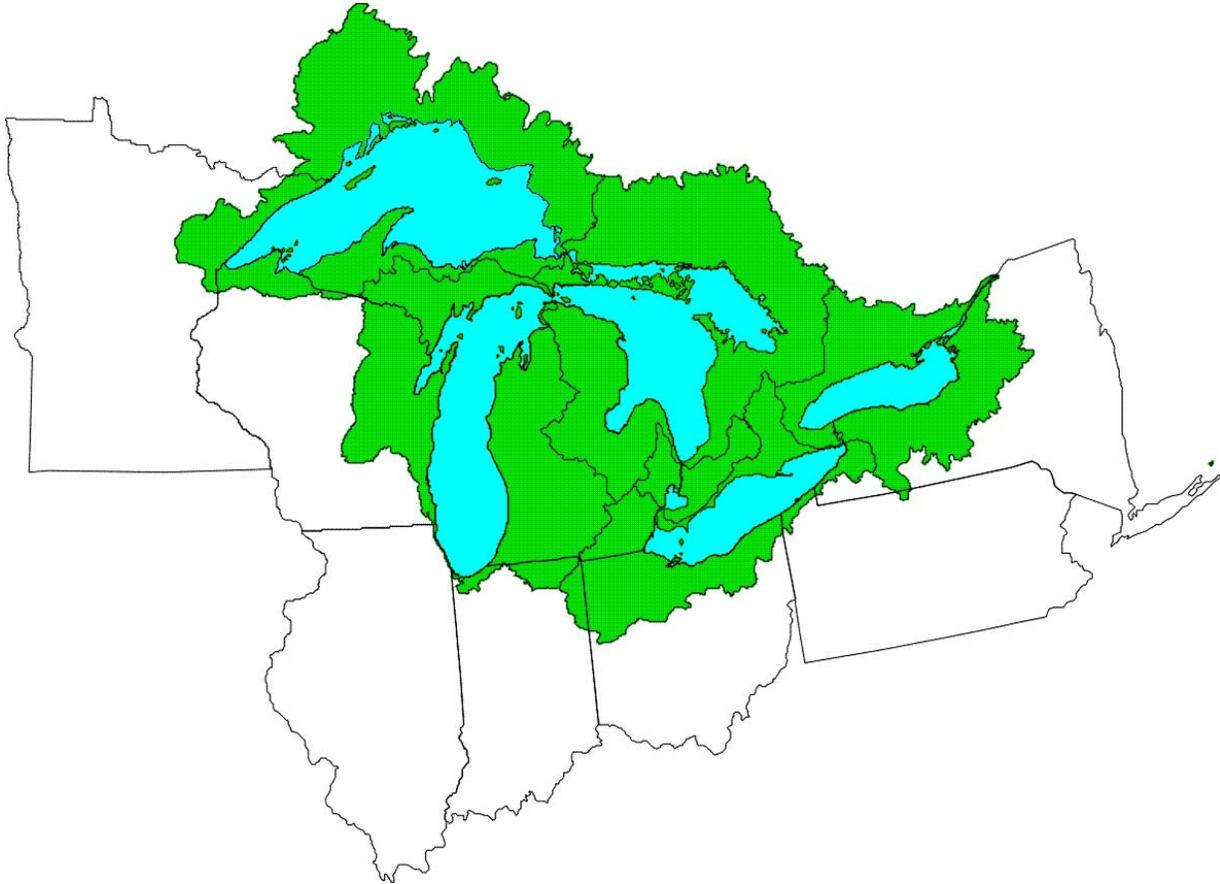


John Glenn Great Lakes Basin Program Strategic Plan

In response to Public Law 106-53, Water Resources Development Act of 1999,
Section 455(a), John Glenn Great Lakes Basin Program,

Main Report – Final Draft



April 2005



US Army Corps
of Engineers®

John Glenn Great Lakes Basin Program – Strategic Plan

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List of Acronyms

ANS	aquatic nuisance species
AOC	Area of Concern
APCR	aquatic plant control research
ARCS	Assessment and Remediation of Contaminated Sediments
BIA	Bureau of Indiana Affairs
BMP	Best Management Practice
BTS	Binational Toxics Strategy
CAP	Continuing Authorities Program
CCS	Challenge Costshare
CDF	confined disposal facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CG	Construction General
Coop Program	Cooperative Water Program
CSC	Coastal Services Center
CSD	Commission on Sustainable Development
CSO	combined sewer overflow
CWA	Clean Water Act
CWP	Clean Water Partnership
CZARA	Coastal Zone Act Reauthorization Amendments
CZM	Coastal Zone Management Program
CZMA	Coastal Zone Management Act of 1972
D9	Ninth Coast Guard District
DDT	dichlorodiphenyltrichloroethane
DNR	Department of Natural Resources
DOER	Dredging Operations and Environmental Research
DOI	Department of the Interior
DOTS	Dredging Operations Technical Support
EPA	Environmental Protection Agency
EWP	Emergency Watershed Protection Program
FCA	Flood Control Act
FEMA	Federal Emergency Management Agency
FMA	Flood Mitigation Assistance
FUSRAP	Formerly Utilized Sites Remedial Action Program
FWS	Fish and Wildlife Service
FY	fiscal year
GAO	U.S. General Accounting Office
GDP	gross domestic product
GI	General Investigations
GIS	geographic information systems
GLC	Great Lakes Commission
GLERL	Great Lakes Environmental Research Laboratory
GLNPO	Great Lakes National Program Office
GLPF	Great Lakes Protection Fund

GLWQA	Great Lakes Water Quality Agreement
H.Doc.	House Document
H.Ex.Doc.	House Executive Document
HMGP	Hazard Mitigation Grant Program
HR	House Resolution
IJC	International Joint Commission
IL-DNR	Illinois Department of Natural Resources
ISLRBC	International St. Lawrence River Board of Control
IWS	International Water Studies
LaMPs	Lakewide Management Plans
LCR	Landscape Characterization and Restoration Program
LERRD	lands, easements, rights-of-way, relocations, and disposal
LWD	low-water datum
MI-DEQ	Michigan Department of Environmental Quality
MOU	Memorandum of Understanding
MPCA	Minnesota Pollution Control Agency
NACD	National Association of Conservation Districts
NAISA	National Aquatic Invasive Species Act
NANPCA	Nonindigenous Aquatic Nuisance Prevention and Control Act
NAWQA	National Water Quality Assessment Program
NFIP	National Flood Insurance Program
NFWF	National Fish and Wildlife Foundation
NGO	non-governmental organization
NISA	National Invasive Species Act
NMFS	National Marine Fisheries Service
NOBOB	no-ballast-on-board
NPL	National Priorities List
NPS	nonpoint source
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRCS	Natural Resources Conservation Service
NYSDEC	New York State Department of Environmental Conservation
O&M	Operation and Maintenance
OMB	U.S. Office of Management and Budget
OMOE	Ontario Ministry of Environment and Energy
PBDE	polybrominated diphenyl ester
PCB	polychlorinated biphenyl
PDF	Declaration of Partnership
PFOS	perfluorooctanyl sulfonate
PL	public law
POS	Plan of Study
PRP	potentially responsible party
RAP	Remedial Action Plan
RC&D	Resource Conservation and Development Program
R&D	research and development
RHA	River and Harbor Act

S.Doc.	Senate Document
SDWA	Safe Drinking Water Act
SFO	Support For Others
SLSDC	Saint Lawrence Seaway Development Corporation
SOLEC	State of the Lakes Ecosystem Conference
SR	Senate Resolution
SRF	State Revolving Fund
SSO	sanitary sewer overflows
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TFM	3-trifluoromethyl-4-nitrophenol
TMDL	total maximum daily load
TNC	The Nature Conservancy
UCS	Union of Concerned Scientists
UN	United Nations
US	United States
USC	U.S. Code
USDA	U.S. Department of Agriculture
U.S. EPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WAWTAP	Wind and Water Technical Assistance Program
WIN	Water Infrastructure Network
WOTS	Water Operations Technical Support
WRDA	Water Resources Development Act
WY	Water Year

1. Study Authority

In 1999, the United States Congress established a program titled the John Glenn Great Lakes Basin Program under Section 455 of WRDA 1999. Under this program, Congress asked the U.S. Army Corps of Engineers to better define and understand Great Lakes water resources issues and to develop a *Great Lakes Strategic Plan* to address current and emerging regional needs. Among the more salient issues are the following seven major challenges identified by Congress in Section 455(a) of the Act:

1. Maritime Transportation;
2. Navigation Infrastructure for Recreational Vessels;
3. Environmental Restoration;
4. Water Level Control;
5. Technical and Planning Assistance to States and Remedial Action Planning Committees;
6. Sediment Transport Analysis and Management Planning for Prevention of Excess Sediment Loadings; and
7. Flood Damage Reduction and Shoreline Erosion Prevention.

This study focused primarily on the last five of these seven challenges. Maritime transportation and navigation infrastructure for recreational vessels – equally significant considerations – are addressed in detail in complementary projects authorized in WRDA 1999.

2. Study Purpose and Scope

The Great Lakes-St. Lawrence system holds six quadrillion gallons of fresh water; one-fifth of the world's fresh surface water (only the polar ice caps and Lake Baikal in Siberia contain more) and 95 percent of the U.S. supply. This vast freshwater basin is not only impressive because of its sheer size and natural beauty; it also holds the key to the economic prosperity, environmental health, and quality of life of tens of millions of basin residents.

A significant fraction of the U.S. gross domestic product (GDP) – over \$150 billion in goods – is generated annually in the Great Lakes region. The region owes this global significance largely to the Great Lakes freshwater system. The region's vast and easy-to-access water supply, along with trading possibilities of a waterborne transportation system, have fostered the it's development and prosperity. Today, the lakes continue to serve as commercial waterways; supply water for agricultural, municipal, and industrial use; and provide numerous opportunities for outdoor recreation and tourism.

The Great Lakes- St. Lawrence system is rich and diverse, providing fish and wildlife habitat, shaping weather and climate, and supplying drinking water to some 40 million residents in the U.S. and Canada. Its chemical and biological integrity is essential to the environmental health and quality of life not only for today's residents but also for future generations. Yet, a legacy of misuse and abuse has revealed how vulnerable the Great Lakes ecosystem is – some three decades ago the state of the Great Lakes was so dire that portions were declared “dead or dying.” Since then, policies were put into action and the Great Lakes have come a long way toward recovery. Today, we understand that the health, economic prosperity and quality of life of future generations will depend on our individual and collective efforts to manage this complex ecosystem in a scientifically sound, well-focused manner.

3. Location of Study and Congressional Districts

The area encompassed by this study focused on the Great Lakes basin, comprised of the five Great Lakes, their connecting channels, and associated drainage area. Additionally, the St. Lawrence River, as a vital component of the Great lakes-St. Lawrence navigation system is addressed as well. Jurisdictions within this area include: the following U.S. states Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, and the Canadian provinces of Québec and Ontario.

The report area lies within the jurisdiction of the following Congressional Districts:

a. For the U.S. Senate:

- Illinois: Senator Richard J. Durbin (D)
Senator Barack Obama (D)
- Indiana: Senator Richard G. Lugar (R)
Senator Evan Bayh (D)
- Michigan: Senator Carl Levin (D)
Senator Debbie Stabenow (D)
- Minnesota: Senator Norm Coleman (R)
Senator Mark Dayton (D)
- New York: Senator Hillary Rodham Clinton (D)
Senator Charles Schumer (D)
- Ohio: Senator Mike DeWine (R)
Senator George V. Voinovich (R)
- Pennsylvania: Senator Arlen Specter (R)
Senator Rick Santorum (R)
- Wisconsin: Senator Herb Kohl (D)
Senator Russell D. Feingold (D)

b. For the U.S. House of Representatives:

Great Lakes U.S. Congressional Districts within Basin

State	District No.	Lake Basin	In-Basin Area, sq. mi.	Percent of District In-Basin	Name
IL	01	Lake Michigan	1.5	1.5	Bobby L. Rush (D)
IL	02	Lake Michigan	21.0	11.2	Jesse Jackson, Jr. (D)
IL	05	Lake Michigan	2.5	4.4	Rahm Emanuel (D)
IL	07	Lake Michigan	6.7	11.6	Danny K. Davis (D)
IL	08	Lake Michigan	22.4	3.4	Melissa L. Bean (D)
IL	09	Lake Michigan	8.7	11.3	Janice D. Schakowsky (D)
IL	10	Lake Michigan	37.0	14.6	Mark Steven Kirk (R)
IN	01	Lake Michigan	351.3	15.9	Peter J. Visclosky (D)
IN	02	Lake Michigan	455.0	12.3	Chris Chocola (R)
IN	03	Lake Erie	842.1	25.6	Mark Souder (R)
IN	03	Lake Michigan	1444.7	43.9	Mark Souder (R)
IN	06	Lake Erie	415.1	7.5	Mike Pence (R)
MI	01	Lake Huron	8868.7	34.6	Bart Stupak (D)
MI	01	Lake Michigan	9030.6	35.2	Bart Stupak (D)
MI	01	Lake Superior	7683.0	30.0	Bart Stupak (D)
MI	02	Lake Michigan	5474.0	100	Peter Hoekstra (R)
MI	03	Lake Michigan	1900.2	100	Vernon J. Ehlers (R)
MI	04	Lake Huron	3126.0	40.9	Dave Camp (R)
MI	04	Lake Michigan	4519.5	59.1	Dave Camp (R)
MI	05	Lake Huron	1772.5	100	Dale E. Kildee (D)
MI	06	Lake Michigan	3402.4	99.7	Fred Upton (R)
MI	07	Lake Erie	1684.7	38.7	John Schwarz (R)
MI	07	Lake Michigan	2670.5	61.3	John Schwarz (R)

MI	08	Lake Erie	372.1	16.2	Mike Rogers (R)
MI	08	Lake Huron	499.1	21.8	Mike Rogers (R)
MI	08	Lake Michigan	1422.4	62.0	Mike Rogers (R)
MI	09	Lake Erie	323.7	100	Joe Knollenberg (R)
MI	10	Lake Erie	1668.3	46.7	Candice S. Miller (R)
MI	10	Lake Huron	1902.5	53.3	Candice S. Miller (R)
MI	11	Lake Erie	404.4	97.2	Thaddeus G. McCotter (R)
MI	11	Lake Huron	11.5	2.8	Thaddeus G. McCotter (R)
MI	12	Lake Erie	160.8	100	Sander M. Levin (D)
MI	13	Lake Erie	107.2	100	Carolyn Cheeks Kilpatrick (D)
MI	14	Lake Erie	121.7	100	John Conyers, Jr. (D)
MI	15	Lake Erie	973.6	100	John D. Dingell (D)
MN	08	Lake Superior	6203.4	20.8	James L. Oberstar (DFL)
NY	22	Lake Ontario	66.7	2.0	Maurice D. Hinchey (D)
NY	23	Lake Ontario	3910.5	28.3	John M. McHugh (R)
NY	23	St. Lawrence R.	1873.5	13.6	John M. McHugh (R)
NY	24	Lake Ontario	2115.0	33.3	Sherwood L. Boehlert (R)
NY	24	St. Lawrence R.	90.6	1.4	Sherwood L. Boehlert (R)
NY	25	Lake Ontario	1603.7	96.7	James T. Walsh (R)
NY	26	Lake Erie	192.0	7.0	Thomas M. Reynolds (R)
NY	26	Lake Ontario	2539.5	92.5	Thomas M. Reynolds (R)
NY	27	Lake Erie	1063.1	57.3	Brian Higgins (D)
NY	27	Lake Ontario	22.6	1.2	Brian Higgins (D)
NY	28	Lake Erie	9.7	1.8	Louise M. Slaughter (D)
NY	28	Lake Ontario	535.2	98.2	Louise M. Slaughter (D)
NY	29	Lake Erie	337.3	5.9	John R. Kuhl, Jr. (R)
NY	29	Lake Ontario	2473.6	43.0	John R. Kuhl, Jr. (R)
OH	05	Lake Erie	5902.1	95.8	Paul E. Gillmor (R)
OH	08	Lake Erie	36.8	1.8	John A. Boehner (R)
OH	09	Lake Erie	1128.5	100	Marcy Kaptur (D)

OH	10	Lake Erie	196.7	100	Dennis J. Kucinich (D)
OH	11	Lake Erie	135.8	100	Stephanie Tubbs Jones (D)
OH	13	Lake Erie	409.0	76.0	Sherrod Brown (D)
OH	14	Lake Erie	1537.4	84.5	Steven C. LaTourette (R)
OH	16	Lake Erie	206.8	11.9	Ralph Regula (R)
OH	17	Lake Erie	307.4	29.7	Timothy J. Ryan (D)
PA	03	Lake Erie	524.0	13.1	Phil English (R)
PA	05	Lake Ontario	96.1	0.9	John E. Peterson (R)
WI	02	Lake Michigan	177.5	4.9	Tammy Baldwin (D)
WI	04	Lake Michigan	111.4	100	Gwen Moore (D)
WI	05	Lake Michigan	578.4	44.4	Jim Sensenbrenner, Jr. (R)
WI	06	Lake Michigan	4168.6	69.3	Thomas E. Petri (R)
WI	07	Lake Michigan	489.8	2.5	David Obey (D)
WI	07	Lake Superior	2928.4	15.1	David Obey (D)
WI	08	Lake Michigan	8383.0	82.9	Mark Green (R)
WI	08	Lake Superior	106.3	1.1	Mark Green (R)

4. Prior Studies, Reports and Existing Water Projects

The Corps is authorized to conduct a number of specific Great Lakes programs as well as numerous local projects in the basin under general or site-specific authorities (see Table 5.1). The overview presented in **Sections A – D** below recognizes the water resources challenges identified in Section 455(a) of WRDA 1999: i) environmental restoration; ii) flood damage reduction and shoreline erosion prevention; iii) navigation; iv) sediment transport analysis and management planning; v) planning assistance and technical support programs; and vi) water level monitoring and management. **Section A** describes specific Great Lakes programs of the Corps. **Section B** surveys continuing authorities, research programs, and other specific Corps authorities used nationwide by the Corps and also for the Great Lakes. The Continuing Authorities Program (CAP) is a group of nine legislative authorities that enable the Corps to plan, design, and construct projects of limited scope and complexity without additional and specific congressional authorization. Appendix C provides additional information on Corps of Engineers program authorities, requirements, and accomplishments. **Section C** provides a comprehensive summary of recent Corps activities in the Great Lakes. **Section D** describes the activities of other federal and state agencies.

Table 5.1. Corps of Engineers water resources programs for the Great Lakes basin.

Program Name	Purpose	Program expenditures (1992–2001)^a
Great Lakes Programs		
Great Lakes Fishery & Ecosystem Restoration	Plan, design, and construct projects to restore Great Lakes fisheries and beneficial uses.	\$66,000
Great Lakes Navigational System	A reconnaissance study of potential capital improvements to optimize the Great Lakes navigation system infrastructure, including locks, dams, harbors, ports, channels, and other related features.	\$579,000
Great Lakes RAPs & Sediment Remediation	Plan, design and construct demonstrations of promising technologies for contaminated sediment remediation.	\$3,667,100
International Water Studies/Surveillance of Northern Boundary Waters	Supports of IJC in a wide variety of technical and scientific studies and technical support roles, including support to the IJC Boards of control, working committees and study boards.	\$44,025,000 ^c
Great Lakes Sediment Transport Models	Develop computer models of sediment loading and transport to Great Lakes tributaries to support state and local conservation and pollution prevention activities.	\$1,493,270
Soo Replacement Lock	Construct a second lock adjacent to the Poe lock at the Soo Lock complex in Sault Sainte Marie, Michigan.	\$4,252,024
Continuing Authorities		
Aquatic Ecosystem Restoration	Plan, design and construct projects to restore and enhance aquatic ecosystems.	\$9,210,400
Aquatic Plan Control	Control of Eurasian watermilfoil and other obnoxious aquatic plant growths.	\$0
Beneficial Use of Dredged Material	Plan, design and construct projects to protect, restore, and enhance aquatic habitat using sediments dredged from federal navigation projects.	\$465,400
Emergency Streambank and Shoreline Protection	Plan, design, and construct projects to protect public facilities and services from streambank and shoreline erosion.	\$11,509,400
Environmental Improvements	Plan, design, and construct projects to restore and enhance aquatic ecosystems at sites impacted by Corps projects	\$15,421,200
Riverine Ecosystem Restoration & Flood Hazard Mitigation	Coordinate local flood damage reduction or riverine and wetland restoration studies with projects that conserve, restore, and manage hydrologic and hydraulic regimes and restore the natural functions and values of floodplains.	\$0
Water Management (Table 5.1 continued)		

Shore Damage Mitigation	Provide mitigation for damages that are caused by federal navigation structures built by the Corps of Engineers.	^b
Shore Protection	Plan, design, and construct projects to restore and protect shores against waves and currents.	\$1,195,000
Small Flood Control Projects	Plan, design, and construct projects to reduce flood damages.	\$13,060,000
Small Navigation Projects	Plan, design, and construct projects to improve navigation.	\$8,715,800
Snagging and Clearing	Plan, design, and construct projects for emergency removal of debris threatening to aggravate flood damages.	\$4,000
Other Construction Authorities		
Environmental Dredging	Plan, design, and construct projects to remove contaminated sediments from areas outside federal navigation channels.	\$716,100
Environmental Infrastructure	Environmental infrastructure projects provide technical solutions to the alleviation of water quality problems. Examples are water supply and storage facilities, wastewater routing and treatment, mitigation of combined sewer overflows, and acid mine drainage.	\$16,412,027
Planning and Technical Support Programs		
Flood Plain Management Services	Provide flood plain information and technical assistance.	\$5,245,200
Planning Assistance to States	Assist planning for use, development, and conservation of water resources.	\$3,891,200
Tribal Partnership Program	Assist planning for use, development, and conservation of water resources.	\$0
Lake Michigan Diversion Accounting	The objective of the program is, in cooperation with the State of Illinois, to make flow measurements, gauge records, make hydraulic and hydrologic computations, including periodic field investigations and measuring device calibrations, necessary to compute the amount of water diverted from Lake Michigan by the State of Illinois and its municipalities, political subdivisions, agencies, and instrumentalities,	\$7,277,200
Ecosystem Restoration Projects		
Chicago Sanitary & Ship Canal Dispersal Barrier	A feasibility study to investigate and identify environmentally sound methods to prevent or reduce the dispersal of non-indigenous aquatic species between the Great Lakes and Mississippi River drainage basins.	\$2,481,100
Research Programs		
Aquatic Nuisance Control Research	The program is producing information on the growth and ecological requirements of problem aquatic plants as well as new biological, chemical, and ecological technologies for their management.	^b
Dredging Operations Environmental Research	DOER supports the Navigation O&M Program. Research is designed to balance operational and environmental initiatives and to meet complex economic, engineering, and environmental challenges of dredging and disposal in support of the navigation mission.	^b

Continuing Authorities (Table 5.1 continued)		
Dredging Operations Technical Support	DOTS provides engineering and environmental engineering support to the O&M mission of the Corps. DOTS provides an envelope structure for dredging-related research programs such as DOER and a platform for technology transfer from such programs to the O&M mission of the Corps.	b
National Shoreline Erosion Control Development and Demonstration Program	This program provides a vehicle by which shore protection devices, designs, and methods can be constructed, monitored, and evaluated. It is geared toward innovative solutions advancing the state-of-the-art in coastal shoreline protection.	b
Regional Sediment Management Demo Program	RSM has the objective to increase collaboration and to improve decision-making regarding issues of planning, development, damage reduction, and resource management in coastal regions. RSM is further intended to provide improved information on environmental, economic, and social consequences of proposed actions and a better understanding of potential tradeoffs.	b
Water Operations Technical Support	WOTS activities include new technologies to solve water quality and related environmental problems resulting from ANS, shoreline erosion, and other impacts related to water resources projects and operations.	b

^aUnless otherwise noted, the funding figures in this column represent federal fiscal year expenditures.

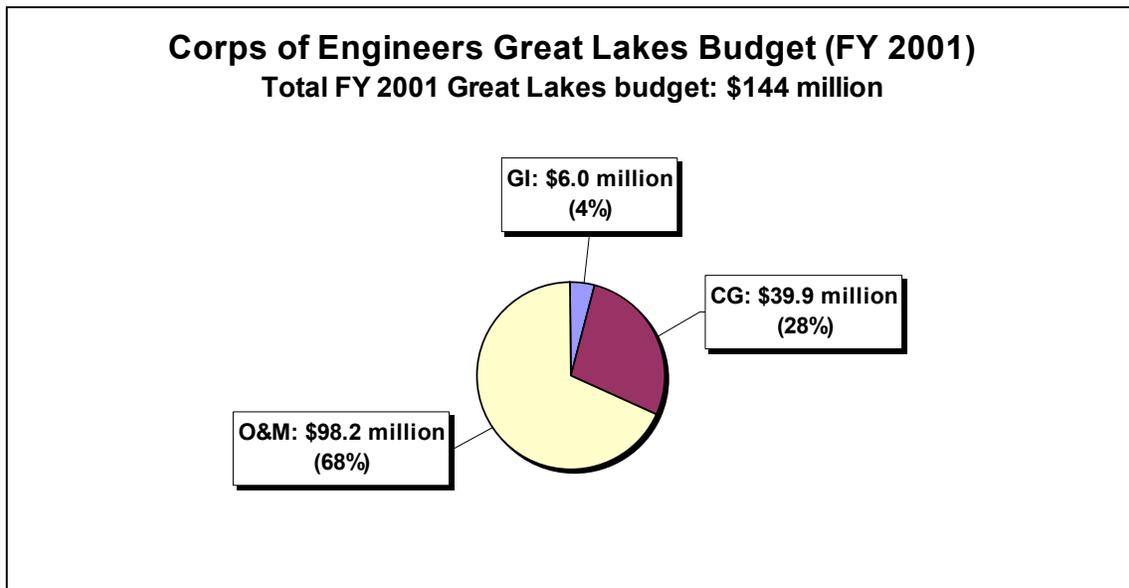
^bNot known for this program.

^cFederal fiscal year expenditures FY 1994 – FY 2002.

The funding mechanism for programs of the Corps of Engineers is quite different from that of most programs of other federal agencies. Unlike most other federal agencies, the Corps of Engineers is not a granting agency offering financial support through grants or loans for specified purposes. Instead, potential non-Federal “partnership” sponsors can request support from the Corps in the form of technical and planning assistance or the construction of specific projects. The Corps then initiates a Federally funded reconnaissance report to determine if a feasibility study, assistance and/or project construction is warranted. The Corps of Engineers conducts feasibility study, Preconstruction Engineering and Design (PED) and project construction work under a cost-sharing agreement, as long as a local sponsor can meet the program-specific cost share and LERRD (lands, easements, rights-of-way, relocations, and disposal) requirements.

The annual Energy and Water Appropriations bill determines the Corps of Engineers national budget. The Corps budget is provided under three major funding categories (see Figure 5.1): General Investigations (GI), which includes planning studies of water resources projects and planning support programs; Construction General (CG), which is for design and construction of new Civil Works projects, including those constructed under continuing authorities as well as specifically authorized projects; and, Operation and Maintenance (O&M), which is for projects that are the continuing responsibility of the Corps.

Figure 5.1. FY 2001 budget of the Corps of Engineers Great Lakes basin districts (Buffalo, Chicago and Detroit)



A. Corps of Engineers Great Lakes Programs and Projects

At the present, the Corps has four Great Lakes-specific programs, one major regional study, and one project of basinwide and national significance:

- Great Lakes Fishery and Ecosystem Restoration (Section 506, WRDA 2000)
- Great Lakes-St. Lawrence Seaway System Review (Section 456, WRDA 1999)
- Great Lakes Remedial Action Plans (Section 401, WRDA 1990)
- Great Lakes Tributary Model (sediment transport) (Section 516(e), WRDA 1996)
- International Water Studies-Surveillance of Northern Boundary Waters (U.S. obligations under the provisions of the Boundary Waters Treaty of 1909 and other international agreements)
- Soo Lock Replacement Project (specifically authorized project at Sault Ste. Marie, Michigan) (Section 1149, WRDA 1086)

1. Great Lakes Fishery and Ecosystem Restoration

The Section 506 provision of WRDA 2000 authorizes \$100 million for Corps projects supporting ecosystem restoration, fishery, and beneficial uses in the Great Lakes. The provision also authorizes \$300,000 to develop an evaluation program for measuring the success of completed projects in meeting fishery and ecosystem restoration goals. The evaluation program is to be conducted in consultation with the Great Lakes Fishery Commission and appropriate federal, state, and local agencies. Section 506 also orders the Corps to develop a plan for its activities in support of Great Lakes fisheries management. The plan is to be developed within one year of full funding of the program in cooperation with the signatories of the Joint Strategic Plan for Management of the Great Lakes Fisheries (see Appendix B-1). The plan will be based on existing documents, such as lakewide management plans (LaMPS) and Remedial Action Plans (RAPs). In FY 2002, the Corps received initial funding for this program at \$66,000. Completion of the support plan is expected by the end of 2003.

2. Great Lakes St. Lawrence Seaway Navigation System

This is a supplemental reconnaissance study of the current and future status of commercial navigation on the Great Lakes and St. Lawrence Seaway, including the infrastructure (locks, channels, harbors, ports and other navigation related features) upon which it relies. This study extrapolates the current status of the system out 50 years, assuming the system is maintained as it exists today, with no major improvements.

The Corps is conducting the study in partnership with Transport Canada, as well as the U.S. Fish and Wildlife Service, Environment Canada, U.S. Department of Transportation and both the U.S. and Canadian Seaway authorities. The study started as a reconnaissance level review of the recommendations made in the 1985 Great Lakes Connecting Channels and Harbors report. The Corps received funding in the amount of \$1.3M for the initial reconnaissance study between FY2001 and FY2002. The Corps has received \$670,000 in FY2003 and \$1.4M in FY2004 for the more detailed supplemental study effort, which is currently scheduled to be complete in the fall of 2006.

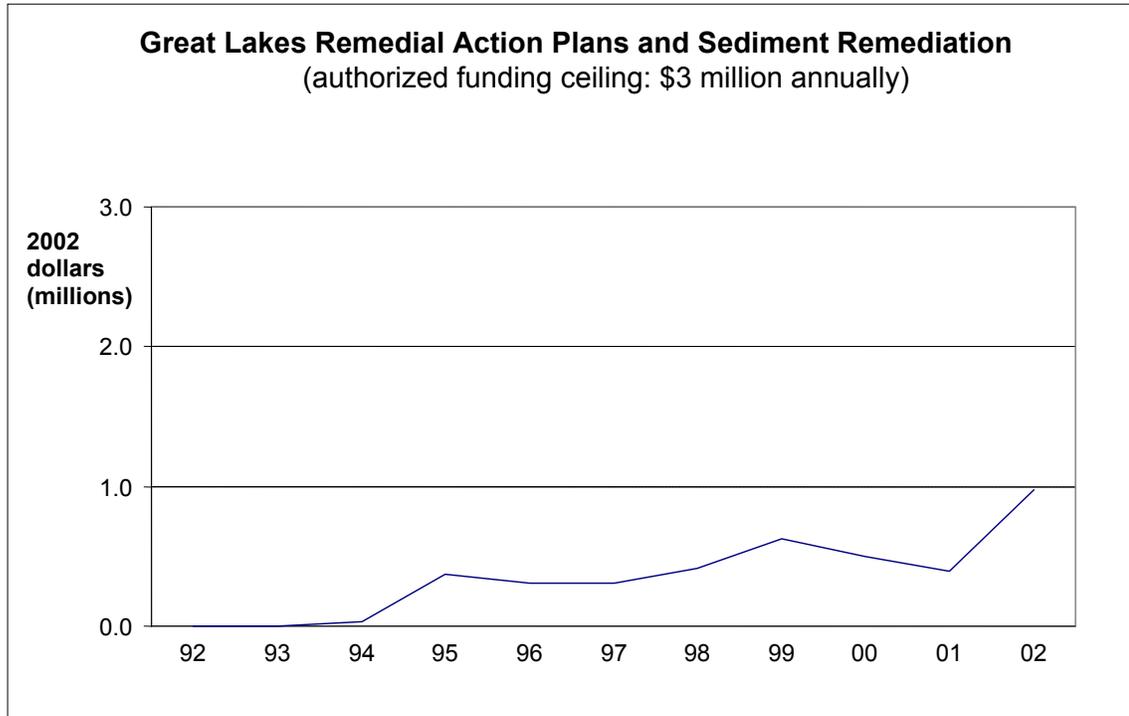
3. Great Lakes Remedial Action Plans and Sediment Remediation

Through this program, the Corps may support remedial action planning in the 26 Great Lakes Areas of Concern (AOCs) on the U.S. side of the Great Lakes basin. States, local governments, and non-governmental entities are eligible partners to apply for this type of support, which may be used to implement RAPs and to conduct pilot and full scale sediment remediation projects. RAP support may include a variety of services, including physical and environmental monitoring, remedial planning and design, construction management, development of geographic information systems (GIS), computer modeling and analysis, cost estimating, public outreach support, and project construction. The program is cost-shared at 35 percent.

All funding to date for the RAP program has been through congressional add-ons, which have resulted from the advocacy by the Great Lakes Task Force in the U.S. Congress, the Great Lakes Commission, and other regional interests. The appropriations of recent fiscal years provided base level funding for the program: \$600,000 in FY 2001, \$2 million in FY 2002, and

\$1.5 million in FY 2003. The current level of funding is not adequate to shift program targets from remediation planning to remedial actions (see also Figure 5.2 below).

