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- Statement of Robert M. Hirsch, Associate Director for Water, U.S. Geological Survey, U.S. Department of the Interior Before the Subcommittee on General Farm Commodities, Resource Conservation and Credit, House Committee on Agriculture on H.R. 4013, September 13, 2000
- Statement of Dennis B. Fenn, Associate Director for Biology, U.S. Geological Survey, U.S. Department of the Interior Before the Subcommittee on Water and Power, Committee on Resources, Hearing on H.R. 4013 -- Upper Mississippi River Basin Conservation Act of 2000, July 27, 2000
- Statement of Daniel D. Roby, Ph.D., Assistant Unit Leader, Oregon Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, U.S. Department of the Interior Before the Subcommittee on Water and Power, Committee on Resources, United States House of Representatives, April 27, 2000
- Statement of Daniel D. Roby, Ph.D., Assistant Unit Leader, Oregon Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, U.S. Department of the Interior Before the Subcommittee on Water and Power, Committee on Energy and Natural Resources, United States Senate, April 18, 2000
- Opening Statement of Dr. Charles Groat on the FY 2001 Budget Request for the USGS before the Subcommittee on the Interior & Related Agencies, Committee on Appropriations, U.S. House of Representatives, March 16, 2000
- Statement of P. Patrick Leahy, Chief Geologist, U.S. Geological Survey, Department of the Interior before the Subcommittee on Energy and Mineral Resources, Committee on Resources, U.S. House of Representatives, March 16, 2000

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- Statement of Timothy S. Collett on S. 1418, the Methane Hydrate Research and Development Act of 1997, before the Energy and Natural Resources Committee Subcommittee on Energy Research, Development, Production, and Regulation, May 21, 1998
- Testimony of Thomas J. Casadevall for Budget Appropriations Hearing with the House Subcommittee on Interior and Related Agencies, March 18, 1998

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- Statement of Dr. John Zogorski on MTBE before the Committee on Environment and Public Works, U.S. Senate, December 9, 1997
- Statement of Dr. Mark Schaefer on El Nino before the Subcommittee on Water and Power of the Committee on Resources, U.S. House of Representatives, October 30, 1997
- Statement for the Record of Mark Schaefer on *Pfiesteria* and its Impacts on our Fishery Resources Before the Subcommittee on Fisheries, Conservation, Wildlife, and Oceans of the Committee on Resources, October 9, 1997
- Statement of Gordon P. Eaton on GPRA Activities Before the Subcommittee on Water and Power of the House Resources Committee, July 17, 1997
- Testimony of P. Patrick Leahy Before the Subcommittee on Basic Research of the Committee on Science, U. S. House of Representatives, April 24, 1997
- Testimony of P. Patrick Leahy Before the Subcommittee on Science, Technology and Space of the Committee on Commerce, Science and Transportation, U.S. Senate, April 10, 1997
- Testimony for Budget Appropriations Hearing with the House Subcommittee on Interior and Related Agencies, Testimony of Gordon P. Eaton for Budget Appropriations Hearing, with the House Subcommittee on Interior and Related Agencies, March 18, 1997
- Testimony of Gordon P. Eaton for Budget Oversight Hearing with the House Subcommittee on Energy & Mineral Resources March 4, 1997
- Testimony of Robert Hirsch for Budget Oversight Hearing with the House Subcommittee on Water and Power March 4, 1997
- House Resources Committee - Subcommittee on Energy and Minerals Hearing on Reauthorization of the Geologic Mapping Act, February 27, 1997

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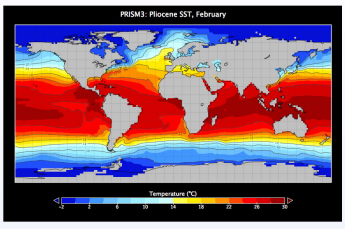

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Statement OF Robert M. Hirsch Associate Director for Water U.S. Geological Survey U.S. Department of the Interior Before the Subcommittee on General Farm Commodities, Resource Conservation, and Credit House Committee on Agriculture on H.R. 4013 September 13, 2000

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to provide the views of the Department of the Interior on H.R. 4013, the "Upper Mississippi River Basin Conservation Act of 2000." The Administration supports many of the provisions of H.R. 4013; we especially appreciate the emphasis within the bill on the need for reliance on sound science. The Administration has strong reservations concerning Title IV of H.R. 4013, which we will discuss later. We also have concerns about the financial resources that would be required for the United States Geological Survey to carry out this bill. Implementation of this bill would be subject to the availability of resources in the context of overall Administration priorities. We are continuing to review H.R. 4013 and the Administration will be able to provide views on it at a later date.

The bill directs the Department of the Interior and the Department of Agriculture, through the Natural Resources Conservation Service, to establish a cooperative effort to reduce sediment and nutrient loss in the Upper Mississippi River. This would be accomplished through establishing a sediment and nutrient monitoring network; conducting sediment and nutrient modeling; conducting research and demonstration projects regarding best management practices; providing financial and technical assistance; and establishing advisory groups consisting of local, State, and Tribal stakeholders.

USGS has the scientific expertise to address a significant resource-management problem--nutrient and sediment loss in the Upper Mississippi River Basin. As you know, nutrients and sediment in the Upper Mississippi River Basin and their relation to the hypoxia in the Northern Gulf of Mexico is a very controversial issue. The USGS as a non-regulatory, non-advocacy, scientific agency collects additional monitoring data, conducts modeling and research, and examines the effectiveness of alternative management measures. The information and analysis USGS provides, when linked to the fact that we do not serve as advocates, often helps to diffuse controversy that attends issues such as this.

The role identified for USGS in this bill is consistent with the bureau's leadership role in monitoring, interpretation, research, and assessment of the health and status of the water and biological resources of the Nation. As the Nation's largest water, earth, and biological science, and civilian mapping agency, USGS conducts the largest single ambient non-regulatory water-quality

monitoring activity in the Nation. The Office of Management and Budget (OMB Memo 92-1) established the Department of the Interior, through USGS, as the lead agency of the Water Information Coordination Program. The overall purpose of the Program is to improve water information for decision making regarding natural resources management and environmental protection. The Program works with all levels of government, Tribal interests, and the private sector through the Advisory Committee on Water Information, which identifies water information needs, evaluates the effectiveness of water information programs, and recommends improvements.

The USGS is an active member of the Mississippi River, Gulf of Mexico Watershed Nutrient Task Force representing the DOI, Assistant Secretary for Water and Science. This Task Force, which has representation from Federal agencies, and State and Tribal governments in the basin, is charged with fulfilling requirements of The Harmful Algal Bloom and Hypoxia Research and Control Act of 1998, by preparing a plan for controlling hypoxia in the Northern Gulf of Mexico, and shares a common goal of improving water-quality conditions in the Mississippi River Basin. This Task Force has expressed many of the same concerns as addressed in H.R. 4013, and has identified the importance of many of the same science and management activities as proposed in this bill. Task Force discussions have emphasized the need for a science-based, adaptive management framework for its management action plan. The USGS has had a lead role in the preparation of a science report that uses available water-quality information to define a recent baseline condition for nutrient sources and loads in the Mississippi River Basin -- a baseline from which future water-quality trends and improvements will be measured. This report identifies parts of the Upper Mississippi River Basin as having some of the highest nutrient yields in the basin.

As identified in H.R. 4013, an essential element of an efficient monitoring and interpretation program in support of nutrient and sediment management in the Upper Mississippi River is the incorporation of existing monitoring activities. The USGS has offices in each of the five Upper Mississippi River Basin States. These offices have a long history of conducting water-quantity and water-quality monitoring and assessment activities within the basin. Existing USGS programs, such as our National Water-Quality Assessment Program, our National Stream Quality Accounting Network, and our Federal-State Cooperative Water Program, currently provide information on nutrients and sediment within the basin that would serve as a foundation for the activities proposed by this bill.

H.R. 4013 would also enable existing USGS monitoring and science programs in the Upper Mississippi River Basin to better meet future information needs by filling data gaps between existing programs and accelerating development of models. These models are tools for defining how water-quality conditions are affected by human activities and natural climatic variations and how management actions may best improve water-quality conditions at a wide range of scales from the farm field to the main stem of the Mississippi River. Furthermore, the bill will enable improved integration of activities conducted in cooperation with other Federal partners and will emphasize and expand the existing USGS role of coordinating and assisting State monitoring programs. For example, the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife program restores wetland habitat in watersheds across the country, including the Upper Mississippi River Basin. The Service is available to apply its expertise to the reduction of sediment and nutrient loss in the basin through participation in demonstration projects, technical assistance, and working groups.

In addition, for the past 20 years, the USGS Upper Midwest Environmental Sciences Center (UMESC) has provided research support in the Upper Mississippi River Basin to Department of the Interior agencies and the U.S. Army Corps of Engineers to address complex issues of navigation, contaminants, and other natural resource concerns. More recently, this Center, which is based in La Crosse, Wisconsin, has developed an active partnership with the Natural Resources Conservation Service on sediment and nutrient concerns of the agencies. For 15 years, the UMESC has provided the scientific and management leadership for the Long-term Resource Monitoring Program of the U.S. Army Corps of Engineer′s Environmental Management Program for the Upper Mississippi River Basin main stem rivers. This monitoring program of water quality, fisheries, vegetation, land use, and other critical indicators of river health is the largest main stem river assessment program in the Nation. The USGS leadership of this program documents the agency′s ability to conduct large-scale data collection and scientifically-based analyses, as well as to manage and serve extensive data files to resource managers and the public.

With regard to State efforts, the USGS also conducts monitoring activities in cooperation with many States and local governments in the Upper Mississippi River Basin. Coordination and enhancement of these cooperating activities and ensuring that State data collection efforts adhere to standard practices would provide the needed scientific basis for implementation of sound, science-based management strategies in the Upper Mississippi River Basin. We also recognize the need to ensure that future monitoring activities complement and do not duplicate State monitoring activities.

With regard to Title IV, it would generally prohibit the release or disclosure of information and data, collected pursuant to Federal conservation programs, to the public or any governmental agency outside the Department of Agriculture. Passage of Title IV would make coordinated implementation of the wetlands provisions of the Clean Water Act and the Swampbuster provisions of the Food and Security Act extremely difficult. For example, under Title IV, USDA would no longer be allowed to share its wetland delineations on agricultural lands with EPA or the Corps of Engineers, ending the coordinated implementation of these statutes and implementation of administrative reforms that provide a single point of contact for farmers. In addition, Title IV would undercut Federal and State programs designed to control the discharge of pollutants and the degradation of wetlands by routinely depriving government agencies and the public of critical information concerning wetlands delineations, cropping histories, and prior converted crop land.

In summary, the bill contains provisions that the Administration supports and are well within the scope and expertise of USGS. However, it also contains a very problematic provision restricting the use of data.

Finally, funding for the activities in H.R. 4013 is not included in the fiscal year 2001 President's Budget proposal, or the current versions of the House and Senate Interior appropriations bills. Financial support for these activities would have to be redirected from ongoing USGS monitoring and data collection activities at a time when the USGS already faces significant budget constraints.

Thank you, Mr. Chairman, for the opportunity to present this testimony. I will be pleased to answer any questions you and other members of the Subcommittee might have.

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Statement of Dennis B. Fenn, Associate Director for Biology
U.S. Geological Survey, U.S. Department of the Interior
Before the Subcommittee on Water and Power
Committee on Resources
Hearing on H.R. 4013 "Upper Mississippi River Basin Conservation Act of 2000"
July 27, 2000

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to provide the views of the Department of the Interior on the "Upper Mississippi River Basin Conservation Act of 2000", H.R. 4013. The Administration supports the activities and concepts contained in H.R. 4013; we especially appreciate the emphasis within the bill on the need for reliance on sound science.

The bill directs the Department of the Interior and the Department of Agriculture to establish a cooperative effort to reduce sediment and nutrient loss in the Upper Mississippi River. This will be accomplished through establishing a sediment and nutrient monitoring network; conducting sediment and nutrient modeling; conducting research and demonstration projects regarding best management practices; providing financial and technical assistance; and establishing advisory groups consisting of local, State, and Tribal stakeholders.

H.R. 4013 identifies an opportunity for USGS to focus its diverse scientific expertise on a significant resource-management problem -- nutrient and sediment loss in the Upper Mississippi River Basin. As you know, nutrients and sediment in the Upper Mississippi River Basin and their relation to the hypoxia in the Northern Gulf of Mexico is a very controversial issue. The USGS as a non-regulatory, non-advocacy, scientific agency is well suited for the task of collecting additional monitoring data, conducting modeling and research, and examining the effectiveness of alternative management measures. The information and analysis USGS provides, when linked to the fact that we do not serve as advocates, often diffuses controversial situations related to contentious water issues such as this.

The role identified for USGS in this bill is consistent with the bureau's leadership role in national water monitoring, interpretation, research, and assessment of the health and status of the biological resources of the Nation. As the Nation's largest water, earth and biological science, and civilian mapping agency, USGS conducts the largest single ambient non-regulatory water-quality monitoring activity in the Nation. The Office of Management and Budget (OMB Memo 92-1) established the Department of the Interior, through USGS, as the lead agency of the Water Information Coordination Program. The overall purpose of the Program is to improve water information for decision making regarding natural resources management and environmental protection. The Program works with all levels of government, Tribal interests, and the private sector through the Advisory Committee on Water Information, which identifies water information needs, evaluates the effectiveness of water information programs, and recommends improvements.

The USGS is an active member of the Mississippi River, Gulf of Mexico Watershed Nutrient Task Force representing the DOI, Assistant Secretary for Water and Science. This Task Force, which has representation from Federal agencies, and State and Tribal governments in the basin, is charged with fulfilling requirements of The Harmful Algal Bloom and Hypoxia Research and Control Act of 1998, by preparing a plan for controlling hypoxia in the Northern Gulf of Mexico, and shares a common goal of improving water-quality conditions in the Mississippi River Basin. This Task Force has expressed many of the same concerns as addressed in H.R. 4013, and has identified the importance of many of the same science and management activities as proposed in this bill. Task Force discussions have emphasized the need for a science-based, adaptive management framework for its management action plan. The USGS has had a lead role in the preparation of a science report that uses available water-quality information to define a recent baseline condition for nutrient sources and loads in the Mississippi River Basin -- a baseline from which future water-quality trends and improvements will be measured. This report identifies parts of the Upper Mississippi River Basin as having some of the highest nutrient-loss yields in the basin.

The Task Force's Draft Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico, currently open for public comment, states:

"(W)hile the current understanding of the causes and consequences of Gulf of Mexico hypoxia is drawn from a massive amount of direct and indirect evidence collected and reported over many years of scientific inquiry, significant uncertainties remain. Further monitoring, modeling and research are needed to reduce those uncertainties in future assessments and to aid decision making in an adaptive management framework. A comprehensive program of planning, monitoring, interpretation, modeling, and research to facilitate improvement in scientific knowledge and adjustments in management practices should be coupled to the initial nutrient management strategies identified in this plan. This adaptive management scheme involves continual feedback between interpretation of new information and improved management actions and is the key to targeting BMPs (Best Management Practices) within watersheds where they will actually be effective."

H.R. 4013 places USGS in a leadership position with respect to collection and interpretation (including modeling) of water-quality information that will be used for setting goals, designing and refining management strategies, and measuring success in reducing nutrient and sediment loss in the Upper Mississippi River Basin. The bill provides a framework whereby monitoring information will be interpreted periodically and used directly for resource management and restoration decision making at the State, Tribal, and Federal levels -- a linkage that maximizes use and relevance of monitoring activities and is important for the USGS monitoring programs.

As identified in H.R. 4013, an essential element of an efficient monitoring and interpretation program in support of nutrient and sediment management in the Upper Mississippi River is coordination of existing monitoring activities. Important roles for USGS will be facilitating collection of consistent and high-quality data, coordinating centralized data storage and availability, and ensuring effective use of all available data to measure progress toward water-quality goals, and providing feedback to decision makers to assist them in continually improving management strategies.

H.R. 4013 will enable existing USGS monitoring and science programs in the Upper Mississippi River Basin to better meet future information needs by filling data gaps between existing programs and accelerating development of models -- models that are tools for defining how water-quality conditions are affected by human activities and natural climatic variations and how management actions may best improve water-quality conditions at a wide range of scales from the farm field to the main stem of the Mississippi River. Furthermore, the bill will emphasize and expand the existing USGS role of coordinating and assisting State monitoring programs and enable improved integration of activities conducted in cooperation with other Federal partners.

The USGS has offices in each of the five Upper Mississippi River Basin States. These offices have a long history of conducting water quantity and quality monitoring and assessment activities within the basin. Existing USGS programs, such as our National Water-Quality Assessment Program, our National Stream Quality Accounting Network, and our Federal-State Cooperative Water Program, currently provide information on nutrients and sediment within the basin that will serve as a foundation for the activities proposed by this bill. For the past 20 years, the USGS Upper Midwest

Environmental Sciences Center (UMESC) has provided research support in the Upper Mississippi River Basin to Department of the Interior agencies and the U.S. Army Corps of Engineers to address complex issues of navigation, contaminants, and other natural resource concerns. More recently, this Center, which is based in La Crosse, Wisconsin, has developed an active partnership with the Natural Resource Conservation Service on sediment and nutrient concerns of the agencies. For 15 years, the UMESC has provided the scientific and management leadership for the Long-term Resource Monitoring Program of the U.S. Army Corps of Engineer's Environmental Management Program for the Upper Mississippi River Basin main stem rivers. This monitoring program of water quality, fisheries, vegetation, land use, and other critical indicators of river health is the largest main stem river assessment program in the Nation. The USGS leadership of this program documents the agency's ability to conduct large scale data collection and scientifically-based analyses, as well as to manage and serve extensive data files to resource managers and the public. The USGS also conducts monitoring activities in cooperation with many States and local governments in the Upper Mississippi River Basin. Coordination and enhancement of these USGS activities would provide the needed scientific basis for implementation of sound, science-based management strategies in the Upper Mississippi River Basin.

In summary, the Administration supports this bill and the activities proposed are well within the scope and expertise of the USGS. However, implementation of this bill would depend on the amount of funding available to USGS through appropriations specifically earmarked for this purpose.

Thank you, Mr. Chairman, for the opportunity to present this testimony. I will be pleased to answer any questions you and other members of the Subcommittee might have.

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Statement of Daniel D. Roby, Ph.D., Assistant Unit Leader, Oregon Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, U.S. Department of the Interior Before the Subcommittee on Water and Power Committee on Resources United States House of Representatives April 27, 2000

Good morning Mr. Chairman and Members of the Subcommittee. My name is Dan Roby, and I am testifying regarding the issue of Caspian tern predation on juvenile salmonids in the Columbia River estuary. I am an Associate Professor in the Department of Fisheries and Wildlife at Oregon State University and the Assistant Unit Leader for the Oregon Cooperative Fish and Wildlife Research Unit, which is part of the U.S. Geological Survey.

For the last three years I have been the Principal Investigator for the research project entitled "Avian Predation on Juvenile Salmonids in the Lower Columbia River." This project was initially funded jointly by the U.S. Army Corps of Engineers and the Bonneville Power Administration (BPA), but it is now funded solely by BPA. The research has been carried out cooperatively between the Columbia River Inter-Tribal Fish Commission and Oregon State University. My colleagues and graduate students, Ken Collis, David Craig, Don Lyons, Stephanie Adamany and Jessica Adkins, deserve much of the credit for this study. I am testifying today in my capacity as a research biologist with no management authority or responsibility on this issue.

To briefly summarize our previous research results, we found that the largest Caspian tern colony in the world resides on a dredge material disposal island in the Columbia River estuary, called Rice Island. This island has recently been the nesting site for over 16,000 terns, and the breeding colony has grown substantially in the last decade. The nesting period for this species generally coincides with the period of juvenile salmonid out-migration in the Columbia River estuary. Our data indicated that Caspian terns were most reliant on juvenile salmonids as a food source, amounting to about 75% of food items in 1997, 1998, and 1999.

Over 40,000 salmonid smolt PIT tags were recovered on the Rice Island Caspian tern colony that have been deposited there over the last 10 years. The recovered PIT tags indicate that steelhead smolts were consumed in greater proportion to availability than other salmonid species, and that juvenile salmonids of hatchery origin were consumed in greater proportion to availability than wild smolts.

We used a bioenergetics model to estimate the numbers of juvenile salmonids consumed by the Rice Island Caspian tern colony in 1997 and 1998. We estimated that between 6 and 25 million juvenile salmonids were consumed by Caspian terns, or approximately 6 to 25 % of the estimated 100 million out-migrating smolts that reached the estuary in 1997. In 1998 the estimated number of

juvenile salmonids consumed by Rice Island Caspian terns was 7 - 15 million, or approximately 8 - 16% of the estimated 95 million out-migrating smolts that reached the estuary in 1998. Preliminary analysis of diet data from 1999 indicates that smolt consumption by terns was similar to 1998.

