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Strategic Vision for the U.S. Geological Survey in the Great Lakes-St. Lawrence Region, 2001-2010

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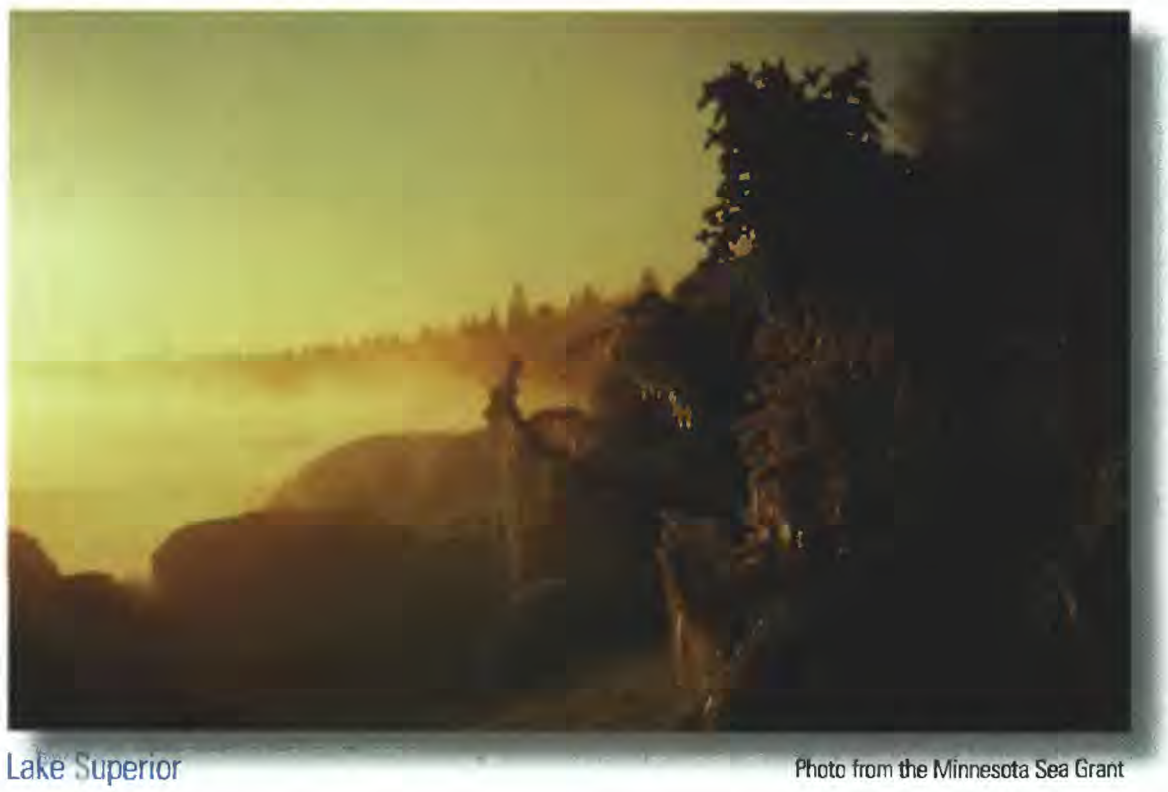
Toledo Lighthouse on Lake Erie

Photo by Joyce and Ainsley Dixon

ABTRACT

The U.S. Geological Survey's (USGS) strategic vision for the Great Lakes-St. Lawrence Region is that of a healthy ecosystem, whose ecological integrity and economic health are nurtured and sustained through sound resource-management decisions based on reliable, timely, and objective scientific information and data. The USGS is a leader in providing reliable, relevant, timely, and objective scientific data and information at local, statewide, regional, national, and international scales to assist in the management and restoration of the natural resources in the Great Lakes-St. Lawrence Region. The mission of the USGS in the Great Lakes-St. Lawrence Region is to provide natural-science information to the broad community of policymakers, resource managers, regulators, scientists, and private citizens who contribute to informed decisions concerning natural-resource management practices and ecosystem quality and integrity.

The strategic vision for the USGS in the Great Lakes-St. Lawrence Region is a plan to address complex issues that require integrated natural-science information. The strategic vision describes how the USGS will coordinate existing programs and draw upon the strengths of the entire organization. It provides the framework for long-term coordination and integration of USGS Programs and activities over the next decade (2001-10). The strategic vision describes the role of the USGS in the Great Lakes-St. Lawrence Region, the coordination of activities within and outside the Bureau and Department of Interior, and interactions between the USGS and its cooperators, partners, and stakeholders in the Region.



Lake Superior

Photo from the Minnesota Sea Grant

STRATEGIC VISION FOR THE U.S. GEOLOGICAL SURVEY IN THE GREAT LAKES-ST. LAWRENCE REGION, 2001-2010

VISION

The U.S. Geological Survey's (USGS) vision for itself is as a world leader in the natural sciences through scientific excellence and responsiveness to society's needs. The USGS vision for the Great Lakes-St. Lawrence Region (the Region) is that of a healthy ecosystem, whose ecological integrity and economic health are nurtured and sustained through sound resource-management decisions based on reliable, timely, and objective scientific information and data. The USGS sees itself as one of the leaders in providing reliable, relevant, timely, and objective scientific data and information at local, statewide, regional, national, and international scales to assist in the management and restoration of the natural resources in the Great Lakes-St. Lawrence Region.

MISSION

The mission of the USGS in the Great Lakes-St. Lawrence Region is to provide natural-science information to the broad community of policy makers, resource managers, regulators, scientists, and private citizens who contribute to informed decisions concerning natural-resource management practices and ecosystem quality and integrity.