Figure 5.2. Corps of Engineers program spending for Great Lakes Remedial Action Plans and Sediment Remediation

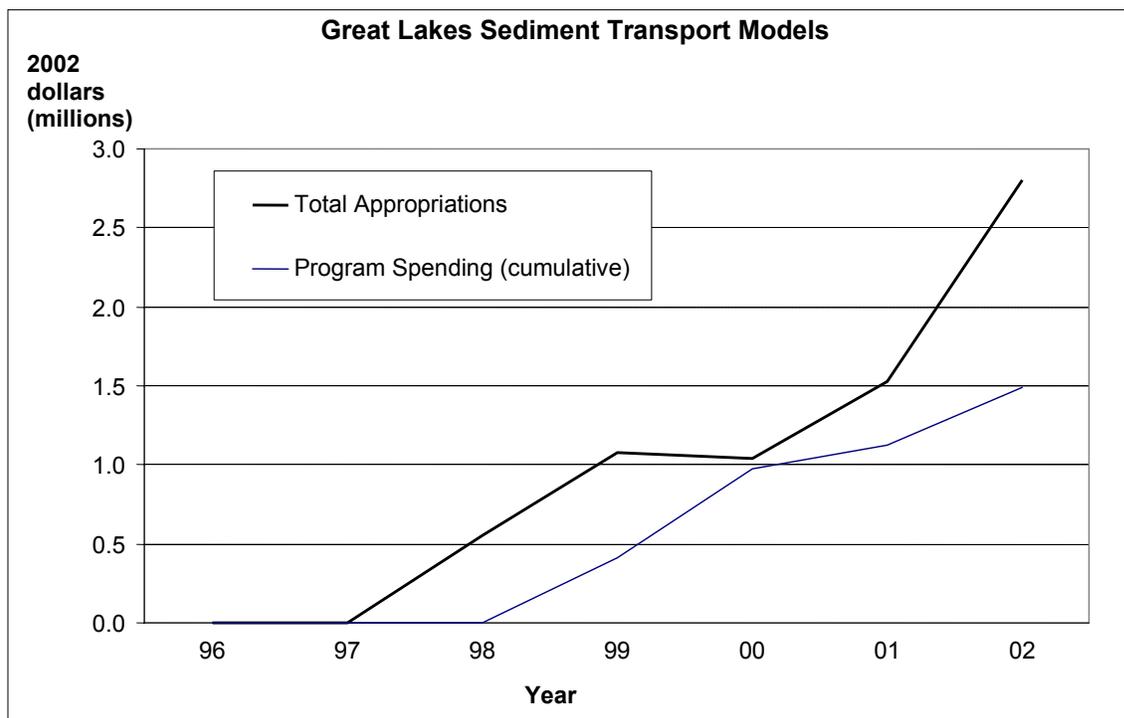


4. Great Lakes Sediment Transport Models

The Corps is directed to develop sediment transport models for tributaries to the Great Lakes that discharge to federal navigation channels or AOCs. These models are being developed to assist state and local resource agencies across the basin in evaluating alternatives for soil conservation and nonpoint source pollution prevention in the tributary watersheds. The ultimate goal is to support state and local measures that will reduce the loading of sediments and pollutants to navigation channels and AOCs, and thereby reduce the costs for navigation maintenance and sediment remediation.

Congress has provided \$500,000 for the Great Lakes Tributary Models authority in each of FYs 1998, 1999, and 2001; \$1.25 million in FY 2002; and, \$2.5 million in FY 2003. This funding was used toward model development for 12 Great Lakes tributaries (see Figure 5.3). The value of this program is expected to grow as model development becomes more integrated with watershed planning, total maximum daily load (TMDL) evaluations, RAPs, and LaMPs.

Figure 5.3. Appropriations and program spending for Great Lakes Tributary Models for Sediment Transport



5. International Water Studies-Surveillance of Northern Boundary Waters

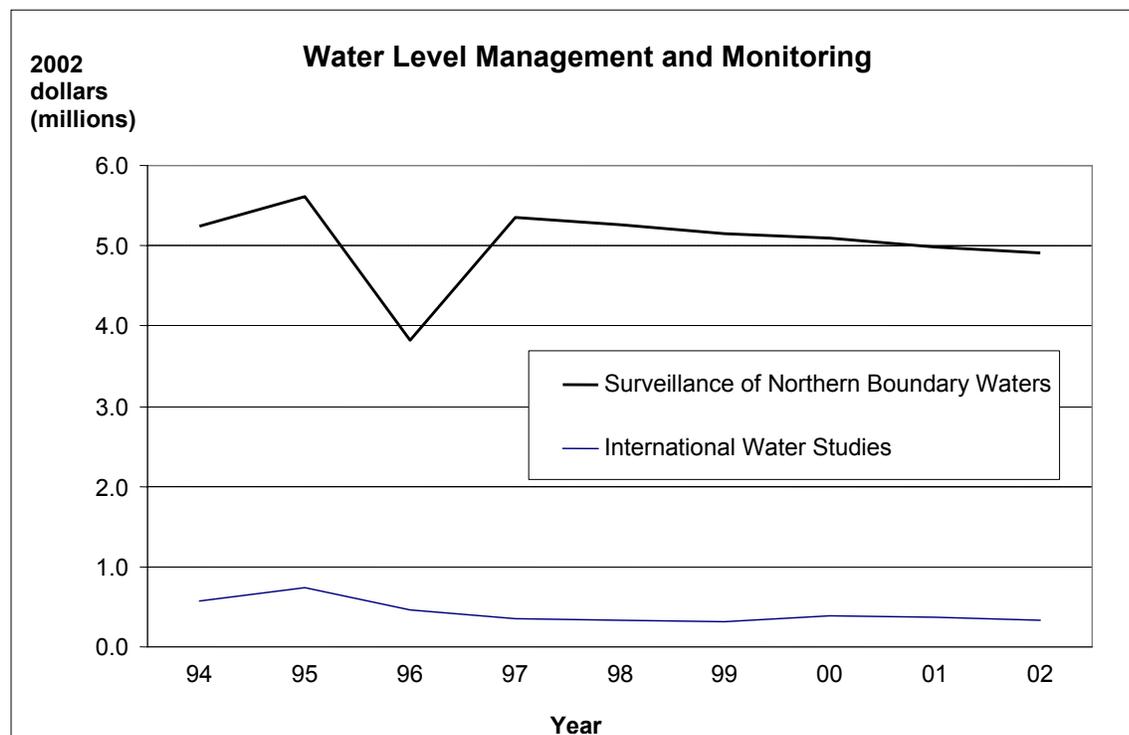
The Corps supports the International Joint Commission (IJC) in a wide variety of technical and scientific studies and technical support roles. For instance, the Corps provides the regular monthly Lake Superior outflow recommendations for the IJC International Lake Superior Board of Control. The outflow recommendations are based upon a review of the hydrologic factors influencing future conditions of Lakes Superior, Michigan-Huron, St. Clair and Erie.

To this end, the Corps collects data on hydropower operations, water levels, flow releases, and water supplies to the basin in coordination with U.S. and Canadian partners. The Corps also supports other IJC boards including the International Niagara Board of Control and the International St. Lawrence River Board of Control (ISLRBC). Beyond its support to Great Lakes water management activities of the IJC, the Corps also provides an extensive variety of water management products for the entire Great Lakes system, including water levels, meteorological data and geographic information systems. The Corps also routinely forecasts water supply and water levels in the basin and conducts hydraulic flow measurements in the Great Lakes connecting channels and the St. Lawrence River.

Between FY 1993 and FY 2002, the International Water Studies (IWS) and Northern Boundary Water Surveillance programs have received sufficient funding to keep the Corps of Engineers Great Lakes water monitoring and management activities operational. However, the inflation-adjusted funding level for the Surveillance of Northern Boundary Waters program has declined by about ten percent since 1996 (see Figure 5.4). Between 1994 and 2002, the mean

value of annual appropriations for this program was at \$4.8 million. Appropriations for IWS have ranged between \$288,000 (FY 1999) and \$625,700 (FY 1995)(Figure 5.4).

Figure 5.4. Corps of Engineers program spending for water level management and monitoring in the Great Lakes basin.



6. Soo Lock Replacement Project

In 2002, dry-bulk movement on the Great Lakes exceeded 160 million tons, half of which went through the Soo Locks on the St. Mary’s River at Sault Ste. Marie, Michigan, from and to ports on Lake Superior. The Soo Locks complex consists of four locks, of which two are currently being used: the McArthur Lock (80 feet wide, 800 feet in length, and 31 feet deep) and the Poe Lock (110 feet wide, 1,200 feet in length, and 32 feet deep). The purpose of this project is to build a new Poe-sized lock for in the current location of the technologically obsolete Davis and Sabin locks at the Soo Lock complex. With a depth of only 23 feet, both locks are too shallow for most commercial vessels. U.S. Great Lakes vessels that are restricted by size to the use of a single lock (the Poe Lock) represent almost 70 percent of the fleet’s carrying capacity.

Most interests agree that building the replacement lock is an important investment in the safety and reliability of waterborne transportation on the Great Lakes. The major obstacle to progress remains the substantial nonfederal cost share to be paid by the Great Lakes states. When the lock was authorized by WRDA 1986, the cost-sharing formula required a nonfederal sponsor to assume 35 percent of the project cost, or about \$70 to \$80 million. While there has not been a ruling yet on the exact portion to be carried by nonfederal project partners, WRDA 1999 included a provision that reduces the states’ share of the project to 23.8 percent, or approximately \$50 - \$55 million, and allows it to be paid over 50 years, interest-free. The Great Lakes Commission has since agreed to become the nonfederal project sponsor responsible for

coordinating the payment of the states' cost share. This provision in WRDA 1999 recognizes the national importance of the Soo Locks and will ease the burden on the Great Lakes states.

By the end of FY 2002, total federal expenditures for preconstruction planning and design amounted to \$5.6 million dollars. For FY 2002, the Congress appropriated \$3 million toward construction. However, the project has not proceeded to the construction phase and the starting date has not been set. The FY 2003 appropriation was adjusted to \$2.5 million in construction funds.

B. Corps of Engineers Great Lakes Nationwide Programs

1. Environmental Restoration (Project Modifications for the Improvement of the Environment) (see Box 5.2 and Appendix B-1)

WRDA 1990 established environmental protection as one of the three primary missions of the Corps Civil Works branch, along with navigation and flood damage reduction. By now, the Corps has a considerable and growing number of authorities for water resources programs with environmental goals. Section 404 of the Clean Water Act (CWA), as amended in 1977, gave the Corps of Engineers the authority to regulate discharges of dredged or fill materials into lakes, rivers and wetlands. Specifically, the Corps is authorized to require that any wetland habitat loss through fill materials shall be compensated either by restoring, enhancing, or preserving existing wetlands, or by creating new wetlands.

The Corps' "green engineering" programs span a broad range of activities from aquatic habitat restoration to employing natural materials in project construction where possible. As discussed in the previous section, two of these programs—Great Lakes Fishery and Ecosystem Restoration and Great Lakes Remedial Action Plans — are specific to the basin (see Section A above). The environmental restoration mission also includes five CAPs: Aquatic Ecosystem Restoration; Aquatic Plant Control; Beneficial Use of Dredged Material; Environmental Improvements (Restoration of Environmental Quality); and Riverine Ecosystem Restoration and Flood Hazard Mitigation.

CAPs are Corps-wide programs that can be used to implement projects within specified funding limits without the need for additional, specific authorization by Congress. Two research and development (R&D) programs, Dredging Operations Technical Support (DOTS) and Water Operations Technical Support (WOTS), address environmental challenges of water resources development operations, such as dredging or hydropower. The Corps also has an Aquatic Nuisance Plant Control research program. The Chicago Sanitary and Ship Canal Dispersal Barrier (Section 1202, National Invasive Species Act of 1996) is a specifically authorized local project with basin-wide significance: it aims to prevent invasive species from moving between the Mississippi River and Great Lakes basins.

Environmental restoration may well be the Corps mission with the largest number of general program authorities. These programs span a broad range of activities, including aquatic habitat restoration and mitigation of environmental damages related to Corps projects. Five of nine CAPs serve environmental purposes (see Box 5.2). In addition, the Corps has general authorities for Environmental Infrastructure and Environmental Dredging projects and two Great Lakes programs: Great Lakes Fishery and Ecosystem Restoration, and Great Lakes Remedial

Action Plans and Sediment Remediation. All of these programs are relatively new (authorized under WRDA 1990 or later legislation) and their share of the Corps budget is relatively small. In FY 2000, environmental restoration activities accounted for \$2.8 million, which was approximately two percent of the total Corps budget for the Great Lakes (see Figure 5.5).

Box 5.2. Corps of Engineers Environmental Restoration Programs

Great Lakes Programs (see Section A)

- Great Lakes Fishery and Ecosystem Restoration (Section 506, WRDA 2000)
- Great Lakes Remedial Action Plans (Section 401, WRDA 1990)

Continuing Authorities Program

- Aquatic Ecosystem Restoration (Section 206, WRDA 1996)
- Beneficial Uses of Dredged Material (section 204, WRDA 1992)
- Environmental Improvements (Section 1135(b), WRDA 1986)

Other Construction Authorities

- Environmental Dredging (Section 312 WRDA 1996)

Local Projects:

- Chicago Sanitary and Ship Canal Dispersal Barrier (Section 1202 NISA 1996)

Research programs:

- Aquatic Plant Control Research
- Dredging Operations and Environmental Research
- Dredging Operations Technical Support
- Water Operations Technical Support

2. Flood Damage Reduction and Shoreline Erosion Prevention (see Box 5.3 and Appendix C-2)

The Corps of Engineers has constructed dams, levees, and other water control structures to reduce flood damages in the Great Lakes basin. The majority of these projects (over 35) are operated and maintained by state and local governments, although the Corps is responsible for four federally owned Flood Control Projects, all of which were specifically authorized by Congress. These are: Chicago River North Branch, Chicago, IL; Saginaw River Flood Control, Saginaw County, MI (both authorized by River and Harbor Acts); Mt. Morris Lake, Waushara County, NY; and the flood control project at Sebewaing River, Sebewaing, MI. The Corps is in charge of O&M for the federally owned flood control projects, which involves controlling releases at dams, monitoring of water levels and flows, monitoring water quality, maintenance and repair of dams, and the operation of visitor centers.

Shore Protection Projects include structural and non-structural measures to protect shorelines against erosion and reduce storm damage to public lands and facilities. A number of these projects provide for beach erosion control and beach nourishment. Although there is a Shore Protection CAP (Section 103, RHA 1962), all current shore protection and beach nourishment projects in the region are specifically authorized. Of these, the Chicago Shoreline project is the costliest with \$132 million spent to date. Specifically authorized shore protection projects were authorized by miscellaneous acts of legislation, including WRDA as well as a number of House bills, including resolutions of the Committee on Transportation and Infrastructure and the Committee on Public Works. In addition, the Corps has a research authority focusing on shoreline erosion control.

Six of the Corps' ~~eleven~~ **nine** CAPs are programs to address problems related to flooding and shoreline or streambank erosion: Emergency Streambank and Shoreline Protection, Flood Mitigation and Riverine Ecosystem Restoration, Shore Damage Mitigation, Shore Protection, Small Flood Control Projects, and Snagging and Clearing.

Box 5.3. Corps of Engineers programs for flood damage reduction and shoreline erosion prevention.

CAPs:

- Emergency Streambank and Shoreline Protection
(Section 14, FCA 1946, as amended)
- Shore Damage Mitigation
(Section 111, RHA 1968)
- Shore Protection
(Section 103, RHA 1962)
- Small Flood Control Projects
(Section 205, FCA 1948)
- Snagging and Clearing
(Section 208, FCA 1954)

Research programs:

- National Shoreline Erosion Control Development and Demonstration Program (Section 227, WRDA 1996)

3. Navigation (see Box 5.4 and Appendix C-3)

Navigation support is the Corps of Engineers' oldest mission and the one that receives the most funding (see Section C below). In the Great Lakes, the Corps of Engineers is in charge of the federally operated Great Lakes and Connecting Channels navigation system. The Corps-supported system includes both deep-draft/commercial (≥ 14 ft) and shallow-draft/recreational (≤ 14 ft) facilities. Altogether, the Great Lakes navigation system comprises a total of 68 commercial harbors, 71 recreational harbors, 734 miles of navigation channel, 150 miles of breakwater, 25 lock chambers, 3 visitor centers, and 44 confined disposal facilities (CDFs) for contaminated dredged material.

The Corps' navigation support activities fall roughly into two categories:

1) construction of new projects and repairs (e.g., construction and repairs of jetties or breakwaters, or modification to navigation channels); and, 2) O&M activities. Typical O&M activities are maintenance dredging of harbors and navigation channels, lock operations, and the construction and operation of CDF's. Twenty-seven CDF's were constructed under the authority of Section 123, River and Harbor Act (RHA) of 1970. All others were constructed under the O&M authority of specific navigation projects. O&M is by far the largest of the three Civil Works activity sectors: in FY 2001, 68 percent of the total Civil Works budget for the Great Lakes basin (\$98 million of \$144 million) was used for O&M activities (see Figure 5.1).

The navigation support mission of the Corps of Engineers stems from the Commerce clause of the U.S. Constitution (Article I, Section 8). Generally, WRDA Section 101 (project authorizations) provides authorization of federal navigation projects (including O&M provisions) on a project-by-project basis. The Small Navigation Projects CAP (Section 107, RHA 1960)

enables the Corps to build or modify navigation projects or make modifications without specific authorization by Congress, if the cost is less than \$4,000,000. Typical navigation projects include the deepening and widening of harbors and navigation channels, extension or removal of breakwaters, or construction of piers and wharves. Further discussion of Corps support for maritime transportation is not included in this report (see Chapter 3, Study Purpose and Scope). These activities are being addressed comprehensively in a project authorized under Section 456 of WRDA 1999.

Box 5.4. Corps of Engineers navigation program:

- Great Lakes Navigation System (reconnaissance study)
(Section 456, WRDA 1999)
- Small Navigation Projects (CAP)
(Section 107, RHA 1960)
- Soo Lock Replacement Project (specifically authorized project)
(Section 1149, WRDA 1986)

4. Sediment Transport Analysis and Management Planning (see Box 5.5 and Appendix C-4)

From a Corps perspective, sediment loadings to the Great Lakes are a major financial burden. For example, maintenance dredging to remove sediments from federal navigation channels in the Great Lakes costs over \$20 million annually. The costs for managing dredged material can be even more substantial when toxic chemicals contaminate the dredged material. In addition, sediment remediation to achieve environmental restoration in Great Lakes AOCs is being hindered by new sediment depositions containing residues of pesticides, nutrients, and other nonpoint source (NPS) pollutants.

Whether for navigation or environmental restoration, it has been recognized that dredging is a reactive solution to problems posed by sediment accumulation. Hence, the Corps has developed an R&D program—the Regional Sediment Management Demo Program (RSM)—focusing on sediment management planning issues to reduce costs for navigation maintenance and sediment remediation through proactive measures. The regional Great Lakes Sediment Transport Models program (see Section A above) ties into efforts for soil conservation and erosion control to reduce sediment loadings and NPS pollution originating in tributary watersheds.

Box 5.5. Corps of Engineers programs for sediment transport analysis and management planning.

- Great Lakes Sediment Transport Models (Great Lakes program)
(Section 516(e), WRDA 1996)
- Regional Sediment Management Demonstration Program
(research program)

5. **Planning Assistance and Technical Support Programs** (see Box 5.6 and Appendix B)

The Corps provides specialized engineering support to other federal, state, and local agencies on a cost-reimbursable basis under the authority of the Economy Act of 1932 and the Intergovernmental Cooperation Act of 1968 (Support For Others = SFO). In addition to specialized engineering services, the Corp's Civil Works units also provide planning assistance and technical support to eligible recipients, which include the states and remedial action planning committees, local and tribal governments, as well as NGOs and nonprofit groups. The Great Lakes Remedial Action Plans and Sediment Remediation program provides RAP support in Great Lakes AOCs (Section A). In addition, the Corps has three nationwide program authorities to provide planning assistance and technical support services. Planning Assistance to States (Section 22, WRDA 1974) and the Tribal Partnership Program (Section 203, WRDA 2000) are very broad authorities for the Corps to provide a wide range of planning assistance and technical support to eligible partners for the development, utilization, and conservation of water and related land resources. Also, the Floodplain Management Services authority (Section 206, FCA 1960) specifically addresses flood mitigation through land-use planning for floodplains.

Box 5.6. Corps of Engineers planning assistance and technical support programs

- Floodplain Management Services
(Section 206, FCA 1960, as amended)
- Planning Assistance to States
(Section 22, WRDA 1974, as amended)
- Tribal Partnership Program
(Section 203, WRDA 2000)

6. **Water Level Control** (see Box 5.7 and Appendix B)

The Corps' water level control activities focus on hydrologic studies and technical assistance in support of the IJC (see Section A.2 above). Lake Michigan Diversion Accounting (Section 1142, WRDA 1986) is an additional water management program with regional significance. The objective of the program is to fund activities that are necessary to compute the amount of water diverted from Lake Michigan by the State of Illinois and its political subdivisions and municipalities.

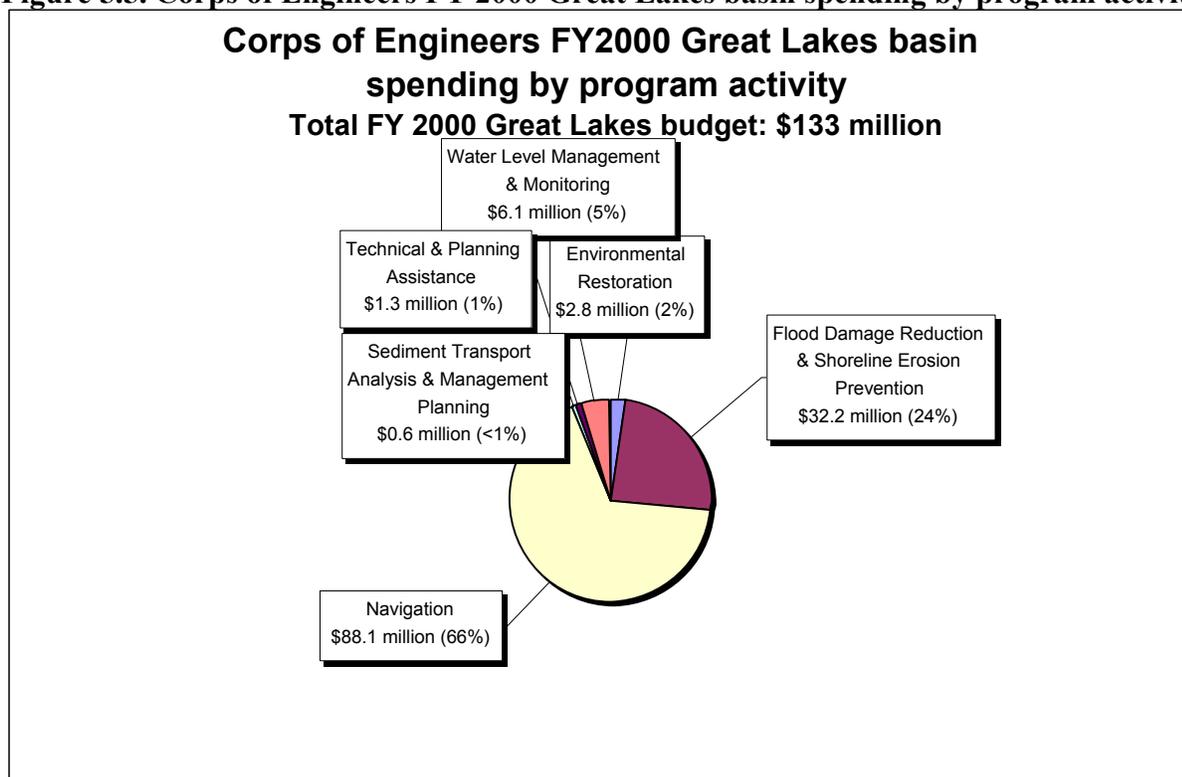
Box 5.7. Corps of Engineers water level management and monitoring programs.

- International Water Studies
- Lake Michigan Diversion Accounting
(Section 1142, WRDA 1986)
- Surveillance of Northern Boundary Waters

C. Corps of Engineers Water Resources Program Funding

Navigation programs are the largest operation of the Corps in the Great Lakes. In FY 2000, the Corps invested two thirds (\$88 million) of its Great Lakes budget (approximately \$133 million) (see Figure 5.5). The most ambitious new navigation project is a replacement lock at the Soo Lock complex in Sault Sainte Marie, MI. Construction costs are currently estimated at \$225 million, but the new lock is expected to be a significant asset to maritime transportation on the Great Lakes and to the national economy. As shown in Figure 5.6, commercial and recreational navigation O&M accounts for more than 90 percent of the navigation budget. From 1992 to 2002, the Small Navigation Projects CAP (Section 107, RHA of 1960) supported three new navigation projects at a total of \$8.7 million (see Figure 5.7). All three were for recreational boating purposes, even though the administration traditionally opposes federal spending on such projects. Congressional district representatives brokered the necessary Section 107 funds through federal budget add-ons.

Figure 5.5. Corps of Engineers FY 2000 Great Lakes basin spending by program activity.



Water level management and monitoring activities of the Corps include making outflow recommendations for Lake Superior and monitoring river and lake levels, as well as other hydrologic factors, to assist federal and local efforts in water diversion accounting or flood mitigation. Between 1994 and 2002, the funding for these activities was between \$5.2 and \$6.0 million per year. Figure 5.4 indicates that, when inflation-adjusted, the funding level for Surveillance of Northern Boundary Waters has been slightly declining since 1997, by about 10 percent. Most recently, the FY 2002 figure reflects approximately five percent of the Corps' Great Lakes budget.

Figure 5.6 Corps of Engineers Great Lakes basin navigation program activities in 2000.

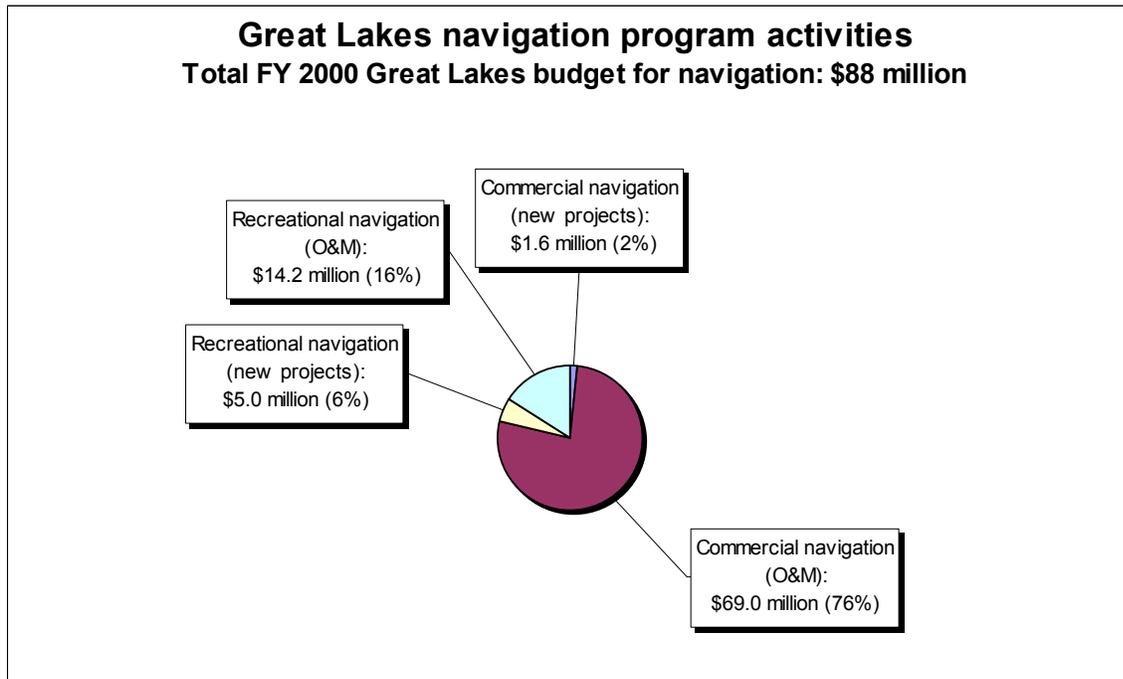


Figure 5.7. Corps of Engineers CAP Spending (FY 1992 – FY 2002).

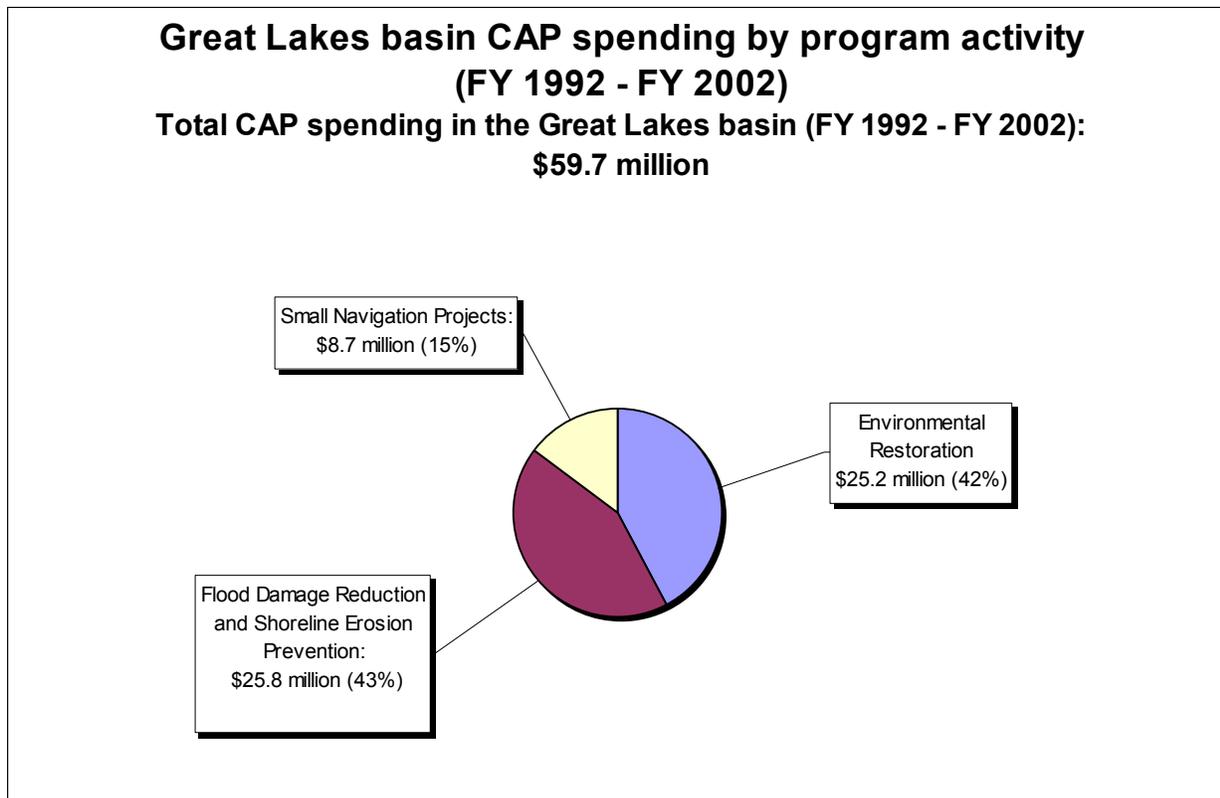
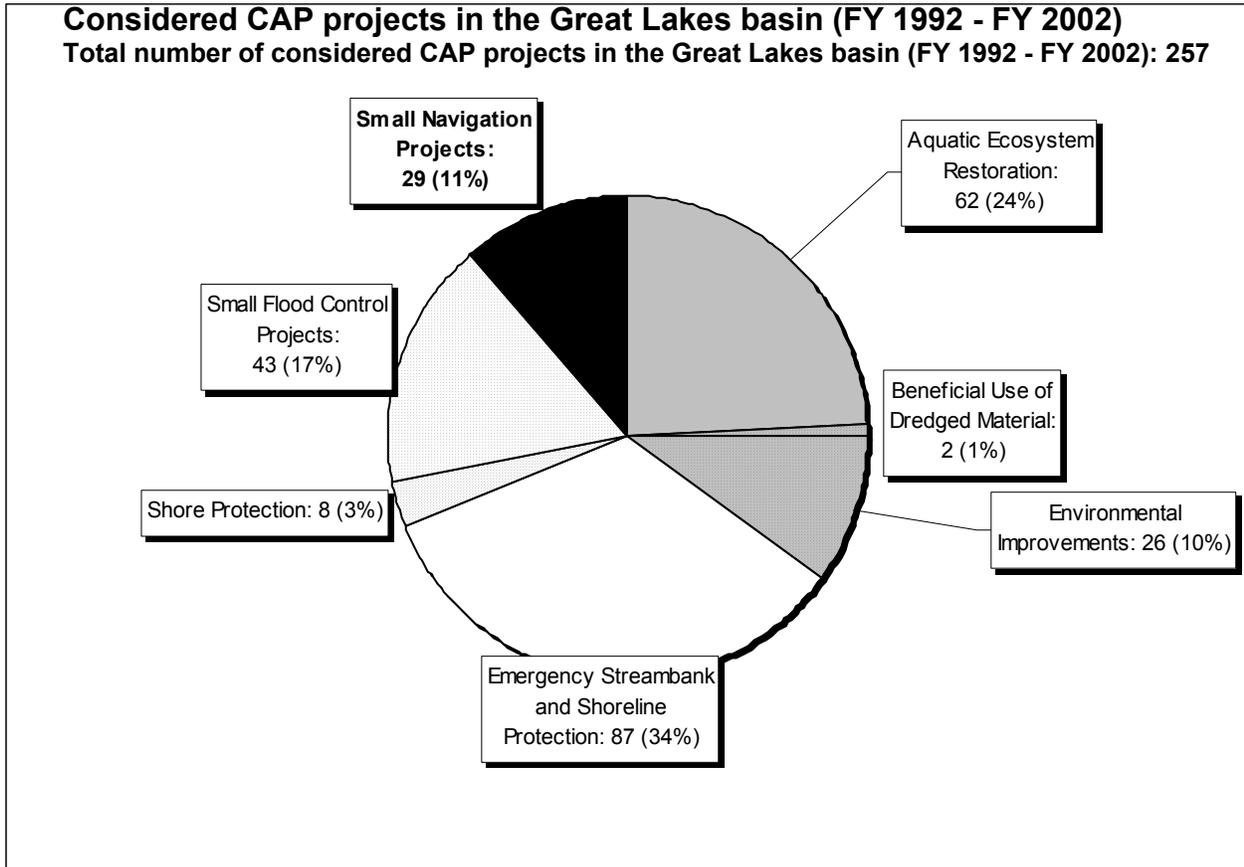


Figure 5.8. Number of projects considered for construction under CAP in the Great Lakes basin (FY 1992 – FY 2002).



