

**CHARACTERIZATION OF AQUATIC HABITATS OF
SOUTHERN CAYUGA LAKE TRIBUTARIES AND SHORELINE,
ITHACA, NEW YORK**

Prepared for

City of Ithaca

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I. INTRODUCTION

The City of Ithaca, Tompkins County, NY is pursuing a waterfront revitalization plan that includes dredging Cayuga Inlet, the Flood Control Channel, Fall Creek, Cascadilla Creek, and Six Mile Creek, the major tributaries feeding the southern end of Cayuga Lake. As part of the feasibility and ecological review process, EcoLogic, LLC (EcoLogic) conducted a characterization of the aquatic habitats of the southern Cayuga Lake tributaries and shoreline that could potentially be affected by the proposed dredging project. This report provides the results of that survey conducted on July 17-18, 2008.

II. STUDY AREA

The aquatic habitat characterization was limited to the southern Cayuga Lake tributaries (Cayuga Inlet and Sixmile, Cascadilla, and Fall creeks) and shoreline that could potentially be affected by the proposed dredging project (Figure 1). This included the following areas.

- Cayuga Inlet main channel from mouth to the to Route 79 bridge
- Sixmile Creek from mouth to the State Street bridge
- Cascadilla Creek from mouth to the Route 13 bridge
- Fall Creek from mouth to ~1,000 ft downstream of the Route 13 bridge.
- The extreme southern end of Cayuga Lake east of the mouth of Fall Creek (adjacent to Stewart Park)

III. METHODS

The field survey was conducted by a two-person crew observing the project area from a canoe. The crew paddled the entirety of the project area making observations, taking photographs, and recording pertinent data related to available habitat and impairment of aquatic resources and their use due to sediment deposition within the waters of the project area. Individual habitat units within the project area were identified based on substrate type, the presence and type of vegetation, other cover types, depth, and bottom slope. A map of the various habitats within the

project area was created by sketching the approximate locations of habitat boundaries on a base map of the project area. Habitat units were identified during field reconnaissance as segments of the project area with relatively uniform habitat characteristics (e.g., substrate, vegetation, slope/depth, cover, wetland development, etc.). Each discrete habitat type within the project area was assigned a unique identifying number. Disjunct segments of similar habitat within the project area were given the same identifying number to increase efficiency in the field and complete the survey in a timely manner. Observations of fish, wildlife, and human use of the project waters and adjacent areas were also recorded.

Areas of special interest such as those bordering wetlands; those supporting notable vegetation, fish and wildlife use, or human use; and those with obvious impacts from sediment deposition were specifically documented. In addition, photographs were taken at representative points within each habitat type to document habitat. Observations regarding substrate, sediment deposition, cover, slope, depth, vegetation species, riparian habitat, and fish and wildlife use for each habitat segment were recorded on standard field forms to ensure consistent and complete collection of data.

IV. RESULTS

The habitat characterization survey was completed on July 17-18, 2008. The weather was primarily sunny and warm, though a large thunderstorm did pass through the area during the morning of July 17. Water clarity was relatively poor, with visibility limited to several inches below the water surface. Cayuga Lake water level at the U.S. Geological Survey gage on Cayuga Inlet, Ithaca, NY (Gage No. 04233500) was approximately 382.5 ft for the duration of the investigation. Twenty-two distinct habitat types were identified during the survey, and brief descriptions of each type found follow. Table 1 provides further details on the substrate, cover, depth, shoreline covertime, and noted aquatic/wetland vegetation of each habitat unit. Photographs of the various habitats documented and other features observed within the survey area are also provided.

Habitat Unit 1

This habitat unit is abundant in portions of Sixmile Creek, Cascadilla Creek, and Cayuga Inlet (Figure 2A-C). It is characterized by significantly human-modified shoreline consisting of wooden, concrete, rock, or metal bulkheads, docks, retaining walls, riprap, or other structures (Table 1, Photos 1 and 2). These structures provide the bulk of the available in-water cover, which is generally abundant. Aquatic vegetation is generally lacking. Depth in near-shore areas often exceeded 5 ft. Littoral fish species [e.g., sunfish (*Lepomis* spp.), bass (*Micropterus* spp.), and minnows (Cyprinidae)] may make use of this habitat due to the cover provided by the various structures. Wildlife use of this habitat is limited due to a general lack of forage and terrestrial cover, though some passerine birds and ducks (mallard, *Anas platyrhynchos*) were observed in this habitat. Recreational use of this habitat in the form of boating is heavy.