The magnitude of Caspian tern predation on juvenile salmonids has been cause for considerable surprise and concern, and drew an immediate and strong reaction from fisheries managers. How could losses of smolts to birds, especially to one species of fish-eating bird nesting at one colony in the Columbia River estuary, be so high? Is this level of avian predation the norm, or does it represent an aberrant situation reflecting a highly perturbed ecosystem? We think there are four observations that relate to the current situation. First, the Columbia River estuary has experienced declines of forage fish stocks that would, under other circumstances, provide alternative prey for fish-eating birds such as terns. Second, most of the salmonids consumed by Caspian terns at the Rice Island colony were raised in hatcheries, and the proportion of hatchery-raised smolts in the diet of terns exceeds what would be expected based on availability. This suggests that hatchery-raised smolts are especially vulnerable to tern predation, and may attract foraging terns. Third, juvenile salmonids that survive the out-migration to the estuary must negotiate dams, slack water impoundments, and other obstacles in their efforts to reach the sea. The cumulative stress associated with this migration likely enhances their vulnerability to tern predation. Finally, the Caspian tern colony on Rice Island is one of only two known colonies of its kind along the coast of Oregon and Washington, and Rice Island represents one of the few, if not the only suitable nesting habitat for this species along the coast of the Pacific Northwest. This colony has coalesced at Rice Island because there are few other options for Caspian terns searching for a colony site. There is substantial pressure to initiate management immediately in order to mitigate the impact of Caspian tern predation on smolt survival.

One of our research objectives for the 1999 field season was to test the feasibility of using restoration of former Caspian tern colonies to reduce predation on smolts in the Columbia River estuary. Specifically, we wanted to test the hypothesis that relocating the tern colony on Rice Island to a previous colony site on East Sand Island would result in a significant reduction in tern predation on juvenile salmonids. East Sand Island is about 13 miles down-river from Rice Island and five miles up-river of the mouth of the Columbia River. A greater diversity of forage fishes are thought to be available to fish-eating birds in the vicinity of East Sand Island compared to Rice Island. Attempts to attract Caspian terns to nest at East Sand Island using habitat restoration, tern decoys, and audio playback systems were successful. In 1999, 1,400 pairs of Caspian terns attempted to nest on East Sand Island, and average nesting success was 1.2 young raised per nesting pair (1,600 - 1,700 young terns fledged). Caspian terns that nested on East Sand Island consumed 41% fewer juvenile salmonids than terns nesting on Rice Island (44% and 75% of prey items consumed, respectively).

These research results suggest that relocating the Caspian tern colony from Rice Island to East Sand Island near the mouth of the river is a feasible short-term management option for reducing tern predation on juvenile salmonids. This proposed management action has the potential to save 3 - 12 million smolts that have reached the estuary and would otherwise have been consumed by terns. Longer-term management may include attracting portions of the current Rice Island Caspian tern population to nest outside the Columbia River estuary. Potential locations include former Caspian tern colony sites in Willapa Bay, Grays Harbor, and Puget Sound in the State of Washington, colonies which no longer exist because of human activities. There is evidence that these former colonies have coalesced to form the very large Rice Island colony. Re-establishing these colonies may provide considerable benefits for salmon restoration in the Columbia River Basin and reduce the vulnerability of the tern population to localized catastrophic events. An attempt to restore a Caspian tern colony to Grays Harbor in 2000 was thwarted when local opposition forced state resource management agencies in Washington to withdraw their active support of the restoration effort.

Management action focusing on tern predation in the estuary may be an effective and efficient component of a comprehensive plan to restore salmon to the Columbia River Basin. There is consensus support within the Interagency Caspian Tern Working Group to pursue relocation of the tern colony in 2000. The Working Group also is committed to restoring former Caspian tern colonies at sites outside the Columbia River estuary, so that the very large population in the Columbia River estuary can be redistributed over a number of smaller colonies throughout the Pacific Northwest. However, funding for this management activity or for the continued monitoring and evaluation of this problem has not been formally addressed.

Thank you, Mr. Chairman, for the opportunity to present this testimony. I will be pleased to answer any questions the Subcommittee might have.

Department of the Interior, U.S. Geological Survey, Reston, VA
URL http://internal.usgs.gov/clo2/roby_testimony2.html
Contact: USGS Congressional Liaison Office
Last modification: 19-Aug-2002@07:05 (cey)

Statement of Daniel D. Roby, Ph.D., Assistant Unit Leader, Oregon Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, U.S. Department of the Interior Before the Subcommittee on Water and Power Committee on Energy and Natural Resources United States Senate April 18, 2000

Good morning Mr. Chairman and Members of the Subcommittee. My name is Dan Roby, and I am testifying regarding the issue of Caspian tern predation on juvenile salmonids in the Columbia River estuary. I am an Associate Professor in the Department of Fisheries and Wildlife at Oregon State University and the Assistant Unit Leader for the Oregon Cooperative Fish and Wildlife Research Unit, which is part of the U.S. Geological Survey.

For the last three years I have been the Principal Investigator for the research project entitled "Avian Predation on Juvenile Salmonids in the Lower Columbia River." This project was initially funded jointly by the U.S. Army Corps of Engineers and the Bonneville Power Administration (BPA), but it is now funded solely by BPA. The research has been carried out cooperatively between the Columbia River Inter-Tribal Fish Commission and Oregon State University. My colleagues and graduate students, Ken Collis, David Craig, Don Lyons, Stephanie Adamany and Jessica Adkins, deserve much of the credit for this study. I am testifying today in my capacity as a research biologist with no management authority or responsibility on this issue.

To briefly summarize our previous research results, we found that the largest Caspian tern colony in the world resides on a dredge material disposal island in the Columbia River estuary, called Rice Island. This island has recently been the nesting site for over 16,000 terns, and the breeding colony has grown substantially in the last decade. The nesting period for this species generally coincides with the period of juvenile salmonid out-migration in the Columbia River estuary. Our data indicated that Caspian terns were most reliant on juvenile salmonids as a food source, amounting to about 75% of food items in 1997, 1998, and 1999.

Over 40,000 salmonid smolt PIT tags were recovered on the Rice Island Caspian tern colony that have been deposited there over the last 10 years. The recovered PIT tags indicate that steelhead smolts were consumed in greater proportion to availability than other salmonid species, and that juvenile salmonids of hatchery origin were consumed in greater proportion to availability than wild smolts.

We used a bioenergetics model to estimate the numbers of juvenile salmonids consumed by the Rice Island Caspian tern colony in 1997 and 1998. We estimated that between 6 and 25 million juvenile salmonids were consumed by Caspian terns, or approximately 6 to 25 % of the estimated 100 million out-migrating smolts that reached the estuary in 1997. In 1998 the estimated number of

juvenile salmonids consumed by Rice Island Caspian terns was 7 - 15 million, or approximately 8 - 16% of the estimated 95 million out-migrating smolts that reached the estuary in 1998. Preliminary analysis of diet data from 1999 indicates that smolt consumption by terns was similar to 1998.

The magnitude of Caspian tern predation on juvenile salmonids has been cause for considerable surprise and concern, and drew an immediate and strong reaction from fisheries managers. How could losses of smolts to birds, especially to one species of fish-eating bird nesting at one colony in the Columbia River estuary, be so high? Is this level of avian predation the norm, or does it represent an aberrant situation reflecting a highly perturbed ecosystem? We think there are four observations that relate to the current situation. First, the Columbia River estuary has experienced declines of forage fish stocks that would, under other circumstances, provide alternative prey for fish-eating birds such as terns. Second, most of the salmonids consumed by Caspian terns at the Rice Island colony were raised in hatcheries, and the proportion of hatchery-raised smolts in the diet of terns exceeds what would be expected based on availability. This suggests that hatchery-raised smolts are especially vulnerable to tern predation, and may attract foraging terns. Third, juvenile salmonids that survive the out-migration to the estuary must negotiate dams, slack water impoundments, and other obstacles in their efforts to reach the sea. The cumulative stress associated with this migration likely enhances their vulnerability to tern predation. Finally, the Caspian tern colony on Rice Island is one of only two known colonies of its kind along the coast of Oregon and Washington, and Rice Island represents one of the few, if not the only suitable nesting habitat for this species along the coast of the Pacific Northwest. This colony has coalesced at Rice Island because there are few other options for Caspian terns searching for a colony site. There is substantial pressure to initiate management immediately in order to mitigate the impact of Caspian tern predation on smolt survival.

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Thank you, Mr. Chairman, for the opportunity to present this testimony. I will be pleased to answer any questions the Subcommittee might have.

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Contact: USGS Congressional Liaison Office
Last modification: 19-Aug-2002@07:05 (cey)

Opening Statement of Dr. Charles Groat on the FY 2001 Budget Request for the USGS before the Subcommittee on the Interior & Related Agencies, Committee on Appropriations, U.S. House of Representatives, Mar. 16, 2000

Good morning, Mr. Chairman, and members of the Subcommittee. It is a great pleasure to come before you today to present our proposal for the budget of the U.S. Geological Survey (USGS) for Fiscal Year 2001. The proposed budget requests $895 million, an increase of $82 million over the Fiscal Year 2000 enacted level. This historic request will enable us to enhance a number of our core science and monitoring programs to more fully realize our potential for providing the Nation with "Science for a Changing World."

Before I begin, Mr. Chairman, I would like to thank you for your strong support of the USGS over the years. You are a good friend of the Survey, and I speak for all of us in the USGS when I say we appreciate what you have done for us.

This morning I will forgo the usual recitation of our recent accomplishments. Rather than focus on the past, I want to talk to you about our future. Last year, this Committee asked specifically about the USGS vision of our future role. I am happy to spend a few moments sharing our views on where the USGS is going, why, and what tools we need to get there. I also look forward to hearing your thoughts on these topics as well.

As natural scientists, we at the USGS have a long-term view of things. We know that the history of our planet is a history of change. Our role is to monitor and understand change in the places people care about -- our marine and inland coasts, our national parks and refuges, our vast and beautiful natural heritage of lands and rivers and living things. The USGS also provides a context for understanding change in our natural world, both the changes caused by our human activities, as we live and build and work and play on our planet, and the natural processes of change that continually shape our world and form the backdrop for human influences.

We have learned from the past century that understanding the way our Earth works is essential to the well being of our society. Our experiences with natural disasters, with issues of resource scarcity, with unexpected environmental effects of well-intentioned decisions, have taught us that scientific knowledge is the critical tool that permits the early detection of and early response to emerging problems. Science can prevent crises. Science creates opportunities. Science supports enduring solutions.

Our mission at the USGS is to understand natural processes and to communicate our understanding to people who can benefit from this information. Policymakers at all levels, from the U.S. Congress, to a business, to a local community, need accurate forecasts so that they can envision the consequences of the many choices they face today. The decisions made today will shape the world we inhabit tomorrow.

I have asked our key science leaders to develop the future science directions for the bureau,

incorporating the views of external partners such as the National Research Council as appropriate. Some of the overarching questions they are considering include:

- Will the science goals of our programs enable us to reach fundamental understandings of change, sustainability, and resilience of natural systems?
- Is our science directed toward understanding earth and life systems so we can model them and make projections into the future?
- Are we developing and delivering the tools needed to answer critical management questions, both today and for the future?
- What is the unique contribution of USGS to understanding and resolving societal issues?

More specifically, we are studying the ways in which the diverse capabilities of the USGS can provide the science needed for

- mitigating the impacts of earthquakes through better maps of potential ground shaking and through rapid notification of the onset of earthquakes;
- resolving conflicts over the management of rivers for multiple purposes such as water supply, habitat, hydropower, flood control, and recreation;
- developing strategies for the detection and control of invasive species;
- guiding protection and development of our Nation's coastlines consistent with growing coastal populations and vulnerable estuary and wetland environments;
- developing a better knowledge base for the sustained development of our Nation's ground-water supplies;
- guiding land-use decisions to ensure the availability of natural resources and the safety of growing communities;
- providing information on the availability, quality, and development impacts of energy resources;
- providing near real-time detection and warning of wildland fires in the United States and its territories and of volcanic activity and associated volcanic ash clouds worldwide.

These statements should sound familiar. They build on our core scientific strengths in monitoring, in interpreting, and in maintaining long-term databases that are key to understanding the Earth. I take great pride in the outstanding caliber of USGS scientists, whose excellence is recognized by their peers through countless honors and awards. We are committed to maintaining and enhancing our scientific excellence by training our current staff, to ensure that their knowledge and skills remain at the peak of their fields, and by bringing on board a new generation of bright and dedicated scientists who can ask and answer the questions of the future.

Investments in people must be matched by investments in our scientific infrastructure, in our laboratories, our monitoring instruments and systems, and the technologies we use to communicate with other scientists and with the public. Our budget request includes specific items that will strengthen our capabilities in real-time earthquake and streamflow monitoring, ensure the continued availability of Landsat remotely sensed data for earth science monitoring and research, and enhance our ability to provide excellent science, effectively communicated, to those who need it.

People rely on our information to help them make decisions that shape the future for their communities, the Nation, and the world. Hence we have an increasing responsibility to ensure that our scientific results are effectively communicated. We welcome this evidence of our value, and we recognize that our success brings with it the obligation to strengthen our dialogue with our customers.

As Director of the USGS, I have taken steps to work with our stakeholders to help us envision the best future for the USGS. Our goal is to provide the scientific information that the Nation and the world need

to thrive -- not simply survive -- in the 21st Century. Next week, the USGS leadership will be meeting with many more of our stakeholders to get their help in shaping our vision of the future.

Now let me give you a few highlights of our proposed FY 2001 budget.

Budget Highlights

USGS has developed four overarching themes within which program components address science challenges related to people, wildlife, and the land and resources that support them:

Safer Communities (+$7.1 million) -- The cost of natural disasters -- earthquakes, floods, volcanoes, coastal storms -- has skyrocketed to more than $50 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.

A $2.6 million increase will expand and modernize our earthquake monitoring in urban areas in the United States. This request will install or upgrade a total of 150 regional/urban seismic stations as is proposed in the plans developed for the USGS Real Time Hazards Initiative and for the Advanced National Seismic System. We are requesting $500,000 to expand the real-time volcano monitoring capability at one additional high-risk Alaskan volcano. Since FY 1996 we have installed, operated, and maintained seismic monitors at 20 active volcanoes in Alaska's Aleutian Islands so that airplane encounters with ash clouds can be averted. This initiative also includes $4 million to improve our existing streamgaging network. We will be working with the National Weather Service and other partners to determine locations for adding stations and upgrading existing gages to provide the real-time information needed by emergency managers and the public during floods.

Livable Communities (+$47 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.

We propose $10 million for decision support for Urban Dynamics as part of the Department's Lands Legacy program. The funding will allow us to expand efforts to understand landscape change in large metropolitan regions and assess the impacts of such changes on a regional scale. This work will enable us to transfer historical data and tools to organizations around the country to plan for sound urban growth.

Also supporting the Lands Legacy program is a $30 million increase to fund partnership projects across the country to increase creation and use of geospatial information for informed decisionmaking. These partnerships are aimed at developing local solutions to local problems. Of the $30 million requested, $25 million will be allocated through competitively awarded matching grants and cooperative agreements. Through these partnerships, USGS and communities will share the cost of generating data and providing tools that both solve local problems and address national interests.

The OhioView pilot project taught us valuable lessons about using the Internet to deliver natural science data. In 2001, we propose investments in our information technology infrastructure that is a necessary precursor to expand partnership models like Ohio View to other regions of the country. A $2 million increase will enable us to expand, improve reliability and speed for data delivery, and provide real-time data to customers by upgrading transmission lines.

Data from Landsat satellites have provided the United States and other users with a continuous stream of land-image data since 1972. These data sets are of great value to the earth science community. In

the current Mozambique flooding, for example, Landsat 7 satellite images from April of 1999 and March of 2000 are being analyzed by the United Nations and Mozambique officials to determine the impacts on transportation systems, extent of flooding, where to establish relief centers, and conditions in populated areas. A $5 million increase will allow USGS to assume long-term management responsibility for Landsat 7 operations in 2001. 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) -- 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.

Over the past 50 years, the Columbia River landscape has been changed by urbanization, heavy logging, and agricultural development impacting its natural resources, including Pacific salmon. A $4 million increase will enable us to provide integrated science for managers to establish a foundation for restoring natural processes within the river, monitoring system health, and improving the survival of critical species.

The budget includes a $1.3 million increase to address critical and emerging resource management issues in the Great Lakes Region, the Greater Yellowstone Area, and the Mojave Desert. We will approach these place-based studies with the combined expertise of our multiple disciplines to predict consequences of decisionmaking. We will also work with local, State, and Federal managers to develop decision support tools addressing high-priority resource issues through our proposed $10 million increase for the State Planning Partnerships, part of the Department's Lands Legacy program.

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.

The budget includes a $15 million increase to support the Department's highest priority science needs. This includes $13 million for "DOI Science Priorities" that will be dedicated to bureau-specific projects and $2 million that will be used for monitoring the Upper and Lower Mississippi River Basins to characterize habitat in areas of demonstrated amphibian loss, to develop methods to use spatial analysis techniques to predict potential loss, and to conduct comprehensive research studies on causal factors.

With $1 million for new research on Fish and Wildlife Disease, we will better understand diseases such as the West Nile virus in birds of the East and Gulf Coast States, to mitigate the impacts of the disease on humans.

Finally, I would like to complete a multi-year effort to fill and support all science vacancies in the Cooperative Fish and Wildlife Research Units program by requesting an increase of $700,000. This program allows government and non-government entities with common interests and responsibilities for natural resource management to work together to address biological resources issues.

In closing, Mr. Chairman, this budget request strengthens our ability to provide "Science for a Changing World." I would be pleased to answer any questions this Subcommittee may have.

Department of the Interior, U.S. Geological Survey, Reston, VA
URL http://internal.usgs.gov/clo2/groat03162000.html
Contact: USGS Congressional Liaison Office

Last modification: 19-Aug-2002@07:05 (cey)

Statement of P. Patrick Leahy, Chief Geologist U.S. Geological Survey, Department of the Interior before the Subcommittee on Energy and Mineral Resources Committee on Resources U.S. House of Representatives March 16, 2000

Madam Chairman and Members of the Subcommittee, thank you for this opportunity to discuss the Administration's FY 2001 Budget Proposals for the Geology Programs of the U.S. Geological Survey (USGS). For FY 2001, the budget requests a total of $224.8 million for USGS programs addressing geologic hazards, resources and processes. This level of funding represents a net increase of $13.6 million, or approximately 6 percent, above the FY 2000 enacted level for these programs. The FY 2001 budget request proposes increases in earthquakes, volcanoes, earth surface dynamics, and geologic mapping, and also proposes net reductions in minerals and energy programs. The balance of my statement will discuss significant accomplishments and proposed budget changes for FY 2001 for each of the major categories of USGS Geology Programs.

Geologic Resource Assessments

As you know, we conduct basic and applied research on geologic resources and on the environmental and economic impacts of their extraction and use to provide reliable, impartial scientific information and comprehensive analyses of the 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 and minerals industry, and the environmental community.

In Energy Resources, we face the simultaneous challenges of an expanding energy appetite, an increasing dependence on imported oil, and an increasing demand for energy resources with minimal accompanying environmental effects. 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 for the next 20 years 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. Even now, natural gas consumption in the U.S. is at an all time high.

To meet these increasing demands for energy resources, the USGS Energy Resources Program is addressing several avenues of future energy resource availability. A new National Oil and Gas Assessment will quantify the natural gas endowment and the potential for additional reserves of oil and gas from existing fields in the United States, exclusive of Federal waters. Previous work tells us that our remaining energy supply will come from these sources and from imports. Research starting in FY 2000 and continuing to FY 2004 will focus on regions of the Nation that have high potential for

future production of conventional and unconventional natural gas resources and newer, less well known sources such as coal-bed methane in Wyoming, the Gulf Coast, and Alaska and gas hydrates in Alaska and the Gulf Coast. In addition, the 1990 Clean Air Act Amendments and concern about greenhouse gas emissions to the atmosphere, indicate that natural gas, the cleanest burning fossil fuel, will be more in demand. National Oil and Gas Assessment efforts in FY 2000 and FY 2001 will focus on Alaska, the Appalachians, Colorado, the Gulf of Mexico, Texas, Utah, and Wyoming.

Because we rely on imports for much of our energy resource needs, the location of worldwide resources is increasingly important. Currently, more than 50% of the oil we use is imported; in 20 years, this could rise to 64%. In FY 2000 we will release a World Energy Assessment of the most productive oil and gas provinces of the world that contain about 95% of the world's oil and gas resources. This 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. Results of the assessment will be presented in briefings later this spring and the results will be published in time for the World Petroleum Congress in Calgary this summer. 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. In FY 2001, the World Energy Assessment effort 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.

The Energy Resources Program is assessing coal resources that will be used 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 national coal resources is scheduled for release in FY 2000, although reports on individual regions are being released as they are completed. The 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. When the national assessment is completed, our focus will shift to integrating the 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.

The USGS National Coal Quality Inventory (NaCQI), a database of the chemistry of coals used in power plants, has been established recently 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.

The Energy Resources Program has developed an energy resource decision support system, called Geo-Data Explorer, or GEODE. This software is designed to assist land and resource managers by delivering spatially referenced digital energy, cultural, and environmental data via the Internet using standard World Wide Web technology. Wise stewardship of federally managed lands requires detailed knowledge of domestic energy-resource availability, quality, and distribution, and GEODE will enable us to integrate that resource knowledge with other environmental and land-use information. 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. GEODE can be accessed at http://geode.usgs.gov/.

In this budget a $0.5 million increase is proposed 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 proposed reduction of $2,509,000 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 to fund higher priority programs elsewhere in the budget.

In the area of mineral resources, the USGS Mineral Resources Program is the sole Federal provider of scientific information on mineral potential, production, consumption, and environmental behavior. Minerals and mineral products are important to the U.S. economy; in 1998 processed materials of mineral origin accounted for an estimated $415 billion, about five percent of the gross domestic product. USGS minerals research and information are used to characterize the life cycles of mineral commodities from deposit formation and discovery to mineral recycling. 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. USGS continues to increase the availability and usefulness of its minerals data by designing and implementing methods for integrating and delivering spatially referenced digital data via the Internet using standard World Wide Web technology and software. USGS minerals information and research is available on the World Wide Web at http://minerals.usgs.gov/.

