3. SITE DESCRIPTION (FWIA STEP I)

This section of the BERA addresses the requirements of Step I of NYSDEC's Fish and Wildlife Impact Analysis (FWIA) for Inactive Hazardous Waste Sites. According to NYSDEC (1994a), the objectives of Step I are to:

- Identify the fish and wildlife resources that presently exist at the site and that existed there before contaminant introduction.
- Provide information necessary for the design of a remedial investigation (RI).

Step I of the FWIA (NYSDEC, 1994a) includes preparation of various site maps, description of fish and wildlife resources, description of fish and wildlife resource values, and identification of applicable fish and wildlife regulatory criteria. The contents of this section are also consistent with the component of Ecological Risk Assessment Guidance for Superfund (ERAGS) Step 1 (see Chapter 4) that addresses the environmental setting (USEPA, 1997a).

3.1 Site Maps

The site maps required for Step I of a FWIA include topographic, wetland, drainage, and covertype (NYSDEC, 1994a). The topographic map for the site is presented in Figure 3-1 and includes the following information:

- Demarcation of the 2-mi (3.2-km) area around the site.
- Topographic features.
- Surface waters (i.e., streams and lakes).
- State and federal wetlands.
- General locations of rare plant species and communities listed in the New York Natural Heritage Program (NYNHP) database.
- Roads and settlements (urban and residential).

As required by FWIA guidance, a drainage map depicting surface flows after hydrological events is presented in Figure 3-2. Wetlands regulated by NYSDEC and those documented by the National Wetlands Inventory (NWI) are presented in Figure 3-3, and are discussed in detail in Section 3.2.4. The covertypes located within 0.5 mi (0.8 km) of Onondaga Lake are presented in Figure 3-4, and are discussed in detail in Section 3.2.4.

3.2 Description of Site Characteristics and Fish and Wildlife Resources

This section describes the physical and biological resources of Onondaga Lake and its surrounding areas.

3.2.1 Lake Morphometry

Onondaga Lake covers an area of approximately 4.6 sq mi (12 sq km), or 3,000 acres, and has a maximum length of 4.7 mi (7.5 km) and width of 1.2 mi (1.9 km) (based on PTI, 1991). The volume of the lake is 139×10^6 m^3. The mean depth of the lake is 12 m, and its maximum depth is 19.9 m. The lake has approximately 11.7 mi (18.8 km) of shoreline (based on PTI, 1991, 1992b). The most recent bathymetric survey of Onondaga Lake was conducted in April 1992 for the RI/FS; the results of this survey are presented in Figure 3-5 (PTI, 1992b). The lake has two basins (northern and southern), which are separated by a slight ridge that is approximately 56 ft (17 m) deep. The maximum depths of the northern and southern basins are 62 and 65 ft (18.8 and 19.9 m), respectively (PTI, 1992b).

As shown in both the bathymetric plot and the hypsographic curve for the lake (Figure 3-5), the nearshore zone of much of the lake at depths less than 4 m is represented by a relatively broad shelf (or bench) bordered by a steep offshore slope at depths of 4 to 8 m.

3.2.2 Climate

The climate in the Onondaga Lake drainage basin can be described as "temperate continental" (Trewartha, 1968) and somewhat humid. The area's geographic proximity to Lake Ontario results in moderated extremes in air temperature, relative to areas at the same latitude that are farther east and are less subject to the "lake effect" (Effler and Harnett, 1996). The mean annual temperature is 48°F (8.8°C), with a mean July temperature of 71°F (22°C) and a mean January temperature of 23°F (−4.9°C) (National Oceanic and Atmospheric Administration [NOAA], 2001). Record temperatures range from 102°F (39°C) in July to −26°F (−32°C) in January, February, and December. Based on data from the period from 1971 to 2000, the average first occurrence of freezing temperatures (daily low of 32°F [0°C]) in the fall is November 15, and the average last occurrence of freezing temperatures in the spring is April 8 (NOAA, 2001).

Moisture enters the area primarily via low-pressure systems that move through the St. Lawrence Valley toward the Atlantic Ocean. Monthly precipitation averages approximately 8.2 cm and is relatively evenly distributed throughout the year, ranging from 6.4 cm in February to 9.4 cm in July (National Climatic Data Center [NCDC], 1995).

Winds in the Syracuse area are predominantly from the west and northwest, as shown in the annual wind rose for the ten-year period prior to 1992 (Figure 3-6). The predominant wind directions remain relatively constant throughout the year, although minor variations occur during different months (Figure 3-7). Most of the strongest winds (20 to 23 m/sec, 44 to 51 mph) occur between November and April (NCDC, 1998).

3.2.3 Geology

Onondaga Lake is located in the southern Ontario Lowlands Province. It is a remnant of ancient Lake Iroquois, a body of water that covered the northern half of Onondaga County 10,000 years ago and included present-day Lake Ontario (Storey, 1977). Onondaga Lake is typical of lakes in the region that were formed by glacial scour approximately 10,000 years ago (NYSDEC, 1989).

Onondaga Lake and most of its drainage basin are located in the Limestone Belt of central New York State (Berg, 1963), a physiographic region that extends from Buffalo eastward to Albany (Figure 3-8). The southern part of the drainage basin is located on the Northern Appalachian Plateau. The surface of some areas in the Limestone Belt consist of deep glacial till derived from limestone and alkaline shales, as well as lacustrine deposits from those materials. Other locations are characterized by outcrops of intact parent strata, particularly Onondaga Limestone. Because most of the water that flows into Onondaga Lake is derived from the Limestone Belt, the soils of the belt have a large influence on the characteristics of the lake water. This influence is particularly apparent for calcium, magnesium, bicarbonate, and alkalinity, the concentrations of which are all higher in lakes influenced by the Limestone Belt than in lakes influenced primarily by the Northern Allegheny Plateau to the south (e.g., the Finger Lakes) or the Ontario-Oneida-Champlain Lake Plain to the north (e.g., Oneida Lake).

Directly underlying Onondaga Lake is Vernon shale, a thick, argillaceous shale. The Syracuse Formation, which is approximately 590 ft (180 m) thick and comprised of shales, dolostones, and salt (Blasland and Bouck, 1989), overlies the Vernon Formation to the south of Onondaga Lake. In this formation, groundwater flows up-dip to the north toward Onondaga Lake and is the source of brines in the area. Brine from the local bedrock also influences water quality in overlying overburden groundwater and in Onondaga Lake tributaries. Kantrowitz (1970) noted that the lower overburden groundwater zones near the lake are influenced by underlying saline groundwater in bedrock.

Pleistocene glaciers extensively eroded the preglacial bedrock and deposited glacial till, which is typically a compact, unsorted, poorly stratified mixture of sands, silt, clay, gravel, and boulders. Till generally overlies the bedrock in this area as a thin veneer about 10 to 16 ft (3 to 5 m) thick. During the time of glacial retreat, large volumes of sediments (glaciolacustrine sediments) accumulated in preglacial lakes. These sediments consist primarily of fine-grained sand and silt, but gravel, coarse-to-medium sand, and clay are present at some locations. More than 245 ft (75 m) of glaciolacustrine sediments were deposited in the southern end of Onondaga Lake (Onondaga County, 1971). In other areas of the Onondaga Lake basin where till and bedrock elevations are higher, glaciolacustrine sediments range from about 15 to 50 ft (5 to 15 m) in thickness.

During the 1992 RI field programs performed by Honeywell as per the Onondaga Lake RI/FS Work Plan (PTI, 1991), sub-bottom profiling revealed about 45 to 60 ft (14 to 18 m) of finer-grained sediment overlying glacial till where acoustic penetration of the sediment was possible in some littoral areas (PTI, 1992b).

3.2.4 Physical Resources

The physical resources of Onondaga Lake described in this section include the major components of both the aquatic and terrestrial environments in and near the lake. The aquatic components include lake water, lake sediment, tributaries, and wetlands. The terrestrial components include soils, the Solvay Wastebeds, and terrestrial covertypes. NYSDEC-designated significant habitats are found in both the aquatic and terrestrial environments of Onondaga Lake.

3.2.4.1 Aquatic Environment

The descriptions of the key components of the aquatic environment in Onondaga Lake are based largely on information presented in the RI/FS Work Plan (PTI, 1991) and on the data collected during Honeywell's 1992 field investigation.

Lake Water

Onondaga Lake is part of the New York State Barge Canal System, and the elevation of the lake is controlled by a dam on the Oswego River at Phoenix, New York, downstream from the lake. Lake elevation can influence numerous characteristics of the nearshore zone because it affects shoreline wetlands, as well as parts of the littoral zone that are subjected to wave and ice disturbance. The mean annual elevation of the lake generally is highest in early spring (due to rainfall and melting snow) and lowest during the summer dry period. From 1971 to 2000, the monthly mean elevation of the lake varied by approximately 1.5 ft (0.5 m) over the annual cycle (Figure 3-9). From 1983 to 1992, the maximum annual variations in lake level ranged from 1.5 ft (0.5 m) (in 1988) to 4.7 ft (1.4 m) (in 1983), with an overall mean of 3.2 ft (0.9 m) for the entire ten-year period (Table 3-1).

