Place-based Studies

Integrated Science	1999 Estimate	Uncontrol. & Related Chgs.	Program Redirect	Program Changes	FY 2000 Budget Request	Change from 1999
Placed-based Studies	0	0	15,286	2,400	17,686	17,686

Note: The Program Redirect column reflects the redirection of funds to the Integrated Science from other program areas.

Current Program Highlights

As local land owners, resource managers and the public see the availability and quality of their resources diminish, there are increasing calls to restore what has been lost, or to better manage altered ecosystems that will be healthy and sustainable under the conditions of human use. The costs of rehabilitation can be large, both for physical environmental alterations, and for forgone use of land and water resources. These economic realities demand effective environmental solutions and efficient resource use. Environmental restoration must minimize unnecessary impacts on human activities, while sustaining the environment, its resources, and the local economy. Scientific information helps to ensure that future plans have realistic expectations for restoration, structures under construction are optimally managed, and managers have the tools to predict outcomes of possible restoration actions. In the Place-based Studies Program, USGS provides scientific information to ensure that planning and management can continue while scientific understanding improves. Studies are customized to fit the complexity of problems.

For several years we have addressed natural resources science issues from a multidisciplinary perspective, integrating the geological, hydrological, biological, and mapping sciences. This approach has been successful in South Florida, San Francisco Bay, Chesapeake Bay, Greater Yellowstone, Mojave Desert, Platte River, and Salton Sea. These studies form the basis of the Place-based Studies Program.

South Florida ($8.6 million in FY 1999) — Diversions of water and excessive nutrients and mercury within the Everglades have decimated bird populations and driven the Florida panther to the brink of extinction. In Florida Bay, declines in seagrasses, which hold sediment in place and provide habitat for fish, result in decreasing water clarity and declining fish populations. Resource managers are planning $2 to 3 billion restoration efforts in the Everglades and Florida Bay. The U.S. Army Corps of Engineers (USACE), the South Florida Water Management District (SFWMD), and other stakeholders are drawing up plans for restoration. USGS information and models help the USACE, the National Park Service (NPS), Florida Department of Environmental Protection (FDEP), the U.S. Environmental Protection Agency (EPA), the U.S. Fish and Wildlife Service (FWS) and the SFWMD predict the consequences of varied management alternatives, set ecological goals by providing yardsticks to measure the success of the restoration, and manage the natural resources of the system.

In FY 2000 the USGS will continue the shift from primary data collection and research activities to synthesis, integration and enhancement of the electronic availability of the scientific information that has been collected. The synthesis will help to chart the future scientific direction of the USGS program, and will contribute to interagency synthesis activities to assist decisionmaking for restoration of south Florida. In the Everglades and Florida Bay, the USGS provides information and models on water flow and quality, contaminant dynamics,

bathymetry, sediments, ecology of fish, vegetation and wildlife, geology, and ecosystem history to its clients and partners through the South Florida Ecosystem Restoration Task Force and associated workgroups. These stakeholders are using USGS hydrologic and biological models, monitoring data, and ecosystem history results in models for the detailed planning phase. The National Oceanic and Atmospheric Administration is using Florida Bay data to manage the Marine Sanctuary. The SFWMD uses USGS flow, geochemistry, and water quality information to develop water quality standards required before FY 2002, and to implement a mercury monitoring plan. USGS hydrologic and geologic base information also helps determine water supply potential for communities on the west and east coasts, and potential impacts of water redirection southward on Biscayne Bay National Park. Many of the USGS studies are shifting their focus from field data collection to information synthesis so that the interdisciplinary value of the information can be maximized.

San Francisco Bay and Delta ($1.8 million in FY 1999) — CALFED and its component agencies are making key decisions about how to restore the ecological health of the Bay/Delta while improving water management for beneficial uses. USGS studies will provide information to answer two questions that are critical to understanding fundamental issues of wildlife suitability and the tradeoffs inherent in ecosystem restoration.

- What is the relative importance of abandoned ponds versus tidal marshes to the region's fish and wildlife species?
- What are the linkages between local hydrodynamics, pollutant transport, and exposure to pollutants and environmental effects in shallow bay environments?

Sites were selected to maximize their benefit to local partners because the sites are either slated for management action, or are critical habitat for some of the bay's threatened and endangered species and strongly influenced by the management of freshwater inflows to maintain the X2 salinity standard. USGS scientists are working closely with our partners within the CALFED Community, and other State and local environmental management and resource agencies.

