Great Lakes Coastal Wetlands Classification

First Revision (July 2003)

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on behalf of the Great Lakes Coastal Wetland Consortium
(GLCWC)

Great Lakes coastal wetlands can be separated into three specific systems based on their dominant hydrologic source and current hydrologic connectivity to the lake. These systems are different than those defined by the National Wetlands Inventory (NWI) (Santos and Gauster 1993). NWI defines three *systems*, Lacustrine, Riverine, and Palustrine. All of these NWI systems can have *classes (Aquatic bed* or *Emergent)* that are included within our wetland classification, but many of the classes are not wetland classes but hydrologic or substrate classes, such as *rock bottom, unconsolidated bottom, unconsolidated shore,* or *open water.*

Each wetland polygon mapped for the GLCWC will be given a four character code. The first character (**-**---) will for the *hydrologic system*. The second character (-**-**--) will be for the *geomorphic* type. The third and fourth characters (--**--**) are further *geomorphic modifiers*.

1. **Lacustrine (L---)** system wetlands are controlled directly by waters of the Great Lakes and are strongly affected by lake-level fluctuations, nearshore currents, seiches and ice scour. Geomorphic features along the shoreline provide varying degrees of protection from coastal processes. Lacustrine, as defined by NWI, would also include dammed river channels and topographic depressions not related to Great Lakes. NWI does not consider wetlands with trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% cover; in contrast we consider these vegetation cover classes to be included within our lacustrine wetlands, focusing our classification on the lacustrine formation process. NWI only considers wetlands larger than 8 hectares (20 acres), while we include smaller wetlands. NWI will include wetlands smaller than 8 hectares if a) a wave formed or bedrock features forms part or all of the shoreline or has a low water depth greater than 2 meters in the deepest part of the basin.

2. **Riverine (R---)** system wetlands occur in rivers and creeks that flow into or between the Great Lakes. The water quality, flow rate and sediment input are controlled in large part by their individual drainages. However, water levels and fluvial processes in these wetlands are influenced by coastal processes because lake waters flood back into the lower portions of the drainage system. Protection from wave attack is provided in the river channels by bars and channel morphology. Riverine wetlands within the Great Lakes also include those wetlands found along large connecting channels between the Great Lakes with very different dynamics than smaller tributary rivers and streams. NWI excludes palustrine wetlands, which they define as dominated by trees, shrubs, persistent emergents, and emergent mosses or lichens, from riverine systems. In contrast, we include all of these types of vegetation within our riverine system.

3. **Barrier-Protected (B---)** system wetlands have originated from either coastal or fluvial processes. However, due to coastal processes the wetlands have become separated from the Great Lakes by a barrier beach or other barrier feature. These wetlands are protected from wave action but may be connected directly to the lake by a channel crossing the barrier. When connected to the lake, water levels in these wetlands are determined by lake levels, but during seiche related water-level fluctuations, wetland water levels are tempered by the rate of flow through the inlet. During isolation from the lake, groundwater and surface drainage to the basin of the individual wetland provides the dominant source of water input, although lake level may influence groundwater flow and, hence, wetland water levels. Inlets to protected wetlands may be permanent or ephemeral. Nearshore processes can close off the inlet from the lake. The ability of the nearshore processes to close the inlet is related to the rate of sediment supply to the

shoreline, grain size and sorting of sediment, type and duration of nearshore processes, lake level elevation and rate of change, and discharge rate of water exiting the inlet. The greater part of most of these wetlands would be classified by NWI as palustrine system, with small water bodies or streams within the wetland possible being classified as inclusions of either lacustrine or riverine system.

Within these hydrologically based systems, Great Lakes coastal wetlands can be further classified based on their geomorphic features and shoreline processes.