USGS Mineral Resources Program research addresses the challenges of understanding how mineral resources occur and interact with the environment, and of developing methodologies for predicting occurrence and amount of undiscovered mineral deposits. Current projects include collaborative work with Federal land managers aimed at understanding the origins and environmental consequences of the lead-zinc deposits of southeastern Missouri. USGS research has provided a basis for interpreting 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. As part of this work, the USGS identified a larger area prospective for mineralization than previously known, as rock units that host numerous mines and mineral deposits in southeastern Alaska, including the Greens Creek mine and the Windy Craggy prospect, are exposed over a broader area than previously thought. New geologic, geochemical, and geophysical modeling of basin formation in the arid southwest includes detailed analysis of new geophysical data which shows extensions of known mineral districts beneath the edges of the basins, providing information valuable both for predicting water quality and for mineral resource exploration.

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 Mineral Resources Program is increasing its emphasis on assessments of aggregate resources, such as sand, gravel, and crushed stone. Ongoing work in the Front Range of Colorado brings together minerals, energy, water, and biological resource scientists who are developing new ways to describe the relationships between aggregate, water, energy, and biological resources and to predict both the availability of the non-renewable resources and the effect their extraction might have on the living resources. The results of this project are intended to be transferable to additional arid and semi-arid regions experiencing rapid growth. Other 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.

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 status of ecosystems. 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 geochemical information for approximately two-thirds of the land area of the U.S. During FY 1999 and FY 2000 Mineral Resources Program 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 Montana and Idaho have also been reviewed and updated. Samples collected by the National Uranium Resource Evaluation program in the late 1970s and early 1980s have been made available on the World Wide Web for all of 17 states and parts of four others.

The growing need for mineral resources worldwide raises questions of sustainability and responsible resource utilization. The Mineral Resources Program conducts geologic, environmental, and public health studies in cooperation with land-management agencies, biologists, medical professionals, States, universities, and industry. Current activities include examining how minerals affect ecosystem status in northern Idaho and western Montana; assessing abandoned mine lands in Colorado and Montana; characterizing the source, transport, and fate of toxic elements, particularly mercury and arsenic, in Alaska, California, the Upper Midwest, and the Eastern states; and developing regional and national geologic, geochemical, and geophysical baseline and background maps and databases required for evaluating the status of our Nation′s lands.

USGS minerals research leads to the development and implementation of new technologies that advance studies of mineral resources and are applicable to solving other important problems such as mapping earthquake and volcanic hazards, location and evaluation of energy resources, characterization of hydrology, or location of buried ordnance. Recent mapping of the floor of Yellowstone Lake is an example of the benefits of this approach to technology transfer. 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. 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 occur on the ocean floor, one of the processes which produce rich mineral deposits such as Red Dog, Alaska, the world′s largest zinc deposit.

In this budget, a $1.2 million increase is proposed that will permit the Mineral Resources Program to expand development of decision support systems needed by land managers dealing with natural resources issues such as sand and gravel and the historical impact of mining.

A proposed reduction of $3.2 million will (a) conclude a planned three-year collaboration between USGS and other Federal agencies, State agencies, universities, Native corporations, Alaska libraries, and industry to improve access to mineral information in Alaska, and (b) end the Mineral Resources Program studies on the origin and environmental consequences of gold deposits in the Great Basin in Nevada.

Geologic Processes

Economic growth is driven largely by access to the Earth's resources. Geologic maps provide the spatial framework to locate energy resources such as coal, petroleum, and natural gas; construction materials such as sand, gravel, limestone, and building stone; soil and rock types that enhance agricultural productivity; and metals and other mineral resources as diverse as gold and fertilizer. The geologic map remains a keystone product of the U.S. Geological Survey and in FY 2001 the USGS is again making geologic mapping a high priority, proposing a $7.5 million increase for our National Cooperative Geologic Mapping Program as part of the Administration′s Lands Legacy initiative (State Planning Partnerships). The Program, established by the National Geologic Mapping Act of 1992 and reauthorized in 1999 as PL 106-148, has been designed so that the Nation will have accurate geologic maps needed to address tomorrow's problems. The development of 3-dimensional

digital mapping technology has increased the utility of maps of all kinds. We anticipate increased demand for digital geologic maps in the future because they are one of the cornerstones needed for interpreting information about the Earth. Geologic maps are used by land, water, and natural resource managers at the Federal, State and local levels and by the private-sector to achieve the most efficient use of Earth resources in a way that is at once both sustainable and economically viable.

The USGS Coastal and Marine Geology Program provides geologic information critical to the management of the Nation's coastal and marine environments. Research in the Program addresses four main themes: 1) environmental quality and human health, 2) natural hazards and public safety, 3) natural resources, and 4) technology and information. In FY 2001, as several current coastal and marine geology studies are completed, funds will be used to begin or augment high priority studies in three areas: effects of coastal storms, sediment-hosted pollution in the lower Mississippi River, and Coral Reefs. An increase of $0.5 million will support geologic research to 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. There is also a proposed reduction of $0.5 million associated with completion of a pilot project using Light Distance and Ranging (LIDAR) technology to evaluate and monitor habitat of Chinook Salmon and Summer Chum Salmon.

The USGS will continue its close affiliation with other federal agencies under the auspices of the U.S. Global Change Research Program. Areas of emphasis are on the human dimension of environmental change, which includes understanding the sensitivity of regional systems to human activities and land use and the impacts of global and regional environmental change to human health; on understanding the impact of climate change and land use on the carbon cycle and carbon sequestration in soils and sediments; and on better understanding the role of land-use change and associated erosion, sedimentation and biological processes on carbon storage and nutrient cycles in wetlands and riparian areas.

Geologic Hazards

USGS scientific information also reduces the impact of natural hazards and disasters on human life and the economy. A wide variety of natural hazards--earthquakes, volcanic eruptions, landslides, coastal and solar storms, and erosion threaten the U.S. economy and population every year. Though we cannot prevent the events, losses can be reduced if scientific information is made available and used by affected communities. Improved planning and emergency response; adaptations to social, economic, and engineering structures; and real-time warning capabilities reduce the loss of life and economic impact of natural disasters--these objectives require information about the nature and degree of risk, which the USGS can provide. USGS not only responds to actual events, but also provides information about the fundamental geologic processes that control these hazards, thus improving the foundation for our response.

The USGS has many programs that provide scientific information targeted to specific types of natural disasters. Within the Geologic Division there are programs that are devoted partially or entirely to hazards including Landslides, Earthquakes, Volcanoes, Geomagnetism, and Coastal and Marine hazards:

- The Landslide Hazards Program improves the understanding of causes and mechanisms of ground failure, monitors threatening landslides and forecasts catastrophic movement in certain areas. It provides the scientific basis for land use and emergency planning decisions, cost-benefit analyses of possible loss reduction measures, and determinations of insurance risk.
- The Earthquake Hazards Program is a major component of the National Earthquake Hazards Reduction Program (NEHRP) authorized by P.L. 105-47. Under NEHRP, the USGS identifies and assesses earthquake hazards, monitors seismic activity, and conducts research on strategies that will reduce societal losses in the U.S. During and after earthquakes, USGS assists emergency response officials by characterizing the extent

of damage, size and risk from aftershocks and ground failure.

- On an international scale, the Global Seismic Network enhances our monitoring of earthquakes and other ground-shaking events at home and abroad, enabling us to forecast tsunamis and detect underground nuclear tests.
- The Volcano Hazards Program assesses and provides warning information on volcanic unrest. With major observatories and university partnerships in volcanically active areas of Hawaii, western Washington, Alaska, Wyoming, and California, it is well positioned to monitor volcanic behavior that could threaten these increasingly populous areas.
- Another type of natural disaster, induced by solar activity, disrupts satellites, electrical power distribution systems, radio communications, navigation, and geophysical surveys, and can cost hundreds of millions of dollars per event. Geomagnetic storms are monitored by a USGS network of 13 magnetic observatories, which provide near real-time data used by the U.S. Air Force, and NOAA and the private sector mitigate hazards.
- In coastal regions, the USGS focuses much of its hazards work within the Coastal and Marine Program, which helps mitigate losses to coastal areas by improving the understanding of tsunamis and coastal erosion, landslides, earthquakes and the local and regional susceptibility to adverse change.

In FY 2001, the USGS proposes an increase of $2.6 million 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 an 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 and construct new structures. The increase would allow a total of 150 new regional/urban seismic stations to be upgraded in Seattle, WA; Anchorage, AK; the San Francisco Bay Area, CA; Salt Lake City, UT; Memphis, TN; and Reno, NV.

The Volcano Hazards Program seeks an increase of $0.5 million to expand its real-time volcano monitoring capability to an additional high-risk Alaskan volcano to mitigate volcanic risk to aviation. From 1996 to 2000, the Federal Aviation Administration provided $2 million annually for the USGS to install, operate, and maintain seismic monitors at 20 active volcanoes in Alaska's distant and relatively inaccessible Aleutian Islands. These monitors provide information about impending volcanic activity to the aviation community to help aircraft avoid ash clouds. In addition, there is a proposed reduction of $250,000 associated with not extending a cooperative agreement with the University of Hawaii to support monitoring and research activities of the Hawaiian Volcano Observatory.

Again, thank you for this opportunity to review the Administration's FY 2001 Budget Proposals for the Geologic Programs of the USGS. The Geology Program is an integral piece of the entire FY 2001 budget proposal for the USGS to provide science for a changing world. I would be pleased to answer your questions.

Department of the Interior, U.S. Geological Survey, Reston, VA
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Statement of

Timothy S. Collett
Research Geologist
U.S. Geological Survey

Before the
Energy and Natural Resources Committee
Subcommittee on Energy Research, Development, Production, and Regulation

Hearing on S. 1418, the Methane Hydrate Research and Development Act of 1997

Dirksen Senate Office Building, Rm-366
Washington, D.C.

May 21, 1998

Please also see U.S. Gas Hydrate Resources map.

Mr. Chairman and Members:

I am Timothy S. Collett, Research Geologist with the U.S. Geological Survey (USGS). In this testimony I will discuss the USGS assessment of natural gas hydrate resources and examine the technology that would be necessary to safely and economically produce gas hydrates.

I. Summary

The primary objectives of USGS gas hydrate research are to document the geologic parameters that control the occurrence and stability of gas hydrates, to assess the volume of natural gas stored within gas hydrate accumulations, to identify and predict natural sediment destabilization caused by gas hydrate, and to analyze the effects of gas hydrate on drilling safety. The USGS in 1995 made the first systematic assessment of the in-place natural gas hydrate resources of the United States. That study shows that the amount of gas in the hydrate accumulations of the United States greatly exceeds the volume of known conventional domestic gas resources. However, gas hydrates represent both a scientific and technologic frontier and much remains to be learned about their characteristics and possible economic recovery.

II. Gas Hydrate Occurrence and Characterization

Gas hydrates are naturally occurring crystalline substances composed of water and gas, in which a solid water-lattice holds gas molecules in a cage-like structure. Gas hydrates are widespread in permafrost regions and beneath the sea in sediments of the outer continental margins. While methane, propane, and other gases are included in the hydrate structure, methane hydrates appear to be the most common. The amount of methane contained in the world's gas hydrate accumulations is enormous, but estimates of the amounts are speculative and range over three orders-of-magnitude

from about 100,000 to 270,000,000 trillion cubic feet of gas. Despite the enormous range of these estimates, gas hydrates seem to be a much greater resource of natural gas than conventional accumulations.

Even though gas hydrates are known to occur in numerous marine and Arctic settings, little is known about the geologic controls on their distribution. The presence of gas hydrates in offshore continental margins has been inferred mainly from anomalous seismic reflectors that coincide with the base of the gas-hydrate stability zone. This reflector is commonly called a bottom-simulating reflector or BSR. BSRs have been mapped at depths ranging from about 0 to 1,100 m below the sea floor. Gas hydrates have been recovered by scientific drilling along the Atlantic, Gulf of Mexico, and Pacific coasts of the United States, as well as at many international locations.

To date, onshore gas hydrates have been found in Arctic regions of permafrost and in deep lakes such as Lake Baikal in Russia. Gas hydrates associated with permafrost have been documented on the North Slope of Alaska and Canada and in northern Russia. Direct evidence for gas hydrates on the North Slope of Alaska comes from cores and petroleum industry well logs which suggest the presence of numerous gas hydrate layers in the area of the Prudhoe Bay and Kuparuk River oil fields. Combined information from Arctic gas-hydrate studies shows that, in permafrost regions, gas hydrates may exist at subsurface depths ranging from about 130 to 2,000 meters.

The USGS 1995 National Assessment of United States Oil and Gas Resources focused on assessing the undiscovered conventional and unconventional resources of crude oil and natural gas in the United States. This assessment included for the first time a systematic appraisal of the in-place natural gas hydrate resources of the United States, both onshore and offshore. Eleven gas-hydrate plays were identified within four offshore and one onshore gas hydrate provinces. The offshore provinces lie within the U.S. 200 mile Exclusive Economic Zone adjacent to the lower 48 States and Alaska. The only onshore province assessed was the North Slope of Alaska. In-place gas hydrate resources of the United States are estimated to range from 113,000 to 676,000 trillion cubic feet of gas, at the 0.95 and 0.05 probability levels, respectively. Although this range of values shows a high degree of uncertainty, it does indicate the potential for enormous quantities of gas stored as gas hydrates. The mean (expected value) in-place gas hydrate resource for the entire United States is estimated to be 320,000 trillion cubic feet of gas. This assessment does not address the problem of gas hydrate recoverability.

Seismic-acoustic imaging to identify gas hydrate and its effects on sediment stability has been an important part of USGS marine studies since 1990. USGS has also conducted extensive geochemical surveys and established a specialized laboratory facility to study the formation and disassociation of gas hydrate in nature and also under simulated deep-sea conditions. Gas hydrate distribution in Arctic wells and in the deep sea has been studied intensively using geophysical well logs. These efforts have also involved core drilling of gas-hydrate-bearing sediments in cooperation with the Ocean Drilling Program (ODP) of the National Science Foundation, and, most recently a cooperative drilling program onshore in northern Canada.

III. Gas Hydrate Production

Gas recovery from hydrates is hindered because the gas is in a solid form and because hydrates are usually widely dispersed in hostile Arctic and deep marine environments. Proposed methods of gas recovery from hydrates usually deal with disassociating or "melting" in-situ gas hydrates by (1) heating the reservoir beyond the temperature of hydrate formation, (2) decreasing the reservoir pressure below hydrate equilibrium, or (3) injecting an inhibitor, such as methanol, into the reservoir to decrease hydrate stability conditions. Computer models have been developed to evaluate hydrate gas production from hot water and steam injection, and these models suggest that gas can be produced from hydrates at sufficient rates to make gas hydrates a technically recoverable resource. Similarly, the use of gas hydrate inhibitors in the production of gas from hydrates has been shown to be technically feasible, however, the use of large volumes of chemicals comes with a high economic and potential environmental cost. Among the various techniques for production of natural gas from in-situ gas hydrates, the most economically promising method is considered to be depressurization. The Messoyakha gas field in northern Russia is often used as an example of a hydrocarbon accumulation from which gas has been produced from hydrates by simple reservoir

depressurization. Moreover the production history of the Messoyakha field possibly demonstrates that gas hydrates are an immediate producible source of natural gas and that production can be started and maintained by "conventional" methods.

IV. Safety and Seafloor Stability

Seafloor stability and safety are two important issues related to gas hydrates. Seafloor stability refers to the susceptibility of the seafloor to collapse and slide as the result of gas hydrate disassociation. The safety issue refers to petroleum drilling and production hazards that may occur in association with gas hydrates in both offshore and onshore environments.

Seafloor Stability

Along most ocean margins the depth to the base of the gas hydrate stability zone becomes shallower as water depth decreases; the base of the stability zone intersects the seafloor at about 500 m. It is possible that both natural and human induced changes can contribute to in-situ gas hydrate destabilization which may convert a hydrate-bearing sediment to a gassy water-rich fluid, triggering seafloor subsidence and catastrophic landslides. Evidence implicating gas hydrates in triggering seafloor landslides has been found along the Atlantic Ocean margin of the United States. The mechanisms controlling gas hydrate induced seafloor subsidence and landslides are not well known, however these processes may release large volumes of methane to the Earth's oceans and atmosphere.

Safety

Throughout the world, oil and gas drilling is moving into regions where safety problems related to gas hydrates may be anticipated. Oil and gas operators have described numerous drilling and production problems attributed to the presence of gas hydrates, including uncontrolled gas releases during drilling, collapse of wellbore casings, and gas leakage to the surface. In the marine environment, gas leakage to the surface around the outside of the wellbore casing may result in local seafloor subsidence and the loss of support for foundations of drilling platforms. These problems are generally caused by the disassociation of gas hydrate due to heating by either warm drilling fluids or from the production of hot hydrocarbons from depth during conventional oil and gas production. The same problems of destabilized gas hydrates by warming and loss of seafloor support may also affect subsea pipelines.

V. Conclusions

Our knowledge of naturally occurring gas hydrates is limited. Nevertheless, a growing body of evidence suggests that (1) a huge volume of natural gas is stored in gas hydrates, (2) production of natural gas from gas hydrates may be technically feasible, (3) gas hydrates hold the potential for natural hazards associated with seafloor stability and release of methane to the oceans and atmosphere, and (4) gas hydrates disturbed during drilling and petroleum production pose a potential safety problem. The USGS welcomes the opportunity to collaborate with domestic and international scientific organizations to further our collective understanding of these important geologic materials.

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Last modification: 11-May-1998@16:00 (stm)

Testimony of Thomas J. Casadevall for Budget Appropriations Hearing

with the House Subcommittee on Interior and Related Agencies

March 18, 1998

Mr. Chairman and members of the Subcommittee, we appreciate the opportunity to appear before you today to highlight recent accomplishments of the U.S. Geological Survey and to discuss our budget request.

The new USGS motto is "Science for a Changing World." For a science agency to be relevant and responsive to the American people today, it must anticipate new directions, be able to meet new needs, and evolve with an ever-changing world. USGS' unique, multidisciplinary capabilities in hydrology, biology, geology, geography, and cartography enable us to provide scientific information for a changing world. Sound stewardship of the Nation's land, water, and living resources requires that policymakers have up-to-date scientific information on how these resources are being used, as well as an understanding of how possible changes in their use might impact the environment, the national economy, and the quality of life for the American people. The USGS provides policymakers with reliable, impartial, scientific information to describe and understand the Nation's resources, and the USGS will strive continually to uphold and enhance this support.

The USGS recognizes the continuing need to control Federal spending. We also must grapple with understanding and providing data related to the complex scientific issues facing America. The challenging job ahead requires that we work smart: efficiently, collaboratively, and by creatively seeking partnerships in accomplishing our mission of providing natural resources science for a changing world.

Today, I will highlight areas of high-priority research that we propose to undertake in Fiscal Year 1999. In addition, I will review some of USGS' recent accomplishments within a framework of four themes: natural hazards, the environment, natural resources, and information management.

But before I begin, on behalf of all USGS employees, past and present, I would like to offer heartfelt thanks to the former Chairman of the Subcommittee, Mr. Yates, for his strong support of USGS programs over the years. Under his watchful eye, his keen interest, and his patient tutelage, there is no program within the Geological Survey that has not prospered. More specifically, without his advocacy, one of our premier programs, the National Water-Quality Assessment Program would not even exist. The Survey is indebted to Mr. Yates, and our work will stand as a permanent legacy to the man who always understood and promoted the need for objective scientific research in the management decisions

affecting our Nation's natural resources.

New Directions for FY 1999

For Fiscal Year 1999, the USGS budget request of $806.9 million, includes **programmatic increases of $52 million**.

A **$16.5 million** increase is designed to improve the health of aquatic systems in all of the Nation's watersheds. USGS support of the **Clean Water and Watershed Restoration Initiative** takes advantage of multi-disciplinary capabilities across a range of programs.

- The USGS will use its Federal-State Cooperative Water Program to develop needed information to support Federal, State, Tribal and local government efforts to improve water quality; provide data to help States determine the Total Maximum Daily Loads as required by the Clean Water Act; and evaluate non-point source pollution management practices in a wide variety of watersheds across the Nation.
- An increase ($6.0 million) in the National Water-Quality Assessment (NAWQA) Program will allow initiation of investigation in two study units in FY 1999. The USGS will enhance the level of NAWQA partnerships with the National Park Service, emphasizing water-quality issues in national parks and measuring background water-quality conditions in pristine park areas.
- The USGS proposes to evaluate nutrient loads and transport in major rivers and ground-water systems, including a specific focus on causes of hypoxia and toxic algal blooms in the Gulf of Mexico and other coastal waters.
- Through the Geographic Research and Applications Program, the USGS will develop new data handling and serving capabilities, including the use of geographic information systems and visualization. These will be designed in close consultation with watershed groups and will apply existing Federal Geographic Data Committee standards to build improved data access and decision-support tools for watershed groups and State and local agencies to use in planning for watershed-based restoration efforts.
- USGS-developed State geo-environmental maps will help the Bureau of Land Management and other agencies plan for remediation of the effects of past mining practices on water quality.
- We will collaborate with the Bureau of Reclamation to characterize water quality of and fish passage through reservoirs and streams affected by Reclamation facility operations in high-priority western watersheds.

An increase of **$11 million** is requested to support **species and habitat research** needed by the U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, and State and local agencies for their management of public and protected lands.

- In the Salton Sea, we will continue to assess the factors driving the fish and bird die-offs in order to determine how these die-offs can be prevented. In Greater Yellowstone, Platte River, and Mojave Desert, we will expand efforts to support management decisions to prevent and resolve

habitat problems.