Chesapeake Bay ($1.8 million in FY 1999) — In Chesapeake Bay, the Nation's largest estuary, excessive nutrients have caused declines in submerged aquatic vegetation (SAV) which provides essential habitat for shellfish and fin fish and food for waterfowl. Additionally, excessive nutrients appear to be related to the occurrence of Pfiesteria and associated fish and human-health problems. The interagency Chesapeake Bay Program (CPB) has been attempting to reduce nutrient loads into the estuary by 40 percent by the year 2000, but it is unclear whether these goals are realistic, especially considering the preliminary information indicating that nutrient practices are not improving water quality very quickly. The intergovernmental agreement on nutrients requires a better understanding of the effects of different land-use practices, the lag time in which resulting changes in water quality will occur, and the effects of those practices on biota.

The USGS program directly contributes to the information needed to manage these important problems. The USGS information on changes in nutrients in surface water, the role of watershed conditions and ground-water in nutrient transport, and factors affecting the response of SAV and fish health help the CBP better understand and develop strategies to address the lag time between changes in nutrient management practices and improvements in

water quality and living resources. USGS information on ecosystem response and variability over historic and geologic time scales helps to determine the relevance of environmental goals and the relationship of changes caused by nutrient management to those caused by natural factors and variability. USGS spatial coverage of land and estuarine characteristics documents current environmental conditions at different spatial scales. The USGS results will also be used to help identify emerging challenges to the Bay ecosystem in the formulation of the Year 2000 Chesapeake Bay agreement.

Greater Yellowstone Area ($1.3 million in FY 1999) — An increasing number of people are drawn to live and recreate in the greater Yellowstone ecosystem, which contains our oldest National Park, unique wildlife resources and the influences of one of the largest dormant volcanic areas in North America. Coexistence with wildlife is a delicate balance as the area is developed and wildlife habitat is fragmented. Such a balance requires vastly improved information on landscape attributes (geology, topography, vegetation, climate, roads and trails and hydrology), parallel information on the utilization of the landscape by wildlife and humans, and on the dynamic interactions among wildlife species. Existing scientific data mirrors the patchwork of land and wildlife management agencies and their distinct policies and objectives. In a pilot study, the USGS is bringing this information into a common spatial framework (geographic information systems) for collaborative decision-making that reflects the needs of the greater Yellowstone area. By developing and sharing data resources with federal and state agencies, information will be consistent and useful across ownership and management unit boundaries, and in a form that can be applied to management decisions concerning wildlife and its habitat, local zoning, geothermal and mineral resources and natural hazards. The current level of support allows the program to incorporate a limited suite of information into the database, and allows for limited construction of the habitat models that would be of most benefit to decision makers.

Mojave Desert ($0.8 million in FY 1999) — Human activities, such as off-highway vehicle use, urban expansion, waste disposal, recreation, and water withdrawal; and natural processes influenced by man, such as fire and invasive species, have made land use decisions more critical to the long-term economic and ecological sustainability of the area. USGS is working closely with the National Park Service, Department of Defense, BLM, State of California and land management groups in the Mojave Desert. In a pilot study, USGS brings together multiple sources of scientific information to provide managers with assessments of habitat vulnerability and recoverability. The ultimate goal is to create a decision support system to:

- describe the vulnerability of the land to erosion, invasion by noxious weeds, climatic variability and other disturbances;
- identify emerging patterns of resource use; and
- determine the potential for recovery of degraded land so managers can better target management activities. The pilot-level activity includes a small number of sites that encompass a limited suite of environmental types.

The Platte River ($0.7 million in FY 1999) — The central Platte River valley is an internationally significant staging area that supports the migration of one-half million sandhill cranes and several million waterfowl of the Central Flyway. The endangered whooping crane, piping plover, and least tern use habitats in the central Platte River valley. Changes in water and land use have transformed the river channel and altered adjacent wet meadows. These

habitat changes have placed in doubt the sustainability of populations of migratory and resident birds and other biota. The Department of the Interior and the States of Colorado, Nebraska, and Wyoming formally agreed to develop a habitat recovery program which cleared the way for a scientifically-informed approach to ensure current and future water uses and recovery of target species. The USGS pilot study assists in developing successful management strategies by providing water and land managers with information on hydrology, river morphology, biological communities and riparian habitat from a limited group of sites.

