
Real-time streamgages (cumulative)	4,467	4,571	4,671	5,132	Discontinued	
Real-time streamgages on the Internet (quarterly average)	Replacement			4,500	4,700	5,000
Real-time earthquake sensors (cumulative)	70	100	120	120	200	350
Stakeholder meetings	n/a	16	16	16	13	13
Customer satisfaction	Pilot	Pilot	Pilot	Pilot	Baseline	Measure

* The decline in the number of risk assessments delivered is not related to the budget, but rather the cyclic nature of the investigations.

Goal Description

Programs: USGS will enhance our ability to characterize and monitor hazardous events in near-real and real time by adding telemetered streamgages and earthquake sensors that are capable of delivering information almost instantaneously. In addition, long-term data vital both to emergency response and to analysis of flood, earthquake, and other hazard risks will continue to be collected and maintained through current monitoring networks.

We will upgrade our monitoring infrastructure; measure the reliability, delivery times, and accuracy of our real-time hazards information to evaluate improvements; and improve the utility of our information by identifying areas vulnerable to damage by particular hazards. Scientific datasets integral to the delivery of hazards information — key maps and geospatial information, for example — will be made easier to interpret and integrate. This will assist in risk assessment, rescue, recovery, and reconstruction efforts. Stakeholder

meetings will be held with customers, cooperators, and the public who have a major role or interest in hazard warning or response to help us define needs and set program priorities. We will also continue to develop better ways to measure outcomes linked to those of our key partners such as Federal Emergency Management Agency, National Weather Service, and State groups.

Operations: USGS will maximize the efficiency of administrative, science support, and programmatic activities by streamlining and enhancing the reliability of our systems for hazards data delivery. We will continue to upgrade our information infrastructure to improve our ability to integrate hazards-related data and assessments.

People: Our employees are at the core of achieving the Hazards goal over the long term. They are in the field before, during, and after events, installing instruments and making measurements. They use a wide range of analysis and modeling methods to turn these measurements into improved hazard assessment products.

We will evaluate our current capabilities and skills, and actively invest in training employees in the skills needed to keep pace with technology to understand and model natural systems. We are aligning our rewards systems to encourage the integration of capabilities and to support increased responsiveness to customers' needs, such as better prediction of and response to hazards, and development of tools tailored to the needs of emergency managers. Finally, we will respond more quickly and effectively to natural disasters by developing response plans, using new contractual mechanisms for obtaining new skills, removing barriers to resource sharing, and increasing use of cooperative agreements with other emergency response entities.

Customers: USGS will focus on understanding the needs of key users of hazards information, such as emergency managers, industry, community planners, and citizens. We will increase development and delivery of products and services tailored to the current and future needs of these customers.

FY 2001 Goal

For FY 2001, USGS has developed an initiative to accelerate achievement of the Hazards long-term goal. The Safer Communities initiative requests increased funding totaling \$7.1 million to update portions of the national earthquake monitoring network (+\$2.6 million), expand real-time monitoring of volcanoes in Alaska (+\$0.5million), and upgrade the streamgaging network (+\$4.0 million).

The cost of natural disasters — earthquakes, floods, volcanoes — has skyrocketed in recent decades. Overall, 39 States are exposed to significant **earthquake risk**. Safe air travel is imperiled by the threat of crippling damage to aircraft from volcanic-ash clouds drifting at high altitudes, particularly in the North Pacific where heavily traveled air routes overlie Alaska's numerous **active volcanoes**. More lives and property are lost due to **flooding** than any other natural disaster, and every State in the Nation is affected. The USGS has the primary Federal responsibility for monitoring and issuing warnings concerning earthquakes and volcanoes, and provides the streamflow and related hydrologic information needed by the National Weather Service to predict and monitor floods. In all of these programs, USGS hazards experts work closely with local, State, and Federal partners in pursuit of the national goals of reducing the toll of natural disasters and building disaster-resilient communities.

USGS seeks to develop better monitoring techniques, and faster, more reliable communication links so that information is quickly available to all who need it during natural disasters. We propose to accelerate and enhance our ability to provide advance

warning of impending natural disasters to appropriate authorities, which in turn will enable communities to save lives and property, and create stronger, safer communities for our children, and grandchildren.

Customer Satisfaction Measurement: USGS customers will be surveyed to determine their satisfaction with key USGS hazards information products. Product usefulness will be evaluated on the basis of customer requirements such as media, format, and timeliness. A baseline will be established in FY 2000, and targets will be set for the revised final FY 2001 plan to ensure continual improvement. A more complete description is included in Section 3 Customer Service.

Growth Rate: Hazards-related activities represented 15% of the total FY 1999 budget, and 16% of the FY 2000 and 2001 budgets. Of the net funding increases from year to year, hazards-related programmatic increases represented about 70% from FY 1999 to FY 2000, and about 14% from FY 2000 to FY 2001.

FY 1999 Annual Performance Report

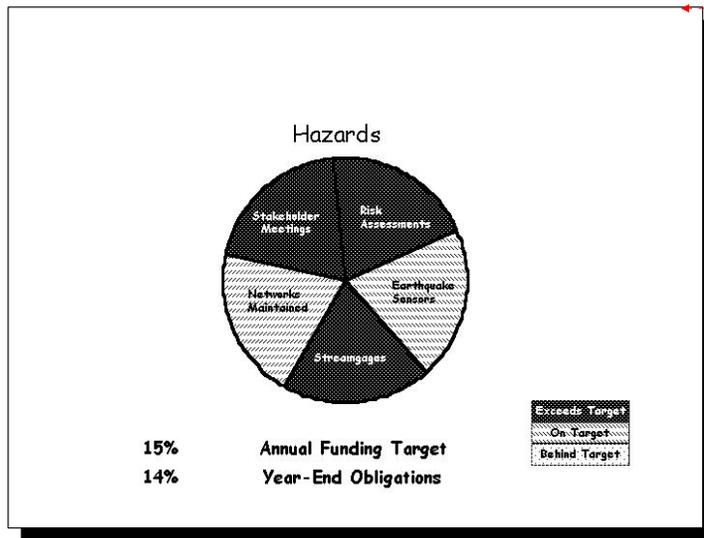
Goal: Develop, maintain, and improve monitoring networks and techniques of risk assessment by: maintaining the baseline of data and risk assessments transferred to customers; increasing by 100 sites streamgages with real-time capability, and increasing by 20 improved earthquake sensors to deliver real-time information on potentially damaging earthquakes to minimize loss of life and property.

Report: USGS met or exceeded all performance indicators for the Hazards goal. Actual numeric performance data are shown on the previous table on page 9. We exceeded our target for streamgage telemetry installed in FY 1999 by more than 500%, testimony to our commitment to enhancing our real-time hazards capability. Our verification and validation efforts have compelled us to revise the streamgage performance metric for FY 2000, described further in the verification and validation section.

USGS planned to obligate approximately 15% of our FY 1999 appropriation to achieving the Hazards goal. Actual obligations and expenditures for FY 1999 totaled 14% of appropriated and reimbursable funds.

Data Verification and Validation

Each performance measure has its own performance data collection strategy and validation hierarchy of review. In addition to those efforts cited, USGS conducts cyclical program evaluations that contribute to the validation of performance measurement.