The New York State water quality classifications of Onondaga Lake and the lower reaches of its tributaries (6 NYCRR part 701) are presented in Figure 3-10 and include:

- Class B Waters – The lower reaches of Sawmill Creek and Bloody Brook, and most of the northern end of the lake. According to 6 NYCRR Part 701.7, the best uses of Class B waters are primary and secondary contact recreation and fishing. These waters should be suitable for fish propagation and survival.

- Class C Waters – The lower reaches of Harbor Brook, Ninemile Creek, Ley Creek, and Onondaga Creek, the southern end of the lake, and the area of the lake off the mouth of Ninemile Creek. According to 6 NYCRR Part 701.8, the best use of Class C waters is fishing and these waters should be suitable for fish propagation and survival. Class C waters should also be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes. Tributary 5A is "not classified," but Class C standards apply because it discharges to the southern end of the lake (6 NYCRR Part 895.2).

Like most inland northern lakes, Onondaga Lake is thermally stratified during winter and summer and is isothermal in spring and fall. Stratification governs the distribution of many water-column variables (e.g., water temperature, nutrient concentrations, dissolved oxygen [DO] concentrations) because the thermocline limits vertical mixing between the epilimnion and hypolimnion. During 1992, the thermocline appeared at a depth of approximately 16 ft (5 m) in mid-May and gradually declined to a maximum depth of approximately 43 ft (13 m) by mid-October, when fall turnover occurred (Figure 3-11). In the epilimnion, water temperature reached a maximum value of 72°F (22°C) in mid-June and remained near 68°F (20°C) until the end of September (Figure 3-11). In the hypolimnion, water temperature gradually increased during the period of stratification and reached a maximum of 54°F (12°C) immediately prior to fall turnover.

Prior to 1987, the lake regularly failed to turnover in the spring due to salinity stratification largely caused by manmade influences on the lake (Owens and Effler, 1996). The water inputs from the tributaries affected by the Solvay process tended to plunge into the hypolimnion due to their saline nature and caused a significant saline stratification. The failure of the lake to turnover caused a depletion of the DO in the hypolimnion and prevented the normal heating of these waters (Effler et al., 1996; Owens and Effler, 1996). After the chlor-alkali plant closed in 1986 turnover resumed, although saline inputs from the wastebeds continue to affect stratification. Dissolved oxygen in the hypolimnion is also generally depleted in the late summer or early fall due to manmade eutrophication (Effler et al., 1996).

Lake Sediments

The grain-size distribution and total organic carbon (TOC) content of sediments can be used to infer depositional patterns throughout Onondaga Lake. As shown in Figure 3-12, grain-size distribution and TOC content were closely associated in Onondaga Lake in 1992. The highest percentages of fine-grained sediment (>90 percent) and TOC (>3.0 percent) were found in the deeper parts of both the northern and southern basins. By contrast, the coarsest sediments (<10 percent fine-grained fraction) and lowest TOC values (<1.0 percent) were found (PTI, 1993e) throughout most of the nearshore zone along the entire eastern shoreline and the western shoreline north of Ninemile Creek. The sedimentary patterns in Onondaga Lake in 1992 are similar to the patterns found by others in the lake (Johnson, 1989; Auer et al., 1996b).

Historically, a flocculent layer (estimated to be approximately 17 percent solids by weight) was believed to be present over much of the surface of the sediments (Effler, 1975). Verification of the presence, depth, and extent of the flocculent layer was impeded by the difficulty of recovering core samples from this layer. However, Effler (1975) estimated that the flocculent layer at that time was approximately 50 to 90 cm thick. A flocculent layer was not observed during the 1992 and 2000 field investigations.

Much of the nearshore area of Onondaga Lake is covered with oncolites resulting from the calcium-contaminated discharge of ionic waste into the lake (Dean and Eggleston, 1984), as discussed in Chapter 4, Section 4.1.1.3. Oncolites are irregularly rounded, calcareous nodules that range in size from 0.5 to 30 cm and are not attached to substrates (Pentecost, 1989).

Using cesium-137 as a chemical marker for strata corresponding to the years 1963 to 1964,[1] Saroff (1990) estimated that sedimentation rates for the northern and southern basins of the lake were approximately 0.8 and 0.9 cm/year, respectively, from 1963 to 1990. During the RI/FS, mercury, calcium, cesium-137, lead-210, and pollen were used as markers to estimate sedimentation rates based on core samples taken near the center of each basin. The results of these analyses indicated that the average sedimentation rate from 1972 to 1992 was approximately 0.9 cm/year, with a decrease in sedimentation rate after plant closure in1986.

Tributaries

Onondaga Lake receives surface runoff from a drainage basin estimated to cover approximately 248 sq mi (642 sq km) (Figure 3-13) (Effler and Whitehead, 1996). Surface water flows primarily from the south and southeast into the lake via six tributaries: Ninemile Creek, Onondaga Creek, Ley Creek, Harbor Brook, Bloody Brook, and Sawmill Creek. Water is also discharged to the lake by Metro and through intermittent bidirectional flow from the Seneca River at the outlet of the lake (Effler et al., 1986). In addition, a small amount of water is added to the lake through two industrial conveyances: the East Flume and Tributary 5A.

Together, Ninemile Creek and Onondaga Creek accounted for approximately 62 percent of the total inflow during the period 1971 to 1989 (Figure 3-14) (Effler and Whitehead, 1996). During the same period, the Metro discharge accounted for 19 percent of the total inflow, Ley Creek accounted for 7.7 percent of the inflow, and Harbor Brook accounted for 2.2 percent of the inflow. Contributions by all other tributaries were minor.

The highest inflow of water to Onondaga Lake occur in March and April and the lowest inflow occurs in August (USGS, 1990). Water exits the lake via the outlet at the northwest end and flows into the Seneca River (Figure 3-13). The Seneca River merges with the Oneida River to form the Oswego River, which discharges to Lake Ontario.

Groundwater within the Onondaga Lake drainage basin generally flows from the tributary valleys to the lake, following the topography. The groundwater-flow paths and exchanges with surface water depend on local geologic conditions within each tributary valley. Groundwater within the bedrock discharges to the lake through a number of natural brine seeps along the southwest and southern portions of the lake and along the various tributary valleys leading to the lake (Blasland and Bouck, 1987).

Seneca River

The Seneca River is a large river that drains approximately 3,500 sq mi (9,000 sq km) of central New York to the Oswego River, and subsequently to Lake Ontario. Much of the river is part of the Barge

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[1] Large quantities of cesium-137 were released into the atmosphere in 1963, the year before the Nuclear Test Ban Treaty went into effect (1964).

Canal, and flows and water levels are regulated accordingly. The Seneca River receives all of the outflow from Onondaga Lake via the lake outlet.

Near the confluence with the lake outlet, the water column of the Seneca River is sometimes affected by salinity stratification, which results largely from ionic discharges from the lake (Canale et al., 1996; Owens and Effler, 1996). Relatively dense lake water often exits along the bottom of the lake outlet, as river water flows into the lake in the upper levels of the channel. This occurrence is promoted by the elevated salinity of the lake water and the absence of a natural hydraulic gradient between the lake and river (a condition that resulted from the historical channelization of the lake outlet to support navigation).

Stratification in the Seneca River has been identified as a reason for reduced concentrations of dissolved oxygen in the river near the confluence with the lake outlet (Canale et al., 1995, 1996). In July 1991, the stratification extended more than 5 mi (8 km) downstream from the lake outlet (Canale et al., 1995, 1996). The stratification is generally limited to periods of low flow in the river, because turbulence during high flow is sufficient to break up the stratification.

Wetlands

There is little information regarding the original condition of the wetlands surrounding Onondaga Lake. Onondaga County is noted for conditions that lead to the formation of marl fens (i.e., peatlands with the water table usually at or just above the surface) (Olivero, 2001). The marl found in the soil and sediments surrounding the lakes suggest that some of the original wetlands surrounding the lake were marl fens. The remnant inland salt ponds and marshes, and historical accounts of salt springs on the lakeshore, suggest that inland salt marshes were also present in the area surrounding the lake (Effler and Harnett, 1996). The total extent of wetlands was likely affected when the level of Onondaga Lake was lowered by about 2 ft (0.6 m) in 1822 (Effler and Harnett, 1996). In addition, development and waste disposal by Honeywell (formerly AlliedSignal) along the southern and southwestern shoreline (e.g., in the vicinity of Wastebeds 1 through 8) has buried much of the original wetland habitats.