Salton Sea ($0.250 million in FY 1999) — The Salton Sea Basin is a highly productive ecosystem, with tremendous importance to the migration, wintering, and breeding for many water birds in the Pacific Flyway. The decline of wetlands on the western flyway during this century makes the Salton Sea much more crucial habitat for many birds. Since the Sea's accidental formation early in this century, salinity and nutrient levels have increased dramatically because, as a terminal lake, incoming irrigation drainwater evaporates under the intense heat of the desert. Although it continues to be important for wildlife, wildlife diseases appear to be increasing, and the economic and recreational benefits from hunting, fishing and tourism have declined. Stakeholders are exploring options for restoration to economic and environmental productivity, but need better information on factors contributing to system decline, including hypersalinity, toxic chemicals from American and Mexican agricultural runoff, and wildlife diseases. Funding supports development of effective and lasting actions to reverse the declining conditions.

Recent Accomplishments

South Florida

- **Ecosystem History of Biscayne Bay, Florida Bay, and the Everglades** — Setting restoration goals for flow of water and period of inundation (hydroperiod) requires an understanding of natural variability of flow and the changes in salinity that have resulted from human activities. Hydroperiod controls plant and animal communities, and affects salinity and productivity in coastal bays. USGS found that the historic Everglades have been drier, with shorter hydroperiods, during the 20th century than any time since the 14th century. Shortly after construction of major canals and roads in the early 1900's, hydroperiods became shorter throughout much of the fresh-water Everglades, the ongoing salinity increase in the saline Everglades accelerated, and salinity levels increased in Florida Bay and Biscayne Bay. Continued alteration of the natural hydroperiod since the early 1900's resulted in relatively localized changes to wetland plant communities and greater salinity fluctuation in the bays. This trend is punctuated by discrete events attributed to construction of the Flagler Railway along the Florida Keys from 1905 to 1912, implementation of water management practices, and construction of canals throughout South Florida. In Florida Bay, results suggest that significantly different salinity and seagrass conditions existed before intense water management practices and land development in southern Florida began. The paleo record reflects the importance of the rate of freshwater flow to the stability of the estuarine ecosystem, and the need to increase freshwater inflow to return to natural conditions. This information will enable managers to better understand the range of conditions that are "natural". Additionally, natural variability

can be filtered out of the human-induced component of change, thus allowing land managers to set more accurate, realistic, and sustainable salinity goals.

- **Sulfur and Phosphorus in the Everglades** — High phosphorus levels in the northern Everglades have altered the ecology of wetland marshes, causing cattails, which are more tolerant of low-oxygen conditions, to displace natural sawgrass. Since EPA and the State of Florida established regulatory guidelines regarding phosphate concentrations, the source and impact of phosphate have been highly contentious issues. The USGS provided managers with the first direct evidence that phosphorus in Everglades' peat originated from agricultural fertilizer. EPA and the State can now establish water quality standards with greater confidence and a more complete understanding of the interactions between agricultural waste products and the Everglades ecosystem.

  Sulfur, used as an agricultural amendment, reduces the amount of phosphorus that farmers must apply in the Everglades Agricultural Area (EAA) to get equivalent amounts of fertilization. Questions have been raised concerning the derivative effects of agricultural amendments on fish-eating birds. The USGS found that large portions of the northern Everglades are contaminated with sulfur and has helped regulators to understand interactions that create environmental threat. This information will be used by EPA and the State regulators to incorporate sulfur into their regulatory framework as part of an overall strategy for reducing contamination of fish and wildlife in the Everglades.

Flow of Sulfur Contamination in the North Everglades and Methyl Mercury Production

San Francisco Bay and Delta

- **Water flows in San Francisco Bay and Delta** — The ability to manage and predict water flows and salinity in San Francisco Bay and Delta is key to meeting the needs of agriculture, public water supply and the environment. Predicting the timing of spring runoff, for example, is critical to fish spawning cycles, irrigation activities, and the filling of storage reservoirs. USGS models can now predict the initiation of the spring snowmelt pulse up to two weeks in advance in the Merced River, a river with flow patterns that are characteristic of rivers throughout the central Sierra Nevada. The new models link USGS hydrologic models with NOAA 14-day forecasts of air temperatures. These new models will improve the ability of dam operators to conserve water in times of drought and to release it in advance of predicted flooding.

- **Management of Freshwater Flow to Meet the X2 Salinity Standard** — In 1994, the U.S. Environmental Protection Agency, in coordination with stakeholder groups, established a salinity standard ("X2") that requires the salt content of the water in ecologically sensitive regions of the estuary to be maintained at specified levels. USGS flow study results have demonstrated that the landward flow of salty bottom-water in the Suisun Bay area is arrested by the abrupt shallowing of Suisun Bay east of the Benicia Bridge, rather than by the balance of seaward-flowing river water on the surface and landward-flowing saline water at the bottom. This finding will influence decisions about the proposed deepening of the ship channel near Benicia and, more generally, the management of freshwater flow to meet the X2 standard. Deepening of the channel to accommodate the passage of deeper draft vessels could elevate salinities in Suisun Bay and the western Delta, thus requiring increased freshwater outflows to meet the X2 standard.

