3.0 FACILITY DESCRIPTION

3.1 SITE LOCATION AND DESCRIPTION

The Tobico Marsh SGA site covers approximately 3 acres of land within the State of Michigan's Tobico Marsh State Game Area and is located in the SE quarter of the NE quarter of Section 25, T15N, R4E in Bay County, Kawkawlin Township, Michigan (Figure 3–1). The site is located approximately 1.5 miles west of Saginaw Bay, which is part of Lake Huron, and approximately 1.75 miles north of the Kawkawlin River. The area surrounding the site is relatively flat with an average elevation of 585 feet above mean sea level (msl). The site itself (top of the cap) is elevated in relation to the surrounding area by approximately 5 feet with an approximate average elevation of 590 feet above msl. The highest point at the site is approximately 595 feet above msl.

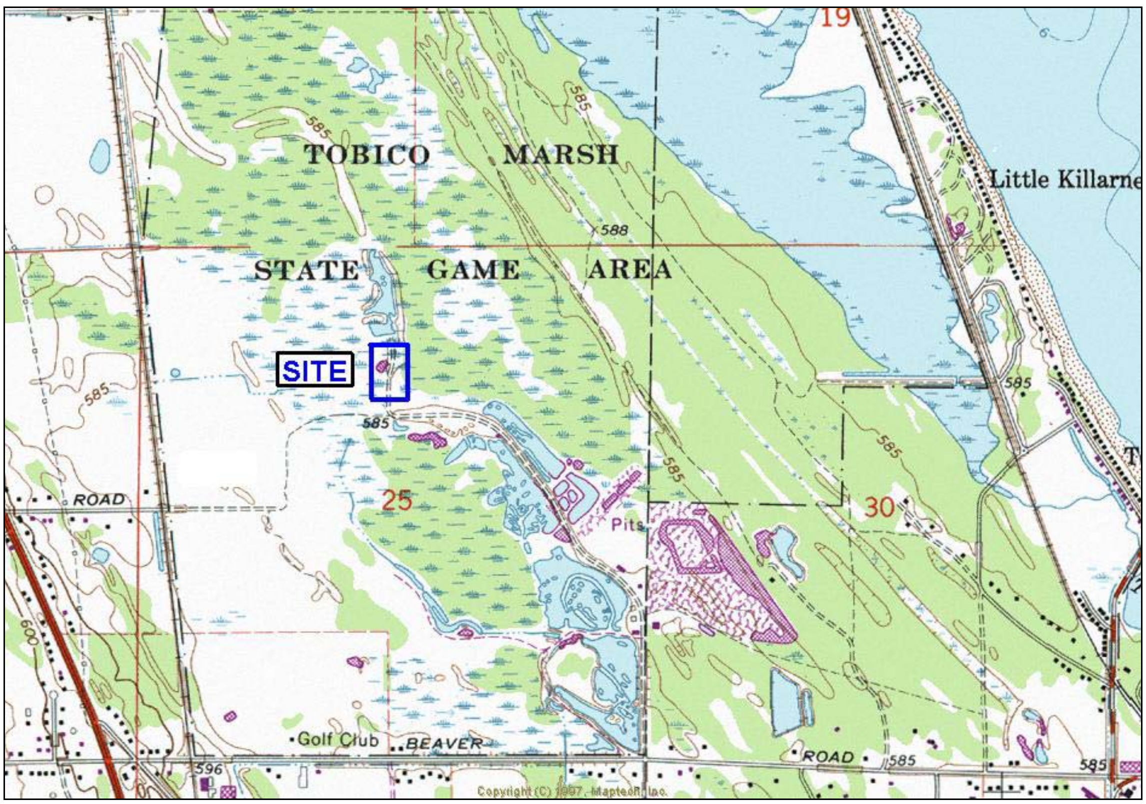

Figure 3–1 Topographic Map of the Site and Immediate Vicinity

Onsite facilities include one building, which was constructed to house a leachate collection and treatment system (LCTS) originally designed to collect and treat leachate from within the constructed cell. The LCTS system was never made operational and has been partially dismantled. The building remains on the property. The crock wells and piping from the leachate recovery system are still in place. The site is surrounded by a chain-link and barb-wire fence, and has four gates with padlocks installed.

Properties immediately surrounding the site (Figure 3–2) include:

- Tobico Marsh State Game Area

  The site is located within Michigan's Tobico Marsh State Game Area. The Tobico Marsh State Game Area land abuts the site property boundaries to the north, east, and west.

- Waste Management Landfill

  The parcel of land to the immediate south of the site is also part of the former Hartley and Hartley landfill operation and is currently owned by Waste Management, Inc.

Nearby (but not abutting) properties in the immediate vicinity of the site include:

- Residential

  The nearest residential properties to the site are located along Schmidt and Jose Roads approximately 0.5 miles (or more) to the west of the site. A few residential properties are situated along Beaver Road to the south of the site. These properties, however, are approximately 1 mile (or more) away from the site.

- Recreational Land

  Land to the north and east of the site within a radius larger than 1 mile lies within the Tobico Marsh SGA and is set aside for recreational land uses. A State park is located over one mile to the east of the site along the shore of Saginaw Bay. The Spring Valley golf course and clubhouse are located approximately 0.7 miles south-southwest of the site along Beaver Road.

- Commercial

  The nearest road to the site is Two Mile Road, which dead ends at the Waste Management property. This road provides access to the site. In addition to the Waste Management property, there are two small commercial properties located on Two Mile Road to the southeast of the site. Along Highway 13, nearly 1 mile to the west, there are a number of commercial businesses and restaurants.

The nearest population centers/areas to the site include Kawkawlin Township, approximately 1.8 miles south of the site, and Bay City, approximately 5.5 miles south of the site.

A detailed list of the nearest residences, recreational lands, and commercial properties and facilities, along with their locations relative to the site, are presented in Table 3-1.

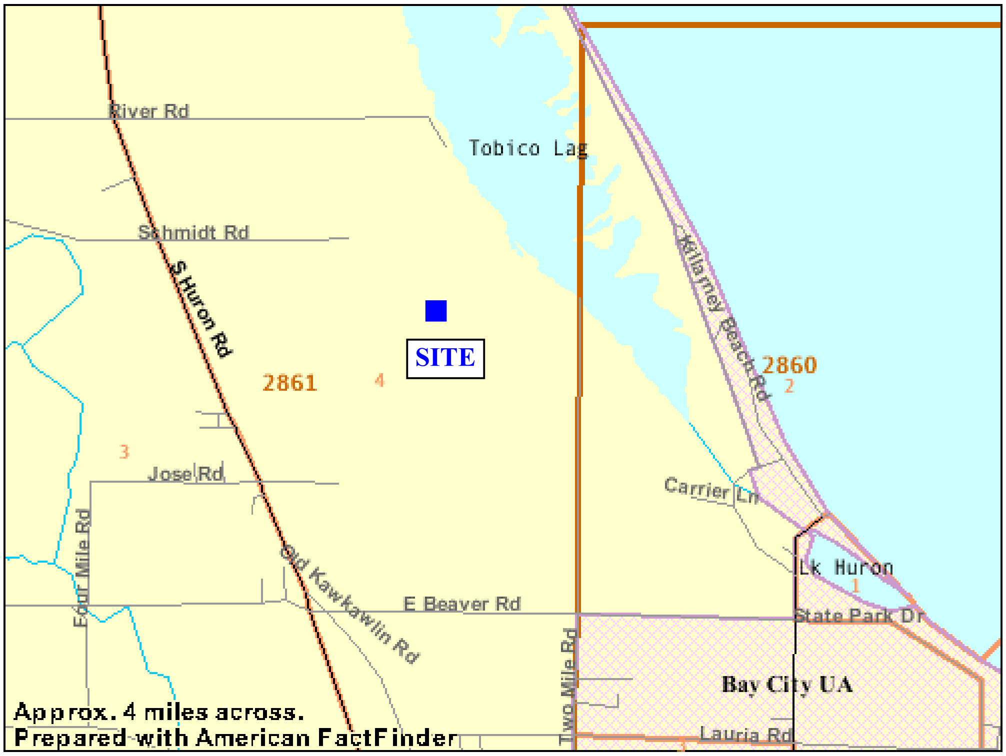

Figure 3–2 Immediate Vicinity of the Site

3.2 POPULATION DISTRIBUTION

The year-2000 population of Bay County was estimated at 111,500 individuals. The population within a 1-mile radius of the site is estimated at 750 individuals.[1] No residential properties exist within a 0.5-mile radius of the site. The population data for Bay County, Michigan, over the past five decades is presented in Table 3-2 (Bay County 2000).

The population of Bay County is projected to continue to decline over the next 20 years based on U.S. Census Bureau data. Table 3-3 presents Bay County projected future population trend (MI 2000).

The overall trend in population (past and that projected for the near future) in Bay County is graphically portrayed in Figure 3–3.

1 This estimate was conservatively derived by multiplying the number of livable structures by 5 people for each livable structure. The 2000 U.S. Census data for Bay County, Michigan indicates that the average household size is 2.47 people.

Table 3-1 Location of the Nearby Residences and Properties

POPULATION AREA/LOCATION	APPROXIMATE DISTANCE (miles)	APPROXIMATE BEARING FROM SITE (degrees)
2430 Schmidt (Schmidt Road near RR tracks)	0.50	241
2446 Schmidt (Schmidt Road)	0.60	238
Spring Valley Golf Course	0.70	196
Beaver Road	0.75	180
Spring Valley Golf Course Clubhouse	0.75	193
Highway 13	0.80	244
Industrial Complex (Highway 13)	0.80	221
Little Killarney Beach	1.25	72
Killarney Beach	1.30	45
Tobico Beach	1.50	84
Kawkawlin Township	1.80	185
Bay City State Park	1.90	113
Lagoon Beach	2.80	116
Donahue Beach	3.90	116
Bay City	5.50	158

Table 3-2 Bay County Past and Current Population

YEAR	1960	1970	1980	1990	2000
POPULATION	107,042	117,339	119,881	111,723	111,500

Table 3-3 Bay County Future Population Projections

YEAR	2000	2005	2010	2015	2020
PROJECTED POPULATION	111,500	110,700	109,400	107,700	105,800

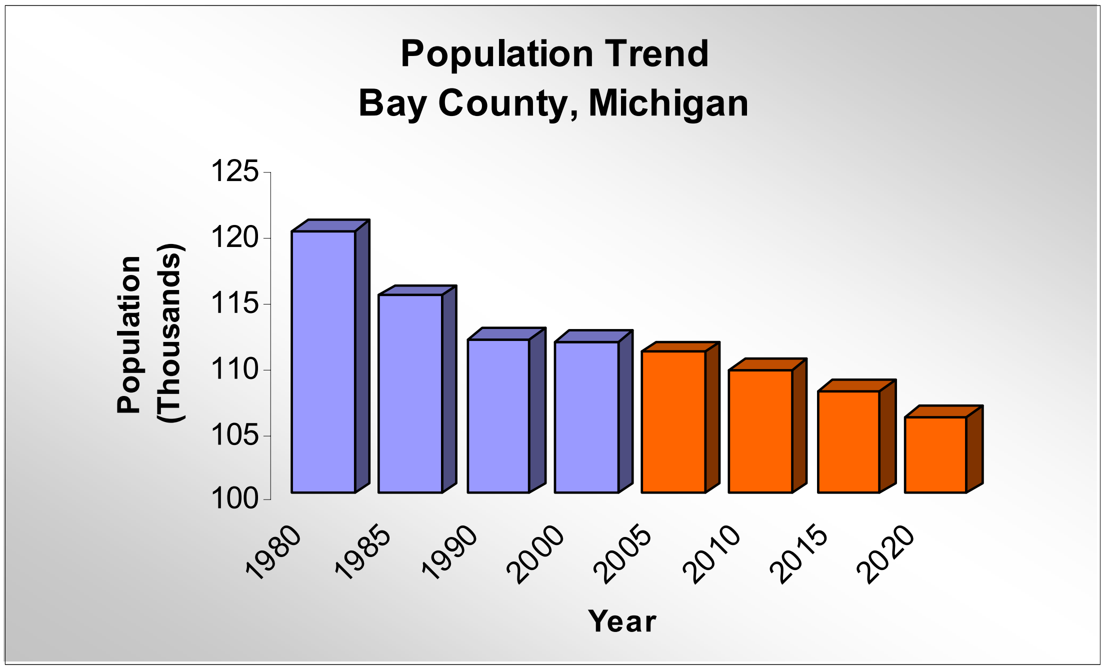

Figure 3–3 Population Trend—Bay County, Michigan

3.2.1 Minority Population Demographics

Localized demographic data tabulated by census tract and block group are useful in assessing the presence of minority or low-income populations in the immediate vicinity of the site that are significantly greater than those present in a larger regional area.

According to the U.S. Office of Management and Budget's (OMB) Directive No. 15 (OMB 1997), individuals who are Black or African American, Hispanic, Asian or Pacific Islander, American Indian, Eskimo, Aleut, or other non-white persons are identified as minorities. A geographic area is determined to have a "minority population" if either: (1) the minority population in the area is larger than 50 percent of the total population, or (2) the minority population percentage in the area under consideration is "meaningfully greater" than the minority population percentage in the general population or other appropriate larger unit of geographic analysis.

The site itself is located within (and near the eastern edge of) census tract #2861, block group #4. Blocks 2 through 5 in census tract #2861 describe the population to the west of the site. Blocks 2, 4, and 5 in tract #2862 describe the population to the immediate north of the site. Census tract #2860, with block groups 1, 2, and 3 lies to the east of the site. The southern side of the site is bounded by block groups 1, 3, and 4 of census tract #2857. The 2000 Census block groups immediately surrounding the site are mapped in Figure 3–4.