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GPRA Consolidated Performance Report and Plan

Performance Measure and Definition	Data Collection Methodology, Sources, and Limitations	Validation
Hazards monitoring networks maintained A monitoring network consists of an array of sensing devices, IT infrastructure, and personnel that together detect, record, interpret, integrate and deliver data for a given hazard	Managers monitor and supervise functioning of networks at observatories, research centers, and Water Districts, and report status by exception	Program Coordinators/ Program Officers validate
Risk assessments delivered Regional or national assessment of risk for one or more hazards	Hazards assessments are tracked as published USGS reports; Hazards notifications based on monitoring data are recorded at and reported by USGS observatories, centers, etc.	Official USGS Annual Publications listing verifies publication
*Real-time streamgages Telemetry is added to existing streamgages to provide real-time flow info for NWS forecasters and emergency management and response officials	*Annual inventory of streamgaging stations conducted by all USGS Water District Office data section chiefs and reported to HQ at the end of the fiscal year	*Certification by each District Chief and the Chief of the Office of Surface Water
Real-time earthquake sensors Ground motion detectors are the initial instrument installed to capture and transmit real-time info	Annual inventory of earthquake sensors conducted by Seismic Network operators and reported to HQ at the end of the fiscal year	Certification by Coordinator of the Earthquake Hazards Program
Stakeholder meetings Major meetings with other Feds, customers, cooperators, Administration and congressional oversight groups and/or the public who have a major role/interest in hazard warning or response	Program coordinator schedules, organizes/attends annual stakeholder meetings and maintains records that the meetings have taken place	Regional or Associate Director verifies that stakeholder meetings have taken place.

* Verification and validation processes change in FY 2000 as further discussed in this section.

Our verification and validation efforts have compelled us to revise the streamgage performance metric for FY 2000. Because USGS has responsibility to deliver hazards information to the National Weather Service and others, the reliability of the systems that deliver streamflow data is a crucial component of USGS's performance. In addition, we encountered problems with collecting reliable performance data on a quarterly basis to provide timely information for management purposes. Questions of streamflow data systems reliability are fundamental to the validation process and should be reflected in the performance metric:

- During floods or other natural disasters, do we have the capability to continue providing data to those who need it, by using electrical generators and "mirror" Web sites and other system backups?
- Under normal circumstances, on a day-to-day basis, how reliable are our Web sites that provide data?
- How reliable are the individual data collection stations and the satellite links and other systems that relay the data from the stream to the USGS National Water Information System database?

All of these factors can affect USGS's ability to deliver hazards information in real time, in fulfillment of its strategic goals. Therefore, USGS is proposing to change our real-time streamgages metric not only to reflect the number of real-time streamgages that USGS puts in place each year but also to capture our ability to deliver hazards data to those who need it, and to automate the performance tracking process as well. USGS developed a "robot" program that queries each District Office Web site every day, asking: "how many sites are delivering real-time data on the Web right now?" This query results in a total number of gaging stations across the Nation that are delivering real-time data over the Internet at that particular moment. Numbers may vary from day to day for several reasons:

- District Office computers can be affected by maintenance problems, storms, or power outages;
- The satellites which transmit the data can be affected by solar interference or heavy storm activity; and
- Individual gaging stations may be out of commission at the moment of the robot query due to weather, high water, power outages, vandalism, or routine maintenance activities or quality control activities.

At the end of the quarter, all the daily values collected by the robot program will be averaged together, resulting in one number that represents the "quarterly average number of gages reporting real-time data on the Internet" — our proposed performance measure for FY 2000 and beyond. A test run of this method conducted over a period of 15 days at the end of FY 1999 resulted in a baseline average of approximately 4,500 gages.

USGS is also exploring alternatives to the earthquake sensor performance measure to better capture our ability to deliver hazards data to those who need it, and automate the performance tracking process.

2.2 GPRA Program Activity: Environment and Natural Resources

Description

Provide science for a changing world in response to present and anticipated needs to expand our understanding of environmental and natural resource issues on regional, national, and global scales, and enhance predictive/forecast modeling capabilities.

Our environment — the air, water, soil, and plant and animal life — is constantly changing as natural processes and human actions affect it. Changes in demographics also affect the competition for and use of the renewable and nonrenewable natural resources — land, water, minerals, and energy — needed to sustain life, and to maintain and enhance our Nation's economic strength. As land and resource management issues become increasingly complex, both environmental and natural resources sciences are needed to guide decisions, predict outcomes, and monitor results. The need for cross-discipline, integrated science has never been more apparent. USGS environment and natural resources mission activities focus on studies of natural, physical, chemical, and biological processes, and on the results of human actions. These studies encompass collecting data, making long-term assessments, conducting ecosystem analyses, monitoring change, and forecasting the changes that may be expected in the future.

The USGS cannot and does not seek to collect all of the environmental and natural resources data required for managers, regulators, and the general public to make informed decisions. We are increasingly **building partnerships** among Federal, State, local, private, and industrial entities to leverage resources and expertise. **Established protocols for data collection** are critical to ensuring the comparability, the validity of interpretation, integration, and usefulness of data for land and resource decisionmaking. The USGS is establishing data standards and protocols, and working with customers to identify their long-term environmental and natural resource issues, current trends, and available information to improve our data collection and data management efforts; to deliver systematic analyses needed by our customers; and to develop and improve decision support systems. We are also seeking new applications and increased use of our classified assets.

“Established a State-wide frog monitoring program utilizing NAAMP [North American Amphibian Monitoring Program] protocols. The information provided by NAAMP is current and easily available over the WWW. Because the protocols have been peer reviewed and often validated with specific research studies, they are very helpful in efficiently planning solid monitoring research projects of my own.”

University respondent to customer survey

FY 2001 Goal

Provide and improve long-term environmental and natural resource information, systematic analysis and investigations, and predictive options for decisionmaking about natural systems by: providing essential information to address environmental and natural resources issues by maintaining 45 long-term data collection/data management efforts and supporting two large data infrastructures managed in partnership with others; delivering 1,077 new products from systematic analyses and investigations to our customers; improving and developing nine new decision support systems and predictive tools for decisionmaking; and collaborating with university partners to understand natural systems and facilitate sound management practices through 258 external grants and contracts.

Proposed Legislation

Congress is working on reauthorization of the Water Resources Research Act which expires September 30, 2000. The Water Research Institute component of the university-based partnership performance measure is conducted under this legislation.

Budget Table

Budget Activity/Subactivity (\$000)	FY 1999 Enacted Appropriation less rescission		FY 2000 Enacted Appropriation less reductions		FY 2001 Pres Budget	
	Total	Env & NR	Total	Env & NR	Total	Env & NR
National Mapping Program (<i>Budget Activity</i>)	138,148	132,133	126,717	118,767	155,282	147,332
Mapping Data Collection and Integration	63,691	63,691	56,330	51,080	67,327	62,077
Earth Science Info Management and Delivery	36,388	31,833	34,270	33,020	36,911	35,661
Geog Research and Applications	38,069	36,609	36,117	34,667	51,044	49,594
Geologic Hazards, Resources, and Processes	238,659	145,362	211,222	127,114	224,809	134,609
Geologic Hazard Assessments	76,237	0	69,111	0	73,236	0
Geologic Landscape and Coastal Assessments	73,935	56,875	65,435	50,438	77,189	60,225
Geologic Resource Assessments	88,487	88,487	76,676	76,676	74,384	74,384
Water Resources Investigations	208,542	195,778	185,819	171,055	197,576	178,812
Water Resources Assessment and Research	103,991	103,991	91,037	91,037	90,355	90,355
Water Data Collection and Management	29,359	27,169	29,167	24,977	39,275	31,085
Fed-State Coop Water Program	70,137	59,563	60,553	49,979	62,879	52,305
Water Resources Research Act Program	5,055	5,055	5,062	5,062	5,067	5,067
Biological Research	162,187	162,187	136,896	136,896	158,781	158,781
Biological Research and Monitoring	138,247	138,247	113,232	113,232	123,430	123,430
Bio Info Management and Delivery	11,443	11,443	10,484	10,484	21,243	21,243
Cooperative Research Units	12,497	12,497	13,180	13,180	14,108	14,108
Programmatic Total	747,536	635,460	660,654	553,832	736,448	619,534
General Administration/Science Support (prorated)	27,204	23,123	67,104	56,367	70,895	59,552
Facilities (prorated)	21,501	18,276	85,618	71,919	88,036	73,950
Appropriations Total (not including supplementals)	796,241	676,859	813,376	682,118	895,379	753,036

