John Glenn Great Lakes Basin Program
Biohydrological Information Base

In response to Public Law 106-53, Water Resources Development Act of 1999,

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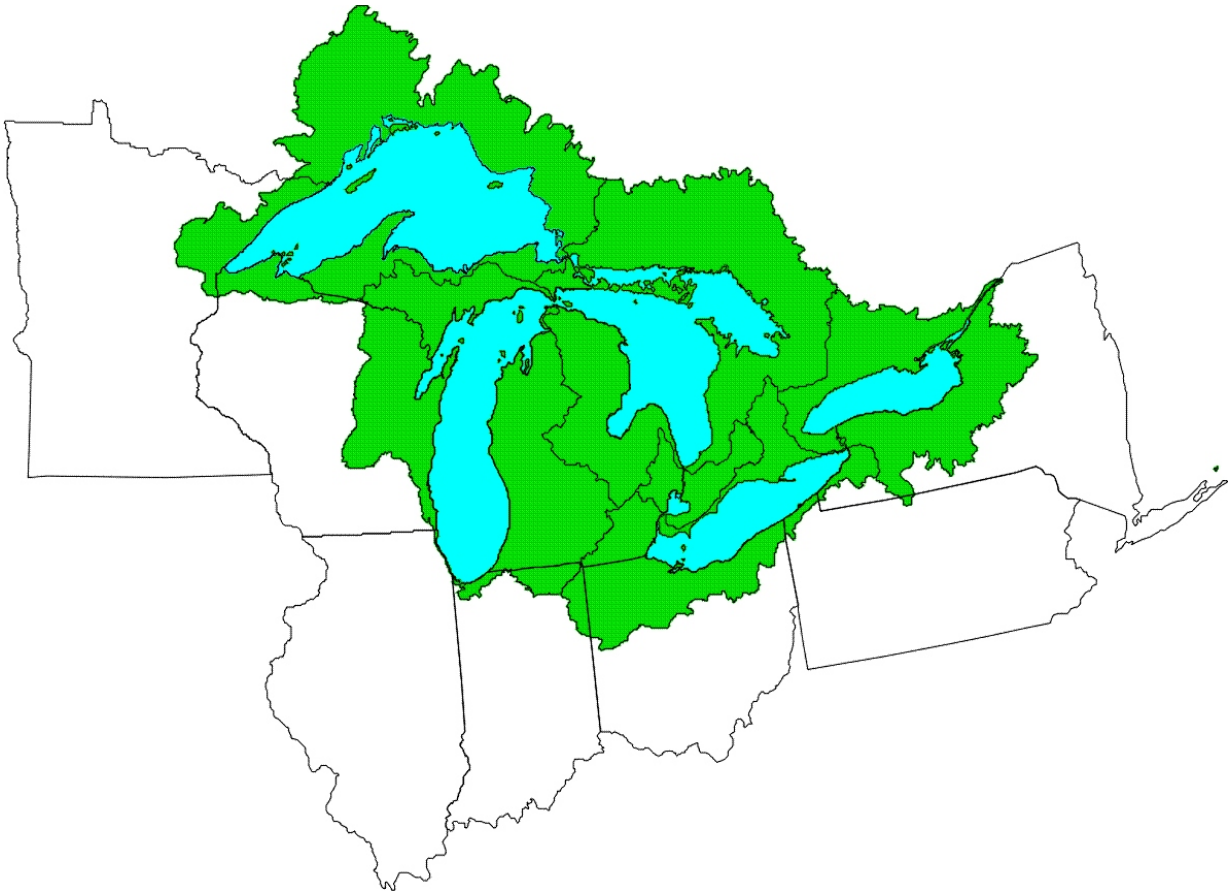

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US Army Corps of Engineers®

Appendix I:
Land Use and Land Cover

Measurement Converter Table

U.S. to Metric

Length
feet x 0.305 = meters
miles x 1.6 = kilometers

Volume
cubic feet x 0.03 = cubic meters
gallons x 3.8 = liters

Area
square miles x 2.6 = square kilometers

Mass
pounds x 0.45 = kilograms

Metric to U.S.

Length
meter x 3.28 = feet
kilometers x 0.6 = miles

Volume
cubic meters x 35.3 = cubic feet
liters x 0.26 = gallons

Area
square kilometers x 0.4 = square miles

Mass
kilograms x 2.2 = pounds

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APPENDIX I:

Land Use and Land Cover

Introduction

Water resources are heavily impacted by human activity on the lands that surround them. Historical patterns for that activity in the Great Lakes-St. Lawrence River region can be divided into four or five general categories. Prior to European settlement and through the fur trade era, the human population was small and the land throughout the region was covered by forests, prairies, small settlements and small agricultural plots. During the logging era, forests were cleared and extensive damage was done to riparian vegetation and stream banks as logs were transported by river to growing cities and mill sites. During the agricultural era that followed, cleared forests and other wooded areas and prairies were turned into cropland, and large cities began to develop. The industrial era brought still larger cities and the introduction of an expanding paved road network. The modern era is marked by extensive imperviousness, urban sprawl and commercial and institutional features that accompany it, and limited regrowth of wooded areas and forests as agriculture uses decline.