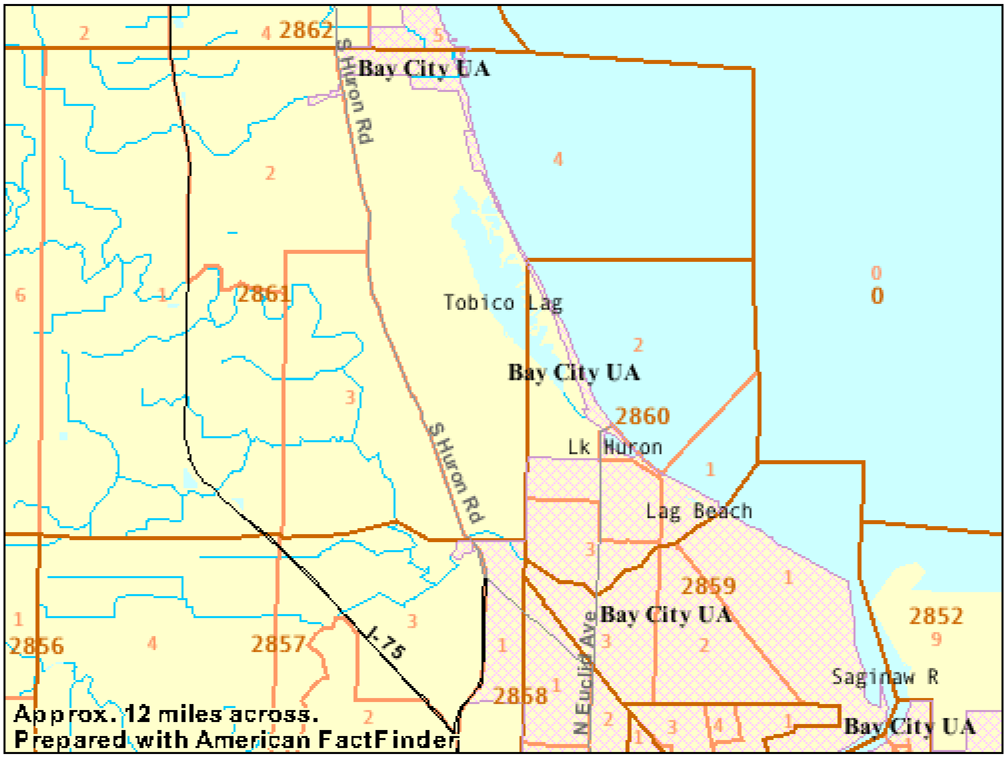

Figure 3–4 2000 U.S. Census Block Group Map for the Area in the Immediate Vicinity of the Site

According to the 2000 U.S. Census, the regional (Bay County) population is comprised of approximately 93 percent white, single race persons, while the greater Saginaw-Bay City-Midland region is comprised of approximately 85 percent white, single race persons. Table 3-4 presents the population demography for Bay County, Michigan based upon ethnicity as reported in the 2000 U.S. Census data. Inspection of Table 3-4 reveals that percentages of minority populations in both the census tract and block group geographic divisions are substantially less than the 50 percent benchmark criterion for identifying local minority populations. It is also evident from the percentage figures reported in Table 3-4, that the minority population percentages in the geographic units in the immediately vicinity of the site are not "meaningfully greater" than the minority population percentage in the two larger geographic units considered (Bay County and the greater Saginaw-Bay City-Midland area). In fact, the minority population percentage generally decreases as the geographic units consider smaller land areas near the site. From this analysis, it does not appear that a considerable minority population exists in the area potentially impacted by the site.

Table 3-4 Population Ethnicity Demographics by Region, Census Tract, and Block Group

Location	Total Population	Ethnicity by Percentage of Total Population: White	Hispanic or Latino	African American	American Indian	Asian	Hawaiian, Pacific Islander	Some Other Race	Mixed Ethnicity
Greater Saginaw-Bay City-Midland Area	403,070	84.8	4.9	10.3	0.4	0.9	0.0	1.9	1.7
Bay County, Michigan	110,157	92.7	3.9	1.2	0.5	0.5	0.0	0.0	1.2
BG 1, CT 2861	1603	96.2	1.4	0.2	0.3	0.1	0.0	0.0	1.7
BG 2, CT 2861	861	94.5	4.2	0.5	0.3	0.0	0.0	0.0	0.5
BG 3, CT 2861	913	94.9	2.5	0.0	0.5	0.4	0.0	0.1	1.5
BG 4, CT 2861	1727	94.6	2.0	0.9	0.6	0.2	0.0	0.0	1.6
BG 5, CT 2861	1257	97.5	2.1	0.0	0.2	0.2	0.0	0.0	0.1
BG 6, CT 2861	1549	98.1	1.0	0.0	0.1	0.2	0.0	0.0	0.6
BG 1, CT 2860	1077	96.3	1.8	0.0	0.3	0.1	0.0	0.0	1.6
BG 2, CT 2860	1185	98.1	1.3	0.0	0.0	0.4	0.0	0.0	0.2
BG 3, CT 2860	1557	96.6	2.1	0.3	0.3	0.5	0.0	0.0	0.3
BG 1, CT 2857	1724	95.8	2.6	0.2	0.3	0.2	0.0	0.0	0.9
BG 2, CT 2857	705	96.5	1.6	0.0	0.4	0.7	0.0	0.0	0.9
BG 3, CT 2857	534	96.4	0.9	0.6	0.6	0.2	0.0	0.0	1.3
BG 4, CT 2857	914	96.3	2.0	0.0	0.1	0.5	0.0	0.0	1.1
BG 2, CT 2862	546	96.0	0.2	2.7	0.2	0.0	0.0	0.0	0.9
BG 4, CT 2862	1008	94.9	1.5	0.7	0.5	0.8	0.0	0.0	1.6
BG 5, CT 2862	959	97.2	1.6	0.0	0.4	0.3	0.0	0.0	0.5
Source: U.S. Census Bureau, 2000 Census Data, http://factfinder.census.gov									

3.2.2 Low-Income Population Demographics

Low-income populations are identified as those communities within the region for which the percent of the population living in poverty exceeds 25 percent (Michigan State University Extension – Bay County). According to the 2000 Census Block Group estimates (which measure economic parameters based upon income for the calendar year 1999), about 9.7 percent of the regional population (Bay County, MI) is at or below the poverty level. A broader regional survey (2000 U.S. Census Supplementary Survey) covering the greater Saginaw–Bay City–Midland area estimates that approximately 12 percent of the population lives at or below the poverty level. U.S. Census Bureau calculations estimate the upper and lower bounds of this estimate to be between 8.9 and 15.1 percent respectively. Comparisons of the regional poverty statistics with those from the 2000 census block groups in the immediate vicinity of the site are presented in Table 3-5. No localized population (as demarcated by census block group) in the immediate vicinity of the site exceeds the low-income population threshold (more than 25 percent earning at or below the poverty level).

Table 3-5 Comparison of Poverty Level Statistics by Region and Block Group

Location	Population	Population Below Poverty Level	Percentage Below Poverty Level
Greater Midland, Bay City, Saginaw Region	~390,000	46,751	12.0%
Bay County, Michigan	108,881	10,605	9.7%
Block Group 1, Census Tract 2861	1764	62	3.5%
Block Group 2, Census Tract 2861	930	26	2.8%
Block Group 3, Census Tract 2861	747	72	9.6%
Block Group 4, Census Tract 2861	1591	89	5.6%
Block Group 5, Census Tract 2861	1250	46	3.7%
Block Group 6, Census Tract 2861	1550	105	6.8%
Block Group 1, Census Tract 2860	1085	77	7.1%
Block Group 2, Census Tract 2860	1160	49	4.2%
Block Group 3, Census Tract 2860	1525	43	2.8%
Block Group 1, Census Tract 2857	1727	130	7.5%
Block Group 2, Census Tract 2857	735	52	7.1%
Block Group 3, Census Tract 2857	524	32	6.1%
Block Group 4, Census Tract 2857	891	70	7.9%
Block Group 2, Census Tract 2862	524	25	4.8%
Block Group 4, Census Tract 2862	1026	107	10.4%
Block Group 5, Census Tract 2862	977	86	8.8%
Source: U.S. Census Bureau, 2000 Census Data, http://factfinder.census.gov			

All but one block census group population in the immediate vicinity of the site have a poverty rate lower than the county poverty rate, and none exceed the rate for the broader region described.[2] A graphic portrayal of the geographic trend in low-income demographics is presented in Figure 3–5.

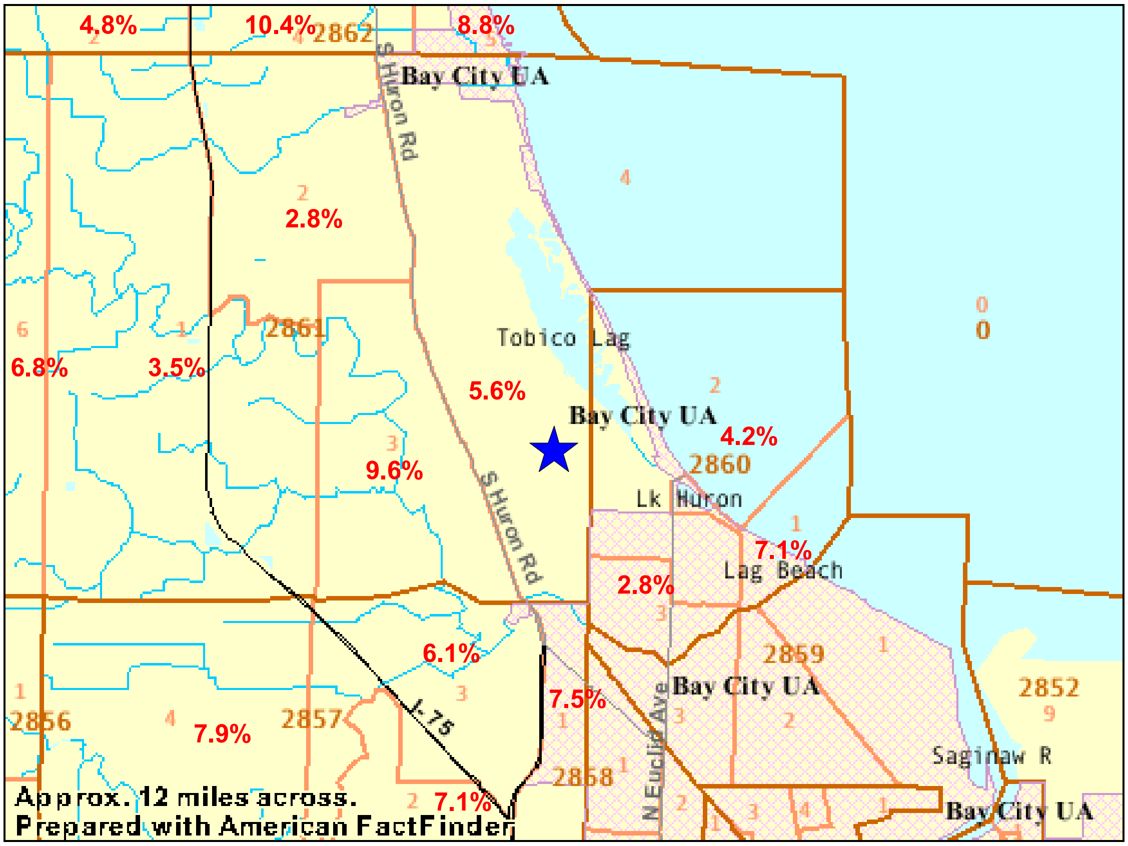

Figure 3–5 Households with Median Income Below the Poverty Level By Block Group

3.3 CURRENT/FUTURE LAND USE

Bay County is predominately rural but has an urban center (Bay City) near its southern end. Nearly half of the land use is agricultural, principally producing potatoes, sugar beets, beans, corn, and wheat. Pinconning, to the north of the site, is known for cheese, while Bay City is home to manufacturers of automotive parts, petroleum, cement, chemicals, beet sugar, and heavy machinery. While a significant portion of the land area of the county is agricultural land, the economy relies most heavily on the manufacturing, services, retail, and government sectors (See Figure 3–6). Approximately 1 percent of workers are employed in agricultural occupations (BOC 2000). There are several tracts of public land along Saginaw Bay including: Pinconning and Bay City State Parks, Quanicassee and Nayanquing Point Wildlife Areas, and Tobico Marsh State Game Area. The site lies completely within the Tobico Marsh State Game Area.

2 Caution should be exercised in making direct comparisons of poverty rates computed for a block group because the sample size for a block group is relatively small resulting in larger margins of error.

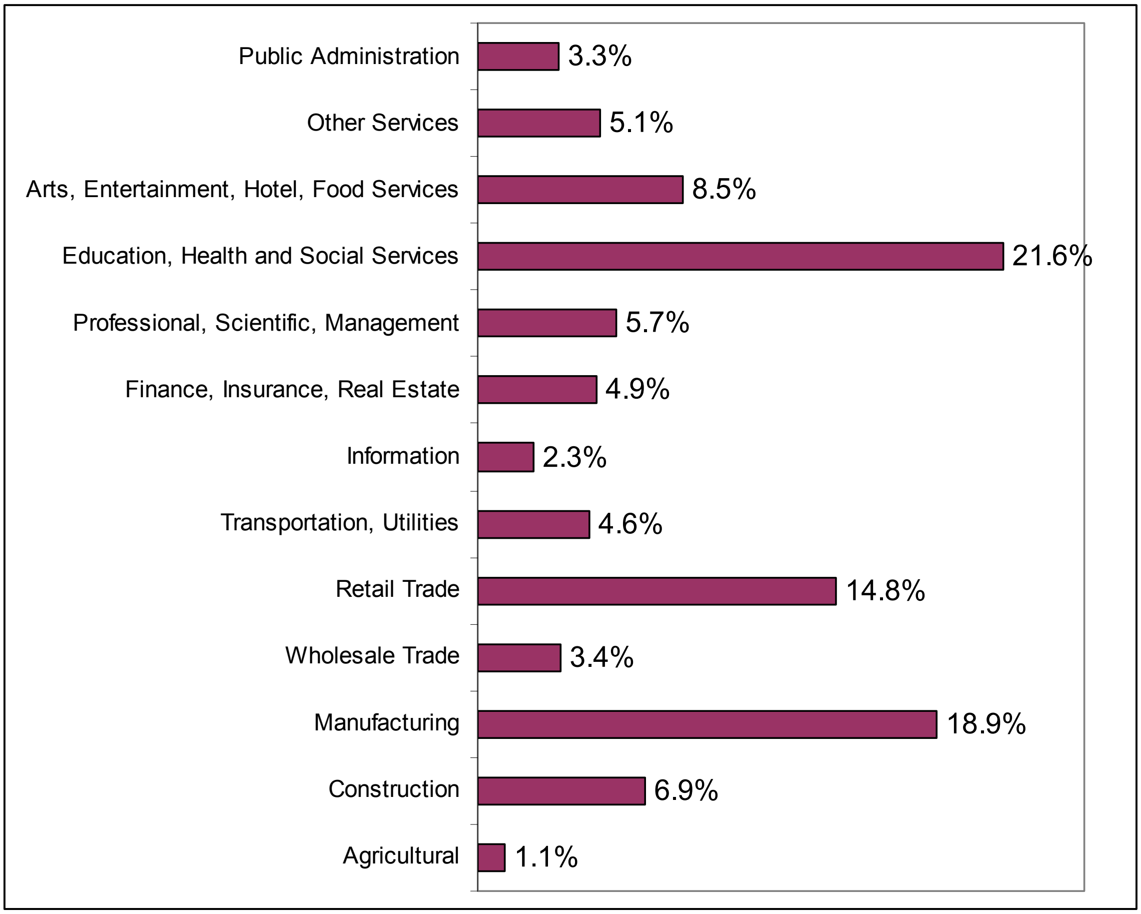

Figure 3–6 Employment by Industry in Bay County, Michigan in 2000

The site is currently fenced and posted to preclude unauthorized access. The land use in the surrounding Tobico Marsh SGA land is best described as seasonal/recreational. Activities commonly engaged in by land users include hunting, fishing, and naturalist activities.