GPRA Program Activity: Environment and Natural Resources						
Long-Term Goal: Ensure the continued availability of long-term environmental and natural resource information and systematic analysis and investigations needed by customers, and by 2005, develop 20 new decision support systems and predictive tools for informed decisionmaking about natural systems.						
FY 2001 Annual Performance Goal: Provide and improve long-term environmental and natural resource information, systematic analysis and investigations, and predictive options for decision-making about natural systems by: providing essential information to address environmental and natural resources issues by maintaining 45 long-term data collection/data management efforts and supporting two large data infrastructures managed in partnership with others; delivering 1,077 new products from systematic analyses and investigations to our customers; improving and developing 9 new decision support systems and predictive tools for decision-making; and collaborating with university partners to understand natural systems and facilitate sound management practices through 258 external grants and contracts.						
Performance Measure:	FY 97 Actual	FY 98 Actual	FY 99 Plan	FY 99 Actual	FY 00 Plan	FY 01 Proposed
Long-term data collection and data management efforts maintained and improved, and large data infrastructures supported	34	40	40	40	46	47
New products from systematic analyses and investigations delivered to customers	n/a	865	843	959	995	1,077
Decision support systems or predictive models developed or improved, and delivered to customers	n/a	5	6	7	6	9
University-based partnerships for natural systems analysis	235	270	272	238	248	258
Stakeholder meetings	207	212	228	473	438	459
Customer satisfaction	Pilot	Pilot	Pilot	Pilot	Baseline	Measure

Goal Description

Programs: Environment and Natural Resource programs will focus on understanding, modeling, and predicting how multiple forces affect natural systems. This knowledge will enable land managers, decisionmakers and citizens to make sound decisions about how to live on and manage the land. The USGS will provide these customers with a better understanding of natural systems at all scales, with more and better predictive tools and decision support systems, and with easier access to natural science data. USGS will continue to improve the quality and usability of our long-term datasets and accompanying interpretive products, including water quantity and quality assessments, mineral and energy information, biological data and information, water use information, and high-quality digital maps depicting the character of the earth’s surface. In particular, we will develop predictive models and decision support systems that allow managers and decision-makers to evaluate the resource and environmental consequences of management choices under various scenarios. This information can be used to improve management decisions. Stakeholder meetings will be held with customers, cooperators, and the public who have a major role or interest in environment and natural resource issues to help us define needs and program priorities.

Operations: USGS will improve the efficiency of administrative, science support, and programmatic activities to streamline systems for delivery of environment and natural resources data and information. USGS will implement our Information Infrastructure Plan to ensure that data comply with common standards and protocols.

People: As with Hazards, USGS employees are at the core of achieving the Environment and Natural Resources goal. USGS will assess our current capabilities and skills, and actively invest in training our employees in the skills needed to improve our ability to understand natural systems, develop improved predictive models, and better communicate with customers. USGS is aligning our rewards systems to reinforce the need for better integration of capabilities, and more responsiveness to customer needs. Finally, we will take steps to increase our flexibility to respond quickly and effectively to the needs of our customers by putting in place new contractual vehicles for obtaining new skills, removing barriers to resource sharing, and increasing use of cooperative agreements with others who use our data and information on natural resources and the environment.

Customers: We will focus on key users of environment and natural resources information, such as Federal, State, and local managers, to ensure their needs are understood and are being met. USGS will increase development and delivery of products and services tailored to the current and future needs of these customers.

FY 2001 Goals

For FY 2001, USGS has developed initiatives to address a series of questions and management issues related to people and wildlife, and the land and resources that support them. These initiatives are categorized by theme — livable communities, sustainable resources for the future, and America's natural heritage. Several components also support the Administration's Lands Legacy initiative, State Planning Partnerships, to help States and communities preserve local lands and habitat and develop decision support tools for land and resource managers. These funding increases are requested to accelerate achievement of the Environment and Natural Resources mission goal.

Livable Communities (+\$47.0 million): Americans want communities in which they can enjoy a healthy environment while earning a decent living. To balance competing demands for natural resources, recreational opportunities, wildlife habitat, and economic growth, planners need reliable tools and a variety of information. The USGS delivers these products to the doorsteps of communities, empowering them to plan for intelligent sustainability and

Government Technology Leadership Award. In 1999, USGS received two of 21 awards selected from 109 nominations. This award was created to recognize projects that have directly aided in fulfilling the mission of an organization by improving service to the public through original uses of technology, boosting efficiency and effectiveness, and lowering costs. The USGS programs that received the awards are the National Atlas and the National Biological Information Infrastructure (NBII). See <http://www.govexec.com/features/1299/1299s6.htm>. The NBII was also selected as one of 1999's Best Feds on the Web by GovExec.com, the website of Government Executive magazine. The NBII was one of 16 winners chosen from 120 nominations.

USGS Minerals Information. During 1999, the USGS minerals information website was visited a monthly average of 153,000 times, which included the download of an average of 55,000 copies of USGS minerals information publications by over 17,000 different customers every month. The use of the Internet has helped improve the timeliness of an access to USGS minerals information publications. Subscriptions for paper copies of these publications have fallen from a high of about 17,000 to the current level of about 5,000.

growth. With the funding increase proposed for FY 2001, USGS will help local communities solve natural resource problems by upgrading our infrastructure to provide easy access to understandable, usable information on the natural resources vital to community health. USGS will develop planning tools that help decisionmakers understand and predict the effects of their choices. The result will be a balance of strong local economies and healthier environments.

Sustainable Resources for the Future (+\$15.3 million): Understanding how our land responds to change is essential for continued enjoyment of the natural landscape. With additional funding in FY 2001, USGS will develop tools to help understand and predict how the land interacts with the oceans and air, and how it reacts to our many uses of it. Special attention will be paid to such critical areas as the Columbia River, Lower Mississippi, Great Lakes, Yellowstone area, and Mojave Desert in an effort to develop restoration tools. With a solid understanding of how the Earth works, we can help to ensure thriving, vital landscapes for people and wildlife.

America's Natural Heritage (+\$16.7 million): A vital part of America's natural legacy is its parks, refuges, and other public lands, many of which are entrusted to the Department of the Interior. These landscapes, and the fish and wildlife they support, are at the core of our national identity. USGS, in partnership with stakeholders throughout the Nation, is helping land and resource managers preserve our natural heritage by monitoring, assessment, and research that address issues of critical importance. With the increased funding requested in FY 2001, USGS will increase science support for high-priority land and resource management needs of the DOI; increase efforts to monitor amphibian status and investigate factors related to their decline; study fish and wildlife diseases, such as the West Nile Virus; and track birds that carry disease to anticipate future outbreaks in humans. USGS also will fully staff science positions at Cooperative Research Units. This work will provide the scientific foundation for preserving America's treasures.