1) Lacustrine System (L---)

Open Lacustrine (LO--)

These lake-based wetlands are directly exposed to nearshore processes with little or no physical protection by geomorphic features. This exposure results in little accumulation of sediment vegetation development to relatively narrow nearshore bands. Exposure to nearshore processes results in little to no organic sediment accumulation, and variable bathymetry, ranging from relatively steep profiles to more shallow sloping beaches.

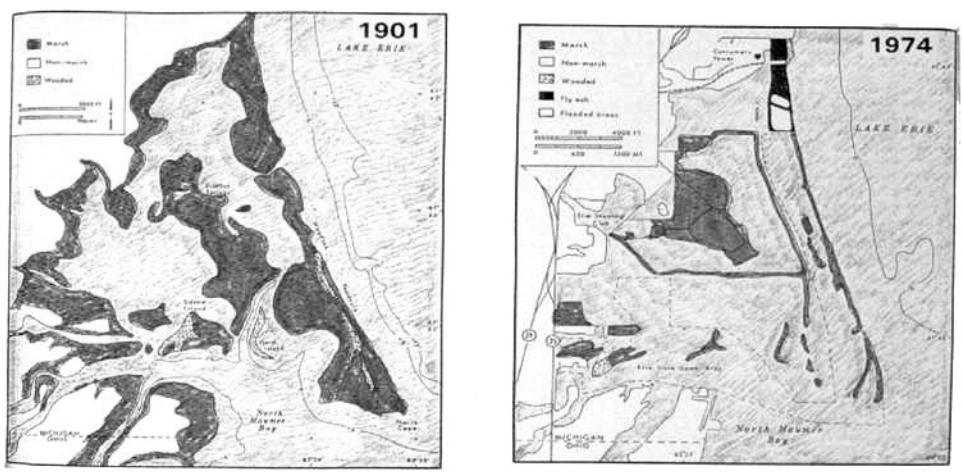
***Open Shoreline*. (LOS-)** Typically characterized an erosion-resistant substrate of either rock or clay, with occasional patches of mobile substrate. The resultant expanse of shallow water serves to dampen waves which may result in sand bar development at some sites. There is almost no organic sediment accumulation in this type of environment. Vegetation development is limited to narrow fringes of emergent vegetation extending offshore to the limits imposed by wave climate. Some smaller embayments also fit into this class due to exposure to prevailing winds; most of these have relatively narrow vegetation zones of 100 meters or less. Examples include Epoufette Bay and xxx in the Bay of Quinte on Lake Ontario. Mapping of *open shoreline* wetlands will be restricted to those that were identified by either Herdendorf et al. (1981a-f) or NWI. Many *open shorelines* do not have large enough areas of aquatic plants to be identified from aerial photography.

***Open Embayment.* (LOE-)** This can occur on gravel, sand, and clay (fine) substrate. The embayments are often quite large – large enough to be subject to storm-generated waves and surges and to have established nearshore circulation systems. Most bays greater than three or four kilometers in diameter fit into this class. These embayments typically support wetlands 100 to 500 meters wide over wide expanses of shoreline. Most of these wetlands accumulate only narrow organic sediments near their shoreline edge. Saginaw Bay, St. Martin Bay, Little Bay de Noc, Green Bay, and Black River Bay all fit in this category.

Protected Lacustrine (LP--)

This wetland type is also a lake-based system, however it is characterized by increased protection by bay or sand-spit formation. Subsequently, this protection results in increased sediment accumulation, shallower off-shore profiles and more extensive vegetation development than this type's open lacustrine counterpart. Organic sediment development is also more pronounced.

Protected Embayment.* (LPP-*)
Many stretches of bedrock or till-derived shorelines form small protected bays, typically less than three or four kilometers in width . These bays can be completely vegetated with emergent or submergent vegetation. At the margins of the wetlands there is typically 50 to 100 cm of organic accumulation beneath wet meadow vegetation. Examples include Duck Bay and Mackinac Bay in the Les Cheneaux Islands on Lake Huron, Matchedash Bay on Lake Huron, and Bayfield Bay on Wolfe Island in Lake Ontario.