Need for a Strategic Vision

Within and outside the USGS, there is a need for integrated, issue-driven, coordinated approaches that link the science being done in the lakes to the science being done in the watershed and the surrounding region. The Great Lakes Commission, other commissions, agencies at all levels of government, and nongovernmental organizations require vast amounts of information to develop policy and manage resources. Many of these organizations rely on USGS for information to support policy decisions, other research and assessment efforts, and to further the wise use and development of natural resources. The USGS seeks to enhance collaboration among its natural-science disciplines and among its partners, cooperators, and users of USGS data and information (Box 1).

Photo from the Michigan Travel Bureau

Box 1. USGS relationships with other organizations

The USGS maintains several types of working relationships with public and private organizations. Organizations defined as cooperators participate with the USGS in cost-sharing programs and projects. Partners are organizations working alongside USGS in a collaborative role. Stakeholders are those organizations who have a vested interest in the natural resources, environment, and economy of the region and are users of USGS products but might not participate in their development, unlike cooperators and partners. Other organizations and individuals are customers, and use USGS data for activities that might be unrelated to the purposes for which the data were collected. Customers include consulting firms, academia, and private citizens. In many cases, there are overlapping roles between the cooperators, collaborators, partners, and customers.

The goal of the Strategic Vision is to provide a road map that can be used to improve the ability of the USGS to address complex issues that require integrated natural-science information. This Strategic Vision describes how the USGS will coordinate existing programs and draw upon the strengths of the entire organization. Such an approach will allow more relevant information to be extracted from our programs and projects in a more useful and efficient manner. For example, the USGS plans to systematically address the fundamental linkage between the Great Lakes, their watersheds, and the surrounding region.

A Strategic Vision is needed to focus the mission and role of the USGS within the Region and to enhance the level of importance of the Region to the overall mission and role of the Bureau. The vision and scope of this document are developed in relation to five major societal goals identified for the Region: ecological health and integrity, sustainable development, human health, minimization of natural hazards and risk, and scientific-information transfer. This Strategic Vision outlines how this integration can result in improvements to USGS programs and to products such as scientific reports and journal articles, models, and decision-support tools created for use by resource managers and decisionmakers.

Purpose and Scope

The purpose of this "Strategic Vision for the U.S. Geological Survey in the Great Lakes-St. Lawrence Region" (Strategic Vision) is to offer a vision and strategy for integrated scientific investigations that address environmental, natural resources, socioeconomic, and public-health issues in a coordinated fashion. The intent of the Strategic Vision is to increase and sharpen the focus of current and future USGS activities, to enhance our partnerships with other organizations, and to provide more useful and relevant information to decisionmakers and natural-resource managers.

The Strategic Vision provides the framework for long-term coordination and integration of USGS Programs and activities over the next decade (2001-2010). The Strategic Vision describes the need for and role of the USGS in the Great Lakes-St. Lawrence Region, the coordination of activities within and outside the Bureau and Department of Interior, and interactions between USGS and its valued partners.

Photo from the National Park Service

The scope of this document includes the current and future core programs of the USGS within the Great Lakes-St. Lawrence Region. The core programs within the Geologic Discipline include detailed geologic mapping of glacial materials in Illinois, Indiana, Michigan, and Ohio[1]; studies of earth-surface processes in areas prone to shoreline erosion, landslides, and earthquakes; research into the potential effects of changing climate on the Earth and its resources; and aquatic-habitat and benthic mapping in coastal areas. The core programs within the Water Discipline include water-quality assessments in the watersheds of western Lake Michigan and southern Lake Erie; water-quality research on pathogens, pharmaceuticals, pesticides, and mercury; and a streamflow-gaging program for assessing water-resource availability, for flood-warning systems, for drought-management plans, and for detection of long-term trends. The Water Discipline program also includes a ground-water-level network that provides data for environmental assessment and ground-water resources management.

[1] In cooperation with the State Geologists through the Central Great Lakes Geologic Mapping Coalition.

The core programs within the biology discipline include fisheries research and assessment in the lakes, biodiversity studies of terrestrial and aquatic species, and research into and assessment of invasive species and related control practices. The core programs within the Mapping Discipline include production of a vast array of mapping products describing the land surface: elevation, hydrology, land use and land cover, and land-surface change in urban and agricultural areas. Recent maps are based on data from satellites and other remote sensing technologies.

USGS programs and projects, which are performed at local, statewide, regional, and national scales, are often independent of state and local jurisdictional boundaries. The watershed is most often the appropriate boundary and scale for hydrologic systems such as the Great Lakes and St. Lawrence River. Factors outside the boundaries of the lakes can affect them, such as atmospheric deposition of contaminants transported from outside the Region.

Photo by R. Royce

USGS, which is a multidisciplinary organization, has the expertise to provide unbiased information and products. These capabilities, combined with our organizational presence in offices and centers throughout the Region, define our role as one of providing data and information in support of wise use of natural resources and sound natural-resources decision making. Thus, it is fitting for the USGS to develop an integrated science program in the Great Lakes-St. Lawrence Region that builds upon the framework of these and other core capabilities to provide information that can be used to address the socioeconomic pressures and natural stresses on the environment and the Region.