Customer Satisfaction Measurement: USGS customers will be surveyed to determine their satisfaction with key USGS environment and natural resource information products. Product usefulness will be evaluated on the basis of customer requirements such as media, format, and timeliness. A baseline will be established in FY 2000, and targets will be set for the revised final FY 2001 plan to ensure continual improvement. A more complete description is included in Section 3 Customer Service.

Growth Rate: Environment and Natural Resources-related activities represented 85% of the total FY 1999 budget and 84% of the FY 2000 and 2001 budgets. Of the net increases from year to year, environment and natural resources-related programmatic increases represented about 30% from FY 1999 to FY 2000, and about 86% from FY 2000 to FY 2001.

FY 1999 Annual Performance Report

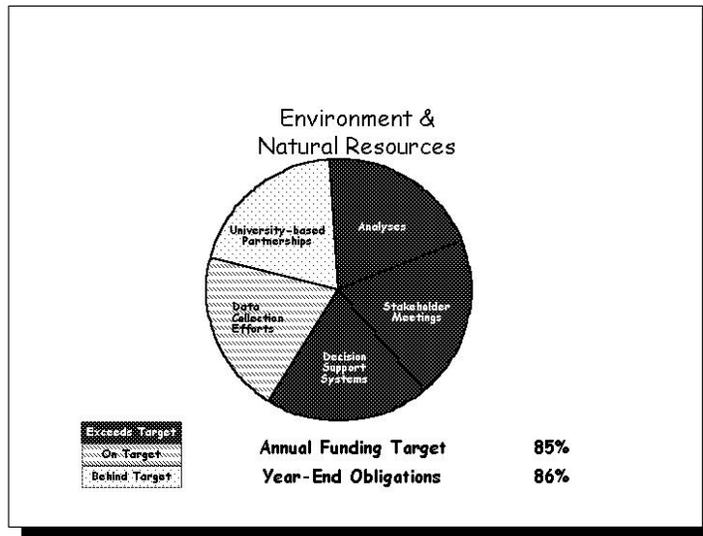
Goal: Provide and improve long-term environmental and natural resource information, systematic analysis and investigations, and predictive options for decisionmaking about natural systems by: providing essential information to address environmental and natural resources issues by maintaining 38 long-term data collection/ data management efforts and supporting two large data infrastructures managed

in partnership with others; delivering 843 new products from systematic analyses and investigations to our customers; improving and developing six new decision support systems and predictive tools for decision-making; and collaborating with university partners to understand natural systems and facilitate sound management practices through 272 external grants and contracts.

Report: USGS met our data collection target, failed to meet our university-based partnership target, and exceeded the three remaining targets for analyses, decision support systems, and stakeholder meetings for the Environment and Natural Resources goal. Actual numeric performance data are shown on the previous table on page 16. Our shortfall in

university research work orders for the Cooperative Research Units resulted from fewer than anticipated large/long-term studies with severable research components. This shortfall actually represents improved time and cost efficiency rather than lost or decreased productivity. Partner and cooperator satisfaction remain high. Evaluation and validation efforts for the Environment and Natural Resources program activities will endeavor to produce a measure that can more capably capture performance and outcome for this external component of our programs.

USGS planned to obligate approximately 85% of our FY 1999 appropriation to achieve the Environment and Natural Resources goal. Actual obligations and expenditures for FY 1999 totaled 86% of appropriated and reimbursable funds.



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“Partner and customer satisfaction...the Coop Units’ work has refined what we now consider optimum habitat for elk and will change how we manage road closures for the species.”

BLM respondent to customer survey

Data Verification and Validation

Each performance measure has its own performance data collection strategy and validation hierarchy of review. In addition to those efforts cited, USGS conducts cyclical program evaluations that contribute to the validation of performance measurement.

Performance Measure and Definition	Data Collection Methodology, Sources, and Limitations	Validation
<p>Long-term data collection and data management efforts maintained and improved, and large data infrastructures supported</p> <p>Long-term, large-scale database efforts to ensure the collection, preservation, and dissemination of natural science data, including support for the development of national infrastructures for the management and sharing of these data produced at all levels of government.</p>	<p>Performance data are collected by project scientists at research/field centers and are reported through an automated, electronic system</p>	<p>For geospatial databases, reports provided by the Federal Financial System and the Sales Data Base verify the amount of maps, data, aerial photographs and satellite images available in the various databases and inventories. For geologic databases, certification is made by Program Coordinator. For water resources data collection, certification is made by each District Chief and the Office of Surface Water. For biological databases, validation occurs through national program element reviews, and reviews of individual research centers.</p>
<p>New systematic analyses and investigations delivered to customers</p> <p>Reports or other products delivered to managers or the scientific community that result from long-term assessments or from investigations to determine causes and/or effects of environmental change. Reports and other products are delivered as paper copies or Internet products.</p>	<p>USGS compiles a list of new publications monthly and makes it available on the Internet at:</p> <p>http://pubs.usgs.gov/publications/index.html</p> <p>A paper version of this list is updated quarterly.</p>	<p>Accuracy of "new reports" listing can be confirmed by each internal organization's reports tracking system.</p>

Performance Measure and Definition	Data Collection Methodology, Sources, and Limitations	Validation
<p>Decision support systems or predictive models developed or improved and delivered to customers</p> <p>Decision support tools and predictive models are broad in scope, are robust, yield either quantitative predictions about natural resources or the environment or quantitative options for land and resource management, and are used regularly by managers for informed decision-making.</p>	<p>Data on development delivery and use of decision support systems and predictive models are monitored and reported by project scientists at research/field centers and are reported through automated, electronic systems such as http://water.usgs.gov/software/ for new water investigation models and Science Information System (SIS) http://www.nbs.gov/science/currproj.html for biological models</p>	<p>For mapping models, the Senior Program Advisor for Geographic Research and Applications validates delivery and use by customers. For geologic models, validation is conducted by Program Coordinators and stakeholder reps. For water resources models, a technical memorandum is issued for each model. For biological models, validation occurs through national program element reviews and reviews of individual research centers. Ultimately customers validate that the systems and models are acceptable and useful.</p>
<p>University-based partnerships for natural system analysis</p>	<p>For water resources research partnerships, source of data is the Chief, Office of Research. For biological partnerships, source of data is the Cooperative Research Unit Coordinator.</p>	<p>Certification from USGS Contracts Office that the partnerships have been awarded.</p>
<p>Stakeholder meetings</p> <p>Major meetings with other Feds, customers, cooperators, Administration and congressional oversight groups and/or the public who have a major role/interest in environmental and natural resource issues</p>	<p>Program coordinator schedules, organizes/ attends annual stakeholder meetings and maintains records that the meetings have taken place</p>	<p>Regional or Associate Director verifies that stakeholder meetings have taken place.</p>

Section III - Additional GPRA Information

3.1 Customer Service

The USGS recognizes that excellent customer service is critical to good government. Similarly, our interface with our customers reflects the effectiveness of our organization. Our vision is to provide and support impartial scientific information, products, and services that are timely, cost effective, useful, and relevant in a changing world. We know that we must talk to our customers, find out what they need, integrate those needs into our program planning, and deliver products, services, and information in a timely and accurate manner.

The USGS has set standards for customer service. When interacting with the USGS, customers can expect:

- Relevant, impartial scientific information about the natural sciences and support systems for these sciences;
- Courteous and respectful treatment;
- Prompt and accurate answers to questions;
- Timely responses to information requests without being referred elsewhere, whenever possible;
- Customer input to be considered in our plans, programs, and services; and prompt attention to correcting mistakes and problems.