- Monitoring techniques will be developed to evaluate the effectiveness of Habitat Conservation Plans and Conservation Agreements in the protection and recovery of imperiled species.
- The GAP Analysis program is a proven and valuable decision tool for terrestrial habitats. We propose to expand this program to begin development of an Aquatic Gap Analysis, with the initial focus on southeastern systems.
- USGS biologists will study the consequences of reintroducing fire as a tool to improve the ecosystem health on Bureau of Land Management lands and to support management of national wildlife refuges.
- Monitoring and assessment of habitat and migratory bird populations in wetland and upland ecosystems will be enhanced to support the goals of the North American Waterfowl Management Plan.
- Research on fish passage methods will assist Fish and Wildlife Service managers in their hydropower relicensing reviews.

Since 1992, the American public has payed an average of $50 billion per year for losses suffered in natural disasters. The "disaster tax" can be effectively reduced by integrating disaster information from all sources, including classified, and making it available for emergency managers and others who can take action to reduce disaster losses. The USGS is requesting an increase of **$15 million** to establish a standardized, integrated **disaster information network** for cooperative exchange of timely, relevant information on floods, volcanoes, earthquakes, landslides, and wildland fires. The disaster information network will unify and establish standards for data, making available to Federal and non-Federal sources much of the information collected from individual hazards research programs. With all the significant hazards information -- archived, current, and resulting forecasts -- available for a particular geographic area, managers at all levels will be better equipped to make life-saving and disaster- reducing mitigation and preparedness decisions. The network will make the information more readily available to those responsible for all phases of disaster management -- mitigation, preparedness, response, and recovery. Federal coordination will be achieved through an integrated program office hosted by the USGS, and a public/private partnership will involve those who manage or are affected by natural disasters.

As the nation's civilian mapping agency, USGS maintains the **National Satellite Land Remote Sensing Data Archive**, a permanent, comprehensive government archive of global remotely sensed data. In 1998, Landsat 7, MODIS, and ASTER -- new remote sensing instruments --

will begin to challenge USGS archival systems with unprecedented amounts of data. Our budget request includes **$2.5 million** to begin to develop the required systems and infrastructure capacity to ensure the availability and avoid permanent loss of these data.

As the primary provider of water quality information to Federal, State and local agencies, USGS is requesting **$7.0 million** for a **Water Quality Information Initiative** that is focused on improving the availability and dissemination of water quality data. Elements of this proposed increase include:

- increasing the availability of water quality information, including real-time data, for rivers and coastal waters near 86 of the Nation's largest cities;
- modernizing sampling and measurement equipment to improve the cost-effectiveness and timeliness of water quality information; and,
- working with cities to improve information about drinking water source areas and approaches to protecting their water supplies.

In FY 1999, USGS is also asking for an additional $17,495,000 to cover increased uncontrollable costs for such items as salaries and rent. This funding provides critical support for existing programs throughout the USGS.

USGS is also requesting programmatic decreases totaling $15,634,000.

Under the Government Performance and Results Act (GPRA), the USGS has developed strategic and annual performance plans that focus on the performance of our scientific programs. Development of outcome measures has not been an easy task for the Federal scientific community as the GAO acknowledged in their report to Congress on *Strengths and Limitations of Research Indicators*. Because USGS research is responsive to the scientific needs of others, the ultimate outcome of our science can best be defined only when the outcome of their science-based decision is known. To that end, the USGS is committed to doing everything possible to make our science useful, useable, and used by our customers. The USGS is developing customer service models, beginning with State geologic mapping and biological status and trends report pilots in FY 1998.

Reducing the Effects of Natural Hazards -- from Floods to Fires

Natural hazards -- floods, landslides, volcanic eruptions, earthquakes, coastal erosion, and wildland fires -- can devastate people and property, frequently causing loss of life and great economic hardship. In an effort to save human lives and reduce impacts on communities across the country, the USGS is seeking to maintain and improve a number of research and monitoring programs nationwide.

- Flooding began early in 1997 in the West. Later flooding inundated parts of the South and Midwest. El Niño continues to bring more flooding to much of our country. Throughout these events, USGS scientists have monitored river and stream levels to provide continuously updated flow data to the National Weather Service (NWS), the U.S. Army Corps of Engineers (COE), the Bureau of Reclamation, and to State and local emergency response officials. The timely, accurate USGS information used by these agencies improves flood forecasts, reservoir management, and evacuation plans, minimizing the risk of loss of life and property.
- Landslides caused by the intense rains from the storms of 1997 and 1998, present continuing threats to local communities. The Woodway landslide between Seattle and Edmonds, Washington, sent ten freight rail cars plunging into Puget Sound and continues to threaten rail lines. USGS scientists, with support from the Federal Emergency Management Agency (FEMA), have installed real-time monitoring equipment and conducted low-level air photography to

provide a more detailed and timely assessment of the slope's instability in this area. Recent intense El Niño-related storms in the West are causing major flooding and landslide problems. The USGS is working closely with FEMA and other Federal agencies, State and local government, and emergency officials to understand and address hazardous conditions.

- As more and more Americans move into close proximity with fire-prone or fire-dependent ecosystems, the need to be able to predict or quickly identify wildland fires, as well as to understand their role in ecosystem health, becomes more critical. Last year's fires in the Malibu, California, area provide an excellent example of a fire-prone region that is experiencing continuing population growth. USGS works closely with other agencies to improve the predictability of wildland fire and its relationship to local regimes and ecosystems. For example, the USGS uses images obtained by weather satellites to prepare weekly updates of vegetation conditions that are critically important to agencies working to assess local fire danger conditions and is working with the U.S. Forest Service to model a fire potential index for southern California which, when combined with weather observations and a geospatial grid, give a daily indication of fire potential for the region. The USGS also provides the scientific basis for integrating prescribed wildland fire into land and resource management plans to help DOI land managers improve habitat in the West and Great Plains.

Understanding our Environment

Our environment -- the air, water, soil, and plant and animal life around us -- is constantly changing as natural processes and human actions affect it. Understanding how the pieces of this complex puzzle fit together will allow us to forecast changes, prepare for and minimize adverse impacts, and develop methods to restore degraded parts of the environment. The well-being and security of our citizens and economy depend on a healthy environment.

- A variety of diseases claim tens of thousands of fish and birds in California's Salton Sea every year. Public health hazard warnings regarding contaminants and infectious diseases in fish and wildlife have led to economic impacts and lost recreational opportunities. The USGS, in collaboration with the U.S. Fish and Wildlife Service and the Bureau of Reclamation, is conducting studies examining trace elements and pesticide contamination in the Salton Sea.
- Efforts by many agencies to restore the Chesapeake Bay have been under way for many years. The recent fish kills in the Pocomoke River, a tributary of the Chesapeake Bay that goes through Maryland and Virginia and circumstantial evidence that *Pfiesteria piscicida* was involved have heightened the public's awareness of problems and sense of urgency for solutions. Similar fish kills have occurred in Delaware coastal waters. Interdisciplinary research by the USGS is focusing on the cause-and-effect relationship between fish health and water quality. USGS research and modeling of water quality, sediments, surrounding land-use practices, and surface- and ground-water flows are targeting our efforts most notably to the lower eastern shore of Maryland for further regional studies of fish health.
- Invasive plant species are impacting natural communities throughout the Nation. Noxious weeds have invaded more than 17 million acres of public rangelands in the West -- more than quadrupling their range from 1985-1995. USGS research is addressing this issue in the West. The

problem is even more severe in Hawaii and the Pacific Islands, where invasive plant species are altering already diminished habitat for numerous threatened and endangered plant and animal species. USGS is focusing on those species determined to be most destructive or that are in a phase of being controllable. Collaborative efforts with Fish and Wildlife Service and National Park Service managers are helping to identify land management practices to reduce the vulnerability of Federal lands to further invasions.

Natural Resources and Problems Affecting Their Use

The strength of our Nation and our economy depends on our vast resources, both renewable and nonrenewable. How we use the land, water, plants, animals, energy and mineral deposits dictates whether future generations can enjoy and reap the benefits that these natural resources provide us today.

- USGS hydrologists in the State of Washington recently developed a procedure that determines the vulnerability of ground water to pesticide contamination. This procedure reduces the amount of costly water quality monitoring needed to meet regulations that protect drinking water supplies. As a result of this new USGS procedure, the Washington State Department of Health has estimated that water-supply companies will save up to $6 million annually in monitoring costs.
- In New Mexico, the rapidly growing Albuquerque-Santa Fe urban corridor is facing serious problems of ground-water and surface-water depletion. In response, USGS scientists integrated geophysical techniques with ground-water flow models to help determine the available ground-water supply. Research results are being used by the City of Albuquerque, the State of New Mexico, Indian Pueblos, the National Park Service, and the Bureau of Land Management to determine ground-water resources and water-use policy for the future. Using these technologies, USGS scientists will be able to develop and apply computer models to enable water managers to predict the effects of future development on existing ground-water and surface-water resources.
- In support of critical information needed by the North American Waterfowl Management Plan, the Partners in Flight program and the USGS, scientists are collaborating to assemble information on numerous migratory waterfowl and songbird species and their habitats. A primary emphasis of the USGS has been on modernizing the delivery of information from the Bird Banding Laboratory and the National Breeding Bird Survey. The biological information made available from these efforts reflects a national reference resource used by Federal, State, and university personnel in deciding land and resource management issues.

Managing and Providing Access to Scientific Information

The USGS maintains national databases containing field and remote-sensing observations of physical, chemical, and biological features and phenomena. The strength of these databases lies in their breadth, consistency, and historical and long-term applicability. The USGS has long provided scientific information to government agencies, policymakers, fellow scientists, and industry, and our commitment to them will continue. Advances in information technologies will allow all Americans easy access to this

information. Using flexible delivery techniques such as CD-ROM, the Internet, and partnerships with other government and private sector organizations, we are striving to make these databases available to those who seek them. For example:

- The USGS recently published CD-ROMs of water-quality data for a 30-year period from selected streams and rivers in the United States. Collected through two national networks -- the Hydrologic Benchmark Network and the National Stream Quality Accounting Network -- the data describe water quality conditions in major rivers and some small streams during a period when considerable change, brought about in part by regulatory actions, occurred in terrestrial and atmospheric sources of water pollutants in the United States. The information on these CD-ROMs has been used to track changes in water quality and investigate the effects of natural and human contaminant sources on water quality.
- Nonindigenous aquatic species, such as zebra mussels, hydrilla, and round goby, have a major adverse economic impact on many sectors of American society. These species also present a significant threat to biological diversity. The USGS National Nonindigenous Aquatic Species Geographic Information System provides online access to more than 40,000 geographically referenced accounts of over 750 species of aquatic vertebrates, invertebrates, and plants. The service also provides maps, facts sheets, and scientific reports about nonnative aquatic introductions reported since 1850.
- USGS mineral resource databases contain widely used information on known mineral deposits and additional mineral resource data that are beneficial for sustainable resource use. Currently, the USGS is home to two major mineral resource databases, the Mineral Resource Data System and the Minerals Availability System. These databases are used to perform mineral resource assessments for use in required land management plans on Federal lands, primarily at the request of the Bureau of Land Management and the U.S. Forest Service. In addition, these databases support research on the environmental consequences of mining and supply scientific information needed to formulate plans for cost-effective cleanup of abandoned mine lands. As part of our research, USGS scientists developed a model that was used by the Bureau of Land Management, the Forest Service, and the State of Montana to help establish priorities for cleanup efforts on multiple watersheds affected by mining in that State.
- The House Appropriations Committee Report accompanying the FY 1996 Interior and Related Agencies appropriation requested that the USGS work within the Department of the Interior to identify opportunities for consolidating Federal mapping functions at Interior and to work with OMB on a similar exercise governmentwide. As a result, the USGS collaborated with NOAA, U. S. Forest Service, and BLM to contract with the National Academy of Public Administration (NAPA) to assess the use of Federal geographic information resources for ensuring the availability of geospatial information for the Nation. The NAPA study analyzed a broad range of geospatial information management issues, publishing its final report in December 1997.

In summary, Mr. Chairman, finding solutions to the complex earth science and natural resource problems that confront our country will require the efforts of many people. With the broad and multidisciplinary scientific capabilities of the USGS at work in every State, we stand ready to provide

the American people with the science they need for a changing world.

Thank you, Mr. Chairman and Committee members, for your continuing support and interest in the work of the USGS.

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URL http://internal.usgs.gov/clo2/031898_budget.html
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Last modification: 08-Apr-1998@10:15 (stm)

STATEMENT
BY
DR. JOHN ZOGORSKI
CHIEF, NATIONAL SYNTHESIS ON VOLATILE ORGANIC COMPOUNDS
NATIONAL WATER-QUALITY ASSESSMENT PROGRAM
U.S. GEOLOGICAL SURVEY
U.S. DEPARTMENT OF THE INTERIOR
BEFORE
UNITED STATES SENATE
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

Methyl Tertiary Butyl Ether
December 9, 1997

Senator Boxer, I appreciate the opportunity to appear before the Senate Committee on Environment and Public Works to testify on the subject of methyl tertiary butyl ether--commonly referred to as MTBE--and water quality. My name is John Zogorski. I'm a hydrologist with the U.S. Geological Survey (USGS). As you may know, the mission of the USGS is to assess the quantity and the quality of the earth resources and to provide information that will assist resource managers and policy makers at the Federal, State, and local levels in making sound decisions. Assessment of water-quality conditions and trends is an important part of this overall mission. I am working on the National Water-Quality Assessment Program--often referred to as NAWQA. More specifically, I am responsible for the aspect of the NAWQA Program that is focused on synthesizing information on the occurrence and distribution of volatile organic compounds (VOCs) in ground water and surface water. MTBE is one of about 60 VOCs that we are assessing. The building blocks for the NAWQA assessment are comprehensive water-quality investigations of more than 50 large river basins and aquifers distributed across the United States (Figure 1). The San Joaquin-Tulare, Sacramento, and Santa Anna River basins in California are 3 of the study units that NAWQA is assessing.

In 1995, the NAWQA Program published a report discussing the occurrence of MTBE in shallow ground water in urban and agricultural areas from the first set of 20 study units. Chloroform and MTBE were the two most frequently detected VOCs in samples from about 200 shallow wells in 8 urban areas and about 500 shallow wells in 20 agricultural areas. MTBE was detected in about 25 percent of the urban wells and about 1 percent of the agricultural wells. Concentrations ranged from the detection level of 0.2 micrograms per liter to as high as 23,000 micrograms per liter. MTBE was most frequently detected in shallow ground water in Denver, Colorado and urban areas in New England. In Denver, about 80 percent of the samples from shallow urban wells had detectable concentrations of MTBE and in New England, about 35 percent of the samples from urban wells had detectable concentrations. Only

3 percent of the wells sampled in urban areas had concentrations of MTBE that exceeded 20 micrograms per liter, which is the estimated lower limit of the U.S. Environmental Protection Agency (USEPA) draft drinking water health advisory level (figure 2).

I believe my colleagues from the USEPA will more fully discuss what is known about the human and aquatic health effects of MTBE and other fuel oxygenates. The initial sampling did not include information from urban areas in California. An urban ground water study is a component of the Sacramento River basin investigation, however, and our data collection in Sacramento will be completed at the end of this fiscal year.

Last year, at the request of the USEPA and the Office of Science and Technology Policy (OSTP), I co-chaired an interagency panel to summarize what is known and unknown about the water-quality implications associated with the production, distribution, storage, and use of fuel oxygenates and their movement in the hydrologic cycle (figure 3).

The results of our efforts were published as a chapter in a report entitled "Interagency Assessment of Oxygenated Fuels" prepared by the National Science and Technology Council, Committee on Environment and Natural Resources. The chapter summarizes the scientific literature and data on the sources, concentrations, behavior, and the fate of fuel oxygenates in ground water and surface water. We also discussed the implications for drinking water

quality and aquatic life and we identified areas where the data are too limited to make definitive statements about the costs, benefits, and risks of using oxygenated gasoline in place of conventional gasoline. Recommendations for further data-base compilation, monitoring, assessment, research and reporting were made that we believe would reduce uncertainties and allow a more thorough assessment of human exposure, health risks and benefits, and environmental effects.

I'd like to briefly summarize for the Committee the major findings, conclusions and recommendations of this interagency assessment that was completed in late 1996:

MTBE is the most commonly used fuel oxygenate. U.S. production in 1995 was estimated to be about 9 million tons. Essentially all of the MTBE that is produced is used for fuel oxygenation. Ethanol is the second most used oxygenate in gasoline blending. Ethanol production in the U.S. in 1994 was estimated to be about 4.5 million tons or roughly half the production of MTBE. No data are available to estimate the portion of this production used in gasoline.

Like other hydrocarbon components of gasoline, fuel oxygenates are introduced to the environment during all phases of the petroleum fuel cycle: production, distribution, storage, and use. Releases of gasoline containing oxygenates to the subsurface from, for example, underground storage tanks, pipelines, and refueling facilities provide point sources for entry of oxygenates as well as gasoline hydrocarbons into the hydrologic cycle. Urban and industrial runoff and wastewater discharges also represent potential sources of oxygenates to the environment. In a few instances, such as in Santa

Monica, California, high concentrations of MTBE have caused the shutdown of a drinking-water production wells and the source of contamination is believed to be leaking underground gasoline storage tanks.

Exhaust emissions from vehicles and evaporation from gasoline stations and vehicles are sources of MTBE and other oxygenates to the atmosphere. Because of their ability to persist in the atmosphere for days to weeks and because they will, in part, "mix" into water, fuel oxygenates are expected to occur in precipitation in direct proportion to their concentration in air. Hence, fuel oxygenates in the atmosphere provide a non-point, low concentration source to the hydrologic cycle. MTBE is much less biodegradable than ethanol or the aromatic hydrocarbon constituents of gasoline and, therefore, it will persist longer in ground water. MTBE also adsorbs only weakly to soil and aquifer materials. Consequently, MTBE will move with the ground-water flow and migrate further from sources of contamination.

MTBE was detected in 7 percent of 592 storm-water samples in 16 cities surveyed by the USGS between 1991-1995. When detected, concentrations ranged from 0.2 to 8.7 micrograms per liter, with a median of 1.5 micrograms per liter. A seasonal pattern of detections was evident, as most of the detectable concentrations occurred during the winter season. MTBE was detected both in cities using MTBE-oxygenated gasoline to abate carbon monoxide non-attainment and in cities using MTBE-oxygenated gasoline for octane enhancement.

At least one detection of MTBE has occurred in ground water in 14 of 33 states surveyed. MTBE was detected in 5 percent of about 1,500 wells sampled, with most detections occurring at low micrograms per liter concentrations in shallow ground water in urban areas.

Limited monitoring by Federal, State, and local agencies and organizations has shown that drinking water supplied from ground water is a potential route of human exposure to MTBE. As of 1997, MTBE has been detected in 51 public drinking water systems based on limited monitoring in 5 states including New Jersy, Iowa, Colorado, Illinois, and Texas. However, when detected, the concentrations of MTBE were, for the most part, below the lower limit of the current USEPA health advisory. This indicates that the consumption of drinking water was not a major route of exposure for these few systems. Because of the very limited data set for fuel oxygenates in drinking water, it is not possible to describe MTBE's occurrence in drinking water nor to characterize human exposure from consumption of contaminated drinking water for the Nation. There is not sufficient data on fuel oxygenates to establish water quality criteria for the protection of aquatic life, however, the petroleum industry is sponsoring research to complete needed studies.

The presence of MTBE and other alkyl ether oxygenates in ground water does not prevent the clean up of gasoline releases: however, the cost of remediation involving MTBE will be higher than for releases of conventional gasoline. Also, the use of natural bioremediation to clean up gasoline releases containing MTBE may be limited because of the difficulty with which MTBE is biodegraded.

The OSTP chapter on fuel oxygenates and water quality includes three broad recommendations.

First, more complete monitoring data and other information is needed to:

A. Identify and characterize major sources of MTBE to the environment;

B. Characterize the relation between use of MTBE (and other alkyl ether oxygenates) in gasoline and water quality; and

C. Enable an exposure assessment for MTBE in drinking water.

Completing the exposure assessment for MTBE in drinking water should be given high priority. Monitoring of MTBE in drinking water for this purpose should initially be targeted to high MTBE use areas, and to those environmental settings that are otherwise thought to be most susceptible to contamination.

Second, additional studies are needed to expand current understanding of the environmental behavior and fate of MTBE and similar oxygenates. For example, these studies are needed to help determine the significance of the urban atmosphere and land surface as non-point sources of contamination to surface and ground water, and to identify environmental settings where MTBE will be of concern.

Finally, studies of the aquatic toxicity of MTBE and similar oxygenates are needed for a broad range of aquatic animals and plants indigenous to surface waters to define the extent of any threat and to form the basis of Federal water-quality criteria, if warranted.

Again, I appreciate the opportunity to testify at this hearing. I'd be happy to try to address any questions of the Committee.

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URL http://internal.usgs.gov/clo2/testimony/mtbe.html
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Last modification: 15-Dec-1997@15:15 (stm)

STATEMENT OF GORDON P. EATON, DIRECTOR, U.S. GEOLOGICAL SURVEY, U.S. DEPARTMENT OF THE INTERIOR BEFORE THE SUBCOMMITTEE ON WATER AND POWER OF THE HOUSE RESOURCES COMMITTEE JULY 17, 1997

I appreciate this opportunity for the U.S. Geological Survey (USGS) to discuss with members of Congress our early plans and accomplishments under the Government Performance and Results Act (GPRA). We welcome interaction with Congress on GPRA activities as we work together to set goals and establish evaluation criteria for our programs.

