# Section III. Physical Characterization

## III. A. Climate

The location of Lake St. Clair minimizes the influence of Great Lakes weather patterns associated with prevailing westerly winds except for a noticeable increase in cloudiness during the late fall and early winter months. Northerly winds blowing off Lake Huron often produce a similar "lake" effect of cloudy skies. Local Lake St. Clair breezes modify temperatures during the summer months. Diminished wind speeds or winds that do not traverse large unfrozen lakes often produce clearing skies and the colder temperatures expected at mid-continent locations.

**HIGHLIGHT**
The Lake St. Clair region seldom experiences prolonged periods of hot, humid weather in the summer or extreme cold during the winter.

Because the day-to-day weather is controlled by the movement of pressure systems across the continent, the Lake St. Clair region seldom experiences prolonged periods of hot, humid weather in the summer or extreme cold during the winter. The prevailing wind is southwesterly, averaging 10 mph. The strongest one-minute wind speed, 95 mph, was recorded in June 1890. The average 1:00 p.m. relative humidity varies from 53 percent for May and July to 71 percent for December, and averages 60 percent annually. The average percent possible sunshine varies from 29 percent for December to 69 percent for July, and averages 53 percent annually.

Summers are dominated by moderately warm temperatures. Between 1951 and 1980 an average of 8 days exceeded the 90° F (32° C) mark. During the same period, on average, 1 day was 100° F (38° C) or higher. During this period, the lake influence was reflected in the minimum temperatures; an average of 134 days was 32° F (0° C) or lower, an average of 4 days was 0° F (-18° C) or lower, and only 5 years stayed above 0° F (-18° C). The highest average monthly maximum temperature of 89.0° F (32° C) was recorded July 1955 and the lowest average monthly minimum temperature of 6.5° F (-14° C) was recorded January 1977.

Temperature extremes (as recorded at Selfridge Air National Guard Base):

- Maximum = 106° F (41° C), recorded July 5, 1911
- Minimum = -24° F (-31° C), recorded February 10, 1912
- Warmest monthly mean = 78.7° F (25.9° C), recorded July 1955
- Coldest monthly mean = 13.2° F (-10.4° C), recorded January 1977

Heating and cooling degree-day data are used as an index of the heating and cooling requirements for buildings which are proportional to the number of degree-days. Heating degree-days for a single day are obtained by subtracting the mean temperature from 65° F (18° C) when the mean temperature is below 65° F (18° C). Cooling degree-days for a single day are obtained by subtracting 65° F (18° C) from the mean temperature when the mean temperature is above 65° F (18° C). Each are then summed to yield monthly totals.

Again looking at the 1951-80 period, the average date of the last freezing temperature in the spring was April 27, while the average date of the first freezing temperature in the fall was October 19. The freeze-free period, or growing season, averaged 174 days annually.

Precipitation was well distributed throughout the year with the crop season, April-September, receiving an average of 16.14 inches or 57 percent of the average annual total for the 1951-80 period. During this same period the average wettest month was June with 3.04 inches, while the average driest month was February with 1.53 inches. Average precipitation for the project area is 33.97 inches (86.28 cm).

Precipitation extremes (as recorded at Selfridge Air National Guard Base):

Greatest precipitation in a single day = 4.78 inches, recorded June 26, 1968
Greatest precipitation in a single month = 9.22 inches, recorded July 1976
Least precipitation in a single month = 0.00 inches, recorded December 1900

Summer precipitation comes mainly in the form of afternoon showers and thundershowers. Annually, thunderstorms occur on an average of 35 days. Lake St. Clair is located on the northeast fringe of the tornado belt. The lower frequency of tornadoes occurring in Southeast Michigan and Southwest Ontario may be the result of the colder waters of Lake Michigan during the spring and early summer months, a prime period of tornado activity. For instance, during 1950-87, Michigan averaged 15 tornadoes each year. During this same period, 14 tornadoes occurred within Macomb County. The 1950-51 through 1979-80 average seasonal snowfall was 34.4 inches. During this period, 50 days per season averaged 1 inch or more of snow on the ground, but varied greatly from season to season.

FACT

Lake St. Clair is located on the northeast fringe of the tornado belt. The lower frequency of tornadoes occurring in Southeast Michigan and Southwest Ontario may be the result of the colder waters of Lake Michigan during the spring and early summer months, a prime period of tornado activity.

Evaporation data from the Class "A" pan[1] were not available for Lake St. Clair, but should be similar to those observed at Dearborn, Michigan where during the 1953-1980 time frame the pan evaporation for May through October exceeded the average precipitation by 86 percent. Therefore, soil moisture replenishment during the fall and winter months plays an important role in the success of agriculture for this area. While drought occurs periodically, the Palmer Drought Index indicated drought conditions reached extreme severity only 2 percent of the time.[2]

Snowfall extremes (as recorded at Selfridge Air National Guard Base):

Greatest snowfall in a single day = 13.7 inches, recorded March 27, 1934
Greatest snowfall in a single month = 29.6 inches, recorded January 1978
Greatest seasonal total = 77.5 inches, recorded during 1925-26
Smallest seasonal snowfall = 11.2 inches, recorded during 1982-83 season
Greatest snow depth = 19 inches, recorded February 5, 1904

## III. B. Geology/Geography

During the Pleistocene epoch, continental glaciers repeatedly advanced and retreated over the present day Great Lakes region. Sand, silt, clay and rock were deposited in various mixtures and forms as the glaciers receded. These deposits are collectively referred to as glacial drift and created geomorphic features such as moraines, flat till plains, till drumlins,

**HIGHLIGHT**

Glacial lakes once covered the entire project area, as well as present-day Lake Erie, and parts of Ontario, Ohio and southeast Michigan. Fine-grained clays and silts deposited in glacial lakes are exposed today as lakeplain, with old beach ridges interspersed within the clayey, silty soils.

and eskers. Areas having substantial deposits of well sorted sands and gravels (eskers, kames, and outwash plains) are usually significant aquifers.[3]

As the glaciers began to retreat, meltwater collected in large lakes between the ice front and the previously deposited end moraines. As mentioned earlier, glacial lakes once covered the entire project area, as well as present-day Lake Erie, and parts of Ontario, Ohio and southeast Michigan[4]. Fine-grained clays and silts deposited in glacial lakes are exposed today as lakeplain, with old beach ridges interspersed within the clayey, silty soils. Moraines within the project area were deposited in water and subsequently eroded, making them difficult to identify today[5].