At the end of every calendar year, the USGS collects information that helps assess how well goals are being met. A report on our customer service performance is prepared and made available to our customers. The 1998 Report to Customers can be found on-line at <http://www.usgs.gov/customer/>. Our 1999 Report to Customers will be available at the same Web address in March 2000.

The USGS has planned the following activities for Year 2000 to advance Customer Service goals and ensure service standards are met:

Conduct Cross-Program Survey: Pilot projects begun in 1997 marked the start of formalized efforts by USGS to gather information from customers about performance in specific programs. With an expanded information collection effort in FY 2000, USGS expects to identify customer service satisfaction levels across our programs. A cross-program survey based on USGS major products will ask customers to rate satisfaction. Results will be reported through USGS customer service Web pages and will provide a baseline for customer satisfaction metrics for GPRA performance measurement. USGS will use the information collected to make improvements to programs and products, and as part of a bureau-wide customer measurement framework.

Collect Customer Satisfaction Information Related to Our Web Pages, Earth Science Information Centers, and Biological Programs: In 1999, the Office of Management and Budget approved a three-year generic clearance for information collection that enables the USGS to work with customers to research customer service performance. One information collection activity will involve a survey that reviews our Web site. Another activity involves expansion of a survey initiated in 1999 that seeks input from our Earth Science Information Center visitors and customers. The customer survey of biological programs will continue for a fifth year — the survey of FY 1998 products was the first attempt to link customer satisfaction to GPRA performance measures. The *Partner and Customer Survey Report on Biological Programs for FY 1998 Products* presents the results from this survey and is available on the Internet at: <http://www.mp2-pwrc.usgs.gov/brd/customer98.htm>

Complete Development and Design of a Measurement Framework: The USGS Customer Service and Research team will complete the design and testing of a framework that characterizes our customers, their needs, and how they interact with the bureau. The framework will provide USGS program managers and customer service representatives with the tools that they need to effectively identify their customers and their customer needs and requirements; to design products/services/information to meet those needs and requirements; and to assess customer satisfaction.

Continue Customer Service Pilots: Six new pilots were initiated in FY 1999. In FY 2000, four pilots will be continued to test the measurement framework. Additional pilots are anticipated.

Continue Customer Service Recognition Awards: In FY 1999, the USGS fully implemented a Customer Service Recognition Award to recognize USGS employees who are providing superior customer service. Recipients are highlighted on the customer service Web page. In FY 2000, USGS will continue this program, increasing efforts to encourage our customers to nominate potential recipients.

Design a Customer Service Training Program: The USGS will be part of a DOI team, which will design a customer service educational training program for DOI employees based on the results of a National Performance Review survey conducted in 1999.

Benchmark Customer Complaint Processes: The USGS participated in DOI-sponsored benchmarking project focusing on identifying the best practices of other government agencies and the private sector in customer complaint systems. This project will lay the groundwork for designing and establishing a customer complaint/compliment system within the USGS. A report with recommendations is expected in March 2000.

DOI Customer Forum Leadership: USGS will continue to provide leadership for the DOI Customer Forum. Initiated in FY 1999, the forum serves as a mechanism through which Interior offices and bureaus can share experiences, ideas, and success stories in customer service, and identify opportunities and actions for improvement.

3.2 Crosscutting Issues

The USGS is the science bureau for the Department of the Interior and the only integrated natural resources research bureau in the Federal Government. We support the Department's research needs as well as provide the water, biological, energy, and mineral resources information and capabilities needed by other Federal agencies and State and local governments to guide planning, management, and regulatory programs. Our research priorities are established in concert with our stakeholders to ensure their highest priority science needs are addressed, and to avoid duplication of effort among stakeholders. The USGS maintains consistency of its priorities with program evaluations and the National Science and Technology Council's (NSTC's) underlying principles for Federal science and technology investments.

USGS partners with NOAA to Deliver Real-time Hazards Information. NOAA's Internet access capability could not handle the enormous traffic generated by natural disasters. Using existing network infrastructures NOAA was connected to DOINET on September 15, 1999.

The next day Hurricane Floyd put it to the test as the National Hurricane Center in Florida immediately needed to deliver hurricane status information to the public, educational, news, and science communities through the Internet.

Hurricane Floyd generated the largest sustained rate of data delivery to the public that was ever recorded within DOI or NOAA – about 6 times what we normally experience – with tens of millions of citizens using our Internet capability to stay abreast of hurricane developments.

For example, for FY 2000 and 2001 the NSTC's Interagency Research and Development Priorities include Integrated Science for Ecosystem Challenges. The USGS staff of biologists, geographers, geologists, hydrologists, and other professionals has the capability to work hand-in-hand with land managers at the local, State, and national level to solve today's problems, and provide knowledge to land managers that will ensure decisions made today will not have unintended consequences tomorrow. We have engaged the public, private, and academic sectors in dialogue to guide our efforts at integrating science and develop our research agenda. In FY 1999 the USGS, Ecological Society of America (ESA), and Geological Society of America (GSA) held a workshop on enhancing integrated science. The participants discussed the social, scientific, and administrative environments that lead to successful collaboration and integration, produced an initial set of principles for integrating scientific efforts, and made recommendations for both the USGS and the larger scientific community to facilitate interdisciplinary work. Two previous workshops held by USGS, ESA, GSA, and the Keystone Center (a non-profit science and public policy and educational organization) identified new interdisciplinary research opportunities relevant to USGS mission. The outcome of these and other stakeholder dialogues have focused USGS "Integrated Science" efforts, resulting in more efficient planning and operations.

To ensure the provision of sound and effective USGS science support for the Department, the DOI bureau directors have an Agreement on USGS Research Support for DOI Resource Management Bureau Needs. The bureaus engage in a defined process that assesses the status of current science support, identifies gaps and cross-bureau applications, and formulates priorities for USGS research in support of land management needs. Consultation and formulation includes: regional science forums that supply input on regional bureau priorities to the USGS; meetings between the USGS Director and each bureau director to discuss the regional input in the context of national perspectives; DOI Science Board meetings, chaired by the Secretary of the Interior, to present and discuss individual bureau priorities; and a meeting of DOI teams to review the priorities and identify linkages among priorities, applied across a matrix of common issues, species, or geographic locations. The results help establish the basis for future integrated proposals and, with the summaries of each bureau's priorities, form the framework for budget priorities. The FY 2001 budget proposes increases for integrated science aimed at addressing the highest priority science needs of DOI bureaus.

The depth of coordination in which we engage may be demonstrated by looking at stakeholders working together on complex issues in a single location. For example, in South Florida, the USGS provides scientific information to all agencies involved in the restoration effort including:

- The U.S. Army Corps of Engineers and the South Florida Water Management District need USGS data and information to improve models of water flows and water quality, and to predict the consequences of the restoration efforts in South Florida.
- Everglades National Park needs USGS information about historical environmental conditions and the frequency of fire to understand current and historical water and fire conditions; to set ecological goals for restoration; to distinguish human influences from the natural background of water fluctuations and trace-element contamination; and to provide yardsticks to measure the success of the restoration.
- The Florida Department of Environmental Protection, the National Marine Fisheries Service, and the U.S. Environmental Protection Agency need information on mercury cycling to predict changes in the availability of mercury to fish as a result of restoration. This information includes interactions of mercury with peat, algae, and dissolved organic carbon, as well as historical mercury concentrations in peat.

- Communities in the Florida Keys need information on nutrient seepage from ground water, provided by the USGS, to determine whether it is necessary to modify their sewage-disposal practices.