Two approaches are commonly taken to mapping areas and impacts of human activity on the land. The term "land use" describes activities taking place on or affecting the land's surface, e.g., residential housing, retail commerce, crop farming or recreational uses. Land use is typically characterized at the parcel scale, especially in urban, suburban and developing areas. It can readily be gathered from property (cadastral) maps and zoning maps. "Land cover", on the other hand, refers to the physical properties of the land surface and the materials that overlay it, e.g., grass, wetland, mixed deciduous forest or asphalt. Several different types of land cover are possible within any land use category, so land cover mapping usually requires ancillary data from sources like parcel or zoning maps.. For small areas, land cover can be determined by ground surveys or from site plans, but normally it is mapped from aerial or satellite imagery.

Land cover data gathered from images of any kind is subject to the amount of detail available from the image, referred to as its resolution. It is usually possible to gather more detailed information from low-altitude aerial photography than from photographs taken at high altitudes. In the same manner, satellite sensors capable of viewing the Earth's surface as a collection of 1-meter pixels will provide more information than those that discern pixels of 30 meters wide by 30 meters long. However, the notion that higher resolution is better does not always hold true as the geographic extent expands. The process of classifying satellite data or aerial photographs into land cover categories is labor intensive at any scale. As the area of interest increases, data quantities and processing needs grow exponentially and large investments need to be made in computer resources. For large geographic areas, slightly lower resolution data often provides adequate information at substantially lower costs.

Land use and land cover mapping efforts take place at many levels across the Great Lakes-St. Lawrence River basin. The spectrum ranges from local work focused on individual political

jurisdictions or drainage areas to national programs housed at multiple federal agencies. Data for these efforts come from a variety of sources, including ground surveys, property and zoning records, aerial photography and satellite imagery. Results, in turn, may exist in a number of formats and projections, and they may not be accessible by other units of government.

Land Use and Land Cover — Consequences and Impacts to Water Resources

Both surface waters – lakes, streams and rivers – and groundwater are affected by land use/land cover characteristics. Land cover impacts the rate at which surface precipitation flows into lakes, rivers and streams, and helps determine what materials are carried from the land surface into those water bodies. Land cover also affects whether waters falling on the ground can be absorbed and transported into groundwater aquifers.

Trees, shrubs and grasses on natural, vegetated land surfaces act as shelters and a retaining system for the underlying soil. In the Great Lakes region, approximately 70 percent of the precipitation that falls on these surfaces is absorbed at that location, then returns to the atmosphere, either as transpiration from plants or as simple evaporation (Bowles, 2002). The remainder moves either laterally through surface vegetation and topsoil layers into wetlands and surface waters, or infiltrates into deeper layers and recharges groundwater.

In comparison, bare soil, without a covering layer of vegetation, does a relatively poor job of absorbing moisture. Instead, water from precipitation can flow overland as sheet runoff, picking up unanchored particles in the process and carrying them into lower-lying areas or depositing them in surface waters as sediment. Early examples of this come from the logging era, when tree cover was removed for commercial purposes and riparian vegetation that stabilized stream banks was destroyed as logs were transported downriver. The process continued during the agricultural era because exposed soil between crop rows and in areas of overgrazing exhibits similar characteristics. Topsoil is lost, sediment loads in streams are increased, groundwater recharge is reduced, and the risk of flooding rises.

Compacted soils and any land covered by a building or by materials such as concrete or asphalt take this a step further by being impenetrable to water. Such areas, commonly categorized as impervious surfaces, are receiving considerable attention from many sectors as impacts, corrective measures and plans for the future are evaluated.

The Issue of Impervious Surfaces

Impervious surfaces in general impact groundwater recharge and streamflow. At the purely physical level, none of the precipitation that falls on an impervious surface can be absorbed where it fell, and very little of it will remain at that location long enough to evaporate. Both the amount and velocity of surface runoff increases in and around these areas, which means:

- Water levels in receiving tributaries fluctuate more rapidly and across a greater range
- Erosion increases
- Flooding increases
- More sediment is carried to surface waters
- Surface water temperatures increase
- Groundwater recharge is reduced

In addition, there is a potent chemical dimension to runoff from many impervious surfaces because:

- Many of these surfaces collect significant quantities of pollutants (leaked vehicle fluids, transported chemicals, road deicing compounds, fertilizers, etc.) which wash into surrounding soils and surface waters
- Natural processes linked with infiltration (physical filtration and the breakdown of some compounds by biological processes) are prevented or reduced

Studies indicate that surface waters are affected by low total percentages of impervious surface in the watershed. In one study, 5.3 percent impervious surfaces was sufficient to cause measurable declines in stream biotic integrity (Milton et al, 2003). The same study cited declines in a rapidly urbanizing area with impervious surface totals as low as 4 percent, but speculated that poorly regulated construction practices may have been the source of much of that damage. Common figures from a number of sources show habitat and biological diversity decline sharply when impervious surface percentages exceed 8 – 10 percent of the watershed. Beyond 25 – 30 percent, habitat ratings become “poor” and biological indicators decline below Clean Water Act goals.

Urban land uses bring with them the largest percentages of impervious surface to total land cover. A USDA report estimates that land cover on a $1/10^{th}$-acre residential lot, with the house, driveway, outbuildings and sidewalks factored in, will include 65 percent impervious surface. As lot size increases, this percentage goes down, but even on a one-acre lot, 20 percent of the land will be covered by impervious surfaces (Urban Hydrology for Small Watersheds, 1986). Thus, almost any residential neighborhood lies beyond the threshold where impervious surfaces impact water resources.