About 4,000 years ago, the precursor to today's Great Lakes, or the "Nipissing" Great Lakes, began to wane due to crustal rebound as the glaciers retreated, forcing the full discharge of the upper Great Lakes through the St. Clair and Chicago Rivers. The Chicago outlet, having a limestone sill[6], resisted downward cutting. The St. Clair outlet, channeled in unconsolidated glacial drift, yielded to steady erosion. When the upper lakes' (e.g., Lakes Superior, Michigan and Huron) surface dropped below the level of the Chicago River, the St. Clair River became the only outlet. As these lake levels continued to drop, a series of clay lake plains were exposed. The tributaries flowing into Lake St. Clair deposited sediments along valley floors to create floodplains. Concurrently, deposition in Lake St. Clair created the St. Clair Delta due to the shallowness on the lake and the abundance of sediments. No other significant deltaic formations occur in the Great Lakes.[7]

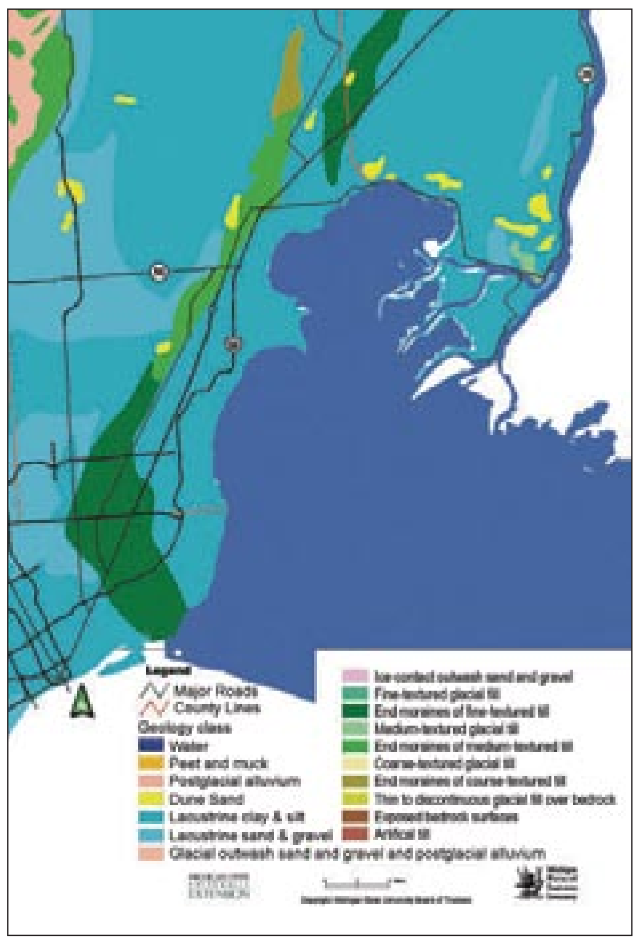


**Figure III B - 1**
Southeast Michigan quartnernary geology

## Michigan

Lake St. Clair and the majority of its watershed is located within the Maumee Lake Plain landform. The Maumee Lake Plain, a broad, flat plain, is bounded on the west by the Defiance Moraine and extends south into northern Ohio. The northern third of the lake plain, where the project area lies, is bisected by drainage-ways, narrow beach ridges and several water-lain moraines, which collectively form a mosaic of slight rises and depressions. See Figure III B - 1 for a generalized view of the quaternary geology in Michigan bordering Lake St. Clair[8].

The Clinton River, located just north of Detroit, flows 80 miles (128 km) from its headwaters to Lake St. Clair near the city of Mt. Clemens. The river drains 760 square miles (1,968 km2) of southeastern Michigan, including portions of Oakland and Macomb Counties and small areas of St. Clair and Lapeer Counties. Its entire watershed is considered an Area of Concern. About half of the river's flow is treated wastewater from six municipal wastewater treatment plants. Land use on the north branch of the river is agricultural. The main industries in the area are automotive-related[9].

## Ontario

Lake St. Clair is located within the St. Clair Clay Plain physiographic region, which encompasses the majority of the counties of Lambton, Kent, and Essex. The St. Clair Clay Plain has little topographic relief. The St. Clair Clay Plain is subdivided into four regions: the Essex Clay Plain, the Lambton Clay Plain, the Chatham Flats, and the St. Clair Delta. A major tributary to Lake St. Clair, the Thames River drains a 350,000 hectare (864,870 acre) watershed of southern Ontario lands, mostly in agricultural use. As the river approaches St. Clair, it crosses flat clay plains; between Chatham and the lake, the river drops less than 0.01m/km. The shallow Thames River channel has been extensively dyked to control the frequent spring flood waters, and little natural wetland habitat remains along the river flood plain. The lakeshore marshes lie on stratified clays combined with a series of sandy beach ridges formed long ago by lake wave action. There is an overlying deposit of organic materials from decayed marsh vegetation. The clay plains are among the most fertile in Canada. The rich soils once supported tall grass prairies and now produce fertile marshes or high yields of agricultural crops.[10]

**HIGHLIGHT**

The Lake St. Clair watershed is comprised of the contributing waters of Anchor Bay, Clinton River, Belle River, Black River, and Pine River on the Michigan side and the Thames River, Sydenham River and Belle River on the Ontario side, as well as direct drainage.

## III. C. Hydrology

The Lake St. Clair watershed is comprised of the contributing waters of Anchor Bay, the Clinton, Belle, Black and Pine Rivers on the Michigan side and the Thames, Sydenham and Belle Rivers on the Ontario side, as well as direct drainage. The Great Lakes waters of Superior, Michigan, and Huron feed Lake St. Clair through the St. Clair River and exit the lake through the Detroit River to Lake Erie. The Lake St. Clair watershed encompasses approximately 3,927,175 acres (1,589,270 hectares) in Michigan and Ontario. Lake St. Clair itself has an area of 430 square miles (1,115 square kilometers) with a shoreline length of 169 miles (272 kilometers)[11]. Its average depth is 12 feet (3.7 meters) with a maximum natural depth of 21 feet (6.4 meters). In 1855 a commercial navigation channel was dredged through the lake from the St. Clair Cutoff Channel (between Seaway Island and Bassett Island) to the Detroit River. The navigational channel is now maintained to a depth of 27.2 feet (8.3 meters). The average retention time for water in Lake St. Clair is nine days.[12]

Due to the shallow depth of Lake St. Clair, water dynamics are greatly affected by wind, lake levels, and stratification. "Wind set-up", is a phenomena associated with a major lake storm whereby a local rise in water is caused by winds pushing water to one side of a lake. Another extreme form of oscillation, known as seiche, occurs with rapid changes in winds and barometric pressure.[13]

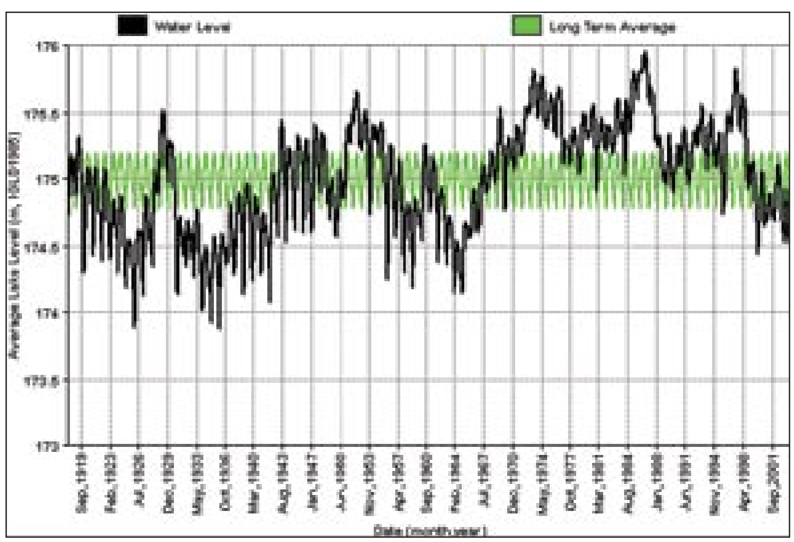


**Figure III C - 1**
Lake St. Clair historic water levels

HIGHLIGHT

Water level fluctuations are an important factor in Great Lakes coastal wetlands development. Lake St. Clair's gently sloping marshes and lakeplain experience dramatic changes as a result of relatively small fluctuations, which create diversity among plant and animal communities that rely upon the highly changeable wetland environment.