NYSDEC and federal wetlands (based on NWI maps) currently located within 2 mi (3.2 km) of Onondaga Lake are shown in Figure 3-3. Characteristics of these NYSDEC wetlands, such as class, area, and predominant vegetation, are presented in Table 3-2. NYSDEC classifies and regulates wetlands in New York State pursuant to 6 NYCRR Parts 663 and 664. Regulated wetlands must be at least 12.4 acres (5.02 hectares) in area and must be dominated by hydrophytic vegetation. Smaller wetlands having "unusual local importance as determined by the Commissioner" may also be regulated by the state.

Twenty-two state-regulated wetlands exist either wholly or partially within 2 mi (3.2 km) of Onondaga Lake (see Figure 3-3) (NYSDEC, 1986). Four of these wetlands occur along or near the lake's shoreline near the mouths of Harbor Brook, Ley Creek, and Ninemile Creek, as well as along the northwest shoreline of the lake. These four wetlands, SYW-6, 10, 12, and 19, are directly connected to Onondaga Lake and are therefore believed to be representative of the impact of the lake's contamination on wetlands in its vicinity.

- **Wetland SYW−6,** located at the northwest border of Onondaga Lake, is a 100-acre (40.6-hectare), Class I wetland. The wetland is divided by a series of elevated paths. The paths are used primarily by pedestrians, but are large enough to support vehicles. The paths create cells in the wetland that are not obviously connected by surface flows, though some cells are hydrologically connected via culverts. A few cells in this wetland are directly connected to the lake through culverts under the paths. The cells in the wetland vary in vegetation type but are dominated by floodplain forest or emergent swamps.

- **Wetland SYW−10,** located along Ninemile Creek, is a 27.2-acre (11-hectare), Class I wetland. This wetland is divided by Interstate 690 (I-690). On the lake side of I-690 the wetland is dominated by emergent vegetation and floodplain forest. This portion of the wetland is also being investigated as part of the Geddes Brook/Ninemile Creek site. The wetland section on the western side of I-690 was originally a salt marsh; however, the saline inputs appear to be gone and the wetland is now dominated by typical emergent vegetation. A portion of the wetland on the western side of I-690 (known as the "Maestri 2" site) has been filled with waste from the Crucible Materials Corporation and is currently being independently investigated as part of a separate RI/FS by the potentially responsible parties (PRPs) for the Maestri 2 site.

- **Wetland SYW−12,** located between the mouth of Onondaga Creek and the mouth of Ley Creek, is a 40.7-acre (16.5-hectare), Class I wetland. The northeast edge of this wetland is separated by railroad tracks. As the wetland approaches the lake it is dominated by emergent vegetation. Along the shore of the lake the wetland is a combination of floodplain forest and emergent marsh.

- **Wetland SYW−19,** located at the mouth of Harbor Brook, is a 19.8-acre (8-hectare), Class II wetland. This wetland is currently dominated by reedgrass (*Phragmites australis*), a species commonly found in disturbed or contaminated areas. This wetland area is located on Honeywell property and is also being investigated as part of the Wastebed B/Harbor Brook site. A discussion of the Wastebed B/Harbor Brook site as a source of contamination to Onondaga lake is discussed in Appendix G of this BERA and in the Onondaga Lake RI (TAMS, 2002b).

The US Fish and Wildlife Service (USFWS) maintains maps of wetlands and deepwater systems through the NWI program. NWI-identified wetlands may be any size and fall within the jurisdiction of the US Army Corps of Engineers (USACE). A total of 205 individual NWI wetlands and deepwater systems occur within 2 mi (3.2 km) of Onondaga Lake (see Figure 3-3) (USFWS, 1999), including 3 limnetic lacustrine systems, 15 littoral lacustrine wetlands, 2 low-perennial riverine systems, and 185 palustrine wetlands.

Table 3-3 presents the physical and biological attributes of each of the above-listed wetlands or systems, according to the NWI classification scheme (USFWS, 1999).

NYSDEC Significant Habitats

According to the database maintained by the NYNHP, sensitive aquatic habitats located near Onondaga Lake are inland salt ponds and marshes (NYNHP, 2001, 2002; see Appendix C). As described below, inland salt ponds are found along the southeastern shoreline of the lake (see Figure 3-4). Inland salt marshes are found adjacent to the inland salt ponds, as well as along Ninemile Creek, west of I-690 (see Figure 3-4).

3.2.4.2 Terrestrial Environment

The following descriptions of the key components of the terrestrial environment near Onondaga Lake are based largely on the information presented in the RI/FS Work Plan (PTI, 1991).

Soils

The soils of the Onondaga Lake watershed consist primarily of glacial till mixed with glacial outwash, alluvial deposits, and unconsolidated sediments. The soils tend to be medium-textured, well drained, and high in lime (NYSDEC, 1989; Soil Conservation Service [SCS], 1977). The drainage basin of the lake is in the northern portion of a region of drumlins and is characterized by narrow, steep-sided valleys. During rainstorms, large amounts of soil erode into valley streams (Lincoln, 1982; Murphy, 1978; NYSDEC, 1989).

Most of the soils along the western, southern, and eastern sides of the lake have been so substantially altered by humans that the original soils are unrecognizable or absent. These soils are classified as "made land" and "urban land" (NYSDEC, 1989). The urban land includes developed areas covered by concrete and buildings, such as parking lots, business parks, and shopping malls. In addition, land has been created along the southern half of the lake shoreline by filling areas with sand, silt, brick, ashes, cinders, Solvay waste, and other wastes.

Solvay Wastebeds

The soda-ash wastes generated as part of the soda-ash manufacturing process at the Honeywell facilities were deposited in a series of wastebeds along the southern and western shorelines of Onondaga Lake and along Ninemile Creek (PTI, 1991). The wastebeds located on the western shoreline are currently exposed (see Chapter 2, Figure 2-3), whereas some of the remaining wastebeds have been covered. The Solvay wastes also extend into the lake in some areas. Vegetation has begun to colonize some of the wastebeds; however, in many areas the vegetation is sparse and composed of few species. In areas where the slope of the wastebed is steep, vegetation is unable to grow and exposed cliffs are visible. Along the southwest shoreline of the lake, cliffs have formed due to the erosion of the waste into the lake.

Lakeshore

In general, the eastern shore of Onondaga Lake is urban and residential, and the northern shore is dominated by parkland, wooded areas, and wetlands. The northwest upland is mainly residential, with interspersed urban structures and several undeveloped areas. Much of the western lakeshore is covered by wastebeds, and, to a lesser extent, dredge spoils from the lake, many of which have been abandoned and recolonized by vegetation. Urban centers and industrial zones dominate the landscape surrounding the south end of Onondaga Lake from approximately the fairgrounds to Ley Creek. More detailed descriptions of the covertypes found along various parts of the lakeshore are presented below.

The terrestrial covertypes found within 0.5 miles (0.8 km) of Onondaga Lake were presented previously in Figure 3-4. The covertypes were mapped using a combination of aerial photographs and the results of ground-level surveys. Approximately 42 percent of the areal extent of covertypes identified in Figure 3-4 is residential, 33 percent is urban/industrial, and 25 percent is characterized as open, forested, or palustrine. Detailed descriptions of each kind of covertype are in Appendix A. Characteristic flora of each covertype community are listed in Table A-1 of Appendix A.

East

Urban development associated with the city of Syracuse and the towns of Liverpool and Galeville characterizes the eastern shore of Onondaga Lake. Onondaga Lake Parkway (Highway 370) and railroad tracks pass very close to the southern portion of the eastern shore. The middle section of the eastern shoreline includes a marina, public landing, and Onondaga Lake Park. The parkland follows the shoreline north to the lake outlet, and similar habitat (mowed lawn with trees) extends north along the east side of the outlet to the Seneca River. Several segments of the former Oswego Canal still exist within the park.

Shallow emergent marsh and marsh dominated by reedgrass and purple loosestrife (*Lythrum salicaria*) border Ley Creek, which flows into the southeast corner of the lake. Successional open habitat (old fields and shrubland) and unmowed roadside areas characterize the area lying northwest of Ley Creek, to the east of the Oswego Boulevard Parkway. Several inland salt ponds surrounded by salt marsh and successional shrubland occur along the southern section of the eastern shore.

Northwest

The Sawmill Creek area north of the lake is generally low-lying and dominated by reedgrass/purple loosestrife marshland and floodplain forest. These communities extend northwest toward the Seneca River and are bisected below John Glenn Boulevard by a stand of successional northern hardwoods. The open residential lands lying to the east of the wooded areas are characterized by mowed lawn with trees.