Population growth is a key element in assessing the potential for changes in land use patterns and increasing development. The population in Bay County has been steadily decreasing over the past 20 years with a corresponding increase in the amount of farmland lying fallow. Economic and agricultural statistics for the region show a decreasing trend in the importance of agricultural land uses. The U.S. Census Bureau and State statistical resources project that the population of Bay County as well as that of the greater Saginaw–Bay City–Midland metropolitan area will continue to decrease over the next 20 years (BOC 2000, MI 1996). In spite of these trends, it cannot be ruled out that some development in the vicinity of the site might occur. However, there is little reason to believe that an increased demand for agricultural land will result in further agricultural land development in the vicinity of the site and certainly not within the land area where the site is located. There may be some commercial and residential development along the major highway corridors, but there is no realistic expectation that development might occur along the stretch of Beaver Road to the south and east of the site. This is due to a variety of factors, such as wetlands in the area and public land (established State game and recreation areas). Many of the commercial properties in the immediate area cater to and depend upon tourism.

The site itself is anticipated to retain its current land use as a closed, MDNR-owned, industrial waste-disposal site. In the absence of fencing and posting, the land use at the site is anticipated to be consistent with the current designated recreational land uses in the publicly accessible portions of the Tobico Marsh State Game Area. It is further anticipated that the public recreational land designation for the Tobico Marsh SGA will remain in place indefinitely into the future. In fact, the State of Michigan has recently consolidated a number of designated public lands in the vicinity of the site (including the Tobico Marsh SGA) into an expanded Bay City Recreation Area (www.michigandnr.com/parksandtrails) further solidifying the publicly owned, recreational land-use future for the site.

3.4 METEOROLOGY AND CLIMATOLOGY

The site is located in southeastern Bay County near the southwestern edge of Saginaw Bay and north of Bay City, Michigan. The Saginaw River flows along the west side of downtown Bay City and the northwest side of Essexville, and then empties into Saginaw Bay. Saginaw Bay is part of Lake Huron. Meteorological and climatic information presented in this section has been compiled from Federal and State historical weather data bases covering approximately 30-year periods (extending from 1951 to 1980 or 1961 to 1990, depending upon the data source) (http://climate.geo.msu.edu).

The effect of Lake Huron on the Bay City area's climate is most influential during periods of northeasterly winds. Under these conditions, the Bay City area receives cooler summer temperatures, while increased snow activity may accompany milder fall and early winter temperatures.

3.4.1 General Meteorology and Climatology

Summers are generally considered moderately warm with the warmest period usually occurring in July with the mean daily temperature averaging 71.5 °F. Winters are generally considered moderately cold with the coldest period usually occurring in January when average daily temperatures is 21.6 °F. Precipitation amounts (Figure 3–7) and the daily chance of precipitation are usually well distributed throughout the year (Figure 3–8). The "crop season", April through September, receives an average of 16.4 inches, or 59 percent of the average annual precipitation. The wettest month, on average, is August (2.93 inches), while the driest month, on average, is February (1.18 inches). Summer precipitation comes mainly in the form of afternoon showers and thundershowers. Local site conditions are similar to overall regional conditions. Since the site is situated in an open area with no trees or buildings to act as windbreaks, it is prone to being slightly colder in the winter months. In addition, the site is slightly warmer in the summer months from lack of shade.

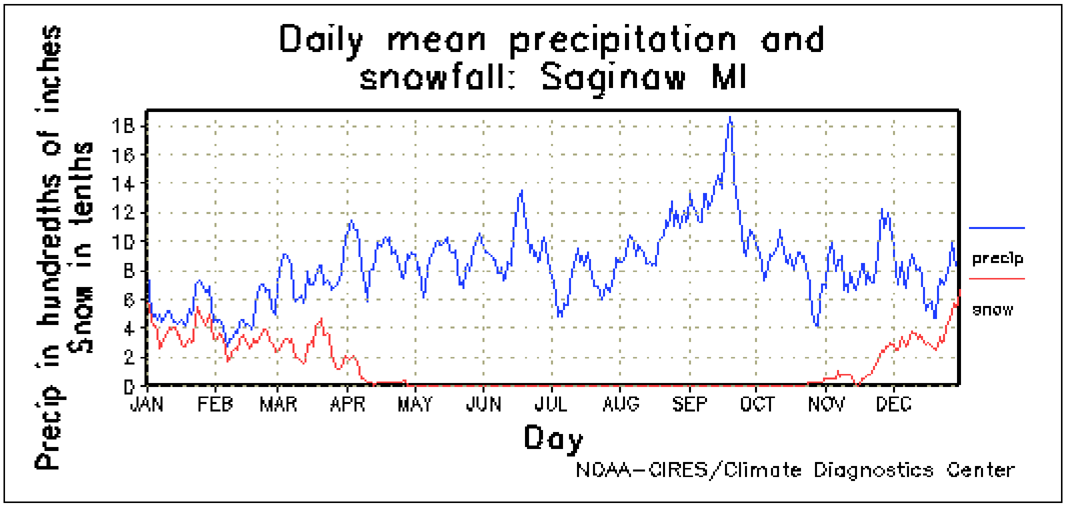

Figure 3–7 Mean Precipitation Amounts–Time Series

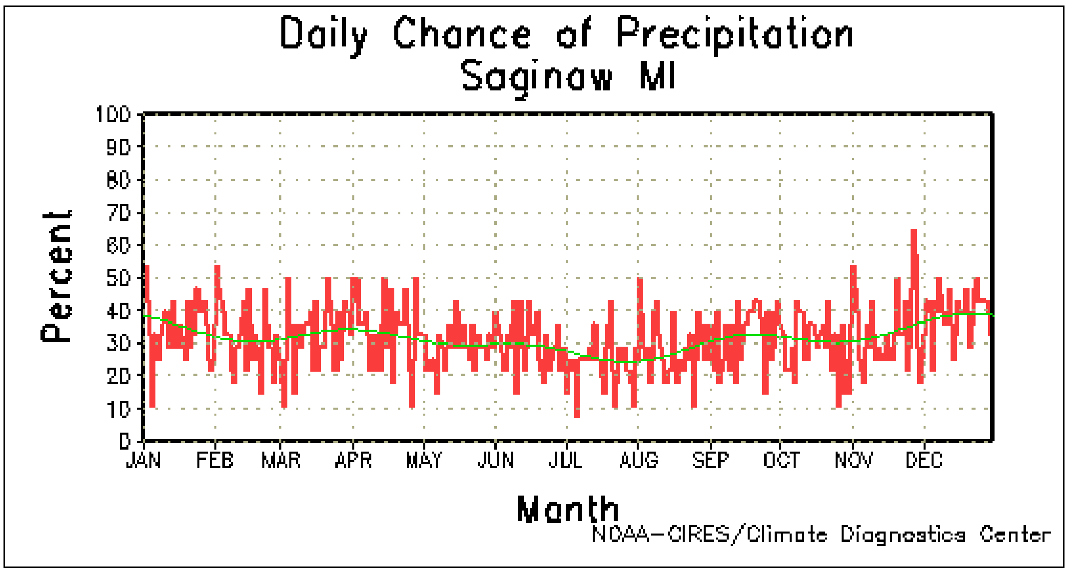

Figure 3–8 Mean Chance for Precipitation–Time Series

Annual snowfall (occurring in November through April) for the 30-year period averages 38.8 inches. January typically has the greatest monthly snowfall, averaging 11.3 inches. The average date for the last freezing temperature is May 1, while the average date of the first freezing is October 17. The freeze-free period, or growing season, averages 167.9 days annually. Table 3-6 presents the 30-year monthly average temperature ranges and precipitation levels.

Table 3-6 30-Year Monthly Average Temperature and Precipitation for Bay County

MONTH	HIGH TEMP (°F)	LOW TEMP (°F)	MEAN TEMP (°F)	PRECIPITATION (Inches)	SNOWFALL (Inches)
January	28.6	14.6	21.6	1.51	11.3
February	31.1	15.6	23.4	1.18	7.9
March	40.4	24.6	32.5	2.15	6.0
April	55.5	36.2	45.9	2.62	1.3
May	67.9	46.4	57.2	2.62	0.0
June	78.0	56.5	67.3	2.87	0.0
July	82.0	60.9	71.5	2.58	0.0
August	79.9	59.2	69.6	2.93	0.0
September	72.1	52.0	62.1	2.78	0.0
October	60.5	41.8	51.2	2.57	0.2
November	46.2	31.8	39.0	2.28	3.1
December	33.6	20.7	27.2	1.83	9.0

Wind conditions at the site are typically mild with winds trending from the south and west and blowing to the north and east. A cumulative average wind rose plot using data from the Saginaw MBS Airport meteorological station (Station #72639) collected over a 5-year the period, from 1987 to 1991, is presented in Figure 3–9 (Lakes 1998). The average wind speed is calculated to be approximately 4.2 meters per second (9.35 mph) with calm winds reported approximately 7 percent of the time.

3.4.2 Extreme Meteorology and Climatology

This area seldom experiences prolonged periods of hot, humid weather in the summer or extreme cold during the winter. The highest average monthly maximum temperature in the 30-year period between 1951 and 1980 was 89.1°F in July 1955, and the lowest average monthly minimum temperature was 4.6°F in January 1977. On average, temperatures in excess of 90ºF occur only 10 days annually, and only 1 day in the 30-year period exceeded 100ºF. For the 30-year period, the high and low temperatures are listed in Table 3-7.

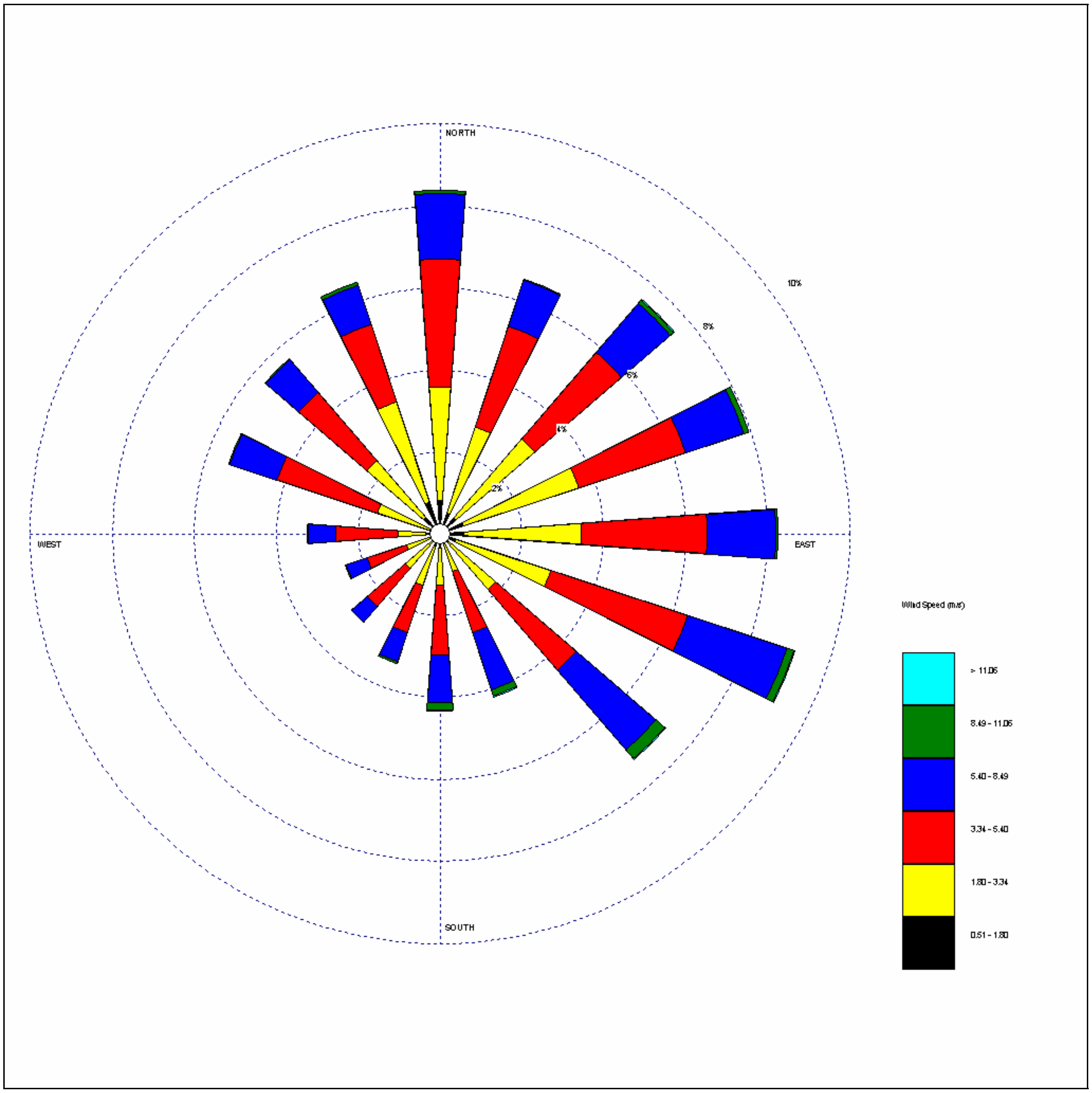

Figure 3–9   Wind Rose Diagram, Five Year Average (1987-1991)

Annually, thunderstorms occur on an average of 33 days. While drought occurs periodically, the Palmer Drought Index indicates drought conditions rarely reach extreme severity, historically occurring only 3-percent of the time. The largest single snowfall total, 24.0 inches, was recorded in January 1914. The greatest total monthly snowfall on record, 42.5 inches, occurred in December 1929. The greatest seasonal snowfall was 85.8 inches, recorded during the winter of 1911-1912. The smallest seasonal snowfall total was 7.3 inches, recorded during the winter of 1931-1932. The greatest snow depth was recorded in January 1979 at 25 inches. For the 30-year period, the severe weather maximum precipitation (by month) is presented in Table 3-8.

Table 3-7 Severe Weather Phenomena 30-Year High and Low Temperatures

MONTH	HIGH (°F)	YEAR	LOW (°F)	YEAR
January	62	1966	-14	1977+
February	58	1976	-15	1979
March	78	1963	-9	1962
April	85	1980+	12	1954
May	93	1977+	22	1966
June	99	1971+	36	1971
July	98	1977+	41	1965
August	100	1955	37	1971
September	98	1953	28	1976
October	87	1951	17	1976
November	76	1978	-6	1977
December	68	1971	-9	1951
+ indicates the last (of more than one) occurrence of the minimum or maximum temperature within the 30-year evaluation period.				

Monthly mean weather-related extremes are plotted in time series in Figure 3–10 for the 30-year period beginning in 1961. The same time-series data are normalized to the corresponding mean extreme value over the 30-year period and presented in high/low bar graphs in Figure 3–11 to portray the relative variability in the extreme weather data and to identify anomalies.