Table I.1 below lists values for estimating land cover by land use type for some urban land uses. In another, more general categorizing scheme, offices, stores, houses, etc., where people live and work account for approximately 35 percent of the total. The other 65 percent is made up of parking lots, roads, driveways, sidewalks and other transportation infrastructure, much of it designed to accommodate the automobile.

Table I.1 Impervious Surface Estimates for Selected Urban Land Use Types (adapted from "Do It Yourself!", NEMO Technical Paper No. 4)			
Minimum Lot Size (Acres)	**Minimum Lot Size (Hectares)**	**Land Use Description**	**Percent Impervious Surface (USDA-NRCS Study Values)**
0.12	0.05	Individual Residential Lot	65
0.25	0.10	Individual Residential Lot	38
0.32	0.13	Individual Residential Lot	30
0.50	0.20	Individual Residential Lot	25
1.0	0.40	Individual Residential Lot	20
		Townhouse/Garden Apt.	44
		Commercial/Business	85
		Industrial	72

Land Use / Land Cover Information Resources

Information on land use is commonly drawn from jurisdiction-based maps. At the state and regional level, community boundaries and areas of special jurisdiction like national parks and state game preserves allow depictions of land use by general category, such as urban, rural, agricultural or open land. Within individual jurisdictions, cadastral (property) maps, zoning maps and community master plans present a more detailed depiction of land use, both in terms of physical location and often by providing detailed descriptions of property requirements and particular activities allowed.

Current land cover information is available through several federal programs, programs in most states and through planning agencies in many counties and cities:

Two federal datasets exist for the Great Lakes region, the National Land Cover Dataset (NLCD), housed at the US Geological Survey, and the datasets developed for the National Oceanic and Atmospheric Administration's Coastal Change Analysis Program (C-CAP). Both were developed from Landsat Thematic Mapper satellite images. They are limited to the 30m by 30m resolution of the satellite's sensor, meaning grid cell of data represents approximately one- quarter acre of landscape, so the information becomes difficult to use if applied to too small an area. On the other hand, these images represent the entire Great Lakes-St. Lawrence River basin and can function as a reasonable overview of the entire area or any of its component watersheds at the time the imagery was acquired.

Satellite imagery is now the norm for statewide land cover mapping as well, and the NLCD is commonly used as a baseline from which update efforts are carried out state by state. State land cover mapping programs may include older data extracted from aerial photography, and several states have acquired and processed satellite imagery above and beyond the NLCD in the interest of having shorter or more consistent update cycles.

Local land use/land cover data development efforts vary with the community's perceived needs. Often, land use information has been developed based on property boundaries, zoning maps and community master plans. Meanwhile, recent aerial photography or high-resolution satellite imagery may exist, but primarily as reference material for projects undertaken in a number of departments. There is little emphasis on categorized land cover information from such sources, so land cover data layers are seldom created from them.

Implementation Strategies

Tasks for improving the information base related to the land use and cover across the Great Lakes-St. Lawrence River basin are presented in this section. These tasks are defined within the framework of identifying the potential U.S. federal role in creating and maintaining an information base to support science-based decisions on water withdrawals and diversions from the Great Lakes-St. Lawrence River basin. Each task is defined at different options of implementation under the U.S. Army Corp of Engineers' plan formulation approach. This approach, in a broad sense, is being used to develop systematic strategic plans that Congress could consider for supporting the states' Great Lakes Charter Annex decisionmaking process.

Five implementation strategies are presented, each as a separate integrated approach. This, however, is not an exclusive list and does not represent an "all or nothing" approach. Individual elements from one strategy could be pulled out and funded separately, making an important contribution to Great Lakes - St. Lawrence River basin information base. Even modest increases in funding over the "Without Plan" strategy can enhance decisionmaking. Water resources managers should examine each particular integrated strategy as well as individual tasks to discern where important progress can be made.

Described below are five implementation strategies considered:

- **Without Plan Strategy** – Describes the status of the activity as it currently exists. Without change, this current status may actually decline, representing negative impacts. If negative impacts are expected, they are highlighted wherever possible.

- **Minimum Investment Strategy** – Describes the least costly measures needed to insure minimum functionality of the decision support system. Not all system components of an implementation plan are included in this strategy.

- **Selective Implementation Strategy** – Describes an integrated system comprised of prioritized components. Few components are fully funded, but no essential components are excluded.

- **Enhanced Implementation Strategy** – Describes an integrated system that includes all essential components at funding levels, which enhance information accuracies and decision support system functionalities.

- **Full Implementation Strategy** – Describes an integrated system that fully implements the described activity. Technical staff and financial resources are not restricted. Information accuracies and completeness approaches state-of-the science.

Due to the interdependent nature of many issues described in the appendices, some findings may be repeated in total or in part elsewhere in another appendix. The interdependence of the information is noted explicitly in the appendices wherever appropriate.

A dollar value has been estimated for the four potential strategies that require additional investment over a 10-year implementation schedule. Monetary value is based on the best available information through extensive research and review by project collaborators and is presented in 2004 U.S. dollars. Further information is provided in Appendix K – Cost Evaluations and Risk Assessments, including an analysis of the uncertainty associated with these estimates.

Comparisons of costs at various implementation levels provide a useful measure of investment versus return. It is important to remember that the primary objective of all investments is to reduce uncertainties associated with decisionmaking. Since the hydrogeology and meteorology of the Great Lakes – St. Lawrence River system is highly complex; reductions in uncertainty are sought for each task outlined for the integrated information system.