Stratification, or layering, of water in the lake is due to density changes caused by shifts in temperature. The density of water increases as temperature decreases. In the late fall surface waters cool, becoming denser, and descend, displacing deep waters and cause a mixing or turnover of the entire lake. The process may be repeated in reverse during the warming of the spring. Lake stratification as it warms in summer can also prevent the dispersion of effluents from tributaries causing increased concentration of pollutants near the shore.

Lake levels fluctuate significantly as a consequence of climate variability upstream in the upper Great Lakes and local short term weather events. Long term changes in water levels on Lake St. Clair are usually the result of precipitation. Temperature, cloud cover and winter ice cover that drive evaporation are also factors. Short term changes in water levels on Lake St. Clair also occur within a few days of heavy rains in the Thames and Clinton River watersheds or when ice dams appear in the St. Clair and Detroit Rivers. Water levels have declined throughout the Great Lakes and Lake St. Clair over the last five years. While the declining lake levels have alarmed some recreational boaters and others dependant upon access to nearshore infrastructure, current levels are not inconsistent with historic lake level fluctuations. On average, Lake St. Clair's water levels vary about 1.6 feet (0.5 meters) annually, with low levels typically occurring in February and high levels occurring in July. Figure III C - 1 shows water levels in Lake St. Clair from 1918 to 2002 rising and falling over a range of 6.6 feet (2 meters)[14].

Water level fluctuations are an important factor in Great Lakes coastal wetlands development. Lake St. Clair's gently sloping marshes and lakeplain experience dramatic changes as a result of relatively small fluctuations, which create diversity among plant and animal communities that rely upon the highly changeable wetland environment.

Modeling has shown that circulation patterns for Lake St. Clair fall into three large regions. Waters on the western side (Michigan) are fed primarily by the North and Middle Channels of the St. Clair River Delta and the Clinton River, which form a spiral clockwise flow pattern bounded by the western shoreline and the navigational channel. Water entering the lake through the South and Cutoff Channels of the St. Clair River Delta remain in or adjacent to the navigational channel to the Detroit River. Flows on the eastern side (Ontario) are fed by the channels in and around Walpole Island First Nation and the Thames River. These flows form an eastern counterclockwise gyre. Because of the fast velocities and substantial water temperature difference for flows within the maintained commercial navigational channel, mixing between the western and eastern regions is infrequent.[15]

## III. D. Land Cover

Generally, the forests, tall grass prairies and coastal wetlands of the project area have given way to urban, residential and farming lands. However, on the unceded lands of Walpole Island First Nation in the delta of the St. Clair River, remnant plots of tall grass prairie, savanna and extensive coastal wetlands remain, though modification through diking and draining have still occurred. For a more detailed discussion on the existing habitat and land cover types within the project area, please read Section IV. Major Ecosystem and Habitat Types of Lake St. Clair.

The Lake St. Clair area has experienced a long history of human settlement due to its rich natural resources and key location along the Great lakes trade routes. The most unique aspect of Lake St. Clair's historical land cover were the vast coastal marshes that spread across the mouth of St. Clair River in the mid 1800's. What made these marshes particularly unique was not just their sheer size, but the fact that they were located on what is considered today to be the largest freshwater delta in the world. In much of the delta these marshes graded into lakeplain prairie. Sizable marshes were also located at the mouth of the Clinton River, and further south in what is now Grosse Pointe. Although presettlement vegetation maps are presently available only for Michigan, Figure IIID-1 gives a sense of what natural communities were present on both sides of the lake.

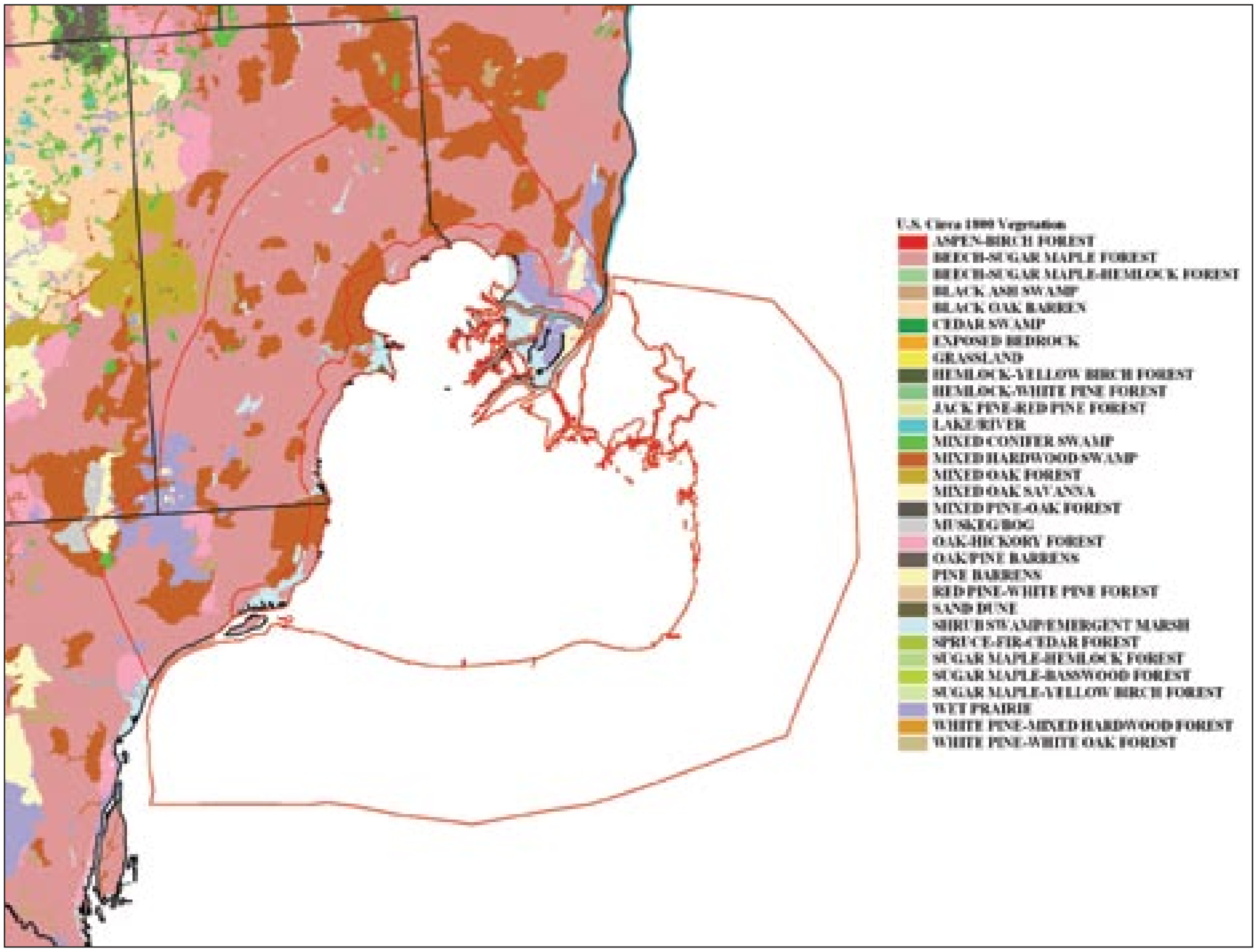


**Figure III D - 1**

Since the mid 1800's, this area has undergone a tremendous transformation from nomadic Native American tribes to intensive urbanization and agricultural operations. As a result, much of the abundant natural resources that originally attracted Native Americans and European settlers to this area have suffered serious declines or have been lost.

**HIGHLIGHT**

Ontario is dominated by agricultural lands whereas Michigan is represented by a more diverse grouping of high and low intensity development, agricultural land, grassland and deciduous forest.

