BASIN CHARACTERISTICS

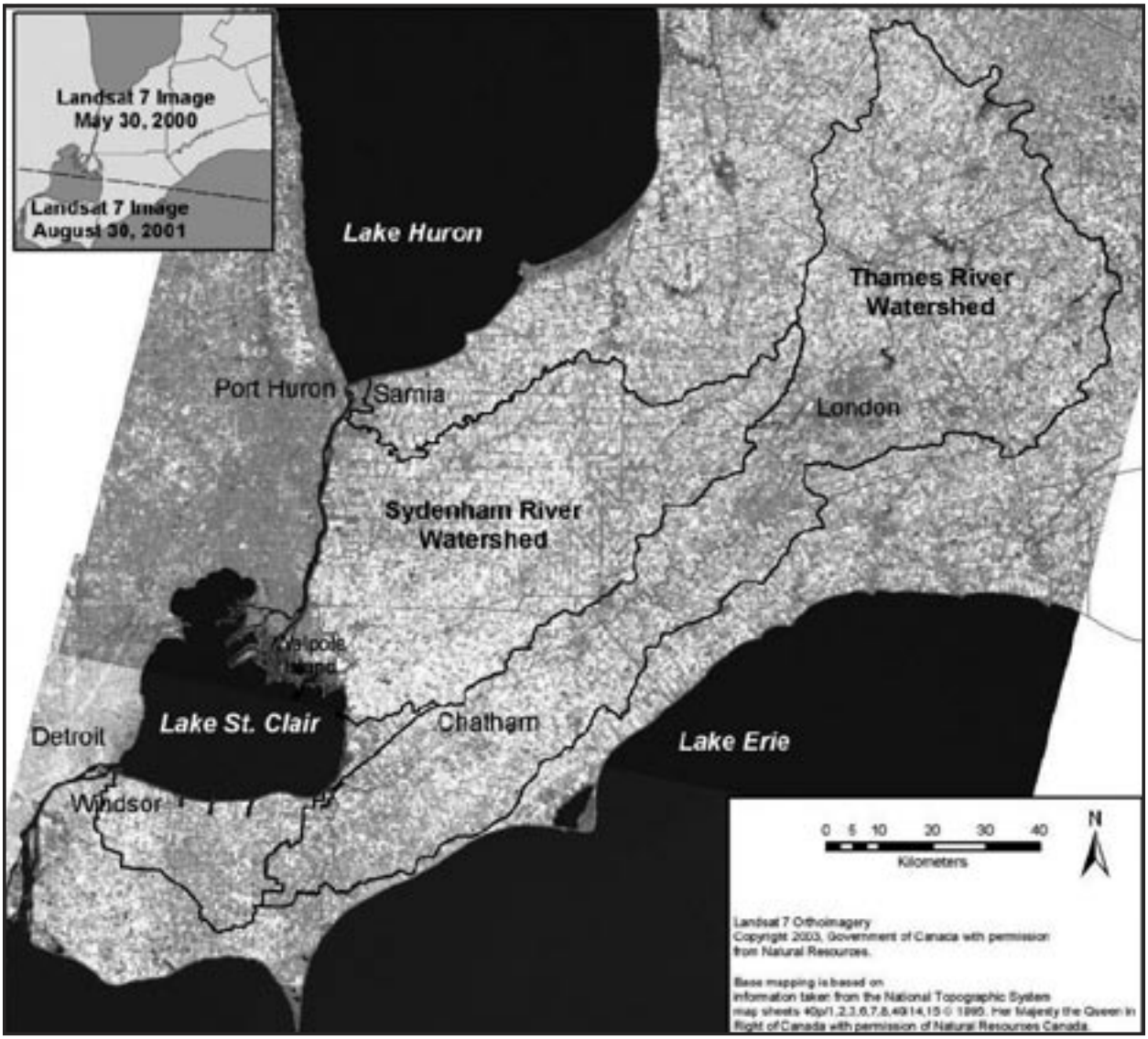

Figure 1: Satellite photo of the St. Clair River and the Lake St. Clair Canadian watershed.
(Source: Landsat 7Orthoimagery and St. Clair Region Conservation Authority)

Lake St. Clair, together with the St. Clair and Detroit Rivers, provides the connecting channel between Lake Huron and Lake Erie (Figure 1). This corridor is part of the international boundary between Canada and the United States, and serves as an integral link in the major shipping channel that connects the Great Lakes.