In your letter of invitation to the Secretary, you expressed interest in having us discuss the following four topics:

1. The unique responsibilities of the USGS as opposed to those of other government entities.

2. The extent to which USGS is coordinating with other agencies in developing its Strategic Plan.

3. The process being used to involve customers and other interested groups.

4. The planned schedule for Congressional consultations.

I will consider each of these topics in turn, particularly as they apply to our Water Resources Division. But before doing so, I'd like to share with the Subcommittee some background information about the USGS strategic planning efforts, in general, and GPRA planning in particular.

In June 1996, the Geological Survey concluded an 18-month strategic planning effort with the publication of the Strategic Plan for the U.S. Geological Survey: 1996 to 2005. The document was the product of what evolved, during the 18 months, into a joint effort between the 22-person strategic planning team that represented the geographic, organizational and functional diversity of the Geological Survey, and the Survey's senior management. The June 1996 document provided both a vision and a mission statement, but did not provide statements of goals and objectives as contemplated by GPRA. The plan anticipated, but did not fully address, the Congressionally mandated merger of the National Biological Service (NBS) with the Geological Survey.

Because of the need to address the requirements of GPRA and the merger with NBS, the Survey enhanced its strategic planning effort in April 1996 that resulted in a February 1997 draft Strategic Plan for the U.S. Geological Survey: 1997 to 2005. The revised document is being used for review within the Department and OMB and as a basis for consultation with Congress. The revised plan carries forward much of what was in the June 1996 publication but adds goals and objectives, and addresses the programs of the NBS, which became the Survey's Biological Resources Division on October 1, 1996. That document has been revised as of June 1997 to reflect comments provided to us by departmental staff and through preliminary consultations with Congressional staff, including this Subcommittee.

While the strategic planning efforts were in progress, the U.S. Geological Survey also participated in the pilot phase of the implementation of GPRA by conducting a performance plan pilot project of the National Water-Quality Assessment (NAWQA) Program. Through this early experience, we learned that:

- The discipline of GPRA requires an agency to anticipate future program plans and budget proposals throughout the GPRA process. Specifically, an agency needs to consider the kinds of proposals it will make in out-year annual performance plans while it is developing its strategic plan.

- It is possible for different measures of success to have different significance depending on the interests and perspectives of reviewers. For example, accountants might be concerned with the average cost per water quality sample while program managers might be concerned with the number of study units that are underway or completed. Demographers and policy officials might be concerned with the percentage of the U.S. population that is covered by water quality assessments and whether water quality is improving or getting worse, both locally and nationally.

- For performance plans, performance measures, and critical results to produce desired outcomes, there must be an ongoing communication between performers and reviewers, and among the various reviewers. The communication helps bring the performer much closer to widely recognized success and helps reviewers agree on what success looks like.

While we feel we've made progress, it has been a significant challenge for the USGS, as a science agency, to develop results-oriented performance measures that will allow ourselves and others to determine whether goals are being met. We are not unique in this experience and it is a topic that continues to be discussed in an interagency Research Round Table that is composed of staff of Federal science agencies. We find that we are joined by other science agencies such as the National Science Foundation, the Army Research Laboratory, and the Agricultural Research Service in having difficulty in developing measures that can be used to measure progress on an annual basis. There are several difficulties:

- In most cases, a minimum of 5 years is needed to realize "outcomes" from research, though some research might not yield results for 10 to 20 years.

- Because of the nature of science, we cannot anticipate whether research will be successful, or the extent to which information generated from the research will be used, or what the outcomes or "results" of the use of the information might be.

- Often, a single research project can support multiple objectives and yield results that were not anticipated or even conceived of when the project was first embarked upon.

With this information as background, let me now turn to the Subcommittee's four specific areas of interest.

1. The unique responsibilities of the USGS define its mission. This mission can be summarized as providing the Nation with reliable, impartial information to describe and understand the Earth. This information is used by others to:

- minimize loss of life and property from natural disasters;

- manage water, biological, energy, and mineral resources;

- enhance and protect the quality of life; and

- contribute to wise economic and physical development.

Within this overall mission of the USGS, the mission of the Water Resources Division (WRD) is to provide reliable, impartial, timely information needed to understand the Nation's water resources. WRD actively promotes the use of this information by decision makers to:

- Minimize the loss of life and property as a result of water related natural hazards such as floods, droughts, and land movement.

- Effectively manage ground-water and surface-water resources for domestic agriculture, commercial, municipal, industrial, recreational, and ecological uses.

- Protect and enhance water resources for human health, aquatic health, and environmental quality.

- Contribute to wise physical and economic development of the Nation's resources for the benefit of present and future generations.

Consistent with its mission, WRD collects and manages high quality hydrologic data. WRD activities include data collection, assessments of water resources, and applied and basic research and development with the purpose of solving water-related problems.

In summary, the Water Resources Division of USGS is a primary source of scientific information on one of the Nation's most important natural resources--water. This responsibility fulfills a unique Federal role by providing standardized, objective information for the entire country through long-term hydrologic data, interpretive reports, and new analytical methods. OMB Memorandum 92-01 designates USGS as the lead Federal agency in coordinating water information activities among all levels of government and the private sector. The USGS has the primary responsibility for coordinating water data activities in the Federal Government. Because river basins and aquifers cross many jurisdictional boundaries there is great efficiency in having one national agency, the USGS, provide standardized regional water information to all interested groups through cost-sharing arrangements. In addition, because many water issues involve interjurisdictional disputes, it is very important that the data and conclusions be viewed as credible by all parties involved. This includes adjudication of water rights within a State, among States, or at international boundaries. The USGS is accepted as a credible source by parties involved in disputes.

2. The USGS has been very active historically in coordinating with other agencies. As mentioned previously, OMB Memorandum 92-01 designates USGS as the lead Federal agency in coordinating water information activities. The newly formed Advisory Committee on Water Information, convened by the USGS, brings together 35 water resource organizations at the Federal, State, and local levels of government, as well as representatives from the private sector, universities, and public-interest groups.

Through its reimbursable and collaborative programs with numerous Federal agencies, the USGS has many opportunities to interact with these agencies in developing priorities for work that address real-world issues. These contacts provide an acute awareness of current and future needs for water information that is reflected in the USGS Strategic Plan.

One example of this process is the Watershed and River System Management Program, a cooperative venture between the USGS and the Bureau of Reclamation (BOR). The Program is providing integrated computer modeling capability for managing the varied demands for water in arid watersheds in the Western U.S. The Program supports the development and application of data-based decision support systems assisting resource managers at Federal, State, and local levels in achieving an efficient allocation of water among competing interests. The USGS Strategic Plan addresses data collection, analysis and research to assist others in managing resource scarcity issues. As a result, a performance measure related directly to evaluating success of the watershed modeling work described above has been incorporated into our GPRA document.

In addition to programmatic interactions, the USGS has established a number of bilateral committees with other Federal agencies having a need for USGS information and products in order to better coordinate priorities and programs. Within the Department of the Interior, the USGS has established committees with the Office of Surface Mining, Bureau of Land Management, Minerals Management Service, Bureau of Reclamation, and Fish and Wildlife Service. Discussions are underway to form a similar committee with the National Park Service. Coordination committees have also been established with other agencies including the Defense Mapping Agency, National Oceanic and Atmospheric Administration, Environmental Protection Agency, U.S. Forest Service, Natural Resource Conservation Service, and National Aeronautics and Space Administration. Finally, under the leadership of the Office of Science Technology Policy, USGS and its Water Resources Division are active participants in the Committee on the Environment and Natural Resources.

More specifically related to GPRA, the USGS participates in the Interagency Research Roundtable and the Natural Resources Performance Management Forum--Federal agency groups sharing experiences in implementing GPRA. The Department of the Interior has established a Strategic Planning Steering Group to promote coordination among Interior's bureaus. Where appropriate we are involved with individual Federal agencies on GPRA-related activities of joint interest. For example, we are working with the Environmental Protection Agency on its "Environmental Goals for America With Milestones for 2005."

3. Regarding the process to involve customers and other interested groups, the USGS is very active in soliciting information on program plans and priorities from its stakeholders. The USGS conducts about two-thirds of its total water resources work in partnership with more than 1,100 local, State, and Federal land and water management agencies. These agencies are directly involved in determining the scope of effort in jointly funded data collection and interpretive studies and in reviewing plans and products. The USGS relies on these partnerships to identify emerging water resource issues and to assure that USGS water information is relevant to the needs of decision-makers at the local, State, and national level.

The overall direction of the remaining USGS water programs is also strongly influenced by stakeholders. For example, in the case of the National Water-Quality Assessment (NAWQA) Program, the Water Science and Technology Board of the National Research Council conducted a review of the NAWQA pilot program and provided suggestions which helped to revise the program's overall design and implementation. The Federal/non-Federal Advisory NAWQA Council helped to identify water-quality issues for the program and prioritize study units. Multi-organizational liaison committees at the study unit and national level provide another important mechanism for stakeholder interaction. To date, more than 2,000 representatives from Federal, State, and local management agencies along with Indian nations, universities, and citizens groups have had an opportunity to provide input to the NAWQA Program.

With regard to soliciting specific feedback on the original USGS Strategic Plan published in May 1996, 1,200 copies were distributed nationwide, about 350 of which were sent to water related organizations,

including:

State water management agencies

State soil and water conservation agencies

County planning boards

State offices of land and water

State geologists

County government agencies

Municipal agencies

State agencies responsible for abandoned mine lands

Universities

Commonwealth of Puerto Rico agencies

Corps of Engineers

U.S. Environmental Protection Agency

U.S. Department of Agriculture

U.S. Department of Energy

Non-governmental organizations such as the Nature

Conservancy and American Crop Protection Association

4. Regarding Congressional consultations, the USGS has met on two occasions with the House GPRA Team for Interior--on April 25 and May 2. As you know, this team includes representatives from this Subcommittee, the Energy and Minerals Subcommittee, the Appropriations Subcommittee on Interior and Related Agencies, the Committee on Government Reform and Oversight and the Budget Committee. We received valuable contributions to our GPRA document on both occasions. In addition, copies of the USGS draft Strategic Plan have been sent to majority and minority staff for the appropriate committees in both the House and Senate. The Department has offered further consultations with the

House and is prepared to meet with the Senate. We are anxious for constructive interaction from both houses of Congress so that our revised GPRA plan will be ready to submit to the Congress by September 30. We recognize that making GPRA work effectively requires the combined efforts of the Bureau, the Administration, and the Congress. The USGS is an eager and active participant in this process, Mr. Chairman, and we appreciate your strong interest in GPRA.

I will be pleased to answer any questions you may have.

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URL http://internal.usgs.gov/clo2/gpra_testimony.html
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Last modification: 21-Nov-1997@14:45 (stm)

TESTIMONY OF P. PATRICK LEAHY, CHIEF GEOLOGIST, U.S. GEOLOGICAL SURVEY, BEFORE THE SUBCOMMITTEE ON BASIC RESEARCH OF THE COMMITTEE ON SCIENCE, U.S. HOUSE OF REPRESENTATIVES
April 24, 1997

INTRODUCTION

Mr. Chairman and members of the Subcommittee, thank you for this opportunity to present testimony on the reauthorization of the National Earthquake Hazards Reduction Program (NEHRP) and the role of the U.S. Geological Survey (USGS) in this multi-agency partnership.

NEHRP was created 20 years ago to reduce the loss of life and property from earthquakes. Clearly the Program has been successful. Looking back over time, one can appreciate how the enormous increase in scientific and technical knowledge provided by NEHRP has enabled more effective loss reduction strategies and stimulated mitigation actions. To mention just one example, in the 1970's earthquakes were not generally regarded as a serious threat either in Seattle or Portland in the Pacific Northwest, or in Memphis or St. Louis in the mid-continent. NEHRP changed that perception. Seismic provisions in building codes have been upgraded and adopted; regional consortia have been formed to promote policies and practices to reduce earthquake losses; and local governments, corporations and citizens have initiated actions to reduce their vulnerability to earthquake damage.

In spite of such heartening progress, much remains to be done to further safeguard the Nation against earthquakes. The recent tragedies of Northridge and Kobe painfully show that even in quake-conscious California and Japan modern cities remain far too vulnerable to earthquakes. The need to do more presents a challenge to the NEHRP agencies, especially at the present time when budgets of Federal agencies are severely constrained. This situation requires programs to be more creative in finding ways to leverage scarce resources.

One way in which the NEHRP agencies are responding to this challenge is through the use of partnerships--partnerships of all types involving a wide variety of agencies and institutions. Partnerships bring dual benefits to NEHRP: leveraging resources and tightening links between researchers and practitioners. Partnerships are proving to be an effective mechanism for speeding the implementation of new knowledge in more effective risk-reduction strategies and for fostering actions by State and local government and the private sector to reduce seismic vulnerability.

USGS ROLE IN NEHRP

The four NEHRP agencies--Federal Emergency Management Agency (FEMA), National Science Foundation (NSF), National Institute of Standards and Technology (NIST), and USGS--have complementary roles and work closely with one another to coordinate activities and planning. The USGS role in this partnership is to monitor seismic activity, to identify and characterize earthquake hazards, to conduct research in support of improved hazard-assessment methods, to disseminate scientific data and information, and to demonstrate application of earth-science knowledge in effective loss-reduction strategies. The USGS program addresses questions fundamental to all loss-reduction strategies: where and how often will earthquakes occur; how large will they be; and what will be the severity and extent of strong ground shaking, landsliding, and other types of ground failure. The USGS program collaborates with a broad range of agencies, institutions and organizations in all aspects of its program from monitoring and research to the application of earth-science knowledge. In pursuing its NEHRP role, the USGS enlists the talents and expertise of researchers and practitioners from the academic, private, and governmental sectors. The internal and external program components are closely coordinated through use of a common plan to guide program activities.

Investigations and activities conducted or supported by the USGS contribute to the reduction of earthquake losses through a broad variety of mechanisms, including land use planning, seismic engineering, earthquake preparedness, and earthquake disaster response. The USGS fact-sheet series, Reducing Earthquake Losses Throughout the United States, highlights a number of these contributions and the partnerships through which they have been implemented. The examples range from increasing awareness of the earthquake threat in the central Mississippi Valley, to motivating governmental and corporate actions to reduce earthquake vulnerability in the San Francisco Bay region, to improving seismic design standards, to speeding disaster relief.

I would like to bring you up to date on progress and developments within the USGS part of NEHRP. I will highlight some recent accomplishments, describe promising new partnerships, and discuss the future direction of USGS NEHRP efforts.

RECENT ACCOMPLISHMENTS

New Shaking Hazard Maps. One of the recent major USGS accomplishments is a new series of maps for the conterminous United States that depict and quantify how the shaking hazard varies across the country. The maps show the maximum shaking likely to occur over a period of decades and incorporate current knowledge about the rate of earthquake activity across the United States and how the intensity of ground shaking decreases with distance from the earthquake source in various parts of the country. Preparation of these maps involved extensive collaboration with NEHRP researchers, practicing design engineers, and State and local governments across the country. For California, the USGS and the California Division of Mines and Geology jointly developed the geologic data used to calculate the hazard in and around the Golden State.

A prime purpose of the hazard maps is to provide the scientific basis for setting seismic design values in building codes. The 1996 maps were used by the Building Seismic Safety Council to establish seismic design values for the 1997 NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings. Most of the States east of the Mississippi River base their building codes on either of two model codes, both of which rely on the NEHRP Recommended Provisions. In this way, new construction in most of the Eastern United States incorporates NEHRP assessment of the shaking hazard.

The USGS hazard maps are also used by insurance companies to analyze their risk exposure and as a guide in setting premium rates in various parts of the country. The Environmental Protection Agency uses the maps to set construction standards to ensure the safety of waste-disposal facilities, and FEMA uses information from the maps to allocate assistance funds to States for earthquake education and preparedness. The hazard values from the maps are also incorporated into the HAZUS loss-estimation software developed by FEMA with which State and local governments can analyze potential earthquake losses.

Northridge, California, Earthquake Investigations. In the weeks after the devastating 1994 Northridge earthquake--the most costly earthquake in the United States since the 1906 San Francisco earthquake--the four NEHRP agencies initiated coordinated investigations to learn lessons that could be applied to reducing life loss and property damage in future earthquakes. Last spring, 2 years after the event, the USGS published a report, USGS Response to an Urban Earthquake: Northridge '94, that summarizes lessons and findings from investigations of the earthquake. The report highlights findings related to the origin of the earthquake and its effects including seismic shaking, landslides, other types of ground failure, and damage to buildings and freeways. In addition, it describes how government agencies cooperated in responding to the disaster and in pursuing post-earthquake investigations. The report is available electronically on the World Wide Web (http://geohazards.cr.usgs.gov/northridge/).

Beyond this initial Northridge report, the USGS is currently completing detailed scientific reports on its investigations and incorporating information and findings into products that will help to reduce losses from future earthquakes in the San Fernando Valley and the Los Angeles Basin. For example:

The USGS is compiling digital information, including a map and database, on the locations and rates of activity of faults and folds in the Los Angeles region in consultation with the California Division of Mines and Geology and the Southern California Earthquake Center (SCEC). Such information is fundamental to the evaluation of future earthquake potential and assessment of hazard. The digital data are available electronically from the World Wide Web.

From seismic imaging surveys crossing the Los Angeles metropolitan region, scientists from the USGS and the SCEC have developed a more complete understanding of the geology beneath part of the Los Angeles region and how that geology contributes to earthquakes hazards in the region. A critical piece of information to emerge from the seismic imaging is the depth to rock beneath sedimentary basins and near their edges. Because the depth of sedimentary fill profoundly effects the characteristics of strong

ground shaking experienced at a basin site, knowledge of basin configuration allows better estimates of the shaking that is likely to occur in future large earthquakes. The seismic surveys also help resolve the configuration of buried thrust faults, like the fault responsible for the Northridge shock.

The Northridge earthquake caused tens of thousands of landslides over an area of 4,000 square miles. Most of the slides occurred in the sparsely populated mountains north of the Los Angeles metropolitan area; however, slope failures destroyed dozens of homes, blocked roads, disrupted pipe and power lines, and blocked streams within and around the urban region. Using the Northridge data and information on slope steepness and strength of geologic hillside materials, USGS scientists have constructed a digital landslide susceptibility map for the northern Los Angeles urban region that depicts areas where landslides are likely to occur in future earthquakes. The map was prepared in collaboration with State and county geologists and private consulting firms who will be among the principal users of the map in its application to land development and emergency preparedness and response planning. For example, the State is using the map information to define earthquake hazard zones as required by the 1990 California Seismic Hazards Mapping Act.

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Measuring building response. A critical element to reducing fatalities and damage in earthquakes is knowing how buildings, bridges, and dams respond to and are damaged by strong seismic shaking. As part of its National Strong Motion Program, the USGS, in cooperation with numerous Government agencies and private owners, has installed motion sensors in a variety of structures across the Nation to record their complex behaviors in earthquakes. The USGS has instrumented 33 buildings, most of which are in California, where earthquakes are most frequent. One or more buildings also have been instrumented in Alaska, Hawaii, Missouri, Puerto Rico, South Carolina, Tennessee, Utah, and Washington.

Building-response records obtained by the California Division of Mines and Geology and by the USGS during recent California shocks are providing engineers with new insights into building behavior and the effectiveness of various earthquake-resistant design strategies. Three examples from the Northridge earthquake illustrate the value of instrumenting buildings. First, unexpected twisting motion measured in a regularly shaped building has caused engineers to scrutinize building code provisions guarding against damage from such motions. Second, records obtained from two buildings employing different innovative schemes to partially isolate the structure from severe motions of its base showed the efficacy of one scheme and the inadequacy of the other. Third, recordings from damaged buildings allow engineers to determine when damage begins and how it progresses as shaking continues; however, only two of the buildings damaged during the Northridge earthquake were adequately instrumented.

NEW PARTNERSHIPS

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Continuous Monitoring of Earth Movement in Southern California. In another major partnership, the USGS, NSF, National Aeronautics and Space Administration, and the SCEC are implementing a state-of-the-art geodetic network to monitor fault movements and Earth strain. The Southern California Integrated GPS Network (SCIGN) makes use of the Global Positioning System (GPS), a satellite navigation system operated by the Department of Defense, which permits points on the Earth's surface to be located to a precision of a millimeter. When complete, the network will track the movement of 250 stations concentrated along a corridor through the Los Angeles basin, but also extending south to the Mexican border and east to the Colorado River. The data will improve understanding of the large-scale tectonic processes responsible for earthquakes and of the framework of faults on which tectonic stresses are relieved in earthquakes. Scientists hope to get indications of how fast strain is building up, where it is concentrated, and where earthquakes might occur in the near future. SCIGN is operated primarily by three institutions: the USGS, Caltech's Jet Propulsion Laboratory, and the University of California--San Diego's Scripps Institution of Oceanography.

Earthquake Hazards in the San Francisco Bay Area. In central California, the USGS and Pacific Gas and Electric Company (PG&E) are engaged in a multi-year Cooperative Research and Development Agreement (CRADA) to improve the assessment of hazards and potential damage associated with large earthquakes in the San Francisco Bay area. PG&E, a publicly regulated utility serving northern and central California, has embarked on an effort to reduce the impact of damaging earthquakes on gas and electrical systems and on customer service. This CRADA provides for improvements in software and hardware systems for the rapid broadcast of seismic information, improved methods to predict local variations in earthquake shaking and to estimate permanent ground displacements, and refinement of long-term probabilistic earthquake forecasts.