The breadth of USGS coordination may be demonstrated in the following representative listing of USGS crosscutting relationships with Federal, State, local, non-government, and international organizations.

FEDERAL
National/Government-wide: Federal Geographic Data Coordination, National Spatial Data Infrastructure, National Biological Information Infrastructure, US Global Change Research Program, National Atlas, Geographic Names, Image and elevation data collection programs
Agriculture/Forest Service: Endangered Species, Conservation genetics, Habitat management, Forest plan, Wildlife, Invasive species, Fire science, National Forest maps, Drought/Fire fuel monitoring, Energy and mineral resources, Natural hazards, Mine lands, Land cover characteristics, Hydrologic data collection/studies
Commerce: Interactive mapping www, Hydrologic data collection/studies
Commerce/NOAA: Endangered Species, Salmonid restoration, Coral reefs, Hazards monitoring and research, Geomagnetism, Vegetation change, Coastal erosion, Fish habitat, Marine sanctuaries, Landsat 7 operations, GIS
Defense: Endangered Species, Salmonid restoration, Coral reefs, Coastal erosion, Backup mapping during conflict, Natural hazards, Test ban monitoring, Strategic minerals and energy resources, Geomagnetism, Terrain visualization, Hydrologic data collection/studies
Defense/Army Corp of Engineers: Endangered Species, Habitat assessment, Fish behavior, Fish physiology, Dam impacts, Wetlands restoration, Seafloor mapping, Shoreline stability, Floodplain morphology, Mine lands, Energy resources, Natural Hazards, Hydrologic data collection/studies
Energy: Endangered Species, Bio resource monitoring, Contaminant cause and effects, Gas Hydrates, Mining technology, Energy resources, Geologic hazards, Groundwater framework, Coal bed methane, Hydrologic data collection/studies
EPA: Endangered Species, Endocrine disruption, Contaminant effects, Status/Trends, Mine lands and drainage, Emissions modeling/clean air, Water quality, Seafloor mapping, Geochemical analyses, Coal resources and mining, Urban dynamics/land characterization, Hydrologic data collection/studies Remote sensing, Mineral baselines, GAP Analysis
Federal Emergency Management Administration: Hazards monitoring and mitigation, Hydrologic data collection/studies
FEMA/Federal Insurance Administration: Hazards assessment
Health and Human Services: Chemical Analyses
Intelligence Community: Information coordination, Environmental/ resource studies, Hazards Support
Interior/BIA: Integrated Resources (water, geology, vegetation inventory, remote sensing)
Interior/BLM: Rangeland Health, Wild Horse Management, Invasive Species, Abandoned Mine Lands, Air Quality, T&E species, Water Quality, Mineral Resource Assessments, Prescribed Fire
Interior/BOR: Water quality, Ecological models, Decision Support Systems

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Interior/FWS: Inventory and Monitoring, Aquatics and Contaminants, Biological resources, T&E species, Water Quantity/Quality, GAP Analysis
Interior/MMS: Gas hydrates
Interior/NPS: Water quantity/quality, Geologic mapping, Biological resources
Interior/OSM: Acid mine drainage
Justice: GIS
Labor: Energy resources
National Academy of Science: Hazards studies
National Aeronautics and Space Administration (NASA): Planetary research, Landsat 7 operations, Natural hazards, Earth Science research, Data management, Land Processes Distributed Active Archive, GIS, United Nations Environment Programme clearinghouse, Remote sensing
NASA/Jet Propulsion Lab: Spaceflight support
National Institutes of Health: Human health and environment
National Science Foundation: Hazards studies, Antarctic research and mapping, Global seismology
Smithsonian Institution: North American vertebrate collections
State: Natural hazards, Energy resources, Global seismology, Hydrologic data collection/studies
Tennessee Valley Authority: Hydrologic data collection/studies
Transportation/Federal Highway Administration: Hazards studies, Hydrologic data collection/studies
Transportation/Federal Aviation Administration: Volcano hazards
US Agency for International Development: Geologic hazards, Hydrologic data collection/studies, Energy resources, Atmospheric moisture index
STATE and LOCAL GOVERNMENT
Airports: Volcanic hazards
American Indians/ Alaska Natives: K-12 educational resources, Streamgaging, Water quality/ quantity, Technical training and capability upgrade, Environmental hazards, Fisheries research, Invasive species
Civil Defense: Hazards mitigation
Departments of Natural Resources/Geographic Information Councils: Volcanic hazards, Map data production, Hydrologic data collection/studies
Departments of Environmental Protection/Quality/Health: Hydrologic data collection/studies
Departments of Fish and Game/Conservation Commission/Wildlife and Parks: Endangered species, Population dynamics, Habitat requirements, Fire management, Fisheries, Wildlife disease, Invasive species, Waterfowl surveys Bird banding, Aquaculture, GAP Analysis
Offices of Emergency Management/Services: Hazards monitoring and mitigation
Planning Commissions/Transportation/Engineering/Municipalities: Conservation plans, Hydrologic data collection/studies, Topographic mapping
State Geological Surveys/Depts of Mines and Geology: Geologic and topographic mapping, Hazards assessment

Water Resources Authorities/Public Works/Sanitation: Contaminant Transport, Hydrologic data collection/studies
NONGOVERNMENT ORGANIZATIONS
American Farm Bureau/ American Society of Civil Engineers/Chemical Manufacturers Association/etc.: Coordination of hydrologic programs
American Red Cross: Hazards monitoring and mitigation
Electric Power Research Institute: Coal quality
FERC permittees/licensees: Hydrologic data collection/studies, Restoration of T&E migratory fish
Industry: Spatial data modeling, Spatial data browsing and retrieval, Product development and production, Environmental monitoring, Acid rain deposition program
The Nature Conservancy: Endangered species, Species at Risk, Ecological research, Biological Status/Trends, Coordination of hydrologic programs, GAP Analysis
National Park and Conservation Association: Ecosystems assessments, Biological information
Universities/Cooperative Fish and Wildlife Research Units/State Water Resources Research Institutes: Planetary research, Space-based instrumentation, Natural science information delivery, Natural science research and applications, Hazards research, Training/education, Geologic mapping, Hydrologic data collection/studies, GAP Analysis
Utilities: Seismic studies, Hydrologic data collection/studies
Woods Hole Oceanographic Institute: Marine research
The Public: Breeding bird survey, Bird banding, Water resources education/outreach
INTERNATIONAL
Global: Natural hazards support as requested
Africa: Ecological monitoring, Famine Early Warning System
Canada: Hydrologic data collection/studies, Scientific/technical cooperation
Central America: Hazards mitigation, Database development, GIS
China: Scientific/technical cooperation
International Civil Aviation Administration: Volcanic Hazards
International Organization for Standardization: Standards activities
Mexico: Border mapping, Habitat Restoration, Environmental Education, Water quantity/ quality, Landscape health, Fish species
United Arab Emirates: Hydrologic data collection/studies
United Nations: United Nations Environment Programme/Global Resources Information Database, Geographic names activities

3.3 Management Issues

The USGS has no problems that have been identified on the Inspector General's list of top ten management issues for FY 2000 or in GAO's *Major Management Challenges and Risks* (GAO/OCG-99-28). The USGS also has no significant management problems of a mission-critical nature that threaten the achievement of major performance goals.