Flood Damage Reduction and Shoreline Erosion Control projects accounted for 24 percent (\$32 million) of the Corps' FY 2000 budget in the Great Lakes basin (see Figure 5.5). About 10 percent of these funds (\$3.3 million) were used for O&M of federally owned projects. The remainder was invested in the study and construction of new projects. Notable is the proportionally high use of CAP funding for flood damage reduction and shoreline erosion control. Between 1992 and 2002, flood control and shoreline or streambank protection projects accounted for: (a) \$25.8 million (43 percent) of the total CAP expenditures of \$59.7 million in the Great Lakes basin (see Figure 5.7); and, (b) 27 of 34 CAP-funded projects (79 percent) (see Figure 5.9)

Figure 5.9 Number of projects constructed under CAP in the Great Lakes basin (FY 1992 – FY 2002).

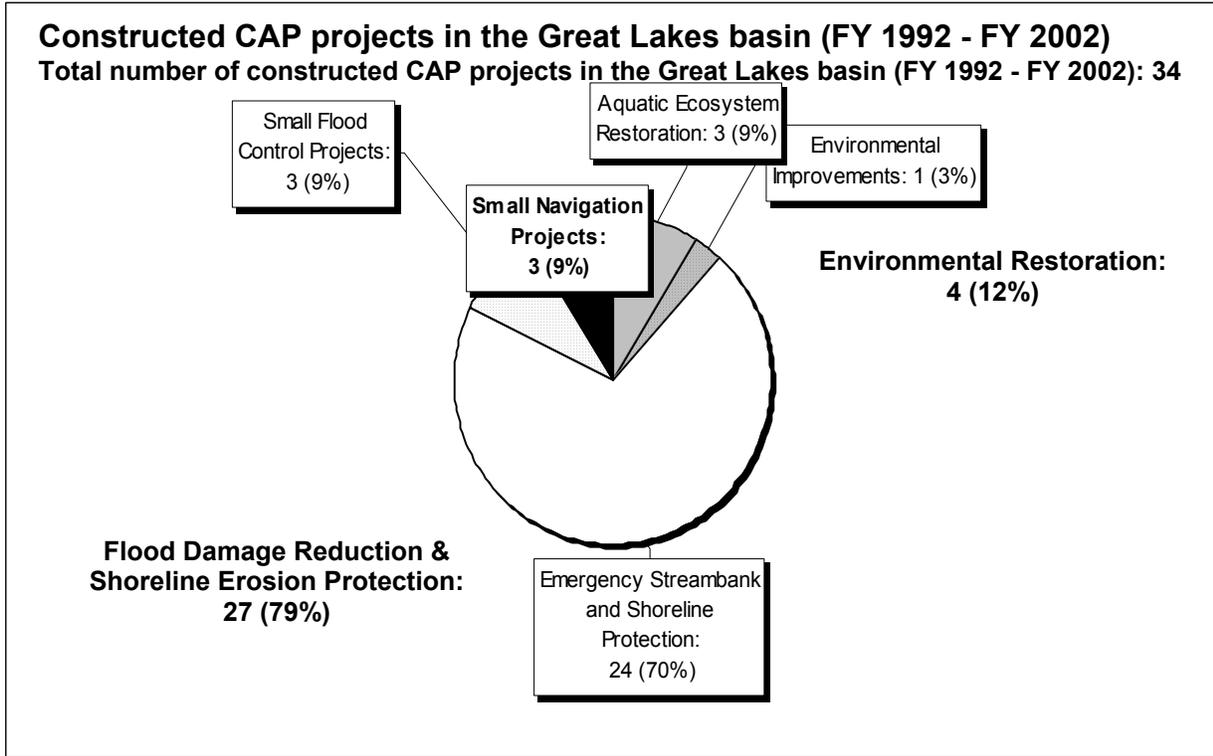
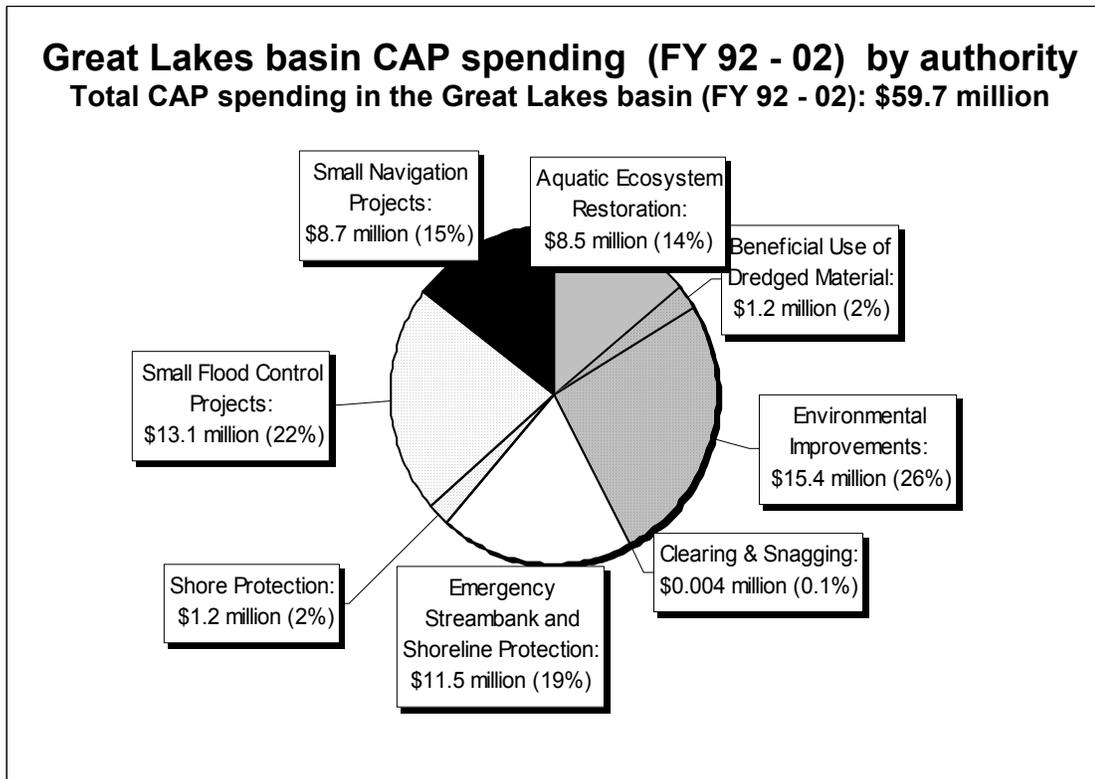


Figure 5.10 CAP spending in the Great Lakes basin (FY 1992 - 2002), by Authority.



From 1992 to 2002, the Corps has provided planning and technical assistance to 159 projects in the Great Lakes using the Planning Assistance to States and Flood Plain Management Services programs, at a total cost of \$9.1 million. With \$3.9 million, Planning Assistance to States supported a variety of water resources projects in the Great Lakes states, including ecosystem restoration and habitat creation. The Flood Plain Management Services program received \$5.3 million to provide planning guidance on floods and flood plain issues to state, tribal, and local governments. The new Tribal Partnership Program has not yet been used in the region.

Since 1992, the Corps has spent \$1.5 million to develop models for sediment transport analyses and management planning on 12 Great Lakes tributaries (Section 516(e), WRDA 1996). The program is adequately funded. Congress has provided \$500,000 for the Great Lakes Tributary Models in each of FY 1998, 1999 and 2001; \$1.25 million in FY 2002; and \$2.5 million for FY 2003. The value of this program is expected to grow as model development becomes more integrated with watershed planning, TMDL evaluations, RAPs, and LaMPs.

The Corps has a number of research programs with the capability to support Great Lakes restoration and management efforts. The Regional Sediment Management Demo Program was funded at \$95,000 in FY 2001 and 2002. These funds support a pilot project on the eastern shore of Lake Michigan. Project outcomes are expected to help integrating sediment management activities across the basin; for example, by guiding joint strategies for dredging (where to dispose of the dredged material) and beach nourishment (where to get the sand). Sediment management issues are inherently tied to shoreline and soil erosion control. Under the National Shoreline Erosion Control Development and Demonstration Program, two Great Lakes sites were selected to implement and evaluate new shoreline erosion control techniques. Additional research and development programs aim to reduce and mitigate impacts of navigation and flood control projects (Water Operations Technical Support), advance dredged material management (Dredging Operations Technical Support), and support the control of Eurasian milfoil and other invasive aquatic nuisance plants.

In addition to its Great Lakes programs, the Corps is charged with several local projects of basin-wide importance. These include the Soo Lock Replacement Project, sea lamprey control at the Soo Locks (Section 1135, WRDA 1986), the Chicago Sanitary and Ship Canal Dispersal Barrier (Section 1202, NISA 1996), and the pilot projects of the Regional Sediment Management Demonstration and National Shoreline Erosion Control Development and Demonstration programs. In addition, the Corps constructs and manages numerous water resources projects in the basin that are locally planned and local in scope. In one way or another, these localized efforts contribute to Great Lakes restoration and management. However, with the exception of the commercial navigation system, most of these projects are not tied into a larger strategic framework for the Great Lakes basin.

D. Other Federal and State Agencies

The following discussion is largely excerpted from the recent U.S. General Accounting Office (GAO) report: "An Overall Strategy and Indicators for Measuring Progress Are Needed to Better Achieve Restoration Goals".

The GAO report identified 148 federal and 51 state programs supporting Great Lakes restoration activities, including the programs of the Corps of Engineers. They include programs

that focus specifically on the Great Lakes basin as well as localized applications of national or state initiatives. The majority of the identified programs support activities relating to cleanup of contaminated areas, habitat restoration, pollution prevention, and environmental research.

The GAO reported that Great Lakes restoration activities employ a variety of strategies at the binational, federal, and state level. However, there is no overarching plan for coordinating and tying them together into a coherent approach. It is also recognized that a comprehensive assessment of restoration progress is needed. The biennial State of the Lakes Ecosystem Conference (SOLEC) has worked to develop a set of indicators for Great Lakes restoration. This effort relies on the voluntary contributions of several organizations and its success is thus far uncertain. A monitoring system has not yet been established and no completion date for developing a list of indicators has been set.

Thirty-three federal programs focus specifically on the Great Lakes basin and account for \$387 million in federal spending in fiscal years 1992 through 2001. Sixty-four percent, or \$248.9 million, was for U.S. EPA programs; 17 percent, or \$67.2 million, was for NOAA programs; and 9 percent, or \$33.4 million, was for Fish and Wildlife Service (FWS) programs. The Great Lakes states provided \$956 million for Great Lakes-specific programs, with Michigan's programs accounting for 96 percent of this amount. In general, these programs focus on a range of activities meeting specific state needs (see Table 5.2). An example is the Clean Michigan Initiative, which provides bond funding for brownfields and greenspace preservation across Michigan. However, most of the programs identified by the GAO do not specifically focus on basin concerns but are localized applications of programs operating within as well as outside the basin. U.S. EPA is the federal agency administering the majority of programs. While these programs substantially contribute to Great Lakes restoration and management, the portion of funding going to the basin cannot be tracked in many cases.

Tables 5.2 through 5.5, summarize water resources programs in the Great Lakes basin. Table 5.2 lists water resources programs that give federal agencies action capabilities in the Great Lakes (i.e., programs that enable the agency to deliver management and technical services, conduct research and monitoring, or carry out certain types of restoration projects). This includes specific Great Lakes programs (e.g., U.S. EPA's Great Lakes Program) as well as nationwide programs (for example, the National Fish Passage Program of FWS). Tables 5.3 and 5.4 summarize federal and state programs that provide grants and funding opportunities for Great Lakes restoration projects. Examples are the Great Lakes Basin Program for Soil Erosion and Sediment Control (NRCS), Clean Water State Revolving Fund (U.S. EPA) and the Great Lakes Protection Fund (GLPF) of the states. Finally, Table 5.5 describes foundation programs that focus on Great Lakes needs.

1. Federal Water Resources Programs with Action Capability

Under authorities of the CWA and other legislation, the U.S. EPA often leads on federal programs addressing water quality and related watershed issues in the basin. U.S. EPA's Great Lakes Program serves to meet U.S. responsibilities under GLWQA. This executive agreement outlines U.S. and Canadian obligations to restore and protect the chemical, physical, and biological integrity of the Great Lakes basin ecosystem. To support these goals, the Great Lakes Program oversees and coordinates a range of integrated program activities, including the development and monitoring of Great Lakes ecosystem indicators (Monitoring Program, SOLEC) and support of LaMPs and RAPs with water quality management planning and funding

coordination. The Water Quality Standards and TMDL programs work with states and tribes to establish water quality criteria and ensure that they are met. U.S. EPA also undertakes research on the relationship between landuse, watershed management, and water quality through its Aquatic Stressors Research Program, with a focus on Lake Superior watersheds.

Other federal agencies with major water quality programs in the basin are the U.S. Geological Survey (USGS) and Natural Resources Conservation Service (NRCS). As part of its National Water Quality Assessment Program (NAWQA), USGS monitors water quality in streams and groundwater of the Lake Erie-St. Clair drainage and in watersheds on western Lake Michigan. The USGS Ground Water Resources Program also provides quantitative information on priority water management issues, including support for aquifer management decisions, natural groundwater recharge, and groundwater and surface water interaction. NRCS offers Conservation Technical Assistance to land users, communities, units of state and local governments, and other federal agencies seeking advice on how to improve water quality through conservation measures in the watershed.

The U.S. Fish and Wildlife Service (FWS) has several national programs supporting aquatic nuisance species (ANS) control and habitat restoration in the basin. Through the Fish and Wildlife Management Assistance program, eligible entities in the basin have access to FWS biologists who develop fishery management plans, coordinate fishery restoration activities, and evaluate the results of management actions.

Program responsibilities include: (1) fish conservation in cooperation with state, tribal, federal, and private interests; (2) Native American tribal assistance; (3) interjurisdictional fisheries assistance (for example, surveillance of interjurisdictional fish populations and technical support and coordination services for the Great Lakes Fishery Commission); (4) the National Fish Passage Program; and (5) invasive species control. The National Fish Passage Program has been used since 1999 to restore flow regimes and fish migration in streams by dam removal or bypassing. Nine dam removal projects have been completed in the basin at a total cost of \$268,500. In FY 2003, work has begun on five additional projects. In addition, the FWS manages two ANS programs with relevance to the Great Lakes: (1) ANS Surveillance and Control supports exotic fish surveys across the basin, with a particular focus on the Eurasian ruffe; and (2) the New York State Canal System ANS program supports workshops and meetings as a means to educate and inform the public about ANS issues related to the New York State Canal System. Workshops target issues such as state ANS plan development.

Several federal agencies are involved in the assessment and remediation of contaminated sites. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, commonly known as Superfund, provides broad authority to U.S. EPA to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. Since 1980, over 130 contaminated sites within the basin have been entered on the National Priorities List (NPL) of the Superfund program and are subject to CERCLA-financed remedial actions. There are currently 105 active NPL sites in the basin. Remedial engineering has been completed at 33 sites (24 percent) in the basin. Twenty-one of these sites have been deleted from the NPL and the remainder are undergoing long-term remediation.

CERCLA also directs U.S. EPA to coordinate the assessment and remediation of affected natural resources with designated trustees. Trustees of Great Lakes resources include the

Department of the Interior (DOI) as well as states and tribes. The DOI Restoration Program Management Office coordinates the Damage Assessment and Restoration Program with FWS or other concerned DOI bureaus. The designated DOI bureau assesses the damages and injuries to natural resources and negotiates legal settlements or takes other legal action against the parties responsible for the spill or release. Funds from these settlements are then used to recover costs incurred in assessing the damages, to restore the injured resources, and to fund further damage assessments at no expense to the taxpayer. The FWS has or is currently conducting Natural Resource Damage Assessments for several dozen sites in the Great Lakes basin.

The Federal Emergency Management Agency (FEMA) leads and coordinates federal flood mitigation programs within the Great Lakes basin. The Water and Wind Technical Assistance Program provides technical support to flood mitigation initiatives of states and local communities. Other flood mitigation programs of FEMA provide both technical and financial assistance to eligible entities.

Table 5.2

Federal water resources programs with action capability in the Great Lakes basin.

Program Name	Purpose	Program expenditures (1992–2001)^a
U.S. Department of Agriculture – Natural Resources Conservation Service		
Conservation Technical Assistance	Provides technical assistance to land users, communities, units of state and local governments, and other federal agencies programs in planning and implementing conservation systems. In the Great Lakes basin, water quality issues such as erosion are a program priority.	^b
U.S. Department of Homeland Security – Federal Emergency Management Agency		
Wind and Water Technical Assistance Program	This program provides ad hoc short-term technical assistance to states that participate in FEMA Flood Programs. This assistance is provided at no cost to the requesting state or local community. Examples of projects that can be executed under WAWTAP are flood mitigation planning assistance, technical guidance in developing flood retrofit measures, study and analysis of storm phenomena, and training associated with flood mitigation.	^b
U.S. Department of Interior – Fish and Wildlife Service		
Aquatic Nuisance Species Surveillance and Control	This program was started in 1991 to prevent and control infestations in the coastal and inland waters of the U.S. by nonindigenous invasive species. Its activities include research, prevention and control of ANS, and mitigation of impacts to native fish and wildlife resources.	\$3,659,400
Fish and Wildlife Management Assistance – Great Lakes Operations	This program aids in conservation of native fish and wildlife species and their habitats. It provides support for the management of interjurisdictional fisheries, aids in restoration of depleted fish populations, and provides technical assistance to states and tribal fish and wildlife management agencies to fulfill federal trust responsibilities.	\$5,915,000
National Fish Passage Program	Typically, the program is used to remove barriers to fish movement (i.e. dams) or to provide ways for aquatic species to bypass them. The program works with federal, state, local, and tribal agencies, as well as private partners and stakeholders.	\$268,500
National Resource Damage Assessment Program	Provides for the assessment of damage to FWS trust resources from oil spills/and or other hazardous substance releases, so that the restoration or replacement of these injured resources are paid for by the responsible parties.	\$2,496,000
New York State Canal System Aquatic Nuisance Species Program	This 1998 program includes various components to address aquatic invasive species issues within the Canal system. It seeks to work with partner agencies to detect, monitor, and manage populations of invasive species inhabiting or transiting the Canal and implement prevention strategies as appropriate.	\$221,342
U.S. Department of Interior – Restoration Program Management Office		
Damage Assessment and Restoration Program	The purpose of this program is to restore injuries from oil spills and hazardous material discharges to the Department of Interior's trust resources by assessing damages and settling with responsible parties.	^b
U.S. Department of Interior – U.S. Geological Survey		
National Water Quality Assessment (NAWQA) Program	The NAWQA program assesses status and trends in water quality of streams, groundwater, and related aquatic ecosystems as well as the factors affecting it.	\$16,039,000
National Water Use Information Program	This program was created in 1979 to collect, store, analyze, and disseminate water use information, both nationally and locally, to a wide variety of government agencies and private organizations. It is a cooperative program that includes state and local government entities.	^b
USGS Ground-Water Resources Program	Encompasses regional studies of groundwater systems; provides access to groundwater data, and research and methods development	\$60,000

U.S. Environmental Protection Agency (Table 5.2 continued)		
Aquatic Stressors Research Program	The goals of this research program include identifying impaired watersheds; diagnosing causes of degradation; and developing risk-based assessments for supporting restoration and remediation decisions.	b
Environmental Protection - Consolidated Research	The goals of these research programs include (1) support research to determine the environmental effects of air, drinking water, water quality, hazardous waste, toxic substances and pesticides; (2) identify, develop, and demonstrate necessary and effective pollution control techniques; and (3) support research to explore and develop strategies and mechanisms to use in environmental management decisions.	b
Great Lakes Program	The goal of this program is to restore and maintain the chemical, physical, and biological integrity of the Great Lakes basin ecosystem.	b
Monitoring Program/State of the Lakes Ecosystem Conference	The purpose of this research program is to assess the ecosystem health of the Great Lakes; information is gather and provided to measure whole lake response to control measures using trend analysis and cause/effect relationships	b
Public Water Supply Program	The purpose of this program is to ensure that clean and safe drinking water is provided to the public.	b
Superfund	The goal of this program is to protect human health and the environment from risks associated with hazardous waste sites and to respond to hazardous substance spill emergencies. The primary focus of the program is the assessment and remediation of long-term cleanups.	\$749,149,250 c
Total Maximum Daily Load Program	The purpose of this program is to identify waters not meeting state water quality standards, and for those waters, calculate the maximum amount of a pollutant the water can receive and still meet water quality standards.	b
Water Quality Standards Program	Supports efforts to restore and maintain the chemical, physical, and biological integrity of the nation's waters by defining the uses to be protected and the water quality conditions needed to protect these uses.	b

^aUnless otherwise noted, the funding figures in this column represent federal fiscal year expenditures.

^bNot known for this program.

^cFunding amount for Regions 3 and 5.

2. Federal water resources programs with funding and granting capabilities

U.S. EPA: A suite of U.S. EPA granting programs is available to fund CWA-related activities in the basin. The Great Lakes National Program Office (GLNPO) awards competitive CWA Section 104(b)(3) grants to projects addressing Great Lakes priorities, such as contaminated sediments, nonpoint pollution, habitat and wetlands restoration, and invasive species. The program funds a wide variety of activities but does not fund construction projects, such as the building or removal of infrastructure. Eligible recipients include federal agencies, state water pollution control agencies, interstate agencies, municipalities, Indian tribes, and nonprofit institutions. Other CWA-based programs make grants to states and tribes to develop and maintain water quality monitoring programs (Section 106 Grants) or to implement watershed-based water quality management plans as well as LaMPs and RAP-related activities (Section 319 Grants).

The Clean Water State Revolving Fund (SRF) provides capitalization grants to states for low-cost financing of a wide range of public water quality infrastructure such as wastewater treatment facilities and other nonpoint source pollution control projects (for example, the Minnesota Pollution Control Agency's Clean Water Partnership). Similarly, states can obtain capitalization grants through the Drinking Water State Revolving Fund to support activities

related to the Safe Drinking Water Act (SDWA). These include low-cost loans to public water systems for infrastructure projects or funding of source water protection measures.

The Clean Water Indian Set-Aside Grant Program, under Section 518(c) of CWA, provides grants for the planning, design, and construction of tribal wastewater treatment facilities. U.S. EPA also provides funding for various initiatives at the community level: Brownfields Assessment, Revolving Loan Fund, and Cleanup Grants; Superfund Technical Assistance Grants for Citizen Groups at Priority Sites; and, the Five-Star Restoration Program for streambank and wetlands restoration.

FWS: FWS endorses the use of Challenge Costshare (CCS) Grants to encourage partnerships for funding projects. CCS Grants require a 50 percent cost share (services or labor can qualify) and may typically be used in three different ways: 1) landowners restore the land and are reimbursed directly for some or all of the expenses; 2) the FWS or the landowner hires a contractor to complete the work; or, 3) FWS employees may do the on-the-ground work. CCS Grants are the typical funding mechanism to support most of the following programs: Great Lakes Fish and Wildlife Restoration Act, Great Lakes Coastal Program, North American Wetlands Conservation Act Grants, Partners for Fish and Wildlife, and Federal Aid in Sport Fish Restoration.

The most important funding authority for FWS is the Great Lakes Fish and Wildlife Restoration Act of 1998. The Act establishes a proposal and funding process to implement critical fisheries restoration actions. Critical actions include the evaluation and restoration of habitat in Great Lakes estuaries and tributaries, the restoration of Lakes Erie and Ontario's lake trout populations, and the rehabilitation of Great Lakes sturgeon in the basin. Between 1998 and 2002, the Act supported 73 fish rehabilitation projects totaling \$12 million, which includes more than \$5 million in matching funds.

Examples of activities funded with this program are scientific studies and assessments, habitat enhancements, and the development of fishery management plans. Project proposals are submitted to the Great Lakes Fishery Commission and reviewed by a committee that represents the signatories to the Joint Strategic Plan for Management of Great Lakes Fisheries. All projects are implemented by collaborative partnerships that involve nonfederal partners who provide nonfederal matching funds. These partnerships involve federal, state, and local agencies; tribal institutions; Canadian governmental units; nongovernmental organizations, and universities. The FWS may or may not be involved in implementing these projects.

The Great Lakes Coastal Program is another example of a basin-specific granting program of the FWS; the focus here is on coastal and riparian wetlands. The program aims at community-based partnerships and awards small grants (\$20,000 maximum) for planning, monitoring, restoration, and outreach activities. Federal agencies (including regional FWS offices), states, tribes, local governments, and nongovernmental organizations can apply for this program.

Wetland conservation projects may also receive funding through the North American Wetlands Conservation Act Grants Program, which supports activities under the North American Waterfowl Management Plan. In addition, the Partners for Fish and Wildlife Program restores and protects fish and wildlife habitat on private lands through voluntary alliances with

individuals or organizations, while leaving the land in private ownership. States can also receive Federal Aid in Sport Fish Restoration through a cost-reimbursement program. The state covers the full amount of an approved project and then applies for reimbursement for up to 75 percent of the project expenses. The state must provide at least 25 percent of the project costs from a nonfederal source. The program provides funding that can be used for aquatic education programs, coastal wetlands conservation, or boating access.

NOAA: The National Oceanic and Atmospheric Administration (NOAA) support in the Great Lakes basin spans a wide range of activities. NOAA's National Ocean Service (NOS) manages the Coastal Zone Management Program (CZM), which is the largest federal funding source for Great Lakes programs for the states. This program makes financial assistance available to any coastal state, including those on the Great Lakes. The funding can be used to develop and implement a comprehensive coastal management program consistent with CZM goals, which are to preserve and protect coastal resources while allowing compatible economic growth.

States also have access to mediation, technical, and information services through CZM. Section 309, which amended the Coastal Zone Management Act (CZMA) of the Coastal Zone Act Reauthorization Amendments (CZARA) of 1990, established an additional Coastal Zone Enhancement Grants Program, under which coastal states address priority issues identified by Congress to enhance existing coastal management programs. These issues include coastal wetlands protection and creation; natural hazards mitigation; public access enhancement; assessment of cumulative and secondary impacts; preparation and implementation of special area management plans; and energy facility siting procedures. CZARA also requires that states with approved coastal management programs develop Coastal Nonpoint Pollution Control Programs to meet CWA goals. This program is jointly administered by NOAA and U.S. EPA and makes CZMA-authorized grants for states to develop and implement their nonpoint source management programs.

The Great Lakes Sea Grant Network is part of NOAA's National Sea Grant College Program, a national program of partnerships among universities and the public and private sectors promoting wise stewardship of Great Lakes resources. The program combines research, education, outreach, and technology transfer activities related to coastal and marine resources under one roof. Sea Grant makes project grants to fund research, education, training, and advisory services. Eligible recipients are any organizations or individuals with a professional interest in Great Lakes resources, including the states, academic institutions, and private organizations.

NOAA's National Marine Fisheries Service (NMFS) has two grant programs to support fishery restoration and management projects in the Great Lakes. Project grants through the Anadromous Fish Conservation Act Program are available to any agency, organization, or individual, as long as the proposal is submitted by a state fishery management agency. These grants are intended for cooperative projects that either benefit Great Lakes fish ascending streams to spawn or serve for sea lamprey control. The Interjurisdictional Fisheries Act makes formula grants to states for research and law enforcement, the development of fishery management plans, and for restoration of interjurisdictional fishery resources damaged by a natural disaster.

The Coastal Services Center (CSC) of NOAA sponsors the Landscape Characterization and Restoration Program (LCR), which funds geographic and issue-based characterizations of coastal resources. Geographic characterizations are funded via cooperative agreements, a special form of grants that allow LCR to contribute staff and technological resources to a project in addition to providing the grant recipient with funds. Issue-based characterizations are developed through contracts.

Each issue-based characterization takes an interdisciplinary look at the physical, ecological, and socioeconomic aspects of a coastal management issue that affects a large geographic area (e.g. multiple watersheds). A "best value" approach is used to select the contractor; that is, the selection team balances the cost of the work with the quality of the proposed product to determine the combination that yields the best value to the coastal management community. The funds available for the contracts are on the order of \$100,000 and CSC contributes to the final product. Contractors focus on developing the content, and LCR staff focus on assembling and distributing the resulting documents.

NRCS: NRCS programs offer technical assistance to support water management and improve water quality in tributary watersheds. The Great Lakes Basin Program for Soil Erosion and Sediment Control improves water quality through soil erosion and sedimentation control demonstration projects, technical assistance, and education programs. Through FY 2003, the program has supported 259 projects totaling almost \$8 million. Seventy-two projects are currently active and 187 projects have been completed. Grants go to projects that improve water quality in the Great Lakes basin through improved land management practices. Nonfederal project sponsors are expected to provide matching funds.

The Great Lakes Commission, in partnership with NRCS, U.S. EPA and the Corps of Engineers, coordinates the program. The Resource Conservation and Development Program (RC&D) supports state, tribal, and local units of government and local nonprofit organizations to plan and carry out programs for resource conservation and development in rural watersheds. Authorized RC&D areas in the basin, if they become a 501(c)(3) nonprofit, can apply for financial and technical assistance to meet various land conservation, water management, community development, and environmental needs.

The Watershed Surveys and Planning Program assists local organizations with watershed surveys and planning for small watersheds (250,000 and fewer acres). The focus of these plans is to identify solutions that use conservation practice and nonstructural measures to solve water-related resource issues. The program addresses watershed protection, flood prevention, erosion and sediment control, water supply, water quality, opportunities for water conservation, wetland and water storage capacity, drought problems, municipal and industrial water needs, upstream flood damages, water needs for fish, wildlife, and forest-based industries, fish and wildlife habitat enhancement, wetland creation and restoration, and public recreation in watersheds of 250,000 or fewer acres. Both technical and financial assistance are available. The program also furnishes technical assistance to landowners and operators to accelerate planning and application of needed conservation measures on their individual land units.

The Emergency Watershed Protection program (EWP) provides funding to project sponsors for such work as clearing debris from clogged waterways, restoring vegetation, and stabilizing riverbanks. The measures that are taken must be environmentally and economically sound and generally benefit more than one property owner. NRCS provides up to 75 percent of

the funds needed to restore the natural function of a watershed. The community or local sponsor of the work pays the remaining 25 percent, which can be provided by cash or in-kind services. Under the floodplain easement option, a landowner voluntarily offers to sell to the NRCS a permanent conservation easement that provides the agency with the full authority to restore and enhance the floodplain's functions and values at up to 100 percent federal cost. Each EWP project, with the exception of floodplain easements, requires a sponsor who applies for the assistance. A sponsor can be any legal subdivision of state or local government, including local officials of city, county, or state governments, Indian tribes, soil conservation districts, U.S. Forest Service, and watershed authorities. Project sponsors determine priorities for emergency assistance while coordinating work with other federal and local agencies.

FEMA: FEMA mitigation programs provide financial and technical assistance for a range of flood-related activities. Flood Mitigation Assistance (FMA) is a state-administered, costshare program through which states and communities can receive grants for flood mitigation planning, technical assistance, and mitigation projects. Eligibility to receive FMA planning and project grants is dependent upon community participation in the National Flood Insurance Program (NFIP). Examples of eligible FMA projects include the elevation, acquisition, and relocation of NFIP-insured structures. In a flood emergency, states with an approved enhanced state mitigation plan in effect at the time of disaster declaration may receive funding through the Hazard Mitigation Grant Program (HMGP). The Pre-Disaster Mitigation Program assists states and local governments (including Indian tribal governments) in implementing cost-effective hazard mitigation activities that complement a comprehensive mitigation program. All applicants must be NFIP participants, if they have been identified as having a special flood hazard area. The National Dam Safety Program supports research, training of dam professionals and owners, and state assistance funding.