Photo by Lake Michigan Federation

Milwaukee River, Wisconsin

MAJOR SOCIETAL ISSUES THAT USGS CAN ADDRESS

The Great Lakes-St. Lawrence Region, encompassing the five Great Lakes, connecting channels, the St. Lawrence River, and the surrounding states and provinces, is a physically magnificent, geographically unique, and economically vital part of the United States and Canada. The five Great Lakes and St. Lawrence River, which contain about one-fifth of the Earth's fresh surface water, are critically important for water supplies, for productive fisheries, and for important transportation and recreation corridors. This Region is a microcosm of the rest of the United States. Within its borders, one can find diverse commerce and industry, major population centers, varied land uses, natural areas, varied climate, and multiple ecosystems (Box 2). Two federal governments, eight states, two provinces, several First Nations, and many native tribes work together in a series of international agreements, treaties, and commissions to manage the Region's land, mineral, water, and living resources (Box 3).

The Region has its share of environmental, socioeconomic, and human-health concerns. The Region is home to pristine natural areas and to highly contaminated sites. Like the rest of the United States, the Region is experiencing expanding population growth along its coasts. This growth has resulted in intensive shoreline development, loss of open space, and other land-use changes that are having major, often adverse, impacts on the landscape and on the natural resources that are essential to the socioeconomic and environmental well-being of the Region. This growth and its consequences pose formidable challenges to managers who must balance the many competing interests.

Although scientific and technical achievements in the Region have been notable (for example, the cleanup of Lake Erie and the identification of the effects of emerging contaminants on wildlife reproduction), much of the research has been fragmented and isolated. Numerous government agencies, universities, nongovernmental organizations, and citizen groups have conducted scientific studies related to environmental and natural-resources issues in the Region. Despite the billions of dollars spent to improve the quality of the Great Lakes ecosystem, the long-term effects of human activities on natural systems remain largely unknown. Many fundamental processes are unmeasured or poorly understood. New and emerging issues arise from technological advances in society, and these emerging issues often require new approaches and methods of investigation, along with increased funding. More than ever, there is an urgent need for the understanding derived from science to help unravel the complexities of natural systems and human impacts as listed below.

- What are the long-term effects in the Great Lakes-St. Lawrence Region of population growth and demographic shifts with their associated development, resource use, and land-use changes?
- How can the Region sustain wise economic development while maintaining ecosystem integrity and protecting human health?
- What are the effects of human-induced and natural stressors? Can they be controlled, minimized, or made beneficial?
- Are regulatory controls appropriate to achieve desired outcomes, and are they adequately supported by scientific data?

The key to answering these and similar questions is to understand the linkages between past and present geologic, hydrologic, biologic, geographic, and demographic processes and then project this knowledge into the future. Knowledge about past and present geologic framework and earth-system processes, when integrated with studies of human health, land use, and development activities, can equip decisionmakers and others with improved tools to guide policy development and natural-resources management.

The combination of its international position, unique attributes, common issues, and the need for scientific guidance in resource-management and policy decisions makes the Great Lakes-St. Lawrence Region an ideal area for an integrated, regional science program. The National Research Council (2001) recommended that "The USGS should place more emphasis on multi-scale, multidisciplinary integrative projects that address priorities on a national scale." The integrated-science approach was adopted in the USGS Strategic Direction for 1999-2005 (U.S. Geological Survey, 1999).

In undertaking an integrated-science approach, the USGS recognizes that the application of "earth system science" (Box 4) is an essential, but missing component of many otherwise useful and informative programs and projects. The basis for this new strategic vision in the Great Lakes Region is that an integrated-science approach will enhance the utility and impact of USGS science.

Box 2. The Great Lakes-St. Lawrence Region

The Great Lakes-St. Lawrence Region is home to a global-scale economic resource, the five Great Lakes and St. Lawrence River. The lakes contain about 6 quadrillion gallons of water. The St. Lawrence River is the second largest continental river system in North America, exceeded in magnitude only by the Mississippi River. The area of the Great Lakes in the United States is 94,000 square miles, which constitutes about 32 percent of the 295,000 square-mile watershed. The northern coastline of the Great Lakes in the United States is 10,900 miles long—about 44 percent of the circumference of the Earth. Michigan's coastline is longer than the coastline in every other state except Alaska. More than 31 million people—about 12 percent of the population of the United States —live in the watershed. More than 90 million people live in the states and provinces of the region—about one-quarter of the population of North America. Most people near the Great Lakes drink and use water from the lakes, the St. Lawrence River, or the connecting channels, and most livelihoods depend directly or indirectly on the economic and transportation resources of the lakes. The Great Lakes States produce more than 33 percent of the national manufacturing output, including 70 percent of the steel. Some of the Nation's most abundant sand and gravel resources are within the Region. Fishing, recreation, and tourism are multibillion-dollar industries. In Michigan alone, recreation and tourism had an estimated annual value of $14 billion (U.S.) in 1996. The Great Lakes-St. Lawrence Region has a world-class maritime transportation system and about one-quarter of the Nation's rail and interstate miles. Agriculture is a major industry and includes production of fruit, specialty crops, and 45 percent of the Nation's corn.

The Great Lakes-St. Lawrence Region is geographically and ecologically diverse. Continental glaciers deeply excavated the lake basins from 12,000 to 20,000 years ago and covered the rest of the Region with complex deposits ranging in size from boulders and cobbles to sand, gravel, silt, and clay. Locally, these deposits can exceed 1,000 feet in thickness. Many productive aquifers are within these thick glacial deposits. Pristine natural areas are common in the northernmost watersheds of the upper lakes. The Lake Superior Basin contains four of the seven Great Lakes National Parks and Lakeshores. The watersheds of the lower lakes are predominantly working landscapes. The U.S. part of the basin is 52 percent forested and 35 percent agricultural. Urban and residential areas make up only 7 percent of the land; however, most major urban areas, including Duluth, Milwaukee, Chicago, Detroit, Toledo, Cleveland, Buffalo, Rochester, Toronto, and Montreal, are concentrated on lakeshores. Twelve National Wildlife Refuges in the Great Lakes States serve as critical nesting areas for migratory waterfowl. The lakes host a total of about 120 native fish species and 40 native mollusk species. Nearly all fish species depend on tributary streams, coastal wetlands, and nearshore shallow-water habitats during some part of their life cycle.