The predominant vegetative community on Klein Island (at the mouth of the lake outlet) is successional northern hardwood forest. Two stands of floodplain forest visible in aerial photographs suggest that lower areas are subject to periodic flooding. However, this land is private and could not be accessed for verification.

The area extending west from the northern section of the lake outlet toward the Seneca River and following the river west for at least 0.5 mi (0.8 km) is primarily wetland and includes floodplain forest, shallow and deep emergent marshes, and reedgrass/purple loosestrife marsh. A mixture of habitats, including open residential land, stands of successional northern hardwoods, patches of floodplain forest, and a pine plantation, lie between John Glenn Boulevard and I-90 on the west side of the lake outlet. From here, an industrial zone extends southwest on either side of I-90.

Onondaga Lake Park extends down the northwest shore of the lake from the lake outlet to Ninemile Creek and includes both wetlands and adjacent forested upland areas. The shoreline here is characterized by wetland communities, including reedgrass/purple loosestrife marsh, floodplain forest, deep emergent marsh, and, in particular, silver maple/ash swamp. Several patches of open water occur throughout this zone. The upland communities to the southwest of the park are mainly residential, with a few forested areas as well as smaller patches of trees and successional open habitat.

Lakeview Point Area (West)

The mouth of Ninemile Creek forms the northern border of an area known as Lakeview Point. A reedgrass/purple loosestrife community and floodplain forest follows the creek bed upstream, southwest of the lake. Lakeview Point is comprised mainly of calcareous waste derived from soda-ash production, although several of the wastebeds here were also used as landfills for steel-mill waste and sewage sludge disposal (PTI, 1991). Some vegetation has colonized these wastebeds despite the poor nutrient content of the calcareous substrate (Richards, 1982). One section of Lakeview Point was seeded with grass in the recent past.

A large section of Lakeview Point serves as a parking area for the state fairgrounds and is classified as unmowed roadside habitat. South of Lakeview Point are the fairgrounds themselves, surrounded by unmaintained lawn, pavement, mowed roadside, and urban structures. Several successional old fields and a stand of successional northern hardwoods lie beyond the railroad tracks south of the fairgrounds. East of this area, the terrain is covered with a mixture of urban structures, urban vacant lots, successional shrubland, and pavement. Another inland salt marsh, considerably larger than those remaining on the east side of the lake, lies just west of the north end of Lakeview Point, to the west of I-690.

South

Reedgrass/purple loosestrife marsh dominates the lakeshore south of Lakeview Point. The mouths of Tributary 5A, the East Flume, and Harbor Brook lie within this marsh, as does a strip of successional shrubland. Trees and shrubs follow Harbor Brook upstream, south of the marsh. The upland portion of the southwestern shoreline includes wastebeds, urban vacant lots, successional shrubland, mowed roadside, and several interconnecting railroad tracks. Tributary 5A is surrounded by shrubland.

The old Barge Canal terminal is at the mouth of Onondaga Creek. The lakeshore to the west of the terminal is riprap, while a mixture of reedgrass/purple loosestrife marsh and floodplain forest populate the shoreline between the terminal and Ley Creek.

An entirely industrial area lies to the west of the canal terminal. The ground cover in that area includes junkyards, maintenance spoils depositories, the Metro sewage-treatment plant, urban structures, mowed and unmowed roadsides, pavement, and interstate highways.

Urban structures and an old field form most of the west bank of the canal terminal. A large regional shopping mall is located immediately to the north of the canal terminal and west of the Oswego Boulevard Expressway. A large paved area is located southeast of the mall, also alongside the canal terminal. North of the expressway and southeast of Ley Creek is another urban area comprising mowed and unmowed roadside, old fields, mowed lawn, and urban structures.

NYSDEC Significant Habitats

According to the database maintained by the NYNHP, there are no significant or sensitive terrestrial habitats near Onondaga Lake (see Appendix C).

3.2.5 Biological Resources

The key biological resources described in this section include the major communities of aquatic, semiaquatic, and terrestrial organisms, including rare, threatened, and endangered species, found in and around Onondaga Lake, as follows:

- Major aquatic communities – macrophytes, phytoplankton, zooplankton, benthic macroinvertebrates, and fish.
- Major semiaquatic organisms – amphibians and reptiles.
- Major terrestrial organisms – plants, birds, and mammals.

These groupings are used for general descriptions of biological resources. However, there are exceptions to these broad characterizations. For example, some snakes may spend their entire life cycle in upland areas and some birds and mammals (e.g., loon [*Gavia immer*] and river otter [*Lutra canadensis*]) may spend most of their time in aquatic habitats.

3.2.5.1 Aquatic Species

Macrophytes

Little information is available on the historical occurrence of macrophytes in Onondaga Lake. There are accounts of macrophyte beds at the northern end of the lake, near the mouths of tributaries, and immediately south of the discharge point of Tributary 5A (Murphy, 1978). It has also been reported that *Potamogeton pectinatus* (Stone et al., 1948), *P. crispus* (Saroff, 1990), and *Ceratophyllum* sp. (Saroff, 1990) have been observed in the lake at various times. Dean and Eggleston (1984) suggested that extensive beds of charophytes (either *Nitella* sp. or *Chara* sp.) were present in the lake because the stems of those plants formed the nuclei of the majority of the oncolites that are found throughout parts of the nearshore zone of the lake. The disappearance of charophytes may be attributed to the enriched calcium discharge associated with the Solvay process (Dean and Eggleston, 1984).

The most recent studies of macrophytes in Onondaga Lake have been conducted between 1991 and 1995 (Madsen et al., 1993, 1996; Auer et al., 1996a; PTI, 1993c; Arrigo, 1995). The six species identified in the lake during those studies are *Ceratophyllum demersum*, *Elodea canadensis*, *Heteranthera dubia*, *Myriophyllum spicatum*, *Potamogeton crispus*, and *P. pectinatus*. The distribution of macrophytes throughout the nearshore zone of Onondaga Lake was mapped in 1992 during the RI using aerial photography and ground-level verification of the photographic results (Figure 3-15). The survey was repeated in 1995 using identical methods to evaluate potential changes in macrophyte distributions during the three-year period between surveys.

In 1992, five macrophyte species were identified in the lake (all species noted above except *Elodea canadensis*). Although macrophyte beds were found throughout the littoral zone of the lake, relatively large areas of the littoral zone were characterized by sparse beds. Major beds were largely confined to the southeastern corner of the lake (between Harbor Brook and Onondaga Creek) and along the eastern and northern shorelines between Bloody Brook and the lake outlet. In 1995, an additional species (*E. canadensis*) was identified in the lake and the distribution of macrophyte beds had expanded throughout the nearshore zone of the lake. Major new beds were found (Arrigo, 1995) near the mouths of Ninemile and Ley Creeks, and a series of new beds was found off the western shoreline north of Tributary 5A.

Phytoplankton

Phytoplankton communities have been routinely monitored at two stations in Onondaga Lake since 1970 by the Onondaga County Department of Water Environment Protection (OCDWEP). One station is located near the center of the northern basin of the lake, and the other station is located near the center of the southern basin. In addition to the monitoring studies, Sze and Kingsbury (1972) and Sze (1975, 1980) conducted evaluations of phytoplankton communities in the lake. Murphy (1978) has reviewed much of the historical information on phytoplankton communities of Onondaga Lake. More recent information is presented in Auer et al. (1996a).

In 1992, 36 phytoplankton taxa were collected (PTI, 1993c; Stearns & Wheler, 1994) in Onondaga Lake (Table 3-4). According to Stearns & Wheler (1994), blooms of phytoplankton in 1992 continued to be a symptom of the eutrophic condition of the lake. The major algal groups in 1992 were flagellated green algae, non-flagellated green algae, diatoms, cryptomonads, and cyanobacteria (i.e., blue-green algae). Since 1986, non-flagellated green algae and diatoms have declined in abundance, whereas cryptomonads and flagellated green algae have continued to be abundant. Between 1990 and 1992, phytoplankton abundances remained relatively constant. However, there has been an overall decline in the abundance of eukaryotic algae, coupled with an increase in abundance of blue-green algae. From April to June of 1992, phytoflagellates were dominant until a clearing event with low algal abundances began on June 3. Blue-green algae were abundant from mid-July until early September.

Zooplankton

In addition to phytoplankton, zooplankton communities in Onondaga Lake have been routinely monitored since 1970 by OCDWEP. Murphy (1978) briefly reviewed a subset of this historical information. The zooplankton communities of the lake have also been evaluated by Meyer and Effler (1980), Garofalo and Effler (1987), Auer et al. (1990, 1996a), and Siegfried et al. (1996).