Improving Tsunami Warning. In December 1996, the National Oceanic and Atmospheric Administration (NOAA), USGS, and FEMA initiated work on the new Tsunami Hazard Mitigation Implementation Plan, which was developed in cooperation with emergency managers and earth scientists from California, Oregon, Washington, Alaska, and Hawaii. The plan is designed to maximize the efficiency of detecting tsunami threats, issuing warnings, and responding to tsunami damages using the combined resources of the cooperating agencies. The USGS is responsible for upgrading seismic equipment and monitoring facilities of cooperative regional seismic networks that it supports in these five states, where tsunami-generating earthquakes are likely to occur. The upgraded seismic networks will be able to provide pertinent seismic information reliably and nearly instantaneously to NOAA's West Coast/Alaska Tsunami Warning Center in Alaska and the Pacific Tsunami Warning Center in Hawaii.

Engaging the Insurance Sector. Recognizing that the private insurance sector can become a forceful agent for promoting loss reduction, the USGS is seeking to build links to that sector. As one step toward this end, the USGS has developed a Statement of Understanding with the Insurance Institute for Property Loss Reduction (IIPLR), an independent nonprofit research and communications corporation supported by over 250 insurance companies and about 100 insurance groups. The USGS will work with IIPLR to raise awareness in the insurance sector about earthquakes and their hazards and to help institutionalize earthquake disaster mitigation as a public value. This June the USGS will present a short course on earthquakes at the annual congress of IIPLR. In addition, plans are proceeding for the USGS and IIPLR to jointly prepare a series of fact sheets and technical notes about the nature of earthquakes and their impacts.

FUTURE PROGRAM DIRECTION

The USGS has just completed an extensive planning effort that culminated in a 5-year program plan for its component of NEHRP. A primary factor motivating the planning effort was the need to establish program priorities in the context of limited program resources.

The program planning process involved a broad cross section of the earthquake loss-reduction community, including scientists, engineers, emergency managers, planners, and social scientists from academia, various levels of Government, and the private sector. Comments on a draft program plan were solicited through a series of workshops held in several cities around the country and through mail solicitation of about 400 individuals, including State geologists and emergency managers, external program participants and collaborators, and leaders in the earthquake hazards community.

Under the new 5-year plan, the USGS Earthquake Hazards Program will focus on delivering usable products for earthquake loss reduction, providing earthquake information, and pursuing fundamental research on earthquake occurrence and earthquake effects.

Information Products for Earthquake Loss Reduction. The new plan places increased emphasis on developing and demonstrating earth-science information products that enable the public and private sectors to assess earthquake hazards and implement effective loss mitigation strategies. Priority products

include updated national maps of shaking hazard that incorporate new knowledge, digital maps and databases of active faults and chronologies of historic and prehistoric earthquake activity, hazard maps of shaking and unstable ground for selected high- risk urban regions, 30-year probabilistic earthquake forecasts for well-studied regions, and earthquake planning scenarios for a selected urban region outside of California. The program will rely on a variety of partnerships to develop and demonstrate the application of these products. To ensure effective and proper use of earth-science products, the USGS will increase its collaboration with professional organizations and regional earthquake consortia and centers to communicate seismic hazard issues and determine the needs of user groups.

Earthquake Information. The USGS will lead the national program to collect, interpret, and disseminate information on earthquakes throughout the United States and significant earthquakes worldwide in support of disaster response, scientific response, national security, and public education. The USGS will maintain support for seismic monitoring at global, national, regional and urban scales to meet the diverse needs of the Nation for rapid reliable information about the occurrence of earthquakes and the resultant strong shaking. Over time, rapid information systems will be developed in urban areas at greatest risk and antiquated seismic instruments will be upgraded with digital technology to provide more complete information at faster speed. In its FY 1998 budget request, the USGS is seeking direct funding to support operation of the Global Seismographic Network, which is operated cooperatively with the Incorporated Research Institutions for Seismology under the auspices of the NSF. The USGS will also continue to monitor the buildup and release of Earth strain related to seismicity in areas of the Western United States and conduct post-earthquake investigations in cooperation with U.S. and foreign agencies and institutions.

Earthquake Research. The USGS will conduct and sponsor research to understand earthquake occurrence and earthquake effects for the purpose of developing improved hazard assessment and risk reduction methods. The USGS will support research that is expected to lead in the short or long term to new or improved methods and strategies for loss reduction. Research priorities under earthquake occurrence include understanding how earthquakes begin and what factors control their size and recurrence rates, and improving the precision of earthquake forecasts. Research priorities related to earthquake effects include understanding the factors that determine the characteristics of strong ground shaking and the response of unstable ground and man-made structures to strong ground shaking.

External Program. From its inception, the USGS Earthquake Hazards Program has enlisted and relied on the talents and expertise of academia, other Government agencies, and the private sector in implementation of its program. The USGS expects to continue this vital partnership with the external community. Activities in the external program include: operating regional seismograph networks to locate earthquakes and disseminate information, mapping seismic hazards in urban areas, developing credible planning scenarios, deciphering 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 increases the geographical impact of its program, raises earthquake awareness across the Nation, promotes the application of new hazards assessment techniques and loss reduction strategies by State and local governments and by the private sector, and raises the level of technical knowledge within State and local public agencies.

CONCLUSION

In conclusion, I hope that I have conveyed a sense of optimism for the future of NEHRP and the USGS role within this critical national program. The present offers many challenges to Federal agencies and programs, but I believe that the USGS and its sister NEHRP agencies are working boldly and effectively to meet these challenges and to assure a safer future for the country. After 20 years, the fruits of NEHRP are becoming more apparent: the Nation is increasingly aware of its earthquakes hazards, effective strategies for reducing seismic vulnerability now exist, and the public and private sector are more willing to take action to reduce their seismic risk. By building on these successes, NEHRP has the opportunity to speed the pace of mitigation.

Mr. Chairman, this concludes my remarks. I would be happy to answer any questions.

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Last modification: 10-15-97@08:00 (stm)

TESTIMONY OF P. PATRICK LEAHY, CHIEF GEOLOGIST, U.S. GEOLOGICAL SURVEY BEFORE THE SUBCOMMITTEE ON SCIENCE, TECHNOLOGY AND SPACE OF THE COMMITTEE ON COMMERCE, SCIENCE AND TRANSPORTATION
U.S. SENATE
April 10, 1997

INTRODUCTION

Mr. Chairman and members of the Subcommittee, thank you for this opportunity to present testimony on the reauthorization of the National Earthquake Hazards Reduction Program (NEHRP) and the role of the U.S. Geological Survey (USGS) in this multi-agency partnership.

NEHRP was created 20 years ago to reduce the loss of life and property from earthquakes. Clearly the Program has been successful. Looking back over time, one can appreciate how the enormous increase in scientific and technical knowledge provided by NEHRP has enabled more effective loss reduction strategies and stimulated mitigation actions. To mention just one example, in the 1970's earthquakes were not generally regarded as a serious threat either in Seattle or Portland in the Pacific Northwest, or in Memphis or St. Louis in the mid-continent. NEHRP changed that perception. Seismic provisions in building codes have been upgraded and adopted; regional consortia have been formed to promote policies and practices to reduce earthquake losses; and local governments, corporations and citizens have initiated actions to reduce their vulnerability to earthquake damage.

In spite of such heartening progress, much remains to be done to further safeguard the Nation against earthquakes. The recent tragedies of Northridge and Kobe painfully show that even in quake-conscious California and Japan modern cities remain far too vulnerable to earthquakes. The need to do more presents a challenge to the NEHRP agencies, especially at the present time when budgets of Federal agencies are severely constrained. This situation requires programs to be more creative in finding ways to leverage scarce resources.

One way in which the NEHRP agencies are responding to this challenge is through the use of partnerships--partnerships of all types involving a wide variety of agencies and institutions. Partnerships bring dual benefits to NEHRP: leveraging resources and tightening links between researchers and practitioners. Partnerships are proving to be an effective mechanism for speeding the implementation of new knowledge in more effective risk-reduction strategies and for fostering actions by State and local

government and the private sector to reduce seismic vulnerability.

USGS ROLE IN NEHRP

The four NEHRP agencies--Federal Emergency Management Agency (FEMA), National Science Foundation (NSF), National Institute of Standards and Technology (NIST), and USGS--have complementary roles and work closely with one another to coordinate activities and planning. The USGS role in this partnership is to monitor seismic activity, to identify and characterize earthquake hazards, to conduct research in support of improved hazard-assessment methods, to disseminate scientific data and information, and to demonstrate application of earth-science knowledge in effective loss-reduction strategies. The USGS program addresses questions fundamental to all loss-reduction strategies: where and how often will earthquakes occur; how large will they be; and what will be the severity and extent of strong ground shaking, landsliding, and other types of ground failure. The USGS program collaborates with a broad range of agencies, institutions and organizations in all aspects of its program from monitoring and research to the application of earth-science knowledge. In pursuing its NEHRP role, the USGS enlists the talents and expertise of researchers and practitioners from the academic, private, and governmental sectors. The internal and external program components are closely coordinated through use of a common plan to guide program activities.

Investigations and activities conducted or supported by the USGS contribute to the reduction of earthquake losses through a broad variety of mechanisms, including land use planning, seismic engineering, earthquake preparedness, and earthquake disaster response. The USGS fact-sheet series, Reducing Earthquake Losses Throughout the United States, highlights a number of these contributions and the partnerships through which they have been implemented. The examples range from increasing awareness of the earthquake threat in the central Mississippi Valley, to motivating governmental and corporate actions to reduce earthquake vulnerability in the San Francisco Bay region, to improving seismic design standards, to speeding disaster relief.

I would like to bring you up to date on progress and developments within the USGS part of NEHRP. I will highlight some recent accomplishments, describe promising new partnerships, and discuss the future direction of USGS NEHRP efforts.

RECENT ACCOMPLISHMENTS

New Shaking Hazard Maps. One of the recent major USGS accomplishments is a new series of maps for the conterminous United States that depict and quantify how the shaking hazard varies across the country. The maps show the maximum shaking likely to occur over a period of decades and incorporate current knowledge about the rate of earthquake activity across the United States and how the intensity of ground shaking decreases with distance from the earthquake source in various parts of the country. Preparation of these maps involved extensive collaboration with NEHRP researchers, practicing design engineers, and State and local governments across the country. For California, the USGS and the California Division of Mines and Geology jointly developed the geologic data used to calculate the

hazard in and around the Golden State.

A prime purpose of the hazard maps is to provide the scientific basis for setting seismic design values in building codes. The 1996 maps were used by the Building Seismic Safety Council to establish seismic design values for the 1997 NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings. Most of the States east of the Mississippi River base their building codes on either of two model codes, both of which rely on the NEHRP Recommended Provisions. In this way, new construction in most of the Eastern United States incorporates NEHRP assessment of the shaking hazard.

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awareness across the Nation, promotes the application of new hazards assessment techniques and loss reduction strategies by State and local governments and by the private sector, and raises the level of technical knowledge within State and local public agencies.

CONCLUSION

In conclusion, I hope that I have conveyed a sense of optimism for the future of NEHRP and the USGS role within this critical national program. The present offers many challenges to Federal agencies and programs, but I believe that the USGS and its sister NEHRP agencies are working boldly and effectively to meet these challenges and to assure a safer future for the country. After 20 years, the fruits of NEHRP are becoming more apparent: the Nation is increasingly aware of its earthquakes hazards, effective strategies for reducing seismic vulnerability now exist, and the public and private sector are more willing to take action to reduce their seismic risk. By building on these successes, NEHRP has the opportunity to speed the pace of mitigation.

Mr. Chairman, this concludes my remarks. I would be happy to answer any questions.

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Last modification: 10-15-97@08:00 (stm)

Testimony for Budget Appropriations Hearing with the House Subcommittee on Interior and Related Agencies
Testimony of Gordon P. Eaton for Budget Appropriations Hearing with the House Subcommittee on Interior and Related Agencies
March 18, 1997

Mr. Chairman,

Thank you for this opportunity to appear before you and describe some of the more notable recent accomplishments of the U.S. Geological Survey, as well as our plans for continuing work on behalf of the American public.

We have just celebrated our 118th birthday, and we used the occasion to remember with gratitude some of the giants of the past on whose shoulders we stand, who helped make our organization what it is today: the premier natural science agency in the country. We also thank the American people for their understanding of the relevance of our work.

This relevance is more important than ever, as our Nation faces challenging questions about the world we live in and the resources we use each day.

- How can we prevent or mitigate the effects of natural hazards--earthquakes, floods, volcanoes, landslides, wildfires, coastal erosion, outbreaks of disease among our wildlife?
- How can we ensure an adequate supply of critical resources--land, biota, water, energy, minerals--for our children and grandchildren?
- How is our natural environment altered when we extract and use these resources, and how can we minimize or repair any negative effects of these alterations?
- How can we make accessible the ever-increasing amounts of data and information about the Earth's natural resources, environment, and natural hazards?

For more than a century, the mission of the USGS has been to provide the sound and impartial scientific information to help answer questions like these.

The issues facing our society today have become increasingly complex, demanding new approaches and new partnerships. In the past few years, the USGS has changed dramatically to meet the changing needs of the Nation. The New USGS incorporates minerals information specialists from the former U.S. Bureau of Mines and the biological expertise of the former National Biological Service, complementing

traditional strengths in geology, mapping, and water.

The Earth's physical, chemical, and biological systems depend on and are influenced by each other. The integration of physical and biological research at the USGS enhances our ability to provide the sound science needed to understand some of the vexing issues facing our Nation. We are building strong multidisciplinary teams of scientists to improve sound decisionmaking.

While we continue to address critical national issues and conduct high-priority research, we also work with nearly 2,000 cooperating agencies and organizations to focus on the resource development and management issues of greatest local, regional, and national concern. To that end, we have staff, facilities, and instrumentation at work in every State, helping to serve millions of local, regional, and national customers.

Coping With Natural Hazards

Natural hazards are taking an increasing toll on the lives and property of our Nation. The recent devastating floods in California, Pacific Northwest and the Ohio River Valley are a case in point. To help reduce the burden of suffering and economic loss, the USGS maintains a number of research and monitoring programs across the United States. In 1996 and early 1997, the USGS responded to threats posed by landslides, floods, volcanoes, and a major outbreak of avian botulism.

- Landslide experts worked in the Pacific Northwest, Virginia, and California to document ground failures and work with other Federal agencies, including the Federal Emergency Management Agency and the National Park Service, to develop mitigation strategies for the future. In Colorado, our scientists gave advance warning to county officials that the Aspen Country Day School was at risk from possible debris flows. Classes were moved, and when the flows hit the school a few days later no one was hurt.

- A network of 7,000 streamgaging stations, many of them funded in partnership with local, State, and other Federal agencies, provides continuous information on floods and droughts. More than 2,500 of those stations are linked by satellite communications to the World Wide Web, where the public, emergency management agencies, utilities, and private industry can access real-time streamflow data updated as often as four times an hour during floods. In January 1997, major flooding in California, Nevada, and the Pacific Northwest set all-time records for peak flows at nearly 40 streamgaging stations in five States, caused record-setting inflows to San Francisco Bay, and damaged or destroyed homes and businesses as well as about 150 of our streamgaging stations. In early March of this year, USGS hydrologists worked long hours measuring the flooding in West Virginia, Kentucky, Ohio, and Indiana and repairing streamgages in the flooded area. The flooding set records in West Virginia, Ohio, and Kentucky, with high flows on the Kentucky, Salt, Licking, and Green Rivers.

- In California, USGS investigators studying the deaths of unprecedented numbers of pelicans at the Salton Sea determined that a simultaneous fish die-off posed a possible hazard to human health. USGS worked with the U.S. Fish and Wildlife Service to develop consensus views among representatives of agriculture, wildlife conservation, water resources agencies, and other parties that depend on the Sea for their activities. USGS scientists are also studying emerging wildlife diseases such as cryptosporidiosis, Valley fever (coccidioidomycosis), and bubonic plague to understand their effect on human health.

- National seismic hazard maps, which we completed and released in 1996, show the severity of expected shaking of the ground in response to earthquakes all across the United States. These maps are being put to immediate use by the Building Seismic Safety Council as it publishes its recommended seismic regulations for building codes throughout the Nation. Through this kind of cooperative effort with engineers and urban planners, the USGS is working to reduce the human and economic losses from potential earthquakes in Alaska, the West Coast, and the more poorly understood hazardous areas of the Central United States and South Carolina. The USGS, through its National Earthquake Information Center, works with partners at State, regional, national and international levels to monitor earthquake activity.

Understanding Our Natural Resources

Much of our strength as a Nation comes from our abundant--yet finite--heritage of natural resources. USGS studies of water supplies, mineral and energy deposits, land use, and our wealth of plants and

animals provide essential information to industry, managers, regulators, and the public for sound decisions on our unique resource heritage.

- On average, each U.S. citizen uses 78 gallons of water at home per day, and the demand for good-quality water for drinking, recreation, farming, and industry continues to rise. Through the National Water Quality Assessment Program (NAWQA), USGS scientists are tracking the quality of our surface- and ground-water resources currently in 60 large watersheds with others starting up across the country that account for fully two thirds of the Nation's total water use. In the State of Washington, USGS data on ground-water quality are being used in the State's first 4-county ground-water management area. In North Carolina, results of studies of the way nitrate is transported in ground water are helping State officials better manage the quality of surface-water sources such as the Neuse River of central North Carolina.

- In Tennessee, information from the Gap Analysis Program (GAP), a cooperative effort to map natural land cover, vertebrate species, and the land practices for maintaining biological diversity, is being used by the Tennessee Wildlife Resources Agency for locating and managing particular habitat types. In California, GAP information is used by developers to help make real estate investment decisions and by area governments to guide decisions on open space planning.

- A new analysis of the dramatic urban growth and changes in land use in the Baltimore-Washington area over the past 200 years, and a similar analysis for the San Francisco area, are helping city and county planners, regulators, developers, and the public better understand the overall patterns of urban growth and estimate impacts on resources.

- USGS scientists, in cooperation with States, universities, and local groups, are monitoring the health of America's biological resources, from polar bears in Alaska to manatees in Florida. In the Great Lakes, the populations of major commercial and sport fish are being monitored in a cooperative effort to provide a scientific basis by which fisheries managers and researchers can evaluate potential management plans for the region's important commercial and recreational fisheries.

- Scientists at the USGS monitor trends and statistics for more than 600 mineral commodities, from agricultural minerals to zirconium, and study where and how mineral deposits are created and modified. Local, regional, and national assessments delineate the amounts and quality of our mineral and energy resources. Our information on the domestic and world soda ash industry was used by Congress, the Bureau of Land Management, the State of Wyoming, and industry to negotiate the new royalties for soda ash mined in Wyoming. The revenues generated by the proposed increase will be split between the Federal Government and the State of Wyoming.

Addressing Environmental Issues

The safety and health of our Nation's citizens depend on the environment in which we live. USGS scientists are working to provide the information needed to help sustain a healthy environment and to recognize and mitigate adverse effects on it.

- The Mississippi River is the source of almost one quarter of the public surface water supply for the United States. A USGS study of water quality for the river system, published in 1996, documents seasonal cycles in the levels of agricultural contaminants, a significant drop in overall sewage contamination, and the continuing presence of polychlorinated biphenyls (PCB's) in river sediments. These and other results of the study are helping water managers make informed decisions about the best ways to protect and enhance the river environment.

- Through a cooperative effort to provide "Science in the Parks", our scientists are working with the National Park Service in more than 250 parks, monuments, national rivers, and recreation areas. Investigations in Nevada are looking at possible links between disruptions in fish endocrine systems and pesticides and organic chemicals in the Lake Mead National Recreation Area. Visitors Centers at Lake Mead, Grand Canyon National Park, and elsewhere are being redesigned in partnership with USGS geologists to emphasize the geologic history of the parks.

- USGS studies at the Marine Corps Air Station in Beaufort, S.C., are saving the Marine Corps hundreds of thousands of dollars in cleanup costs. A leaky storage tank had released about 10,000 gallons of jet fuel into the soil and ground water in 1990, and conventional cleanup of the spill would have cost about $600,000.

Our scientists showed that natural attenuation, the natural ability of bacteria living in the soil and water to remove contaminants, was effectively confining the contaminated ground water and thus no risk was posed to the environment.

- More than 500,000 abandoned mines dot the landscape of the United States. USGS scientists are working with Federal land management agencies to remediate contamination associated with abandoned mines, focusing on the sites that have the greatest effect on water quality and ecosystem health in specific watersheds. The work requires coordinated efforts by experts in digital data collection and management, ecology, geochemistry, geology, water quality studies, hydrology, and mapping. At the California Gulch Superfund Site in Leadville, Colo., mineral maps produced by the USGS using imaging spectroscopy, the latest in remote sensing technology, have cut costs and accelerated cleanup of mine wastes over a large area.

- Invasive exotic plants and animals are a major threat throughout the Nation, costing billions of dollars in economic losses and causing untold damage to the environment. Non-native species damage agricultural crops and rangelands, contribute to the decline of commercially important fishes, spread diseases that affect domestic animals and people, and disrupt vital ecosystem functions. USGS biologists are studying such invaders as zebra mussels, leafy spurge, and brown tree snakes to determine the best ways of controlling their spread.

- As more and more people live and work near coastlines, they put enormous stresses on these fragile environments. USGS studies in coastal estuaries like San Francisco Bay and Chesapeake Bay are helping to explain how the Nation's coastal environments respond to natural change, such as floods and hurricanes, as well as human influences.

Managing Data and Information

An essential part of the USGS mission is making sure that the results of our scientific studies are available in a wide variety of formats, both traditional and electronic, to those who need the information. The USGS maintains a wide range of databases and other sources of information that are consulted millions of times each year.