USGS: The USGS Cooperative Water Program (Coop Program) is a cost-sharing partnership between the USGS and nonfederal public agencies at all levels of government. The program supports the collection of basic hydrologic data. In addition, the program also funds research projects and initiatives targeted at priority water issues. The current seven high-priority issues of the Coop Program are hydrologic hazards; water quality; hydrologic data networks; water availability and use; wetlands, lakes, reservoirs and estuaries; water resources issues in the coastal zone; and environmental effects on human health.

Bureau of Indian Affairs (BIA): The BIA administers two programs to fund tribal water resources projects. The Water Resources on Indian Lands program provides funding for the collection and analysis and for water management, planning, and development projects. The Fish, Wildlife, and Parks Program on Indian Lands funds a wide variety of projects, including base line inventories; habitat enhancement or protection; regulation of fishing, boating, and related public use activities; water quality compliance measures; and fish hatchery maintenance.

Table 5.3
Federal water resources programs with funding and granting capabilities
in the Great Lakes basin.

Program Name	Purpose	Program expenditures (1992–2001) ^a
U.S. Department of Agriculture – Natural Resources Conservation Service		
Emergency Watershed Protection	This program is available for areas in the basin that have been damaged by natural disasters. The purpose of the program is to provide financial and technical assistance to remove debris from streams, protect destabilized streambanks, establish cover on critically eroding lands, repairing conservation practices, and the purchase of flood plain easements. The program is designed for installation of recovery measures.	^b
Great Lakes Basin Program for Soil Erosion and Sediment Control	Funds projects that protect and improve Great Lakes water quality by promoting soil erosion and sediment control through information and education programs, grants, technical assistance, and coalition building. Objectives include(1) limiting the input of associated nutrients and contaminants to waters in the basin, (2) minimizing off-site sources of sediment that cause damage to harbors, fish and wildlife habitat, recreational facilities, and public work systems.	\$3,625,000
Resource Conservation and Development Program	Provides technical and financial assistance to designated communities in the Great Lakes basin with the purposes to plan, develop, and carry out projects for resource conservation and development.	^b
Watershed Surveys and Planning	The purpose of this program is to assist federal, state, and local agencies; local government sponsors; tribal governments, and non-governmental program participants to protect and restore small watersheds from damage caused by erosion, floodwater, and sediment; to conserve and develop water and land resources; and solve natural resource and related economic problems on a watershed basis. The program provides technical and financial assistance to local people or project sponsors, builds partnerships, and requires local and state funding contribution.	^b
U.S. Department of Commerce – National Oceanic and Atmospheric Administration		
Anadromous Fish Conservation Act Program	This program can serve as a vehicle to cooperate with the states and other nonfederal interests to (1) conserve, develop, and enhance those fish species in the Great Lakes that ascend streams to spawn, and (2) to control sea lamprey. NMFS administers this grant program in cooperation with FWS.	^b
Coastal Zone Management Program	A federal-state partnership that provides a basis for protecting, restoring, and responsibly developing coastal communities and resources. The program includes encouraging and assisting states in the wise use of land and water, and encouraging the participation and cooperation of all government sectors with programs affecting the coast.	\$107,906,394
Coastal Zone Management Enhancement Program (Section 309, CZARA of 1990)	Grants are available to coastal states with federally approved coastal management programs, and encourages states to develop program changes in one or more of nine coastal enhancement areas: wetlands, public access, coastal hazards, cumulative and secondary impacts, energy and government facility siting, marine debris, ocean resources, special area management plans and aquaculture. To receive funds, the programs must assess these nine specified areas of coastal zone management and identify priority enhancement activities.	^e
Interjurisdictional Fisheries Act	Provides grants to assist states in managing interjurisdictional fisheries resources.	^b

Table 5.3 (continued)

Landscape Characterization and Restoration Program	This program began in 1997 to help coastal resource managers examine the effects of management on coastal habitats. LCR works via grants (cooperative agreement), and contracts with the coastal management community to accomplish this goal.	b
National Sea Grant College Program	National Sea Grant supports education and research in the various fields relating to the development of marine resources. All Great Lakes states, except Pennsylvania, have a Sea Grant program.	\$2,174,000
U.S. Department of Homeland Security – Federal Emergency Management Agency		
Flood Mitigation Assistance Program	Provides funding to assist States and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program	b
Hazard Mitigation Grant Program	Provides project grants to help states and communities implement long-term hazard mitigation measures following a major disaster declaration.	b
National Dam Safety Program	The primary purpose of the National Dam Safety Program Act is to provide financial assistance to the states for strengthening their dam safety programs.	b
Pre-Disaster Mitigation Program	Provides technical and financial assistance to States and tribal governments that, in turn, provide sub-grants to local governments for cost-effective pre-disaster hazard mitigation activities that complement a comprehensive mitigation program.	b
U.S. Department of Interior – Bureau of Indian Affairs		
Fish, Wildlife, and Parks Program on Indian Lands	The goal of this program is to promote the conservation, development, and utilization of fish, wildlife, and recreational resources for sustenance, cultural enrichment, economic support, and maximum of benefit for Indians. The program provides direct payments for specified use.	b
Water Resources on Indian Lands	The goal of this is program is to assist Indian tribes with the management, planning, protection, and development of their water and related land resources. The program provides direct payments for specified use as well as advisory and technical assistance.	b
U.S. Department of Interior –Fish and Wildlife Service		
Challenge Grant Cost Share	This program provides grants to states, tribes, local agencies, organizations, and private interests to manage, enhance, and restore fish and wildlife resources.	b
Federal Aid in Sport Fish Restoration	This program provides grants for approved state projects related to sport fish restoration.	b
Great Lakes Coastal Program	This program, which began in 2000, funds projects that seek to protect and restore Great Lakes coastal ecosystems for the benefit of fish, wildlife, and people. Its goals are to identify and prioritize coastal habitats and to evaluate ecosystem health, identify threats, and lend biological focus to the planning process of other agencies.	\$500,000
Great Lakes Fish and Wildlife Restoration Act	Since 1991, this program has developed and implemented proposals for restoration of fish and wildlife resources in the Great Lakes basin. It has provided assistance to the Great Lakes Fishery Commission, states, tribes, and others to encourage cooperative conservation, restoration, and management of the fish and wildlife resources and their habitats.	\$6,900,000
North American Wetlands Conservation Act Grants Program	Provides matching grants to private or public organizations or to individuals who have developed partnerships to carry out wetlands conservation projects.	b
Partners for Fish and Wildlife (Private Lands Program)	Provides restoration expertise and financial assistance to private landowners, tribes, and other conservation partners who voluntarily restore fish and wildlife habitat on their properties. The program targets interjurisdictional fisheries. Activities started in 1987.	\$268,500
U.S. Department of Interior – Office of Environmental Policy and Compliance		
Damage Assessment and Restoration Program	The purpose of this program is to restore injuries from oil spills and hazardous material discharges to the Department of Interior's trust resources by assessing damages and settling with responsible parties.	b
U.S. Department of Interior – U.S. Geological Survey (Table 5.3 continued)		

Cooperative Water Program	This is a cost-sharing partnership between USGS and nonfederal agencies. The program funds the collection of directly comparable basic hydrologic data, studies of specific water resources problems, and hydrologic research.	b
U.S. Environmental Protection Agency		
Brownfields Assessment, Revolving Loan Fund, and Cleanup Grants	<i>Assessment</i> grants provide funding for a grant recipient to inventory, characterize, assess, and conduct planning and community involvement related to brownfield sites. <i>Revolving Loan Fund</i> grants provide funding for a grant recipient to capitalize a revolving loan fund and to provide subgrants to carry out cleanup activities at brownfields sites. <i>Cleanup</i> grants provide funding for a grant recipient to carry out cleanup activities at brownfield sites.	b
CWA Pollution Control (Section 106 Grants)	This program develops and implements comprehensive monitoring programs at the state and tribal levels to address all water quality management needs under the CWA. Section 106 awards grants to states and to eligible Indian tribes as base program support to maintain their surface water and groundwater programs.	b
Clean Water Indian Set-Aside Grant Program	Provides grants to Indian tribes for planning, design, and construction of wastewater systems.	b
Clean Water State Revolving Fund	Provides grants to states for the construction of wastewater treatment facilities and implementation of state management plans.	b
Drinking Water State Revolving Fund	Provides grants to states to establish drinking water state revolving funds, whose purpose is to support drinking water system infrastructure improvements. These grants provide loans and other types of financial assistance to eligible public water supply authorities.	b
Five-Star Restoration Program	To provide funds to four intermediary organizations--the National Association of Counties, the National Association of Service and Conservation Corps, the National Fish and Wildlife Foundation, and the Wildlife Habitat Council--which then make challenge grants, provide technical support, and opportunities for information exchange to enable community-based wetland and riparian restoration projects.	b
Great Lakes Program – CWA Section 104(b)(3) Water Quality Cooperative Agreements/Grants	GLNPO, in concert with Regions 2, 3, and 5; makes funding available pursuant to CWA Section 104(b)(3) for activities in the Great Lakes Basin and in support of the Great Lakes Water Quality Agreement. State pollution control agencies, interstate agencies, other public or nonprofit private agencies, institutions, and organizations are eligible. Assistance (through grants, cooperative agreements, and interagency agreements) is available for projects reducing the level of toxic substances in the Great Lakes; protecting and restoring vital habitats, protecting human health; and restoring and maintaining stable, diverse, and self-sustaining populations..	b
Nonpoint Source Implementation (CWA Section 319) Grants	This program provides formula grants to assist states in implementing U.S. EPA-approved CWA Section 319 nonpoint source management programs. The program is jointly administered at the federal level by NOAA and U.S. EPA, and at the state level by coastal management and water quality agencies.	\$13,236,025 ^c
Superfund Technical Assistance Grants for Citizen Groups at Priority Sites	Provides funds to community groups to permit them to hire technical advisors who can assist the groups in interpreting technical information concerning the assessment of potential hazards and selection and design of appropriate remedies at sites eligible for cleanup under the Superfund Program.	b

^aUnless otherwise noted, the funding figures in this column represent federal fiscal year expenditures.

^bGreat Lakes basin funding is not known for this program.

^cFunding amount for Niagara River Toxics Management Program and New York Areas of Concern.

^dFunding amount Region 2 only.

^eIncluded in CZM funding amount.

3. State Water Resources Programs with Funding and Granting Capabilities

With the exception of Illinois, all of the Great Lakes states participate in the CZM. The Coastal Zone Management Programs of Indiana, Michigan, Minnesota, Ohio, Pennsylvania, and Wisconsin use parts of the annual grant award from NOAA to make sub-grants to local governments, nonprofit groups, and state agencies. Projects are selected for funding according to state priorities as described in each program's annual project application announcement. The project sponsors need to provide state or local matching funds (usually 1:1) for grants received under any of the state CZMs.

In 1989, the governors of the eight Great Lakes states created an endowment fund program called the Great Lakes Protection Fund (GLPF). Seven Great Lakes states --Illinois, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin--have contributed \$81 million to the fund's permanent endowment. Indiana has not contributed to the fund. The GLPF endowment is invested to produce income. Two-thirds of the fund's net income is dedicated to regional projects that produce tangible improvements to the health of the Great Lakes ecosystem. The remaining third is distributed annually to the member states, in proportion to their original contribution, so they can support local projects that match up with their priorities. Recipients include state agencies, academia, industry, and nongovernmental groups, as well as collaborative partnerships among these groups.

Two Great Lakes states, Michigan and New York, fund a great part of their environmental restoration activities through bond programs. In 1996, New York voters endorsed the Clean Water/Clean Air Bond Act, a major environmental initiative championed by Governor George E. Pataki. In 1998, Michigan voters approved the Clean Michigan Initiative, which replaces the 1988 Quality of Life Bond Fund.

The Clean Michigan Initiative is a general obligation bond, that is, its funds are to be used as approved by the voters. Of the total approved amount of \$675 million, the State of Michigan has \$335 million to clean up contaminated sites and to promote brownfield redevelopment. Each year, the DEQ must seek an annual appropriation from the state assembly to be able to use Clean Michigan Initiative funds. As part of this request, the DEQ must submit a list of the cleanup project sites that includes a description of planned remedial actions as well as their estimated cost.

New York's Clean Water/Clean Air Bond Act (Bond Act) authorizes a total of \$1.75 billion for five environmental categories: clean water (\$790 million), safe drinking water (\$355 million), clean air (\$230 million), brownfields (\$200 million), and solid waste (\$175 million). Under each of these categories, the state administers a variety of programs that provide grants and other resources to state agencies, municipalities, and community organizations for a wide variety of environmental projects. The selection process for Bond Act projects includes a review by independent committees of environmental experts and community members. The Bond Act authorizes \$25 million of the total of \$1.75 billion to implement priorities for the Great Lakes.

All of this funding has already been awarded to fund a total of 33 projects. The funded projects address Great Lakes priorities as identified in the Lake Ontario and Lake Erie LaMPs, the Niagara River Toxics Management Plan, and RAPs for New York's AOCs. Funded projects include 19 municipal wastewater projects, eight nonpoint source water pollution control projects, and six aquatic habitat projects.

State pollution control agencies have programs to administer State Revolving Fund grants and other CWA-related funding from the U.S. EPA. An example is Minnesota’s Clean Water Partnership (CWP), which provides local governments with resources for nonpoint-source projects. In addition to passing through federal grants to local recipients, Minnesota’s CWP also provides matching funds for eligible CWA Section 319 projects.

CWP funding for local water-quality projects is awarded in two phases: (1) in the resource investigation phase, a diagnostic study and implementation plan are completed; (2) in the project implementation phase, best management practices (BMPs) identified in the first phase are implemented. BMPs may, for example, include sedimentation ponds or wetland restoration. The financial assistance is available through grants or low-interest loans. Grants are available for up to 50 percent of the project costs. Loans can only be used for the project implementation phase but may cover the entire cost of implementation or supplement a grant. Local governments can also use loans to set up their own programs to provide pass-through loans to private parties.

Table 5.4
State Water Resources Programs with Funding and Granting Capabilities in the Great Lakes basin

Program Name	Purpose	Program expenditures (1992–2001) ^a
Illinois Environmental Protection Agency		
Illinois Great Lakes Protection Fund	The Illinois GLPF program funds special studies and projects related to Great Lakes research, cleanup, restoration, or pollution prevention. The projects are selected as part of the states’ budget process.	\$5,000,000
Indiana Department of Natural Resources		
Indiana Lake Michigan Coastal Program	Indiana participates in the CZM via the Indiana Lake Michigan Coastal Program. The purpose of Indiana’s coastal program is to enhance the state’s role in planning for and managing natural and cultural resources in the coastal region of Lake Michigan and to support partnerships between federal, state and local agencies and organizations.	^b
Lake and River Enhancement Program	This program funds restoration activities by providing technical or financial assistance for projects that reduce nonpoint source sediment and nutrient pollution in Indiana’s and adjacent state’s surface waters.	^b
Michigan Department of Environmental Quality		
Clean Michigan Initiative	A \$675 million general obligation bond program that is used for environmental restoration activities such as the cleanup of brownfields and greenspace preservation.	\$255,900,000
Michigan Coastal Management Program	Michigan’s Coastal Management Program was developed under the CZMA and approved in 1978. Since then, the Program has assisted organizations in protecting and enhancing their coastal areas, funded studies related to coastal management and helped to increase recreational opportunities in Michigan’s Great Lakes coastal area.	^b
Michigan Great Lakes Protection Fund	By mandate, Michigan’s GLPF program only funds research projects by universities and for-profit groups. The research project agenda is determined each year by a MDEQ technical advisory board and may be based on legislative direction, recommendations from MDEQ departments, or current environmental issues.	\$5,199,601

Minnesota Board of Water and Soil Resources (Table 5.4 continued)		
Comprehensive Local Water Planning Challenge Grant Program	Provides financial and technical assistance to counties for development and implementation of local water plans.	\$428,732
Erosion, Sediment Control, and Water Quality Costshare Program	Provides funds to soil and water conservation districts for cost-sharing conservation projects that protect and improve water quality by controlling soil erosion and reducing sedimentation. This restoration program provides technical and financial assistance to landowners who install permanent nonproduction-oriented practices to protect and improve soil and water resources.	\$1,293,298
Local Water Planning and Wetland Conservation Act	This block grant program assists local governments in implementing four state-mandated programs. Water planning grants are available for restoration activities related to implementing comprehensive water plans and the local administration of grants.	\$976,313
Minnesota Department of Natural Resources		
Conservation Partnership Program	Provides grants to private organizations and local units of government for activities related to restorations of fish, wildlife, and native plant habitats. The program also funds research to improve fish and wildlife habitats.	^b
Lake Superior Coastal Program (CZM)	Minnesota's Lake Superior Coastal Program provides grants to preserve, protect, develop and where possible restore or enhance coastal resources along Minnesota's north shore of Lake Superior.	^b
Minnesota Pollution Control Agency		
Basin Planning	MPCA created this program in 1995 to coordinate water management efforts around the state's 10 major drainage basins by focusing financial and staff resources upon key water resource management priorities. The program provides support to local and state agencies and citizen groups to develop watershed plans for making sound resource management decisions.	\$175,000
Clean Water Partnership	Funds activities related to runoff from agricultural and urban areas. The program provides funds to local governments for projects that protect and improve lakes, streams, and groundwater resources in Minnesota. Funds can be requested for research, cleanup, restoration, or pollution prevention projects.	\$2,613,798
Minnesota State Planning Agency		
Minnesota Great Lakes Protection Fund	By state statute, funds from Minnesota's GLPF can only be spent to protect water quality in the Great Lakes. Grants are awarded to finance projects that advance goals of the binational Toxic Substances Control Agreement and Water Quality Agreement. Projects involve research, cleanup, restoration, or pollution prevention activities.	\$987,000
New York State Department of Environmental Conservation		
Clean Water and Clean Air Bond Act	This program was established in 1996. It consolidates the funding application processes of several state agencies and programs. One of the major programs is the Environmental Protection Act and Fund, which addresses brownfields cleanup and restoration, land and open space conservation, and waterfront revitalization. Other consolidated programs focus on water quality, safe drinking water systems, and other environmental conservation efforts.	\$428,820,724
New York Great Lakes Protection Fund	New York's GLPF program provides for overall intra- and interstate coordination and planning of the state's Great Lakes programs, and is a source of grants for research, data collection, technology development, policy analysis, and outreach.	\$1,494,053
Ohio Department of Natural Resources		
Great Lakes Coastal Restoration Grant Program	The Great Lakes Coastal Restoration Grant program provides reimbursement to groups who wish to undertake coastal restoration and water quality improvement projects in the Ohio Lake Erie coastal area and drainage basin. The funds are available through NOAA's Coastal Zone Management Program and are administered by ODNR's Office of Coastal Management.	^b

Ohio Environmental Protection Agency (Table 5.4 continued)		
Clean Ohio Fund	This program, since 2002, awards grants for cleanup and restoration of polluted areas and the preservation and conservation of farmland.	^b
Ohio Lake Erie Commission/Lake Erie Protection Fund (Ohio Great Lakes Protection Fund)	The Ohio GLPF program provides grants to fund research, support cleanup and restoration efforts, and educate nonprofit, government, or public entities seeking to protect or enhance Lake Erie.	\$6,943,894
Pennsylvania Department of Environmental Protection		
Growing Greener Grant Program	This program began in 1999 to address critical concerns related to education and outreach, as well as wetland restoration, soil erosion and sedimentation controls, and creek assessments in Lake Erie tributaries.	\$700,000
Pennsylvania Coastal Zone Management Program	Through annual federal grants, CZM provides technical and financial assistance to local governments and state agencies to control development in coastal hazard areas, improve public access, protect natural resources, expand strategies to improve local economies, and promote proper planning. The program also provides technical assistance to federal and state agencies in conserving coastal resources and to property owners with bluff recession problems.	\$938,000
Pennsylvania Great Lakes Protection Fund	The Pennsylvania GLPF provides grants to fund education, research, and monitoring activities.	\$253,721
Wisconsin Department of Administration		
Wisconsin Coastal Management Grants Program	Wisconsin's Coastal Management Program (WCMP) is the state's participation in NOAA's CZM. WCMP awards grants to projects that support the management, protection and restoration of Wisconsin's coastal resources or increase public access to the Great Lakes. Local units of governments in WI's 15 coastal counties, state agencies, tribal governments, regional planning commissions, universities, colleges, technical schools and non-profit organizations are all eligible.	^b
Wisconsin Department of Commerce		
Brownfields Grant Program	Provides financial assistance for brownfields redevelopment and related environmental remediation cleanup and restoration projects.	^b
Wisconsin Department of Natural Resources		
Site Assessment Grants	This grant program was started in 2000 to provide local governments with grants to perform the initial investigation of contaminated properties and other eligible activities. Its focus is the restoration and cleanup of abandoned, idle, or underused industrial or commercial facilities and sites.	^b
Sustainable Urban Development Zone Program	This 1999 WDNR pilot program operates in cooperation with other state agencies and the cities of Milwaukee, Green Bay, La Crosse, Oshkosh, and Beloit. Funds may be used to investigate environmental contamination and clean up brownfields properties in these cities.	\$1,700,000
Wisconsin Great Lakes Protection Fund	The Wisconsin GLPF program provides funds to municipalities and other governmental units, groups, nonprofit organizations, universities and others for various projects. Funds are used for (1) implementing activities included in RAPs, (2) restoring or protecting fish and wildlife habitat in or adjacent to Lake Michigan or Lake Superior, or (3) planning or providing information related to cleaning up or protecting the Great Lakes.	\$2,224,914

^aUnless otherwise noted, the funding figures in this column represent state fiscal year expenditures.

^bGreat Lakes basin funding is not known for this program.

4. Foundation Programs With Funding and Granting Capabilities in the Great Lakes Basin

Dozens of foundations and trusts provide grants and loans for environmental projects or other water resources-related programs or projects. Most foundations have a very specific, and

often localized, purpose. The Great Lakes Fishery Trust, for example, was created to compensate the citizens of Michigan for the lost use and enjoyment of fishery resources of Lake Michigan resulting from the operation of the Ludington Pumped Storage Plant. The George Gund Foundation, another example, makes environmental grants for projects focused on the greater Cleveland, OH, area. The Great Lakes Information Network (GLIN) has a database of foundation funding and granting sources (<http://www.glin.net/infocenter/news/funding.html>). Specifically, the following three foundations maintain major nationwide funding programs with wide applicability to Great Lakes restoration activities in the basin:

The Environment Program of the Charles Stewart Mott Foundation supports efforts to conserve freshwater ecosystems in North America, including the Great Lakes. Grants are provided to improve capacity building for environmental organizations and to protect and restore selected freshwater ecosystems through conservation activities.

The Environment Program of the Joyce Foundation supports various policy initiatives, including long-term efforts to protect the Great Lakes environment, and provides grants to organizations for environmental projects. Program priorities include making improved water quality a goal of state and federal policies on land use, transportation, and agriculture; establishing a better understanding of the supply of and demand for Great Lakes water; and promoting policies that encourage water infrastructure projects to be less capital intensive and more environmentally sensitive, as well as more cost effective.

The General Challenge Grant Program of the National Fish and Wildlife Foundation (NFWF) awards grants to foster cooperative partnerships that conserves fish and wildlife and the habitats on which they depend. Challenge grants are designated for projects that advance specified priority actions and meet certain “challenge” criteria. For example, the Five-Star Challenge program is for restoration efforts that involve partnering, funding, and/or participation of all of the following “five stars” in the project: (1) schools or youth organizations; (2) local or tribal governments; (3) conservation organizations or local citizen groups; (4) state and federal resource management agencies; and (5) foundations or other funders. Projects are awarded that address priority actions by promoting conservation, work proactively to involve other conservation and community interests, leverage NFWF-provided funding, and evaluate project outcomes. Eligible recipients include federal, state, and local governments, educational institutions, and nonprofit organizations.

Table 5.5.
Foundation Programs with Funding and Granting Capabilities in the Great Lakes basin

Program Name	Purpose
Charles Stewart Mott Foundation	
Environment Program	Provides grants to improve capacity building for environmental organizations and to protect and restore selected freshwater ecosystems through conservation activities.
Joyce Foundation	
Environment Program	Provides grants to organizations for environmental projects. Program priorities include making improved water quality a goal of state and federal policies on land use, transportation, and agriculture; establishing a better understanding of the supply of and demand for Great Lakes water; and promoting policies that encourage water infrastructure projects to be less capital intensive and more environmentally sensitive, as well as more cost effective.
National Fish and Wildlife Foundation	
General Challenge Grant Program	Awards challenge grants to foster cooperative partnerships to conserve fish and wildlife and the habitats on which they depend. General challenge grants are available to federal, state, and local governments, educational institutions, and nonprofit organizations.

5. Plan Formulation

A. General

Plan formulation is the process of combining various management measures into comprehensive water and related land resources alternatives plans of action that meet the goals defined in the study authorization. The study objective is to formulate alternative plans that respond to national, regional and local objectives and resolve identified problems, meet commercial navigation needs and facilitate opportunities.

B. The Corps in the Great Lakes—A Brief History

Army engineer activities on the Great Lakes began in 1789, when a group of military engineers explored the southern shore of Lake Erie by boat. The crew took depth soundings, made observations of the land, fortifications and native villages, and drew the first American-made maps of the area.

In their natural state, the Great Lakes offered few natural harbors. Early explorers and traders used river inlets and small bays for landing areas and refuge from storms, but these were inadequate for the larger vessels that would come later. Sandbars, hidden shoals, waterfalls and rapids all presented obstacles to navigation, either in the lakes themselves or the connecting channels between them. Unique landmarks were few along their sandy coasts, and maps and charts poor to nonexistent at the time of this nation's founding. It fell largely to the U.S. Army Corps of Engineers and Topographical Engineers to address these concerns.

The U.S. Army Corps of Engineers officially dates to 1802, when President Thomas Jefferson signed into law a bill creating the Corps and establishing the U.S. Military Academy at West Point as an engineering school (Drescher, 1982). Over the next quarter-century, West Point remained the nation's only school for training engineers.

The Topographical Engineers was formed in 1813. It conducted survey and mapping operations throughout the American frontier, and was responsible for Great Lakes coast surveys, lighthouse construction and many civil engineering projects in the region in the decades prior to the Civil War. It was eventually merged into the Corps of Engineers in 1863 and its actions are considered part of Corps history.

Development in the Great Lakes region was ignited by the completion of the Erie Canal by New York State in 1825. By connecting Lake Erie with the Hudson River, it provided an attractive route for people and goods to move between the East Coast and the innermost reaches of the lakes. Together with Canada's Welland Canal, completed in 1829 to bypass Niagara Falls, it facilitated economic growth and the development of the shipping trade upon the Great Lakes and, by extension, the demand for navigation improvements.

During the 1820s, with funding and authorization from Congress, the Corps began making improvements to a number of harbors on Lake Erie and Ontario, among them Cleveland, Oswego and Buffalo, the latter at the terminus of the Erie Canal. Federal improvements at

Chicago began in 1832. The dredging equipment of the day was relatively ineffective, so natural currents were harnessed whenever possible to clear a channel of sand and gravel. In the case of harbors utilizing tributary rivers, sturdy piers were extended into the lake to confine the river's discharge and carve a deeper channel. For bays, parallel piers, called jetties, were used to direct the ebb and flow of the lake through a single, well-defined channel (Drescher, 1982).

The science of harbor design was an evolving one, as Army engineers learned from experience how to build structures that could withstand the deteriorating effects of constant exposure to water and currents, while minimizing the accumulation of sediment in shipping channels. The usual components used in 1800s pier construction were wooden cribs made of heavy timbers, sunk in place and filled and anchored with rock. Shifting sands beneath their foundations and the pounding of storms caused frequent and extensive damaged to these piers, which Corps engineers repaired, redesigned, rebuilt and expanded as their understanding of the action of the lakes improved.

A significant step in developing this understanding was a hydrographic survey of the harbors at Buffalo and nearby Black Rock, N.Y., conducted in 1929-30 by Capt. W.G. Williams. The first systematic study of any portion of the Great Lakes, it marked the beginning of the Corps' activities in the scientific study and charting of the Great Lakes system. Williams paid particular attention to the action of storms, as well as to the geology and topography of the lake bottom and the action of ice packs in winter. These provided the foundation for permanent improvements at the port of Buffalo and pointed the way toward similar efforts elsewhere in the lakes (Drescher, 1982).

Commerce on the Great Lakes was increasing rapidly. In 1831, six years after completion of the Erie Canal, Lake Erie was home to 11 steam vessels and 100 others totaling 6,582 tons. Five years later, there were 45 steam vessels and 211 other types based on the lake, with a total capacity exceeding 24,000 tons (Larson, 1981a). An 1842 study by the Corps of the value of lake commerce found that the export trade on the lakes had doubled four times in just seven years, growing from \$2 million in 1835 to \$32 million in 1842. Imports increased from \$14 million to \$33 million from 1835-41 (Larson, 1981a).

Water transportation offered an efficient and economical means of moving the goods the region produced and needed, including grain, lumber, ore, fish, furs, salt, finished goods, and more. A network of rivers and canals, along with the growing national rail system, provided the means to collect products from a wide region and bring them to the lakes for shipment. Places such as Chicago, Milwaukee and Duluth were ideally suited to receive the agricultural bounty from the hinterlands for shipment east, as well as send finished goods back the other way. Small harbors in Michigan and Wisconsin shipped out lumber to build the growing nation, while others around the lakes handled supplies and products for local industry and agriculture.

As a result, the region grew rapidly. In 1820, there was not a single community in the Great Lakes basin that the U.S. Census Bureau classed as urban, referring to a population greater than 2,500. By 1860, seven of the 21 largest cities in the U.S. were on the Great Lakes (Gibson); an eighth, Pittsburgh, depended heavily on trade from the lakes. Nowhere was growth more stunning than Chicago; first identified as urban by the U.S. Census in 1840 with a population of

4,470, it exploded to 112,172 by 1860, becoming the largest city in the Great Lakes basin and ninth-largest in the U.S. (Gibson).

But federal funding was hard to come by for Great Lakes navigation projects in the decades leading up to the Civil War, owing to a growing dispute over whether the Constitution allowed the federal government to make internal improvements, as opposed to those along the seacoast. Opposition was particularly strong in the South, which preferred a limited role for the national government.

One of the projects deemed to pass constitutional muster was a survey of the upper Great Lakes, begun in 1841. Eventually known as the United States Lake Survey, it came to encompass all five Great Lakes and their connecting channels by the time the field work was completed in 1882 (Larson, 1981a). Engraved charts from the survey were made available to all Great Lakes vessels and proved an immense boon to safe navigation. The survey also provided the basis for planning improvements to harbors, channels and other navigational infrastructure.

Congress revived the Lake Survey in 1899, when it became apparent the original charts were no longer adequate in an era when vessels drew as much as 20 feet of water. Some 6,000 shipwrecks, some due to inadequate charts, had been recorded on the lakes from 1878-98 (Larson, 1981a). The Lake Survey and ensuring the accuracy of Great Lakes charts remained ongoing Corps of Engineers functions up until 1970, when they were turned over to the newly created National Oceanic and Atmospheric Administration.

Another major project was the Soo Locks. By 1850, the Lake Superior region was becoming an increasingly important source of fish, copper and iron, all of which had to be off-loaded and transported over the portage around the St. Marys Rapids. In 1852, Congress provided a grant of 750,000 acres of public land to fund construction of a shipping canal and two locks bypassing the rapids (Larson, 1981a). Under the supervision of the Detroit District of the Topographic Engineers, all three were completed by the spring of 1855 and deeded to the state of Michigan (Larson, 1981a). With subsequent dredging in the river, by 1859 vessels with a 12-foot draft could make the passage between lakes Huron and Superior (Larson, 1981a).

The effect upon trade was almost immediate. Less than 1,500 tons of iron ore were shipped through the locks in their first year. Ten years later, this had increased nearly a hundredfold, to more than 147,000 tons. Lumber, grain, flour and copper also came down from Lake Superior, and coal was sent upbound. By 1869, Lake Superior mines accounted for one-third of all the iron and two-thirds of the copper produced in the United States (Larson, 1983).

Ships grew rapidly in size. By 1869, Great Lakes shipping companies were building vessels with drafts of 12-14', compared to 10' typical of the largest pre-Civil War vessels, and with 2-3 times the capacity. The economic advantages were distinct; it cost only an additional \$8 a day to man the larger vessels compared to one of medium size (Larson, 1981a).

But larger vessels had greater problems negotiating the connecting channels between the lakes. Shallow and/or narrow passages led to congestion, collisions and groundings, and some vessels were limited to less-than-full loads in order to reduce their draft. Dredging and

sometimes underwater blasting and rock removal was needed to allow vessels to pass freely. One major obstacle was the St. Clair Flats, a large, shallow area at the north end of Lake St. Clair that had to be crossed by all east-west trade with lakes Michigan, Superior and Huron.

Lengthy delays here were common. Vessels were sometimes obliged to unload part of their cargo to have it shuttled through by lighters, and the grounding of a single vessel close the entire passage for days. A meandering natural channel was improved by dredging, but congestion remained severe; an 1866 observer counted 100 vessels jammed in the 2½ miles of the channel. Adding in the cost of towing, pilots and navigation lights, it was estimated that year that the flats imposed an annual financial burden of nearly half a million dollars (Larson, 1981a).