Box 3. Governing Agreements

Protection of the Great Lakes ecosystem is guided by binational agreements and by treaties with Indian tribes. The Boundary Waters Treaty of 1909 between the United States and Canada was created to regulate the shared use of water in the Great Lakes and St. Lawrence River. The Boundary Waters Treaty led to the creation of the International Joint Commission. The Great Lakes Fishery Convention of 1954 created the Great Lakes Fishery Commission. U.S. and Canadian federal, state, provincial, and tribal agencies coordinate their activities through the Great Lakes Fishery Commission to achieve stable, self-sustaining stocks in a healthy aquatic ecosystem. The Great Lakes Basin Compact of 1955 established the Great Lakes Commission and charged it with information sharing, policy development, and advocacy responsibilities for the eight Great Lakes States and the larger international community. Recently, the Provinces of Ontario and Quebec have joined the Great Lakes Commission. The Great Lakes Water Quality Agreement of 1978 and amendments of 1987, as part of the Boundary Waters Treaty, commit the United States and Canada to "restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem." The 1985 Great Lakes Charter and the amendment, Annex 2001, signed by the Great Lakes Governors and Premiers in June 2001, establishes a mechanism among the states and provinces for decisionmaking on water use and diversion in the Region. More than 40 Federally recognized Indian tribes in the Great Lakes States have hunting and fishing rights in the lakes and on adjacent lands under various treaties.

Box 4. Earth System Science

"Earth system science (ESS) takes the main components of planet Earth – the atmosphere, oceans, freshwater, rocks, soils, and biosphere – and seeks to understand major patterns and processes in their dynamics. To do this, we need to study not only the processes that go on within each component (traditionally the realms of oceanography, atmospheric physics, and ecology, to name but three), but also interactions between these components. It is the need to study and understand these between-component interactions that defines ESS as a discipline in its own right." (Lawton, 2001).

Lake Michigan

Photo by Robert De Jonge

The USGS is the natural-science agency that serves the Nation by providing reliable scientific information to:

- describe and understand the Earth
- minimize loss of life and property from natural disasters
- manage water, biological, energy, and mineral resources, and
- enhance and protect our quality of life

The USGS neither administers regulatory programs nor manages land or water resources. Because the USGS is one step removed from a regulatory and resource-management mission, the USGS is able to provide unbiased data and information for natural-resources decisionmaking.

The USGS takes its mission from several mandates and authorizations at the national level (Box 5). These mandates are directly applicable the work of the USGS in the Great Lakes-St. Lawrence Region. The Organic Act of 1879 (amended in 1962) established the USGS and directs the USGS to classify public lands and examine the geological structure, mineral resources, and products within and outside the national domain.

Natural and human-induced stresses, particularly those related to population growth and demographic shifts, will continue to put pressure on the resources and ecosystems of the Great Lakes-St. Lawrence Region. The USGS, in collaboration with its cooperators, stakeholders, partners and the public intends to develop the scientific information and tools to help anticipate and evaluate these pressures and predict the changes that they will induce. USGS work in the Great Lakes-St. Lawrence Region will address five broad societal issues:

- ecological health and integrity
- sustainable development
- human health
- natural hazards and risk
- scientific information transfer

Nested within the five broad societal issues are more specific issues that require natural-science information.

Stakeholder input from liaison committees is a critical component of USGS project and program planning.

Box 5. USGS Authorities and Programs

Geography Discipline: The USGS National Mapping Program supports mapping data collection and integration, earth science information management and delivery, and geographic research and applications. As the lead Federal agency for civilian mapping, the USGS develops and produces maps and geospatial data of elevation (topography), land cover, hydrography (water), geopolitical boundaries, and other natural and socioeconomic features for the entire Nation. These activities are carried out under the authorization of the National Cooperative Mapping Program and the Land Remote Sensing Policy Act. The Great Lakes Shoreline Mapping Act of 1987 directs the National Oceanic and Atmospheric Administration and the USGS to prepare maps of the shorelines areas of the Great Lakes.

Geology Discipline: The USGS supports research in geologic-hazard assessments, geologic-landscape and coastal assessments, and geologic-resource assessments. The National Geologic Mapping Act established a National Cooperative Geologic Mapping Program to determine the Nation's geologic framework through systematic development of atlases and geologic maps at scales appropriate to the geologic setting and the perceived applications. The Geologic Landscape and Coastal Assessments Program includes the Coastal and Marine Program, which includes the Great Lakes, and is charged with conducting studies within the U.S. Exclusive Economic Zone (EEZ). The USGS, through the U.S. Global Change Research Program, is working to promote an understanding of global climate change, including the cumulative effects of human activities and natural processes on the environment, and to promote discussions toward international protocols in global-change research.

Biology Discipline: The USGS supports biological research and monitoring, biological information management and delivery, and cooperative research units. Research into fish and wildlife resources and wildlife health is undertaken through agreements with the U.S. Fish and Wildlife Service and other Interior bureaus. The USGS conducts fisheries research, fish-stock assessments, and research into sea lamprey control through the Great Lakes Fishery Commission under the authority of the Great Lakes Fishery Act. The USGS researches ways to prevent and control invasions of aquatic nuisance species through the Nonindigenous Aquatic Nuisance Prevention and Control Act. The USGS administers cooperative research and training programs for fish and wildlife resources with colleges and universities through the Fish and Wildlife Improvement Act.