Evidence of use impairment of this habitat type due to sediment accumulation was not readily apparent in most areas. The exception to this is the portion of Cascadilla Creek containing this habitat type. Much of the creek in this area has considerable accumulation of fine sediment, reducing water depth to 2-5 ft in most areas. Sediment accumulation in these areas negatively affects motorboat use. In Sixmile Creek, deep-draft (>5 ft) vessels may be limited in their ability to use this habitat due to depth limitations, but other boat traffic in this habitat is apparently heavy based on the number of boat slips and docks present.

Habitat Unit 2

This habitat unit occurs only in a relatively small area along the east side of Sixmile Creek (Figure 2B). It has sand substrate near shore and silt substrate off shore. There is abundant cover in the form of near-shore logs, roots, and shading (Table 1, Photo 3). There is also some wild celery (*Vallisneria americana*) present. Littoral fish species may make use of this habitat due to the cover provided. Wildlife use of this habitat is likely limited due to limited foraging areas and a general lack of habitat diversity, though some passerine birds and mallards were observed in

this habitat. Recreational use of this habitat appears to be limited to transient boating. Evidence of use impairment of this habitat type due to sediment accumulation was not readily apparent though the substrate was dominated by fine sediment.

Habitat Unit 3

This habitat unit consists of a shallow, vegetated bay in Cayuga Inlet immediately downstream of the mouth of Sixmile Creek (Figure 2B, Photo 4). The substrate is dominated by silt, with only minor amounts of gravel and cobble very close to shore. Both submersed and emergent vegetation are present and provide the primary cover for fish and wildlife (Table 1). There were also some mat-like growths of filamentous algae (*Cladophora* sp.). The shoreline is vegetated with a thick growth of successional hardwoods and shrubs, and a small tributary enters the cove at its easternmost point. Suitable habitat exists for a variety of fish and wildlife that frequent shallow, vegetated habitats. Common carp (*Cyprinus carpio*), other minnows, and great blue heron (*Ardea herodias*) were observed using this habitat.

Recreational use of this habitat is likely limited, but could include angling, kayaking, and canoeing. Use of this off-channel habitat by large motorized boats is generally precluded by the presence of abundant vegetation and accumulated soft sediment (likely from the tributary and Cayuga Inlet itself). Although this sediment may impair motorized boat use, it does provide shallow substrate in which a variety of aquatic vegetation can grow, benefiting fish and wildlife that use such habitat.

Habitat Unit 4

This habitat unit consists of boulder riprap-stabilized shoreline with a 20-30 ft wide swath of submersed vegetation from the edge of the boulders to about the 6-ft depth (Table 1, Photo 5). This habitat is limited to the most upstream reach of Cayuga Inlet in the study area (Figure 2A). The substrate is dominated by boulder in the near-shore area and silt off shore. The submersed

aquatic vegetation is relatively diverse and dense and includes wild celery, Eurasian water milfoil (*Myriophyllum spicatum*), sago pondweed (*Stuckenia pectinata*), curly-leaf pondweed (*Potamogeton crispus*), and water stargrass (*Zosterella dubia*).

Littoral fish species may make use of this habitat due to the cover provided by vegetation and boulders. Wildlife use of this habitat is likely limited due to the lack of dense shoreline vegetation and a general lack of habitat diversity. However, mallards were observed in this habitat. Evidence of use impairment of this habitat type due to sediment accumulation was not readily apparent. Although soft sediment dominated the substrate in off-shore areas, water depth near mid-channel reached at least 10 ft, providing adequate depth for general boating purposes.