The definition of the individual tasks outlined in this report has sought to eliminate "double-counting" as much as possible. Costs for the various tasks also explicitly address any interdependencies that occur under a particular implementation strategy. Cost estimates for each task under each implementation strategy also reflect anticipated economies of scale.

Risk and Uncertainty

Risk and uncertainty are inherent aspects of all facets of an integrated information system for water management of the Great Lakes – St. Lawrence River system. Risk can be viewed relative to human and aquatic health, to real property, to the ability to attain profit from a commercial venture, or to relative benefits that can be attained at given investment levels.

The integrated information system described within this report, once improved above current conditions, has a very low likelihood of adverse risk to human health, life or personal property. It is simply a monitoring, modeling and predictive system that does not include significant physical structures or construction. The converse does apply however; continued financial stressors on the monitoring system can cause atrophy of monitoring abilities which could, in turn, mask physical, chemical and biologic change to natural streamflow throughout the system.

Risk is also factored in throughout this report related to the prospective reward or benefit attained at increasing levels of investment. Each task in the integrated information system is evaluated in terms of cost effectiveness, whenever practical. This discussion is addressed in detail in the Main Report, although each appendix includes detailed information on the risk/return for each task under each implementation strategy.

Uncertainty is pervasive throughout the design, implementation and operation of any integrated water management system. At the current level of investment in groundwater, surface water and open lake monitoring and modeling, cumulative withdrawals from headwater systems cannot be detected, measured or adequately estimated. Hence, the uncertainty of cumulative hydrologic effects is extremely large under the Without Plan and Minimum Investment Strategies. Even under the Full Implementation Strategy, uncertainty will continue to exist, albeit at a much lower level. This uncertainty would be accompanied, however, with an accurate error budget including almost all hydrologic and biologic factors, which currently does not exist.

The analytical functions of the integrated information system will generally have reduced uncertainties as funding increases from one implementation strategy to the next. In addition, these uncertainties can be computed with greater confidence as more investment is made in the monitoring frame and computer modeling. The legal defensibility of permitting water withdrawal improves as uncertainty is reduced, in part or in total.

Integrated Information System Tasks

Tasks 52-54 described in this appendix present an integrated approach towards collecting and managing information on the groundwater and geology of the Great Lakes – St. Lawrence River system. It is important to see these tasks as "building blocks" for the integrated information system. Improvements under any specific task will provide incremental benefit, but the sum of the parts provides the greatest opportunity for reducing uncertainties under each implementation strategy. These tasks are repeated below.

Task 52: The USGS, in conjunction with the NOAA and the USACE and in cooperation with state agencies, need to produce comprehensive and consistent land cover datasets for the entire Great Lakes - St. Lawrence River basin on a five-year repeat cycle.

Task 53**:** The USGS, in conjunction with the USACE and in cooperation with state agencies, need to produce high-resolution land cover data within the Great Lakes - St. Lawrence River basin to support detailed assessments of specific water withdrawal proposals.

Task 54: The USGS, in conjunction with the USACE and in cooperation with state agencies, need to produce land cover change evaluations from available data and 30-year land use projections for the entire the Great Lakes – St. Lawrence River basin to refine ecological impact assessments and anticipated future demands on water resources.

Implementation Mechanisms and Costs

The proposed approaches/mechanisms for implementing the tasks and associated costs are provided below for each of the five implementation strategies considered. The U.S. federal agency which has the assigned mission responsibility for implementing these activities is identified, whenever clear. If potential overlap occurs between U.S. federal agencies in mission responsibilities, one is proposed over the other based on perceived technical or administrative competencies to complete the necessary work within budget and schedule.

Task 52: The USGS, in conjunction with the NOAA and the USACE and in cooperation with state agencies, needs to produce comprehensive and consistent land cover datasets for the entire Great Lakes - St. Lawrence River basin on a five-year repeat cycle.

Without Plan Strategy (52) – Various agencies will continue to work together within the Multi-Resolution Land Characteristics consortium which produced the 1992 National Land Cover Dataset (NLCD) and has begun work on a version based on 2000-era data. Completion time will depend on funding from partners and may range from three to seven or more years. No formal repetition cycle is planned. The utility of data that is more than 10-years old is suspect. Current programmatic investments indicate that there will be few predictions of land cover characteristics to support critical water resource management decisionmaking.

Minimum Investment Strategy (52) – Provide additional funding to NOAA to acquire and process 2005 satellite imagery for the Great Lakes-St. Lawrence River region as part of a change analysis cycle under the Coastal Change Analysis Program (C-CAP) at a cost of $300 K over two years.

Selective Implementation Strategy (52) – Provide additional funding to NOAA to acquire and process 2005 satellite imagery for the Great Lakes-St. Lawrence River region as part of a change analysis cycle under the Coastal Change Analysis Program (C-CAP) at a cost of $300 K over two years.

Enhanced Implementation Strategy (52) – Provide additional funding to NOAA to acquire and process 2005 satellite imagery for the Great Lakes-St. Lawrence River region as part of a change analysis cycle under the Coastal Change Analysis Program (C-CAP). In addition, cross-reference classification categories from NOAA C-CAP and USGS NLCD 1992 to allow change analysis for the period over which a national land cover dataset exists and processing has been carried out. The estimated cost for this activity is $500 K over 2 years. Estimated cost is based on similar programs.

