

<http://freshwaterestuary.uwex.edu/estuary.html>

Freshwater Estuaries Defined

Estuary science has, for the most part, been historically focused on areas where *freshwater* from a river mixes with *saltwater* from the ocean. The concept of another estuary-type system occurring at the intersection of a *freshwater* river and large *freshwater* lake has become increasingly recognized by a wide range of scientists and organizations. For example, Great Lakes freshwater estuaries have been addressed and recognized by the Wisconsin Department of Natural Resources, National Oceanic and Atmospheric Administration, and numerous other state and federal natural resource agencies. These systems have also been described and studied in numerous articles and represent an ecological system with important relevance to the Great Lakes region.

What exactly is a freshwater estuary? A variety of definitions exist, and, not surprisingly, the definitions vary. However, three common characteristics are frequently used to define these systems: 1) a drowned river mouth; 2) a zone where lake and river waters mix; and 3) influence from seiche or wind tides. A fourth characteristic that some, but not all, freshwater estuaries have, is a bar or spit that partially encloses the river mouth.

1) Drowned River Mouth

The term “drowned river mouth” may seem a bit odd the first time you hear it, but the term becomes less strange once we understand what it is describing. Simply put, it is a river mouth (the end of a river where it enters another waterbody like one of the Great Lakes) that becomes submerged or flooded. How can a river become flooded? To answer that question, we have to look back into Wisconsin’s history about 10,000 years. At the end of the most recent Ice Age, massive amounts of ice as much as several hundred feet thick retreated from much of the Great Lakes Basin. As the ice retreated, the earth’s crust, which had been pushed down by the incredible weight of the ice, started to very slowly rebound. The rebounding of the earth’s crust is still occurring today.

This rebounding of the earth’s crust has caused the outlet of the Great Lakes to rebound, sometimes faster than areas downstream. The rise in the outlet level of the Great Lakes causes a condition similar to a dam and floods ancient river valleys with Great Lakes water, thereby creating drowned river mouth systems. In fact, the U.S. Geological Survey has found that water levels in the southwestern portions of Lake Superior have risen approximately 15 to 18 feet over the past 2000 years! They estimate that the lake level rise in those areas is occurring at a rate of one inch per decade, and that rising Lake Superior water levels associated with the rebounding of the earth’s crust will continue to flood low-lying river mouths and expand wetlands.

Sources of Additional Information:

Great Lakes estuaries, Estuaries (journal), C. Herdendorf, 1990.

Rapid submergence of Lake Superior shorelines, U.S. Geological Survey, 1995, available at

<http://water.usgs.gov/wid/html/wi.html#HDR11>

2) River-Lake Transition Zone

Freshwater estuaries have a zone of transition from stream water to lake water. The mixing of water in this transition zone creates unique characteristics. For example, stream water typically has a higher temperature and more suspended solids than Great Lakes water. The mixing of river and lake water in a freshwater estuary can affect water temperature, turbidity, and chemical composition. Those affects can, in turn, impact water density; currents; and sediment, nutrient, and contaminant transport, all of which influence important ecological processes.

3) Seiche and Wind Tides

The Great Lakes exhibit an interesting natural phenomenon called a “seiche.” A seiche is an oscillation, or periodic back-and-forth movement, that occurs in large waterbodies. One way to visualize a seiche is to imagine a bowl of

water that you gently shake. After shaking the bowl, the water moves back-and-forth. The same phenomenon happens in the Great Lakes, only the factors “shaking” the Great Lakes are atmospheric disturbances such as winds or changes in barometric pressure. In waterbodies as large as the Great Lakes, the back-and-forth movement never actually stops and seiche effects can be observed on a daily basis. The intervals, or periods, between seiche peaks on the Great Lakes can range from minutes to more than eight hours. Seiches can cause changes in water surface elevations of a few inches to several feet depending upon atmospheric conditions. Freshwater estuaries experience frequent wet and dry periods, especially near the water margins, due to seiche effects.

A wind tide, or storm surge, is a vertical rise in water level on the leeward, or downwind, side of a waterbody as a result of strong winds. Storm surges on the Great Lakes can produce a change in water level of up to eight feet under extreme conditions. Given their association with storms and high winds, the effects of a wind tide are often more dramatic than the effects of a seiche. Wind tides can also be a contributing factor to seiche effects.

Sources of Additional Information:

Living on the coast: Protecting investments in shore property on the Great Lakes, P.Keillor, University of Wisconsin Sea Grant, 2003, available at http://www.lre.usace.army.mil/coastalprocesses/Publications/Living_on_the_Coast.pdf

4) Barrier Spits and Baymouth Bars

Freshwater estuaries are commonly separated from the adjacent main body of water by a barrier spit or baymouth bar. Spits and bars are accumulations of sand and gravel that can form entirely or partly across the mouth of a river. Many, although not all, freshwater estuaries are partially enclosed by bars or spits.

[For a more traditional definition of estuary...Wikipedia](#)

The word “estuary” is derived from the Latin word *aestuarium* meaning tidal inlet of the sea, which in itself is derived from the term *aestus*, meaning tide. There have been many definitions proposed to describe an estuary. The most widely accepted definition is: “*a semi-enclosed coastal body of water, which has a free connection with the open sea, and within which sea water is measurably diluted with freshwater derived from land drainage.*”^[1] However, this definition excludes a number of coastal water bodies such as coastal lagoons and brackish seas. A more thorough definition of an estuary would be “*a semi-enclosed body of water connected to the sea as far as the tidal limit or the salt intrusion limit and receiving freshwater runoff; however the freshwater inflow may not be perennial, the connection to the sea may be closed for part of the year and tidal influence may be negligible.*”^[3] This definition includes classical estuaries as well as [fjords](#), [lagoons](#), [river mouths](#), and [tidal creeks](#). Estuaries are a dynamic [ecosystem](#) with a connection with the open sea through which the [seawater](#) enters accordingly to the rhythm of the [tides](#). The seawater entering the estuary is diluted by the [freshwater](#) flowing from rivers and streams. The pattern of dilution varies in different estuaries and is dependent on the volume of freshwater, tidal amplitude range, and the extent of evaporation from the water within the estuary.^[2]

Hope this helps!
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"Education is not the filling of a pail, but the lighting of a fire." Yeats