Habitat Unit 5

This habitat consists of a heavily vegetated near-shore area (5-25 ft wide) bordered by a successional shrubland shore (Table 1, Photo 6). Habitat unit 5 is limited to the western shore of Cayuga Inlet upstream from the Route 89 bridge (Figure 2B). Sand and gravel are the dominant and subdominant substrates, respectively, in water up to 4 ft deep. Silt is the dominant substrate in deeper areas. Depth near mid-channel in this habitat reaches at least 10 ft; submersed vegetation is limited to water less than 5 ft deep. Similar to habitat unit 4, the submersed vegetation is relatively diverse and dense and included wild celery, sago pondweed, long-leaf pondweed (*Potamogeton nodosus*), water stargrass, and Eurasian water milfoil.

Littoral fish species may make use of this habitat due to the cover provided primarily by vegetation. Common carp, other minnows, and pumpkinseed (*Lepomis gibbosus*) were seen using this habitat. An inactive bass nest was also seen. Wildlife use of this habitat is likely limited due to a general lack of habitat diversity, but waterfowl, wading birds, and other species may forage in the aquatic vegetation. Evidence of use impairment of this habitat type due to sediment accumulation was not readily apparent. Although soft sediment dominated the substrate in off-shore areas, water depth near mid-channel reached at least 10 ft, providing adequate depth for general boating purposes.

Habitat Unit 6

Habitat unit 6 is limited to the west side of Cayuga Inlet immediately upstream of the confluence of Cascadilla Creek (Figure 2B). This habitat unit is similar in nature to habitat unit 5 but the submersed vegetation beds are generally sparser and narrower, and the bottom slope is greater (Photo 7). There is also more gravel and cobble present in the near-shore substrate (Table 1). Silt is the dominant substrate in deeper areas. Depth near mid-channel in this habitat reaches at least 11 ft; submersed vegetation is limited to water less than 5 ft deep.

Littoral fish species may make use of this habitat due to the cover provided primarily by vegetation. Wildlife use of this habitat is likely limited due to a general lack of habitat diversity, but waterfowl, wading birds, and other species may forage in the aquatic vegetation. Evidence of use impairment of this habitat type due to sediment accumulation was not readily apparent. Although soft sediment dominated the substrate in off-shore areas, water depth near mid-channel reached at least 11 ft, providing adequate depth for general boating purposes

Habitat Unit 7

Habitat unit 7 is limited to the mid-reach of Cayuga Inlet, between Cascadilla Creek and the vicinity of the boat launch at Allan H. Treman State Marine Park (Figures 2B, 2C). This habitat is characterized by a relatively broad, densely vegetated littoral zone with sand as the dominant substrate (Table 1, Photo 8). Silt is subdominant in some of the littoral zone and toward mid-channel. Both submersed and emergent vegetation are abundant in this habitat and include wild celery, sago pondweed, Eurasian water milfoil, long-leaf pondweed, cattail (*Typha* sp.), softstem bulrush (*Schoenoplectus tabernaemontani*), and yellow flag (*Iris pseudacorus*). This habitat represents the most extensive area of shallow emergent marsh habitat within the study area. Depth in the vegetated areas was generally 2-4 ft. These areas often extended out 30-60 ft from shore. Mid-channel depths exceeded 8 ft.

Littoral fish species likely make use of this habitat due to the cover provided primarily by vegetation. A school of young-of-year brown bullhead (*Ameiurus nebulosus*) and several minnows were observed among the submersed vegetation. Waterfowl, wading birds, and other aquatic wildlife also likely make use of this area given the vegetative and structural diversity of the habitat. Great blue heron and mallard were observed (Photo 9). This habitat also provides recreational opportunities for park users, primarily in the form of nature observation and boating (off shore). Evidence of use impairment of this habitat due to excessive sediment accumulation was not apparent. The broad flat composing the littoral zone is likely a result of sediment accumulation over time but did not appear to hinder navigation except in near-shore areas. The existence of this shallow zone actually provides for a diverse aquatic plant community and the ecological and recreational benefits it can provide.

Habitat Unit 8

Habitat unit 8 is defined by the boat launch and surrounding structures at the Allan H. Treman State Marine Park (Figure 2C, Photo 10). Cover is provided by docks, pilings, and a small bed of wild celery near the south end of this area (Table 1). Substrate is primarily sand in the southern half of the site and silt in the northern half. Depth is 3-4 ft near shore and up to at least 9 ft off shore.