Full Implementation Strategy (52) – Coordinate NOAA's C-CAP efforts and the efforts of the Multi-Resolution Land Characteristics Consortium to institutionalize and streamline the efforts of all agencies involved in those processes. Establish a program to acquire and process new imagery every 3- years, releasing new land cover datasets within 6-months of data acquisition. The estimated cost for this activity is $1.5 M over 10 years, with commensurate funding annual funding thereafter to insure that the 5-year repeat cycle is maintained. Estimated cost is based on similar programs.

Task 53: The USGS, in conjunction with the USACE and in cooperation with state agencies, needs to produce high-resolution land cover data within the Great Lakes - St. Lawrence River basin to support detailed assessments of specific water withdrawal proposals.

Without Plan Strategy (53) – Local communities, especially urban areas, will gradually acquire high-resolution data products for use in land use planning and other efforts. There will be poor spatial completeness and little or no temporal match between adjacent political units. The data may or may not be processed for classification into land cover categories.

Minimum Investment Strategy (53) – Provide funding to the USGS to acquire high-resolution satellite imagery and create a high-resolution land cover dataset for priority rapidly changing areas within the Great Lakes - St. Lawrence River basin. Existing lower resolution data sets and census information would be used to determine these priority areas. The estimated cost of this activity would be $500 K over 3 years.

Selective Implementation Strategy (53) – Provide funding to the USGS to acquire high-resolution satellite imagery and create a high-resolution land cover dataset for rapidly changing areas within the Great Lakes - St. Lawrence River basin. Existing lower resolution data sets and census information would be used to determine priority areas. The estimated cost of this activity would be $3 M over 10 years.

Enhanced Implementation Strategy (53) – Provide funding to the USGS to acquire high-resolution satellite imagery and create a high-resolution land cover dataset for all urban areas and major transportation arteries across the Great Lakes - St. Lawrence River region and update this mapping every 5-years. Existing land cover datasets can be used to determine priority areas. The cost for this activity is estimated at $4.5 M over 10-years with commensurate annual funding thereafter.

Full Implementation Strategy (53)
Provide funding to the USGS to acquire high-resolution satellite imagery and create a high-resolution land cover dataset for all areas within the Great Lakes - St. Lawrence River region and update this mapping every 3-years. The cost for this activity is estimated at $6.0 M over 10-years with commensurate annual funding thereafter.

Task 54: The USGS, in conjunction with the USACE and in cooperation with state agencies, needs to produce land cover change evaluations from available data and 30-year land use projections for the entire the Great Lakes – St. Lawrence River basin to refine ecological impact assessments and anticipated future demands on water resources.

Without Plan Strategy (54) – Various agencies will likely develop land cover change mapping products. These products, however, will not be complete, be inconsistent over varying analysis periods, with varying classification strategies and varying spatial scales. Comprehensive and comparable products for the region will be lacking. Emphasis on future land cover projections will also not likely be addressed, and if so, will likely be incomplete in geographic scope, inconsistent in spatial scale, and temporal detail and based upon differing classification methods.

Minimum Investment Strategy (54) – Provide funding to the USGS to develop data standards and consistent analysis procedures for land cover change and future projections

specific to the needs of water resource decisionmaking for the Great Lakes – St. Lawrence River system. At a minimum, the National Land Cover Dataset would be used to assess changes over the last 10-12 years. The cost for this activity is estimated at $200 K over 2 years.

Selective Implementation Strategy (54) – Provide funding to the USGS to develop data standards and consistent analysis procedures for land cover change and future projections specific to the needs of water resource decisionmaking for the Great Lakes – St. Lawrence River system At a minimum, the National Land Cover Dataset would be used to assess changes over the last 10-12 years. The cost for this activity is estimated at $200 K over 2 years.

Enhanced Implementation Strategy (54) – Provide funding to the USGS to develop data standards and consistent analysis procedures for land cover change and future projections specific to the needs of water resource decisionmaking for the Great Lakes – St. Lawrence River system. Information from the National Land Cover Dataset would be used to assess changes over the last 10-12 years and other ancillary and higher-resolution data sources. The cost for this activity is estimated at $300 K over 2 years.

Full Implementation Strategy (54) – Provide funding to the USGS to develop data standards and consistent analysis procedures for land cover change and future projections specific to the needs of water resource decisionmaking for the Great Lakes – St. Lawrence River system. Information from the National Land Cover Dataset would be used to assess changes over the last 10-12 years and other ancillary and higher-resolution data sources. The cost for this activity is estimated at $1.5 M over 10 years and commensurate annual funding thereafter.