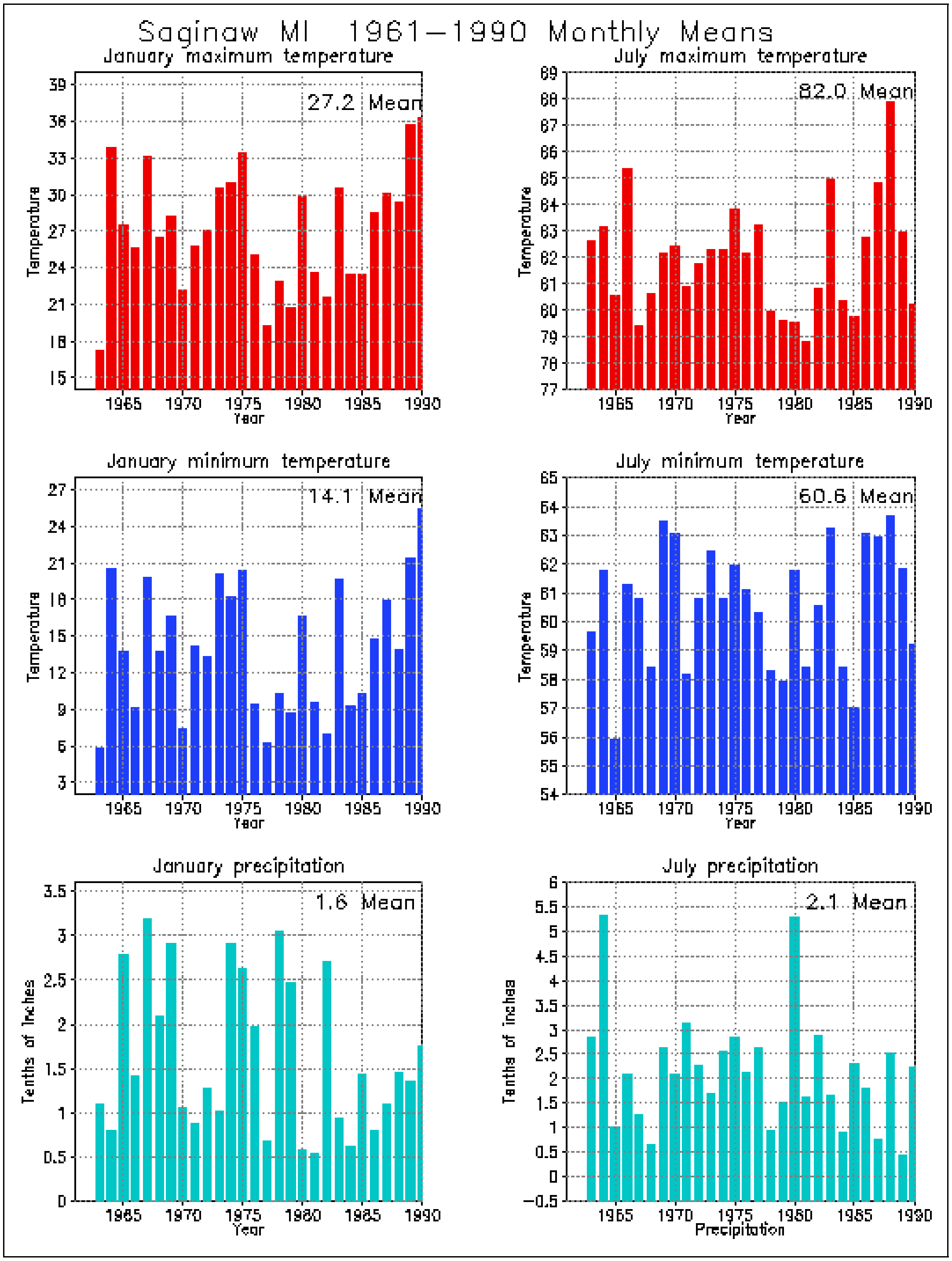

Figure 3–10 30-Year Time-Series Plots of Weather Extremes

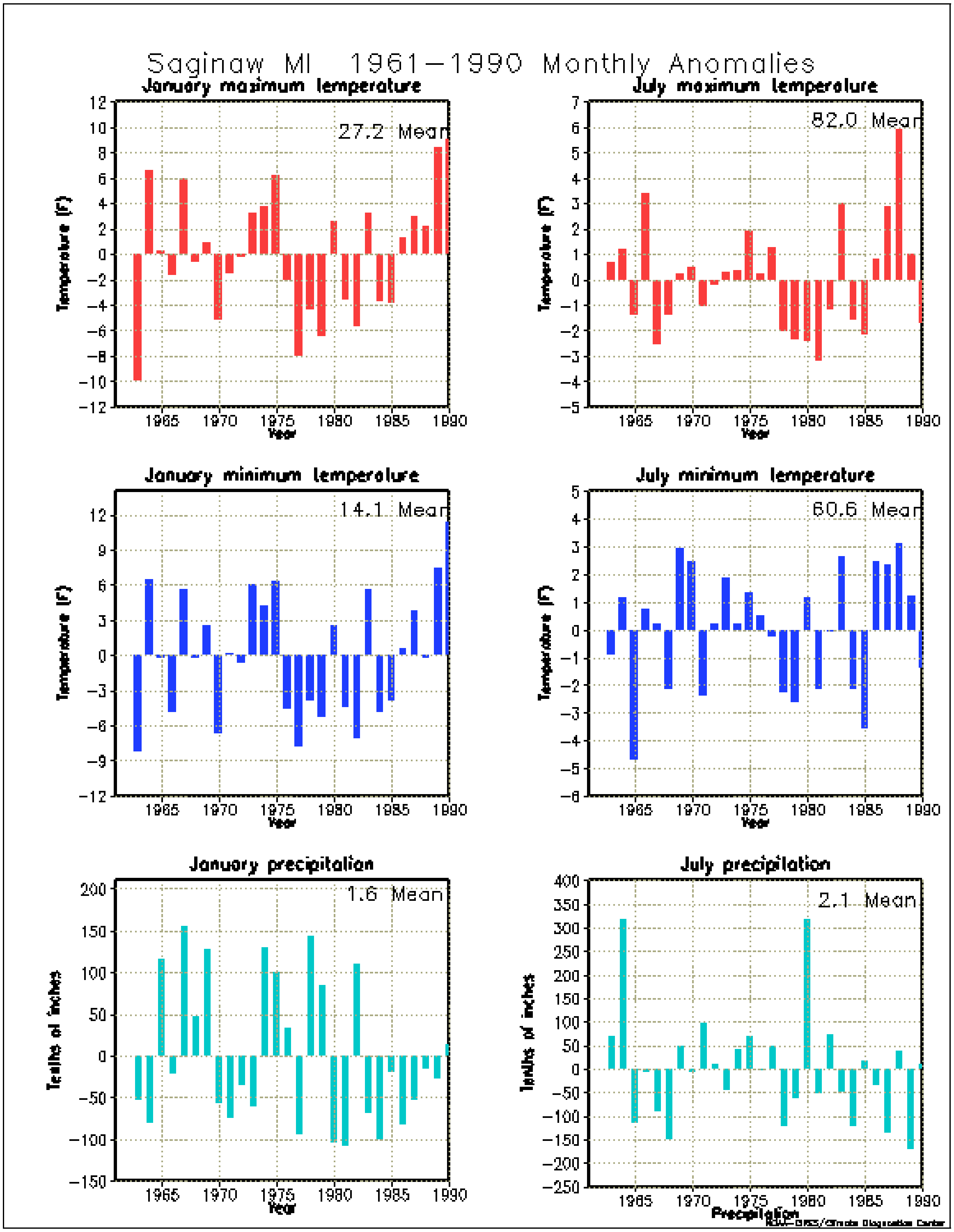

Figure 3–11 30-Year Time-Series Plots —Monthly Anomalies

Table 3-8 Severe Weather Phenomena, 30-Year Maximum Precipitations

MONTH	MAX RAINFALL (inches, year)	MAX. SNOWFALL (inches, year)	MAX. DAILY SNOW AMOUNT (inches, year)	MAX. TOTAL SNOW DEPTH (inches, year)
JANUARY	2.02, 1974	29.0, 1979	12.0, 1967	25, 1979
FEBRUARY	1.28, 1974	19.5, 1956	6.7, 1962	21, 1959
MARCH	4.35, 1973	14.7, 1965	11.0, 1968	13, 1978
APRIL	2.31, 1967	13.0, 1975	9.0, 1970	12, 1975
MAY	2.17, 1978	Trace, 1961+	Trace, 1961+	Trace, 1957
JUNE	2.95, 1973	0.0	0.0	0
JULY	2.81, 1980	0.0	0.0	0
AUGUST	2.50, 1951	0.0	0.0	0
SEPTEMBER	2.20, 1957	0.0	0.0	0
OCTOBER	2.90, 1954	3.5, 1967	3.5, 1967	3, 1967
NOVEMBER	1.62, 1965	17.9, 1951	8.0, 1951	4, 1977+
DECEMBER	1.69, 1979	21.0, 1951	8.0, 1957+	12, 1962
+ indicates the last (of more than one) occurrence of the minimum or maximum temperature within the 30-year evaluation period.				

Michigan is located on the northeastern fringe of the Midwest "tornado belt." This results in a relatively low frequency of occurrence for tornadoes in Michigan. When tornadoes or funnel clouds are reported, they are typically category F0 or F1, with little or no property damage reported.

3.4.3 Ambient Air Quality

The ambient air quality of the entire State of Michigan is in attainment for each of the five "criteria" pollutants as described by the National Ambient Air Quality Standards (NAAQS) (MDEQ 2000). In addition to the ambient air quality standards for so-called criteria pollutants, the federal government has categorically designated 156 national parks and wilderness areas as Class 1 areas (Figure 3–12) subject to enhanced air quality protection guidelines. Some American Indian tribal governments have also designated lands under their jurisdiction as Class 1 areas (Figure 3–13). The site is not located in a Class 1 Area as designated by Federal or tribal governments. The closest Class 1 Area to the site is the Seney Wilderness Area, located 200 miles to the north in the Upper Peninsula of Michigan. The first downwind Class 1 Area is the Lye Brook Wilderness Area, located approximately 550 miles to the east in the State of Vermont.

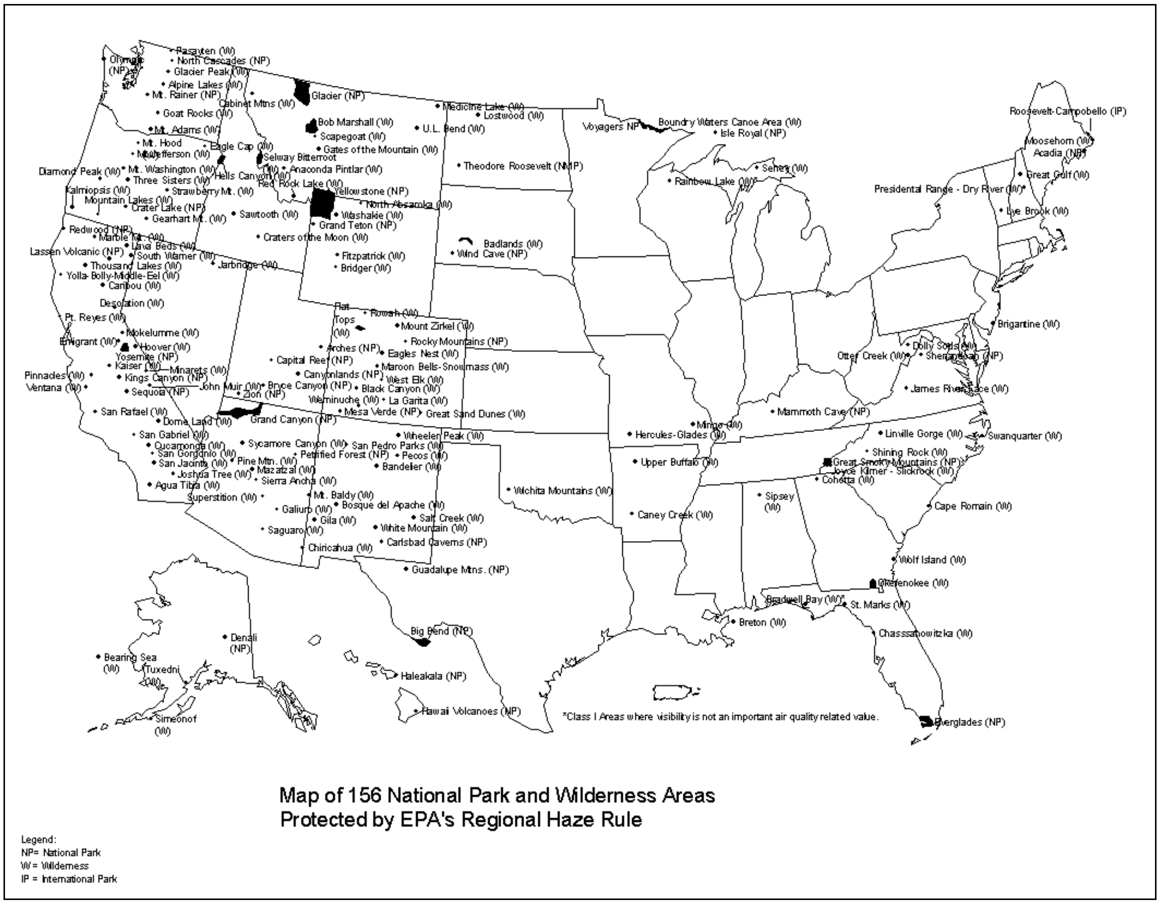

Figure 3–12 Federally Designated Class 1 Areas

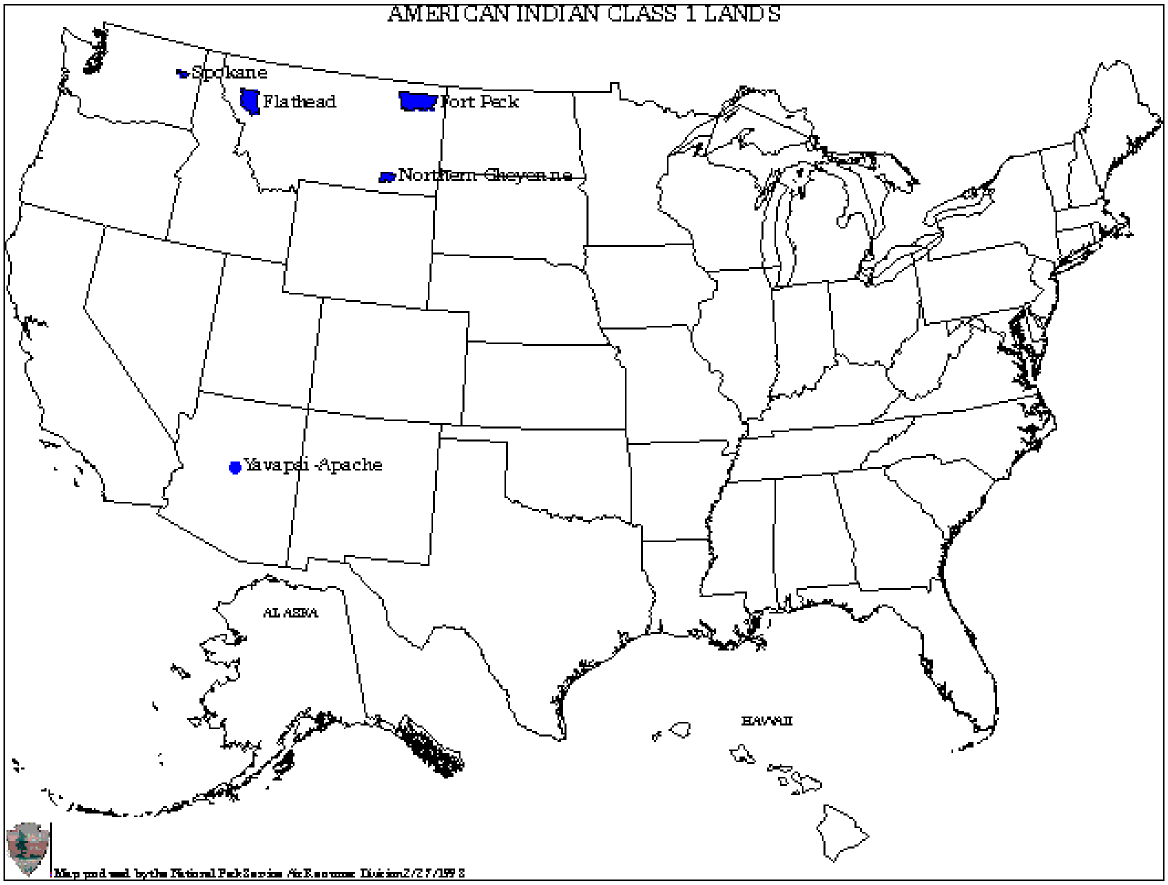

Figure 3–13 Lands Designated Class 1 Areas by American Indian Tribal Governments

3.5 GEOLOGY AND SEISMOLOGY

Glacial till underlies the entire site, and is composed of clay with silt, medium- to fine-grained sands, and trace amounts of gravel. The till was encountered at depths as shallow as 3 feet beneath the surface of the landfill cap. The lacustrine (fresh-water lake) deposits consist of silts and clays, little coarse- to fine-grained sands, and trace amounts of gravel. There is also some organic material (plant roots, wood chips) in the deposits.