A straight new channel was completed in 1871. A mile shorter than the original, it was a relatively spacious 15 feet deep and 300 feet wide. Perhaps its most distinctive feature was that to prevent infilling, dikes overplanted with grass, poplars and willows fortified the sides. At approximately \$400,000, it cost less than the annual losses incurred on the old channel (Larson, 1981a). As with nearly all Corps projects in the post-Civil War decades, it was done by contracting out the work under Corps supervision and design.

The Civil War effectively ended Southern opposition to federal involvement in Great Lakes navigation projects. The federal government made considerable investments in Great Lakes navigation over the next half century, during which improvements to locks, harbors and shipping channels were hard-pressed to keep up with rapid increases in both vessel size and traffic. New technologies facilitated the construction of increasingly larger vessels, with steel hulls, while fueling an economic boom that fed the demand for the cargoes these vessels carried. Nowhere was this more vividly illustrated than in the evolution of the Soo Locks.

A new lock, 500 feet long and 16 feet deep, opened in 1881. However, traffic had increased fivefold during the 12 years of its construction, and within four months its superintendent was recommending construction of another (Larson, 1981a). In 1883, 4,000 vessel passages bearing 1.8 million tons of freight were recorded at the Soo Locks; ten years later, there were three times as many vessels bearing more than five times the freight. Cargoes included iron and iron ore, copper, flour, grain, coal (upbound), lumber, and salt. The growth in iron ore and flour shipments over the decade were particularly impressive, with iron increasing from 804,000 to 4.6 million tons, and flour from 427,000 to 5.6 million barrels (Larson, 1983).

Work on another lock began in 1887, under the supervision of Col. Orlando Poe, the new commander of the Corps' Detroit District and for whom the lock would eventually be named. With dimensions of 800x100 feet and a 22-foot depth, it was designed to handle four ships at once. Vessel sizes increased so fast, however, that by the time it opened in 1896, it could typically handle only two; by 1905, sometimes only one (Larson, 1981a). The Canadians opened a 900-foot lock of their own in 1895 (Larson, 1983). Meanwhile, commerce passing through the locks increased from nine million tons in 1891 to 44 million by 1905, with iron ore the chief commodity, owing in large part to the discovery of iron ore in Minnesota's Mesabi Range (Larson, 1981a).

“For 35 years I have watched the increase of Great Lakes commerce,” Col. Poe wrote in 1891, “But neither I nor anyone else has been able to expand in ideas at the same rate. The wildest expectations of one year seem absurdly tame by the side of the actual facts of the next” (Larson, 1981a).

By 1906, vessels of greater than 600 feet in length were in operation upon the lakes and it was clear that additional locks were needed. Over the next 13 years, two new locks were added, each with dimensions of 1,350x80 feet to enable them to lock through two 650-foot vessels at once; they were eventually named for the commander who oversaw construction of the first, Lt. Col. Charles E. L. B. Davis, and General Superintendent Louis Sabin, the lead civilian engineer on both projects (Larson, 1983). By 1916, total commerce through the Soo Locks reached 92 million tons (Larson, 1981a). Fortunately, vessel size had stabilized at around 650 feet and it was some years before further improvements were needed.

One consequence of the increasing size of vessels on the Great Lakes was that the original charts developed by the Lake Survey were no longer adequate in an era when ships drew of vessels drawing as much as 20 feet of water. Some 6,000 shipwrecks, some due to inadequate charts, were recorded on the lakes from 1878-98 (Larson, 1981a). As a result, Congress reestablished the Lake Survey in 1899 as a Corps of Engineers function; it was responsible for ensuring the availability of accurate Great Lakes charts up until 1970, when its functions were merged into the newly created National Oceanic and Atmospheric Administration.

Obviously, larger locks were of little value unless the connecting channels between the lakes could accommodate the larger vessels as well. The Corps engaged in a steady program of improvements to shipping channels during this era, dredging sediment and sometimes blasting out solid rock in order to deepen and widen the passages. This was done on a case-by-case basis prior to 1892, when Congress approved initial funding for a comprehensive plan to provide a minimum 20-foot depth and 300-foot width in all Great Lakes passages between Chicago, Duluth and Buffalo (Larson, 1981a).

Though railroads offered increasing competition, water transportation in the late 1800s still cost only one-seventh as much and was favored for bulk commodities. This spurred the development of Great Lakes cities as centers of commerce based on those commodities. Buffalo, at the western terminus of the Erie Canal, became a major milling center in the late 1800s, taking Midwestern grain and turning it into flour for East Coast markets. The easy shipment of iron ore, limestone and coal spurred the growth of the steel industry and related manufacturing in such cities as Detroit, Gary, Cleveland, Milwaukee and Chicago. The latter’s position at the southwest corner of the Great Lakes and rail links to the Great Plains and beyond fueled its rise to the second-largest city in the nation.

To serve these ports, a new approach to harbor design was needed. The previous model of extending parallel piers from the mouth of a river was inadequate for the needs of commerce in the late 1800s. Corps engineers began to favor the construction of outer harbors that provided greater space for docking by allowing use of the shoreline, and did not require vessels to venture into the confines of the river. Wider entrances, protected by breakwaters, also provided a greater

margin of safety for vessels entering in bad weather, as opposed to the narrow, unprotected entrances of the earlier model.

One such project, and one that clearly illustrates the role of navigation projects in spurring economic development, began inauspiciously in 1870. In that year, Congress appropriated \$50,000 to begin construction of a modest harbor of refuge at the mouth of the Calumet River, for vessels unable to enter Chicago Harbor in rough weather. Unlike the Chicago River, the Calumet had abundant land available for development, and it grew quickly, with grain elevators, steel mills, rail connections, a shipyard, docks and slips, eventually becoming one of the biggest ports on the Great Lakes. Shipping out grain and bringing in iron ore, limestone and coal, by 1916 it had far surpassed Chicago in tonnage, handling 10 million tons of commerce compared to 2.5 million for Chicago (Larson, 1981b).

The Corps also played an active role in river navigation in the Great Lakes region during the postwar period, with pronounced economic benefits. Two notable examples are the Saginaw and Rouge rivers of Michigan. Both had seen extensive commercial navigation prior to the Civil War, but the demands of commerce and increases in vessel size soon made them inadequate in their natural state. A 12-foot-deep channel dredged through the Saginaw enabled communities such as Bay City and Saginaw to develop into manufacturing centers that received their raw materials by water. Dredging the Rouge opened up new areas for industry south of Detroit, whose waterfront was fully occupied by manufacturing operations by 1886. Shipments on the Rouge, primarily iron ore, coal, stone, sand and petroleum products, increased nearly 1,000 percent from 1903 to 1912, from 135,000 to 1,321,000 tons (Larson, 1981a).

A more extensive inland navigation project took place in the 20th century, after the federal government assumed responsibility for the water route between Lake Michigan and the Mississippi River in 1930 (Larson, 1981b). During this time, the main connection was the Chicago Sanitary and Ship Canal, which connected to the Chicago River. But in looking to improve the route, Corps engineers questioned the wisdom of bringing more water traffic into downtown Chicago. The Calumet River and harbor offered more room for expansion, and so over the decades to come, Corps engineers gradually improved the Sag Canal to accommodate modern barge traffic.

Almost immediately, these produced a huge increase in freight traffic on the Sag Canal, rising from 67,000 tons in 1932 to more than 1 million tons in 1944 (Larson, 1981b). Most shipments on the Illinois Waterway were upbound, and included coal for generating electricity, sulfur from Louisiana and Texas brought north for loading aboard lake vessels, crude oil for Chicago-area refineries, as well as local traffic in sand, gravel, limestone and other bulk products (Larson, 1981b). Improvements to the Grand Calumet River after 1945 allowed the development of a network of channels that allowed the industrial areas of Gary and East Chicago to tie into the Illinois Waterway (Larson, 1981b). From 1955 to 1971, the 16.2 mile Sag Canal was widened from 60 to 225 feet throughout, bridges presenting obstacles along the route were altered or removed and locks and turning basins added (Larson, 1981b). Traffic on the Illinois Waterway continued to rise and by 1974 reached 45.3 million tons (Larson, 1981b).

The Sanitary and Ship Canal and Sag Canal are significant in Corps history for another reason. Both were built to dilute sewage in the Chicago and Calumet rivers by drawing water out of Lake Michigan, opposite the two rivers' natural flows. As a result, they raised for the first time the question of the diversion of Great Lakes water out of the basin. The Sanitary and Ship Canal opened in 1900, by 1906 plans were underway for the Sag and a third sewage canal, and cities in Wisconsin and northern Illinois were thinking about using lake water to flush their sewage into tributaries of the Des Plains and Fox rivers.

The Chicago District Engineer calculated that such plans would mean the diversion of 20,000-30,000 cubic feet of water per second, which if maintained for five years would lower lakes Michigan and Huron by 1½ feet. In 1910, the Secretary of War issued a permit limiting the Chicago Sanitary District's total diversions to 250,000 cubic feet per minute (4,111 per second), including the new canals (Larson, 1981b), with the Corps' Chicago District responsible for monitoring the flow, a responsibility that continues to this day. Supreme Court decrees in 1930 and 1967 further limited these diversions to an average of 3,200 cfs (Larson, 1981b). These actions form the foundation that informs current policy discussions regarding the consumptive use and out-of-basin diversion of Great Lakes water.

Shortly after the turn of the century, controlling works were built on both the U.S. and Canadian sides of the St. Marys River at the Soo Locks to manage the outflow from Lake Superior. The Boundary Waters Treaty of 1909, which established the International Joint Commission, made provisions for binational cooperation in regulating the outflow (Larson, 1981a); in 1914, IJC established the two-member International Lake Superior Board of Control to set outflows and operate the works, with the U.S. representative being from the Corps of Engineers, an arrangement that remains in effect.

From these measures and the need of commercial shipping to anticipate useable depths in shipping channels, the Corps' developed the function of making water level forecasts. The Corps began making monthly precipitation estimates for each of the five Great Lakes watersheds beginning in the 1880s (Croley, 1993). Drawing on information a network of water level gages and multiple U.S. and Canadian federal agencies, the Corps' Detroit District, in cooperation with Environment Canada, continues to publish a monthly forecast of the likely ranges of water levels over the next six months in the Great Lakes and Lake St. Clair.

Shortly after the turn of the century, a new role began to emerge for the Corps of Engineers at Niagara Falls. Early power generation at the falls was haphazard and nearly unregulated, without regard for its effects on the aesthetics of the falls or navigation above and below them. Following passage of the Burton Act in 1906, engineers of the Corps' Buffalo District were given responsibility for conducting hydrological studies of the river and ensuring that water diversions by power companies did not exceed the limits of their permits; engineers were also made available on a contractual basis to assist companies in deriving the greatest efficiency from their allocated flows (Drescher, 1982).

With the American entry into World War I, engineers of the Corps' Buffalo District were called on to lend their expertise in ensuring an uninterrupted supply of power to support the war effort. This work led to a number of recommendations to increase reliability and efficiency,

including the interconnection of adjoining systems. The general thrust of these recommendations were later incorporated into national policy and gave rise to the power grid system in use today (Drescher, 1982). The Buffalo District also played a major role in the construction of the Niagara Power Company hydraulic plant following the war, including ensuring that the facility would not interfere with the grandeur of the falls.

Great Lakes shipping hit a record 138.5 million tons in 1929, primarily iron ore, grain, coal and limestone, but fell to 41.6 million tons in 1932 with the arrival of the Great Depression. Nevertheless, the Depression was a time of significant improvements to Great Lakes navigation, owing to economic stimulus projects overseen by the Corps. These primarily related to improving connecting channels and harbors. By 1936, a minimum depth of 24 feet had been provided in all downbound channels; lesser depths were available in upbound channels, where vessel loads tended to be less. Channels were widened as well, so as to provide a minimum of 300 feet for one-way traffic and 600 feet for two-way in most areas. Dredging that would provide depths comparable to the connecting channels was carried out at numerous harbors as well (Larson, 1983).

In the late 1930s, it became apparent that a new lock was once again needed on the St. Mary's River. The outbreak of WWII provided a powerful impetus for the project; which was completed in a mere 16 months, compared to a minimum of six years for all previous locks. Known as the MacArthur Lock, it provided additional shipping capacity for the war effort and minimizing the likelihood that hostile action could close the passage. Vessel sizes were increasing again by the 1960s, leading to the replacement of the aging Poe Lock by a new one of the same name. Measuring 1,200x110 feet with a 32-foot depth, the new Poe Lock opened to traffic in October 1968. Within four years the Stewart J. Cort, the first 1,000-foot bulk freighter, arrived, beginning the age of the superfreighters that now carry the majority of Great Lakes cargo.

Just prior to construction of the new Poe Lock, the Corps had completed one of the largest projects it was ever involved in: construction of the St. Lawrence Seaway. A U.S. - Canadian partnership to build the Seaway was approved by Congress and President Eisenhower in 1954 (Drescher, 1982). The Corps' share of the project included construction of two of the seven locks and three major dams; excavating the 10-mile-long Wiley-Dondero Ship Canal around the International Rapids; removing shoals among the Thousand Islands; as well as building dikes, a high-level suspension bridge, roads and buildings related to the project. When it opened in 1959, the Seaway offered a passage 27 feet deep that, along with related improvements by the Canadians to the Welland Canal, opened the port cities of the Great Lakes to the oceangoing commerce of the world (Larson, 1983).

At the beginning of the 20th century, the Great Lakes shipping season typically began in late May and ended in early December when the Soo Locks opened and closed for the year. By the 1940s, icebreakers and other means had extended the season to nine months, and by 1965, new technologies and expertise in ice navigation offered the potential of year-round navigation (Larson, 1981a). In 1970, Congress authorized the Corps to undertake a study and demonstration program of winter navigation on the Great Lakes and St. Lawrence Seaway, which showed that year-round navigation on the lakes was possible. Shipping interests favored an extended season,

but environmental groups expressed reservations about the impacts on such things as shorelines, spawning grounds and emerging wetlands. In 1993, a compromise was reached among the four primary agencies involved – the Corps, the U.S. Coast Guard, the U.S. Fish and Wildlife Service, and the Michigan Department of Natural Resources – to establish a closing date for the Soo Locks of no later than Jan. 15, and an opening no earlier than March 21 (Larson, 1981a).

Though flood control is now one of the Corps' primary civil missions, it had relatively little to do in this area in the Great Lakes region prior to 1927. In that year, Congress authorized the Corps to carry out nationwide studies of river systems to provide a basis for improvements in navigation, power development, flood control and irrigation. A national flood control policy was not adopted until the Flood Control Act of 1936, which authorized the Corps to undertake 200 flood control works nationwide (Larson, 1981a). In the decades to come, this included such measures as dikes, levees, channel improvements, reservoirs and bypass channels in such places as the Illinois, Kalamazoo, Saginaw, Clinton, Sebewsing and other rivers under the authority of the Corps' Chicago, Detroit and Buffalo districts.

The biggest of these projects was the Mt. Morris dam, on the Genesee River above Rochester, N.Y. Major floods occurred in the Genesee River valley on a regular basis, averaging one every seven years from 1865-1950, causing both agricultural and urban destruction, and dumping silt into Rochester's Charlotte Harbor on Lake Ontario (Drescher, 1982). Completed in 1952, the Mt. Morris dam is one of the largest of its type in the eastern United States, standing 215 high and 1,028 feet long. It was estimated the dam prevented \$8 million in property damage during its first decade alone, but the real test came in 1972 following tropical storm Agnes. The reservoir was filled to capacity by inflows at a rate expected only once every 290 years. Minor flooding occurred downstream due to controlled releases, but it was estimated that the dam prevented \$210 million in damages, primarily in the Rochester area (Drescher, 1982).

A different type of flood control project was Operation Foresight, launched in December 1972 in anticipation of high Great Lakes water levels expected the following spring. Doubling as a shoreline preservation effort, Operation Foresight resulted in construction projects to protect 59 lakeshore communities through such measures as earthen dykes protected by riprap, sand- and rock-filled cribs and other measures. Technical assistance and flood-fighting materials were provided to another 141 communities. Total federal costs for the project were \$26.8 million; total damages prevented were estimated to be five times as much (Larson, 1981a).

A growing role for the Corps has been in beach protection and erosion management along Great Lakes shores. Early efforts along these lines began in the 1800s, when the Corps took action to prevent the erosion of the sandy peninsula protecting the harbor at Presque Isle. These efforts came to include the installation of bulkheads, groins and riprap along the beach. In the 1950s, a beach replenishment program added 4 ½ million cubic yards of sand, hydraulically pumped from offshore (Drescher, 1982). These became the model for similar efforts elsewhere around the Great Lakes, particularly during the high water levels of the 1970s and 80s. Section 111 of the River and Harbor Act of 1968 authorized the Corps to undertake projects to prevent or mitigate shore damage resulting from federal navigation works. At the request of the state of Michigan, mitigation studies were conducted at 20 harbors in that state during the 1970s, and corrective measures taken at many. At St. Joseph, clean sand pumped from the lake bottom was

used to rebuild 3,400 feet of shoreline; similar measures were taken at Muskegon, Holland, Grand Haven, Ludington, and Manistee, to name a few (Larson, 1981a).

The move toward what might be termed “quality of life” projects, those with a recreational and/or environmental emphasis, as opposed to strictly navigation or flood control, for the Corps evolved gradually throughout the 20th century. In 1932, Congress took an action with significant implications for the modern Great Lakes economy, expanding the definition of waterborne commerce to include recreational boating (Larson, 1981b). This set the stage for other legislation in 1945, in which Congress authorized the rehabilitation or construction of a number of small harbors on the Great Lakes to serve as harbors of refuge for recreational craft. Many of these had originated as lumbering harbors or for serving local commerce during the 1800s and had received little or no federal assistance in nearly a century. Recreational boating had grown to the point where, by 1941, there were over 300,000 registered motorboats on the Great Lakes, with increasing numbers being used for extended cruises (Larson, 1981a). A chain of harbors of refuge 30 miles apart would provide safety and act as a sort of “marine highway.”

The Corps role in public recreation was expanded by the Flood Control Act of 1944, which authorized the Chief of Engineers “to construct, maintain and operate recreational facilities in reservoir areas,” such as swimming beaches, boat launches and docks, and the like. This was expanded in 1962 to include authority for recreation in all water resources projects (Larson, 1981b). The impacts of measures such as these are keenly felt today, when recreational boating and sportfishing in and around the Great Lakes have become a multibillion-dollar industry and important element of the regional economy.

The 1960s saw the Corps take on increasing responsibility for environmental protection and restoration, both in carrying out its traditional functions and in undertaking new projects. This was not a completely new role; Maj. William Marshall, commander of the Chicago District from 1888-1899, had frequently clashed with local interests over the use of the Chicago River as an open-air sewer. The Refuse Act of 1899 gave the Corps authority to regulate or shut down “any effluent source on any navigable waterway,” an authority used several times in the 1960s to force industrial polluters to redress cases of severe river pollution (Drescher, 1982). This direction was solidified with the passage of the National Environmental Policy Act of 1969, which required all federal agencies to consider the environmental impacts of their activities.

One of the ways this was expressed was in regard to the Corps’ disposal of dredged material. Up through the 1960s, dredged material was typically dumped in the open waters of the Great Lakes. However, many of these sediments were contaminated with toxic pollutants left by 150 years of industrialization, which could be re-released by open-water disposal. As a result, the Corps began to investigate, design and use confined disposal facilities (CDF’s), where dredged material could be safely disposed off. Although not originally designed as an environmental cleanup program, CDF’s resulted in the removal of some 50 million tons of contaminated sediment from Great Lakes harbors and waterways by 1992 (Larson, 1981a). To help minimize the burden on such facilities, the Corps has also been involved in identifying environmentally safe beneficial uses for clean and less-contaminated dredged material, including land reclamation, glassmaking, road building, fill material, aggregate for concrete, and other applications. The Clean Water Act of 1977 also gave the Corps authority to regulate the

discharge of dredged or fill material into lakes, rivers and wetlands, and to mandate that any wetlands habitat loss be compensated.

The creation of the U.S. Environmental Protection Agency in 1970 set the tone for a variety of new environmental initiatives for the Corps. Among these has been providing technical and management assistance to USEPA on Superfund projects, including assistance with remedial actions (Larson, 1981a). In addition, the Corps provides its expertise to the Great Lakes states and local entities in developing and implementing remedial action plans to address the contaminated sites identified as “Areas of Concern” under the U.S.-Canada Great Lakes Water Quality Agreement. The Corps’ Buffalo District developed a wastewater management policy in the 1980s that helped to control phosphorous levels in Lake Erie (Drescher, 1982), helping to bring back a lake that once was considered “dead.” Debris removal and streambank stabilization efforts around the basin helped improve water quality in both Great Lakes tributaries and the lakes themselves

The passage of the Water Resources Development Act (WRDA) of 1986 resulted in significant changes in the way water resource projects are conducted. In addition to required a nonfederal cost share for most projects, the act mandates that all federal agencies prepare an environmental impact statement for projects with the potential to affect the environment (Larson, 1981a). It also required a study of need, cost-effectiveness, and possible alternatives, with input from the public and in partnership with federal, state and other agencies with an interest in the project. The WRDA 1990 officially established environmental protection as one of the Corps’ three primary civil missions, along with navigation and flood control, giving rise to growing number of authorities for programs with environmental goals, ranging from aquatic habitat restoration to brownfields redevelopment.

The civil role of the Corps of Engineers in the Great Lakes region has evolved considerably over the past 200 years, from one almost solely concerned with matters of navigation, to protection of life and property against natural hazards such as floods, to wider concerns involving recreation, public health and the environment. One thing has remained constant though, and that is to apply the skills and resources of the Corps, with the support of the U.S. federal government and local and state interests, to address the natural resource challenges of the nation, the region, and the states and communities within. That will not change.

C. Public Concern

To assess water resources needs in the Great Lakes basin, a questionnaire was designed and conducted by the Great Lakes Commission to solicit feedback from a diverse range of stakeholders with a vested and immediate interest in program activities of the Corps. This group includes, for example, agencies and organizations that are strategically involved in navigation, water quality, sediment remediation, habitat restoration and protection, shoreline protection, flood damage reduction, water level monitoring and management, or brownfield restoration and urban planning. It also includes government units at the state, federal, and local levels, certain relevant businesses and industries, tribal entities, binational organizations, non-governmental organizations, and miscellaneous other stakeholders. Appendix C contains the results of the survey designed and conducted by the Great Lakes Commission, as well as detailed statistics of survey respondents.

The survey questions spanned a range of water resources issues, but are not all encompassing. Rather, the goal was to address water resources challenges of concern to the *John Glenn Great Lakes Basin Program* authorized by Congress. To meet this purpose, the Commission survey contained eight sections:

- 1) Great Lakes Water Resources Challenges—The Big Picture;
- 2) Restoring and Protecting the Great Lakes;
- 3) Flood and Storm Hazard Response and Prevention around the Great Lakes;
- 4) Waterways and the Urban Waterfront;
- 5) Reducing Excess Sediment Loadings;
- 6) Great Lakes Water Levels and Flows;
- 7) Water Resources Planning and Management;
- 8) Partnerships and Opportunities for the Corps of Engineers (Survey – Appendix C. Part B).

Other major challenges outside of the scope of the program, such as toxic air deposition, industrial development, or land use management, were intentionally not addressed by this survey. The following summary highlights the most salient observations.

Characteristics of the participants in the Commission’s survey are provided in Appendix C, Section 8. Eighty-eight of 309 survey recipients participated, which represents a 28 percent response rate (Part A - Section 8:1b).

Water Resources Needs from a Nonfederal Perspective. Four of five survey participants (80 percent) were representatives of nonfederal entities. Forty-one percent were representatives of state entities. More than two of three respondents (71 percent) were from agencies and organizations involved in natural resources restoration and management, either through any or a combination of regulatory authority; policy, planning, or coordination policy; information and/or education involvement; and research programs (Part A - Section 8: 1a). There were no major differences in the results when excluding the responses of federal respondents (due to their similarity to the presented results, the results minus federal responses are not specifically shown).

Relationship with the Corps of Engineers. Twenty-four percent of the recipients answered survey Part B: Partnerships and Opportunities for the Corps programs (Part A - Section 8: 1b). Of these, 55 percent answered that they have program partnerships with the Corps of Engineers and 43 percent answered that they have none (Part B: 3a). Forty-four percent of the participants maintain partnerships with the Corps involving technical collaboration and implementation of projects in the Great Lakes basin (Part B: 3d). On a scale from 1 (no interaction) to 7 (strong partnership), the average level of interaction with the Corps was assessed between 4 and 5 (Part B: 4a; p. D-28). More than two of three participants (72 percent) rated the adequacy of their interaction with the Corps as either good (33 percent), adequate (23 percent), or very good (16 percent) (Part B: 4b).

1. Great Lakes Water Resources Challenges—The Big Picture

Balancing economic and environmental needs is the key to managing Great Lakes resources successfully. The stakeholder responses affirmed the significance of this balance: 57 percent of the participants chose “seek solutions that balance economic and environmental needs” as one of the key actions for economic sustainability and better quality of life (Part A - Section 4: 2). Also, 28 percent of the participants chose “make the environment an equal goal with economic benefits in project selection” as one of the three most important actions (from a list of twenty-seven) for restoring the Great Lakes environment (Part A - Section 2: 2). However, the Commission’s survey respondents also indicated that current efforts to attain the balance are not fully sufficient (Part A – Section 2:3). Only 2 percent of the participants rated current efforts toward this end as “fully adequate”. Ninety-five percent rated current efforts to balance economic and environmental objectives as only “somewhat adequate” (38 percent), “inadequate” (38 percent), or “very inadequate” (19 percent).

Establishing management priorities and restoration goals is also considered as one of the most important strategic actions to meet water resources challenges across the Great Lakes basin; this measure is a top priority for 50 percent of the participants (Part A– Section 1: 4).

2. Restoring and Protecting the Great Lakes

There is broad consensus for the need for environmental restoration across all water resources stakeholders in the Great Lakes basin. Ninety-three percent of the participants assessed the need for “environmental restoration” as either “very important” (69 percent) or “important” (24 percent) [Part A – Section 1:2]. Seventy-seven percent identified the issue as a highest priority (out of nine to choose from). However, 55 percent rate ongoing efforts to restore the Great Lakes ecosystem as either “inadequate” (47 percent) or “very inadequate” (8 percent) (Part A - Section 2: 3). Seventy-nine percent indicated that they would benefit from program partnerships with the Corps to enhance their own environmental restoration activities (Part B: 5).

Concern over invasive species emerged as the “hot topic” of the water resources stakeholder survey. With 28 percent, the issue topped a list of seven possible priority water resources challenges, from which participants could choose one as their single-largest concern (Part A Section 1: 1). Sixty percent of the participants identified “prevention and control of invasive species” as the most important of a dozen environmental issues (Part A Section 2: 1). Nearly a third of all participants chose “finding environmentally sound ways to prevent the introduction of invasive species” as the most important action (from a list of twenty-seven) for restoring the Great Lakes (Part A - Section 2: 2). In addition, participants shared a number of additional concerns and comments, indicating that this issue has a high priority. Measures for the control of invasives that were suggested in written comments include the creation of a dead zone in the Chicago Sanitary and Ship Canal and the development of an on-shore ballast exchange system.

Restoration of fish and wildlife habitat stands out among environmental challenges as perceived by survey participants. Sixty-two percent rate ongoing efforts to restore wetlands and other habitat as either “inadequate” (47 percent) or “very inadequate” (15 percent) (Part A - Section 2: 3). Among survey participants, this unmet need is also the one where technical and

financial assistance is most desired: Forty-seven percent of the participants chose “restoring local ecosystems” as one of the water resources challenges where the participants lack of resources or experience is most critical (Part A - Section 7: 2). Forty percent identified “habitat restoration projects” as one of the most needed forms of water resources planning and management assistance (Part A - Section 7: 2). Those projects include, for example, fish passage and restoration of spawning habitat in headwaters.

3. Flood and Storm Hazard Response and Prevention Around the Great Lakes

Watershed management planning and environmentally sound flood mitigation solutions are widely supported as an approach to flood damage reduction. Fifty percent of the survey participants identified “promote watershed management planning and work for balanced, environmentally sustainable flood solutions” as one of their three preferred action items (of 18 to choose from) of hazard response and prevention in the Great Lakes basin (Part A - Section 3: 2). Current efforts to “reduce flood hazards and damage to urban areas in floodplains” received only a lukewarm approval rating from the stakeholders: 53 percent rated such efforts as “somewhat adequate,” while 24 percent rated them as “inadequate” (Part A - Section 3: 3).

Shoreline erosion and bluff recession by waves and currents was the most salient Great Lakes-related hazard issue among survey participants. Forty-seven percent of the participants selected this hazard issue as one of greatest concern (Part A - Section 3: 1). Forty-six percent of the participants indicated that current efforts in “urban planning for sustainable flood and shoreline erosion solutions” are either inadequate (40 percent) or very inadequate (6 percent). Only 2 percent said current efforts in this area are fully adequate (Part A - Section 3: 3).

4. Waterways and the Urban Waterfront

Abandoned and polluted urban waterfronts topped the list of waterway and waterfront development issues: 54 percent of the participants ranked it the highest among three possible issues (out of nine) that are of greatest concern (Part A - Section 4: 1). Fifty-four percent of the participants also rated efforts to “reclaim and restore the urban waterfront”—including the remediation of contaminated areas—as either “inadequate” (41 percent) or “very inadequate” (13 percent) (Part A -Section 4: 3).

5. Reducing Excess Sediment Loadings

Excess sediment and nutrient loadings to the Great Lakes are a widely shared concern among Commission surveyed stakeholders: 78 percent of the participants rated the issue as “serious” (48 percent) or “very serious” (30 percent) (Part A - Section 5: 1). Their responses also indicate that more needs to be done to address the issue. To 84 percent of the survey participants, “soil erosion, sediment transport, and management planning for prevention of excess loadings” is either a “very important” (43 percent) or “important” (37 percent) need (Part A - Section 1: 2). Ninety-three percent of the participants rated current efforts as either “somewhat adequate” (43 percent), “inadequate” (42 percent), or “very inadequate” (8 percent) (Survey Part A - Section 5: 3). A large majority of participants (92 percent) support “soil conservation in tributary watersheds” as a key action to prevent excess sediment loadings in the Great Lakes: 68 percent rated this action as “very important,” and 24 percent as “important” (Part A - Section 5: 2). In some of the comments, participants noted that the problem persists despite significant efforts, pointed out the need for more funding to address nonpoint source pollution, and the need to

develop and implement efficient BMPs and land use management in watersheds with highly erodible, agricultural soils. Sixty-five percent indicated that they would benefit from partnerships with the Corps to enhance their own programs for sediment and soil erosion control (Part B: 5).

6. Great Lakes Water Levels and Flows

Net loss of water from the Great Lakes basin is a significant concern to stakeholders: two-thirds of the Commission survey participants rated this issue as “very serious” (43 percent) or “serious” (23 percent)(Part A - Section 6: 1). Seventy-six percent consider the need for “monitoring of water diversions from the Great Lakes basin” as either “very important” (55 percent) or “important” (21 percent)(Part A - Section 6: 2). Survey responses indicate that water level management and monitoring needs are being addressed with some level of adequacy; however, they are clearly not being addressed entirely to the satisfaction of the stakeholders. For example, 50 percent rated current efforts to “study and assess criteria for regulating Great Lakes outflows” as “somewhat adequate,” but only 9 percent rated these efforts as “fully adequate (Part A – Section 6:3).” More needs to be done, for example, to address “Great Lakes diversion accounting.” Only 9 percent rated these efforts as “fully adequate.” Eighty-three percent rated them as either “somewhat adequate” (40 percent), “inadequate” (33 percent), or “very inadequate” (10 percent) (Part A - Section 6: 3). The Commission survey suggests that there is a high level of concern about Great Lakes water diversions but does not point to a specific response. Some written comments that were provided point to the need for an international government agreement to prevent Great Lakes water diversions.

7. Water Resources Planning and Management

Critical lack of funding is perceived as the major impediment to meeting water resources needs in the Great Lakes basin. Sixty-six percent of participants rated their access to funding as either “inadequate” (47 percent) or “very inadequate” (19 percent) (Part A - Section 7: 1). Funding issues were also the most recurring theme of the submitted comments. These comments reflect concerns about the lack of funding or inconsistent funding for environmental restoration activities, such as nonpoint source pollution control, or other miscellaneous related activities, such as geologic mapping. To the survey participants, lack of resources is also one of the main obstacles for using Corps programs and capacities. Forty-four percent of the participants identified “cost share and other requirements for nonfederal sponsors” as one of two (out of seven factors) that most severely limit the Corps’ potential to serve the Great Lakes region (Part B: 1). On the other hand, 53 percent of the participants ranked “increased funding likelihood for needed projects” on top of a list of anticipated benefits from program partnerships with the Corps of Engineers (Part B: 6).