Water Resources Discipline: The USGS supports water-resources assessment and research, water-data collection and management, cooperative water-resources investigations, and the Water Resources Research Program. As part of water-data collection and management, USGS collects hydrologic data to support the Chicago diversion from Lake Michigan into the Illinois River by way of the Chicago Ship and Sanitary Canal. The National Water-Quality Assessment Program sponsors two studies in the Region, one in the Western Lake Michigan Drainages and the other in the Lake Erie-Lake Saint Clair Drainages. Another recent activity was the creation of the National Streamflow Information Program. The Cooperative Water Program has authority from the Organic Act and provides for a match between federal and other public funds to assess the quantity, quality, and movement of surface- and ground-water resources. The Water Resources Research Act charges the USGS to administer a Water Resources Research Program to provide grants for research to scientists at colleges and universities.

Ecological Health and Integrity

The Strategic Vision embodies principles similar to those of other organizations in the Region; that is, to enhance and restore ecological health and integrity and to foster a high-quality environment to sustain an expanding human population and economy. Similarly, the overall objective of the Great Lakes Water Quality Agreement between the United States and Canada is " . . . to restore and maintain the chemical, physical, and biological integrity of the Great Lakes Basin Ecosystem" (International Joint Commission, 1978). The vision statement of the Great Lakes Fishery Commission includes promotion of healthy Great Lakes ecosystems (Great Lakes Fishery Commission, 2001). Shared visions such as these are spread across the Great Lakes-St. Lawrence Region and have resulted in the adoption of a multidisciplinary ecosystem approach by many resource-management agencies. By definition, "A living system exhibits integrity if, when subjected to disturbance, it sustains an organizing, self-correcting capability to recover toward an end-state that is normal and 'good' for that system. End-states other than the pristine or naturally whole may be taken to be normal and 'good.' " (Regier, 1993). Striving for environmentally sustainable economic development requires a better understanding of natural- and human-induced factors affecting ecosystem quality because all earth-surface systems are dynamic.

Specific issues that can be addressed with an integrated science approach include the following:

- ecological effects of water use, diversion, and lake-level regulation;
- ecological effects of drainage practices and shoreline hardening;
- causes of destabilized fish communities and restoration of native fish species;
- introduction and spread of terrestrial and aquatic invasive species to the Great Lakes and their tributaries, to inland lakes, and to wetlands and other natural areas;
- losses of critical native plant communities, wildlife habitat, and biodiversity;
- loss and degradation of wetlands; and
- need for a comprehensive ecosystem-restoration strategy.

Resource managers require assistance from the scientific-research community to determine the course and effectiveness of projects and programs to address these issues and, ultimately, to achieve ecosystem integrity in the Region. The USGS work on ecosystem health and integrity will focus on—but not be limited to—the following areas: (1) research and assessment of fisheries and aquatic resources of the open lakes and nearshore areas, (2) new investigations of benthic substrate type and aquatic communities and productivity, (3) research on invasive species and control measures, (4) assessment of biodiversity on land and in water, and (5) research on wetland quantity, quality, function, and restoration.

USGS measures and reports streamflow conditions at several hundred sites on Great Lakes tributaries.

Sustainable Development

Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987, p. 43). Sustainable development embraces numerous issues associated with how a region will encourage its economic development and accommodate its population growth while maintaining ecological health and integrity. Water availability and use, particularly consumptive use, has become a major issue in the Region. Demands on ground-water supplies have increased, as have demands for construction materials (sand, gravel, crushed stone) required to build and sustain infrastructure, and demands for mechanisms to safely dispose of or recycle human and industrial waste on land. Pressures on fisheries and other aquatic resources, and changes in aquatic habitat have further stressed the ecosystem that sustains the Region's economy. Despite increasing pressure to urbanize lands that now support other uses, such as prime farmlands and forestlands, there is a growing desire to sustain a livable environment that includes a safe place to live, suitable employment, adequate recreation and education, a healthy ecosystem, and an esthetically nurturing setting. Some of these issues overlap with other topic areas. Specific issues that can be addressed through integrated science include the following:

- increased withdrawal and consumptive use of Great Lakes water—from the lakes, their tributaries, and ground water in the drainage basin;
- linkages between water withdrawals, the movement of water between streams, lakes, and ground water, and variations in lake levels;
- pressures from urban and suburban sprawl, loss of prime agricultural and forest lands, and restricted land-use options resulting from unplanned or poorly planned development;
- effects of new residential and second-home development on riparian forests, on shoreline erosion, and on estuarine and nearshore water quality;
- availability and location of building resources such as sand, gravel, and crushed stone and effects of extraction on natural diversity and ecosystem health;
- decreased beach nourishment resulting from dams on tributary streams and from shoreline armoring;
- linkages between land-use practices and water quality; and
- environmental quality and land-use history as they effect redevelopment of urban Brownfield areas.

USGS activities in the area of sustainable development will focus on—but not be limited to—the following areas: (1) natural resources, particularly water and aquatic resources; (2) patterns of resource use and waste disposal; (3) patterns of land use, including land-use change from historical to current and current to future uses; (4) effects of natural-resource extraction and use; and (5) decision-support systems for modeling resource-use alternatives.