The greatest losses in the study area were the loss of lakeplain prairie (98.2% loss) and lakeplain oak openings (92.7% loss), both of which are considered to be globally imperiled communities. In addition, there was also a large decrease in all forest types, including mesic southern forest, dry mesic southern forest, southern floodplain forest, and southern swamp. Although there was only a 30% loss of Great Lakes marsh (overall), most of the remaining marsh has been dyked and hydrologically disconnected from Lake St. Clair. If only undiked Great Lakes marsh is considered, probably less than 10% of the original acreage of Great Lakes marsh remains in the Lake St. Clair system. Changes in acreage of important natural community types between 1800 and 2000 are shown in Figures IIID - 2 and IIID - 3.

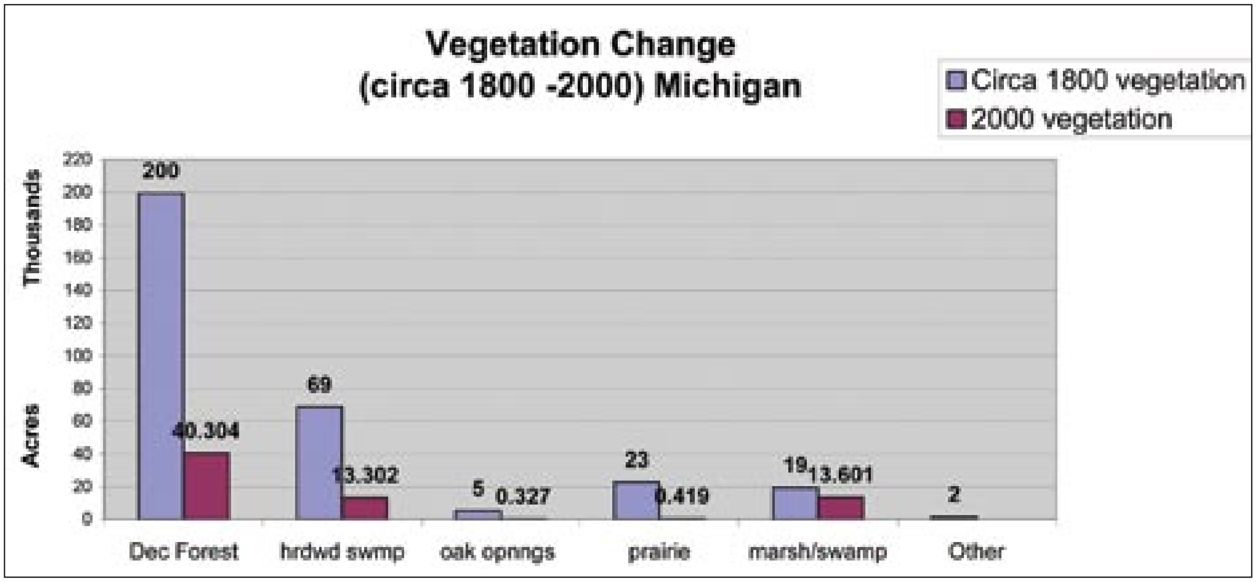


**Figure III D - 2**
Source: Michigan Natural Features Inventory

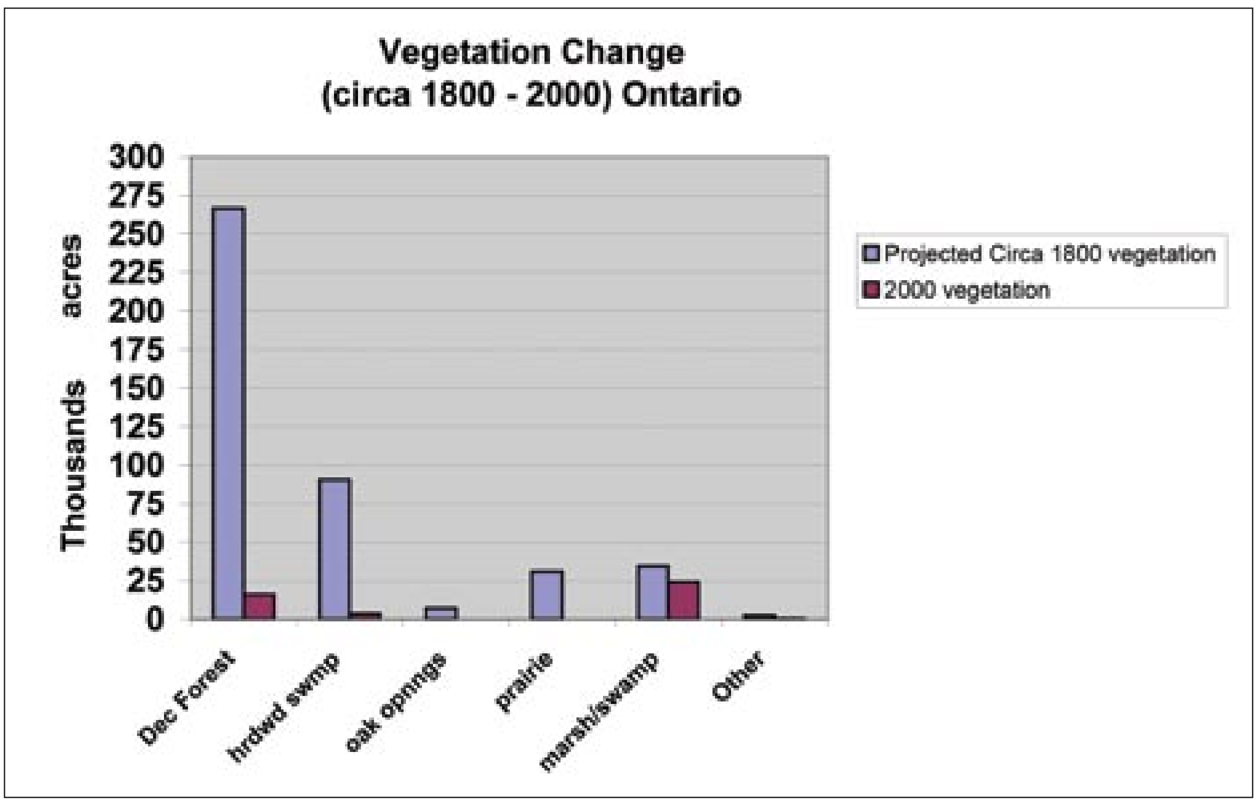


**Figure III D - 3**
Source: Michigan Natural Features Inventory

In assessing present-day land cover, the tool used to identify basic land cover types within the project area is NOAA's Coastal Change Analysis Program (C-CAP). C-CAP was developed to distribute and apply land cover and change data

Table III D - 1

| 1995 - Land Cover Types | Acres |
|---|---|
| High-Intensity Developed | 4,618 |
| Low-Intensity Developed | 123,112 |
| Cultivated Land | 386,037 |
| Grassland | 54,517 |
| Deciduous Forest | 54,254 |
| Evergreen Forest | 5,967 |
| Mixed Forest | 2,721 |
| Scrub/Shrub | 3,885 |
| Palustrine Forested Wetland | 17,113 |
| Palustrine Scrub/Shrub Wetland | 11,550 |
| Palustrine Emergent Wetland | 20,497 |
| Unconsolidated Shore | 742 |
| Bare Land | 1,723 |
| Water | 44,002 |
| Palustrine Aquatic Bed | 2,795 |

for the U.S. coast line. These data sets can be used to assess urban growth, determine changes to natural resources, and develop trend analyses. C-CAP data is 30-meter pixel resolution data derived from Landsat 7 satellite imagery. C-CAP, the USGS National Land Cover Dataset (NLCD) and the Integrated Forest Monitoring, Assessment and Prescription (IFMAP) products are similar For more detailed information on C-CAP, please refer to Section VII. A. C-CAP Products and Application.