8. Partnerships and Opportunities for the Corps of Engineers.

The Corps needs to more efficiently plan and manage programs and projects in the Great Lakes basin. The Commission survey supports this need: only 13 percent of the survey participants are satisfied (12 percent) or completely satisfied (1 percent) with the Corps of Engineers business process whereas 80 percent indicated being only “somewhat satisfied” (51 percent) or “dissatisfied” (29 percent) with the Corps business process (Part B: 4d). Forty-seven percent selected “lengthy planning process for projects” as one of two from seven limiting factors, making it the most frequently selected limiting factor for the Corps (Part B:1). From 16 options (of which three could be selected by each participant), “provide funding of projects for

entire project term” (33 percent), “develop integrated funding mechanism for Great Lakes activities” (32 percent), “increase funding through creative costshare partnerships” (28 percent), and “reduce authority overlaps and policy conflicts with other agencies” (28 percent) were the most commonly selected key actions that would improve the Corps ability to address water resources challenges (Part B:2).

D. Synopsis

In preceding sections, an overview was provided of Corps of Engineers programs with relevance to the Great Lakes, strategies and programs of other agencies and organizations, and stakeholder survey results pertaining to water resources needs in the Great Lakes basin. In this section, this information is synthesized to provide a synopsis of how Corps of Engineers programs and the strategic goals, objectives, and key actions of other partners relate to the water resources priorities that were identified in the Great Lakes Commission’s Great Lakes stakeholder survey. Each of the following 11 subsections corresponds to a water resources priority derived from the Commission’s survey. Under each of the 11 headings, the following is provided: a) a *short definition of the identified need* that underlies each priority; b) a list of all relevant strategies pertaining to this particular priority including *specific strategic goals and objectives to meet the identified need*; and, c) a summary of Corps programs with relevance to this priority and their potential role in meeting the identified need.

1. Balancing Economic and Environmental Needs

Need:

- ◆ Better balance economic and environmental needs in Great Lakes management.

Strategies:

- *Ecosystem Charter for the Great Lakes-St. Lawrence Basin*
 - Guiding principles and action items to manage the Great Lakes for environmental and economic sustainability.
- *Great Lakes Commission: Great Lakes Program to Ensure Environmental and Economic Prosperity*
 - Federal legislative and appropriations priorities of the Great Lakes states to manage Great Lakes resources for environmental and economic sustainability.
- *Great Lakes Governors and Premiers: Great Lakes Charter*
 - Water management principles for both environmental and economic purposes.
- *A Strategic Plan for the Great Lakes Commission*
 - Foster the protection as well as the sustainable use and development of Great Lakes resources.
- *NOAA (CZM): Sustaining America’s Coastal Communities and Resources*
 - Strategic goals for the NOAA-administered CZM to sustain both coastal ecosystems and coastal economies.
- *Great Lakes Fishery Commission: A Joint Plan for the Management of Great Lakes Fisheries*

- Manage interjurisdictional fisheries to meet associated needs for employment and income as well as a healthy aquatic ecosystem.
- *NRCS Strategic Plan 2000-2005*
 - Educate communities about the importance of watershed planning to protect both future economic growth and resource health.
- *SLSDC Fiscal Year 2003/2004 Strategic Plan*
 - Strategic goals include both the environment and trade development.
- *The Strategic Vision for the USGS in the Great Lakes-St. Lawrence Region*
 - Strategic goals include both ecological integrity as well as sustainable development.
- *New York State 25 Year Plan for the Great Lakes*
 - Integrated management of the Great Lakes-St. Lawrence system to sustain both the ecosystem and the economy.

Corps Great Lakes Program:

- *John Glenn Great Lakes Basin Program*
 - An opportunity to ensure the future use, management, and protection of water and related resources in the Great Lakes basin.
- *Great Lakes Fishery and Ecosystem Restoration*
 - Support ecosystem restoration, fishery, and beneficial uses in the Great Lakes.
 - Develop an evaluation program to assess whether accomplished projects meet fishery and ecosystem restoration goals.
- *Dredging Operations and Environmental Research*
 - Balance operational and environmental needs.
 - Provide dredging project managers with technology for cost-effective operation, evaluation of risks associated with management alternatives, and environmental compliance.
- *Riverine Ecosystem Restoration and Flood Hazard Mitigation*
 - Studies and projects are intended to emphasize, to the maximum extent practicable and appropriate, nonstructural approaches to preventing or reducing flood damages.
- *Regional Sediment Management Demo Program*
 - RSM is intended to provide improved information on environmental as well as economic consequences of sediment management actions and a better understanding of potential tradeoffs.
 - RSM demonstrations encompass ecological and economic components.
- *Planning Assistance to States*
 - Planning assistance to states for the development, utilization, and conservation of water and related land resources.
- *Tribal Partnership Program*
 - Planning assistance to Indian tribes for the development, utilization, and conservation of water resources.

2. Great Lakes Restoration Plan

Needs:

- ◆ Establishing management priorities and restoration goals.
- ◆ Full-scale restoration of the Great Lakes ecosystem.

Strategies:

- *Great Lakes Program to Ensure Environmental and Economic Prosperity*
 - Intended to form the basis for a consensus-based Great Lakes Restoration Plan to be developed under the leadership of the Council of Great Lakes Governors with input from the larger Great Lakes community.
 - The GLC program has seven priorities for the Great Lakes basin: 1) cleaning up toxic hot spots; 2) curtailing the introduction of exotic species; 3) reducing nonpoint source pollution; 4) restoring and conserving wetlands and critical coastal habitat; 5) ensuring the sustainable use of Great Lakes water resources; 6) strengthening the decision support capability of the Great Lakes community; and 7) enhancing the commercial and recreational value of Great Lakes waterways.
- *U.S. Policy Committee for the Great Lakes: Great Lakes Strategy 2002*
 - Fulfill the GLWQA and restore and maintain the biological, chemical, and physical integrity of the Great Lakes.
- *U.S.-Canadian Binational Toxics Strategy*
 - Provides a framework to reduce or eliminate persistent toxic substances from the Great Lakes basin.
- *Lakewide Management Plans*
 - The *LaMPs* for Lakes Erie, Michigan, Ontario, and Superior, and the *Lake Huron Initiative* develop ecosystem objectives for each lake and target the restoration of impaired beneficial uses (drinkable, swimmable, fishable).
- *U.S. EPA Region 5 and Region 5 States: Joint Commitment to Achieve Shared Water Goals*
 - Based on the GLWQA, the water goals for U.S. EPA Region 5 and the Region 5 states are 1) healthy aquatic communities; 2) fish populations with safe levels of contaminants; 3) designated swimming waters are swimmable, 4) public water supplies are consistently safe to drink; and 5) the quantity and quality of critical aquatic habitat, including wetlands, will be maintained or improved.
- *New York State 25 Year Plan for the Great Lakes*
 - New York's commitment to the goals of the GLWQA.
- *Strategic Plan for the IJC*
 - Assist Canada and the U.S. in the implementation of the GLWQA.
- *NOAA (CZM): Sustaining America's Coastal Communities and Resources*
 - Specifies environmental restoration goals for the CZM: 1) improve and sustain coastal water quality; and 2) protect, enhance, and restore coastal land and water habitats
 - Specific objectives include federal-state cooperative efforts, both in terms of program operations and policy, to achieve these goals.

- *NOAA: New Priorities for the 21st Century*
 - Restore the Great Lakes through an ecosystem-based management strategy that includes 1) monitoring and observing Great Lakes areas and associated communities to provide basic information on habitats, resources, human activities, and uses; 2) characterizing Great Lakes resources, processes, and human impacts; and delivery of products to facilitate sound management decisions; 3) model development and data integration to assess the ecosystem and predict its future state; and 4) informing and advising decision makers about safe and wise uses of Great Lakes resources.
- *Great Lakes Fishery Commission: A Joint Strategic Plan for Management of Great Lakes Fisheries*
 - Prioritizes sustainable fish communities and the associated ecological and economic benefits.
- *Strategic Direction of the Great Lakes Committee of the NACD*
 - Identifies nonpoint water quality issues as a priority issue and gives strategic guidance for the organization on how to address the issue.
- *Great Lakes United: A Citizen's Action Agenda for Restoring the Great Lakes-St. Lawrence River Ecosystem*
 - Appeals to U.S. and Canadian governments to use current political momentum for developing a broad-based, sufficiently funded, and effective restoration plan for the Great Lakes.
 - Makes specific recommendations on how to address challenges facing the lakes, such as toxic clean-up, sustaining and restoring water quantities and flows, air and water quality standards, and protecting and restoring species and habitat. Some of the key points of the agenda are recommendations to
 - 1) Fully restore the 43 Great Lakes AOCs by 2015, and
 - 2) Reverse wetlands losses and increase the amount of protected Great Lakes wetlands by one million acres by 2025.

Corps Great Lakes Program:

- *John Glenn Great Lakes Basin Program*
 - An opportunity to develop a strategic plan for the Corps of Engineers that
 1. Identifies water resources management priorities in the Great Lakes basin;
 2. Sets restoration goals for Great Lakes programs and proposed projects; and
 3. Defines the role and responsibilities of the organization in a coordinated, full-scale restoration effort for the Great Lakes ecosystem.

3. Program Funding

Need:

- ◆ Sufficient funding for critical water resources programs in the Great Lakes basin.

Strategies:

- *Great Lakes Commission: Great Lakes Program to Ensure Environmental and Economic Prosperity*
 - Federal appropriations priorities of the Great Lakes states
 - Recommendations to fund federal programs that have been authorized, yet inadequately funded, as well as important “new start” initiatives:
 - Great Lakes Restoration Plan:
 - Funding for the Great Lakes states, Great Lakes Commission, and Council of Great Lakes Governors through appropriate federal agencies

- Corps of Engineers:
 - Chicago Sanitary & Ship Canal Dispersal Barrier
 - Environmental Dredging:
 - Acceptance of in-kind services and funds from nonfederal entities
 - Environmental Improvements
 - International Water Studies:
 - John Glenn Great Lakes Basin Program:
 - Cost-Sharing (Section 455[f]): Amend to allow use of in-kind services to satisfy nonfederal costshare requirements
 - Great Lakes Fishery and Ecosystem Restoration Program:
 - Amend section 506(f): Allow in-kind contributions for the nonfederal share for planning, design, and construction, and eliminate costshare requirement for post-construction monitoring and evaluation
 - Great Lakes Navigational System:
 - Great Lakes Remedial Action Planning and Sediment Remediation
 - Great Lakes Sediment Transport Models
 - Navigation Operation and Maintenance:
 - Soo Replacement Lock
 - Water Level Management and Monitoring:
 - Authorize a federal/state partnership and state grants program for forecasting, monitoring, mapping and trend analysis of water withdrawal and use
- FWS:
 - Aquatic Nuisance Species Surveillance and Control
 - Great Lakes Coastal Program
 - Great Lakes Fish and Wildlife Restoration Act
 - Acceptance of in-kind services and funds from nonfederal entities
 - Natural Resource Damage Assessment Program
 - North American Wetlands Conservation Act:
- NOAA:
 - Coastal Zone Management Program
 - Conservation and Reinvestment Act
 - Hydrographic Services Improvement Act
 - Authorizing language to maintain and upgrade 51 lake level monitoring stations
 - National Sea Grant College Program
- NRCS:
 - Great Lakes Basin Program for Soil Erosion and Sediment Control
- U.S. EPA:
 - CWA Section 106
 - CWA Section 319
 - Environmental Protection – Consolidated Research
 - Great Lakes Program
- USGS:
 - NAWQA
 - National Water Use Information Program
 - USGS Ground-Water Resources Program
- *Strategic Vision for the Great Lakes Fishery Commission*
 - Increase partnership funding for enhanced delivery of Great Lakes Fishery Commission programs.
- *Strategic Direction of the Great Lakes Committee of the NACD*
 - Support funding efforts of agencies involved in Great Lakes water quality issues.

- *Section 309 Strategy and Assessment for Pennsylvania's Coastal Zone Management Program*
 - Utilize federal CZM grants more efficiently.
- *Northeastern Illinois Planning Committee: Strategic Plan for Water Resource Management*
 - Increase funding for wastewater treatment plan construction, floodplain mapping, and research on groundwater and surface water supplies in Northeastern Illinois.

Corps Great Lakes Program:

- *John Glenn Great Lakes Basin Program*
 - An opportunity to address funding needs for critical water resources programs in the Great Lakes basin.

4. Invasive Species

Need:

- ◆ Prevention and control of invasive ANS is one of the greatest, if not currently the largest ecosystem concern of Great Lakes stakeholders.

Strategies:

- *Great Lakes governors and premiers: A Great Lakes Action Plan for the Prevention and Control of Nonindigenous ANS*
 - Principles drawn from existing laws, policies, and programs to guide ANS prevention and control plans in each of the states and provinces and to build a basis for communication and cooperation.
 - The *Plan* aims at three goals:
 - 1) Prevent the unauthorized introduction of nonindigenous aquatic species;
 - 2) Limit the spread of established ANS within the region;
 - 3) Minimize the harmful ecological, economic, social, and public health impacts resulting from ANS already present.
 - Selected strategic actions:
 - Management programs:
 - Evaluate technologies and management practices that eliminate or minimize the risk of introduction and spread in an ecologically sound and economically responsible manner.
 - Research and monitoring:
 - Establish ecological and other criteria to guide the design and implementation of new control strategies.
 - Provide technical, scientific, and financial assistance for the implementation of control measures that meet accepted criteria.
- *Great Lakes Commission: Great Lakes Program to Ensure Environmental and Economic Prosperity*
 - Priority: Curtailing the introduction of invasive species.
 - Selected priority actions:
 - ⊖ Dispersal barrier demonstration (Section 1202(i), NISA): construct, maintain, and evaluate the dispersal barrier in the Chicago Sanitary and Ship Canal and undertake related control activities.

- Sea lamprey barriers (Section 1135(c), WRDA 1986, as amended): prevent and control the spread of Asian carp and sea lamprey and construct a second dispersal barrier in the Chicago Sanitary and Ship Canal.
- *Strategic Vision for the Great Lakes Fishery Commission for the First Decade of the New Millennium*
 - Prioritizes integrated management of sea lamprey.
- *USGS Strategic Plan FY 2000 – FY 2005*
 - Development of control strategies for ANS invasions as a strategic direction for the scientific activities of the USGS.
- *FWS Strategic Plan 2000-2005*
 - Prevention and control of ANS invasions, such as the zebra mussel in the Great Lakes, as a long-term goal of the FWS.
- *D9 Regional Strategic Assessment*
 - ANS prevention and enforcement of NISA (open ocean ballast water exchange) are a key element of the regional strategy of the Ninth Coast Guard District (D9).
- *Ninth District FY2001 Strategic Plan*
 - Selected key actions:
 - Awareness-raising to motivate federal government actions to prevent ANS introductions in the Great Lakes;
 - Increasing education of commercial and recreational vessel operators on ANS prevention; and
 - Enforcing ballast water regulations.
- *Lakewide Management Plans*
 - Lake Michigan LaMP*
 - Control and manage ANS
 - Coordinate with the GLFC on ANS and other issues
 - Lake Superior LaMP 2000*
 - Encourage interjurisdictional coordination and information sharing to maximize the effectiveness of programs already in place
 - Lake Huron Initiative:*
 - Undertake efforts to better understand and control sea lamprey and other ANS.
- *Section 309 Strategy and Assessment for Pennsylvania's CZM*
 - Develop an ANS management plan in coordination with the Great Lakes Commission and the Council of Great Lakes Governors.
- *Great Lakes United: A Citizen's Action Agenda for Restoring the Great Lakes-St. Lawrence River Ecosystem*
 - Phase out unsustainable navigation practices, such as dumping ballast water, and halt navigation system expansion plans until the problem of invasive species introduction is resolved.

Corps Great Lakes Program:

- *Chicago Sanitary and Ship Canal Dispersal Barrier*
 - Investigation and identification of environmentally sound methods to prevent or reduce the dispersal of invasive aquatic species between the Great Lakes and the Mississippi River basins.
 -

- *Environmental Improvements*
 - Authority can be used for the control of sea lamprey throughout the Great Lakes basin.
- *Aquatic Plant Control*
 - Control of Eurasian Watermilfoil and other invasive aquatic nuisance plants.
- *Aquatic Plant Control Research*
 - Develop ecologically based, integrated management strategies for Eurasian Watermilfoil and other submerged invasive aquatic nuisance plants.
 - Develop technologies to prevent the introduction and spread of nonindigenous aquatic plant species.
 - Develop technologies to replace nonindigenous aquatic plants with native species.

5. Fish and Wildlife Habitat

Need:

- ◆ Improve efforts to restore fish and wildlife habitat.

Strategies:

- *Great Lakes Commission: Great Lakes Program to Ensure Environmental and Economic Prosperity*
 - Priority: “Restoring and conserving wetlands and critical coastal habitat“
 - See Appendix I for selected priority actions.
- *Strategic Vision for the Great Lakes Fishery Commission for the First Decade of the New Millennium*
 - Advocates interagency efforts to restore coastal habitat.
- *NOAA’s New Priorities for the 21st Century*
 - Increase the percentage of restored habitat.
- *NOAA (CZM): Sustaining America’s Coastal Communities and Resources*
 - Restore coastal habitats impacted by toxic pollution and other disturbances
- *NOAA/Restore America’s Estuaries: National Strategy to Restore Coastal and Estuarine Habitat*
 - Formal restoration of certain sensitive coastal wetland areas of the Great Lakes region.
- *NRCS Strategic Plan 2000-2005*
 - Restore wetland ecosystems and fish and wildlife habitat by
 - 1) Identifying priority wetlands;
 - 2) Identifying community goals for wetland and fish and wildlife conservation;
 - 3) Integrating multiple use planning in wetland and wildlife conservation approaches;
 - 4) Technical assistance for delineation of wetland areas; and
 - 5) Working with partners and private groups to enhance habitat for game species.
- *Lakewide Management Plans*
 - Lakes Erie LaMP 2000:*
 - Habitat restoration action plan identifies proposed habitat restoration projects
 - Lakes Michigan LaMP:*
 - Identify the eco-rich areas in the basin, the connecting corridors and flyways, the fish spawning areas, the status of protection, and provide the data on line.

Lakes Superior LaMP 2000:

- Action plans focus on information gathering on specific aquatic resources

Lake Huron Initiative:

- Restore plant and animal habitat in the Lake Huron Basin.
- Selected key actions:
 - Establish a priority list of projects for restoration of important habitats including critical tributary reaches.
 - Encourage the development of restorative activities in riparian zones, environmental corridors, and buffer zones.
 - Design and implement projects to restore habitat and lost ecosystem functions at degraded sites.
 - Develop means to financially and technically assist dam owners in dam removal and habitat restoration.

Corps Great Lakes Program:

- *Great Lakes Fishery and Ecosystem Restoration*
 - Support ecosystem restoration in the Great Lakes.
- *Aquatic Ecosystem Restoration*
 - Restore aquatic habitat in lakes and streams.
- *Beneficial Use of Dredged Material*
 - Restore aquatic and ecologically related habitat, including wetlands, by using sediments dredged from federal navigation projects.
- *Environmental Improvements*
 - Restore the quality of ecosystem functions impaired by Corps civil works projects.

6. Watershed Management Planning and Flood Protection

Needs:

- ◆ Improved watershed planning for integrated water resources management
- ◆ Environmentally sound flood mitigation solutions

Strategies:

- *NRCS Strategic Plan 2000-2005*

Protection of upstream watersheds from floods by using watershed-level, integrative approaches such as

 - 1) Helping watershed project sponsors to implement watershed protection plans;
 - 2) Addressing flood prevention in the context of comprehensive watershed planning; and
 - 3) Educating communities about the importance of watershed planning to risks from flooding.
- *Northeastern Illinois Planning Commission: Strategic Plan for Water Resource Management*

Strategic recommendations for improving watershed planning and coordination to reduce flood damages in Northeastern Illinois. With regard to the Corps' role in the region, the recommendations involve

 - Coordination with the Corps of Engineers and other federal agencies to address flood remediation needs;
 - Consideration of nonstructural over structural flood controls;

- Method development to incorporate nonstructural and non-flood reduction benefits into the cost-benefit analyses for flood control projects; and
- Identification of flood control projects with multiple benefits (including ecosystem restoration).
- *Lakewide Management Plans*
- *Lakes Michigan LaMP:*
 - Promote watershed planning

Corps Great Lakes Program:

- *Riverine Ecosystem Restoration and Flood Hazard Mitigation*
 - Coordinate local flood damage reduction or riverine and wetland restoration studies with projects that conserve, restore, and manage hydrologic and hydraulic regimes and restore the natural functions and values of floodplains.
 - Studies and projects are intended to emphasize, to the maximum extent practicable and appropriate, nonstructural approaches to preventing or reducing flood damages.
- *Flood Plain Management Services*
 - Provide technical assistance to states, counties, and cities in planning the prudent use of land subject to flooding from streams and lakes.
- *Planning Assistance to States*
 - Provide assistance to states in the planning for the development, utilization, and conservation of water and watershed resources.
- *Tribal Partnership Program*
 - Provide assistance to Indian tribes in the planning for the development, utilization, and conservation of water and watershed resources.
- *Environmental Infrastructure*
 - Provide technical solutions to the alleviation of water-related problems on a local scale.

7. Preventing Coastal Hazards Resulting from Shoreline Erosion and Bluff Recession

Need:

- ◆ Sustainable solutions to mitigate shoreline erosion and bluff recession hazards.

Strategies:

- *NOAA's New Priorities for the 21st Century*
Inform and advise decision makers on hazards affecting environmental health and safety, such as shoreline erosion, bluff recession, and flooding.
- *NOAA (CZM): Sustaining America's Coastal Communities and Resources*
Reduce threats from losses from coastal hazards
Specific strategic objectives of the CZM include:
 - 1) Coordination among federal, state, and local officials in coastal hazard mitigation efforts; and
 - 2) Non-regulatory mechanisms for hazards mitigation.
- *USGS: Strategic Vision for the U.S. Geological Survey in the Great Lakes-St. Lawrence Region*
Minimize natural hazards and risks.

- *USGS Strategic Plan FY 2000 – FY 2005*
 - Guidance for the protection and development of coastlines as a strategic direction for the scientific activities of the USGS.

Corps Great Lakes Program:

- *National Shoreline Erosion Control Development and Demonstration Program*
 - Construction, monitoring, and evaluation of shore protection devices, designs, and methods.
 - Innovative solutions advancing the state-of-the-art in coastal shoreline protection
- *Shore Protection*
 - Reduce storm damage risks to public lands and facilities.
- *Shore Damage Mitigation*
 - Prevent or mitigate shore damage that is caused by federal navigation structures built by the Corps of Engineers.
- *Planning Assistance to States*
 - Provide assistance to states in the planning for the development, utilization, and conservation of water and related land resources.
- *Emergency Streambank and Shoreline Protection*
- *Environmental Infrastructure*
 - Provide technical solutions to the alleviation of water-related problems on a local scale.

8. Waterfront Revitalization

Need:

- ◆ Reclaim and restore abandoned and polluted waterfront.

Strategy:

- *NOAA (CZM): Sustaining America's Coastal Communities and Resources*
Revitalization of urban waterfronts.
Cleanup and reuse of underused areas such as brownfields.

Corps Great Lakes Program:

- *Planning Assistance to States*
 - Provide assistance to states in planning for the development, utilization, and conservation of water and related land resources.
- *John Glenn Great Lakes Basin Program*
 - An opportunity to expand the current scope of brownfield-related activities from planning (Planning Assistance to States) to implementation by means of a new authority.

9. Soil Erosion Control

Need:

- ◆ Reduce excess sediment and nutrient loadings to the Great Lakes.

Strategies:

- *Great Lakes Commission: Great Lakes Program to Ensure Environmental and Economic Prosperity*
 - Priority: “Controlling Nonpoint Source Pollution“
 - See Appendix I for selected priority actions
- *Lakewide Management Plans*
 - *Lakes Michigan LaMP:*
 - Promote watershed planning, including agricultural pollution prevention
 - Lake Ontario LaMP Update 2003:*
 - Promote public outreach on pollution prevention.
 - Lake Huron Initiative:*
 - Identify and prioritize remedial actions to prevent sedimentation.
- *NRCS Strategic Plan 2000-2005*
 - Protection of water resources from agricultural nonpoint sources by
 - 1) Watershed-level planning assistance for nonfederal and tribal lands;
 - 2) Promoting innovative watershed-level approaches in areas with challenges by the urban-rural interface; and
 - 3) Protecting rivers and streams from excess nutrient loadings.
- *NOAA’s New Priorities for the 21st Century*
 - Increase the number of Great Lakes areas (incl. coastal watersheds) with (federal, state, local, or non-governmental) ecosystem management plans using best management practices and approaches.
- *NOAA (CZM): Sustaining America’s Coastal Communities and Resources*
 - Sustain coastal water quality.
- *Strategic Direction of the Great Lakes Committee of the NACD*
 - Priorities:
 - 1) Non-point water quality issues
 - 2) Erosion and sediment control
 - 3) Implementing water quality plans
 - Continue to work with the Corps on the Great Lakes Sediment Transport Models program.

Corps Great Lakes Program:

- *Great Lakes Sediment Transport Models*
 - Develop models to assist state and local resource agencies across the basin in evaluating alternatives for soil conservation and nonpoint source pollution.
 - Support state and local measures that will reduce the loading of sediments and pollutants to navigation channels and AOCs.
- *Planning Assistance to States*
 - Provide assistance to states in the planning for the development, utilization, and conservation of water and related land resources.
- *Tribal Partnership Program*
 - Provide assistance to Indian tribes in the planning for the development, utilization, and conservation of water and watershed resources.

10. Monitoring and Management of Great Lakes Water Levels and Diversions

Need:

- ◆ Prevent net loss of water from the Great Lakes.

Strategies:

- *Great Lakes Charter*
 - Five principles for the management of Great Lakes water resources to conserve Great Lakes water levels and flows:
 - 1) Integrity of the Great Lakes basin
 - 2) Cooperation among jurisdictions
 - 3) Protection of Great Lakes water resources
 - 4) Notice and consultation of all Great Lakes governors and premiers prior to any new major use and consumption of Great Lakes water, and
 - 5) Cooperative programs and practices.
- *Strategic Plan for the IJC*
 - Prevent disputes and resolve issues concerning transboundary levels.
- *ISLRBC: Lake Ontario Outflow Strategy*
 - The ISLRBC of the IJC continuously reviews, discusses, and adapts the short-term (month-to-month) and long-term (several months) outflow strategy to meet the IJC Orders of Approval for the St. Lawrence Seaway and a hydropower project at the controlled outflow of Lake Ontario.
 - The IJC has also called on the ISLRBC to
 - (a) Review the current regulation of levels and flows in the Lake Ontario-St. Lawrence River System, taking into account the impact of regulation on affected interests;
 - (b) Develop an improved understanding of the system by all concerned; and
 - (c) Provide all the relevant technical and other information needed for the review.
 - After the review, which began in 2000 and is expected to take five years, the ISLRBC may recommend that the IJC further amends its Orders of Approval.
- *Section 309 Strategy and Assessment for Pennsylvania's CZM*
 - Fully participate in existing Great Lakes water quantity monitoring programs.
- *Illinois DNR Strategic Plan 2003-2008*
 - Asserts the lead role of the IL-DNR in controlling and regulating Lake Michigan water diversion and use in northeastern Illinois.
- *Great Lakes United: A Citizen's Action Agenda for Restoring the Great Lakes-St. Lawrence River Ecosystem*
 - Halt navigation system expansion plans until the problem of lower water levels from deeper channels is resolved;
 - Adopt a binding agreement for regulating the withdrawal of water from the Great Lakes based on sound science for protecting the ecosystem.

Corps Great Lakes Program:

- *International Water Studies- Surveillance of Northern Boundary Waters*
 - Provides technical information for recommendations of IJC boards regarding regulated flow releases
 - Coordination with Canadian counter-agency

- Data collection and coordination on water levels, flow releases, and water supplies to the basin
- *Lake Michigan Diversion Accounting*
 - Make flow measurements, gauge records, make hydraulic and hydrologic computations, including periodic field investigations and measuring device calibrations, necessary to compute the amount of water diverted from Lake Michigan by the State of Illinois and its municipalities, political subdivisions, agencies, and instrumentalities
- *Planning Assistance to States*
 - Provide assistance to states in the planning for the development, utilization, and conservation of water and related land resources.
- *Tribal Partnership Program*
 - Provide assistance to Indian tribes in the planning for the development, utilization, and conservation of water and watershed resources.

11. Program and Project Management and Planning

Need:

- ◆ The Corps needs to more efficiently plan and manage programs and projects in the Great Lakes basin.

Strategies (of other agencies):

Not applicable.

Corps Great Lakes Program:

- *John Glenn Great Lakes Basin Program*
An opportunity to develop strategic goals for Great Lakes program and project management.

E. Existing Conditions

1. Regional Status

- **Commercial navigation** activity on the Great Lakes is inherently tied to the overall economic well-being of the United States and Canada. As economic growth slowed in the post-2000 period, commercial shipping on the Great Lakes-St. Lawrence Seaway system experienced a commensurate decrease, dipping to a combined 187 million metric tons in 2002, compared to close to 200 million tons in previous years. The recent drop in lake levels is further impacting the shipping industry by decreasing navigable channel depths and, thus, the carrying capacity of cargo vessels. Nevertheless, maritime transportation remains a vital element of the regional economy. According to an economic impact study for the year 2000, prepared by Martin Associates for the U.S. Saint Lawrence Seaway Corporation, more than 150,000 jobs in the region are directly attributed of the U.S. Great Lakes-St. Lawrence Seaway system. Maritime transportation also continues to compare favorably to road and rail in terms of fuel economy, toxic emissions, and safety.

- At the State of the Lakes Ecosystem Conference 2002 (SOLEC 2002), only one out of 34 assessed **Great Lakes ecosystem** health indicators—drinking water—received the rating “good.” On the other hand, twenty-four (or 70 percent) of all the indicators were labeled “mixed,” “mixed-improving,” “mixed-deteriorating,” or “poor.” Among the indicators pointing to a worsening of the condition of the Great Lakes ecosystem are the declining number and diversity of wildlife; invasion and spread of alien nuisance species; as well as the continuing overall increase in the consumption of energy, land, and water in the basin. In its *Eleventh Biennial Report on Great Lakes Water Quality*, the International Joint Commission (IJC) finds that, while there are many ongoing programs and activities in Canada and the United States, progress to restore and maintain the physical, chemical and biological integrity of the Great Lakes is proceeding at a slow pace.
- In 1994, the release of the *Ecosystem Charter for the Great Lakes-St. Lawrence Basin* and convening of the initial SOLEC demonstrated an accelerated movement toward an **ecosystem approach** toward resources management for the Great Lakes basin. On a lake-by-lake basis, Lakewide Management Plans (LaMPs) have been developed for four of the Great Lakes and there are also a number of initiatives around the basin that apply the ecosystem approach to local watershed management. The need for ecosystem-based management has been widely recognized in the region, and interest in a comprehensive restoration plan, as well as a refined list of indicators to measure restoration progress in Great Lakes restoration, is growing.
- According to estimates by the National Oceanic and Atmospheric Administration (NOAA), the population of coastal counties in the Great Lakes basin will continue to grow over the next 10 -15 years, further increasing pressure on coastal resources. The Coastal Zone Management Program (CZM), authorized in the federal Coastal Zone Management Act (CZMA) of 1972, will play a key role in addressing the numerous challenges presented by this trend, such as urban sprawl and cottage development, the restoration of brownfields, nonpoint source pollution, and related water quality considerations. CZM is a voluntary federal-state partnership that provides financial and technical incentives to develop state **coastal management** programs consistent with CZMA goals to preserve and protect coastal resources while allowing compatible economic growth. With the recent federal approval of coastal programs in Ohio (1997), Minnesota (1999), and Indiana (2002), all Great Lakes states but Illinois participate in the program.
- **Global warming** and associated climate change are projected to have major impacts in the Great Lakes-St. Lawrence basin. Under most global warming scenarios, average water levels are expected to drop significantly over time. Some models predict that lake levels could drop by as much as 8 feet from their historic mean. The frequency and severity of weather hazards—torrential rainstorms, river flooding, and droughts—are expected to increase as a result of the higher temperatures. There may be lower frequencies of flooding

induced by high lake levels, but the reduction of resulting damages may be offset by increased storms. Losses to lakefront infrastructure and property from shoreline erosion could be increased or decreased, depending upon changes in water levels, storm frequencies, and landside development.

Measurements taken over the past 160 years indicate that lake levels fluctuate periodically in what appears as a recurring, climate-driven cycle. Over the last century, lake levels varied by as much as four to seven feet between periods of extreme high and extreme low levels. Currently, Great Lakes water levels are at a 30 year-low. This is attributed to the warmer-than-average weather, lower precipitation and, in particular, the reduced snowfall of recent consecutive years. The low water levels are not necessarily due to global warming. Nevertheless, they may offer a glimpse at what global warming entail for water resources-related activities in the basin. If global warming takes place, it will have implications for Corps operations in the Great Lakes basin. For example, there will be a greater demand for the maintenance dredging of federal navigation channels. Also, the operations of the Lake Superior and Lake Ontario outflow controls will likely be affected. There may be considerations to delay water flow between and out of the Great Lakes by means of engineered flow reduction measures. These could include structural engineering in the form of dams and underwater weirs (“speed bumps”). They may also include “green engineering” solutions such as wetland creation.