Human Health

Many chronic health issues may be directly related to earth processes and the environment. The USGS can play a significant role in understanding environmental contributions to diseases and

human health through a more complete understanding of where, when, and how people are exposed to naturally occurring or anthropogenic contaminants that are mediated by natural processes. Specific issues that can be addressed through integrated science include the following:

- vulnerability of beaches to contamination from sewage overflows and nonpoint sources of microbial contamination;
- persistent chemical contaminants in water, streambed sediments, and wildlife, and the associated effects on human and wildlife health;
- vulnerability of the open lakes to atmospheric deposition of chemical contaminants;
- contamination of surface-water and ground-water sources of drinking water by pathogens and other contaminants associated with common land-use and water-management practices; and
- contamination of ground water used for public and domestic supply by naturally occurring substances, such as arsenic.

USGS work on human health will focus on—but not be limited to—the following areas: (1) microorganisms in natural areas, such as beaches, and in source waters for public and domestic water-supply systems; (2) enhanced understanding of emerging contaminants; (3) human exposure to potentially toxic substances in the environment; (4) use of GIS to identify landscape features that pose disease risks and hazards; (5) occurrence and transmission of significant forms of disease among wildlife and humans; and (6) naturally occurring pathogenic metals and chemical compounds and their relation to land and water use practices.

Natural Hazards and Risk

Natural hazards in the Great Lakes-St. Lawrence Region include coastal erosion, floods, earthquakes, subsidence, and landslides. The changes resulting from these hazards, which are sometimes gradual and other times catastrophic, are a threat to public safety, well-being, and economic viability. Specific issues that integrated science can address include the following:

- floods, droughts, losses or reductions of winter ice cover, and other extreme hydrologic responses to changing climate;
- erosion, sedimentation, and impacts to public safety and property from natural coastal processes; and
- effects in the coastal zone from lake level changes due to natural variability and human intervention.

USGS studies related to natural hazards and risk will focus on — but not be limited to — the following areas: (1) better understanding of the frequency, distribution, origin, and impacts of these hazards; (2) local and regional susceptibility to natural climatic and human-induced change; (3) risks that these hazards pose to humans and to natural ecosystems; and (4) development of predictive models that will help managers safeguard public safety and reduce economic loss.

Scientific Information Transfer

The data that USGS collects and interprets, and additional information based on the data, must be rapidly disseminated to meet the needs of decisionmakers. The customers for USGS information in the Region include lawmakers, regulatory authorities, management agencies, scientists, nonprofit organizations, private industry, and the general public. Specific information-transfer issues that USGS can address include the following:

- need for standardized base maps of the Region for use by partners, cooperators, and the public;
- need for derivative products from data sets and maps made in cooperation with cooperators, partners, and stakeholders;
- need to assemble, analyze, and interpret vast amounts of existing data from within and outside USGS to lay a foundation for new products;
- need for simple, user-friendly decision-support tools for all aspects of natural-resources management; and
- need for faster and more efficient transfer of data and information to cooperators, partners, stakeholders, and the public.

Each of the end-users of these data will require targeted products for the information to be most beneficial. For example, management and regulatory agencies will require easily accessible data in useful formats. Scientists and resource managers will benefit from coordinated monitoring approaches and interpretive reports. Nonprofit organizations and the public will need to understand how the resources are changing and how they can contribute to improving the situation. All USGS work in the Great Lakes-St. Lawrence Region will have identified customers and targeted products.

USGS studies related to scientific information transfer will focus on — but not be limited to — the following areas: (1) continued improvement in the efficiency and speed of information transfer; (2) development of user-friendly decision-support tools; and (3) development of standard products, such as base maps and other maps of the Region, in cooperation with the end-user.

USGS research on the open waters of the lakes contributes to the wise management of the fishery.

THE STRATEGY

The strategy for the Great Lakes-St. Lawrence Region describes how the USGS will (1) develop, refine, and communicate a Strategic Vision for the USGS; (2) establish program coordination; (3) develop an integrated scientific program; and (4) develop targeted products and packaging to meet customer needs. The approach the USGS will take builds upon the current work being done by the USGS in the Region and upon the new work proposed to start within the next 10 years. An initial 5-year science plan will be developed. The science plan will place emphasis on near-term technical efforts based on the most critical issues in the Region and the needs of USGS partners and stakeholders

An initial 5-year communication plan will be developed that considers current USGS and external–organization outreach efforts and provides an approach to meet the Government Performance and Results Act (GPRA) information needs. The communications plan will consider USGS directives, will develop USGS and Department of Interior support, and will evaluate the results of the Strategic Vision.

Critical Success Factors and Strategic Objectives

The USGS envisions three Critical Success Factors that are essential for achieving the goals of the Strategic Vision. Strategic Objectives, which are listed below each Critical Success Factor, are seen as necessary to achieve the Critical Success Factors.

Critical Success Factor 1: Coordinate activities of the USGS internally and with external organizations to support the science needs of natural-resource managers in the Region.

Strategic Objective 1: Establish a coordination mechanism that integrates activities of all USGS offices with regard to work in the Great Lakes-St. Lawrence Region.

Strategic Objective 2: Continually enhance coordination of USGS efforts with existing Great Lakes organizations.

Critical Success Factor 2: Establish a scientific program that meets the management and restoration needs of the Region and focuses on the unique strengths of the USGS.

Strategic Objective 1: Determine scientific needs and issues of the Great Lakes Region that USGS can address, including research of fundamental science questions and applied science.

Strategic Objective 2: Develop integrated 5-year science plans for USGS activities in the Great Lakes-St. Lawrence Region.

Critical Success Factor 3: Ensure timely production and efficient distribution of relevant, unbiased data, results, and information to meet the needs of USGS customers, stakeholders, and partners.

Strategic Objective 1: Determine product needs and distribution issues of the users of USGS data and information in the Great Lakes-St. Lawrence Region.