- The USGS home page on the World Wide Web provides access to more than 100,000 pages of information, from how to order any of more than 80,000 U.S. maps and other publications to what is the latest volcano activity in Alaska. During 1996, the monthly tally of visitors to our Web site doubled to more than 160,000 people a month.

- At our EROS Data Center in South Dakota, nearly 15 million aerial photographs and satellite images are archived and available for purchase. These images, spanning three decades, provide valuable information about the status and trends of our planet's landforms, vegetation, resources, and land use.

- USGS topographic maps have provided an accurate foundation for planning and decisionmaking for the past 100 years. Today, digital geospatial information in geographic information systems is helping resource managers, planners, emergency personnel, and others make decisions quickly and with confidence. Last summer we signed a cooperative research and development agreement (CRADA) with 3M of St. Paul, Minn., through which we will develop on-demand alternatives to hard copy maps and 3M will develop a series of commercial instant map-printing systems. The new print-on-demand capability will provide an alternative to the traditional USGS printed map products, enabling a customer to print a specific topographic map in a matter of minutes.

- The USGS Library, established in 1882, is one of the largest earth science libraries in the world. More than 1 million books and 500,000 maps in the library system cover all aspects of the earth sciences. The 12 libraries of the former National Biological Service and the library of the former Bureau of Mines have been added to the USGS library system, greatly expanding its holdings and coverage. In 1996, a new electronic library catalog became available at the main library in Reston, Va., and the branch libraries in Denver, Colo., and Menlo Park, Calif.

Reaching to the Future

For FY 1998, the USGS budget request is $745.4 million, a net increase of $6.5 million above the FY

1997 enacted level. This total includes $19.5 million in program increases and a redirection of about $13 million in program efforts.

Changes in our FY 1998 budget include:

- A $7.5 million increase to expand biological research. New research and monitoring will focus on Pacific salmon and coastal habitats. Extensive work is planned on the spread of invasive weeds in the West and on other exotic species in the East that sometimes harm native plants and animals. Other biological research and monitoring efforts will focus on the effects of air quality on biological resources and the effects of pollutants on populations and ecosystems. The monitoring of migratory birds will be enhanced. The potential threats of endocrine disruptors in fish and wildlife species will be more closely examined. Research and information will be strengthened to continue support for restoration of Great Lakes fisheries and habitats. The increase will improve long-term monitoring of biological resources and make information more available through electronic databases.

- An increase of $9.0 million to join with the Environmental Protection Agency and National Oceanic and Atmospheric Administration to expand the information on water quality available to the Nation's citizens about possible toxic threats to their families. This initiative was announced by the President last August in Kalamazoo, Mich., and will make water quality information available for the 75 largest metropolitan areas in the country through a comprehensive monitoring system, with computer links to schools, libraries, and home computers through the World Wide Web.

- An increase of $3.0 million to expand and upgrade the global seismographic network to service the technical requirements of the nuclear test ban treaty signed by the President on September 24, 1996 and for research on earthquakes and the structure characteristics of the earth's core. The Department of Defense supported the capitalization and installation phase of the network. USGS will be responsible for the long-term operation and maintenance of the majority of the expanded and upgraded global network as well as for analysis, interpretation, and dissemination of the collected data to help verify compliance with the treaty. The data and network will also be used for scientific and disaster-assistance purposes such as determining the magnitude and source mechanisms for potentially damaging earthquakes worldwide.

In addition we are accelerating streamlining efforts (-$6.8 million) and reducing some programmatic activities (-$6.2 million). Some programs will be eliminated, with key components being incorporated into other existing programs, such as parts of Acid Rain into NAWQA. Other programs will be deferred. We are also refocusing $1.2 million of geographic research and applications funds to support investigations of urban growth patterns in New York, Chicago, Philadelphia, as well as Portland, Oregon. This effort builds on prototype studies conducted in San Francisco-Sacramento and Baltimore-Washington urban corridors.

These are tight budget times. The USGS has tried to do its share in reducing the net cost of our work, even as we increase the net value of our service. We have reduced our ranks by hundreds of employees. As resolute as we have been in facing fiscal realities, we plan to be equally frank in describing how realistically we can meet our obligation to provide the American people with the basic science they need in order to live at ease with a changing world. The science they need to find, protect, develop and enjoy the water, energy, mineral, and living resources they need today, and will need tomorrow, in order to provide for their children and their children's children.

As we move into the next century, we will continue to work closely with you in reducing the national monetary debt, while, as scientists and technicians, we will be concurrently vigilant in heading off the "ignorance debt." We will work with you to make sure that our children are not left with an impossible burden of growing ignorance: the burden of undrinkable water, of inadequate energy and mineral resources, of lost plants and wildlife and lost recreation areas, of mounting human and economic tolls from natural hazards.

I am concerned, because as the Federal budget slowly declines in terms of real dollars, Federal responsibility continues to grow and expand. The population of the United States has not declined along with our budget. Rather, there are more people demanding more resources, building and expanding into more areas prone to natural hazards or already home to mineral, energy or water resources or equally desirable for recreation use or wildlife habitat.

In conclusion, Mr. Chairman, we thank you again, and also thank your predecessors and the American people for entrusting us for 118 years with providing the basic science needed to both live in and manage in today's world as well as to plan for tomorrow. Few Federal agencies can claim 118 years of service and progress. Even fewer agencies can claim to serve a large clientele every day in every State. We are enormously proud of our history and even prouder of our service in meeting the needs of today and tomorrow. Thank you for your continuing support.

Department of the Interior, U.S. Geological Survey, Reston, VA
URL http://internal.usgs.gov/clo2/eaton03181997.html
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Last modification: 19-Aug-2002@07:05 (cey)

Testimony of Gordon P. Eaton for Budget Oversight Hearing with the House Subcommittee on Energy and Mineral Resources
March 4, 1997

It is a pleasure to join you today to discuss the programs of the U.S. Geological Survey (USGS) and our FY 1998 budget request.

Our Nation faces challenging questions concerning the world we live in and the resources we use each day.

How can we prevent or mitigate the effects of natural hazards--earthquakes, floods, volcanoes, landslides, wildfires, coastal erosion, outbreaks of disease among our wildlife?

How can we ensure an adequate supply of critical resources--land, water, energy, minerals--for our children and grandchildren?

How is our natural environment altered when we extract and use these resources, and how can we minimize or repair any negative effects of these alterations?

How can we make accessible the ever-increasing amounts of data and information about the Earth's natural resources, environment, and natural hazards? For more than a century, the mission of the U.S. Geological Survey (USGS) has been to provide the sound, credible, impartial scientific information to help answer questions like these.

The issues facing our society have become increasingly complex, demanding new approaches and new partnerships. In the past few years, the USGS has changed dramatically to meet the changing needs of the Nation. The New USGS incorporates minerals information specialists from the former U.S. Bureau of Mines and the biological expertise of the former National Biological Service, complementing our traditional strengths in geology, mapping, and water.

The Earth's physical, chemical, and biological systems depend on and are influenced by each other. The integration of physical and biological research at the USGS enhances our ability to provide the sound science needed to attack some of the vexing issues facing our Nation. We are building strong multidisciplinary teams of scientists focused on research and research outcomes that people can use.

While we continue to address critical national issues and conduct high-priority research we also work with nearly 2,000 cooperating agencies and organizations to focus on the resource development and management issues of greatest concern. To that end, we have staff, facilities, and instrumentation at work in every State, helping to serve millions of local, regional, and national customers.

Coping With Natural Hazards

Natural hazards are taking an increasing toll on the lives and property of our Nation. To help reduce this burden of suffering and economic loss, the USGS maintains a number of research and monitoring programs across the United States. In 1996, the USGS responded to threats posed by landslides, volcanoes, hurricanes, floods, and a major outbreak of avian botulism. Landslide experts worked in the Pacific Northwest, Virginia, and California to document ground failures and work with other Federal agencies, including the Federal Emergency Management Agency and the National Park Service, to develop mitigation strategies for the future. In Colorado, our scientists gave advance warning to county officials that the Aspen Country Day School was at risk from possible debris flows. Classes were moved, and when the flows hit the school a few days later no one was hurt.

Three volcano observatories assess the dangers from active volcanoes in Alaska, Hawaii, and the Cascade Range in Washington, Oregon, and northern California. In cooperation with the aviation industry, the USGS continuously monitors volcanoes in the Aleutian Island chain to reduce the risk to airplanes from clouds of volcanic ash. A year ago, in March 1996, Akutan volcano in the central Aleutians was shaken by intense seismic swarms. Telemetered real-time data and work by our scientists on the island enabled us to reassure the 1,000 people on Akutan that an eruption was unlikely and they did not have to evacuate. The local fishing industry, valued at $120 million annually, was able to continue. The United States, with 65 active volcanoes, ranks third in the world in the number of active volcanoes within its borders.

In California, USGS investigators studying the deaths of unprecedented numbers of pelicans at the Salton Sea determined that a simultaneous fish die-off posed a possible hazard to human health. Our staff guided the disease control efforts of the U.S. Fish and Wildlife service and worked to develop consensus views among representatives of agriculture, wildlife conservation, water resources agencies, and other parties that depend on the Sea for their activities. USGS scientists are also studying emerging diseases such as cryptosporidiosis, Valley fever (coccidioidomycosis), and bubonic plague to understand wildlife diseases and effects on human health.

National seismic hazard maps, which we completed and released in 1996, show the severity of expected shaking of the ground in response to earthquakes all across the United States. These maps are being put to immediate use by the Building Seismic Safety Council as it publishes its recommended seismic regulations for building codes throughout the Nation.

The National Earthquake Information Center works with partners at State and regional levels and around the world to monitor earthquake activity. In addition, earthquake studies and geologic mapping are

needed to outline the areas that are most vulnerable to damage from earthquakes. Through cooperative efforts with engineers and urban planners, the USGS is working to reduce the human and economic losses from potential earthquakes in Alaska, the West Coast, and the lesser known hazardous areas of the Central United States and South Carolina.

A network of 7,000 stream-gaging stations, many of them funded in partnership with local, State, and Federal agencies, provides continuous information on floods and droughts. More than 2,500 of those stations are linked by satellite communications to the World Wide Web, where the public, emergency management agencies, utilities, private industry, and others can access real-time streamflow data updated as often as four times an hour during floods. Major flooding in California, Nevada, and the Pacific Northwest in January 1997 set all-time records for peak flows at nearly 40 stream-gaging stations in five States, caused record-setting inflows to San Francisco Bay, and damaged or destroyed about 150 of our stream-gaging stations, along with other serious damage to homes and businesses. At the request of the California Department of Transportation, our scientists assessed the stability of a bridge just downstream from one that had collapsed during the flooding and determined that the downstream bridge was not likely to fail.

Understanding Our Natural Resources

Much of our strength as a Nation comes from our abundant--yet finite--heritage of natural resources. USGS studies of water supplies, mineral and energy deposits, land use, and our wealth of plants and animals provide essential information to industry, managers, regulators, and the public for sound decisions on our unique resource heritage. Our information on the domestic and world soda ash industry were used by Congress, the Bureau of Land Management, the State of Wyoming, and industry to negotiate the new royalties for soda ash mined in Wyoming. The revenues generated by the proposed increase will be split between the Federal Government and the State of Wyoming. Scientists at the USGS monitor trends and statistics for more than 600 mineral commodities, from agricultural minerals to zirconium, and study where and how mineral deposits are created and modified. National, regional, and local assessments delineate the amounts and quality of our mineral and energy resources.

A new analysis of the dramatic changes in land use in the Baltimore-Washington area over the past 200 years, and a similar analysis for the San Francisco area, are helping city and county planners, regulators, developers, and the general public better understand the overall patterns of urban growth.

In Tennessee, information from the Gap Analysis Program (GAP), a cooperative effort to map natural land cover, vertebrate species, and the lands that are managed in ways that maintain biological diversity, is being used by the Tennessee Wildlife Resources Agency for locating and managing particular habitat types. In California, GAP information is used by developers to help make real estate investment decisions and by area governments to guide decisions on open space planning.

USGS scientists, in cooperation with States, universities, and local groups, are monitoring the health of America's biological resources, from polar bears in Alaska to manatees in Florida. In the Great Lakes,

the populations of major commercial and sport fish are being monitored in a cooperative effort to provide a scientific basis by which fisheries managers and researchers can evaluate potential management plans for the region's important commercial and recreational fisheries.

On average, each U.S. citizen uses 78 gallons of water at home per day, and the demand for good-quality water for drinking, recreation, farming, and industry continues to rise. Through the National Water Quality Assessment Program, USGS scientists are tracking the quality of our surface- and ground-water resources in 60 large areas across the country that account for two thirds of the Nation's water use.

Addressing Environmental Issues

The safety and health of our Nation's citizens depend on the environment in which we live. USGS scientists are working to provide the information needed to help sustain a healthy environment and to recognize and mitigate adverse effects on it.

Through a cooperative effort to provide "Science in the Parks", our scientists are working with the National Park Service in more than 250 parks, monuments, national rivers, and recreation areas. Investigations in Nevada are looking at possible links between disruptions in fish endocrine systems and pesticides and organic chemicals in the Lake Mead National Recreation Area. And Visitors Centers at Lake Mead, Grand Canyon National Park, and elsewhere are being redesigned in partnership with USGS geologists to emphasize the geologic history of the parks.

USGS studies at the Marine Corps Air Station in Beaufort, South Carolina, are saving the Marine Corps hundreds of thousands of dollars in cleanup costs. A leaky storage tank had released about 10,000 gallons of jet fuel into the soil and ground water in 1990, and conventional cleanup of the spill would have cost about $600,000. Our scientists showed that natural attenuation, the natural ability of bacteria living in the soil and water to remove contaminants, was effectively confining the contaminated ground water and thus no risk was posed to the environment.

More than 500,000 abandoned mines dot the landscape of the United States. USGS geologists, biologists, hydrologists, cartographers, and others are working with Federal land management agencies to remediate contamination associated with abandoned mines, focusing on the sites that have the greatest effect on water quality and ecosystem health in specific watersheds. The work requires coordinated efforts by experts in digital data collection and management, ecology, geochemistry, geology, water quality studies, hydrology, and mapping. At the California Gulch Superfund Site in Leadville, Colo., mineral maps produced by the USGS using imaging spectroscopy, the latest in remote sensing technology, have cut costs and accelerated cleanup of mine wastes over a large area.

Invasive exotic plants and animals are a major threat throughout the Nation, costing billions of dollars in economic losses and causing untold damage to the environment. Non-native species damage agricultural crops and rangelands, contribute to the decline of commercially important fishes, spread diseases that affect domestic animals and people, and disrupt vital ecosystem functions. USGS biologists are studying

such invaders as zebra mussels, leafy spurge, and brown tree snakes to determine the best ways of controlling their spread.

More and more people live and work near a coast, yet increasing populations put enormous stresses on these fragile environments. USGS studies in coastal estuaries like San Francisco Bay and Chesapeake Bay are helping to explain how the Nation's coastal environments respond to natural sources of change, such as floods and hurricanes, as well as human influences.

Managing Data and Information

An essential part of the USGS mission is making sure that the results of our scientific studies are available in a wide variety of formats, both traditional and electronic, to those who need the information. The USGS maintains a wide range of databases and other sources of information that are consulted millions of times each year.

The USGS home page on the World Wide Web provides access to more than 100,000 pages of information, from how to order any of more than 80,000 U.S. maps and other publications to what is the latest volcano activity in Alaska. During 1996, the monthly tally of visitors to our Web site doubled to more than 160,000 people a month.

At our EROS Data Center in South Dakota, nearly 15 million aerial photographs and satellite images are archived and available for purchase. These images, spanning three decades, provide valuable information about our planet's landforms, vegetation, and resources.

USGS topographic maps have provided an accurate foundation for planning and decisionmaking for the past 100 years. Today, digital geospatial information in geographic information systems is helping resource managers, planners, emergency personnel, and others make decisions quickly and with confidence. Last summer we signed a cooperative research and development agreement (CRADA) with 3M of St. Paul, Minn., through which we will develop on-demand alternatives to hard copy maps and 3M will develop a series of commercial instant map-printing systems. The new print-on-demand capability will provide an alternative to the traditional USGS printed map products, enabling a customer to print a specific topographic map in a matter of minutes.

The USGS Library, established in 1882, is one of the largest earth science libraries in the world. More than 1 million books and 500,000 maps in the library system cover all aspects of the earth sciences. The 12 libraries of the former National Biological Service and the library of the former Bureau of Mines have been added to the USGS library system, greatly expanding its holdings and coverage. In 1996, a new electronic library catalog became available at the main library in Reston, Va., and the branch libraries in Denver, Colo., and Menlo Park, Calif.

Reaching to the Future

For FY 1998, the USGS budget request is $745.4 million, a net increase of $6.5 million above the FY 97 enacted level (including the budget for the National Biological Service, now the Survey's Biological Resources Division). This total includes $19.5 million in program increases that are partially offset by redirecting about $13 million in program efforts.

Changes in our FY 98 budget include: A $7.5 million increase to expand biological research on Federal lands, increase technical assistance to land managers in Interior Department agencies, and increase the Cooperative Research Units program to assist in fulfilling partnership commitments to states. New research will focus on Pacific salmon and coastal habitats, invasive and exotic species, potential threats from endocrine disruptors, migratory birds, and Great Lakes fisheries and habitats.

An increase of $3.0 million to expand and upgrade the global seismographic network to service the technical requirements of the nuclear test ban treaty. The data and network will also be used for scientific and disaster-assistance purposes.

An increase of $9.0 million to join with the Environmental Protection Agency and the National Oceanic and Atmospheric Administration to expand the available information on water quality for the 75 largest metropolitan areas in the country.

Redeployment of funds to these higher priority activities will be achieved by accelerating our streamlining efforts (a savings of $6.8 million) and reducing some programmatic activities (a savings of $6.2 million). Some programs will be eliminated, with key components being incorporated into other existing programs, such as parts of Acid Rain into NAWQA. Other programs will be deferred such as 10 planned cooperative investigations dealing with water management issues.

We are also refocusing $1.2 million of geographic research and applications funds to support investigations of urban growth patterns in New York, Chicago, Philadelphia, and Portland. This effort builds on prototype studies conducted in San Francisco-Sacramento and Baltimore-Washington urban corridors which is shown below. With our rich scientific heritage and our unique mix of expertise, we at the USGS are poised to reach a new understanding of our Earth. America's abundant water, land, energy, mineral, and biological resources provide the foundation for much of our Nation's wealth and the well-being of its citizens. The New USGS is uniquely able to provide the knowledge and understanding needed for the careful stewardship of these resources and helping to ensure the health, prosperity and quality of life enjoyed by current and future generations of Americans.

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Last modification: 10-15-97@08:00 (stm)

Testimony of Robert Hirsch for Budget Oversight Hearing with the House Subcommittee on Water and Power - March 4, 1997

It is a pleasure to be with you today to discuss the programs of the Water Resources Division of the U.S. Geological Survey (USGS), and our FY 1998 budget request.

The President's budget request for the USGS as a whole reflects Administration priorities related to management of land and water resources, to protecting human health, and national security. The most notable programmatic increase is for a new Water Quality Information Initiative (part of the President's Kalamazoo Initiative) within the Water Resources Division (WRD). For WRD the budget request represents an increase of $1.9 million, about a 1 percent increase.

The USGS Water Resources Investigations Activity is the primary source of scientific information on one of the Nation's most important natural resources--water. The Activity fulfills a unique Federal role by providing standardized, objective information for the entire country through long-term hydrologic data, interpretive reports, and new analytical methods.

The Water Resources Division of the USGS collects and manages reliable, impartial, timely information and understanding of the Nation's water resources. USGS activities include data collection, assessments of water resources, and applied and basic research and development with the purpose of solving water-related problems. The information resulting from these activities is used to make informed decisions to:

Minimize the loss of life and property as a result of water-related natural hazards such as floods, droughts, and land subsidence.

Effectively manage ground-water and surface-water resources for domestic, agriculture, commercial, industrial, recreational, and ecological uses.

Protect and enhance the quality of water resources for human, aquatic, and environmental health.

Contribute to wise physical and economic development of the Nation's resources for the benefit of present and future generations.

Let me highlight here a few of the largest programs of the USGS which address water resource issues.

NATIONAL WATER-QUALITY ASSESSMENT (NAWQA) PROGRAM

Protection and enhancement of the quality of the Nation's ground water and streams are a high priority for the public and all levels of government. Understanding the factors that influence or control water-quality conditions is essential in determining the effectiveness of the Nation's investment in multi-billion dollar programs in the management of water quality. In addition, many decisions that will determine the direction of future water management have yet to be made. These decisions will involve more complex issues than in the past, in areas with scientific uncertainty.

The long-term goals of the NAWQA Program are to: (1) describe the status and trends in the quality of a large, representative part of the Nation's surface water and ground water resources; (2) provide an improved understanding of the primary natural and human factors affecting these conditions; and (3) provide information that supports development and evaluation of management, regulatory, and monitoring decisions by other Federal, State, and local agencies.

Results from NAWQA show how many factors such as air, soil, and water flow influence water quality conditions. Thus, management policy must accommodate known variations in these factors to be effective and efficient. NAWQA, which is evaluating 60 percent of the Nation's water resources, is beginning to provide the kind of information needed to develop effective policy and efficient programs. It is effectively addressing issues such as nutrient enrichment, pesticide contamination, and volatile organic contaminants in ways that have been useful to national and regional policy formulators.