Between 1986 and 1989, 25 zooplankton taxa were collected in Onondaga Lake (Table 3-5) (Auer et al., 1996a). Zooplankton communities were dominated by cladocerans, copepods, and rotifers. From 1990 to 1992, zooplankton abundances remained relatively constant. In 1992, three peaks of copepod and cladoceran abundances were found: late May to June, late July to August, and late September to November (PTI, 1993c; Stearns & Wheler, 1994). Historically, Onondaga Lake has had a very low number of zooplankton species (Auer et al., 1996a). The total number found during the 1986 to 1989 study demonstrated a large increase in the number of species found in the lake. However, even this increased number of species is small when compared to other lakes in the region. Contamination of lake water by stressors and chemicals is the likely cause of the lack of species richness in the lake (Auer et al., 1996a).

Benthic Macroinvertebrates

Historically, the characteristics of benthic macroinvertebrate communities in Onondaga Lake have not been intensively studied. For the historical studies that have been conducted, sampling was performed at only a small number of stations in the lake. Results of the historical evaluations have been described by Stone et al. (1948), Noble and Forney (1971), and Auer et al. (1996a).

In 1989, the populations of benthic macroinvertebrates in the lake were dominated by pollution-tolerant species of oligochaetes and chironomids. While the species richness was low, the density of local population was high. Several pollution-intolerant species that should be expected in similar unpolluted lake environments were absent, including crayfish, caddisflies, and mayflies (Auer et al., 1996a).

In 1992, benthic macroinvertebrate communities were sampled at 68 stations throughout Onondaga Lake as part of the RI (PTI, 1993c). More than 70 taxa were identified in the samples (Table 3-6). Communities at most stations were dominated numerically by oligochaetes and chironomids. The lake's benthic communities were sampled at 15 stations in 2000, with a similar number of taxa identified (i.e., more than 70). Communities continued to be dominated numerically by oligochaetes and chironomids. The benthic macroinvertebrate communities sampled in 1992 and 2000 are described in greater detail in Chapter 9, where they are used as indicators of potential sediment toxicity.

Fish

Historically, Onondaga Lake supported a cold-water fishery. Common species found in the lake included Atlantic salmon (*Salmo salar*), cisco (*Coregonus artedii*), American eel (*Anguilla rostrata*), and burbot (*Lota lota*) (Auer et al., 1996a). The first scientific survey of the lake in 1927 indicted that the cold-water fishery was disturbed due to the impacts of soda-ash production (Table 3-7). By 1969, the fishery of Onondaga Lake was described as a warm-water fishery with none of the cold-water species observed. Historical information on the fish communities of Onondaga Lake has been collected by Greeley (1927), Noble and Forney (1971), and Chiotti (1981). The most current information on fish communities in the lake has been summarized by Gandino (1996) and Auer et al. (1996a).

According to Auer et al. (1996a) and Tango and Ringler (1996), Onondaga Lake supports a warm-water fish community that is dominated by the pollution-tolerant gizzard shad (*Dorosoma cepedianum*), freshwater drum (*Aplodinotus grunniens*), carp (*Cyprinus carpio*), and white perch (*Morone americana*). Sunfish are abundant in the littoral zone. The lake supports several important sportfish, including channel catfish (*Ictalurus punctatus*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), and walleye (*Stizostedion vitreum*).

Between 1927 and 1994, 57 species of fish were collected in Onondaga Lake (Table 3-7). The abundance of these species varies widely. Eleven species, including banded killifish (*Fundulus diaphanus*), bluegill (*Lepomis macrochirus*), brook silverside (*Labidesthes sicculus*), carp, emerald shiner (*Notropis atherinoides*), gizzard shad, golden shiner (*Notemigonus crysoleucas*), largemouth bass, pumpkinseed (*Lepomis gibbosus*), white perch, and yellow perch (*Perca flavescens*), appear to reproduce with moderate or high success around the lake (Table 3-8). All the remaining species of fish have limited or no success reproducing in the lake (Auer et al., 1996a).

The Oswego River basin supports 100 species of fish, including burbot, green sunfish (*Lepomis cyanellus*), trout-perch (*Percopsis omiscomaycus*), and brook trout (*Salvelinus fontinalis*). Individuals of these pollution-intolerant species (Tango and Ringler, 1996) are seldom encountered in the lake and there is no evidence of these species reproducing within the lake.

A number of species collected in Onondaga Lake migrate in from other areas. For example, the one lake trout caught in Onondaga Lake was a tagged fish that originated from a stocking in the Finger Lakes (Tango and Ringler, 1996). Species that are not known to reproduce in the lake are dependant on other areas to maintain the population within the lake. Ringler et al. (1995) conducted a tagging study of lake fish in 1990 and 1991, and found that a number of fish migrated out of the lake and entered the Seneca River system. Tagged fish were found as far upstream as Baldwinsville on the Seneca River (6.2 mi [10 km] away) and as far downstream as Fulton on the Oswego River (15.5 mi [25 km] away). The authors also used radio telemetry to follow fish movements during fall turnover in 1991. Several fish were found to leave the lake and enter the Seneca River during the turnover period (i.e., when DO concentrations become reduced in lake water). At least one individual later moved back into the lake when DO concentrations increased. Ringler et al. (1995) concluded that the Seneca River is a corridor for fish movement into and out of Onondaga Lake. The authors also noted that these movements indicate that some fish with elevated chemical concentrations in tissue likely leave the lake and enter the Seneca River system.

Rare, Threatened, and Endangered Aquatic Species

According to the databases maintained by the NYNHP and USFWS, there are no federally or state-listed rare, threatened, or endangered aquatic species in Onondaga Lake (see Appendix C).

3.2.5.2 Semiaquatic Species

The species associated with the original wetlands surrounding the lake were not recorded. Cicero Swamp, a large wetland in Onondaga County, is home to a large number of unique wetland species such as the eastern Massasauga rattlesnake (*Sistrurus catenatus*) and the spotted turtle (*Clemmys guttata*). Because the conditions of most of the wetlands surrounding the lake are not similar to Cicero Swamp, the species occurring in the swamp have not been considered as species to be expected near the lake. However, it is possible that conditions for these species were historically present around the lake.

The amphibian and reptile species expected to occur in the habitats surrounding Onondaga Lake are listed in Table 3-9. Surveys of the amphibians inhabiting Onondaga Lake and its surrounding wetland and terrestrial habitats were conducted by researchers from the State University of New York (SUNY) Cortland from 1994 to 1997 (Ducey and Newman, 1995; Ducey, 1997; Ducey et al., 1998). In addition, species distributions and qualitative evaluations were conducted from March 1995 to May 1997 (Ducey, 1997). Although the surveys were directed toward the assessment of amphibian populations, reptiles were also identified and recorded when encountered.

The amphibian and reptile species found near Onondaga Lake between 1994 and 1997 are listed in Table 3-10 and include the following taxa:

- **Amphibians** – Seven species, comprised of five species of anurans (i.e., frogs and toads) and two species of salamanders.

- **Reptiles** – Six species, comprised of three species of aquatic snakes and three species of turtles.

Fewer species were found around Onondaga Lake than expected. In general, the numbers of amphibian and reptile species found near the lake were less than the numbers typically found in similar areas of central

New York State (Ducey and Newman, 1995; Ducey, 1997; Ducey et al., 1998). Amphibian reproduction appears to be limited to wetlands that are not directly connected to Onondaga Lake water (Ducey, 1997), indicating intolerance of lake water. Additional discussion on potential toxicity is included in Chapter 9.

Rare, Threatened, and Endangered Semiaquatic Species

According to the databases maintained by the NYNHP and USFWS, there are no federally or state-listed rare, threatened, or endangered semiaquatic species in Onondaga Lake (see Appendix C).

3.2.5.3 Terrestrial Species

Birds

Onondaga Lake provides a variety of habitats for bird species. Table 3-11 lists species of birds found around Onondaga Lake during the Breeding Bird Atlas survey conducted from 1980 to1985 (Andrle and Carroll, 1988). More recent data suggest that additional species have started to use the lake. The recent Breeding Bird Atlas survey (beginning in 2000 and scheduled to extend until 2004) has recorded other species, such as the turkey vulture (*Cathartes atratus*) and Canada goose (*Branta canadensis*) (Table 3-11). A list of 22 additional bird species observed near Onondaga Lake in the summer of 1993, but not identified in the Andrle and Carroll 1988 survey (and, therefore, not presented in Table 3-11), is presented in Table 3-12 (Tango, 1993).

A list of 13 species of waterfowl that overwintered near Onondaga Lake between 1990 and 1999 is presented in Table 3-13. The New York Audubon Society conducts annual winter surveys (Christmas counts by county) and waterfowl surveys (by water body).

Mammals

A list of 45 mammalian species that potentially occur near Onondaga Lake is presented in Table 3-14. Some of the more common species include opossums, shrews, rodents, muskrats, raccoons, skunks, and deer. New York State species of special concern and endangered species are also identified in this table.