The surface and near-surface soil in the area immediately surrounding the site, as defined by the United States Department of Agriculture – Soil Conservation Service and Michigan Agricultural Experiment Station Soil Survey of Bay County, Michigan, is Belleville loamy sand, ponded (#67 on Figure 3–14). Belleville loamy sand is described as nearly level, poorly drained soil. It is covered with 6 to 36-plus inches of water throughout most of the year. Typically, the surface layer is very dark gray, loamy sand about 11 inches thick. The subsoil is grayish-brown, loose sand about 25 inches thick. The substratum is multi-colored clay loam and other loams about 60 inches thick (Soil Survey of Bay County). Permeability is rapid in the sandy uppermost part of the soil and moderately slow in the loamy lower part. In most areas, the soil is submerged under water and covered in marsh vegetation.

Former beach-sand deposits overlie the till and consist of fine- to medium-grained quartz sand, approximately 5 to 8 feet thick in the footprint of the cell. Thin peat laminations are encountered sporadically in the sand deposits. Highly organic, soft topsoil, approximately 2 inches thick, has formed on the surface of the site.

The geology of the Reference Area is generally the same as that found at the site. The glacial till is encountered approximately 7 to 8 feet below ground surface (bgs). The overlying former beach-sand deposits are approximately 4 to 6 feet thick. A thin gravel layer was encountered approximately 4.5 feet bgs. Highly organic, soft topsoil is found on the surface of the site.

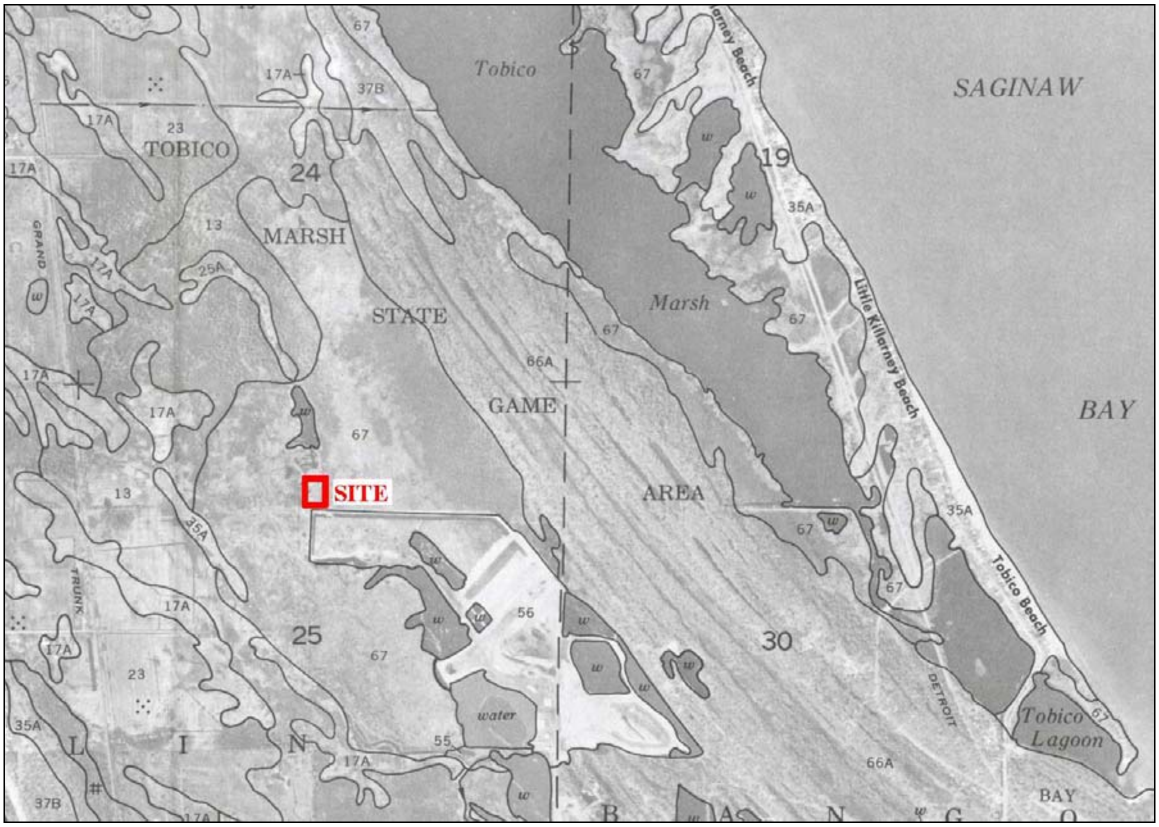

Figure 3–14 Soil Survey Map

3.5.1 Geotechnical Parameters

Two soil samples, collected south of the pond (north of the site) and near the southeastern gate, were submitted to Materials Testing Consultants, Inc. (MTC) in Grand Rapids, Michigan. Undisturbed soil samples consisted of one clay sample and one sand sample. The clay sample was analyzed using ASTM Standard Method D5084 (ASTM 1997), which measures the hydraulic conductivity of saturated porous materials. The sand sample was analyzed using ASTM Standard Method D2434 ("Constant-Head Test, ASTM 2000), which measures the hydraulic conductivity on granular soils. Hydraulic conductivity results for soils are presented in Table 3-9 (Cabrera 2001).

Table 3-9 Hydraulic Conductivity Results

Type of Sample	Dry Unit Weight	Water Content	Coefficient of Permeability
Clay	123.2 PCF	13.5 %	5.4×10^{-8} cm/s
Sand	102.9 PCF	14.7 %	6.4×10^{-3} cm/s
PCF = pounds per cubic foot			

3.5.2 Seismology Parameters

Michigan's bedrock geology is defined by a "bowl-shape" structure known as the Michigan Basin. This basin contains inward-dipping lithified strata. Michigan is located in the tectonically less-active interior of the United States continent, between the Appalachian Mountains and the Rocky Mountains. The site is classified as a seismic Zone 0 in the unified building code, indicating the lowest design criteria necessary for new construction. The seismicity of the site and region is considered very low. Seismic activity is very infrequent due to the stability of the regional geology. The site is in a geological region called the Central Stable Region.

Seismic activity is uncommon in the Michigan Basin. Earthquakes within 200 miles of the site of a magnitude (Richter scale) of 3 or greater, within the last 100 years, are listed in Table 3–10.

Table 3-10 Seismic Activity Greater Than Magnitude 3

Location	Month Day, Year	Latitude & Longitude of Epicenter	Time of Event (Hr Min Sec)	Class	Magnitude (Richter Scale)
Gibralter, MI	Mar 13, 1938	42.08, 83.17	16 09	V	3.8
Gibralter, MI	Mar 14, 1938	42.08, 83.17	16 40	III	--
Lake Erie, OH	Mar 09, 1943	41.628, 81.309	03 25 24.9	V	4.5
Coldwater, MI	Aug 10, 1947	41.928, 85.004	02 46 41.3	VI	4.7
Pt. Pelee, ON	Feb 02, 1976	41.96, 82.67	21 14 02.0	IV	3.4
Harrow, ON	Aug 20, 1980	41.87, 82.99	09 34 53.4	IV	3.2
Central Michigan	Sep 02, 1994	42.57, 84.64	21 23 10	V	3.4

The Michigan Basin is an example of an intracratonic basin. The main deformational events in this central stable region took place during the Precambrian Era, and basins were formed in some areas in the stable interior. These basins accumulated cratonic sediments and are relatively stable geologic environments. There are no known or inferred faults in the site or vicinity (Dorr and Eschman, 1996, Geology of Michigan). The crust underlying the Great Lakes Basin continues to uplift through a process known as isostatic rebound resulting from glacial retreat.

Karst terrain is not a common feature associated with the geomorphology and structural geology of Michigan. The Alpena area of Michigan, located approximately 100 miles to the north of the site, is the only prominent karst topography in the lower peninsula of Michigan. Karst features in the Alpena area are sinkholes.

Figure 3–15 shows the site location and its proximity to tectonic structures.

Landslides are an uncommon phenomenon in Michigan, because the lack of topographic relief is generally not conducive to their occurrence. Infrequent landslides do occur along the eastern shoreline of Lake Michigan approximately 150 miles west of the site. These landslides are the result of shoreline erosion. There are no known or inferred bedrock faults in the immediate vicinity of the site. Human-altered features at the site, or in the vicinity of the site, are sand pits located approximately 0.5 miles to the southeast of the site.

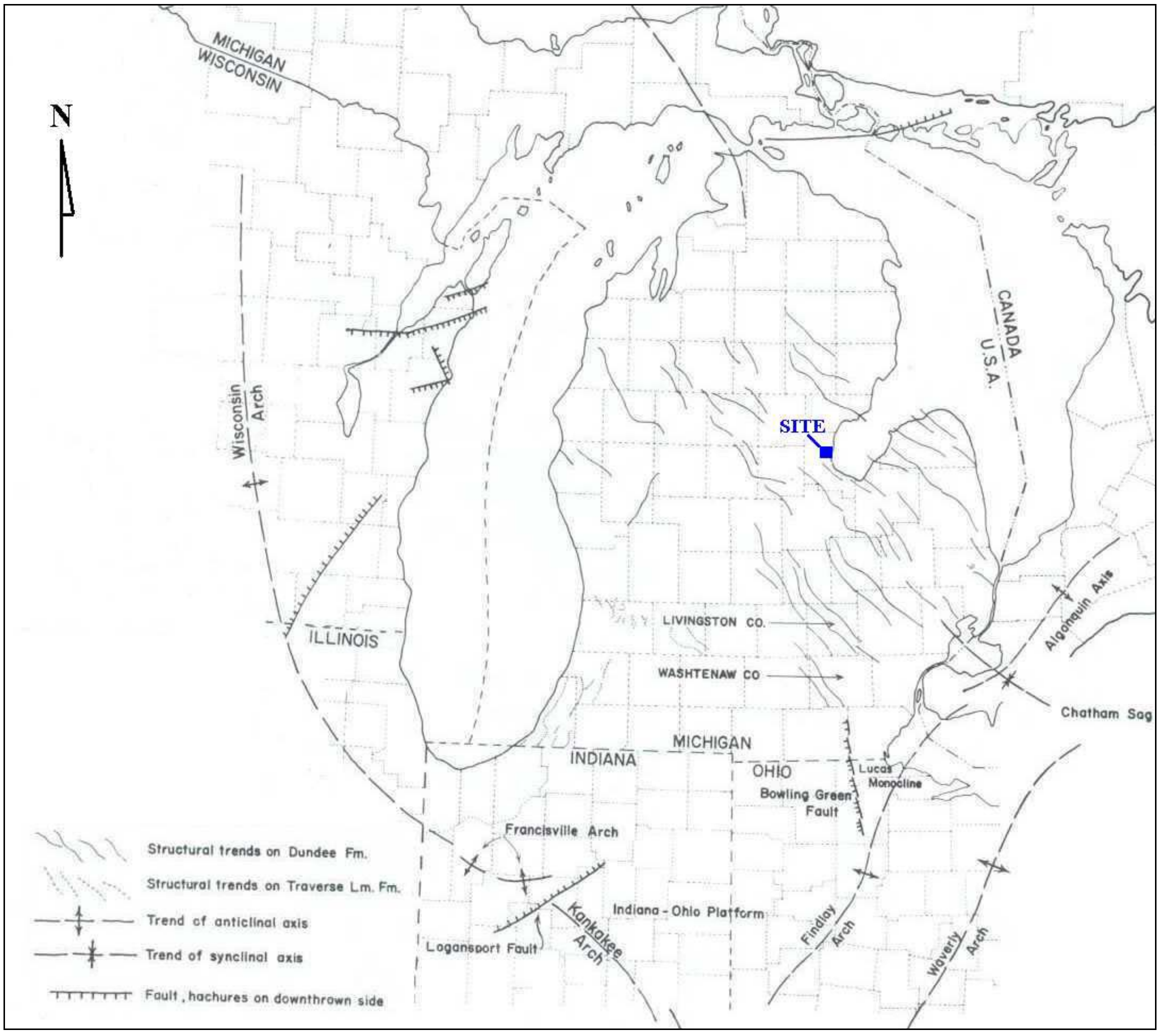

Figure 3–15 Michigan Basin and Surrounding Structural Elements (MBGS, 1969)

3.6 SURFACE-WATER HYDROLOGY

The site is situated in the Tobico Marsh State Game Area. The area is a federally and state-regulated wetland adjacent to the Saginaw Bay, which is part of Lake Huron. Saginaw Bay is approximately 1.5 miles east of the site. The Kawkawlin River is approximately 1.75 miles south of the site with its North Branch tributary approximately

3 miles west of the site. Surface-water bodies in the surrounding area near the site include Saginaw Bay and Lake Huron. Water bodies adjacent to the site include ponded waters to the north and southeast. Wetlands surround the site to the north, east and west.

3.6.1 Lake Huron Water Resource Data

Water-level measurements from the Great Lakes Region have been recorded since at least the beginning of the 1900s. Lake Michigan-Lake Huron water level data recorded from 1918 to 2000 has been summarized in a hydrograph (Figure 3–16). Water levels have ranged between a high of 177.4 meters (1986) and a low of 175.6 meters (1964) above mean sea level (msl).