3.4 Data Verification and Validation

An Intranet-based performance reporting system was developed to track FY 1999 performance — source and procedures for collecting and verifying data were highlighted in Section II for each performance measure for each GPRA program activity. In general, program officers collected and verified performance data from program/project managers for the budget line items within their purview. Data received a final verification at the bureau level to ensure that reported components were discrete entities and that double counting did not occur, particularly in the more vulnerable areas such as integrated science investigations, for which several different line items supporting a single investigation could have resulted in counting by more than one program manager. USGS has not identified any serious data limitations — performance data for all FY 1999 measures were captured by a physical count by in-house sources rather than by sampling or by surveys of external entities outside of Federal control. For FY 2000 the new streamgage measure will require automated sampling as described under the Hazards Data Verification and Validation section.

In addition to ongoing efforts to verify and validate performance data acquired for each performance measure, USGS under the current reorganization, is defining roles and responsibilities of Regional Directors (Eastern, Central and Western) and Associate Directors (for science disciplines and operations) with respect to ensuring that performance metrics for the Strategic Plan are collected, evaluated, and achieved at appropriate levels in the Bureau.

3.5 Program Evaluations

Evaluations are a key part of USGS culture and are critical to maintaining the bureau's reputation for scientific excellence and credibility. We conduct both peer and management reviews to improve the accountability and quality of programs; identify and address gaps in programs; redirect or reaffirm program directions; identify and provide guidance for development of new programs; and reward and/or motivate

External Task Force Review of the USGS Federal – State Cooperative Water Program. As part of the review, a survey was conducted concerning the timeliness and accuracy of water resource research products. Eighty-six percent of respondents stated that requests for data, reports, and information were handled promptly. Ninety-six percent of respondents stated that requests for data, reports, and information are answered accurately. Progress is being made to improve timeliness as evidenced by an improvement from a negative rating of 26% received from cooperators in the period from 1995 – 1997. The effort to improve continues and the Coop Program is capturing customer satisfaction data by soliciting feedback each time a report is delivered in fulfillment of an agreement between the USGS and that customer.

managers and scientists. Reviews are both internal and external — conducted by USGS and non-USGS scientists, technicians, or specialists who are not involved in the specific proposal, project, program, or product under review. Our goal is to conduct an independent external peer review of ongoing programs about every five years, combined with more frequent independent internal management reviews. The following evaluations completed in FY 1999 influenced the revision of the Strategic Plan and contents of the performance measures and budget requests for FY 2000 and FY 2001. Program evaluations scheduled for FY 2000 and FY 2001 are listed in the revised Strategic Plan and will influence the content of the revised final FY 2001 Plan and FY 2002 Plans.

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FY 1999 Program Evaluation	Scope and Methodology	Bureau Goal
Global Disaster Information Network	External Review by National Academy of Public Administration (NAPA)	Hazards
Hydrologic Hazards	External Review by the National Research Council (NRC)	Hazards
Earthquake Hazards: The Advanced National Seismic System	Internal report prepared for Congress	Hazards
Landslide Hazards at USGS	Internal report prepared for Congress	Hazards
National Digital Orthophoto Program (NDOP)	Internal/External Review with multiple Federal agencies and National States Geographic Information Council	Hazards ENR
Strategic Directions for the USGS Water Resources Division	Internal Review	Hazards ENR
Streamgauge Program	Internal review prepared for Congress	Hazards ENR
Coastal and Marine Geology Program	External Review by NRC	Hazards ENR
Gateway to the Earth Workshop	Internal/External Review by technical specialists from USGS, university and State governments	Hazards ENR
USGS Upper Midwest Environmental Sciences Center	DOI Inspector General to support Corps of Engineers management requirements	ENR
Energy Resources Program	External Review by the NRC	ENR
National Cooperative Geologic Mapping	Internal/External Panel Federal Advisory Committee	ENR
Federal-State Cooperative Water Program	External Review by the NRC	ENR
Fisheries and Aquatic Resources Program	Internal/External Review	ENR
Geographic Information for the 21 st Century	NAPA	ENR
Global Change Wetlands Program	Internal/External Review	ENR
Ground Water Resources Program	Internal report prepared for Congress	ENR
National Mapping Program Private Sector Relationships	Internal/External by senior management and private sector partners	ENR
South Florida Ecosystems Restoration	GAO Audit and Programmatic Evaluation	ENR
Biological Resource Status and Trends Program	Internal/External Review	ENR

ENR = Environment and Natural Resources

3.6 Capital Assets/Capital Programming

USGS has prepared capital asset plans for two initiatives — **Accessible Data Transfer** and **Hazard Support System**.

Accessible Data Transfer

Environment and Natural Resources GPRA Program Activity: Accessible Data Transfer is the delivery mechanism that enables a large amount of data to be relayed quickly. This component supports the data infrastructure and long-term data collection efforts by creating a faster, more secure network with more capability to deliver a larger amount of data. This will greatly improve the transfer and delivery of the 40 long-term databases from data collection sites at field offices to on-line archives and delivery of data and information products to customers across the Nation.

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Hazards GPRA Program Activity: Accessible Data Transfer also supports the hazards monitoring networks by creating a faster more secure network with more capability to deliver a larger amount of data. This will greatly improve the transfer and delivery of hazards data and information products to customers across the Nation.

Hazard Support System

Hazards GPRA Program Activity: The Hazard Support System (HSS) is a prototype, satellite-based, wildland-fire detection system designed to provide 24-hour unclassified early warning of the outbreak of wildland fires while they are still only a few acres in size and easily suppressed. The system fuses sensor data in near real-time from the world's environmental weather satellites and the Nation's ballistic missile warning system, and from ancillary sources such as the national lightning detection network, fire-danger and fire-potential indices, and fire-fuel moisture and depth projections. When fully operational, the system has the potential to save tens to hundreds of millions of dollars annually in reduced Federal and State fire-suppression costs and saved timber, rangeland, and private property. The HSS is a joint development of the USGS, the National Reconnaissance Office (NRO), the National Oceanic and Atmospheric Administration (NOAA), and the Federal wildland-fire community, represented by the Bureau of Land Management and the U.S. Forest Service. The HSS together with the USGS Center for Integration of Natural Disaster Information comprise the integrated hazards monitoring network, one of the six hazards monitoring networks maintained under the Hazards GPRA Program Activity annual performance measure.

Information Technology Maintenance

Capital asset plans are also in place for ongoing information technology support efforts in earth science information management and delivery systems, geographic research and applications systems, seismic data acquisition system, U.S. national seismograph network, global seismograph network, mineral resource data system and national coal resources data system.

3.7 Use of Non-Federal Parties in Preparing this Plan

The Annual Plan was prepared in conformance with *OMB Circular A-11 § 220.6*. The USGS did not engage non-Federal parties in preparing the Annual Performance Plan.

3.8 Waivers for Managerial Accountability and Flexibility

The USGS is requesting no waivers of administrative procedural requirements and controls.