- Great Lakes basin jurisdictions are facing a **drinking water supply and wastewater infrastructure** crisis. Over the next two decades, communities of all sizes in the Great Lakes region will need to make significant upgrades to their drinking water and wastewater treatment systems. These needs may not be met, however, according to a recent report by the U.S. EPA in cooperation with the Water Infrastructure Network (WIN). The report highlights the increasing gap between projected water infrastructure needs and the federal government's financial commitment to safe and clean water.
- About 4 million cubic yards of sediment are annually dredged from federal navigation projects in the Great Lakes; approximately half of these are contaminated with toxic chemicals and need to be placed in confined disposal facilities (CDF's)(see Miller, 1997). Many of these CDF's will be approaching capacity within the next decade. Alternative strategies for management of contaminated sediments are often infeasible due to lack of suitable clean-up technologies or prohibitive costs. Beneficial uses of these spoils—such as for landscaping or construction--are feasible but not permitted under current Corps authorities. Advances in sediment remediation technologies and the development of regional guidelines for the safe reuse of partially contaminated sediments could open new possibilities, such as increased beneficial use of dredged material in upland applications. Soil erosion prevention provides a proactive **sediment management** alternative to reduce the need for dredging.

- The Great Lakes offer outstanding **water-based recreation** opportunities, including ice fishing, skiing, snowmobiling, fishing, boating, and swimming. The eight Great Lakes states have approximately 3.7 million registered recreational boats, or about a third of the nation's total. Michigan and Minnesota lead the nation in the number of boat registrations, and six Great Lakes states rank in the nation's top ten. The commercial and sport fishing industry of the Great Lakes is collectively valued at more than \$4 billion annually.
- Improving **program performance** is one of the top priorities in the administration's FY 2004 budget proposal for the Corps of Engineers' Civil Works missions. In a recent program assessment examining flood reduction, emergency management, and wetlands restoration activities of the Corps, the U.S. Office of Management and Budget (OMB) found the lack of acceptable performance data as a major shortcoming. The Corps to identify suitable performance measures as a first step toward filling the gap. To guide program improvement efforts, the administration also proposes five principles to guide future Corps authorization and funding legislation, which include 1) improved cost-benefit analyses, 2) prioritization of projects with high economic and environmental return to society, 3) establishment of project priorities across and within watersheds in each of the three main missions (flood and storm damage reduction, commercial navigation, aquatic ecosystem restoration), 4) legislation to deauthorize low priority projects, and 5) a nonfederal cost share that reflects the extent to which a water resources project economically benefits commercial interests, property owners, or other identifiable parties.
- The U.S. Government Accounting Office (GAO) recently released a report on the effectiveness of government programs to protect and restore the Great Lakes. In its report, the GAO identifies 148 federal and 51 state programs that currently operate to protect or restore the environment in the Great Lakes basin in some fashion but without an **overarching, coordinated strategy**. The GAO report concludes that this lack of coordination impedes current restoration efforts and that an overall strategy – comparable to those of other large restoration projects such as the Everglades or Chesapeake Bay – is needed to better achieve restoration goals in the Great Lakes.

2. Great Lakes Basin Challenges

- **Navigation Infrastructure**

- *Soo Replacement Lock*

- Total annual shipping on the Great Lakes exceeds 180 million tons, over half of which goes through the Soo Locks on the St. Mary's River at Sault Ste. Marie, MI, from and to ports on Lake Superior. The Soo Locks complex consists of four locks, two of which are currently being used: the McArthur Lock (80 feet wide, 800 feet in length and 31 feet deep) and the Poe Lock (110 feet wide, 1,200

feet in length, and 32 feet deep). The Sabin and Davis locks are not presently being used due to size and depth limitations. Twenty-nine lake carriers – representing two-thirds of the U.S. Great Lakes fleet’s carrying capacity – are restricted to the larger Poe Lock because their dimensions exceed those of the McArthur Lock. If the Poe Lock should fail, shipping from and to ports on Lake Superior would cease. To address this issue, Congress authorized in WRDA 1986 the construction of a replacement lock for the Davis and Sabin locks that would be somewhat larger than the Poe Lock. The replacement lock would have a 32-foot depth over its miter gate sills; but its width would be 115 feet instead of 110 feet.

Progress toward construction of the replacement lock has been repeatedly delayed as some considered it too extensive and also because no agreement could be reached on how the nonfederal cost share requirement would be met. By 1993, little progress was made either with respect to determining the nonfederal cost share or the question of economic justification for the full project. Cost estimates had risen from \$227.5 million in 1985 to \$400 million in 1993. The future of the large lock project was doubtful. In search of alternative solutions, the Corps even pursued a plan for rehabilitating the 75-year old Davis Lock. Eventually, the initial plans for a lock that would be somewhat larger than the Poe Lock were scaled back to building a second lock with the same dimensions as the Poe Lock. A “limited reevaluation study” by the Corps recalculated the costs of the project at \$225 million.

Most interests recognize the economic benefits of a replacement lock for the region and for the nation. However, a major challenge is the substantial nonfederal cost share to be borne by the Great Lakes states. When lock construction was authorized in WRDA 1986, the cost-sharing formula required a nonfederal sponsor to assume 35 percent of the project cost, or about \$70 to \$80 million. WRDA 1999 included a provision that reduced the states’ share of the project to 23.8 percent, approximately \$50 - \$55 million, and allows it to be paid over 50 years, interest-free. The Great Lakes Commission has since agreed to become the nonfederal project sponsor responsible for coordinating the payment of the state cost share. This revised legislation recognizes the importance of the Soo Locks to the national interest and will ease the burden on the Great Lakes states.

By the end of fiscal year 2002, total funding for preconstruction planning and design amounted to approximately \$5.6 million dollars, at full federal cost. In its FY 2002 budget, the administration allocated for the first time funds that could be used toward construction in the amount of \$3 million.

Deepening of the Upper St. Marys River

Over half of the shipping on the Great Lakes moves through the upper St. Mary’s River. Water levels in this critical channel fluctuate dramatically and can create a major bottleneck in the Great Lakes navigation system. Deepening of the channel through this segment of the river, particularly in periods of low water, will provide an extra margin of safety. WRDA 1990 authorized \$13 million for

deepening the Upper St. Mary's River to 29 feet. This project met resistance on environmental and economic grounds. It is now generally recognized that a more limited version of the project – deepening the channel from 25.5 to 26.5 feet – would be beneficial. WRDA 1999 authorized the scaled back project to be carried out at full federal cost. No funds have yet been appropriated for construction.

- **Toxic Contaminants**

When the devastating ecological effects and health risks of polychlorinated biphenyls (PCBs), DDT (dichlorodiphenyltrichloroethane), and other toxic chemicals became apparent in the late 1960s and early 1970s, a new policy was spelled out in the Clean Water Act (CWA) of 1974 to phase out the production and use of these substances. The ban of these substances was followed by significant reductions in contaminant levels in water, fish, and wildlife of the Great Lakes during the late 1970s and early 1980s. However, progress in further reducing toxic contaminant levels has been mixed over the past 10 - 15 years and levels of certain regulated chemicals remain above health thresholds.

In the 1987 protocol to the Canada-United States Great Lakes Water Quality Agreement (GLWQA), the two nations committed to “virtually eliminate” a set of persistent toxic substances comprised of intentionally produced chemicals (PCBs, DDT, dieldrin, toxaphene, mirex), production byproducts (hexachlorobenzene, TCDD [tetrachlorodibenzo-p-dioxin], TCDF [tetrachlorodibenzofuran], benzo(a)pyrene), and heavy metals (lead, mercury). Four additional toxic substances (chlordane, cadmium, arsenic, octachlorostyrene) were subsequently added to this list. The 1997 Canada-U.S. Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes (or the Binational Toxics Strategy, BTS) identified 13 of the chemicals listed above as “level 1” substances plus an additional 14 as “level 2” substances for action. Level 1 substances are those that have been identified as pollutants of concern in previous binational agreements, whereas Level 2 substances are those being considered by either country, but which have not been sufficiently considered by both nations as to set joint challenge goals for their reduction at this time.

| In addition, a number of problematic but entirely unregulated chemicals have recently been detected in waters, sediments, and organisms of the Great Lakes. These include estrogenic compounds, pharmaceuticals, and the now ubiquitous perfluorooctanyl sulfonate (PFOS) as well as polybrominated diphenyl esters (PBDEs). PFOS is a carcinogenic substance that was used by 3M in the production of Scotchgard™. Phase-out of PFOS began in 2001, when researchers detected the occurrence of the substance in water, soil, and wildlife tissue in such remote regions as Antarctica or Siberia. PFOS concentrations are currently on the rise in Lake Ontario, as are those of PBDEs. The latter were used as flame-retardants in polyurethane foams and are probably the most troubling “emerging” group of toxic contaminants. PBDEs are unregulated and their concentrations are currently increasing in herring gulls and lake trout around the Great Lakes with a doubling time of about four yrs.

The mixed progress in achieving the goal of virtual elimination demonstrates both the need to further reduce emissions and other non-point sources as well as the need to remove toxic contaminants that were deposited into the sediments decades ago. The Great Lakes ecosystem is still widely impaired by this legacy. The IJC designated 43 Areas of Concern (AOCs) – 31 of which are wholly or partly in the U.S. – as places where human use of the aquatic resource is severely impaired. Only two of these places, Collingwood Harbor and Severn Sound in Ontario, have been sufficiently remediated to be delisted as AOCs.

In 40 of the remaining 41 AOCs (including all U.S. sites), the impairment is due largely or in part to contaminated sediments. Remedial Action Planning (RAP) Committees have been established for each site, but progress beyond the planning stage has been slow compared to the actual cleanup needed. The cumulative amount of contaminated sediment removed from AOCs has tripled from approximately 1.1 million cubic yards in 1993 to more than 3 million cubic yards in 1998, but much remains to be done. A major part of the sediments that remain to be dredged will have to be deposited in CDF's.

The U.S. federal Great Lakes Legacy Act of 2002 authorizes, over a five-year period, a \$54 million-per-year clean-up program to be managed by the U.S. EPA Great Lakes National Program Office (GLNPO). Funds appropriated under the Act are to assist in the clean up of orphaned contaminated sites within AOCs. The Great Lakes Legacy Act has been welcomed by many and stimulated some optimism that some significant progress toward restoring contaminated sites can be achieved if the political momentum can be maintained. Given the magnitude of the unmet need, however, even full appropriation under this act would constitute a “down payment” in addressing the problem as apposed to providing for comprehensive clean up.

- **Invasive Species**

More than 160 non-indigenous aquatic species have been documented in the waters of Great Lakes-St. Lawrence system, of which at least a dozen appear to have entered during the past decade. A number of these species have caused dramatic ecosystem impacts and associated economic costs. A suspected primary pathway for introductions is via ballast water from ocean-going vessels.

Sea Lamprey

Among the most destructive species to invade the Great Lakes is the *sea lamprey*, which virtually destroyed the upper Great Lakes fishery before control measures were taken. Control measures to keep the sea lamprey in check cost nearly \$9 million annually and keep the lamprey population in the Great Lakes basin at about 10 percent of its peak.

The Great Lakes Fishery Commission and its partners maintain a regular schedule of chemical treatment with the lampricide TFM (3-trifluoromethyl-4-nitrophenol) applied in approximately 250 Great Lakes tributaries. Treatment intervals for each river range from 3-10 years. Research continues into reducing

lampricide concentrations and developing alternative, non-chemical control measures. A second method that has proved efficient is construction of physical sea lamprey barriers in Great Lakes tributaries.

In 1991, the release of sterile males was added as a third method of sea lamprey control. The sterile-male-technique is being used exclusively in the St. Marys River. On average, 40,000 sterilized sea lampreys are released annually into the river. The Sterile Male Release Program is part of an integrated non-chemical strategy and used in combination with a Trapping Program, which is a cooperative effort of the Great Lakes Fishery Commission, Great Lakes Power Ltd. (Sault Ste. Marie, ON), and the Corps of Engineers. The Trapping Program has the dual benefit of removing spawning adults from the river and supplying males for the Sterile Release Program.

Zebra Mussel

The Zebra mussel, indigenous to Russia, was first found in Lake St. Clair in the mid-1980s, likely transported in the ballast water of an oceangoing vessel. It has since spread to waters throughout the Great Lakes and to other watersheds across the eastern and central parts of the continent. By 2002, zebra mussel populations had been found in lakes and rivers of 21 U.S. states and 2 Canadian provinces. Zebra mussels have caused massive changes to the Great Lakes ecosystem, including the elimination of native mussels, the triggering of toxic algal blooms, and the decline of the benthic amphipod *Diporeia*, which is the primary food source for many young fish and forage fish species in the Great Lakes. Zebra mussels also have serious economic impacts by clogging water intake and discharge pipes. Large water users such as power plants or municipal water treatment facilities are spending an average of \$350,000 to \$400,000 per facility just to clear zebra mussels from intake pipes. The quagga mussel, a near relative of the zebra mussel, is able to survive in deeper waters and different sediment types, effectively expanding the zebra mussel problem to additional areas of the lakes.

Once zebra mussels have invaded a water body, there is no effective method for eliminating or reducing the infestation. They continue to spread to new water bodies via ballast water of commercial vessels, as “hitchhikers” on recreational boats, and in the bait buckets of anglers. Currently, the most effective control methods to curb the spread to inland waters and freshwater systems outside the Great Lakes basin are the precautions taken by recreational boaters and anglers, such as the cleaning and draining of equipment before transporting it from one water body to another.

Other recent invaders and potential threats

Several more recent invaders causing serious concerns have also likely been introduced via ballast water. The spiny water flea and the fishhook flea, two microscopic crustaceans confirmed in 1984 and 1999, respectively, are gradually replacing their native counterparts. Since their long spines make them harder for fish to capture and digest, these invaders are destabilizing the food chain at its base. Round gobies were first found in the St. Clair River in 1990. Their

population has since expanded explosively in the Great Lakes and is displacing native species. Alas, Eurasian ruffe, introduced to Lake Superior in 1986, are expanding their range rapidly. The decline of value in fisheries in the Great Lakes due to ruffe infestation has been estimated at \$119 million annually. Other concerns are the potential to introduce fish disease-causing pathogens and the potential to import microorganisms causing human diseases such as dinoflagellates, which are the cause of “red” and “brown” algal tides and associated shellfish poisonings, or cholera and other pathogenic bacteria.

An imminent threat is the invasion of three Asian carp species (silver, black, and bighead). Silver carp have infested large areas of the Mississippi river watershed. Despite their recent introduction, they have already out-competed fish species in the Mississippi River, and now comprise a large percentage of the total fish population. An electrical barrier in the Chicago Sanitary and Ship Canal, originally constructed to keep the round goby out of the Mississippi watershed, is currently the only structure that can prevent movement of these invaders into Lake Michigan and the other Great Lakes. In its present design and operation, the barrier is not considered to be a reliable deterrent. Bighead carp have been identified in Lake Erie in recent years, though the low numbers could indicate that the species may not yet be established.

The Great Lakes-St. Lawrence basin is also in danger of compromising its ecological health and biodiversity due to the impact of invasive plants. Reed canary grass, purple loosestrife, and hybrid cattails are among the most notorious aquatic nuisance plant species.

Policy Developments

The arrival of the zebra mussel in the Great Lakes led to the passage of the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA) of 1990, which was subsequently amended under the National Invasive Species Act (NISA) of 1996. NISA focuses primarily on the prevention of unintentional introductions of invasive species via the ballast water of ships, into the Great Lakes and other freshwater systems in the United States. Among its provisions, NISA directs the Coast Guard to ensure that ships headed for the Great Lakes exchange their freshwater ballast with saltwater to flush out and eliminate freshwater organisms. NISA is presently up for reauthorization through the proposed National Aquatic Invasive Species Act (NAISA)

Despite implementation of control measures and a high level of compliance, at least four additional species have been established in recent year, all of which were presumably introduced with ballast water. Unresolved questions remain concerning the effectiveness of exchanging brackish or fresh water ballast from regions such as the Baltic and Black Seas. These regions have been identified as source regions for many recent Great Lakes invaders. Many of these organisms can either survive saline water or form resting stages—eggs, spores, and cysts—that remain in residual sediments settling at the bottom of ballast water tanks. The latter is particularly troublesome: more than 90 percent of all oceangoing vessels entering the Great Lakes do not contain declarable ballast

water on board. These NOBOB (no-ballast-on-board) vessels escape scrutiny under existing U.S. and Canadian federal, state, and provincial laws. Yet the unpumpable water and sediment residuals in the ballast tanks of these ships may contain life organisms and their resting stages, accumulated over previous ballasting operations. Various ballast water treatment technologies are being tested to reduce these problems. The four ballast water options that have been given priority consideration are 1) filtering; 2) nonoxidizing biocides; 3) heat; and 4) retrofitting or redesign of ballast water systems to allow safe and effective exchange. Currently, all of these options have limitations that compromise effectiveness (e.g., high costs, high power requirements, large size, or infeasible treatment rates).

According to the GAO, the current aquatic nuisance species (ANS) prevention and control programs lack a clear, long-term desired outcome and quantifiable measures of performance. The Union of Concerned Scientists (UCS) advocates for new and effective provisions that apply to all invasive ANS and all major pathways of introduction. At the 2003 annual conference of the International Association of Great Lakes and St. Lawrence Mayors, a resolution was adopted that calls on the governments of the U.S. and Canada to make a formal request for the IJC to comprehensively study and address the problem of invasive species in the Great Lakes. The mayors also called on the U.S. Congress to promptly enact NAISA in 2003. Activities in NAISA to be undertaken that are expected to particularly benefit the Great Lakes region include i) a nationwide mandatory ballast water management program; ii) increased funding and research for the Chicago Sanitary and Ship Canal Dispersal Barrier; iii) screening of planned importations of non-indigenous species; iv) public outreach programs; v) funding and assistance for rapid response plans, and vi) funding to conduct ecological surveys for the early detection of invasive species and analysis of invasion rates and patterns.

- **Wetlands and Wildlife Habitat**

NOAA has identified some 883 distinct coastal wetland ecosystems covering approximately 393 square miles in the U.S. portion of the Great Lakes basin. These wetlands are home to numerous wildlife species and ecological communities that are globally rare or imperiled in the coastal zone of the Great Lakes.

One of the challenges in assessing trends for Great Lakes coastal wetlands is the difficulty in evaluating actual wetland acreage given fluctuating water levels. The loss of coastal wetlands on lakes Erie and Ontario is estimated at 80 percent. In total, it is estimated that more than two-thirds of all Great Lakes wetlands have disappeared within the past two centuries.

While the impact of these losses has not been assessed at the basinwide level in detail, effects have been documented. For example, the resultant habitat destruction has led to the decline of numerous reptiles, amphibians, fish, and bird species. The loss of wetlands systems also poses special problems for

hydrological processes and water quality due to the natural storage and cleansing functions of these systems.

In addition to losses, human-induced stressors that degrade the remaining habitat and interfere with beneficial wetland functions are impacting both unprotected and protected wetlands. Human-induced stressors include drainage, dredging, filling, shoreline armoring and modification, changes in water level regime, fragmentation, and diking.

Although the rate of wetlands loss has slowed compared to previous decades, significant losses continue to occur. Recent policy developments also suggest a continued loss of inland wetlands in the basin may occur. A Supreme Court ruling in early 2003 concerning an Illinois landfill removed federal authority and protection from certain isolated wetlands that had previously been included in the category of “navigable waters.” In the Illinois case, the Army Corps of Engineers argued that an isolated pond could be considered part of the nation’s navigable waterways because migrating waterfowl used it. The claim was denied.

- **Great Lakes Water Withdrawals**

If current trends in water consumption are projected into the future, most experts agree that a global water crisis is imminent and that water of sufficient quality and quantity to meet human demands will become a scarce and fought over resource. The United Nations (UN) Commission on Sustainable Development (CSD) found that, by the mid-1990s, about half the world's rivers was seriously depleted and polluted, and some 80 countries—including the U.S.—with 40 per cent of the earth's population were suffering from water shortages. *Global Water Outlook to 2025: Averting an Impending Crisis*, a report published by the International Food Policy Research Institute and the International Water Management Institute, projects that daily global water use for households, industry, and agriculture will increase by at least 50 percent by 2025. By that time, according to estimates by the CSD, more than two-thirds of the world’s people could be living in water-stressed countries.

There are differing opinions on how serious a threat these trends pose for major water diversions from the Great Lakes to other regions. In its report *Protection of the Waters of the Great Lakes*, the IJC concluded that there is little reason to believe that the call for major diversions from the basin would return in the foreseeable future; barring significant climate change, engineering, economic, and social feasibility; and an abandonment of national ethics. Organizations such as the National Wildlife Federation or the Lake Michigan Federation, on the other hand, foresee that water industries and water-needy regions will increasingly seek to sell and export bulk water from the Great Lakes to satisfy consumption demands outside the basin.

Over the next twenty years, the region will most likely see a slight increase in water consumption and demand. The IJC report *Protection of the Waters of the Great Lakes* predicts an increase in irrigation within the basin. On the other hand, the IJC expects that there will be a trend to slower growth in water

withdrawals in the region. The report attributes this slowdown to conservation and environmental measures, shifts in resources from the industrial to the service sector, and a decline in population growth, mainly on the U.S. side of the basin. The IJC concludes in its trend assessment that existing water use data are out of date and do not provide a reliable basis from which to predict future demands.

Recent Calls for Major Water Withdrawals

In recent years, two proposals to divert large quantities of water from the Great Lakes basin focused attention on legal loopholes and the lack of clear, consistent rules for water withdrawals from the basin. The first was an effort to export Lake Superior water to Asia, the second is an attempt to pump and bottle water from a central Michigan aquifer.

In April 1998, the Ontario Ministry of Energy granted the NOVA Group a permit to transport bulk water by tanker ships to Asia. The province's argument for allowing the withdrawal was that it would not have an environmental impact on the lakes and would amount to less than the 19 million liters per day that require an agreement under the Great Lakes Charter. However, the permit was rescinded due to international and public pressure.

In August 2001, the Michigan Department of Environmental Quality granted the Perrier Group permission to pump and bottle 105 million gallons of water per year from central Michigan aquifers. The proposal was objected by then-Attorney General Jennifer Granholm, who argued that the federal statute from WRDA 1986 would apply requiring the consent of Great Lakes governors, since the bottling and transporting of Michigan spring water would constitute diversion and export from the Great Lakes and their tributaries for use outside the Great Lakes basin.

The plan also met with considerable resistance from parts of the local communities: a group of Mecosta County residents formed a nonprofit organization called Michigan Citizens for Water Conservation (MCWC). Based on concerns that the pumping would have adverse effects on the hydrology of adjacent streams and wetlands and dependent ecosystems, MCWC filed a lawsuit to contest the proposed groundwater withdrawal by Perrier. The case went to court in May 2003. In the court trial, MCWC made a motion for a temporary injunction pending the Court's final decision. The court trial resulted in a request to the company to provide more scientific information as evidence for their claim that the planned withdrawal would have no significant impacts on the regional hydrology and ecology. The court trial has ended in September of 2003. The injunction was postponed to a later date and the final decision of the judge is still pending.

Policy Developments

In 1985, the eight Great Lakes governors and the premiers of Ontario and Québec signed the Great Lakes Charter, a good-faith agreement to establish principles for the management of Great Lakes water resources. In the charter, the signatories agreed to prevent water diversions from the basin if they would have

significant adverse impacts on lake levels, in-basin uses, and the ecosystem. In response to Annex 2001, WRDA 1986 prohibited Great Lakes water diversions unless all Great Lakes state governors approve a proposed diversion of water outside of the basin. However, neither the Great Lakes Charter nor WRDA 1986 address consumptive uses within the basin.

The foundered attempt to export Lake Superior water to Asia prompted the Great Lakes Governors to fund a study through the Great Lakes Protection Fund that would examine potential legal problems that the Great Lakes face along with solution options. When the report was delivered to the Governors in the spring of 1999, they formed the Water Management Working Group to address the issues raised in the legal team's report. Later in the year, the provinces of Quebec and Ontario joined this working group. The working group is composed of at least one technical representative from each of the ten jurisdictions and one representative from each governor's and premier's immediate office.

Also in late 1999, the Great Lakes governors issued a set of principles for a stronger water resources management framework in the region. The statement led to the drafting of the Great Lakes Charter Annex 2001 by the working group. Signed by the Great Lakes governors and premiers on June 18, 2001, Annex 2001 is an amendment to the Great Lakes Charter that is intended to prevent future threats by asserting local control over Great Lakes water management and setting forth consensus-based and protective standards for water withdrawals. The suggested deadline for implementing Annex 2001 is June 2004.

The Water Management Working Group has developed a schedule for a series of face-to-face meetings in 2003-2004 to complete its work. As illustrated by the proposed water bottling operation in Michigan, current water laws and withdrawal standards of the states and provinces are considered "leaky" and controversial, particularly as far as the protection of groundwater resources. These and other issues are being addressed by an advisory committee that was formed to ensure broad-based public participation in the implementation of Annex 2001. The committee is made up of over twenty members representing environmental, agricultural, municipal, and industrial concerns. The working group also works closely with a resource group and a number of observers that include representatives from federal agencies, the IJC, and other governmental and related organizations.

- **Nutrient Pollution**

(excerpted from an analysis by the Northeast-Midwest Institute, The Great Lakes at the Millennium: Priorities for Fiscal 2001)

In the 1960s, nutrient pollution (primarily phosphorus, but also nitrate) led to severe degradation of the lower Great Lakes and many embayments of the upper Great Lakes. Massive algal blooms were a frequent occurrence. Decomposition of the algae resulted in anoxia (lack of oxygen), bad odors, and taste problems in drinking water. Fish died in large numbers and parts of the lakes were nearly devoid of aquatic life.

Since then, intergovernmental partnerships have invested more than \$10 billion to address the problems of nutrient pollution and eutrophication in the Great Lakes. Reductions in annual phosphorus loadings have been achieved in all five Great Lakes, with current loads well below the targets of the 1978 GLWQA. Problems remain in some areas, particularly within the Lake Erie basin.

The remaining problems are mainly a result of nonpoint source (NPS) pollution from urban and agricultural runoff. An important part of the strategy to curb nutrient pollution from nonpoint sources is soil conservation and erosion control in tributary watersheds. Since soils used for agricultural production also contain both fertilizer and pesticides, these strategies help to address several types of nonpoint source pollution.

- **Commitment to Great Lakes Restoration Goals**

Institutional arrangements for Great Lakes governance are elaborate and complex, originally more so than in any other freshwater system in the world. Literally hundreds of entities are charged with management of some aspect of the Great Lakes system. These include municipalities, agencies of the eight Great Lakes states and two Canadian Great Lakes provinces, dozens of tribes, U.S. and Canadian federal agencies, and several international commissions. While this extensive network is appropriately viewed as strength, the large number of players can lead to a host of management processes that run parallel or even at cross purposes to each other. In a recent GAO report, the lack of coordination among the many institutions was identified as a hindrance in achieving restoration goals.

GLWQA

Many coordination mechanisms are in place that have met with some success in advancing Great Lakes restoration efforts. Principal among them is the GLWQA, which was signed first by the two federal governments in 1972, with amendments in 1978 and 1987. The GLWQA expresses the commitment of both countries to restore and maintain the chemical, physical, and biological integrity of the Great Lakes basin ecosystem and includes objectives and guidelines to achieve these goals. For example, it establishes criteria that guide water quality-related programs between U.S. and Canadian federal, state and provincial governments.

The IJC was designated to monitor and assess progress pursuant to the goals of the GLWQA, in particular the adequacy of actions by the two federal governments, the province of Ontario, and the eight Great Lakes states. In 1981, the IJC began reporting on the progress toward GLWQA goals every two years. The most recent, the *11th Biennial Report* was released in 2002. Recently, the U.S. Policy Committee for the Great Lakes has released *Great Lakes Strategy 2002* (see Section 3.3. and Appendix B-1), which is intended to coordinate and streamline U.S. governmental program efforts toward fulfillment of the GLWQA. The U.S. Policy Committee is a multi-agency body that was formed under the leadership of GLNPO. Environment Canada has developed the *Great Lakes Action Plan (2001-2006)* to accelerate the restoration of beneficial uses in Canada's 13 AOCs

Beginnings of the GLWQA: Focus on Chemical Pollution

The initial agreement, signed on April 15, 1972, by Prime Minister Pierre Trudeau and President Richard Nixon, committed the two federal governments to control chemical pollution

in the Great Lakes. The focus was on pointsource pollution control by cleaning up wastewater from industries and communities. The major issue at that time was over-enrichment of the lakes with phosphorus. In the new 1978 agreement, the countries specifically committed themselves to rid the Great Lakes of persistent toxic substances, such as PCB, DDT, or dioxins. In 1987, a protocol amending the 1978 GLWQA was signed. the 1987 protocol introduced new annexes focusing on nonpoint contaminant sources (Annex 13), contaminated sediment (Annex 14), airborne toxic substances(Annex 15), contaminated groundwater (Annex 16), and associated research and development (Annex 17).

Annex 14 to GLWQA helped federal, state, and provincial agencies focus attention on contaminated sediments. In response, Congress authorized EPA's Assessment and Remediation of Contaminated Sediments Program (ARCS) under the Water Quality Act of 1987 and the Corps' Great Lakes RAPs & Sediment Remediation Program under WRDA 1990. The most recent initiative advancing Annex 14 goals was the Great Lakes Legacy Act of 2002. The legislation authorizes a \$54 million-per-year clean-up program, over a five-year period, through the U.S. EPA Great Lakes National Program Office (GLNPO). Legacy Act funds are to help accelerate clean up of orphaned contaminated sites.

Expanding the Focus of GLWQA: Addressing Physical and Biological Integrity

The 1987 protocol first emphasized the importance of human and aquatic ecosystem health and introduced provisions to develop and implement LaMPs and RAPs. In addition, SOLEC 1994 established aquatic habitat as an environmental issue that had been largely overlooked by GLWQA. The Great Lakes Fish and Wildlife Restoration Act of 1998 reflected growing concerns about the state of the Great Lakes fisheries. The Great Lakes Panel on Aquatic Species, convened by the Great Lakes Commission in 1991, was a major force in influencing the development of, and support for NISA, which passed in 1996. Panel membership is drawn from U.S. and Canadian federal agencies, the Great Lakes states and provinces, regional agencies, user groups, local communities, tribal authorities, commercial interests, and the university/research community.

Beyond GLWQA

In the past decade, the notion of a large-scale, coordinated Great Lakes Restoration Plan took shape. The key players agree that large-scale restoration planning, and the development of associated restoration priorities, can only succeed if it emphasizes the mutual dependence of environmental, economic, and quality of life objectives for the Great Lakes basin. This thinking is guided by the sustainability concept, which implies that today's society must be able to meet its needs without compromising the ability of future generations to meet their own needs. The Great Lakes Commission has produced two landmark documents that have played a key role in advancing this concept in the region. The first is the *Ecosystem Charter for the Great Lakes-St. Lawrence Basin*, released in 1993. More than 160 agencies, organizations, and businesses throughout the region have since signed the charter, which calls for a clean environment, strong economy, and high quality of life for basin residents. It presents a vision statement, principles, goals, objectives and strategic actions. The second document is the *Great Lakes Program to Ensure Environmental and Economic Prosperity*, which summarizes the U.S. federal legislative and appropriations priorities of the Great Lakes Commission membership. First released in 2000 and updated annually, it provides a blueprint for restoration goals.

Just recently, on October 1, 2003, the Council of Great Lakes Governors released nine priorities for the protection and restoration of the Great Lakes. They are:

- 1) Ensure the sustainable use of water resources while confirming that the states retain authority over water use and diversions;
- 2) Promote programs to protect human health against adverse effects of pollution;
- 3) Control NPS pollution;
- 4) Reduce the introduction of persistent bioaccumulative toxics into the Great Lakes ecosystem;
- 5) Stop the introduction and spread of ANS;
- 6) Enhance fish and wildlife by restoring and protecting coastal wetlands and other habitats;
- 7) Restore the environmental health of AOCs;
- 8) Standardize and enhance the methods by which information is collected, recorded and shared within the region; and
- 9) Adopt sustainable use practices that protect environmental resources and may enhance the recreational and commercial value of the Great Lakes.

In the summer of 2003, the National Sea Grant Program has launched two new cooperative restoration-planning initiatives, one with the Great Lakes Commission and another with the Northeast-Midwest Institute. The Great Lakes Commission-Sea Grant initiative is expected to provide a scientific basis for a comprehensive Great Lakes restoration plan. The ambitious two-year initiative will research ecosystem problems and needs; assess existing restoration initiatives; conduct focus groups that build on the development of state and provincial priorities; and convene a restoration-planning forum to assemble outcomes. Presently, the Great Lakes Commission and Sea Grant are planning and conducting state-specific stakeholder workshops in the Great Lakes states, in which restoration priorities are being developed.

The second initiative, the Northeast-Midwest Institute-Sea Grant cooperation, will explore approaches that other regions have used to launch major ecosystem restoration initiatives. It will compare and contrast other initiatives in order to develop a series of lessons relevant to the Great Lakes. It will also review the legislative history of key regional, national and international efforts to develop a useful reference for legislators.

Both initiatives are in support of the work of the Council of Great Lakes Governors, which is developing a series of restoration planning priorities at the request of the Great Lakes Congressional Task Force. This work is expected to lay the foundation for a Great Lakes Restoration Plan, to be developed under the auspices of the Great Lakes governors.