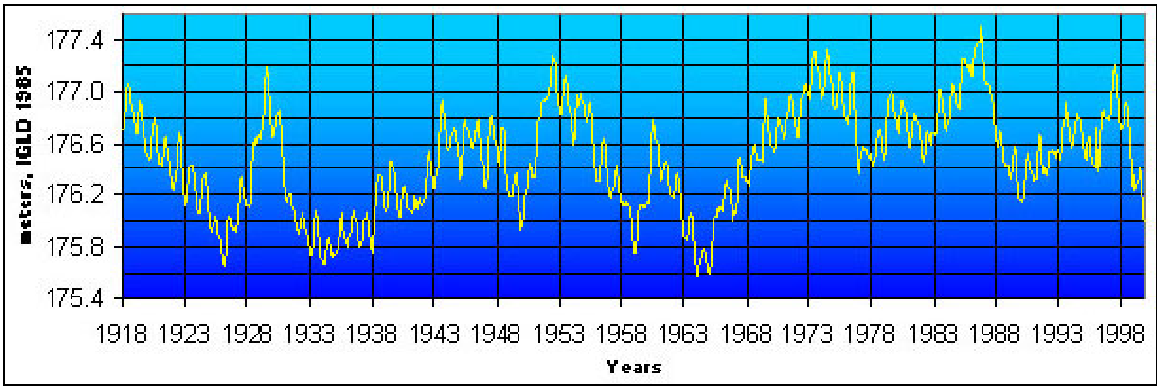

Figure 3–16 Lake Huron Hydrograph (USACE – Detroit District)

Lake Huron Physical Characteristics:

Low Water Datum (LWD):	175.81 m
Length:	331.52 km
Breadth:	294.51 km
Shoreline Length:	5,117.70 km
Total Surface Area:	59,569.43 km^2
Surface Area in U.S.:	23,568.77 km^2
Volume at LWD:	3,538.76 km^3
Average Depth Below LWD:	59.44 m
Maximum Depth Below LWD:	228.60 m
Average Surface Elevation (IGLD):	176.38 m
Maximum Surface Elevation (IGLD):	177.38 m
Minimum Surface Elevation (IGLD):	175.37 m

Natural drainage patterns for the site are directed eastward towards Saginaw Bay, which is part of Lake Huron. The topographic relief of the area (Figure 3–17) shows this drainage pattern.

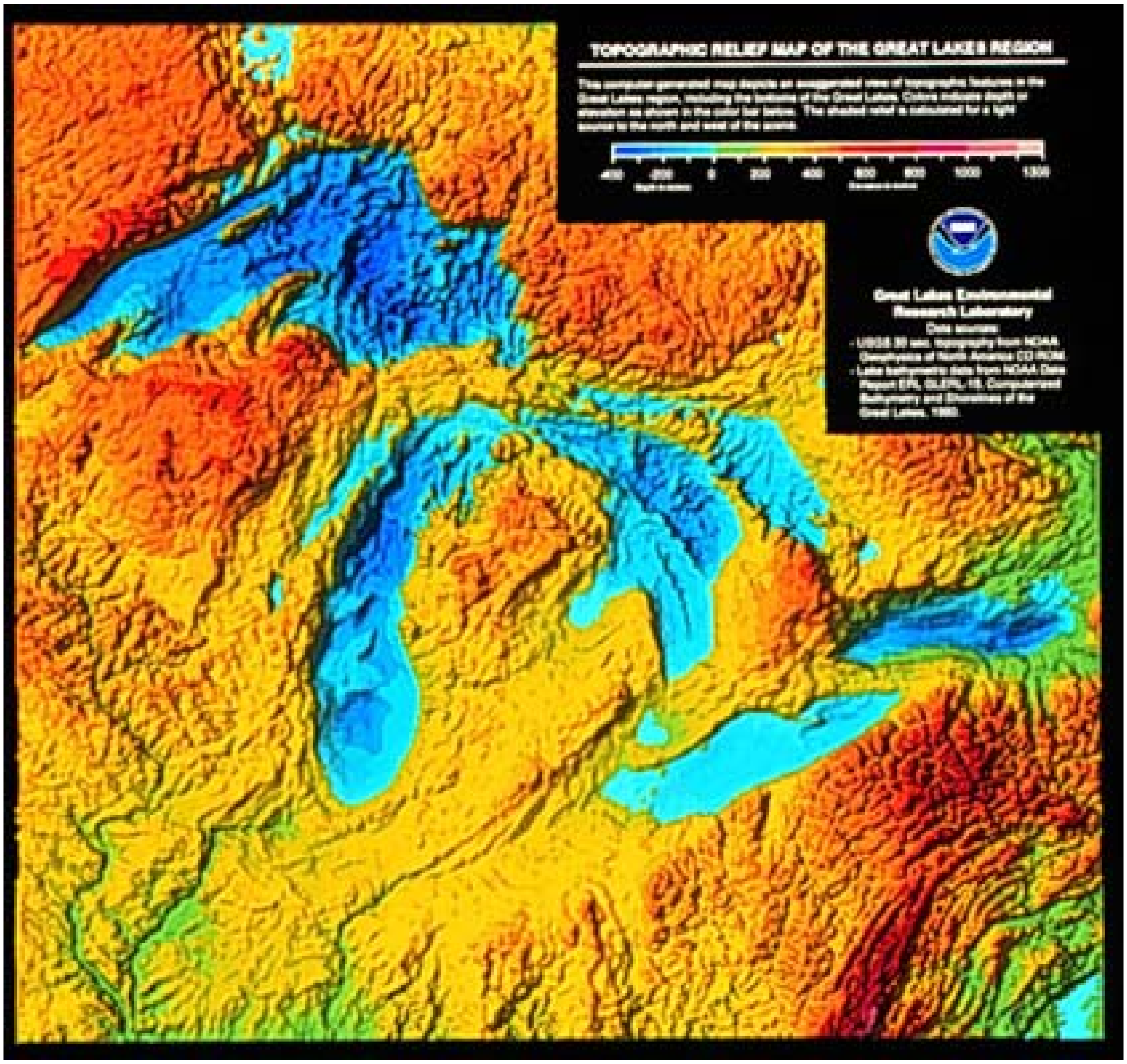

Figure 3–17 Great Lakes Region Topographic Map (NOAA-GLERL)

The Great Lakes Drainage Basin Area consists of Michigan, northern Ohio, northern Indiana, the northeastern corner of Illinois, eastern Wisconsin, northeastern Minnesota, portions of southern Ontario (Canada), northwestern New York, and the northwestern tip of Pennsylvania (Figure 3–18).

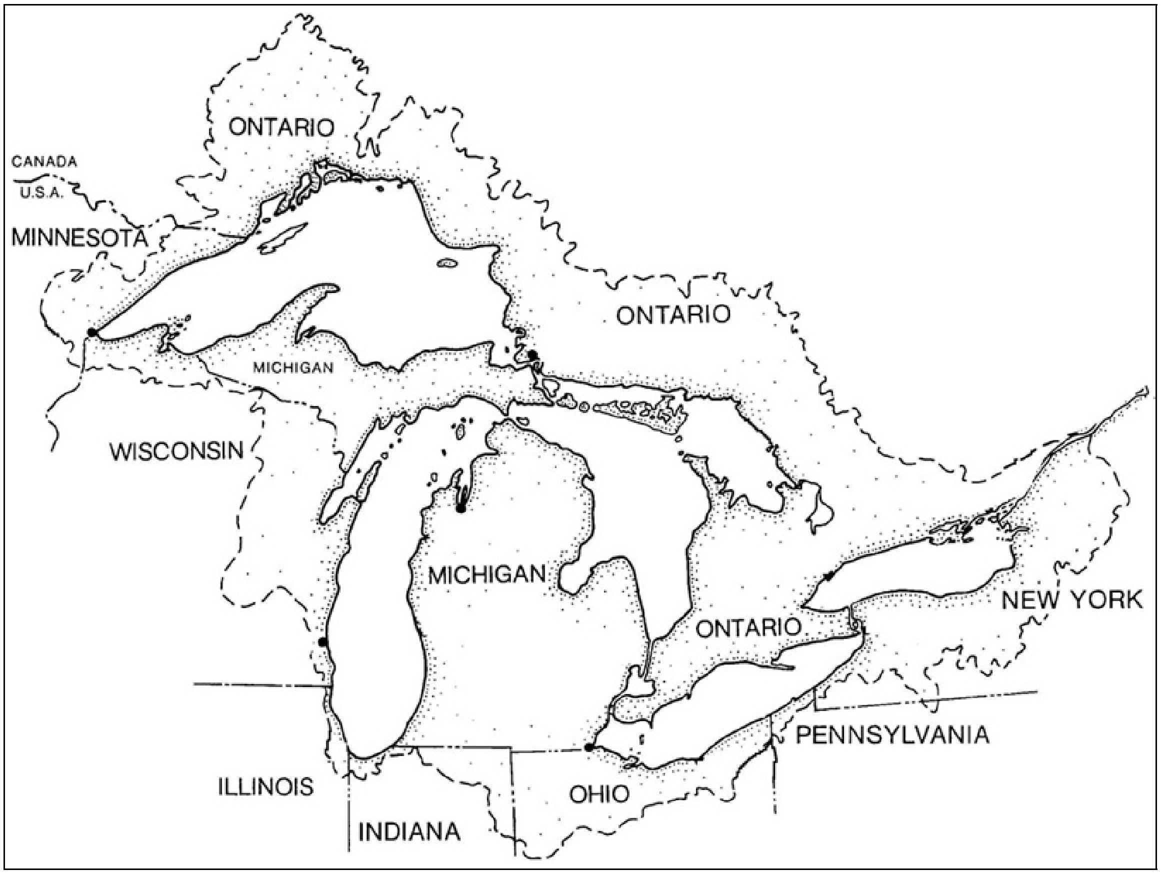

Figure 3–18 Great Lakes Region Drainage Basin Map (NOAA-GLERL)

3.6.2 Existing and Proposed Water Control Structures and Diversions

There are no known existing water control structures, upstream or downstream, that would influence the site. The U.S. Fish and Wildlife Service has proposed associated water-control structures for possible restoration actions for the marsh. Some proposed water-control measures taken into account include a water control weir, a flap gate, county drains, beaver activity, and irrigation practices in the watershed. The goal of the restoration effort being planned is "to facilitate to the extent practicable, natural fluctuations of water levels within Tobico Marsh, while providing adequate flood protection to residences riparian to Tobico Marsh." Other ecological restoration projects and projects that will enhance public use of Tobico Marsh may also be considered (U.S. Fish & Wildlife Service website).

3.6.3 Kawkawlin River Historical Stream Flow-Duration Data

The north branch of the Kawkawlin River is the stream nearest to the site and the largest within several miles. Streamflow data are recorded in the North Branch of the Kawkawlin River at:

USGS 04143500, North Branch Kawkawlin River, Bay County, Michigan
Hydrologic Unit Code 04080102
Latitude 43°40'05", Longitude 83°85'13" NAD27
Drainage area 101.00 square miles
Gage datum 584.00 feet above sea level NGVD29

Historical streamflow data for the north branch of the Kawkawlin River from 1951 through 1982 are presented in Table 3-11 below.

Table 3-11 Kawkawlin River Streamflow Data Table

YEAR	Gage Height (feet)	Peak Stream flow Date	Peak Stream flow (cfs)	Annual Mean Stream flow (cfs)
1951	--	Apr 27	520	--
1952	--	Apr 15	990	84.3
1953	--	May 4	506	37.4
1954	--	Jun 22	1090	76.3
1955	--	Mar 13	1100	51.3
1956	--	May 8	855	52.5
1957	--	Apr 8	415	56.5
1958	--	May 6	714	34.9
1959	--	Apr 3	1220	78.2
1960	--	Apr 1	1540	64.1
1961	7.05	Mar 27	390	37.7
1962	9.97	May 4	1120	58.1
1963	7.28	Mar 29	396	33.2
1964	5.60	May 4	128	9.50
1965	10.33	Apr 13	1540	63.7
1966	7.45	Mar 25	472	51.8
1967	9.09	Mar 28	1020	75.7
1968	9.38	May 30	906	48.2
1969	8.44	May 11	719	70.4
1970	7.81	Apr 9	518	64.0
1971	8.76	Apr 4	846	41.1
1972	--	Apr 14	542	47.1
1973	8.98	Jan 22	840	94.0
1974	10.92	May 18	1610	96.2
1975	8.42	Sep 3	516	80.4
1976	10.44	Mar 22	1420	116
1977	4.58	Mar 13	87.0	19.1
1978	8.75	Mar 31	805	44.5
1979	8.19	Apr 2	548	49.1
1980	6.54	Apr 12	306	43.9
1981	9.44	Feb 25	1010	91.9
1982	9.27	Mar 26	957	--

3.6.4 Site and Adjacent Drainage Areas and Surface Gradients

The area surrounding the site is approximately 585 feet above mean sea level, is relatively flat, and usually contains standing or ponded surface water throughout the year. Aerial photography (Figure 3–19) showing current (1998) site conditions (i.e., post disposal activity) provides a good picture of the surface water features in the near vicinity of the site (surface water bodies are nearly black) and also shows where the natural tree line exists indicating marshy soils (marshy soils are dark gray in the photo, trees appear variegated). Ponded water to the north of the site is the result of former beach-ridge sands being removed by a previous owner.

The majority of the surrounding area is located in marsh vegetation (Figure 3–20). Overall drainage is towards Saginaw Bay to the east/northeast.

Figure 3–19 Aerial Photography (6/20/1998) of Tobico Marsh SGA Site

The site is situated in a fresh water marsh basin and is located within the 100-year flood plain. This is not due to the Kawkawlin River, but rather by high water levels that might occur within the Tobico Marsh system (Figure 3–21).

