

## Ecological Services

**Tremendous progress has been made in reducing gross water pollution and improving water quality over the last three decades, but it is now recognized that many system-wide problems still exist in our surface waters. More than 29,000 water bodies are currently listed as impaired in the United States, and many are so classified because of critical floodplain, wetland, stream bank buffer, or habitat loss, as well as increasing impacts from urban and agricultural nonpoint source runoff. Repairing existing damage and mitigating future damages are an ongoing challenge, made even more challenging by the need for sustainable solutions.**

**The key to finding sustainable and effective solutions to many environmental problems lies in understanding the ecology of the systems involved: that is, the ways in which the living and non-living components of the system interact and are affected by human activity. The ecology of natural systems, however, is seldom simple and requires special expertise.**



*Tremendous progress has been made in reducing water pollution and improving water quality, but many problems still exist.*

As a leader in environmental science and water quality management for nearly three decades, LimnoTech has helped clients create and implement workable watershed management strategies to address impacts and gain regulatory approval. Our experience in this area covers streams, lakes, estuaries, and coastal waters in more than 200 watersheds.



### LimnoTech Services

LimnoTech ecological services include:

- Fish, macroinvertebrate and botanical surveys
- Stream channel inventory & assessment
- Limnological studies
- Rapid stream bioassessment
- Wetlands determination, delineation, and assessment
- Ecological risk assessment
- Aquatic habitat assessment
- Natural resource economic valuation and damage assessment
- Land use planning for watershed restoration and protection
- Stream bank restoration planning & design
- Constructed wetlands for water quality improvement
- Lake nutrient, dissolved oxygen, and nuisance algae control strategies
- Wetland permitting, mitigation, and restoration
- Long-term restoration monitoring



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These project descriptions offer a sample of LimnoTech's experience in helping our clients resolve the challenges of ecosystem evaluation and management.

**Chicago Area Waterway System Habitat Evaluation and Improvement Study.** LimnoTech conducted a physical habitat study in the Chicago Area Waterway System (CAWS) for the Metropolitan Water Reclamation District of Greater Chicago. The objectives of the study were to inventory physical habitat, to determine the relative importance of physical habitat condition to fish, and to develop conceptual approaches for habitat improvement. Existing habitat assessment tools were not applicable because of the unique nature of the CAWS. To quantify biotic and habitat condition, we developed both a CAWS-specific fish index and a CAWS-specific non-wadeable habitat index. Using these tools, it was shown that habitat condition is severely limited in the CAWS, and that nearly half of the variability in fisheries health is attributable to limitations of physical habitat. It was further shown that physical habitat is much more limiting to fisheries than water quality.

**Integrated Hydrodynamic–Sediment Transport–Water Quality Model for the Lower Maumee River and Western Basin of Lake Erie.** LimnoTech is developing a linked hydrodynamic–sediment transport–advanced eutrophication model to inform restoration and management decisions in the lower Maumee River and western basin of Lake Erie. Application of the modeling framework will include evaluation of how localized sediment accretion/erosion behavior changes relative to alternatives for dredged material placement, island building, etc. This model will also quantify the relationship between nutrient loads, zebra mussel density, and physical factors as stressors. The model will also support decisions on clean sediment management and watershed nonpoint source control.

#### **Upper Rouge Streambank Erosion Inventory Study.**

Development in the Rouge River Watershed has been ongoing for decades, and one of the most significant impacts of urbanization is the effect on erosion and sedimentation in waterways. These effects include stormwater

infiltration decreasing and runoff increasing; higher shear stresses on stream banks; and increased stream bank erosion. Erosion poses a threat to property, riparian habitat, and infrastructure.

This project prioritized stream bank erosion sites and recommended protection and erosion mitigation using best management practices. LimnoTech's approach to the project included three main components:

- *Field Inventory* – Conducted stream bank inventory, entering inventory data into handheld computers with built-in GPS.
- *Site Scoring and Prioritization* – Inventory data were stored in a database, and numerical values were assigned to each site, allowing development of a score and priority ranking for each location.
- *Development of Conceptual Designs* – Developed conceptual designs for stream bank protection and erosion mitigation for each site ranked as “severe,” including mitigation measures and techniques.

**Development of a Process-oriented Aquatic Ecosystem Model to Investigate Multi-stressor Interactions in Saginaw Bay, Lake Huron.** To identify and understand alterations in the Saginaw Bay ecological structure and function in response to stressors such as zebra mussel invasion, nutrient loads, sediment loads, hydrology and water levels, and climate conditions, LimnoTech developed a coupled aquatic ecosystem modeling framework by linking EFDC (a hydrodynamic and sediment transport model) with an advanced aquatic ecosystem model (A2EM) by adding Dreissenid (zebra and quagga mussels) and Cladophora sub-models to our existing advanced eutrophication model. This model quantified the relationship between nutrient loads, zebra mussel density, and physical factors as stressors and algal blooms. Model results were used to support

management decisions and to recommend research and monitoring activities to develop a better quantitative understanding of the system.



*The key to finding sustainable and effective solutions to environmental problems lies in understanding how living and non-living components of a system interact and are affected by human activity.*