Fish and wildlife use of this habitat is likely negligible given the high level of activity at the boat launch and the artificial nature of the habitat. Human use of this habitat is high, as the boat launch provides a primary means of access to southern Cayuga Lake. Use impairment due to sediment deposition was not observed, but the accumulation of silt and sand along the bulkhead on both sides of the boat launch may limit access to this area for boats requiring more than 3-4 feet of water.

Habitat Unit 9

Habitat unit 9 is limited to the western side of Cayuga Inlet between the boat launch and marina at Allan H. Treman State Marine Park (Figure 2C). This habitat unit is similar in nature to habitat unit 7 but the shoreline is lined with boulder riprap instead of a fringe of emergent wetland (Table 1, Photo 11). Dense beds of submersed vegetation (primarily wild celery and sago pondweed) extend out 30-40 ft from shore. Depth in the vegetated areas was generally 2-4 ft. Mid-channel depths exceeded 8 ft.

Littoral fish species likely make use of this habitat due to the cover provided primarily by vegetation. Waterfowl, wading birds, and other aquatic wildlife may also make use of this area, but this use is likely limited due to the artificial nature of the shoreline. This habitat also provides recreational opportunities for park users, primarily in the form of nature observation and boating (off shore). Evidence of use impairment of this habitat due to excessive sediment accumulation was not apparent. The broad flat composing the littoral zone is likely a result of sediment accumulation over time but did not appear to hinder navigation except in near-shore areas.

Habitat Unit 10

Habitat unit 10 is limited to the “undeveloped” northern shoreline of the marina at Allan H. Treman State Marine Park (Figure 2C). This area has a relatively steep sloping bottom. The near-shore area is armored with a mix of cobble, gravel, and boulder (Table 1, Photo 12). A 10-15 ft wide band of Eurasian water milfoil grows just outside of this rocky substrate.

Habitat Unit 11

Habitat unit 11 is limited to the west side of Cayuga Inlet north of the marina at Allan H. Treman State Marine Park (Figure 2C). This habitat unit is similar in nature to habitat unit 9 but the shoreline is more natural and vegetated with a successional hardwood forest (Table 1, Photo 13).

Dense beds of submersed vegetation (primarily wild celery and sago pondweed) extend out to about 30 ft at the south end and over 100 ft at the north end. Vegetation growth was sparser at the south end of this unit than at the north end. The substrate is predominantly sand, with gravel and cobble becoming subdominant near shore toward the north end of this unit. Depth in the vegetated areas was generally 2-4 ft. Depth increased to about 5 ft toward mid-channel.

Littoral fish species likely make use of this habitat due to the cover provided primarily by vegetation. Waterfowl, wading birds, and other aquatic wildlife may also make use of this area. This habitat also provides recreational opportunities for park users, primarily in the form of nature observation and boating (off shore). The broad, shallow, vegetated flat associated with this habitat type is presumably a result of sediment deposition over an extended period of time. Use of this habitat by large motorized boats is generally precluded by the presence of abundant vegetation and accumulated soft sediment. Although this sediment may impair motorized boat use, it does provide shallow substrate in which a variety of aquatic vegetation can grow, benefiting for fish and wildlife that use such habitat. Passage through this reach of Cayuga Inlet by larger boats is still possible in deeper off-shore areas on the eastern side of the channel.

Habitat Unit 12

Habitat unit 12 is limited to the east side of Cayuga Inlet immediately south of the concrete jetty at the stream's mouth (Figure 2C). Cover is abundant in the form of downed trees and brush and submersed vegetation (Table 1, Photo 14). The substrate is predominantly sand, with gravel and cobble becoming subdominant near shore toward the north end of this unit. Submersed vegetation occurs in moderate density and consists primarily of wild celery, with lesser amounts of sago pondweed, water stargrass, and Eurasian water milfoil. There are scattered patches of emergent vegetation [cattails and arrowhead (*Sagittaria latifolia*)] along the shore. Depth is 2-5 ft in vegetated areas and exceeds 8 ft toward mid-channel.