Using the analysis from the 1995 and 2000 Coastal Change Analysis Products (C-CAP) from the State of Michigan and the 10-mile buffer from the Province of Ontario surrounding Lake St. Clair, some basic landscape inventories and quantities of land cover change can be computed. Following are a series of charts and tables that illustrate the use of C-CAP within the project area. Table IIID - 1 shows the acreage of the various land cover types within the project area in 1995, as identified in C-CAP images.

In 1995, 49.8% of the project area was identified as cultivated land, the next dominate land cover type was low density developed at 15.9%. Graphically, the distribution of land cover types by percentage is illustrated in the pie chart in Figure IIID - 4.

When similar land cover types listed above are grouped as indicated in Table IIID - 2, agricultural occupies 56.8% of the landscape, forest 8.7%, wetland 6.7%, urban 22.1% and other 5.8%.

For the project area in 2000, the acreage of the various land cover types identified in C-CAP images is shown in Table IIID - 3.

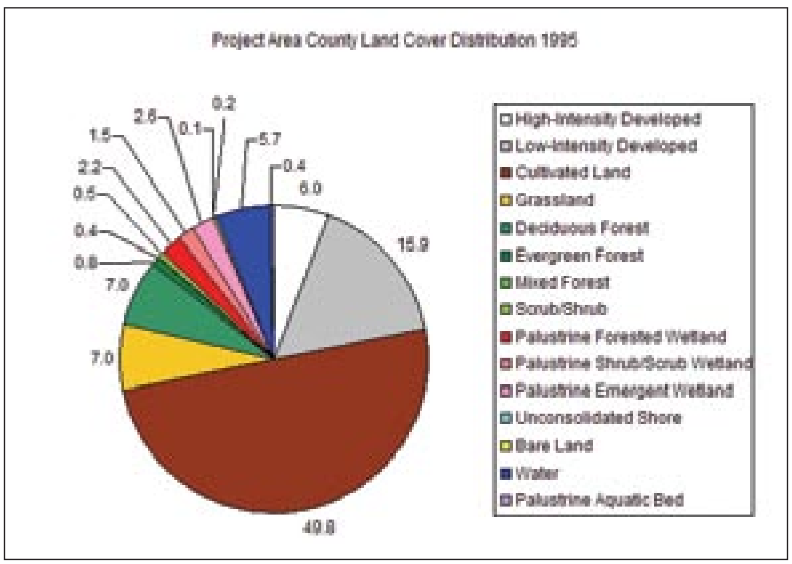


Figure III D - 4

Table III D - 2

| Group | Land Covers Included |
|---|---|
| Wetland | Forested Wetland, Scrub/Shrub Wetland, Emergent Wetland, Aquatic Bed |
| Forest | Deciduous Forest, Evergreen Forest, Mixed Forest, Scrub/Shrub |
| Agriculture | Cultivated Land, Grassland |
| Urban | High-Intensity Developed, Low- Intensity Developed, Bare Land |
| Other | Water, Unconsolidated Shore |

Table III D - 3

| 2000 - Land Cover Types | Acres |
|---|---|
| High-Intensity Developed | 49,083 |
| Low-Intensity Developed | 124,996 |
| Cultivated Land | 377,987 |
| Grassland | 58,373 |
| Deciduous Forest | 52,911 |
| Evergreen Forest | 5,949 |
| Mixed Forest | 2,725 |
| Scrub/Shrub | 3,753 |
| Palustrine Forested Wetland | 16,868 |
| Palustrine Scrub/Shrub Wetland | 11,712 |
| Palustrine Emergent Wetland | 22,458 |
| Unconsolidated Shore | 747 |
| Bare Land | 2,163 |
| Water | 42,539 |
| Palustrine Aquatic Bed | 2,831 |

The pie chart in Figure IIID - 5 shows the percentage of each land cover type from the total acres in the project area. In 2000, 48.8% of the project area was identified as cultivated land, the next dominate land cover type was low density developed at 16.1%.

If the land cover types are divided as they were for the 1995 example, agricultural occupies 56.3% of the landscape, forest 8.5%, wetland 7%, urban 22.7% and other 5.6%.

An analysis of the change over the five years shows that 14,314 acres changed land cover designation. The land cover types that experienced the largest increases were grassland (35.5%), high density developed (20.4%), and emergent wetland (14.2%), as indicated in Figure IIID - 6.

The land cover types that experienced the largest losses were cultivated land (57.6%), deciduous forest (11.5%) and bare land (11.1%), as indicated in Figure IIID - 7.

Over 400 possible land cover changes were possible, making a meaningful graphical display of the information difficult. The previous two figures show only the most significant increases and decreases in land cover types. Land cover changes can be depicted spatially in a general way by coloring all changes the same color. In Figure IIID - 8 below, all changes are displayed in red. The bulk of the 14,314 acres that changed were concentrated on the U.S. side of Lake St. Clair, north of Detroit.

Breaking down the change into the same groupings of agriculture, urban, forest, wetland, and other (water) as described above, Figure III D-9 shows four predominant changes in land use cover during the 5 year period.