- **Predicting the location of contaminated sediments in San Francisco Bay** — Between 1853 and 1884, mercury was used in hydraulic gold mining large amounts of sediment were washed out of Sierra streams to form a contaminated layer on the bottom of San Francisco Bay. Sedimentary mercury can be converted methyl mercury, a potent neurotoxin, and in fact, mercury concentrations in locally caught striped bass or shark are high enough to warrant fish consumption advisories for pregnant women and children. In a unique study that combines historic bathymetric data from the 1850's to the 1990's and state-of-the-art information on historical trends in sedimentary metal contamination, the USGS has developed maps that identify when particular sediments were laid down and thus how deep the contaminated layer will be found. The concentrations of mercury in these accumulated sediments were 3-4 times higher than the regional background. Using this information, managers of harbors and waterways, water quality agencies, and wetland restoration engineers will be able to predict the location of mercury hotspots when sediments are dredged for navigation, disturbed as part of ecosystem restoration, or eroded when flows change in connection with wetland rehabilitation.

Chesapeake Bay

- **Reservoir Storage in Chesapeake Bay** — Reservoir storage of nutrients related to sediments can turn a nutrient sink into a nutrient source when reservoir storage capacity is depleted. The USGS determined that two of the reservoirs on the lower Susquehanna River have reached their sediment storage capacity, and the third will do so in 15-20 years.

Once the storage capacity is reached, the USGS estimates that nutrient and sediment loads to the Bay will greatly increase. Of the nine major rivers, which deliver the vast majority of nutrients and sediment entering the Bay, the Susquehanna River contributes almost half of the nutrients and sediment. This information has prompted the EPA Chesapeake Bay Program to increase its emphasis on reducing sediment loads.

- **Nutrient Lag Times in Chesapeake Bay** — Implementation of best management practices and other nutrient removal strategies do not always result in immediate improvements in surface-water quality because of the lag time associated with infiltration and groundwater percolation into the Bay. USGS has shown that about half of the water and nutrient load entering rivers that drain to the Chesapeake Bay travel through the ground-water system. Nutrients may take between 0-60 years to move through shallow aquifers before discharging to rivers, but most of the water spends about 10 years in the subsurface before discharging to streams, with some variability associated with land characteristics. In response to this information, the intergovernmental Chesapeake Bay Program is reformulating strategies to target reductions of nutrients based on the characteristics of the ground water the basin.

Justification for Program Change

	FY 2000 Request	Program Change
$(000)	17,686	+2,400

The requested increase of $2.4 million would be used to augment pilot efforts in the Platte River, Mojave Desert, Greater Yellowstone, and to begin new work in the Great Lakes region.

In each area, the USGS works closely with the Federal, State and local resource managers to identify the information that is critical for restoration. The increase will enable USGS to meet many of the scientific needs identified in these areas. In the Platte River, Nebraska, Colorado and Wyoming agencies and the US Department of the Interior have helped USGS identify studies that will provide information on what habitat changes are necessary to reverse the decline of whooping cranes and other endangered species, and the potential impacts of restoration strategies that are planned for implementation. In greater Yellowstone, State, Federal and local agencies are helping USGS to develop information would improve management and understanding of wildlife and human interactions in this steadily developing area, including information on roads and habitat use by wildlife. In close coordination with the Desert Managers Group of southern California, USGS is bringing together multiple sources of scientific information to provide managers with assessments of Mojave habitat vulnerability and recoverability. The goal of Mojave-wide applicability of the assessment can only be realized if additional study sites are added to capture the complexity of this unique environment. In the Great Lakes region, EPA, FWS, NPS, the International Joint Commission, the Great Lakes Protection Fund, and the Great Lake States have identified the need for integrated surficial geologic maps, ground water source and availability data, and terrestrial and aquatic resource information to provide decision tools to resource managers. These tools are necessary to help managers determine water supply availability, protect groundwater resources, and restore coastal habitats in this highly populated and increasingly developed region. Partnerships with stakeholders, such as the USGS geologic mapping partnerships with State Geologic Surveys, are essential to the success of this integrated science program.