Total Costs Over 10 Years

Without Plan Strategy (TOTAL) – $0.0 M

Minimum Investment Strategy (TOTAL) – $1.0 M

Selective Implementation Strategy (TOTAL) – $3.5 M

Enhanced Implementation Strategy (TOTAL) – $5.3 M

Full Implementation Strategy (TOTAL) – $9.0 M

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AGENCY OF COLLECTION	DATA SET/ INFORMATION BASE	PURPOSE/ DESCRIPTION	GEOGRAPHICAL DOMAIN	TIME PERIOD	LAST UPDATED	ACCESS TO DATA/INFO (OR KEY CONTACT)
USGS - Gap Analysis Program	Landcover maps	The mission of the Gap Analysis Program (GAP) is to provide state, regional, and national assessments of the conservation status of native vertebrate species and natural land cover types of the U.S. and to facilitate the application of this information to land management activities.	Entire Unidted States by State	1980-present	Constantly Updated	http://www.gap.uidaho.edu/
USGS-Vegation Mapping Program	Landcover maps	The USGS-NPS Vegetation Mapping Program is a cooperative effort by the U.S. Geological Survey (USGS) and the National Park Service (NPS) to classify, describe, and map vegetation communities in more than 270 national park units across the United States. This program provides national-scale descriptions of vegetation and creates national vegetation standards for its data products. Its goal is to meet specific information needs identified by the National Park Service.	Island Royale, MI, Indiana National Lakeshore			http://biology.usgs.gov/npsveg/
USGS-UMESC	Long Term Resource Monitoring Program	The mission of the Long Term Resource Monitoring Program is to provide decision makers with the information needed to maintain the Upper Mississippi River System as a viable multiple-use large river ecosystem. The long-term goals of the program are to understand the system, determine resource trends and impacts, develop management alternatives, manage information, and develop useful products.	The Five Upper Mississippi River System states (Illinois, Iowa, Minnesota, Missouri, and Wisconsin).	1987-present	annually	http://www.umesc.usgs.gov/ltrmp.html
USGS-Geographic Analysis and Monitoring Program	Landcover maps	To establish a baseline of land surface change for the southern Lake Michigan region that would support the Great Lakes Strategic and Integrated Science Plans	southern Lake Mishigan region			Dave Shaver, Mid-Continet Mapping Center, dshaver@usgs.gov
USGS - "The LUHNA Book"	Historical Landcover changes in the Great Lakes region	Two different methods of reconstructing historical vegetation change, drawing on General Land Office (GLO) surveys and fossil pollen deposits, are demonstrated by using data from the Great Lakes region. Both types of data are incorporated into landscape-scale analyses and presented through geographic information systems. Results from the two methods reinforce each other and allow reconstructions of past landscapes at different time scales. Changes to forests of the Great Lakes region during the last 150 years were far greater than the changes recorded over the preceding 1,000 years. Over the last 150 years, the total amount of forested land in the Great Lakes region declined by over 40%, and much of the remaining forest was converted to early successional forest types as a result of extensive logging. These results demonstrate the utility of using GLO survey data in conjunction with other data sources to reconstruct a generalized "presettlement" condition and assess changes in landcover.	Great Lakes	1994 - present	Constantly Updated	http://biology.usgs.gov/luhna/chap6.html
USGS-Earth Resources Observation System (EROS) Data Center	National Land Cover Characterization 2001 (NLCD 2001)	Database consists of normalized tasseled Cap (TC) transformations of Landsat7 imagery for three time periods per scene (early, peak, and late); classified land cover data derived from the Tassel Capped imagery; independent ancillary data layers, including 30m DEM derivatives of slope, aspect and elevation and STATSCO soil moisture estimates; NLCD 1992; independent image derivatives of imperviousness and tree cover; and classification rules and metadata from the land cover classification.	United States (by mapping zone)	2000		http://landcover.usgs.gov/natlandcover_2000.asp
USDA, NRCS	National Resources Inventory	The National Resources Inventory (NRI) is a statistical survey of land use and natural resource conditions and trends on U.S. non-Federal lands. The NRI program serves as the Federal Government's principal source of information on the status, condition, and trends of soil, water, and related resources in the United States. The NRI was conducted every 5 years during the period 1977 through 1997, but currently is in transition to a continuous, or annual, inventory process.	United States	1997-2001	2001	http://www.nrcs.usda.gov/technical/NRI/