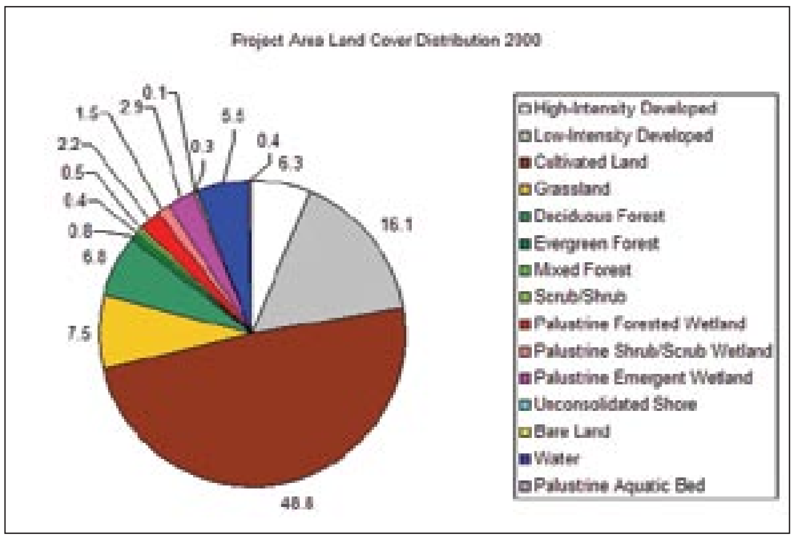


Figure III D - 5

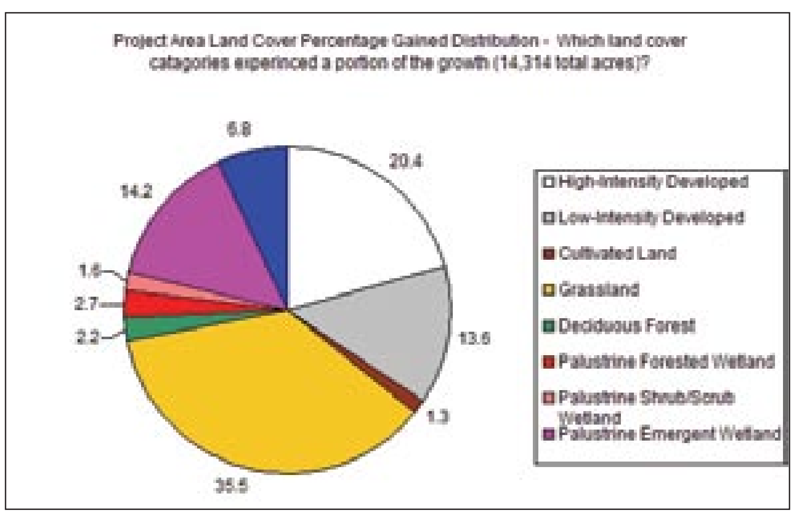


Figure III D - 6

Utilizing C-CAP, land cover was also analyzed separately for the Ontario and Michigan portions of the project area. What is immediately apparent from this exercise is the disparity between the relative proportion of different land cover types in Ontario and Michigan. Ontario is dominated by agricultural lands (77.57 percent - see Table III D - 4) whereas Michigan is represented by a more diverse grouping of high and low intensity development, agricultural land, grassland and deciduous forest (see Table III D - 5). The combined 43 percent high and low intensity development of the Michigan side of Lake St. Clair is representative of the northern expansion of the population from the Detroit Metropolitan area. See Section II. B. Population Growth/Migration for an in-depth discussion on population trends in the project area.

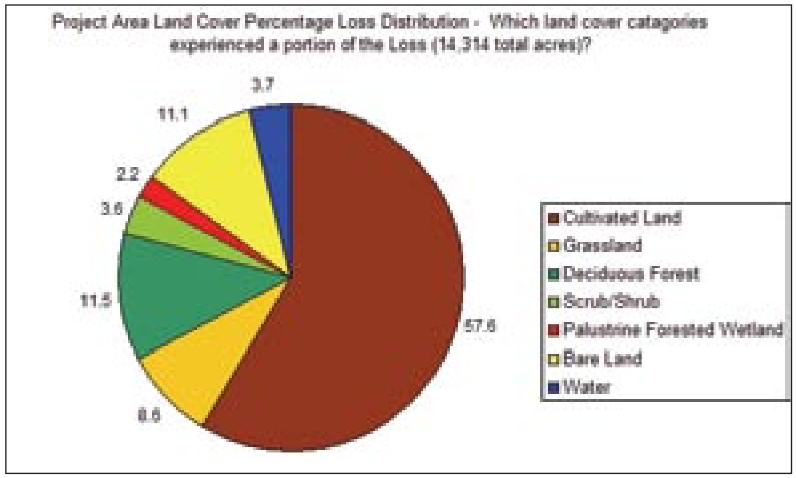


Figure III D - 7

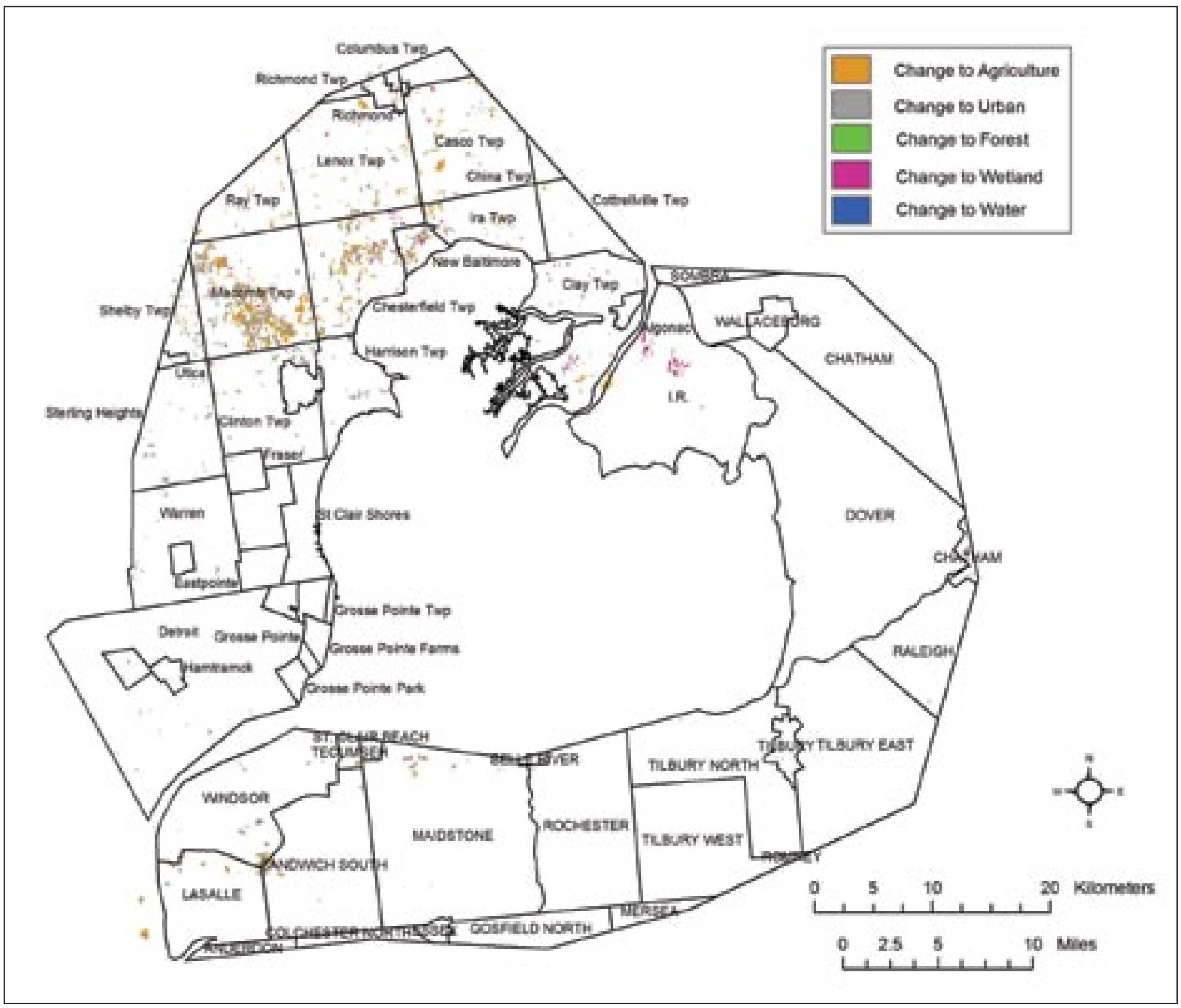


Figure III D - 9

**Table III D - 4,** Ontario Project Area Land Cover Distribution[16]

| Class Name | Area - hectare | Area - acre | Percent |
|---|---|---|---|
| High Intensity Development | 4,547 | 11,235 | 2.60% |
| Low Intensity Development | 11,763 | 29,067 | 6.74% |
| Cultivated Land | 135,441 | 334,683 | 77.57% |
| Grassland | 6,338 | 15,660 | 3.63% |
| Deciduous Forest | 6,444 | 15,925 | 3.69% |
| Evergreen Forest | 0 | 0 | 0.00% |
| Mixed Forest | 0 | 0 | 0.00% |
| Scrub/Shrub | 0 | 0 | 0.00% |
| Palustrine Forested Wetland | 1,379 | 3,408 | 0.79% |
| Palustrine Scrub/Shrub Wetland | 0 | 0 | 0.00% |
| Palustrine Emergent Wetland | 8,377 | 20,701 | 4.80% |
| Unconsolidated Shore | 148 | 365 | 0.08% |
| Bare Land | 157 | 389 | 0.09% |
| Palustrine Aquatic Bed | 0 | 0 | 0.00% |
| **TOTAL** | **174,595** | **431,433** | **100.00%** |