HYDROLOGIC NETWORKS AND ANALYSIS

Data on the quantity of water in the Nation's streams, lakes, and aquifers, as well as analytical studies of water quality, 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 hydrologic networks for collecting long-term, comprehensive data on water quantity and water quality, and the chemistry of atmospheric deposition. These data often form the basis for resolving water policy disputes and legal controversies across jurisdictional lines.

The most significant USGS water quantity data-collection network is the streamflow network, comprising some 7,000 streamflow measurement stations (streamgages) across the country. This network, begun in 1887, provides streamflow data needed by Federal, State, and local agencies for planning, managing and regulating water resources programs.

The most profound change in the USGS streamgaging program in recent years has been the development and widespread use of real-time flow data. As the expansion of water- development projects has slowed, the emphasis has shifted to developing management strategies that make optimum use of water-resources infrastructure. These approaches require the use of more information, provided more quickly than in the past. Throughout the country, USGS streamgages equipped with real-time telemetry are integral components of reservoir operations, river forecasting, drought monitoring, and flood-warning.

Currently, about 4,200 gages--about 60 percent of the network--are equipped with automated Data Collection Platforms (DCPs), which use satellite transmitters to send stream stage data to major users, such as NWS, the U.S. Army Corps of Engineers (USACE), and the Bureau of Reclamation (BOR). These and many other Federal, State, and local agencies use the real-time information to forecast river conditions, issue flood warnings, plan reservoir releases, and schedule water withdrawals. So important are real-time data to the missions of these agencies that the number of stations equipped with DCPs has more than doubled in the past 10 years, even though the overall number of gages is decreasing.

PARTNERSHIPS

The USGS relies on more than 1,100 State and local partners and about 30 Federal partners in developing its water information. In FY 1996 the $192.9 million appropriation for the USGS Water Resources Investigations Activity was leveraged with more than $91 million in reimbursements from State and local agencies and about $92 million from other Federal agencies to advance the knowledge of the Nation's water resources. Also, under the auspices of the Water Resources Research Act, the USGS administers a program of research grants to universities through the Water Resources Research Institute in each State and U.S. Territory. What follows are brief descriptions of these partnership activities.

Federal-State Cooperative Water (Coop) Program

Continuous assessment of the Nation's water resources is a huge and expensive task; it is a vital cornerstone of the USGS mission. The 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 cooperating agencies provide at least half the funding; the USGS does most of the work. These provisions result in an effective cost-sharing arrangement enabling the use of consistent techniques of data collection, archiving, and analysis so vital to a 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 important 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 done 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. A relatively new development in the Coop Program is an emphasis on working with States to help them comply with provisions of the Safe Drinking Water Act Amendments, by improved monitoring and assessment of potential toxics such as arsenic, pesticides, pathogens, radionuclides, and natural organic compounds. The new Drinking Water initiative, begun in FY 1997, is addressing this issue with four studies in New Jersey, Michigan, Georgia, and California, and the States are playing an important role in this work.

Other Federal Agencies

The USGS also serves, on a reimbursable basis, as the primary source of hydrologic information to many other Federal agencies and, through the Bureau of Indian Affairs, to Native American Nations. For example, the USGS provides to the Department of Energy (DOE) most of the hydrologic and geologic capability for evaluating the suitability of Yucca Mountain (Nevada) as the site of the Nation's high-level nuclear waste repository. The USGS collects data for Federal water management agencies (the USACE and BOR). The USGS characterizes the hydrogeologic settings for use by DOE, the Department of Defense, and the U.S. Environmental Protection Agency at many sites where they have responsibility for ground-water contamination clean-up. USGS participation prevents the need to duplicate a hydrologic staff in these agencies and assures that the collected data will be entered into the standardized national USGS data-base so the data will be documented and readily available to all potential users. The diverse programs with other Federal agencies result in new techniques and capabilities that are then put to use throughout the USGS and the wider community of water-resource professionals.

Water Resources Research Act Program

The Water Resources Research Act Program is a Federal grants program which supports academic research to aid in the resolution of State and regional water and related land problems, promote technology transfer, and provide for the training of scientists and engineers. This program enables Federal departments and agencies to use the State Water Resources Research Institutes on a cooperative basis to supplement Federal activities focusing academic research on State-based water issues. The resulting cooperation between the Federal government and the university community encourages complementary, rather than duplicative activities. Federal grants are being supplemented by other sources of funding to the Institutes, providing total funding 10 times greater than the amount of USGS-administered grant monies.

FY 1998 PROGRAM DIRECTIONS

In 1998, the NAWQA Program will be substantially expanded to provide more water-quality information to the public as part of the President's new Water Quality Information Initiative. The initiative has been dubbed the "Kalamazoo Initiative," since the President first announced it in September 1996 in Kalamazoo, Michigan. The initiative is based on the premise that communities across the country need to protect their water resources and know the present condition of drinking water sources. Nationally consistent information on the status of water quality in major urban areas is needed to help communities maintain and protect the source of municipal supply. Access to water-quality information must be improved, providing communities with readily available data supporting their right-to-know about the presence of toxic substances.

The primary goals of this effort are to: (1) describe the water-quality conditions for some of the most important streams and aquifers in 75 of the Nation's key metropolitan areas (including the largest city in each State); (2) provide information that supports the development and evaluation of management, regulatory, and monitoring decisions by local, State, and other Federal agencies, and (3) provide readily available information to the general public on the quality of natural waters in areas where they live.

Through this initiative, data from major rivers, drinking water wells, and water supply watersheds will be made available to the public on the World Wide Web. Also, USGS will prepare and distribute fact sheets on the quality of water in key metropolitan areas. This information can be used by communities and States to set priorities for upgrading waste treatment, hazardous waste cleanup, well-head and source-area protection plans, and improved monitoring in areas of high risk to human or aquatic health.

SUMMARY

We believe the President's budget request will certainly enable USGS to continue its mission of assessing the Nation's water resources and of providing technically sound hydrologic data, investigations, and research on issues important to the American public. The budget provides continued enhancement of programs addressing pressing water quality issues, especially those related to drinking water in urban areas. And we will continue to nurture the relationships with our cooperators at the Federal, State, and local levels, to more effectively address important water resource issues. In short, we see the future of the USGS as being very bright, even in a budget-balancing environment.

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URL http://internal.usgs.gov/clo2/testimn2.html
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Last modification: 10-15-97@08:00 (stm)

House Resources Committee - Subcommittee on Energy and Minerals Hearing on Reauthorization of the Geologic Mapping Act - February 27, 1997

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Outline of Testimony regarding HR 709

o Administration supports H.R. 709, a bill to reauthorize the National Geologic Mapping Act of 1992

o Discussion of the value and importance of geologic maps

o Review of actions taken by USGS to implement the 1992 Act through the National Cooperative Geologic Mapping Program -- review of the status of each major program element

o Discussion of several examples of geologic mapping projects that evidence the refocusing of the program from rural and wilderness areas to urban corridors and urban fringe areas where improved geologic information is needed by decision makers

STATEMENT OF DR. P. PATRICK LEAHY U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR TO COMMITTEE ON RESOURCES SUBCOMMITTEE ON ENERGY AND MINERAL RESOURCES U.S. HOUSE OF REPRESENTATIVES
February 27, 1997

Madam Chairman, I am pleased to be here today to express the Administration's support for H.R. 709, a bill to reauthorize the National Geologic Mapping Act of 1992. I appreciate the opportunity to review the progress made under the Act since 1992 and to outline the goals that we are setting through the reauthorization legislation.

The Earth provides the foundation of our society--we live upon it and we utilize its products. A thorough knowledge of the Earth's resources and dangers is crucial for informed decisions in making public

policy. Geologic maps are the best tools to collect and convey this information. The National Cooperative Geologic Mapping Program, authorized by the National Geologic Mapping Act of 1992, produces geologic maps needed by public and private organizations, maps essential to our continued economic health and vitality.

Geologic maps are a keystone product of the U.S. Geological Survey. They address each of the four principal themes of the Survey's mission: information, hazards, resources, and the environment. The geologic maps prepared by Survey scientists over the past century have been the primary means of communicating geologic information and data. In the past 100 years, society's needs have risen dramatically and have focused the attention of the earth science community on processes at and near the Earth's surface. We continue to seek and refine information that is essential for the protection of human health and safety and for continued economic growth, outcomes that can be traced ultimately to high-quality geologic maps. Old geologic maps must be revised and updated, and new ones prepared. Tight fiscal constraints require that the broadest range of stakeholders determine what information is needed so that our efforts are well targeted. These constraints require that all those who prepare geologic maps, from the U.S. Geological Survey to State geological surveys and the academic community, work cooperatively to maximize each other's strengths and to avoid duplication. It is often said that cooperative efforts of a group can exceed the sum of the individual efforts - today, I will outline how activities under the National Geologic Mapping Act are applying such a cooperative and synergistic approach among the Federal Government, the states, and the academic community.

To the extent possible, humans must be safe from natural hazards. Although natural hazards such as earthquakes, volcanic eruptions, landslides and floods cannot be stopped, recognizing and planning for these dangers can significantly reduce damages or costs of a major disaster. Geologic maps are the principal means for discovering and recording areas that will be affected by natural hazards and for communicating the dangers of hazards such as earthquake- producing faults, landslides, collapse structures, expanding soils, volcanic eruptions, and both natural and human-induced pollution. Identifying the location of hazardous areas on maps allows land managers, industry, and the public to predict potential losses, and develop strategies to minimize these losses.

Human health is affected by environmental quality. Effective environmental policy requires an understanding of the complex interrelationships among components of the biosphere, including the Earth itself. Geologic maps provide the foundation needed to achieve balanced and scientifically credible environmental protection. They provide information on the location of rock types that produce radon, release toxic heavy metals, or interact with water to produce acid drainage. They provide the framework to predict flow paths for contaminated ground water and to identify safe locations for waste sites and other facilities that will minimize the chances for pollution of soil and water. They also help to delineate specific soil or rock types necessary for certain plant communities.

Economic growth is driven largely by access to the Earth's resources. Water, energy, and building materials are required to sustain our vital economic engine. Geologic maps provide the keys for the location of safe drinking water; energy resources such as coal, petroleum, and natural gas; construction

materials such as sand, gravel, limestone, and building stone; soil and rock types that enhance agricultural productivity; and metals and other mineral resources as diverse as gold, fertilizer, and cat litter (zeolite and vermiculite). Policy makers must know the nature and extent of resources in order to plan how to manage the land in an economically sustainable way. Industry and local governments need geologic maps to help estimate the available resources for water supplies, building, energy production, and extraction of raw materials.

NATIONAL COOPERATIVE GEOLOGIC MAPPING PROGRAM

The National Cooperative Geologic Mapping (NCGM) Program ensures that our Nation will continue to have the geologic maps it needs to protect the health of our citizens and promote economic growth. Through involvement with private industry, public policy makers, and the public, the Program seeks to ensure that mapping efforts are focused on priority areas. The Program also uses stakeholder input to determine what formats are most useful as we move into the information age; new geologic maps are being produced in digital formats that can be put on the Internet.

The NCGM Program has been designed so that the Nation will have the quantitative geologic map data needed to address tomorrow's problems. To this end, the following goals are being pursued:

o Continue to enhance the outreach to stakeholders thus ensuring that the maps address societal priorities and are produced in forms easily accessible and usable.

o Expand cooperative agreements with the State geologic surveys, academic institutions, other Federal agencies, and the private sector to enhance the output of map information and data.

o Develop metadata (data about data) for the National Geologic Map database and make the data available through the Internet. Enhance the ability to produce digital as well as analog (paper) map products.

The NCGM Program brings together Earth scientists from the U.S. Geological Survey, State geological surveys, and academia through a process of partnering. The program will ensure a balance of funding between State geological surveys and academia. The goals of the academic funding are to ensure that we train the scientists who will provide the geologic maps of the future.

The National Geologic Mapping Act of 1992, Public Law 102-285 authorized the establishment of a National Cooperative Geologic Mapping Program with the U.S. Geological Survey as the lead Federal agency responsible for coordinating and managing the geologic mapping program. The act also stated that the program is to be implemented through four components: FEDMAP and SUPPORTMAP which constitute the Federal component of the geologic mapping program, STATEMAP, which supports the States' efforts in producing geologic maps, and EDMAP, which ensures the training of students in the production of geologic maps. The 1992 Act also called for the establishment of a National Advisory Committee, the development of a digital National Geologic Map Database, and the development of

methods to increase public awareness of the role and application of geologic map information to the resolution of national issues. Several changes in the geologic mapping program have occurred since the passage of the National Geologic Mapping Act of 1992 that I am pleased to enter into the record:

1. PROGRAM NAME--The National Geologic Mapping Program is now named the NATIONAL COOPERATIVE GEOLOGIC MAPPING PROGRAM, a small change in the name, but a significant change in recognition of the strong partnering aspect of the program with the State geological surveys through the Association of American State Geologists (AASG), with academia, and with the National Park Service and other Federal agencies.

2. STATEMAP--In FY 1995 only about 6 percent of total program funding was available for matching by State geological surveys, whereas in FY 1996 and beyond not less than 20 percent of appropriated funds will be apportioned to the STATEMAP component, thereby significantly increasing the amount of high-priority geologic mapping available to individual States and the Nation. In FY 1996 cooperative agreements were made with 42 States to help support 60 geologic mapping projects. These projects were recommended for funding by a peer review panel consisting primarily of State Geologists. A similar number of projects are being awarded in FY 1997.

3. EDMAP--This important component of the geologic mapping program was implemented for the first time in FY 1996. Two percent of the total program funding is available for matching by universities. The funding is to help support graduate students to conduct geologic mapping in areas of priority to State or Federal agencies. These studies not only help increase the geologic mapping of high priority areas but also help train the next generation of geologic mappers. In FY 1996 cooperative agreements were made with 37 universities to support 40 geologic mapping projects recommended for funding by a peer review panel consisting primarily of university professors who are experts in geologic mapping. A similar number of projects are being awarded in FY 1997.

4. FEDMAP/SUPPORTMAP--The USGS continues to be active in executing geologic mapping (FEDMAP) and supporting studies (SUPPORTMAP) of paleontology, stratigraphy, geochronology, isotope geology, geophysics, and geochemistry. Over the past few years the geologic mapping program has moved from large numbers of essentially one-person projects to more integrated regional synthesis activities in which clients and cooperators are involved in all phases of the planning, implementation, and execution of project work. For this reason, much of our geologic mapping has moved from rural and wilderness areas to the "urban corridor" and "urban fringe" areas, where competing land use decisions benefit from improved geologic information. Three examples of the twelve regional synthesis projects are the Southern California Areal Mapping Project (SCAMP), the Middle Rio Grande Basin Project, and the Florida Cooperative Geologic Mapping Project.

Southern California Areal Mapping Project (SCAMP)

This geologic mapping project is centered on the Los Angeles urban area and covers most of southwestern California. This is a joint effort with the California Division of Mines and Geology.

Clients include the U.S. Air Force (March Air Force Base and Edwards Air Force Base), the U.S. Navy (Twentynine Palms Marine Corps Air/Ground Combat Center and the Chocolate Mountains Gunnery Range), the U.S. Forest Service (San Bernadino National Forest), U.S. Army Corps of Engineers (Seven Oaks Dam), National Park Service (Joshua Tree National Park), San Bernadino Valley Municipal Water Agency (Yucaipa and San Bernadino Basins), Mojave Water Agency (Lucerne and Morango Basins and Mojave River), Metropolitan Water District, and the Southern California Earthquake Center. The components of the project address a variety of urban geology issues for which geologic mapping provides essential primary data. These are: (1) mapping the geometry of ground water basins and flow regimes to assist several California water districts in dealing with water resource and recharge problems and to help the Air Force monitor contaminant plumes in ground water, (2) mapping limestone and aggregate building resources to assist the National Forest Service manage its land, (3) providing geologic map data to assist the Corps of Engineers in siting a dam between two strands of the San Andreas fault and (4) helping the Metropolitan Water District define the structural setting of the "Domenigoni" reservoir, now under construction, which when completed will be the largest water retention structure in Southern California.

Middle Rio Grande Basin Project

One of the new cooperative urban-focus projects organized within NCGMP in FY 1996 provides a geologic framework and geologic map database for investigation of the Middle Rio Grande Basin, a region that includes extensive Federal lands as well as the principal urban centers of New Mexico. This project addresses the critical issue of diminishing ground water supply in the rapidly developing Santa Fe-Albuquerque-Socorro urban corridor of New Mexico. Previous joint studies by the New Mexico Bureau of Mines and Mineral Resources and USGS have shown that the extent of the primary aquifer in the region is more limited in size and distribution than previously believed, and unless new water resources are identified, urban development will be limited. NCGMP has joined with other USGS Divisions, with area universities, New Mexico Bureau of Mines and Mineral Resources, and other federal agencies in a 5-year effort to better define the hydrology and geology of the Middle Rio Grande Basin. As illustrated in Exhibit 4, NCGMP is taking the lead in compiling the overall geologic map database for the region at 1:100,000-scale and in developing airborne geophysical data sets for identifying buried aquifers and geologic structures that control ground water flow.

Florida Cooperative Geologic Mapping Project

This is a cooperative effort with the Florida Geological Survey (FGS) to provide surficial and shallow subsurface geological mapping in the State of Florida. The activities of the FGS include primary responsibility for surficial geologic mapping, stratigraphic test drilling, and analysis and curation of drill core samples. NCGMP provides high resolution biostratigraphy and interpretation of the ancient environments where sediments were deposited. This joint work has established the geologic framework for hydrologic flow modeling by the South and Southwest Florida Water Management Districts and USGS and has resulted in a re-evaluation the stratigraphic setting and flow patterns within the principal Floridan aquifers. This cooperative work with the State has extended the stratigraphic range (thickness) and defined depositional settings where economic deposits of phosphate occur in Florida. NCGMP has also formed a partnership with the Florida Geological Survey, South and Southwest Florida Water

Management Districts, Dade County, U.S. Army Corps of Engineers, National Oceanic and Atmospheric Administration, Everglades National Park, and several area universities to investigate the quality and quantity of water delivered to both the southeast (Biscayne Bay) and south (Florida Bay) coasts of Florida. Both of these shallow bays are showing increasing signs of distress such as algal blooms, seagrass die- offs; fishery declines, increases in pollution, and changes in nearshore vegetation patterns. It is important to know how many of the observed changes are direct consequences of human activity and how many are related to natural variations in the ecosystems. This project is testing theories about human influence by examining the geologic record for the past 300 years and examining the ability of the natural systems to recover from disturbances. Initial results suggest that there are both human-induced changes, such as changes in plant distribution related to canal-building, as well as natural cycles in seagrass abundance and fishery productivity.

5. EXTERNAL ADVISORY COMMITTEE--The U.S. Geological Survey sponsored two national workshops, one in December of 1994 and a second in February of 1995, to begin the process of soliciting advice on the planning and implementation of the geologic mapping program. Workshop participants were producers and users of geologic map information including representatives from Federal and State agencies, academic institutions, and the private sector. A 16-member National Cooperative Geologic Mapping Program Advisory Committee has been chartered, appointed, and met in April 1996 and is scheduled to meet again in April 1997.

6. NATIONAL GEOLOGIC MAP DATABASE--A draft of this database design has recently been released for comment via the Internet by creating a site on the World Wide Web (WWW). The Uniform Resource Locator (URL) for this site is "http://wwwflag.wr.usgs.gov/ ngmdb". This web site is also linked to the recently created web site for the National Cooperative Geologic Mapping Program whose URL is "http://ncgmp.usgs.gov". A critical element in database construction is the development, acceptance, and adherence to a certain level of standardization. The USGS is currently working with both producers and users of geologic map information to develop draft format, symbols, and technical attribute standards so that geologic map database information can be accessed, exchanged, and compared efficiently and accurately as required by Executive Order 12906 (59 Fed. Reg. 17,671; 1994), which established the National Spatial Data Infrastructure (NSDI).

7. USGS CIRCULAR 1111--"Societal Value of Geologic Maps", published in 1993, is an economic analysis by the geologic mapping program that describes geologic maps, a rigorous benefit-cost model for valuing geologic map information, and the economic issues associated with determining whether or not a geologic map is a public good. Nearly ten thousand copies have been requested since publication. This publication and similar studies are increasing public awareness of the utility (value in use) of geologic map information to issues of land use management.

8. FEDERAL PARTNERSHIPS--The geologic mapping program is developing a series of cooperative relationships with various Federal partners in addition to our State and academic cooperators. The most mature of these is with the National Park Service (NPS). In 1995, the USGS and NPS signed a Memorandum of Understanding that outlined areas of interaction between the two bureaus. The geologic mapping program responded by working with NPS during 1995 as part of their "Science in the Parks"

initiative to direct a portion of the program's geologic mapping and supporting activities toward priorities established by NPS. The NPS used a national project call and priority system to rank over 100 proposals for geologic work in FY 1996. The geologic mapping program has begun work in FY 1996 with 10 of the 30 top- priority parks. The geologic mapping program is currently in the process of fostering similar partnerships with other Federal agencies including Bureau of Land Management, U.S. Forest Service, Environmental Protection Agency, and Department of Energy.

Madam Chairman, in concluding my remarks, I would like to state for the record that the National Geologic Mapping Act of 1992 has been instrumental in helping focus more attention on the Nation's need for a systematic, high-quality geologic map database to serve as the primary underpinnings for virtually all applied and basic earth science investigations. The Administration supports reauthorization and urges bipartisan support for this legislation. Thank you, Madam Chairman for the opportunity to express the views of the U.S. Geological Survey on the benefits of the current National Geologic Mapping Act and the value of reauthorizing this program. I would be happy to respond to any questions you may have.

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