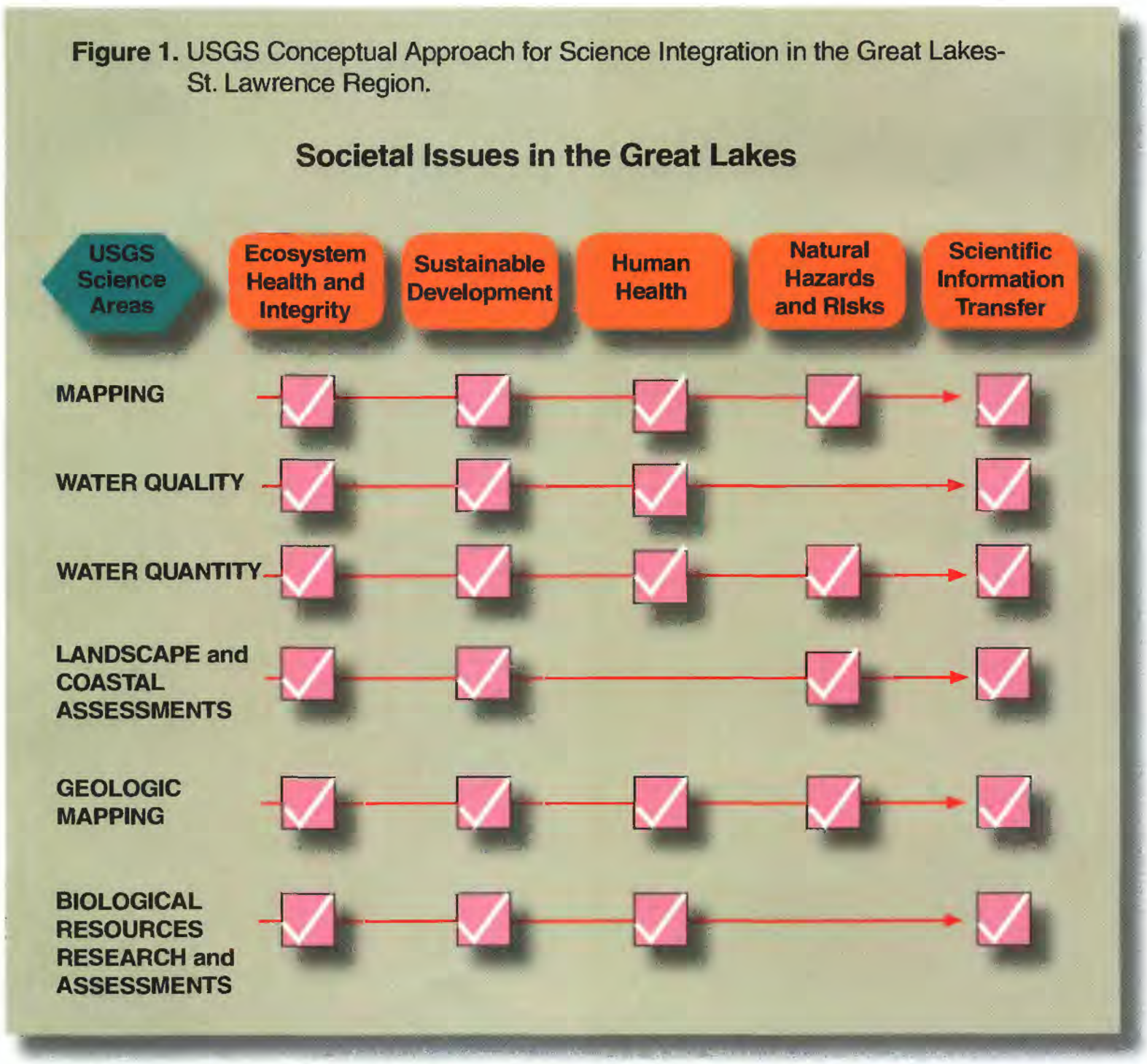
Strategic Objective 2: Develop an effective communications plan.

Current and future USGS integrated science will focus on the five broad societal issues identified in this document, through combined program and scientific activities that will further the USGS mission and vision for the Region. Although specific activities that will be undertaken to achieve integrated science are not included in this Strategic Vision, it is assumed that they will be developed and carried out over the next 10 years.

USGS national programs can respond to regional needs through their program activities. The USGS supports more than 25 national programs within the biology, geography, geology, and water-resources disciplines. The focus of these programs can be linked to the five societal issues identified in this document. The areas of overlapping science activities under each of the societal issues are areas where programs can be integrated (fig. 1).

There are societal issues in the Great Lakes, such as those related to coastal change, that overlap with only one or a few USGS national programs. In these areas, new science activities for the Great Lakes may be needed and can be pursued by various mechanisms including cooperative programs, reimbursable programs, and potentially, new Bureau-level programs.

Figure 1. USGS Conceptual Approach for Science Integration in the Great Lakes-St. Lawrence Region.



Relation to Other Great Lakes Programs

The Strategic Vision is intended to sharpen the focus of USGS activities in the Great Lakes-St. Lawrence Region and foster the coordination and integration of such activities within and outside of USGS. The USGS and individual scientists within the organization must be aware of, and build on, ongoing efforts to ensure success of the Strategic Vision. Specifically, when developing priorities and science plans, the USGS will consider how the plans of the major USGS programs match with plans of other organizations and agencies in the Great Lakes-St. Lawrence Region. Input from other Federal, Tribal, First Nation, State, local agencies, and nongovernmental programs, as well as from Canadian federal and provincial programs, will be sought out so that USGS activities will complement and contribute to the work of other key organizations. Involvement by partners and consultation with cooperators early in the planning process for USGS science initiatives and programs will ensure that partners and customers can contribute to product development. Communication of scientific information, after it is developed, is a critical element of the Strategic Vision.