Rare, Threatened, and Endangered Terrestrial Species

Ten state-listed and one federal rare, threatened, or endangered species have been observed near Onondaga Lake. They include four plant species and seven species of birds (see Appendix C).

The three listed plant species within 2 mi (3.2 km) of Onondaga Lake are Sartwell's sedge (*Carex sartewelli*), little-leaf tick-trefoil (*Desmodium ciliare*), and red pigweed (*Chenopodium rubrum*). All three plant species are known only from historical records. They have not been sighted in the Onondaga Lake area recently, but may be rediscovered. Hart's tongue fern (*Asplenium scolopendrium var* *americanum*), a federally listed threatened species, may also be present in the area of Onondaga Lake. The general locations of listed plants near Onondaga Lake are shown on Figure 3-1.

The six state-listed bird species of special concern observed near Onondaga Lake (Tables 3-11 and 3-12) are the common loon (*Gavia immer*), osprey (*Pandion haliaetus*), sharp-shinned hawk (*Accipiter striatus*), common nighthawk (*Chordeiles minor*), red-headed woodpecker (*Melanerpes erythrocephalus*), and horned lark (*Eremophila alpestris*). The common tern (*Sterna hirundo*) is classified as a New York State-threatened species.

3.2.6 Observations of Stress

As specified for Step I of an FWIA (NYSDEC, 1994a), any atypical biotic conditions observed at a site should be identified. Although there have been numerous observations of potential stress in Onondaga Lake in past studies, some of the more recent observations of potential stress on lake biota include:

- Reduced species richness and standing crop of macrophytes in the nearshore zone (Auer et al.,1996a).
- Blooms of nuisance forms of cyanobacteria (i.e., blue-green algae) in the water column during summer (Auer et al., 1996a).
- Increased oncolite density (Dean and Eggleston,1984).
- Chloride loadings to Onondaga Lake from Wastebeds 1 to 8 through seeps on the east side of the beds, deep groundwater discharges, and direct erosion of Solvay waste by wave action along the lakefront (Blasland & Bouck, 1989).
- Reduced species richness of zooplankton communities (Auer et al.,1996a).
- Dominance of benthic macroinvertebrate communities by pollution-tolerant taxa (Auer et al., 1996a).
- Apparent lack of reproduction in the lake by numerous fish species (Auer et al., 1996a).
- Change in fishery assemblage from cold-water fishery to a warm-water fishery dominated by pollution-tolerant species (Tango and Ringler, 1996).
- Mercury contamination of fish (NYSDEC, 1987).
- Disappearance of fish from the lake during fall turnover (Auer et al., 1996a).

- Reduced species richness of amphibians and reptiles (Ducey et al., 1998).

- Lack of amphibian reproduction in wetlands directly connected to lake water (Ducey, 1997).

- Lack of spring turnover in the lake prior to 1987 (Owens and Effler, 1996).

3.3 Description of Fish and Wildlife Resource Values

As specified for Step I of an FWIA (NYSDEC, 1994a), a qualitative assessment of the value of fish and wildlife resources at a site should be made with respect to both associated fauna and humans. The current conditions and potential future value of contaminant-free resources are discussed below.

3.3.1 Value to Associated Fauna

3.3.1.1 Wetlands

Current Conditions

There are approximately 320 acres (130 hectares) of state-regulated wetlands and numerous smaller wetlands directly connected to Onondaga Lake or within its floodplains (i.e., Wetlands SYW-1, SYW-6, SYW-10, SYW-12, and SYW-19). The value of the wetlands currently connected to the lake has been reduced by the contamination in the lake. The disturbance due to contamination is evident in the limited breeding and decrease in amphibian populations. Lack of waterfowl species identified in the Breeding Bird Atlas for 1980 to 1985 (Andrle and Carroll, 1988) suggested that wetlands around the lake were not being used extensively by waterfowl. The effects of wetland contamination on fish and mammal populations has not been evaluated.

Potential Future Value

Recent improvements in water quality within the lake may be allowing the return of wildlife populations that utilize the wetlands. Also, improvements to the water quality in the lake may improve the wetland habitat quality itself and facilitate the return of additional species. Continued improvement of sewage treatment, closure of the Honeywell plant on the western shore of the lake in 1986, eliminating sources of pollution, and potential lake and wetland remediation projects will permit the wetlands to be more suitable for a variety of species.

The wetlands surrounding the lake can function as breeding habitat for waterfowl and other birds. Recent sightings of increased numbers of waterfowl and shoreline-related birds suggest that the populations may be beginning to recover. The unique saline character of the lake allows for the formation of inland salt marshes, a globally rare habitat. The wetlands surrounding the lake could provide breeding habitat for many species of amphibians and turtles. Fish may use the wetlands directly connected to the lake as breeding habitat; these same wetlands can function as fish nurseries.

3.3.1.2 Aquatic Habitats

Current Conditions

Lake water and sediment contamination has reduced the value of the lake to resident aquatic life, and is having a significant effect on a number of aquatic and semi-aquatic populations. Many fish are unable to reproduce in the lake, due to either breeding habitat degradation or the lack of DO. The fish are contaminated with chemicals, which are passed on to their predators. Lakewide populations of macrophytes are small, due to an inability to anchor in many parts of the lake. The low quality of lake sediments contaminated by ionic wastes and the presence of oncolites make macrophyte establishment difficult, resulting in wave action having an amplified effect on aquatic macrophytes in the lake.

Despite widespread contamination, wildlife populations continue to use the lake. Onondaga Lake is within the Atlantic flyway and functions as a stopover point for mergansers, loons, and other waterfowl migrating to the Adirondack Mountains. The fish populations within the lake provide the basis for the diets of many species. Osprey, gulls, herons, terns, and cormorants regularly feed on fish in Onondaga Lake. Presently many species of fish are dependent on other areas, such as the Seneca River, for breeding habitat to support their populations.

Potential Future Value

In the past, Onondaga Lake has supported salmonid species such as the Atlantic salmon. The upper reaches and tributaries of Ley Creek, Harbor Brook, and Ninemile Creek are Class C waters with C(T) standards (for trout waters), and could potentially provide breeding habitat for salmonids. Research suggests that continued recovery and restoration of aquatic plants could lead to greater reproductive success for the species of fish within the lake.

3.3.1.3 Terrestrial Habitats

Current Conditions

Many locations along the lakeshore area have been heavily urbanized and contaminated, which has reduced the value of the lake to resident terrestrial species. The urbanization and the levels of contamination are having a significant effect on a number of terrestrial populations which inhabit the lakeshore.

Potential Future Value

The shores of Onondaga Lake provide habitat for several mammal species. Recovering populations of otter appear to be moving toward the lake (NYSDEC, 2002a; Stiles, 2001). Woodchuck (*Marmota monax*), muskrat (*Ondatra zibethicus*), and squirrels (e.g., *Sciurus carolinensis*) are regularly observed on the shores of Onondaga Lake. These and other small-mammal species support predators such as mink (*Mustela vison*), fox (*Vulpes fulva* and *Urocyon cinereoargenteus*), and coyote (*Canis latrans*). The less-disturbed shoreline of the northwest section of the lake can provide habitat for more reclusive or larger species, such as beaver (*Castor canadensis*) and deer (*Odocoileus virginianus*).

Typically, large bodies of water in urban areas provide important habitat to migrating bird species, which use the lakeshore as a resting area during migration. Reductions in contamination are also likely to improve the distribution and abundance of terrestrial invertebrates, reptiles, and amphibians, which are major food sources for many terrestrial vertebrates, such as birds and small mammals. Populations of reptiles and amphibians may become reestablished in the Onondaga Lake area.

3.3.2 Value to Humans

The fish and wildlife resources of Onondaga Lake and its surrounding areas are used by humans for a variety of purposes, including:

- **Boating** – The marina located on the eastern shoreline of the lake, and the lake's connection to the Seneca River, facilitate use of the lake by boaters. In addition, Syracuse University maintains a boathouse on the lake outlet and uses the lake for competitive rowing events. The lake is connected to the Barge Canal system and an effort has been made to encourage boaters using the canal to stop at the lake.

- **Fishing** – Onondaga Lake contains numerous fish species, such as walleye, largemouth bass, and smallmouth bass, that are sought after by recreational anglers. Fishing was banned in Onondaga Lake in 1970 due to elevated mercury levels in fish flesh. It was reopened as a catch-and-release fishery in 1986, with an advisory to eat no fish (Sloan et al., 1987). In 1999, restrictions were lifted to current levels, which state that individuals should consume no more than one meal per month of Onondaga Lake fish, with the exception of walleye, which should not be eaten at all due to elevated levels of mercury, and that women of childbearing age and children under the age of 15 should eat none (NYSDEC, 2002b). Recent fishing derbies have been held to increase public interest in the fishery. In the past other species of fish were present in the fishery such as cisco, salmon, and trout.