**Table III D - 5,** Michigan Project Area Land Cover Distribution[17]

| Class Name | Area - hectare | Area - acre | Percent |
|---|---|---|---|
| High Intensity Development | 15,705 | 38,807 | 12.32% |
| Low Intensity Development | 38,977 | 96,315 | 30.59% |
| Cultivated Land | 21,202 | 52,390 | 16.64% |
| Grassland | 17,826 | 15,660 | 3.63% |
| Deciduous Forest | 16,310 | 40,304 | 12.80% |
| Evergreen Forest | 2,446 | 6,045 | 1.92% |
| Mixed Forest | 1,130 | 2,792 | 0.89% |
| Scrub/Shrub | 1,449 | 3,581 | 1.14% |
| Palustrine Forested Wetland | 5,383 | 13,302 | 4.22% |
| Palustrine Scrub/Shrub Wetland | 1,800 | 4,448 | 1.41% |
| Palustrine Emergent Wetland | 8,377 | 20,701 | 4.80% |
| Unconsolidated Shore | 248 | 612 | 0.19% |
| Bare Land | 901 | 2,227 | 0.71% |
| Palustrine Aquatic Bed | 1,188 | 2,937 | 0.93% |
| **TOTAL** | **127,433** | **314,893** | **100.00%** |

Also, of particular note, is the scarcity of present-day wetlands and wetland complexes within the project area. Combined wetland categories for Ontario account for only 5 percent and in Michigan only 8 percent of the total project area which was once largely dominated by coastal and inland wetlands. Where the project area was once largely dominated by forest, wetland and prairies, it has since been logged, drained, farmed and now sub-divided for development on the Michigan side and mostly logged, drained and farmed on the Ontario side. Stresses on natural habitat and critical coastal habitat are apparent in Figure III D - 10, providing a general overview of existing land cover in the project area in 2000.

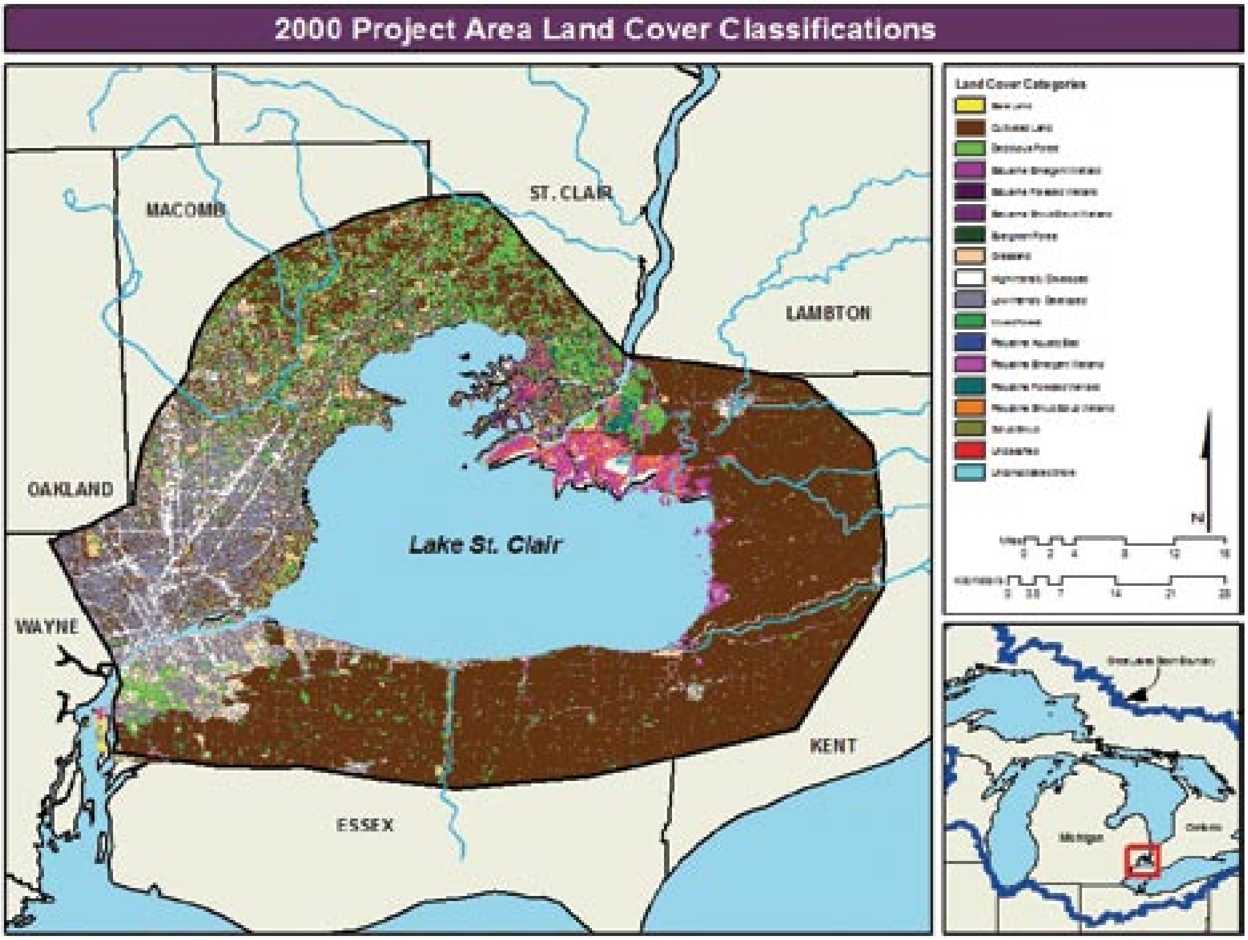


Figure III D - 10

## III. E. Water Clarity and Lake St. Clair Substrate

Lake St Clair's water clarity varies at different locations. For the entire lake, the Secchi disk depth averages 1.8 meters, varying from as shallow as 3 meters in the nearshore areas of Anchor Bay to as deep as 5.1 meters in deep offshore waters (see Figure III E - 1). Anchor Bay's waters are the most turbid in Lake St Clair, particularly on the northern shoreline where the Secchi disk depth is less than a meter. However, in the near-shore areas surrounding the St Clair River Delta and in the St Clair River, the Secchi disks are visible at the bottom. The south end of the lakes Secchi disks depths vary between 0.3 and 2.0 meters, in waters 2.0 to 3.0 meters deep.[18]