Erie Marsh, Western Lake Erie

Marsh Destruction by Agriculture and Industry

Sand-Spit Embayment. **(LPS-)** Sand spits projecting along the coast create and protect shallow embayments on their landward side. Spits often occur along gently sloping and curving sections of shoreline where there is a positive supply of sediment and sand transport is not impeded by natural of man-made barriers. These wetlands are typically quite shallow. Moderate levels of organic soils are typical, similar to those found in other protected embayments. Examples include Pinconning Marsh on Saginaw Bay, Dead Horse Bay on Green Bay, and Long Point on Lake Erie.

2) Riverine System (R---)

Drowned River-Mouth (RR--)
The water chemistry of these wetlands can be affected by both the Great Lakes and river water, depending on Great Lakes water levels, season, and amount of precipitation. These wetlands typically have deep organic soils that have accumulated due to deposition of watershed-based silt loads and protection from coastal processes (waves, currents, seiche, etc.). The terms “estuarine” or “fresh-water estuarine” have been used by some researchers (Herdendorf et al. 1981a) as alternatives to *drowned river-mouth*.

***Open, Drowned River-Mouth*. (RRO-)**
Some drowned river-mouths don't have barriers at their mouth, nor do they have a lagoon or small lake present where they meet the shore. The wetlands along these streams occur along the river banks and their plant communities are growing on deep organic soils. Examples include the West Twin River on the Wisconsin shore of Lake Michigan, the Kakagon River on the Wisconsin shore of Lake Superior, and the Greater Cataraqui River on the Ontario shore of Lake Ontario.

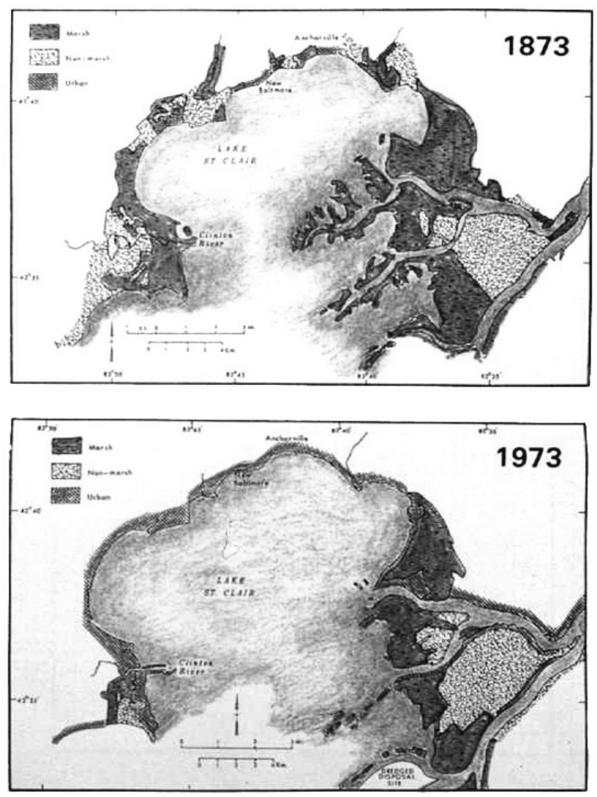
***Barred, Drowned River-Mouth*. (RRB-)**
Most streams that are considered drowned river-mouths actually have a barrier that constricts the stream flow as it enters the lake. Very often, a lagoon forms behind the barrier. However unlike barrier beach wetlands, these wetlands maintain a relatively constant connection to the lakes. These lagoons seldom support large wetlands (possibly as the result of earlier destruction of the wetland by human management). The

vegetation is concentrated where the stream enters the lagoon (if present), but can extend several kilometers upstream, typically forming a fringe of emergent and submergent vegetation along the edges of the channel. Organic deposits are often greater than two meters thick. Examples include the Betsie, Pentwater and Manistee Rivers in Lake Michigan, and Duffins Creek in Lake Ontario.