- **Hunting and Trapping** – Where permission has been granted by the appropriate landowner and when laws permit, the shores of Onondaga Lake provide hunting and trapping opportunities. Waterfowl and deer populations are abundant enough to support hunting. In addition, mink, fox, and other mammals can be trapped.

- **Recreation** – More than 75 percent of the shoreline of Onondaga Lake is owned by Onondaga County and is classified as parkland, which in 1990 was used by more than one million people. Common activities include picnicking, walking, jogging, roller blading, and bicycling. A project is now underway to construct a recreational-use path around the entire lakeshore.

- **Swimming** – In the past, the lake has been used for swimming. The northern two-thirds of the lake is classified by New York State for direct recreational contact (i.e., Class B Waters). Swimming is limited due mainly to the lack of permitted beaches.

- **Inner Harbor** – New development has occurred near the southern shore of Onondaga Lake, along Onondaga Creek and the Barge Canal, as part of the Syracuse Inner Harbor Project. Approximately 42 acres of land, owned by the New York State Canal Corporation, are being developed for recreational and commercial uses by the Lakefront Development Corporation (LDC).

- **Commerce** – Onondaga Lake has long served as a backdrop for a number of industrial and commercial sites. Historically, the shores of Onondaga Lake were extensively developed by industries. The central location in the state, the salt deposits, and the presence of water supported an extensive salt recovery industry. Other industries also developed around the lake, some of which are still in operation today. Industrial sites have been converted to develop commercial properties in the vicinity of the lake, including Carousel Mall, the Regional Farm Market, and the New York State Fairgrounds parking area.

- **Tourism** – The city of Syracuse, Onondaga County, and New York State are attempting to increase the tourism industry in Syracuse. A future expansion of Carousel Mall, the development of the Inner Harbor, and the lakeside bike path are all part of this effort. The lake is central to these efforts as a scenic and recreational area.

- **Stormwater Retention** – The lake and its surrounding wetlands and tributaries are used extensively by Onondaga County for stormwater retention and discharge.

There are several plans to further enhance the use of Onondaga Lake and its surrounding areas by humans. For example, the Onondaga Lake Management Conference (OLMC) has prepared a management plan for the lake (OLMC, 1993), and the State of New York, Onondaga County, and the city of Syracuse have prepared a development plan for the lake (Reimann-Buechner Partnership, 1991).

3.4 Identification of Applicable Fish and Wildlife Criteria

Step I of an FWIA (NYSDEC, 1994a) requires the identification of both contaminant-specific and site-specific criteria applicable to the remediation of fish and wildlife resources. Section 121(d) of

Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) requires that remedial actions comply with state and federal applicable or relevant and appropriate requirements (ARARs). Applicable requirements are defined as any standard, requirement, criterion, or limitation promulgated under federal environmental law or any promulgated standard, requirement, criterion, or limitation under a state environmental or facility siting law that is more stringent than the associated federal standard, requirement, criterion, or limitation.

Relevant and appropriate requirements are those cleanup standards, control standards, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a National Priorities List (NPL) site, address problems or situations sufficiently similar (relevant) to those encountered, and are well-suited (appropriate) to circumstances at the particular site. Requirements must be both relevant and appropriate to be ARARs.

Potentially applicable laws and regulations, fish and wildlife criteria, and benchmark values are summarized in this section for use in the screening evaluation for the Onondaga Lake BERA. Selection of the screening values was based on their applicability to either freshwater or terrestrial environments. The potential chemical-specific, location-specific, and action-specific ARARs for evaluation in the Onondaga Lake FS in each of the three categories, along with other to-be-considered (TBC) requirements, are summarized in Chapter 9, Section 9.2 of the RI (TAMS, 2002b; Tables 9-1 to 9-6).

3.4.1 New York State Laws and Regulations

- **New York Environmental Conservation Law (ECL), Article 15, Title 3 and Article 17, Titles 3 and 8; 6 NYCRR Parts 700-706.** Water quality standards are established under various sections of the New York ECL, including Article 15 (ECL § 15-0313) and Article 17 (ECL §§ 17-0301, 17-0303, and 17-0809). The water quality standards for COCs and SOCs are provided in 6 NYCRR § 703.5 and 6 NYCRR Part 703.2 (and also published in NYSDEC's Technical and Operational Guidance Series [TOGS] Memo 1.1.1, Ambient Water Quality Standards and Guidance Values [NYSDEC, 1998; 1999a]).

- **New York State ECL Article 11, Title 5 – Endangered and Threatened Species of Fish and Wildlife – Species of Special Concern; 6 NYCRR Part 182.** The New York State endangered species legislation enacted in 1970 was designed to complement the federal Endangered Species Act (ESA) by authorizing NYSDEC to adopt the federal endangered species list so that prohibitions of possession or sale of federally listed species and products could be enforced by state enforcement agents. The state list can therefore include species that, while plentiful elsewhere, are endangered in New York. The law was amended in 1981 to authorize the adoption of a list of threatened species that would receive protection similar to endangered species. In addition to the threatened species list, NYSDEC also adopted a list of species of special concern, species for which a risk of endangerment has been documented by NYSDEC. The law and regulations restrict activities in areas inhabited by endangered species. The taking of any endangered or threatened species is prohibited, except under a permit or license issued by NYSDEC. The destroying or degrading the habitat of a protected animal likely constitutes a "taking" of that animal under NY ECL § 11-0535.

- **New York State ECL Article 15, Title 5, and Article 17, Title 3; 6 NYCRR Part 608 – Use and Protection of Waters**. These regulations cover excavation and fill of the navigable waters of the state. No person, local public corporation, or interstate authority may excavate from or place fill, either directly or indirectly, in any of the navigable waters of the state or in marshes, estuaries, tidal marshes, and wetlands that are adjacent to and contiguous at any point to any of the navigable waters of the state, and that are inundated at mean high water level or tide, without a permit (6 NYCRR 608.5). In accordance with CERCLA Section 121(e)(1), no federal, state, or local permits are required for remedial action that is conducted entirely on site, although the remedial action must comply with the substantive technical requirements of this statute and associated regulations.

- **New York ECL Article 17, Title 5, 6 NYCRR Part 701.1**. It shall be unlawful for any person, directly or indirectly, to throw, drain, run, or otherwise discharge into such waters organic or inorganic matter that shall cause or contribute to a condition in contravention of applicable standards.

- **New York ECL Article 17, Title 8; 6 NYCRR Part 750-758 – Water Resources Law**. These regulations provide standards for storm water runoff, surface water, and groundwater discharges. In general, they prohibit discharge of any pollutant to the waters of New York without a State Pollutant Discharge Elimination System (SPDES) permit. In accordance with CERCLA Section 121(e)(1), no federal, state, or local permits are required for remedial action that is conducted entirely on site, although the remedial action must comply with the substantive requirements of the Water Resources Law.

- **New York ECL Article 24 Title 7, Freshwater Wetlands; 6 NYCRR Parts 662 – 665**. Freshwater wetlands of New York State are protected under Article 24 of the ECL, commonly known as the Freshwater Wetlands Act (FWA). Wetlands protected under Article 24 are known as New York State regulated wetlands. The regulated area includes the wetlands themselves and a protective buffer or adjacent area that extends 100 feet landward of the wetland boundary. All freshwater wetlands with an area of 12.4 acres or greater are depicted on a set of maps published by NYSDEC. Wetlands less than 12.4 acres may also be mapped if they have unusual local importance. Four classes of wetlands (Class I, the most valuable, through Class IV, the least valuable) have been established and are ranked according to their ability to perform wetland functions and provide wetland benefits. Vegetative cover, ecological associations, special features, hydrological and pollution control features, distribution, and location are factors considered in the determination of wetland benefit.

- **New York State ECL Article 27, Title 13; 6 NYCRR Part 375 – Inactive Hazardous Waste Disposal Sites.** These regulations establish requirements for the development and implementation of inactive hazardous waste disposal site remedial programs.

3.4.2 Federal Laws and Regulations

- **Federal Water Pollution Control Act, as amended by the Clean Water Act (CWA) – 33 USC § 1251 et seq.; 40 CFR Part 129.** The Federal Water Pollution Control Act provides the authority for USEPA to establish water quality criteria. The toxic pollutant effluent standards are promulgated at 40 CFR 129. The ambient water criterion for COCs in navigable waters are established in 40 CFR § 129.105(a)(4).

- **Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) 42 USC § 103.** The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, provides authority for USEPA to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. CERCLA established prohibitions and requirements concerning closed and abandoned hazardous waste sites; provided for liability of persons responsible for releases of hazardous waste at these sites; and established a trust fund to provide for cleanup when no responsible party could be identified. The law authorizes two kinds of response actions: 1) short-term removals, where actions may be taken to address releases or threatened releases requiring prompt response; and 2) long-term remedial response actions, that permanently and significantly reduce the dangers associated with releases or threats of releases of hazardous substances that are serious, but not immediately life threatening. These actions can be conducted only at sites listed on USEPA's NPL. CERCLA was amended by the Superfund Amendments and Reauthorization Act (SARA) in 1986.