Littoral fish species likely make use of this habitat due to the cover provided primarily by vegetation. Waterfowl, wading birds, and other aquatic wildlife may also make use of this area. Great blue heron, mallard, and belted kingfisher (*Megaceryle alcyon*) were observed in the area.

Recreational use of this habitat is limited primarily to boating in off-shore areas. Wildlife observation, kayaking, and canoeing may also occur. Evidence of use impairment of this habitat due to sediment accumulation was not evident, though the submersed aquatic vegetation is likely growing in sediment that has been deposited over time. The presence of this vegetation and the shallow nature of this vegetated zone preclude the use of large motorized boats in the near-shore area.

Habitat Unit 13

Habitat unit 13 is limited to the upper southern portion of the channel of Cascadilla Creek (Figure 2B). This habitat is characterized by very shallow (mostly <3 ft deep), stagnant, turbid water with cover provided by large woody debris and overhead shading by trees (Table 1, Photo 15). Substrate is predominantly sand with silt as subdominant. No aquatic vegetation was observed except for floating fragments that apparently drifted in from other areas.

This area provides relatively poor habitat for most aquatic organisms due to the high turbidity and low structural diversity. It is also of little recreational value due to the high turbidity and the shallow depth of water. Use impairment due to accumulated sediment is apparent. Motorized boat traffic is precluded due to the shallow depth, and even canoeing or kayaking would be difficult in the shallowest areas. The high turbidity results in low aesthetic quality.

Habitat Unit 14

Habitat unit 14 is similar in nature to habitat unit 13 and is located in the lower southern portion of the channel of Cascadilla Creek (Figure 2B). This habitat is characterized by very shallow (mostly <3 ft deep), stagnant, turbid water with cover provided by submersed vegetation (primarily wild celery) and fallen trees and brush (Table 1, Photo 16). There is also a small stand of cattail at its western end. Substrate is predominantly deep silt.

This area provides marginally better habitat for fish and wildlife than does habitat unit 13. Common carp, belted kingfisher and mallard were observed using this habitat. This area is of

little recreational value due to the high turbidity and the shallow depth of water. Use impairment due to accumulated sediment is apparent. Motorized boat traffic is precluded due to the shallow depth. The high turbidity also results in low aesthetic quality.

Habitat Unit 15

Habitat unit 15 encompasses the entire southern end of Cayuga Lake east of the mouth of Fall Creek (Figure 2D). This area is characterized by an artificially stabilized lake shore and a broad, shallow, heavily vegetated littoral zone (Table 1, Photos 17 and 18). The substrate in this habitat is predominantly firm sand. There is a thin band of cobble/gravel/boulder substrate immediately along the shoreline. A considerable amount of wind-rowed vegetation is also found along the shore. Submersed aquatic vegetation is evident within 100 ft of shore and becomes noticeably abundant about 300 ft from shore and extends offshore to the buoy line located approximately 800-1,200 ft off shore. Aquatic plants observed included wild celery, sago pondweed, clasping-leaf pondweed (*Potamogeton richardsonii*), curly-leaf pondweed, Eurasian water milfoil, and common duckweed (*Lemna minor*). Water depth is typically 1-4 ft, but reaches approximately 6 ft at the off-shore buoy line.

Littoral fish species undoubtedly make use of this habitat due to the cover provided by vegetation. Waterfowl and other water birds also make use of this area due to the abundant, shallow-water vegetation. Canada geese (*Branta canadensis*), mallards, and gulls (*Larus* sp.) were observed using this habitat. This habitat also provides recreational opportunities for park users, primarily in the form of nature observation. Evidence of use impairment of this habitat due to excessive sediment accumulation was not apparent, though boats drafting more than a couple of feet are unable to access much of this area.

Habitat Unit 16

Habitat unit 16 is located at the east side of the mouth of Fall Creek (Figures 2C, 2D). This habitat unit is characterized by a gently sloping bottom of primarily sand mixed with lesser

amounts of cobble and boulder near shore and silt off shore (Table 1, Photo 19). Cover is in the form of shading from overhanging terrestrial vegetation and some fallen trees. No aquatic vegetation was observed. Depth is generally shallow (<4 ft) near shore, increasing to 7 ft off shore.