Connecting Channel (RC--)

This wetland type includes the large connecting rivers between the Great Lakes; the St. Marys, St. Clair, Detroit, Niagara, and St. Lawrence Rivers. These wetlands are distinctive from the other large river wetlands (drowned river mouth) by their general lack of deep organic soils and their often strong currents. The St. Marys and St. Lawrence contain some of the most extensive fringing shoreline and tributary drowned river mouth wetlands in the Great Lakes, while those along the Detroit and Niagara have been largely eliminated or degraded. The Detroit River still has major beds of submergent aquatic plants, as does shallow Lake St. Clair. Connecting channels contain several types of wetlands, each with their own code. These include open shoreline **(Connecting Channel, open shoreline (RCOS))**, open embayment **(Connecting Channel, open embayment (RCOE))**, protected embayment **(Connecting Channel, protected embayment (RCPP))**, sand-spit embayment **(Connecting Channel, sand-spit embayment (RCPS))**, open drowned river mouth **(Connecting Channel, open drowned river mouth (RCRO))**, barred drowned river mouth **(Connecting Channel, barred drowned river mouth (RCRB))**, and deltaic **(Connecting Channel, delta (RCD-))**, which will be noted as subtypes in the attribute tables of wetlands.

Alteration of Marshes on St. Clair River Delta, Lake St. Clair



Delta (RD--)

Deltas formed of alluvial materials, both fine and coarse, support extensive wetlands that extend out into the Great Lake or connecting river. These are extensive wetlands, typically with 30 to 100 cm of organic soils associated with their wet meadow zone, and often with deep organics occupying abandoned distributary channels and interdistributary bays. Two examples are the St. Clair River and Munuscong River (bordering the St. Marys River) deltas.

3) Barrier-Enclosed (B---)

Barrier Beach Lagoon (BL--)

These wetlands form behind a sand barrier. Because of the barrier, there is reduced mixing of Great Lakes waters and the exclusion of coastal processes within the wetlands. Multiple lagoons can form and water discharge from upland areas and incoming drainages may also contribute significantly to the water supply. These wetlands are common at the east end of Lake Ontario and also on the Bayfield Peninsula in western Lake Superior. Thick organic soils characterize these wetlands in Lake Superior and in many, but not all, of the Lake Ontario wetlands. Examples of barrier beach lagoon wetlands include Second Marsh, North Sandy Pond, and Round Pond of Lake Ontario and Bark Bay, Siskiwit Bay and Allouez Bay of Lake Superior. In addition to barrier beach lagoons, *tombolo* are present in selected areas of the Great Lakes. These are defined as islands attached to the mainland by barrier beaches, some of which consist of one or two lagoons with deep organic soils. This feature may also be classified in the swale complex category depending upon the dominant geomorphological features. Small barrier beach lagoons often are completely dominated by vegetation, with no open water remaining; such completely vegetated barrier beach lagoons will be called **Successional Barrier Beach Lagoons** and will be coded **BLS-**.

Swale Complexes (BS--)