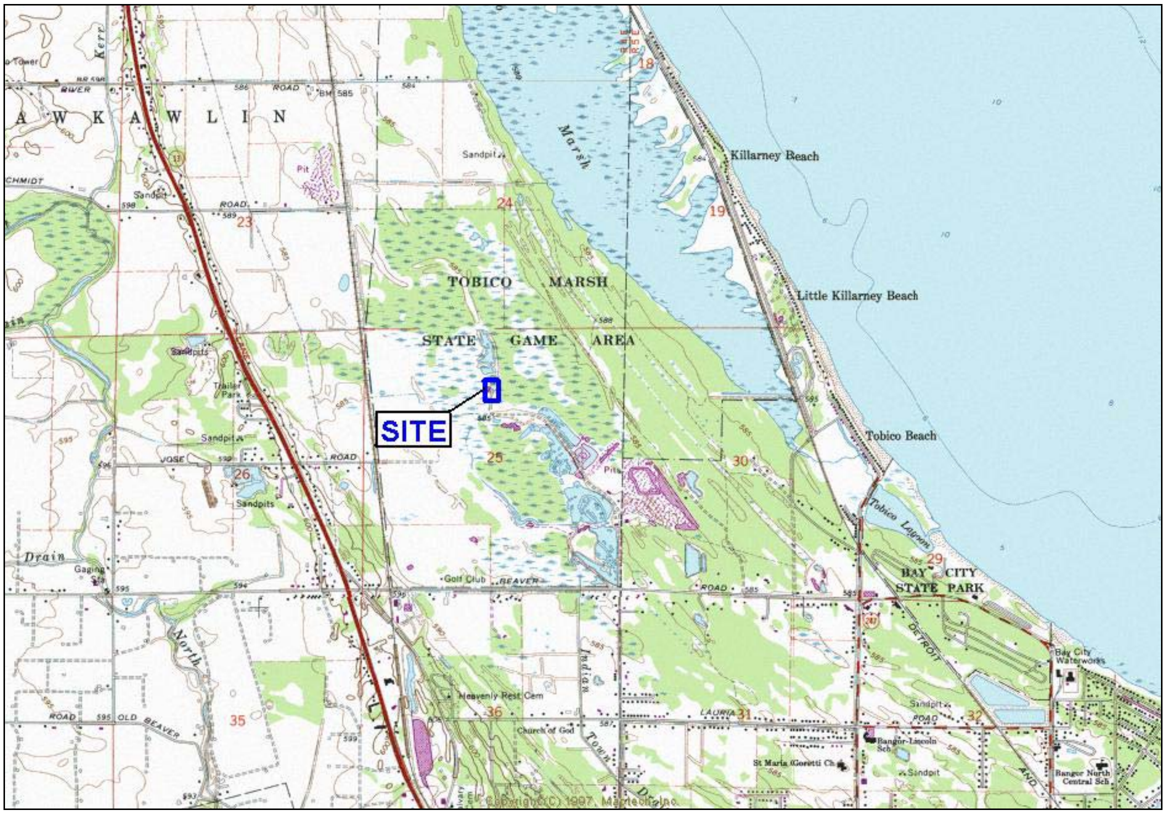

Figure 3–20   Topographic Map of Site and Surrounding Area

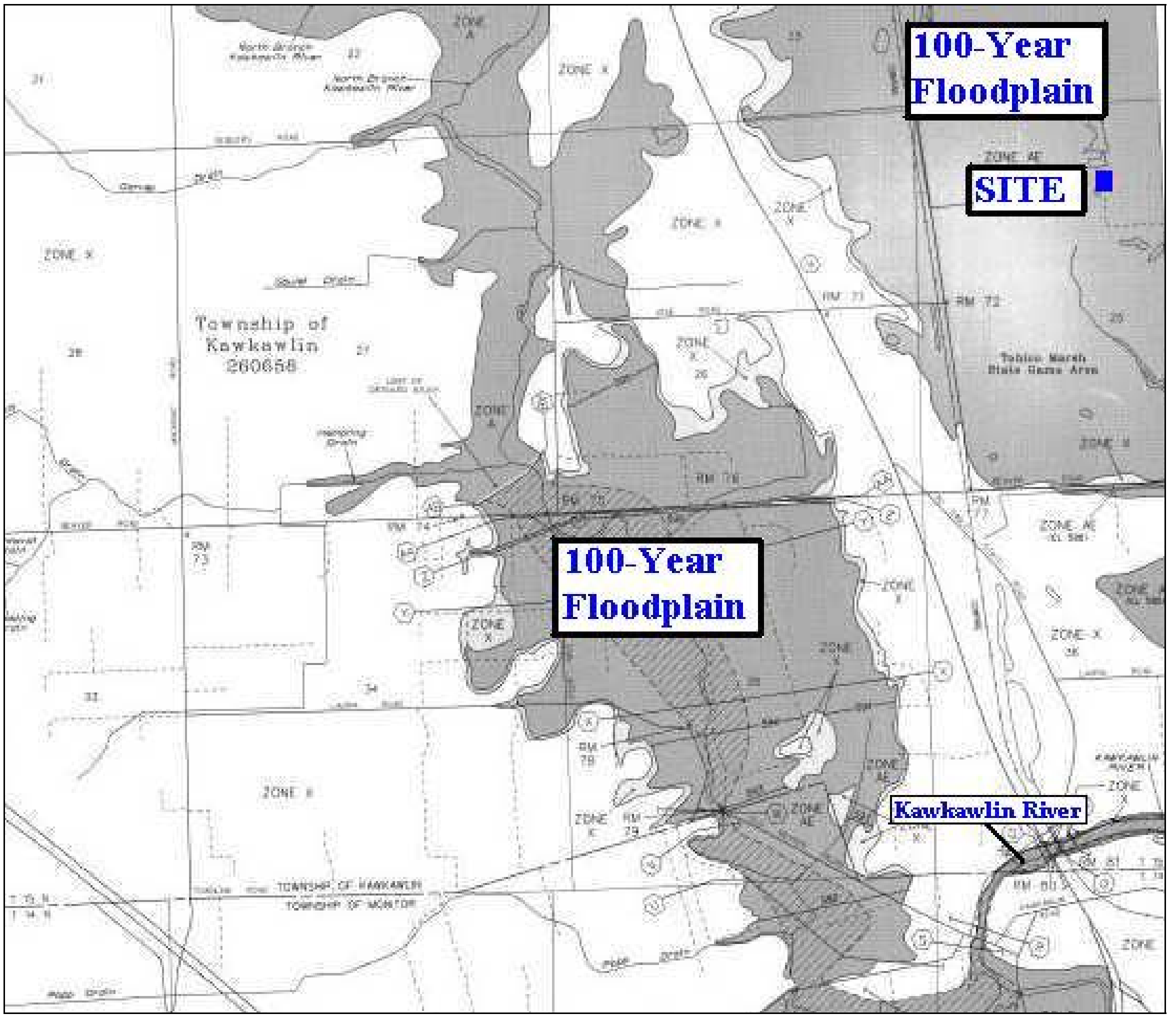

Figure 3–21 100-Year Floodplain Map

3.7 GROUNDWATER HYDROLOGY

3.7.1 Saturated Zone

Much of the land area surrounding the site (excluding the engineered clay cover) is covered with ponds and wetlands. As such, the saturated zone is either near or at the ground surface across these areas. The saturated zone is limited to the shallow sandy loam and is perched on the basal clay till unit. The thickness of the saturated zone varies seasonally but is generally one to three feet thick.

This groundwater has been designated by the State of Michigan (MDEQ) to be "groundwater, not in an aquifer". As such, it is not considered a viable nor adequate source for residential use or irrigation purposes. Refer to Section 4.3 for additional information on groundwater.

Local groundwater flow direction is difficult to characterize due to the low hydraulic gradient, variability within the wetland habitat, and interaction with the landfill-containment structures. Regionally, groundwater flow direction is to the east-northeast, towards Saginaw Bay.

3.7.2 Unsaturated Zone

Approximately 50 to 100 feet of glacial deposits underlie the site. These consist of glacial till with occasional interbedded layers of glaciolacustrine sediments. Former beach sands and peat deposits overlie this till. The glacial till is composed primarily of clay with some silt and medium- to fine-grained sand and a trace of gravel. The till is very dense, unstratified, and heterogeneous. The glaciolacustrine deposits consist of silts and clays with little, coarse- to fine-grained sand, and a trace of gravel. The silts and clays are high in organic material. The post-glacial former beach-sand deposits overlie the till and consist of fine- to medium-grained quartz sand. The thickness of the sand is 5 to 8 feet. With the exception of the overlying sands, the geologic conditions are not conducive to lateral or vertical movement of groundwater. The glacial till underlying the sands is also an impediment to vertical migration of groundwater and dissolved contaminants.

There are three monitoring wells (MW-1, MW-8, and MW-9) inside the site and seven monitoring wells (MW-2, MW-3, MW-4, MW-5a, MW-6, MW-7, and MW-43) along the perimeter of the site.

Monitoring wells onsite are constructed with a 2-inch I.D. stainless-steel well screen and a 2-inch I.D. galvanized riser. Screens were installed in two lengths: 2-foot or 8-foot lengths (Table 3-12).

3.7.3 Distribution Coefficients for the Radionuclides of Interest at the Site

The distribution coefficient, Kd, is the ratio of the mass of solute species adsorbed or precipitated on the solids per unit of dry mass of the soil to the solute concentration in liquids within the pore spaces in the soil. The key component of this definition as it relates to the site-specific conditions and the RESRAD groundwater transport model is that it assumes that the radionuclide is introduced to the soil column as a solute. While this classical approach may be appropriate to describe the retardation of soluble contaminant migration in the soil column beneath the contaminated soil layer, it fails to account for the extremely low leachability of radionuclide from the slag wastes in the "contaminated zone" at the Tobico SGA Site. The physical composition of the contaminant at the site is a vitreous slag that is essentially insoluble even under the most extreme in-situ conditions that might reasonably be encountered.

Table 3-12 Monitoring Well Depths Table

MONITORING WELL	BOTTOM OF SCREEN DEPTH (Feet above mean sea level)
MW-01	579.10
MW-02	573.68
MW-03	576.33
MW-04	576.20
MW-05a	576.17
MW-06	578.37
MW-07	576.75
MW-08	583.23
MW-09	579.61
MW-43	Unknown

Leachability studies performed on comparable thorium-bearing slag found at a site in Washington, Pennsylvania, affirm that very little thorium can be expected to leach out of the slag in the environment (Molycorp 1995). Radiological analysis of leachate samples collected from the engineered cell at the Tobico SGA Site support the conclusion that thorium is not leaching from the slag (ABB 1997, MACTEC 2002).

Within the contaminated zone, two key physio-chemical processes are potentially at work: (1) leaching of soluble contaminants from the slag, and (2) subsequent adsorption/desorption and precipitation/dissolution of contaminants that were introduced to the soil column in leachate. Both of these processes have an influence on the soil/water distribution coefficient. Two fundamental analytical approaches are employed to measure the Kd value of a specific soil column. The most common approach assumes that the contaminant is introduced to a soil column in a completely soluble form. Any retardation of the contaminant as it interacts with the soil can be attributed to the soil's ability to adsorb or precipitate the contaminant, thus removing it from solution. This is the classic approach used to assess the distribution coefficient of a particular soil, but it falls short in its ability to assess the combined effect of contaminant leaching when the contaminant is not introduced as a solute. An alternate approach to assessing what might be termed an "effective Kd", takes into account both of the key physio-chemical processes at work in the contaminated zone, and measures the "desorption distribution coefficient", a treatment that is comparable to a leachability test procedure.

Physical samples of the slag/soil composition within the contaminated zone are not available for measurement. Nonetheless, it is known with a high degree of certainty that the slag form present at the site does not readily leach thorium contaminants. Site-specific desorption distribution coefficient studies performed at similiar sites where contaminants are present in soil in physical and chemical forms that are highly insoluble and resistant to leaching under in-situ conditions, have shown that the effective, or desorption, Kd is many orders of magnitude higher than the “adsorption Kd” measured for the same soil (Wang 1996, ENSR 2001). Given that radio-analytical measurements of the leachate in the cell at the Tobico SGA Site indicate that radiological contaminants are not present in concentrations greater than those found naturally occurring in unaffected groundwater, the effective Kd value of the contaminated zone is judged to be substantially greater than the RESRAD default value.

The Kd value for thorium in the contaminated layer is described in the conceptual site model using the RESRAD default, lognormal-N distribution function, except that bounds have been established on the range of values allowed during probabilistic analysis (a bounded lognormal-N distribution). The central tendency value for the distribution has been set to match the default, single-point estimate used in the RESRAD deterministic module, 60,000 cm3/g (Yu 1993, NRC 1980, Yu 2002). Probabilistic sampling is bounded between 3,200 and 89,000 cm3/g, the lowest and highest geometric mean values for various soils as reported in literature and summarized in the Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil (Yu 1993). Treatment of the contaminated zone Kd value for thorium in this manner is only slightly less conservative than the default treatment of this parameter in RESRAD’s probabilistic module and is at least as conservative as the default treatment in RESRAD’s deterministic module. For all other soil “layers,” the RESRAD probabilistic module default values were used to describe Kd values as adsorption onto host soil particles, and not leaching from the slag matrix, which more appropriately describes the retardation of contaminant migration through the soil column. A graphic representation of the probability density function describing the thorium Kd parameter for the contaminated zone in the RESRAD probabilistic module is offered in Figure 3–22. The vertical green lines represent the bounding conditions at 3,200 and 89,000 cm3/g as described above.

3.7.4 Typical Geologic Cross Sections Showing Groundwater Elevations and Flow Direction(s)

A geologic cross-section (A-A’) was developed by E.C. Jordan Company for the MDNR in the Hartley and Hartley Landfill Site Remedial Investigation Final Report (ECJC 1986) (See Figure 3–23 and Figure 3–24). The cross section was profiled west to east and included monitoring wells MW-7, MW-2, the west slurry wall, monitoring well MW-1, the east slurry wall, and monitoring wells MW-4 and MW-5.