Great Lakes United, an international coalition of nongovernmental organizations (NGOs) and tribal organizations across the basin, has developed the *Great Lakes Greenbook*, an action agenda intended to guide restoration efforts from a citizen point of view (see Appendix B.5). The agenda summarizes recommendations for restoration actions, legislative initiatives, and funding requirements pertaining to i) toxic cleanup; ii) clean production; iii) green energy; iv) sustaining

and restoring water quantities and flows; v) protecting and restoring species; and vi) water and air quality standards.

The Nature Conservancy (TNC) is working on a Great Lakes Ecoregional Plan. The TNC initiative is a systematic approach that identifies all native species, natural communities, and aquatic systems of the Great Lakes basin and then determines how many of these and where these elements for biodiversity need to be protected to preserve the ecological character of the basin in the long term. In a first and second iteration, completed in 1999 and 2000, major portions of the ecoregional plan were completed with the selection of sites for target species and natural communities, including aquatic habitats. Current efforts are directed to fill in gaps, such as the absence of sites on the Canadian portion of the lakes.

3. Strategic Plans for the Great Lakes

In the present study, a total of 37 strategies, strategic plans, and guiding principles for Great Lakes management were reviewed (see Appendix B). The principles of the ecosystem approach, spelled out in the *Ecosystem Charter for the Great Lakes-St. Lawrence Basin*, reappear as a common thread throughout the majority of these documents. Almost all of the current strategies outline integrated management approaches for the Great Lakes and envision a healthy ecosystem and a sustainable economy in the basin. The particular goals vary depending on the mission and role of each organization and, in the case of multilateral strategies, the purpose of an alliance.

Still needed is a comprehensive restoration plan that ties all Great Lakes strategies together. Currently, there is no overarching, coordinated strategic plan that charges each partnering agency and organization with specific responsibilities, projects, and funds. A few documents, however, strive to provide this: *Great Lakes Strategy 2002* is a comprehensive summary of on-going and planned activities on the U.S. side of the lakes to fulfill the goals of the GLWQA (i.e., biological, chemical, and physical integrity of the Great Lakes ecosystem). The Great Lakes Commission's *Great Lakes Program* identifies priorities to tackle both ecological and economic issues.

The Great Lakes Commission recommendations target specific programs, authorizations, and appropriations and are designed to serve as a blueprint for a Great Lakes restoration plan. *A Citizen's Action Agenda for Restoring the Great Lakes* is a grassroots-based blueprint for comprehensive Great Lakes restoration, developed by Great Lakes United, a coalition of NGOs and tribal organizations across the basin. The agenda emphasizes the importance of coordinating a comprehensive Great Lakes restoration plan between U.S. and Canadian governments.

Several joint strategies address specific aspects of Great Lakes management. *A Joint Strategic Plan for Management of Great Lakes Fisheries*, developed by the Great Lakes Fishery Commission, aims at interjurisdictional coordination of fishery management. The interjurisdictional management of fisheries is also a main objective of *Conserving America's Fisheries*, the strategy for the fishery program of the U.S. Fish and Wildlife Service. The *Binational Toxics Strategy* of the U.S. and Canadian federal governments and the *Joint Commitment to Achieve Shared Water Goals* aim at fulfilling specific objectives of GLWQA. Another offspring from GLWQA, *LaMPs* address critical pollution issues at a lakewide basis. In the case of the *LaMPs* for Lake Superior and Lake Erie, the lakewide strategies have evolved beyond addressing critical pollutants to include issues such as sustainable development and

habitat restoration. The *National Strategy to Restore Coastal and Estuarine Habitat* aims at coastal wetlands and habitat restoration. So does the *Great Lakes Ecoregional Plan* of The Nature Conservancy, which aims at developing appropriate partnerships for the restoration and protection of each of its 271 designated conservation sites.

A Great Lakes Action Plan for the Prevention and Control of Nonindigenous ANS spells out a number of principles drawn from existing laws, policies, and programs to guide ANS prevention and control plans in each of the Great Lakes states and provinces. ANS is an identified priority in the majority of the reviewed documents, including the *Saint Lawrence Development Corporation Fiscal Year 2003/2004 Strategic Plan* and the U.S. Coast Guard's *Ninth District FY2001 Strategic Plan*.

Several agencies and organizations have developed strategic plans for the Great Lakes or have national strategies guiding their activities in the Great Lakes region. *Sustaining America's Coastal Communities and Resources* outlines strategic goals for the NOAA-led state-federal CZM. These include the entire spectrum of water resources challenges, ranging from the development and revitalization of ports and waterfronts and the reduction of hazard threats to the restoration of coastal habitats and water quality enhancement. CZM program development aligns with NOAA's goal to protect, restore, and manage the use of Great Lakes resources with management plans using ecosystem best management practices (*New Priorities for the 21st Century*). With its Great Lakes Environmental Research Laboratory (GLERL), NOAA also aims to provide leadership in research, monitoring, technology development, and communication and information transfer (GLERL *Strategic Plan 2000*). The U.S. Geological Survey (USGS) also generates scientific information and disseminates it to decisionmakers in the region. *Strategic Vision for the U.S. Geological Survey in the Great Lakes-St. Lawrence Region, 2001-2010* identifies mapping, water quality, water quantity, landscape and coastal assessments, geologic mapping, and biological resources research and assessments as the USGS science areas that are relevant to the Great Lakes region.

The strategic objectives of the Great Lakes Committee of the National Association of Conservation Districts (NACD) and the Natural Resource Conservation Service (NRCS) may help integrate rural development and agricultural land-use practices into Great Lakes restoration efforts. *The Strategic Direction of the NACD Great Lakes Committee* provides strategic guidance on how to address identified priority issues such as nonpoint water quality issues; erosion and sediment control; strengthening the district role in resource issues; implementing water quality plans; and providing a coordinating and information mechanism for conservation districts in the basin. The *NRCS Strategic Plan* specifies watershed-level, integrative approaches as a strategic direction to address water resources-related issues such as agricultural NPS, protection of rivers and streams from excess nutrient loadings, or wetland conservation.

New York's *25 Year Plan for the Great Lakes*, which has not been updated since 1991 and is hence somewhat outdated, is nevertheless an example of how the individual Great Lakes states could comprehensively strategize water resources management within the framework of an overarching, coordinated restoration plan for the Great Lakes basin. The *Strategic Plan for Water Resource Management* by the Northeastern Illinois Planning Committee is a similar effort to address the issues of water quality, flooding, and water supply in an integrated fashion but does not provide the larger, basinwide perspective.

F. Future Without Project Conditions

Integrating Economic and Ecological Objectives

At the present, there is **no** unified management strategy to integrate economic and ecological objectives for the Great Lakes basin. Such a strategy will be necessary to build a broad, non-partisan coalition to restore the Great Lakes basin for ecological and economic sustainability. The principles of ecosystem management—spelled out in the Ecosystem Charter for the Great Lakes-St. Lawrence Basin—offer guidance for the development of an integrated strategy.

Planning for Great Lakes Restoration

Great Lakes restoration progress is stalling, even though hundreds of federal, state, and provincial programs spanning dozens of agencies are available to support restoration efforts. Several new initiatives aim to turn the tide by developing a Great Lakes restoration plan or strategy that would coordinate existing federal and state efforts and generate the necessary funding to put the plan into action. Due to the range of ecosystems and the large number of stakeholders within the basin, the task of coordinating a comprehensive restoration effort is daunting and requires strong commitments and active support from all parties involved in the restoration effort.

Delisting Great Lakes Areas of Concern

The Great Lakes Legacy Act authorizes a total of \$270 million toward the cleanup of Great Lakes AOCs. If funded, the Legacy Act would only allow for the cleanup of a small fraction of the 31 U.S. and binational AOCs; total costs for the full restoration of beneficial uses at all U.S. AOCs are estimated at more than \$7.4 billion. Additional barriers to restoring beneficial uses are the lack of accountability and responsibility and missing restoration targets, priorities, and monitoring for recovery.

Develop Methods to Curtail Invasive Species

Invasive species are a growing and potentially devastating threat to the economy and environment of the Great Lakes region. For example, the utility and manufacturing industries around the region, dependant on Great Lakes water for production, are expending substantial time and money cleaning intake and discharge pipes clogged by the zebra mussel. The U.S. Fish and Wildlife Service estimates the economic impact to these industries, due to the zebra mussel alone, to be \$5 billion dollars over the next decade. These costs are likely to increase if measures to address the problem are not taken. Presently, strategies and methods for prevention and control of all Great Lakes invasives are lagging behind the initial occurrence and the progressing spread of invaders.

Coordinating Programs to Restore Coastal Habitat

Mandates and program authorities for coastal habitat restoration are very fragmented both across and within different agencies. Habitat restoration and management planning is part of the different LaMPs and other initiatives at the watershed or local level, but strategic, coordinated restoration planning on a basinwide scale is still in the beginning. In addition, many habitat areas have been identified as needing

restoration (for example, in LaMPs) but have yet to undergo any formal restoration or management planning.

Developing Ecosystem Objectives for Fish and Wildlife Habitat

The development of ecosystem objectives is recognized as an important part of habitat restoration management and planning. The individual LaMP processes, for example, involve the expansion of broad, vision-type goals to specific, sub-basin ecosystem objectives. FWS, TNC, and other partners address the need to establish ecosystem objectives for their restoration programs but these efforts are limited by the lack of data and information about the current state of the Great Lakes ecosystem.

Inventory of Wetlands and Other Coastal Habitats

Virtually all who work in Great Lakes resources management and restoration would benefit from a binational GIS database that contains an inventory of all coastal wetlands and other coastal habitat types in the Great Lakes basin. The Great Lakes Coastal Wetlands Consortium, a binational group of scientific and policy experts coordinated by the Great Lakes Commission are developing such a database. When completed, the database will support a long-term program for coastal wetlands monitoring.

Reversing the Loss of Coastal Wetlands and Other Critical Habitat

Habitat loss continues as a progressive, cumulative loss of small wetlands rather than the losses of large parcels. Millions of acres of coastal wetlands and other habitat resources are threatened by low-density development and other unsustainable land uses, hydraulic alterations, and shoreline hardening. The present low lake levels allow emergent wetlands to flourish in many large, protected bays. However, these habitats are vulnerable since they are experienced as a nuisance by affected lakeshore property owners and users.

Adapting Coastal Development to Natural Erosion Processes

Communities and shore property owners are intensifying coastal investments, mostly in the form of public facilities, lakeside condominiums, and year-round homes. However, the natural erosion processes and the risks of erosion to structures are often poorly understood and inadequately considered when making coastal investments. Particularly private shoreline property owners experience a high rate of failure in their efforts to abate shoreline erosion along the Great Lakes.

Turning Urban Sprawl into Smart Growth

One of the greatest stressors to the Great Lakes is not in the water but on the land in the form of urban sprawl, the rapid low-density development that comes at the expense of wetlands, green spaces, and a sustainable service infrastructure. Urban sprawl has become the dominant pattern of development in the Great Lakes basin, but interest is growing in revitalizing urban centers through higher-density, mixed-use community planning and redevelopment of underutilized or brownfields locations. The success of ecosystem management—including efforts of flood protection, antipollution, and habitat

restoration—will hinge on the success of turning the unsustainable trend of urban sprawl around to more responsible land-use practices.

Remediating and Redeveloping Waterfront Brownfields

Many coastal cities in the Great Lakes have plans to or are already revitalizing their deteriorated ports and urban waterfronts for the unique opportunities of community enhancement and development that these amenities provide. Major barriers to revitalization of urban waterfronts include limited funds and the large scale and complexity of these efforts, especially in cases where there is no effective network effort to consolidate resources and responsibilities and to connect remediation and redevelopment efforts.

One of the major obstacles to investment is the stigmatization of vacant or idle properties by perceived or real contamination problems. Lenders, investors, and developers still fear that involvement with these sites may make them liable for cleaning up contamination they did not create. Cleanup of contaminated urban waterfront areas continues to be a major challenge, particularly since remediation and redevelopment do not clearly fall within the responsibility of any particular agency. Contaminated waterfront sites, especially those where the contamination extends to both the land and the water, may fall under the jurisdiction of up to several dozen governmental agencies, often with overlapping and competing responsibilities. At present, there is no single agency providing oversight of the overall remediation process, which slows the process of waterfront remediation and revitalization.

Revitalizing Urban Centers

Many urban centers in the Great Lakes basin, especially former manufacturing centers, are plagued by abandoned commercial property, under-utilized infrastructure, a reduced tax base, and the social problems associated with decay. As a result, skilled workers are leaving the urban centers of the region behind for places that offer better job opportunities and a higher quality of life, either at the ever-expanding fringe of metropolitan areas or outside the basin. The revitalization of urban centers is expensive and complex, but more planners and decisionmakers are becoming aware that redeveloping within population centers, with existing infrastructure, is less expensive in the long run and a good investment in the economic and ecological sustainability as well as the quality of life in the basin.

Cleaning up Superfund Sites

The Great Lakes basin is home to thousands of inactive, abandoned hazardous waste sites. Cleaning them up is often the responsibility of each individual state. But the process often takes years and is hampered by a lack of funds, technical knowledge, and political will.

Preventing Soil Erosion To Reduce Dredging Costs and Needs

Unsustainable farming and development continue to wash hundreds of million of tons of topsoil sediments into the Great Lakes each year. The suspended sediments carry pollutants and fill in shipping channels and harbors. The continued sediment loadings

increase the costs for dredging and sediment remediation, but integrated strategies for sediment management and control that tackle the issue at the roots (i.e., in the upper watersheds) are just in the beginning stages.

Preventing Water Withdrawals From the Great Lakes Basin

In the 2001 Annex to the Great Lakes Charter, the Great Lakes states and provinces agreed to work toward a common decisionmaking standard by June 2004 to evaluate water withdrawals from the Great Lakes-St. Lawrence basin, including surface and ground waters. While the agreement might shield the basin from major diversions, scientists and environmental groups are concerned that it exempts certain small uses diverting less than one million gallons per day. The cumulative effects of groundwater withdrawals, spurred by urban sprawl, could have a major impact on the Great Lakes hydrologic balance.

Mitigating Water Level-Related Hazards

Low lake levels come with erosion hazards to property and infrastructure and shoaling hazards to commercial and recreational vessels; extremely high lake levels can threaten properties and public infrastructure by flooding and shore damage. While lessons have been learned from the past, it appears that current policies fail to put a halt to hazard-prone lakeshore land-use and development practices.

Balancing Great Lakes Water Management

An effective water resources management decision support system to guide sound policy decisions will depend on our ability to accurately calculate the Great Lakes hydrologic balance. Our current understanding of the Great Lakes water balance is limited by our inability to assess the impacts of cumulative minor withdrawals (e.g. groundwater withdrawals) on the water balance. Major unknowns are the surface water-groundwater connection within the basin and across watersheds and projected water demands and uses.

Implementing Needed Projects

Limited funds remain the main barrier to the implementation of Great Lakes restoration programs and projects. Other barriers that need to be overcome include the lack of local technical expertise, poor coordination, and a lack of leadership.

G. Planning Objectives

The following planning objectives were developed based on the Great Lakes water policy and related resource management input from the previous Section 6.H, Problems and Opportunities. They are presented here as guidance; addressing these will help ensure that the aforementioned problems and opportunities are accommodated in the Corps Great Lakes activities and programs:

1. Contribute to integrative and sustainable management of the Great Lakes economy and ecosystem;

2. Contribute to coordinated planning and strategizing for development of a consensus-based Great Lakes Restoration Program;
3. Contribute to timely RAP implementation, coordination of authorities and beneficial use targets for delisting Great Lakes Areas of Concern;
4. Contribute to prevention and control methods to reduce or eliminate the introduction of Aquatic Invasive Species;
5. Contribute to ecosystem management practices, including coordination, monitoring, planning and prioritization, that protect and restore Great Lakes coastal habitat;
6. Contribute to the development of a binational GIS-based coastal wetlands inventory that becomes integrated into Corps program management;
7. Contribute to sustainable watershed management practices, including education on the human impacts on shoreline erosion processes and natural approaches to attenuate it, to mitigate water-related hazards;
8. Contribute expertise and resources to coordination of environmental management programs among federal agencies for remediating urban waterfronts and brownfields;
9. Contribute to integrated watershed planning, soil conservation, education and other best management practices; and,
10. Contribute to interagency research, monitoring, water use accounting information systems, and data coordination to achieve balanced Great Lakes water management.

H. Planning Constraints

Implementation of proposed alternative plans is constrained by technical, environmental, social, economic and institutional limitations. These limits include resources (such as funding or personnel), other uses of scarce resources which compete with the proposed plan and legislative or regulatory restrictions. The scope of alternatives plans must conform to these constraints. Constraints identified during this study include:

- **Unfunded Authorities**

A legacy of Corps programs is that they have the potential to meet water resources needs in the Great Lakes basin but sometimes are never funded or have received funding for feasibility studies but not for the implementation of the projects. For example, the Aquatic Plant Control Program has been used in other parts of the country for more than forty years but never applied in the Great Lakes basin.

- **Underfunded Authorities**

More often than not, federal programs receive funding well below the levels required to achieve authorized program objectives. Not surprisingly, stakeholders responding to the Great Lakes survey identified a critical lack of funding as the major impediment to meeting water resources needs in the Great Lakes basin. This result echoes those of the GAO report: *Great*

Lakes - an Overall Strategy and Indicators for Measuring Progress are Needed to Better Achieve Restoration Goals, which cites a lack of funding as the chief barrier to restoration progress in the Great Lakes. Five underfunded authorities were identified: Aquatic Ecosystem Restoration, Environmental Improvements, Great Lakes RAPs and Sediment Remediation, Emergency Streambank and Shoreline Protection, and Flood Plain Management Services.

- **Program Limitations**

A survey of Program Managers in the Corps Great Lakes district offices (Buffalo, Chicago, and Detroit) identified potential program limitations and barriers. These factors emerged from a systematic comparison of those that are recognized by Corps Program Managers with the most critical shortcomings in current Great Lakes management and restoration efforts, as identified in the survey by the broader stakeholder community. They are discussed in more detail in Section 6.H.1.b. These factors include:

1. Corps policy;
2. Implementation;
3. Lack of matching funds by non-Corps partners;
4. Lack of nonfederal sponsors;
5. Limits to in-kind contributions; and,
6. Statutory limitations.

I. Measures to Address Identified Planning Problems and Opportunities

Integrating Economic and Ecological Objectives

The Corps of Engineers needs to develop a Great Lakes basin strategy that is rooted in the principles of ecosystem management and keyed into a coalition-based, coordinated Great Lakes management strategy. The Corps strategy for the Great Lakes basin will have to integrate commercial navigation and other societal needs with ecological restoration objectives. The John Glenn Great Lakes Basin Program (Section 455, WRDA 1999) and the Great Lakes Navigation Study (Section 456, WRDA 1999) will have to be fully integrated.

Planning for Great Lakes Restoration

Use the John Glenn Great Lakes Basin Program (Section 455, WRDA 1999) as an opportunity to strategize and coordinate restoration activities of the Corps in the basin. Also use the program as a mechanism to coordinate programs with other agencies and organizations under the umbrella of a Great Lakes restoration planning effort.

Delisting Great Lakes Areas of Concern

Develop strategic objectives, and supporting action items, for the application of Great Lakes RAPs and Sediment Remediation (Section 401, WRDA 1990) and Environmental Dredging (Section 312, WRDA 1990) to restore beneficial uses in AOCs. Coordinate the use of these programs with other federal, state, and provincial agencies; RAP committees; and other local partners. Ensure the timely implementation of projects in accordance with basinwide priorities and restoration targets.

Develop Methods to Curtail Invasive Species

The Great Lakes Navigation Study (Section 456, WRDA 1999) adequately assesses the risk of introductions and spread of invasive species. Accordingly, appropriate recommendations for the future use and development of the navigation system are introduced that would minimize this risk. The strategic use of the Aquatic Plant Control (Section 104, RHA 1958) and Aquatic Plant Control Research authorities should be investigated to address Great Lakes invasive species issues.

Coordinating Programs to Restore Coastal Habitat

Based on an ecosystem approach, develop a basinwide program management strategy for the application of environmental authorities—specifically, Aquatic Ecosystem Restoration (Section 206, WRDA 1996), Beneficial Use of Dredged Material (Section 204, WRDA 1992), and Environmental Improvements (Section 1135, WRDA 1986)—to coastal habitat restoration. Develop priorities and evaluation criteria for this coastal habitat restoration strategy in consultation with other agencies and organizations leading regional planning efforts, specifically with NOAA, The Nature Conservancy, and LaMP committees. Coordinate program and project development with these and other partners and implement projects pursuant to regional restoration priorities.

Developing Ecosystem Objectives for Fish and Wildlife Habitat

Implement the ecosystem approach. Coordinate habitat restoration authorities-- Aquatic Ecosystem Restoration (Section 206, WRDA 1996), Beneficial Use of Dredged Material (Section 204, WRDA 1992), Environmental Improvements (Section 1135, WRDA 1986), and Great Lakes Fishery and Ecosystem Restoration (Section 506, WRDA 2000)--with partner agencies and organizations to achieve Great Lakes ecosystem objectives. Develop an evaluation process and specified monitoring procedures to assess whether ecosystem restoration programs and projects meet specified ecosystem objectives.

Inventory of Wetlands and Other Coastal Habitat

In coordination with other agencies and organizations, help fill this need by applying existing technical resources and expertise. Increase investment in a coordinated database of coastal wetlands in the Great Lakes basin and actively support this effort; for example, by contributing data from existing studies and frequently updating completed field investigations. Use the completed inventory in conjunction with Section 404 permitting and for environmental impact assessment studies; for example, to conduct predictive modeling of navigation improvements on coastal wetlands and other habitats in connection with the Great Lakes Navigation Study (Section 456, WRDA 1999).

Reversing the Loss of Coastal Wetlands and Other Critical Habitat

Develop policies to prevent loopholes in Section 404 permitting that allow the gradual destruction of wetlands through cumulative “minimal effects.” Enhance field investigations for Section 404 permitting and inspect and report all violations. Develop strategic goals for how to

advance coastal wetlands restoration priorities by making use of the following ecosystem restoration and planning authorities: Aquatic Ecosystem Restoration (Section 206, WRDA 1996), Beneficial Use of Dredged Material (Section 204, WRDA 1992), Environmental Improvements (Section 1135, WRDA 1986), and Great Lakes Fishery and Ecosystem Restoration (Section 506, WRDA 2000), Great Lakes RAPs and Sediment Remediation (Section 401, WRDA 1990), and Planning Assistance to States (Section 22, WRDA 1974).

Adapting Coastal Development to Natural Erosion Processes

Strategize the use of the Planning Assistance to States (Section 22, WRDA 1974) to support coastal wetlands restoration as a measure of shoreline erosion prevention. Invest in an outreach program to educate local governments and lakeshore property owners on shoreline erosion issues and protection alternatives. Embrace and advocate for a strategic shift from reactive, structural protection to sustainable planning and management solutions for shoreline erosion prevention.

Turning Urban Sprawl into Smart Growth

As part of a strengthened outreach effort, educate local planners and the public how urban sprawl and other unsustainable practices exacerbate water-related problems such as flooding, habitat destruction and pollution. Engage in pilot projects that can demonstrate end-of-pipe savings by conducting planning and prevention activities. Prioritize and advocate watershed planning over structural responses to flooding or other water-related hazards. Trade a narrow view of a project's scope as "improvement" and "federal interest" for a broader, ecosystem-based approach to program priority setting and project planning.

Remediating and Redeveloping Waterfront Brownfields

With a new authority, establish a strategic approach that builds on existing program authorities, resources, and expertise for urban waterfront and brownfield remediation but provides for a more comprehensive waterfront approach that addresses revitalization needs of waterfront communities in the water and on the land. Collaborate more extensively with states and local authorities to develop a strategic approach for how to tie waterfront remediation into revitalization programs. Coordinate and maximize the application of existing program authorities and resources to restore degraded urban waterfronts. Develop strategic objectives for using Planning Assistance to States (Section 22, WRDA 1974) to remediate coastal and other brownfields and Great Lakes RAPs and Sediment Remediation (Section 401, WRDA 1990) and Environmental Dredging (Section 312, WRDA 1990) to dredge and cap contaminated sediments.

Revitalizing Urban Centers

Evaluate Corps policies to determine the extent to which, if at all, they contribute to sprawl, and eliminate or modify them. Collaborate with NOAA, state agencies and coastal management programs, and local authorities to address the challenge of urban revitalization. Identify role, resources and expertise, and strategic objectives of the Corps pertaining to waterfront rehabilitation and brownfields development in the Great Lakes basin. Develop strategic objectives for using the Planning Assistance to States (Section 22, WRDA 1974) to support efforts by the states and their local units to revitalize older urban areas.

Cleaning up Superfund Sites

Develop a strategic objective to use existing technical capacities and expertise to the fullest extent to support other governmental agencies in the cleanup of Superfund sites in the Great Lakes basin.

Preventing Soil Erosion To Reduce Dredging Costs and Needs

Inform your stakeholders on the importance of integrated watershed management. As part of a strengthened outreach effort, educate local planners and the public on how urban sprawl and other unsustainable practices exacerbate water quality and sediment problems, and of the economic and ecological benefits of topsoil erosion prevention. Put more programmatic focus on sediment loading reduction versus dredging, for example, by extending the Regional Sediment Management Demo Program to integrate topsoil erosion prevention with other aspects of sediment management. Invest resources in gathering and coordinating baseline data for the application of Great Lakes Sediment Transport Models (Section 516(e), WRDA 1996). Develop and maintain strong program partnerships with U.S. EPA, NRCS, and relevant state agencies to address sediment control.

Preventing Water Withdrawals from the Great Lakes Basin

As part of a strengthened outreach effort, educate regional decision makers on the Great Lakes hydrologic system. Invest more resources in gathering and coordinating water quantity data as part of the water control mission.

Mitigating Water Level-Related Hazards

As part of a strengthened outreach effort, educate regional stakeholders and the public on the Great Lakes hydrologic system, the human influence on the system, and hazard prevention through responsible landuse and sustainable development.

Balancing Great Lakes Water Management

[Report, in a timely manner](#), Lake Michigan water diversion data. Strategically explore opportunities for program development in water use accounting. Strengthen resource investment and participation in multiagency research, data coordination, and information systems.

Implementing Needed Projects

The Corps must focus on enhancing efficiency and effectiveness of Great Lakes project development, execution and completion.

J. Alternatives

A preliminary screening of strategic objectives identifies one or more alternatives from among those developed in the initial analysis stage. The description and results of the evaluations of the preliminary alternatives considered in this study are presented below.

1. No Action (Without project conditions)

See “Future Without Project Conditions” in Section 6.G for a detailed discussion.

2. Integrating Economic and Ecological Objectives

The Corps of Engineers and a broad coalition of partnering organizations representing all levels of government, industry, and society need to embrace and advance an ecosystem management strategy for the Great Lakes basin. Such an ecosystem management strategy will have to integrate dynamics of the Great Lakes economy with long-term ecosystem management and sustainability objectives.

3. Planning for Great Lakes Restoration

The Corps of Engineers should be a key participant in a coordinated Great Lakes restoration planning process to develop a shared vision for the basin that sets forth specific restoration goals, objectives, and performance measures and specifies projects, funds, and responsibilities of the individual partners. Based on the analysis above, there are sufficient indications that a viable partnership can be developed that will meet the necessary Federal interest criteria. The following strategies should be part of a coordinated Great Lakes restoration planning process:

- i Delist Great Lakes Areas of Concern.
- ii Develop methods to Curtail Invasive Species.
- iii Coordinate Programs to Restore Coastal Habitat.
- iv Inventory of Wetlands and Other Coastal Habitat.
- vi Reverse the Loss of Coastal Wetlands and Other Critical Habitat.
- vii Ecosystem Restoration of Environmental Damage Caused by Past Water Resources Development.
- viii Adaptation of Coastal Development to the Natural Erosion Processes.
- ix Remediation and Redevelopment of Waterfront Brownfields
- x Cleanup of Superfund Sites
- xi Prevention of Soil Erosion To Reduce Dredging Costs and Needs
- xii Balancing Great Lakes Water Management

6. SUMMARY OF COORDINATION, PUBLIC VIEWS, AND COMMENTS

A. Great Lakes Commission Survey of Great Lakes Stakeholders

This study identified Great Lakes water resources needs through a Great Lakes Commission survey of a broad and representative group of stakeholders with a vested and immediate interest in program activities of the Corps. This group included agencies and organizations strategically involved in navigation, water quality, sediment remediation, habitat restoration and protection, shoreline protection, flood damage reduction, water level monitoring

and management, or brownfield restoration and urban planning. It also included related government units at the state, federal, and local levels, certain relevant businesses and industries, tribal entities, binational organizations, non-governmental organizations, and miscellaneous other stakeholders. Appendix C contains detailed survey results; statistics of survey respondents are presented in Section 8. Eighty-eight of 309 survey recipients participated, which represents a 28 percent response rate (Part A-Section 8:1b). The survey questions spanned a range of water resources issues:

- Great Lakes Water Resources Challenges—The Big Picture;
- Restoring and Protecting the Great Lakes;
- Flood and Storm Hazard Response and Prevention Around the Great Lakes;
- Waterways and the Urban Waterfront;
- Reducing Excess Sediment Loadings;
- Great Lakes Water Levels and Flows;
- Water Resources Planning and Management;
- Partnerships and Opportunities for the Corps of Engineers (Survey Part B).

Water Resources Needs from a Nonfederal Perspective

Four of five survey participants (80 percent) were representatives of nonfederal entities. Forty-one percent were representatives of state entities. More than two of three respondents (71 percent) were from agencies and organizations involved in natural resources restoration and management, either through any or a combination of regulatory authority; policy, planning, or coordination policy; information and/or education involvement; and research programs (Part A - Section 8: 1a).

Relationship with the Corps of Engineers

Twenty-four percent of the recipients answered survey Part B: Partnerships and Opportunities for the Corps Programs (Part A - Section 8: 1b). Of these, 55 percent indicated that they have program partnerships with the Corps of Engineers and 43 percent indicated that they have none (Part B: 3a). Forty-four percent of the participants maintain partnerships with the Corps involving technical collaboration and implementation of projects in the Great Lakes basin (Part B: 3d). On a scale from 1 (no interaction) to 7 (strong partnership), the average level of interaction with the Corps was assessed between 4 and 5 (Part B: 4a; p. D-28). More than two of three participants (72 percent) rated the adequacy of their interaction with the Corps as either good (33 percent), adequate (23 percent), or very good (16 percent) (Part B: 4b).

B. Coordination with Corps Districts

The Corps District offices provided funding data and program information for their Great Lakes operations. The details are presented for the Great Lakes programs in Appendix B, with funding data presented in Appendix E. The programs and authorities analyzed in this study are:

- **Environmental Restoration**
 - Aquatic Ecosystem Restoration (CAP)

- Aquatic Plant Control Program (CAP)
 - Beneficial Use of Dredged Material (CAP)
 - Ecosystem Restoration Projects (specifically authorized)
 - Environmental Dredging (CAP)
 - Environmental Improvements (CAP)
 - Environmental Infrastructure (CAP and specifically authorized)
 - Great Lakes Fishery & Ecosystem Restoration (Great Lakes program)
 - Great Lakes Remedial Action Planning & Sediment Remediation (Great Lakes program)
 - Research Programs
 - Riverine Ecosystem Restoration & Flood Hazard Mitigation (CAP)
- **Flood Damage Reduction and Shoreline Erosion Prevention**
 - Emergency Streambank & Shoreline Protection (CAP)
 - National Shoreline Erosion Control Development and Demonstration Program (research program)
 - Shore Damage Mitigation (CAP)
 - Shore Protection (CAP)
 - Small Flood Control Projects (CAP)
 - Snagging and Clearing (CAP)
- **Navigation**
 - Great Lakes Navigational System (feasibility study)
 - Small Navigation Projects (CAP)
 - Soo Lock Replacement Project (specifically authorized project)
- **Sediment Transport Analysis and Management Planning**
 - Great Lakes Sediment Transport Models (Great Lakes program)
 - Regional Sediment Management Demonstration Program (research program)
- **Planning Assistance and Technical Support Programs**
 - Floodplain Management Services
 - Great Lakes Remedial Action Plans and Sediment Remediation (Great Lakes program)
 - Planning Assistance to States
 - Tribal Partnership Program
- **Water Level Control**
 - International Water Studies
 - Lake Michigan Diversion Accounting
 - Surveillance of Northern Boundary Waters

Based on the information presented in this study, there are significant strategic options for the Corps of Engineers in its Great Lakes operations of the future. The specific strategies and

objectives are detailed earlier in this report to meet the three of the five strategic goals recently released in the *Corps Civil Works Strategic Plan: Goals and Objectives, FY 2004-2009*:

- “Provide sustainable development and integrated management of the Nation’s water resources;
- Repair past environmental degradation and prevent future environmental losses; and,
- Ensure that projects perform to meet authorized purposes and evolving conditions.”

These strategies also support the Corps’ primary programs of Navigation, Flood Damage Reduction and Ecosystem Restoration. As noted earlier, Navigation (both commercial and recreational) is being studied comprehensively under separate authorities of WRDA 1999 and, thus, was not considered in great depth herein. Finally, the strategies also address three of the five major water resources challenges identified in the *Corps Civil Works Strategic Plan*. These challenges are:

- “Achieve a balance between traditional water resources demands and environmental/ecosystem goals;
- Restore the vitality of the environment from the degradation caused by past development; and,
- Minimize institutional barriers to efficient and effective water resources planning, decision making, and management.”