This is a relatively small segment of habitat that likely receives minimal use from fish and wildlife given its relatively featureless nature. This area is used recreationally by transient canoeists, rowers, and other boaters accessing Fall Creek. Deep-draft vessels are unable to use much of this habitat due to insufficient depth.

Habitat Unit 17

Habitat unit 17 is located along the east side of Fall Creek at the west end of Stewart Park (Figure 2D). This habitat is characterized by a steeply sloping bottom with gravel, cobble, and boulder being the primary substrates in the near-shore area (out to depths ≥ 4 ft) (Table 1, Photo 20). Docks at the north end of this unit comprise the predominant cover. No aquatic vegetation was observed. Water depth reaches 4 ft not far (within 20 ft) from shore and is up to about 7 ft near mid-channel.

This habitat is of relatively low quality for fish and wildlife due to its low structural diversity. However, it does provide some relatively deep water through which fish can migrate between Fall Creek and Cayuga Lake. Mallards, Canada geese, and gulls were observed in the vicinity. This habitat provides recreational opportunities in the form of shoreline angling, canoeing, kayaking, and nature observation. No evidence of use impairment due to sediment accumulation was observed.

Habitat Unit 18

Habitat unit 18 occurs in two places off of the main channel of Fall Creek (Figure 2D). The largest area of this habitat is located in what is actually the lower reach of Pleasant Grove Brook along the south side of Stewart Park. A smaller area of similar habitat is located in a small cove

off on the east side of Fall Creek about 1,000 ft downstream of the Route 13 bridge. This habitat is characterized by broad, shallow flats of silt and sand substrate that support scattered patches of submersed and emergent vegetation (Table 1, Photo 21). The smaller, southernmost area of this habitat is also fringed with emergent vegetation along much of its shoreline (Photo 22). Depth is generally limited to about 3 ft or less throughout this habitat type.

Suitable habitat exists for a variety of fish and wildlife that frequent shallow, vegetated habitats. Unidentified fish and belted kingfisher were observed using this habitat. Recreational use of this habitat is relatively high, particularly at the Stewart Park site and includes shoreline angling, kayaking, canoeing, and nature observation. Accumulated sediment (likely from both Pleasant Grove Brook and Fall Creek) generally precludes the use of this off-channel habitat by motorized boats and also limits angling methods and the species of fish available to anglers. Although this sediment may impair motorized boat use and, to some degree, angling, it does provide shallow substrate in which a variety of aquatic vegetation can grow, benefiting fish and wildlife that use such habitat.

Habitat Unit 19

Habitat unit 19 is limited to two small areas immediately upstream of the foot bridge across Fall Creek near Stewart Park (Figure 2D). This habitat is characterized by near-shore cobble/gravel/boulder substrate in water 4-5 ft deep (Table 1, Photo 23). The boulder substrate is large and is derived from riprap placed along the stream bank. These boulders and scattered logs provide most of the cover in this habitat type. A small patch of white water lily (*Nymphaea odorata*) occurs in the eastern segment of this habitat unit. Water depth is generally 4-5 ft near shore and up to 9 ft off shore.

This habitat is of generally good quality for fish inhabiting Fall Creek due to its structural diversity and the fact that it provides some relatively deep water through which fish can migrate between Fall Creek and Cayuga Lake. Wildlife use of this habitat is likely low due to the deepness of the water. This habitat provides recreational opportunities in the form of shoreline

angling, canoeing, and kayaking. No evidence of use impairment due to sediment accumulation was observed.

Habitat Unit 20

Habitat unit 20 consists of a short reach along the east side of Fall Creek (Figure 2D). This habitat has predominantly sand substrate with logs, fallen trees, and brush providing cover near shore (Table 1, Photo 24). Water depth ranges from 1-4 ft. This habitat is of only fair quality to fish due to the predominantly sand habitat and minimal structural diversity. Wildlife use of this habitat is likely low due to the low structural diversity and lack of aquatic vegetation. Recreational use of this habitat type is likely minimal, given its small size, lack of shoreline access, and general lack of boating in this reach of Fall Creek. No evidence of use impairment due to sediment accumulation was observed, but the substrate was comprised entirely of fine sediment that is of relatively low quality to fish and wildlife.