AGENCY OF COLLECTION	DATA SET/ INFORMATION BASE	PURPOSE/ DESCRIPTION	GEOGRAPHICAL DOMAIN	TIME PERIOD	LAST UPDATED	ACCESS TO DATA/INFO (OR KEY CONTACT)
USDA , Forest Service, Southern Forest Experiment Station	Forest Laned Distribution Data	The project was developed in support of the Forest and Rangeland Renewable Resources Planning Act 1993 Assessment Update program to provide information on current forest and rangeland conditions. Uses a 24 type classification system.	United States	1993		http://www.srsfia.usfs.msstate.edu/rpa/rpa93.htm
Natural Resources Research Institute, Univerisity of Minnesota (funded by U.S. EPA and MN DNR)	Lake Superior Decision Support System Data Sets	Collection of GIS applications and databases, including depth profiles of Lake Superior	Lake Superior basin		18-Jan-02	http://oden.nrri.umn.edu/lsgis/databases.htm
MSU Extension	Michigan Natural Features Inventory	Rare and declining plants and animals, natural communities and ecosystems native to Michigan	Michigan	Historical (?) - present	Constantly Updated	Dennis Albert 517-335-4580 albertd@michigan.gov http://web4.msue.msu.edu/mnfi/home.cfm
Southeast Michigan Council of Governments	SEMCOG Interactive Maps	To support of current regional planning projects in seven county southestern Michigan region - 11 characteristic classification system	Southeastern Michigan	1995		http://www.semcog.org/Data/InteractiveMapping/index.htm
Michigan Depaartment of Natural Resources and MSU Center for Remote Sensing and GIS	Michigan Resource Inventory System	To is to gather the best available information about the state's land and water resources and place it in a format that provides maximum access.	Michigan	1979	few updates, very sporatic both spatially and temporally (1991 to present)	Data can be accessed through a MSU's RSGIS webpage called Michigan GIS Viewer, http://ims.rsgis.msu.edu/startup.htm
Multi-resolution Land Characteristics Consortium *see notes	National Land Cover Data	One of the projects sponsored by the MRLC (Multi-resolution Land Characteristics) consortium was production of land-cover data derived from images acquired by Landsat's Thematic Mapper (TM) sensor, as well as a number of ancillary data sources. The National Land Cover Data includes the source images, as well as classified land-cover data for specific acquisition dates. It is the first national land-cover data set produced since the early 1970s, effectively replacing the LUDA and GIRAS data sets. Data for the conterminous United States circa 1992 which were derived from Landsat-5 TM images are complete and currently available for download.	entire USA	1992-2000	2000	http://edc2.usgs.gov/scripts/mapserv.exe?map=d%3A%5CInetpub%5Cwwwroot%5Clccp%5Cnlcd%5Cnlcd.map&zoomsize=2
Multi-resolution Land Characteristics Consortium *see notes	Multi-resolution Land Characteristics 2001	MRLC2001 (Multi-Resolution Land Characteristics 2001) consists of a collection of terrain-corrected Landsat 7 ETM+ (Enhanced Thematic Mapper Plus) and limited Landsat 5 TM (Thematic Mapper) scenes that have been acquired by the MRLC Consortium. Because of USGS restrictions on the distribution of terrain-corrected data, the MRLC2001 data is available to MRLC Consortium members and Approved USGS Researchers only. The MRLC2001 data covers the conterminous U.S., Alaska, and Hawaii. The Landsat scenes are primarily 2000 imagery, although individual dates may range from 1999 to present. Multi-temporal scenes may also be available, depending on location. Most of the images are very high-quality, and cloud cover is generally less than 10%. The data will also include a 30-meter Digital Elevation Model (DEM) for all scenes that do not include international (Mexico or Canada) borders.	entire USA	2001	2001	http://edcwww.cr.usgs.gov/products/satellite/mrlc2000.html#description
Central Great Lakes Mapping Coalition (US Geological Survey and the Ohio, Illinois, Indiana, and Michigan state surveys)	Pilot projects include Illinois: 3-D mapping of the glacial deposits for the Antioch Quadrangle in Lake County; Indiana: 3-D mapping of Fort Wayne and surrounding Allen county; Ohio: lower Huron River watershed and an area near the Ohio-Indiana border near Richmond, IN;	To provide 3-D mapping of glacial deposits at the 1: 24,000 scale to improve groundwater management and assess risks to erosion, flooding, land subsidence, and earthquakes.	parts of Illinois, Indiana, Michigan and Ohio			Illinois: William Shilts, shilts@isgs.uiuc.edu; Indiana: John Steinmetz,jsteinm@indiana.edu; Micigana: Harold Fitch, fichh@state.mi.us; Ohio: thomas.berg@dnr.state.oh.us

AGENCY OF COLLECTION	DATA SET/ INFORMATION BASE	PURPOSE/ DESCRIPTION	GEOGRAPHICAL DOMAIN	TIME PERIOD	LAST UPDATED	ACCESS TO DATA/INFO (OR KEY CONTACT)
US EPA, USGS & NASA	North American Landscape Characteristics	The North American Landscape Characterization (NALC) project is a component of the National Aeronautics and Space Administration (NASA) Landsat Pathfinder Program. Pathfinder projects focus on the investigation of global change while utilizing remote sensing technologies. The NALC project is a cooperative effort between the U.S. Environmental Protection Agency (EPA), the U.S. Geological Survey (USGS), and NASA to make Landsat data available to the widest possible user community for scientific research and general public interest.	conterminous United States and Mexico	1970s - present	Mar-00	http://edcdaac.usgs.gov/pathfinder/pathpage.html#nalc
NOAA	Coastal Change Analysis Program (C-CAP)	An immediate objective for C-CAP is to expeditiously complete a national baseline of land cover and change data, from which additional dates of imagery may be used to track coastal trends over time. This is being accomplished through partnerships with private industry and more recently, the U.S. Geological Survey's (USGS) National Land Cover Dataset (NLCD) 2001 efforts. NOAA and USGS share initial land cover processing procedures, with final agency-specific processing conducted to yield each agency's respective products.	Coastal US (including the Great Lakes Basin)	? - Present	2002	Steve Raber Steve.Raber@noaa.gov http://www.csc.noaa.gov/crs/lca/greatlakes.html
U.S. Fish and Wildlife Service	National Wetlands Inventory Maps	To gather informatino on the charcteristics, extent, and status of the Nation's wetlands and deepwater habitats.	44 percent of the lower 48 states are digitized	Varies (1960s to ?)		http://wetlands.fws.gov/
US EPA	Great Lakes Basin Vegetation Change Analysis	In general, changes in the growth of vegetation in the Great Lakes Region is constrained by biophysical conditions (e.g., geology, temperature, and humidity). Research suggests that such changes in vegetation cover may be a consequence of global-scale climatic change. Therefore, vegetation change in the Great Lakes Basin may be a response to shifts in the global climate, including changes in land-cover type and vegetation cover. Such landscape changes, particularly in the short term, may be most pronounced at ecotone boundaries.	The conterminous Great Lakes Basin (U.S. and Canada)	1970s - Present	NA	Curt Edmonds Curtis.Edmonds@epa.gov http://www.epa.gov/nerlesd1/land-sci/great-lakes.htm
Natural Resources Canada - Canada Centre for Remote Sensing & Canadian Forest Service	Land Cover Map of Canada	In a collaborative effort with scientists in 10 provincial or territorial government agencies, the development team evaluated the map's accuracy through visual comparison with 100 Landsat Thematic Mapper (TM) images acquired across Canada and by numerical comparison with classifications derived from TM data of areas in Alberta, Saskatchewan and Manitoba.	Canada	1995 - present	NA	http://www.ccrs.nrcan.gc.ca/ccrs/rd/apps/landcov/map_e.html
Environment Canada	Biodiversity Portrait of the St. Lawrence River	Consolidation of scientific information and data on the physical and biotic characterestics of the region from the past 3 years. Classification of wetlands types, precentage of wetland loss (1945-1978) in 10 km-wide coastal strip	St. Lawrence River, Canada	2000-2003		http://www.qc.ec.gc.ca/faune/biodiv/en/table_contents.html
Minnesota Department of Natural Resoruces	Minnesota Maps	These maps identify recreation areas for hunting, boating and hiking; change in forest cover and inventory natural resources such as forests, natural community and rare species by county, public waters maps (includes wetlands and streams) by county, hydrogeologic assessments.	Minnesota (coverage within the state varies depending on topic)			http://www.dnr.state.mn.us/maps/index.html
Wisconsin Department of Natural Resources	Wisconsin Initiative for Statewide Cooperation on Landscape Analysis and Data (WISCLAND)	To classify and delineate land cover types over counties or watersheds. Delinate land cover corriders. Estimate availbe range forr dear in each dear management unit, as well as for estimation of elk range in Wisconsin. Characterize watersheds to evaluate fisheries quality or support runoff estimation for flood analysis.	Wisconsin	1991 - 1993		http://www.dnr.state.wi.us/maps/gis/datalandcover.html