- **40 CFR Parts 9, 122, 123, 131, and 132, Tuesday March 23, 1995, Final Water Quality Guidance for the Great Lakes System Final Rule.** The Guidance consists of water quality criteria for 29 pollutants to protect aquatic life, wildlife, and human health, and detailed methodologies to develop criteria for additional pollutants.

- **Section 404 of the CWA (Federal Water Pollution Control Act, as amended), 33 USC § 1344; 33 CFR Parts 320 to 329.** Section 404 of the CWA establishes requirements for issuing permits for the discharge of dredged or fill material into navigable waters of the United States, and includes special policies, practices, and procedures to be followed by the US Army Corps of Engineers (USACE) in connection with the review of applications for such permits. These regulations apply to all existing, proposed, or potential disposal sites for discharges of dredged or fill materials into US waters, including wetlands. USEPA may prohibit fill if there is an unacceptable adverse impact on the receiving water body. In accordance with CERCLA Section 121(e)(1), no federal, state, or local permits are required for remedial action conducted entirely on site, although the remedial action must comply with the substantive requirements of CWA Sections 404 and 33 CFR Parts 320 to 329.

- **CWA Section 404 (33 USC § 1344), 40 CFR Part 230.** No activity that adversely affects an aquatic ecosystem (including wetlands) shall be permitted if there is a practical alternative available that has less adverse impact. If there is no practicable alternative, then the adverse impacts of the activity must be minimized.

- **Statement of Procedures on Floodplain Management and Wetlands Protection; 40 CFR Part 6, Appendix A.** These procedures set forth USEPA policy and guidance for carrying out Executive Orders (EO) 11990 and 11988.

  - **EO 11988 – Floodplain Management.** Requires federal agencies to evaluate the potential effects of actions that may be taken in a floodplain and to avoid, to the extent possible, long-term and short-term adverse affects associated with the occupancy and modification of floodplains, and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative.

  - **EO 11990 – Protection of Wetlands.** Requires that activities conducted by federal agencies avoid, to the extent possible, long-term and short-term adverse affects associated with the modification or destruction of wetlands. Federal agencies are also required to avoid direct or indirect support of new construction in wetlands when there are practical alternatives; harm to wetlands must be minimized when there is no practical alternative available.

- **Endangered Species Act, 16 USC§ 1531 et seq.; 50 CFR Parts 17, Subpart I, and 50 CFR Part 402.** The ESA of 1973 and subsequent amendments provide for the conservation of threatened and endangered species of animals and plants, and the habitats in which they are found. The act requires federal agencies, in consultation with the Secretary of Interior, to verify that any action is not likely to jeopardize the continued existence of any endangered or threatened species or its critical habitat, or result in the destruction or adverse modification of a critical habitat of such species. Exemptions may be granted by the Endangered Species Committee.

- **Fish and Wildlife Coordination Act, USFWS, 16 USC 661 – 667e.** Whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose, by any department or agency of the United States, such department or agency first shall consult with the United States Fish and Wildlife Service, Department of the Interior, and with the head of the agency exercising administration over the wildlife resources of the particular state in which the impoundment, diversion, or other control facility is to be constructed, with a view to the conservation of wildlife resources by preventing loss of and damage to such resources.

- **USEPA. Quality Criteria for Water.** This USEPA document (USEPA, 1986a) provides water quality criteria for the effects on freshwater species of organic and inorganic contaminants.

- **USEPA. Update #1 to Quality Criteria for Water.** This USEPA (1986b) document provides water quality criteria for the effects on freshwater species of organic and inorganic contaminants .

- **USEPA. Update #2 to Quality Criteria for Water.** This USEPA (1987b) document provides water quality criteria for the effects on freshwater species of organic and inorganic contaminants.

- **USEPA. Quality Criteria for Water, Update.** This USEPA (1991) document provides water quality criteria for the effects on freshwater species of organic and inorganic contaminants.

- **USEPA. National Recommended Water Quality Criteria – Correction.** This USEPA (1999c) document provides water quality criteria for the effects on freshwater species of organic and inorganic contaminants.

3.4.3 State and Federal Guidance

- **NYSDEC Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites.** This report (NYSDEC, 1994a) provides guidance for evaluating ecological impacts in areas contaminated with hazardous materials.

- **NYSDEC Freshwater Wetlands Delineation Manual.** This document (NYSDEC, 1995) provides the technical requirements for wetlands delineation in New York State.

- **NYSDEC Freshwater Wetlands Regulations Guidelines on Compensatory Mitigation.** This document (NYSDEC, 1997c) provides the technical requirements for wetlands mitigation for impacted wetlands in New York State.

- **NYSDEC Division of Fish and Wildlife – Niagara River Biota Contamination Project: Fish Flesh Criteria for Piscivorous Wildlife, Technical Report 87-3.** This report (Newell et al., 1987) provides a method for calculating contaminant concentration criteria in fish flesh for the protection of piscivorous wildlife, and establishes fish-flesh criteria for various contaminants, including mercury and PCBs.

- **NYSDEC Division of Fish, Wildlife and Marine Resources - Technical Guidance for Screening Contaminated Sediment.** This document (NYSDEC, 1999b) provides sediment screening values for metals and non-polar organic contaminants, such as mercury, PCBs, dioxin/furans, in units of micrograms of contaminant per gram organic carbon in sediment (μg/gOC) for organics and mg/kg dry weight for inorganics.

- **Ecological Risk Assessment Guidance for Superfund (ERAGS), Process for Designing and Conducting Risk Assessments.** This report (USEPA, 1997a) provides guidance on how to design and conduct consistent and technically defensible ecological risk assessments for the Superfund program.

- **USEPA Region 4. Waste Management Division Soil Screening Values for Hazardous Waste Sites.** USEPA Region 4 (1999) provides soil screening values for organic and inorganic contaminants effects on terrestrial species.

- **USEPA. Consensus-Based Freshwater Sediment Quality Guidelines.** This document (Ingersoll et al., 2000) evaluates the ability of consensus-based probable effect concentrations (PECs) to predict sediment toxicity building on the work of MacDonald et al. (2000).

- **USEPA. Ecotox Thresholds.** The Ecotox thresholds (USEPA, 1996a) provide water and sediment quality values for organic and inorganic contaminants effects on aquatic species for use in ecological risk assessments at Superfund sites.

- **USEPA. Calculation and Evaluation of Sediment Effect Concentrations for the Amphipod *Hyalella azteca* and the Midge *Chironomus riparius*.** This report (USEPA, 1996b) provides toxicological benchmarks for contaminant effects on sediment-dwelling benthic invertebrates.

- **USEPA. Technical Basis for Deriving Sediment Quality Criteria for Nonionic Organic Contaminants for the Protection of Benthic Organisms by Using Equilibrium Partitioning.** This document (USEPA, 1993a) provides methodology and sediment effects guidelines for non-polar organics for the protection of aquatic species.

- **USEPA. Considering Wetlands at CERCLA Sites.** This document (USEPA, 1993c) provides guidance on the methods required at Superfund sites when wetlands are either impacted by contamination or potentially impacted by future remedial efforts.

3.4.4 Other Applicable Guidance

- **Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision.** This report (Efroymson et al., 1997a) provides toxicological benchmarks for contaminant effects on terrestrial plants.

- **ORNL Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision.** This report (Efroymson et al., 1997b) provides toxicological benchmarks for contaminant effects on terrestrial invertebrates.

- **ORNL Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision.** This report (Jones et al., 1997) provides toxicological benchmarks for contaminant effects on sediment-dwelling benthic invertebrates.

- **Long et al. 1995. Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments.** This study (Long et al., 1995) provides toxicological benchmarks for contaminant effects on sediment-dwelling benthic invertebrates.

- **Persaud, et al. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of the Environment**. This report (Persaud et al., 1993) provides sediment quality values for organic and inorganic contaminants effects on sediment-dwelling benthic invertebrates.

- **ORNL Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision**. This report (Suter and Tsao, 1996) provides toxicological benchmarks for contaminant effects on aquatic species.

- **ORNL Toxicological Benchmarks for Wildlife: 1996 Revision.** This report (Sample et al., 1996) provides toxicological benchmarks for contaminant effects on birds and mammals.

- **Washington State Department of Ecology. Creation and Analysis of Freshwater Sediment Quality Values in Washington State.** This report (Washington State Department of Ecology [WSDE],1997) provides sediment quality values for organic and inorganic contaminants effects on freshwater sediment-dwelling benthic invertebrates.