Habitat Unit 21

Habitat unit 21 is located along the west shore of Fall Creek upstream of the foot bridge near Stewart Park (Figure 2D, Photo 25). The most notable feature of this habitat is the gravel/cobble substrate found both near shore and off shore (Table 1). There is no notable cover in this habitat, and depth ranges from 1-4 ft. No aquatic vegetation was observed.

This habitat is unique among the habitats identified during this investigation in that it has an extensive amount of near-shore and off-shore rocky substrate. This is due to its location in Fall Creek where the flowing creek meets the slack water of the inundated creek mouth. During periods of high to moderate run-off, current velocity keeps this substrate relatively free of fine sediment. A variety of riverine fish and aquatic invertebrates (e.g., crayfish) likely make some use of this habitat. Wildlife use of this habitat is likely low due to the lack of cover and riparian vegetation. This habitat unit provides good shoreline access to anglers, and anglers were observed in this area during the survey. No evidence of use impairment due to sediment accumulation was observed.

Habitat Unit 22

Habitat unit 22 is located along the west shore of Fall Creek near the stream's mouth (Figures 2C, 2D). This habitat has extensive cover in the form of overhanging and fallen trees, logs, and scattered submersed vegetation (Table 1, Photo 26). This cover is concentrated in the downstream half of this habitat unit. The upstream half of this habitat unit borders the municipal golf course and lacks a wooded shoreline. The substrate is predominantly sand, with silt being subdominant. Water depth is 1-4 ft near shore, sloping gradually off shore.

The extensive and diverse cover within this habitat unit makes it attractive to both fish and wildlife. Canada geese, mallards, belted kingfisher, and sunfish spawning beds were observed. Recreational opportunities are limited in this habitat due to the shallow depth, but opportunities for canoeing, kayaking, and nature observation are available. There is considerable accumulation of fine sediment in this habitat, including some areas of soft silt. This accumulated sediment impairs the use of this area by larger motorized boats.

V. SUMMARY

The habitats of the southern tributaries and shoreline of Cayuga Lake are highly variable in regard to the presence and composition of aquatic vegetation and other cover, depth, and, to a lesser extent, substrate. Submersed aquatic vegetation is abundant in many habitats of the survey area. Much of this vegetation is native to these waters, but some, like Eurasian water milfoil, is exotic. This aquatic vegetation provides important cover, foraging areas, and nursery areas for a variety of fish and wildlife species, as well as habitat for aquatic invertebrates and other biota important to the ecological function of the lake and tributary ecosystems. Large woody debris in the form of fallen trees, brush, logs, and root masses provide similar values in many near-shore areas. Emergent vegetation was relatively limited in the survey area but did provide important structural diversity in the few habitats in which it was prominent. This was particularly true in habitat units 7 and 18.

Nearly all of Sixmile Creek, the north shoreline of Cascadilla Creek, and various areas in Cayuga Inlet consisted of highly modified habitat comprised of wooden, concrete, rock, or metal bulkheads, docks, retaining walls, riprap, or other structures. These areas were associated with high volumes of boat traffic and commercial development and activity. Fish and wildlife use and value of these habitats was typically quite low, but human use and value was high. These areas typically lacked vegetation and other natural cover and had artificially stabilized banks. Excessive sediment deposition in these areas was hard to gauge because water depth even near the shoreline was often in excess of 5 ft. An exception to this was the northern half of the channel of Cascadilla Creek in which depth was often less than 5 ft and deposited sediment was extensive.

Fine sediment (sand and/or silt) was a major component of the substrate in most habitats. In some areas, extensive deposition of fine sediment was clearly evident. In other areas, it is difficult to know if the fine sediment is the result of deposition from excessive bed load or the “natural state” of the habitat. It is important to note that the entire survey area has been drastically modified from its true natural condition. Past dredge and fill activities have altered the habitats and their substrates significantly. Presumably, past dredging of the lower reaches of Cayuga Inlet, Sixmile Creek, and Cascadilla Creek resulted in stream bottoms composed primarily of fine sediment. Parts of some of these reaches have obviously accumulated sediment since then to the point where some uses of these areas are impaired. This impairment is typically in the form of limiting deep-draft vessel access or access of larger motor boats in near-shore areas.