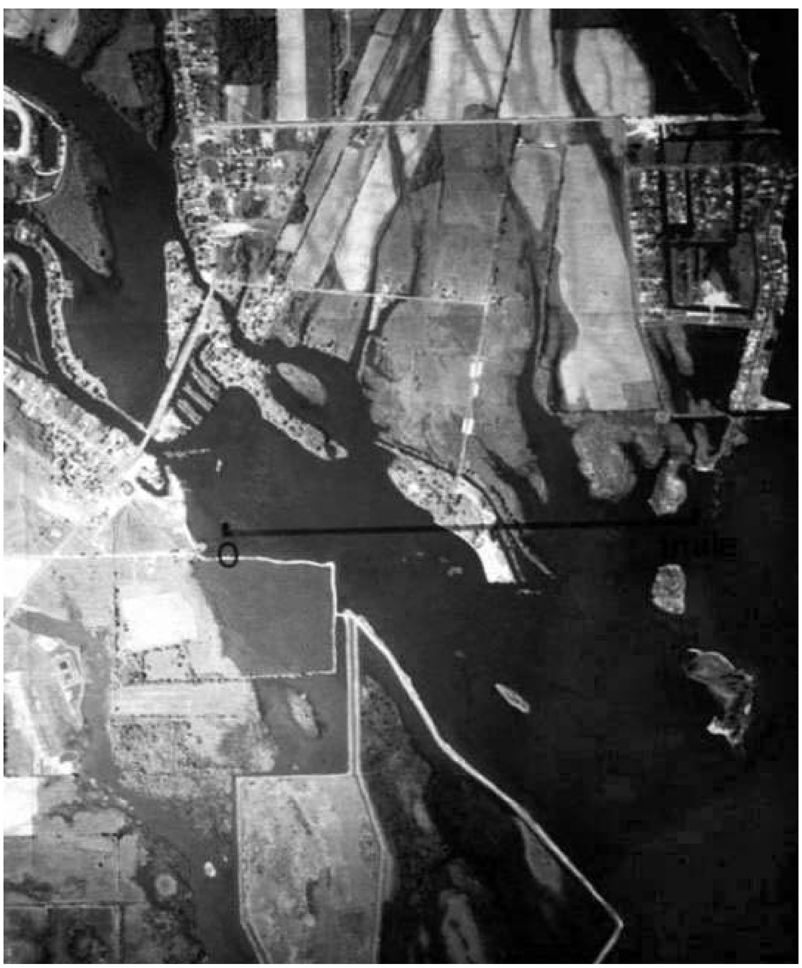
There are two primary types of swale complex wetlands – those that occur between recurved fingers of sand spits and those that occur between relict beach ridges. These are known respectively as *sand-spit swales* **(BSS-)** and *ridge and swale complexes* **(BSR-)** (also referred to as dune and swale and strandplain). The former are common within some of the larger sand spits of the Great Lakes, primarily Presque Isle and Long Point on Lake Erie and Whitefish Point on Lake Superior. Numerous small swales are separated from the Great Lakes,

often becoming shrub swamps with shallow organic soils. Within these sand-spit formations, there are often embayments which remain attached to the Great Lakes, thus maintaining their herbaceous flora.

Ridge and swale complexes are composed of a series of barrier beaches separated by narrow swales. These systems commonly occur in embayment where there is a high supply of sediment are form in response to quasi-periodic fluctuations in lake level. For many of these complexes, only the first couple of swales are in direct hydrologic connection to the lake, but in some, like Pte. Aux Chenes along northern Lake Michigan, the connection continues for hundreds of meters. Organic soil depths are quite variable, as is the vegetation, which ranges from herbaceous to swamp forest. Another example is the Ipperwash Inter-dunal Wetlands Complex on Southern Lake Huron, Ontario.

A rare, third type of swale complex may include *tombolo*. While some are classified as barrier beach features **(BLT-)**, others consist more dominantly of a series of beach ridges **(BWR-)** with small swales and shallow organic soils, and could thus be classified as a ridge and swale complex.

<u>System Modifiers of Naturally Occurring Great Lakes Wetlands</u>



The hydrology and/or geomorphology of all Great Lakes coastal wetlands have been impacted by human activities within the Great Lakes basin. These impacts are through whole lake regulation, watershed alteration or activities within the wetland itself (i.e. diking, dredging and in-filling). Direct modification of the hydrological connection with the lake results in different hydrologic and wetland community responses to Great Lake events (e.g. high/low water level) than would be observed/expected by wetlands in the same classification. Identification of human modifiers in naturally occurring coastal wetlands is important to understanding coastal processes and response to change and thus should be noted when classification is undertaken. System modifiers will not be coded, but will be listed in an attribute table.

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