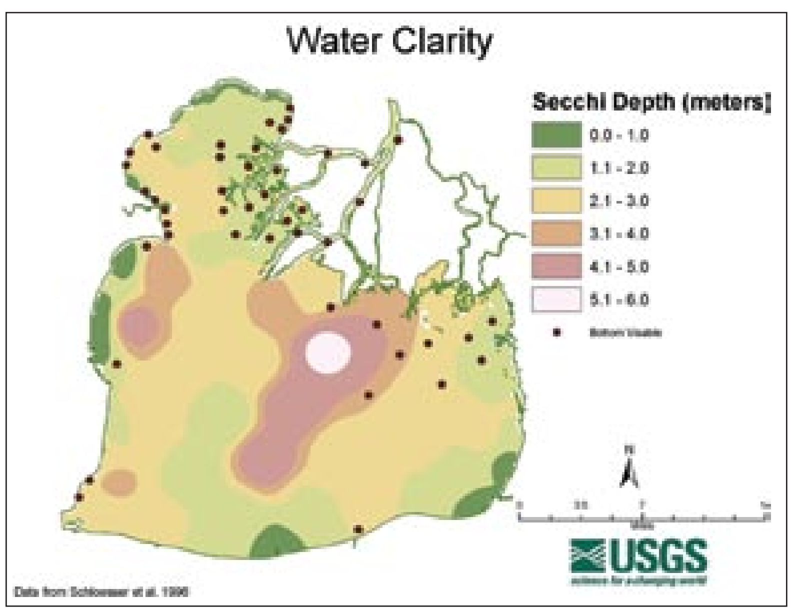


Figure III E - 1

Lake St Clair's substrates consist of clay, silt, sand and gravel. The sediments in the near-shore areas including the outlet of the St Clair river delta in Lake St Clair proper and the Detroit river mouth consist of 50% to 75% sand with the remaining portion a mixture of silt and clay. The lake center's deposits are more then half silt plus a mixture of clay and sand. Areas near the delta, where the current slows at a quicker rate than other areas of the lake, have a greater silt and clay composition than sand. Gravel is rare, but can be found in very small portions near the St Clair River delta and at the head of the Detroit River (Figure III E - 2)[19]. Substrate types are important component of the habitat for benthic invertebrates, particularly *Hexagenia sp.*, an indicator of ecosystem health.[20]

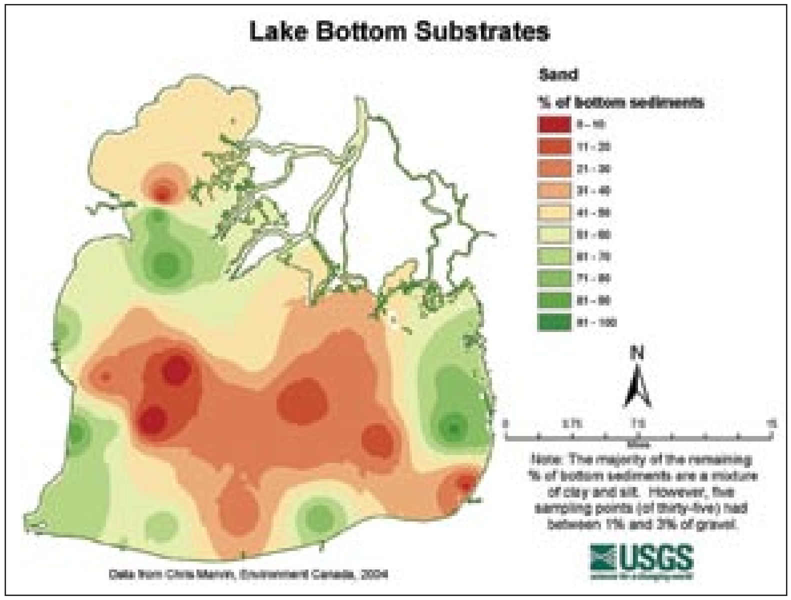


**Figure III E - 2**
Lake St. Clair Substrates

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# Section III Endnotes

1. This is a stainless steel pan for measuring daily evaporation. It is built to be compatible with all standard National Weather Service pan evaporation measurements. The stainless steel pan is normally installed on a wooden platform set on the ground in a grassy location. There are two commonly used procedures for making evaporation measurements. In both procedures, a 10" D x 47-1/2"ID stainless steel pan is used to hold the water. Since the amount of evaporation is a function of temperature, humidity, wind, and other conditions, in order to relate the evaporation to current or expected conditions, the maximum and minimum temperature of the water and the amount of air passage are normally recorded along with the evaporation. A "Class A" evaporation pan includes a drain plug and water level sensor.

2. Michigan Climatological Resources Program, Michigan Department of Agriculture's Climatologist's Office (East Lansing, Michigan).

3. The Great Lakes, An Environmental Atlas and Resource Book, U.S. Environmental Protection Agency (Chicago, Illinois) and Environment Canada (Toronto, Ontario), 1995.

4. Dorr, John A. & Eschman, Donald F., 1970. Geology of Michigan. The University of Michigan Press, Ann Arbor.

5. Appel, L, Craves, J., Smith, M., Weir, B. & Zawiskie, J. 2003 Draft. Explore: A Biodiversity Atlas of the Lake Huron to Lake Erie Corridor. Funded by USEPA, Great Lakes National Program Office and the Wildlife Habitat Council.

6. A submerged ridge at relatively shallow depth separating the basins of two bodies of water.

7. Farrand, William R., The Glacial Lakes Around Michigan, University of Michigan, Michigan Department of Environmental Quality - Geological Survey Division, Bulletin 4, 1988.

8. See note 1 above.

9. USEPA, 2004. Clinton River Area of Concern - Background (www.epa.gov/glnpo/aoc/clintriv.html) Accessed 3 November, 2004.

10. Eagles, P.F.J. and T.J. Beechey (eds.), Critical Unprotected Natural Areas in the Carolinian Life Zone of Canada. Final Report, Identification Subcommittee, Carolinian Canada. The Nature Conservancy of Canada, The Ontario Heritage Foundation and World Wildlife Fund (Canada), 1985.

11. Staff at the Great Lakes Commission utilized geographic information system data from the Ontario Ministry of Natural Resources - Land Information Office and Michigan Department of Information Technology - Center for Geographic Information to compile these figures.

12. Draft St. Clair River and Lake St. Clair Comprehensive Management Plan, U.S. Army Corps of Engineers, Detroit, Michigan, 2003.

13. Like water sloshing in a bathtub, seiches are tide-like rises and drops in Great Lakes coastal water levels caused by prolonged strong winds that push water toward one side of the lake, causing the water level to rise on the downwind side of the lake and to drop on the upwind side. When the wind stops, the water sloshes back and forth, with the nearshore water level rising and falling in decreasingly small amounts on both sides of the lake until it reaches equilibrium.

14. U.S. Army Corps of Engineers, Historic Great Lakes Water Levels, 1918 - 2002, www.lre.usace.army.mil/greatlakes/hh/greatlakeswaterlevels/historicdata/greatlakeshydrographs/

15. Holtschlag, David J., et. al., Visualization of a Drifting Buoy Deployment on Lake St. Clair within the Great Lakes Waterway from August 12-15, 2002, U.S. Geological Survey Open-File Report 02-482, Lansing, Michigan, 2002.

16. Coastal Change Analysis Program (C-CAP), National Oceanic and Atmospheric Administration, Coastal Services Center, Charleston, South Carolina, 2003.

17. Ibid.

18. Schloesser, D W, B A Manny, and T A Edsall. 1996. *Distribution and relative abundance of submerged aquatic plants in the Lake St Clair ecosystem*. Pp. 1-29. In: Edsall (ed) Aquatic plant management investigations of Lake St Clair, Michigan, 1995. Contract Completion Report for Detroit District Army Corps of Engineers. National Biological Service, Great Lakes Science Center, Ann Arbor, Michigan. 67pp.

19. Marvin, Chris. Research Scientist. Environment Canada. 867 Lakeshore Road. P.O. Box: 5050, Burlington, Ontario. Canada. (905) 319-6919 as of 3/16/04.

20. Schloesser, D.W., Edsall, T.A., Manny, B.A., Nichols, S.J. 1991. *Distribution of Hexagenia nymphs and visible oil in sediments of the Upper Great Lakes Connecting Channels*. Hydrobiologia. volume 219, page 250.