The USGS will ensure that the organization's scientists are familiar with and, where appropriate, are engaged in the work of key Regional organizations and commissions. At the international level, such organizations include, but are not limited to, the International Joint Commission, the Great Lakes Fishery Commission, Environment Canada, the Provinces of Ontario and Quebec, and Tribes and First Nations. U.S. Federal agencies include the U.S. Fish and Wildlife Service, the National Park Service, the Bureau of Indian Affairs, the Bureau of Reclamation, the U.S. Environmental Protection Agency, the National Oceanic and Atmospheric Administration, the U.S. Army Corps of Engineers, the U.S. Department of Agriculture, the Federal Highway Administration, the Midwest Natural Resources Group, and the Agency for Toxic Substances and Disease Registry. State and regional agencies include the Central Great Lakes Geologic Mapping Coalition, and the environmental and natural resources agencies of state, county, and municipal governments. Regional and nongovernmental organizations include the Great Lakes Commission, the Great Lakes Fishery Commission, the Council of Great Lakes Governors, the Great Lakes Protection Fund, and The Nature Conservancy. With these programs and organizations in mind, scientists from all areas of USGS who work in the Region will be able to establish effective partnerships and develop research priorities that meet the needs of those responsible for developing policy and making resource-management decisions for the Great Lakes-St. Lawrence Region.

USGS and state geologists map the glacial deposits of the Great Lakes Region to support sustainable development.

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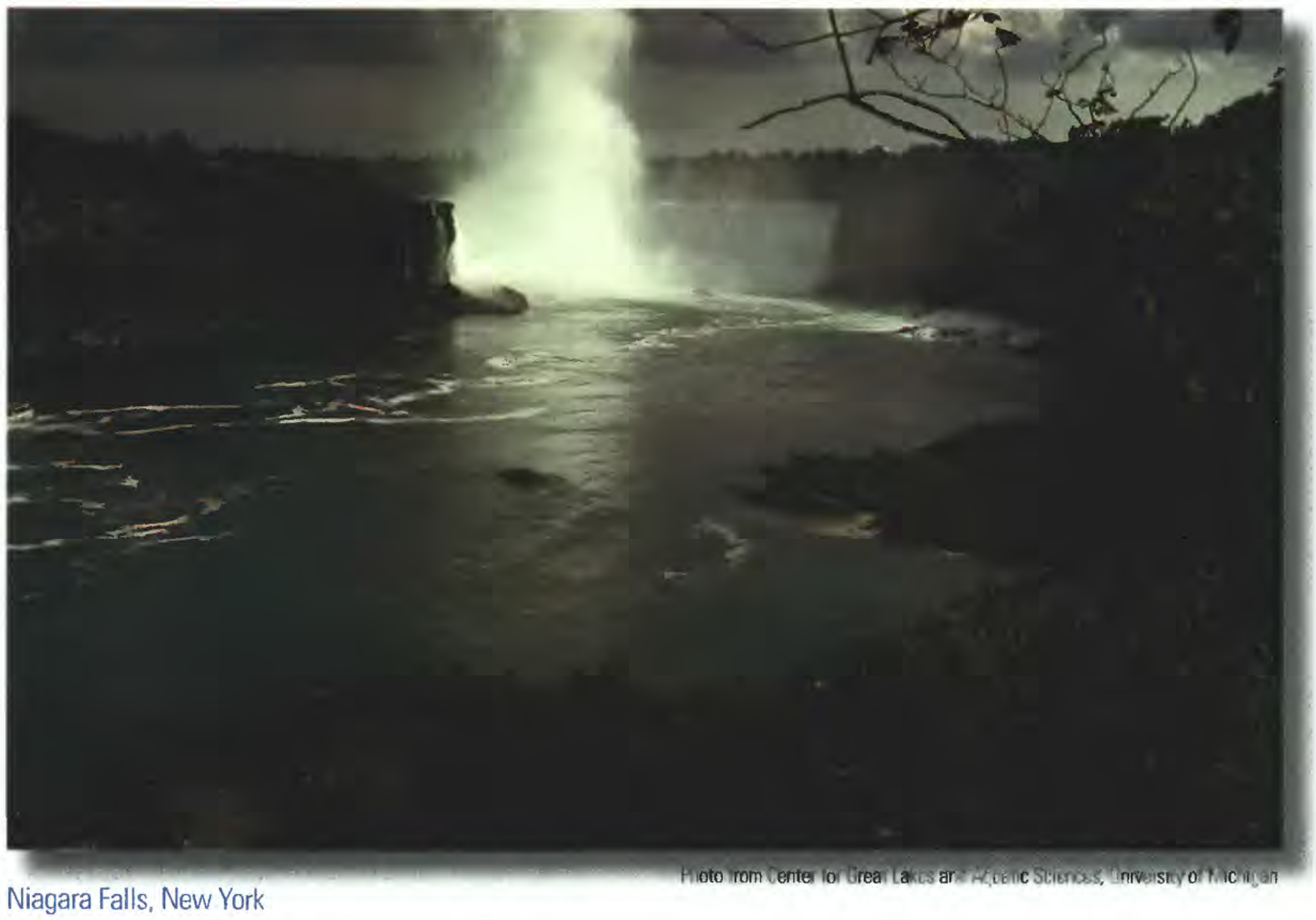

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