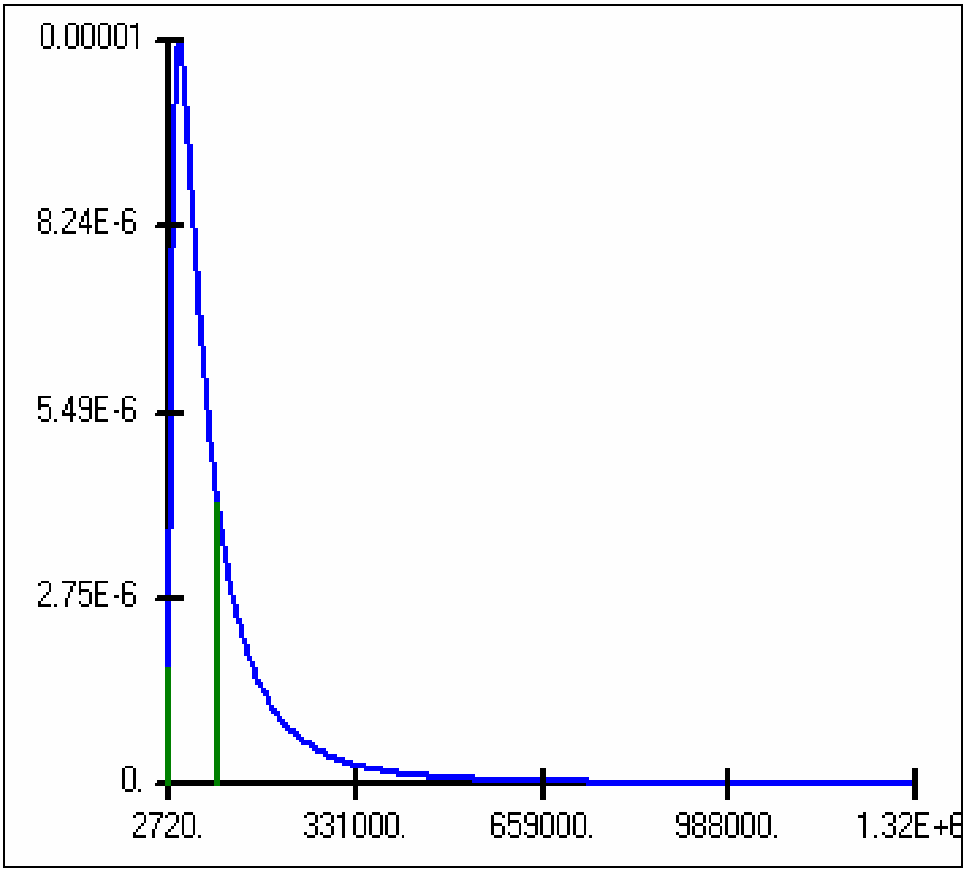

Figure 3–22 Probabilistic Thorium K_d—Contaminated Zone

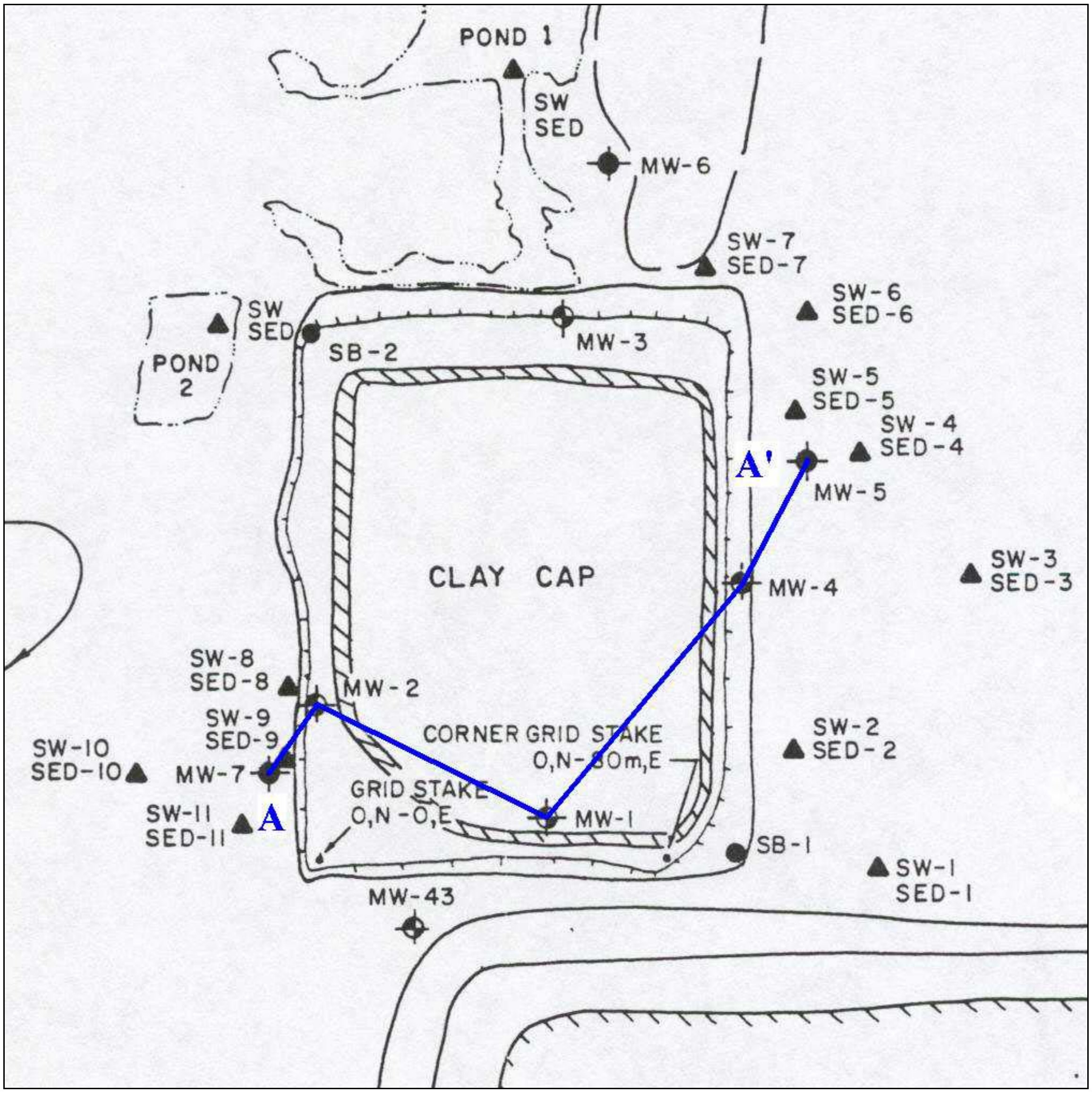

Figure 3–23 Cross section Location Map

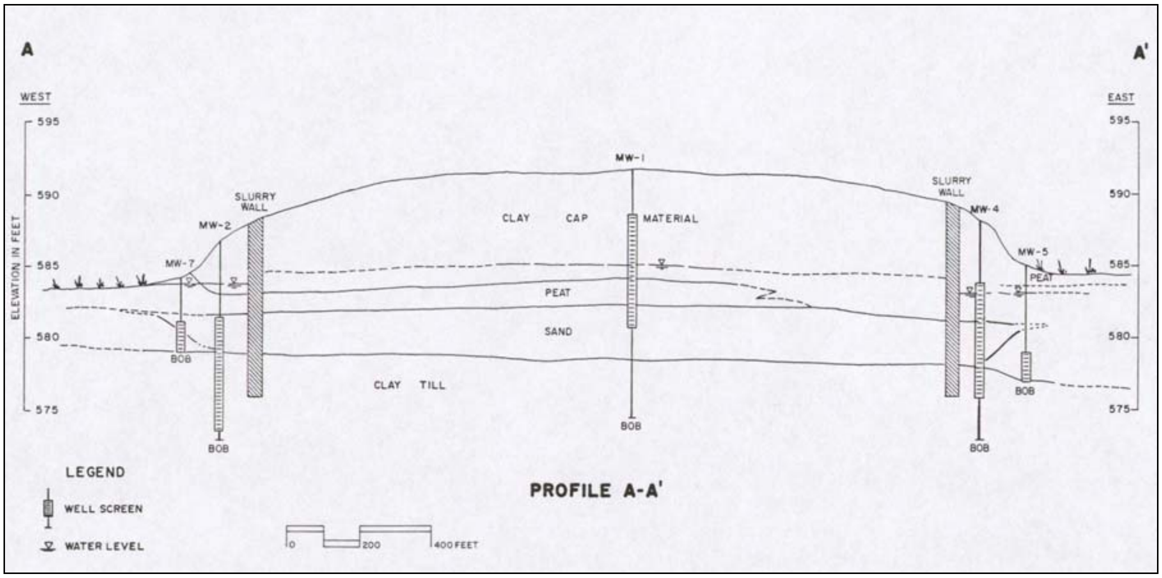

Figure 3–24 Cross section Profile A-A'

3.8 NATURAL RESOURCES

Much of the site and surrounding lands are covered with ponds and wetlands. As such, the saturated zone is either at or near the ground surface. The saturated zone is not connected to a viable aquifer for potable, agricultural, or industrial use. The MDEQ has determined that groundwater is not in an aquifer (MDEQ 2002). However, the Tobico Marsh State Game Area and surrounding area is home to many freshwater fish species.

The following fish species are found in the Tobico Marsh State Game Area and/or surrounding waters: brown trout, burbot, carp, catfish, chinook salmon, coho salmon, lake trout, northern pike, rainbow trout, walleye, white bass, white perch, white sucker, whitefish, and yellow perch (www.saginawbay.com and www.michigan.gov/dnr).

In addition to the presence of fish in the area's waters, agricultural lands in the region are used for both field crops and livestock. Field crops include beans, cantaloupes, cauliflower, corn, hay, oats, onions, peppers, potatoes, pumpkins, soybeans, sugar beets, and wheat. Livestock species include beef cows, milk cows, hogs, pigs, and sheep.[3]

Based upon information from the MDEQ and the USGS, there are no oil or gas resources in or adjacent to the site. Regionally, some oil wells are located to the southwest of the site (Figure 3–25) (MDEQ 2001).

[3] Based on 1995 land use data from the Michigan Agricultural Statistics Service.

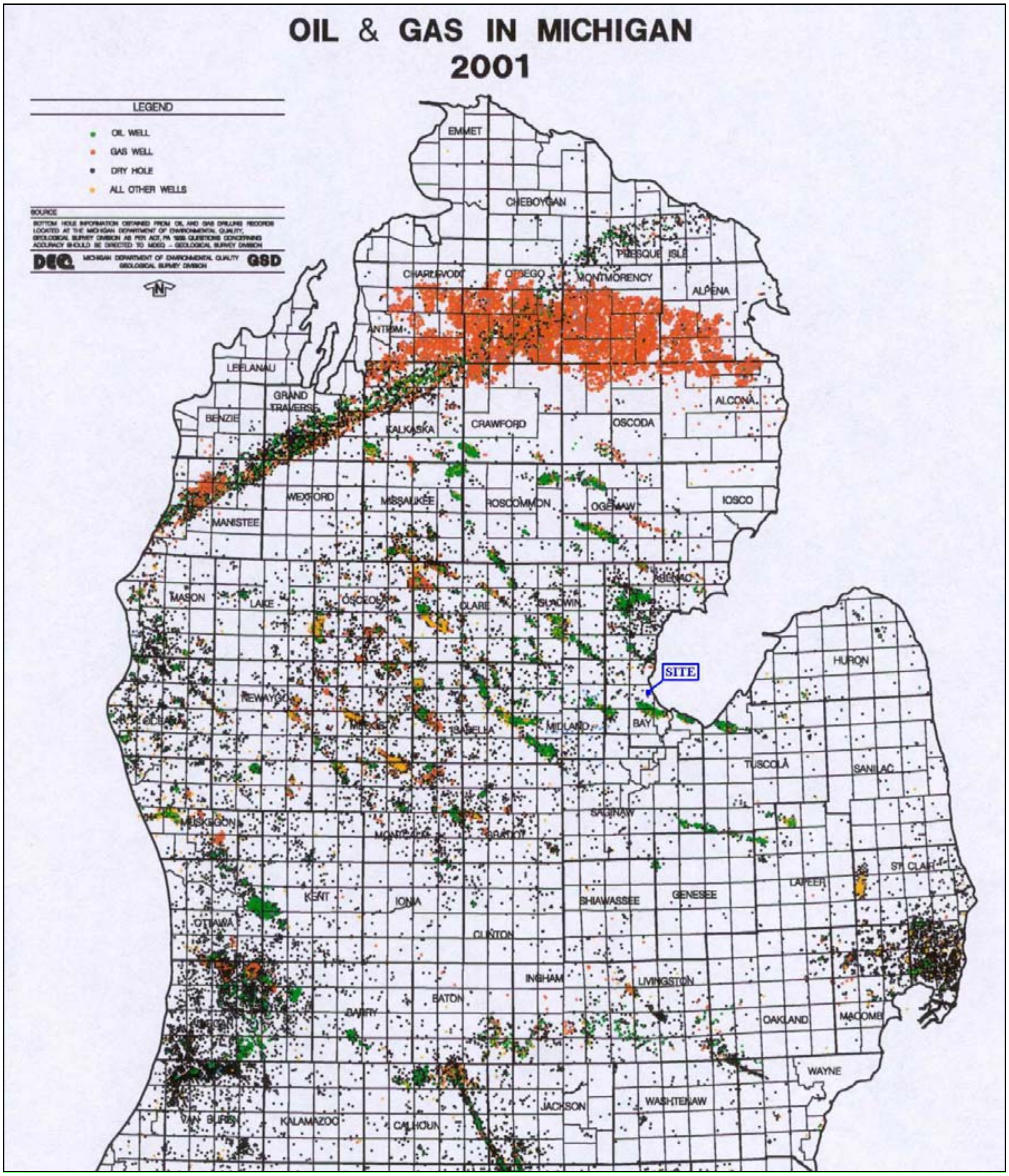

Figure 3–25 Oil & Gas Map of Michigan

3.9 ECOLOGY/ENDANGERED SPECIES

3.9.1 Commercially or Recreationally Important Vertebrate Species

Commercially or recreationally important vertebrate animals known to occur with 5 km of the site are listed below (MDNR – Bay City, and Bay City State Recreation Area):

Mammal Species

- Whitetail Deer;
- Coyote;
- Gray, and Red Fox;
- Skunk;
- Raccoon;
- Possum;
- Gray, and Fox Squirrel;
- Chipmunk;
- Gopher;
- Woodchuck;
- Bobcat;
- Cottontail Rabbit;
- Muskrat;
- Mink;
- Badger;
- Beaver; and
- Otter.

Fish Species

- Brown, Lake, and Rainbow Trout;
- Burbot;
- Carp;
- Catfish;
- Chinook, and Coho Salmon;
- Northern Pike;
- Walleye;
- White Bass;
- White, and Yellow Perch;
- White Sucker; and
- Whitefish.

<u>Bird Species</u>

Various species can be found either year-round or seasonally. A partial list includes:

- Common Loon;
- Pied-billed and Horned Grebes;
- Great Blue, Green, and Black-crowned Night-Herons;
- Great Egret;
- Hooded, Common, and Red-breasted Mergansers;
- Turkey Vulture;
- Osprey;
- Bald Eagle;
- Northern Harrier;
- Sharp-shinned, Cooper's, Red-shouldered, Marsh, Broad-winged, Red-tailed, and Rough-legged Hawks;
- American Kestrel;
- Merlin;
- Peregrine Falcon;
- Black-bellied, and Semipalmated Plovers;
- Killdeer;
- Solitary, Spotted, Semipalmated, Least, White-rumped, Baird's, Pectoral, and Stilt Sandpipers;
- Eastern Screech, Great Horned, and Snowy Owls;
- Red-headed, Red-bellied, Downy, Hairy, and Pileated Woodpeckers;
- Alder, Willow, Least, and Great Crested Flycatchers;
- House, Winter, [Sedge], and Marsh Wrens;
- Swainson's, Hermit, Wood, and Brown Thrashers;
- Solitary, Yellow-throated, Warbling, Philadelphia, and Red-eyed Vireos;
- Blue-winged, Golden-winged, Tennessee, Orange-crested, Nashville, Yellow, Chestnut-sided, Magnolia, Cape Amy, Black-throated Blue, Yellow-rumped, Black-throated Green, Blackburnian, Pine, Palm, Bay-breasted, Blackpoll, Black-and-white, Mourning, Wilson's, and Canada Warblers;
- American Redstart;
- Northern Waterthrush; and
- Scarlet Tanager.

3.9.2 Commercially Important Floral Species Known to Occur Within 5 Km of the Site

There are no known *commercially important* (i.e., important to business) floral species known to occur within 5 kilometers of the site. There are, however, recreationally important floral species within 5 kilometers of the site.

3.9.3 Threatened and Endangered Species

Michigan's threatened and endangered species are:

- Animals

  King Rail, Caspian Tern, Common Tern, Indiana Bat, Gray Wolf, Bald Eagle, American Peregrine Falcon, Piping Plover, Kirtland's Warbler, Common Moorhen, Clubshell, Northern Riffleshell, Hungerford's Crawling Water Beetle, Karner Blue Butterfly, and Mitchell's Satyr Butterfly.

- Plants

  Pitcher's Thistle, Dwarf Lake Iris, Small Whorled Pogonia, Michigan Monkey-Flower, Eastern Prairie Fringed Orchid, Houghton's Goldenrod, and American Hart's-tongue Fern.

Of these, the American Peregrine Falcon and the Bald Eagle are the only species thought or known to be present within a 5 km radius of the site. The preferred decommissioning option selected by the MDNR is to leave the residual radioactivity in-place in the engineered cell. With no further remedial action, there is no evidence or expectation that residual radioactivity from the site will become available in the environment such that an ecological impact might result. It is estimated that a course of no further intrusive remedial action is likely to have the least impact on the local environment and its ecology.