Beginning at Lake Huron**,** the St. Clair River flows approximately 64 km in a southerly direction to Lake St. Clair where it divides into several channels to travel through the delta (Figure 2). Both sides of the river have highly urbanized portions. The river is predominately a straight channel with hardened shoreline structures such as riprap and retaining walls lining much of the shoreline, narrow beaches, and vegetated cliffs.

The rapid deceleration of the flow in the St. Clair River as it enters Lake St. Clair allows the suspended sediment loads held in the river to settle out forming the St. Clair delta.

This unique delta area is predominately wetland with some dyking and land reclamation in the northern sections. It has a complex shoreline with many channels and shallow bays, contributing to one of the most significant wildlife habitats in the Great Lakes.

Lake St. Clair has an area of 1,115 km^2 (430 mi^2) with a shoreline length of 272 km (169 mi) not including the delta shoreline area. It has a mean depth of only 3.7 m (12.1 ft) with a maximum natural depth of 6.4 m (21 ft). The Detroit River is the only natural outlet from the lake. To accommodate commercial shipping, an 8.3 m (27.2 ft) navigational channel was dredged in a northeast-southwest direction from the St. Clair River to the Detroit River. Almost two-thirds of the surface area of Lake St. Clair and 77% of the drainage basin area (total area 13 500 km^2) is in Ontario (Bolsenga and Ladewski 1993; Leach 1991).

The Lake St. Clair Canadian shoreline includes the eastern and southern shorelines. The eastern shoreline of the lake is low lying and characterized by agricultural and recreational land uses with dyked and undyked wetlands providing important wildlife habitat. The southern shoreline is largely agricultural with some urban development. The Thames and Sydenham Rivers, together with several smaller tributaries, drain a large area of southwestern Ontario into the southeastern portion of the lake (Figure 1). The land drained by these tributaries is characterized as one of the most productive agricultural areas in Canada.

Water Levels

Lake St. Clair is shallow and therefore vulnerable to annual and seasonal changes in water level. Long-term historical data (1918-1999) indicated that lake levels ranged between 174.2 m (in 1934) and 175.9 m (in 1986) (MacLennan et al. in preparation). Regional trends in precipitation and ice cover are the main factors that influence annual and long-term water level cycles in Lake St. Clair (Figure 3).

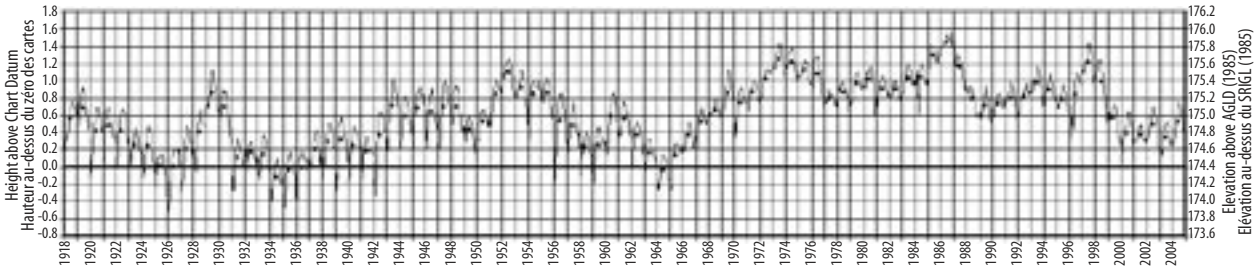

Figure 3: St. Clair River mean annual water levels, 1918-2004. (Source: Canadian Water Survey)

Fluctuating water levels are an important part of coastal wetland development and function. Large shallow areas that are naturally impacted by water level changes characterize the nearshore habitat. Variable water levels tend to result in greater overall plant diversity in coastal wetlands. Known as pulse-stable systems, these systems have plants and animals that are adapted to, and depend on, a highly changeable wetland environment.