AGENCY OF COLLECTION	DATA SET/ INFORMATION BASE	PURPOSE/ DESCRIPTION	GEOGRAPHICAL DOMAIN	TIME PERIOD	LAST UPDATED	ACCESS TO DATA/INFO (OR KEY CONTACT)
Onatario Ministry of Natural Resources - Sourthern Ontario Land Resource Information System (SOLRIS)	Land cover database	To accurately measure the nature and extent of Southern Ontario's natural resources and to track changes to the natural, rural and urban landscape. The ecological land classification (ELC) for sourthern Ontario is made up of four nested scales: ecological community class, community series, ecosity, and vegetation type.	the area of Ontario south of the Canadian Shield	2002-2004		
Onatario Ministry of Natural Resources	Land cover maps of Onatario	A comprehensive, seamless land cover map for the entire province of Ontario with (2000 or 2001?)data of 30 meter resolution has been developed. This map has a classification of 28 different categories. This effort is driving mainly by the development and update of forest management plans. Ontario Ministry of Natural Resources contracted this work to Spectranalysis.	Ontario	2000 or 2001?		http://www.lio.mnr.gov.on.ca/programs.cfm
Ontario Ministry of Natural Resources - Aquatic Research and Development Section	Aquatic Landscape Inventory System (ALIS)	ALIS is a Geographic Information System application within ArcGIS 8.1 developed by the Ministry of Natural Resources (MNR) and used for systematically delineating segments of rivers into segments that have similar characteristics. ALIS produces two pieces of information:Segmented water flow dataset - Valley Segments and Database containing attribute data for each Valley Segment	Ontario			Les Stanfield (les.stanfield@mnr.gov.on.ca) and Randal Kuyvenhoven (randal.kuyvenhoven@mnr.gov.on.ca)
American Farmland Trust	Farming on the Edge: State Maps	To identify the best, most fertile and productve land threatened by development.	United States (by state)	1987 - 1997		http://www.farmland.org/farmingontheedge/maps.htm
NatureServe	Ecosystem Mapping	Occurance information is ploted on 1:24,000 USGS topographical maps in the United States or 1:50,000 NTS topographical maps in Canada. The International Classification of Ecological Communities is used to classify terresttial, freshwater and coastal-marine Habitats. The U.S. National Vegetation Classification is used to classify more than 4,500 vegatation types. A mid-scale classification of ecological systems for conservation planning is being developed.	United States and Canada	1975-2002	continuous	Shara Howie; shara_howie@naturesure.org; Phone (708) 908-1800 http://www.natureserve.org/getData/index.jsp
Northeastern Illinois Planning Commission	Land Use Inventory	Inventory land use cover for sie counties of northeast Illinois (Cook, DuPage, Kane, Lake, McHenry, and Will counties), based on interpretation of aerial photography. The data product is an Arc/INFO coverage, with the 3,750 sq.mi. region delineated into over 80,000 polygons describing 48 different land use categories. It is updated approximately every five years.	Cook, Dupage, Kane, Lake, McHenry , and Will counties of Illinois	1990	1995	David Clark, dclark@nipc.org Phone: 312-454-0400 ext. 608 http://www.nipc.cog.il.us/
Illinois Department of Natural Resources	Critical Trends Assessment Program - Illinois Land Cover Mapping	Using Landsat satellite imagery, DNR scientists have compiled a comprehensive database of the state's surface cover. The data delineates natural features and artificial structures at a level of detail appropriate for regional analyses.	Illinois	1991 - present	NA	http://dnr.state.il.us/orep/inrin/ctap/map/landmap.htm