Appendix 1

FY 1999 Annual Performance Report-at-a-Glance

Departmental Goal 4. Provide Science for a Changing World						
USGS GPRA Program Activity	Long-term Goal	Annual Goal	Performance Measure	1999 Target	1999 Actual	Comment
Hazards Provide science for a changing world focusing efforts in response to present and anticipated needs to predict and monitor hazardous events in near-real and real-time and to conduct risk assessments to mitigate loss.	Ensure the continued transfer of hazards-related data, risk assessments and disaster scenarios needed by our customers before, during and after natural disasters, and by 2005, increase the delivery of real-time hazards information by adding telemetry to 600 streamgages (thus reducing the time it takes to provide flood information at that site from 6 to 8 weeks to 4 hours) and installing 140 improved earthquake sensors (thus reducing delivery time of information on potentially damaging earthquakes from 40 to 20 minutes) to minimize the loss of life and property.	Develop, maintain and improve monitoring networks and techniques of risk assessment by: maintaining the baseline of data and risk assessments transferred to customers; increasing by 100 sites streamgages with real-time capability, and increasing by 20 improved earthquake sensors to deliver real-time information on potentially damaging earthquakes to minimize loss of life and property.	Hazards monitoring networks maintained	6	6	
			Risk assessments delivered	14	16	
			Real-time streamgages (cumulative)	4,671	5,132	Measure replaced in FY 2000
			Real-time earthquake sensors (cumulative)	120	120	
			Stakeholder meetings	16	16	
			Customer Satisfaction	Pilot	Pilot	
Environment and Natural Resources Provide science for a changing world in response to present and anticipated needs to expand our understanding of environment and natural resource issues on regional, National, and global scales and enhance predictive/forecast modeling capabilities.	Ensure the continued availability of long-term environmental and natural resource information and systematic analysis and investigations needed by customers, and by 2005, develop 20 new decision support systems and predictive tools for informed decisionmaking about natural systems.	Provide and improve long-term environmental and natural resource information, systematic analysis and investigations, and predictive options for decisionmaking about natural systems by: providing essential information to address environmental and natural resources issues by maintaining 38 long-term data collection/data management efforts and supporting two large data infrastructures managed in partnership with others; delivering 843 new products from systematic analyses and investigations to our customers; improving and developing six new decision support systems and predictive tools for decisionmaking; and collaborating with university partners to understand natural systems and facilitate sound management practices through 272 external grants and contracts.	Long-term data collection and data management efforts maintained and improved, and large data infrastructures supported	40	40	
			New products from systematic analyses and investigations delivered to customers	843	959	
			Decision support systems or predictive models developed or improved and delivered to customers	6	7	
			University-based partnerships for natural systems analysis	272	238	Subdivided fewer projects.
			Stakeholder meetings	228	473	
			Customer Satisfaction	Pilot	Pilot	

Appendix 2

FY 2000 Annual Performance Plan-at-a-Glance

Departmental Goal 4. Provide Science for a Changing World						
USGS GPRA Program Activities	Long-term Goals	Annual Goal	Performance Measure	2000 Target	2000 Actual	Comments
Hazards Provide science for a changing world focusing efforts in response to present and anticipated needs to predict and monitor hazardous events in near-real and real-time and to conduct risk assessments to mitigate loss.	Ensure the continued transfer of hazards-related data, risk assessments and disaster scenarios needed by our customers before, during and after natural disasters, and by 2005, increase the delivery of real-time hazards information by increasing the quarterly average number of gages reporting real-time data on the Internet to 5,500 (thus reducing the time it takes to provide flood information at that site from 6 to 8 weeks to 4 hours) and installing 500 improved earthquake sensors (thus reducing delivery time of information on potentially damaging earthquakes from 40 to 20 minutes) to minimize the loss of life and property.	Develop, maintain and improve monitoring networks and techniques of risk assessment by: maintaining the baseline of data and risk assessments transferred to customers; increasing by 200 (to 4,700) the quarterly average number of streamgages delivering real-time data on the Internet, and increasing by 80 improved earthquake sensors to deliver real-time information on potentially damaging earthquakes to minimize loss of life and property.	Hazards monitoring networks maintained	6		
			Risk assessments delivered	10		
			Real-time streamgages on the Internet (quarterly avg.)	4,700		Replace-ment
			Real-time earthquake sensors (cumulative)	200		
			Stakeholder meetings	13		
			Customer Satisfaction	Baseline		
Environment and Natural Resources Provide science for a changing world in response to present and anticipated needs to expand our understanding of environment and natural resource issues on regional, National and global scales and enhance predictive/forecast modeling capabilities.	Ensure the continued availability of long-term environmental and natural resource information and systematic analysis and investigations needed by customers, and by 2005, develop 20 new decision support systems and predictive tools for informed decisionmaking about natural systems.	Provide and improve long-term environmental and natural resource information, systematic analysis and investigations and predictive options for decisionmaking about natural systems by: providing essential information to address environmental and natural resources issues by maintaining 44 long-term data collection/data management efforts and supporting two large data infrastructures managed in partnership with others; delivering 995 new products from systematic analyses and investigations to our customers; improving and developing six new decision support systems and predictive tools for decisionmaking; and collaborating with university partners to understand natural systems and facilitate sound management practices through 248 external grants and contracts.	Long-term data collection and data management efforts maintained and improved, and large data infrastructures supported	46		
			New products from systematic analyses and investigations delivered to customers	995		
			Decision support systems or predictive models developed or improved and delivered to customers	6		
			University-based partnerships for natural systems analysis	248		
			Stakeholder meetings	438		
			Customer Satisfaction	Baseline		

FY 2000 Revised Final Budget Table

Budget Activity/Subactivity (\$000)	FY 1999 Enacted Appropriation less rescission			FY 2000 Request			FY 2000 Enacted Appropriation less reductions		
	Total	Hazards	Env & Nat Res	Total	Hazards	Env & Nat Res	Total	Hazards	Env & Nat Res
National Mapping Program	138,148	6,015	132,133	135,434	13,793	121,641	126,717	7,950	118,767
Mapping Data Collection and Integration	63,691	0	63,691	58,125	0	58,125	56,330	5,250	51,080
Earth Science Info Management and Delivery	36,388	4,555	31,833	43,700	11,999	31,701	34,270	1,250	33,020
Geog Research and Applications	38,069	1,460	36,609	33,609	1,794	31,815	36,117	1,450	34,667
Geologic Hazards, Resources, and Processes	238,659	93,297	145,362	198,617	82,083	116,534	211,222	84,108	127,114
Geologic Hazard Assessments	76,237	76,237	0	68,810	68,810	0	69,111	69,111	0
Geologic Landscape and Coastal Assessments	73,935	17,060	56,875	60,701	13,273	47,428	65,435	14,997	50,438
Geologic Resource Assessment	88,487	0	88,487	69,106	0	69,106	76,676	0	76,676
Water Resources Investigations	208,542	12,764	195,778	172,506	16,985	155,521	185,819	14,764	171,055
Water Resources Assessment and Research	103,991	0	103,991	88,298	0	88,298	91,037	0	91,037
Water Data Collection and Management	29,359	2,190	27,169	20,790	5,116	15,674	29,167	4,190	24,977
Fed-State Coop Water Program	70,137	10,574	59,563	58,356	11,869	46,487	60,553	10,574	49,979
Water Resources Research Act Program	5,055	0	5,055	5,062	0	5,062	5,062	0	5,062
Biological Research	162,187	0	162,187	124,964	0	124,964	136,896	0	136,896
Biological Research and Monitoring	138,247	0	138,247	97,734	0	97,734	113,232	0	113,232
Bio Info Management and Delivery	11,443	0	11,443	14,550	0	14,550	10,484	0	10,484
Cooperative Research Units	12,497	0	12,497	12,680	0	12,680	13,180	0	13,180
Integrated Science	N/A	N/A	N/A	47,686	0	47,686	N/A	N/A	N/A
Programmatic Total	747,536	112,076	635,460	679,207	112,861	566,346	660,654	106,822	553,832
General Administration/ Science Support (prorated)	27,204	4,081	23,123	73,996	12,283	61,713	67,104	10,737	56,367
Facilities (prorated)	21,501	3,225	18,276	85,282	14,157	71,125	85,618	13,699	71,919
SIR Appropriations Total (not including supplementals)	796,241	119,382	676,859	838,485	139,301	699,184	813,376	131,258	682,118