The littoral (nearshore) habitat is characterized by large shallow areas that can be significantly impacted by water level changes. This is of particular concern for littoral zones on the eastern and northern shores that are influenced by prevailing southwest winds. If water levels were to drop below a certain threshold, wave energy can be dissipated at an offshore bar, and this may cause significant changes to the water transparency and sediment re-suspension in the littoral zone (MacLennan et al. in preparation). Increased transparency in the littoral zone creates a more extensive euphotic zone (upper layers of water where light penetrates and photosynthesis occurs) enabling

the density and distribution of submerged aquatic vegetation to increase (MacLennan et al. in preparation). This, in turn, affects the fish, invertebrate, and waterfowl communities of the lake.

Drought conditions and mild winter temperatures in 1997 and 1998 brought about a drop in lake levels and reduced ice cover that subsequently resulted in increased winter evaporation and lower water levels in later years. Overall, from 1997-2000, the drop in Lake St. Clair water levels was approximately one third of the average depth of the lake. The future impact of climate warming on lake levels and the ecosystem of Lake St. Clair will be important.

Flow Rates

Roughly 98% of the water entering Lake St. Clair originates in the upper Great Lakes, which have a combined drainage basin of 146,600 km^2. The St. Clair River has a short retention time (approximately 21 hours) as it drains into Lake St. Clair. The annual average discharge is approximately 5,000 m^3/s. The flow is relatively consistent and fluctuates slightly with the water level in Lake Huron.

The flow from the St. Clair River into the lake is divided by the St. Clair delta into three main channels (North Channel, South Channel and Chenal Ecarte) in the upper portion of the delta and a number of secondary channels in the lower portion of the delta (Figure 2). The opening of the South Channel Cutoff in 1962, to improve commercial shipping, decreased the flow in the North Channel and the proportion of river water entering the lake through Anchor Bay. The eastern (Canadian) part of the lake receives a relatively small amount (8%) of St. Clair River inflow via the Bassett Channel and Chenal Ecarte (Environment Canada et al. 1994). The channels and the islands of the delta are shown in Figure 1.

Based on the volume of the lake and inflow from the St. Clair River, the average residence time for Lake St. Clair is about nine days. Wind direction and velocity can have significant impacts on the residence times and circulation patterns in the lake. The residence time for the water from the individual channels and the major tributaries can range from four days for the Middle Channel to more than 30 days for water from the Thames River (Schwab et al. 1989).

The watershed area for the Canadian tributaries draining into Lake St. Clair is approximately 10,000 km^2 (1,000,000 hectares). The two largest tributaries are the Thames River (582,700 ha) and the Sydenham River (272,400 ha). The Thames River discharges into the southeast corner of the lake and the Sydenham River discharges into the Chenal Ecarte. Along the eastern shore, Rankin Creek and several agricultural drains discharge from a small triangle of land located between the Thames and Sydenham Rivers. Along the south shore, the Ruscom, Belle and Puce Rivers, together with small creeks, drain approximately 66,000 ha of Essex County north to the lake (Figure 2).

Circulation Pattern

The North Channel, Middle Channel and Clinton River flow into the northwestern side of the lake and frequently form a gyre (i.e. a circulatory current) bounded by the shoreline and the navigation channel. The South and Cutoff Channels enter the lake and remain in or adjacent to, the navigation channel and flow directly into the Detroit River. Flows from the Basset Channel, Chenal Ecarte, Thames and Sydenham Rivers flow into the southeastern side of the lake and frequently form an easterly gyre.

Water quality measurements made in Lake St. Clair show distinctly different areas of the lake indicating that these water masses rarely mix. The area is dominated

by a southeastern mass of relatively stable water that is enriched by nutrients from inflowing tributaries, agricultural drainage and urban development (Leach 1980, 1991). Temperature and concentrations of nutrients, major ions, and plant pigments increase from northwest to southeast in the lake (Leach 1991). The southeastern water mass is very productive and helps to define the community ecology in the Canadian waters. The northwestern water mass that drains from Lake Huron through the Lake St. Clair delta is less productive (Leach 1980).