The aquatic vegetation that is a prominent feature of many of the habitats within the survey area is typically established in areas of fine sediment and is sometimes associated with obvious areas of deposition. The growth of aquatic vegetation in areas of sediment deposition tends to enhance deposition in these areas by reducing current velocity and thereby allowing sediment to settle when it might otherwise be transported downstream. Dense growth of vegetation can impair motor boat use of some of these areas, but areas of abundant and diverse aquatic vegetation also serve important ecological functions and provide critical cover and foraging habitat for a variety of fish and wildlife species. They also provide opportunities for bird watching and other nature

observation, as well as for angling. Thus, sediment deposition can at once result in resource impairment for some users and resource enhancement for others.

The design of this survey did not allow for a detailed evaluation of use impairment within the survey area due to reduced channel depth as a result of long-term sediment deposition. That would require an analysis comparing the original channel depth since the last dredging to existing channel depths and depth requirements for the wide array of vessels that could potentially use the waterways under consideration. The present survey was aimed at characterizing the various aquatic habitats of the southern Cayuga Lake tributaries and shoreline that could potentially be affected by the proposed dredging project, identifying areas of notable sediment deposition, and, where possible, identifying depositional areas that result in some form of resource use impairment.

The most obvious areas of resource use impairment due to sediment deposition were associated with Cascadilla Creek, Pleasant Grove Brook, and the mouths of Cayuga Inlet and Fall Creek. These were zones with extensive areas of shallow depths with fine, sometimes very soft, sediment. The extensive shallows greatly reduced the suitability of these areas for motor boats or other vessels requiring more than 2-3 ft of water to operate. Some of these areas supported extensive growth of aquatic vegetation that further reduced the suitability of these areas for motor boat use.



Figure 1. Study area for habitat characterization of southern Cayuga Lake tributaries and shoreline conducted July 17-18, 2008.



Figure 2A. Habitat units identified during the habitat characterization of the southern tributaries and shoreline of Cayuga Lake, July 17-18, 2008.



Figure 2B. Habitat units identified during the habitat characterization of the southern tributaries and shoreline of Cayuga Lake, July 17-18, 2008.



Figure 2C. Habitat units identified during the habitat characterization of the southern tributaries and shoreline of Cayuga Lake, July 17-18, 2008.



Figure 2D. Habitat units identified during the habitat characterization of the southern tributaries and shoreline of Cayuga Lake, July 17-18, 2008.

Table 1. Physical characteristics of habitat units identified in the southern tributaries and shoreline area of Cayuga Lake on July 17-18, 2008.

Substrate and Cover Key: D = dominant; SD = subdominant; A = abundant; P = present; S = sparse

| Habitat Unit | Substrate | Cover | % Cover | Depth (ft) | Shoreline Covertypes(s) | Noted Aquatic Vegetation |
|--------------|---|--|---------|---|--|---|
| 1 | Silt - D (off-shore) Sand - D (near-shore) | Docks/boats - A Shading - A Fallen tree/brush - S Boulders (riprap) - S | >25 | Up to 7 ft, reduced to ≤5 in Cascadilla Cr. | Lacustrine riprap/artificial shore Lacustrine submerged structure | None observed |
| 2 | Silt - D (off-shore) Sand - D (near-shore) | Shading - A Log/stump/root - A Submersed veg. - P | >25 | Up to 7 ft (≤4 ft near shore) | Successional northern hardwoods | <i>Vallisneria americana</i> |
| 3 | Silt - D | Submersed veg. - A Emergent veg. - S Fallen tree/brush - S Shading - S Boulder - S | 10-25 | Up to 4 ft | Successional northern hardwoods Successional shrubland | <i>Ceratophyllum demersum</i> <i>Cladophora</i> sp. <i>Elodea canadensis</i> <i>Iris pseudacorus</i> <i>Myriophyllum spicatum</i> <i>Nymphaea odorata</i> <i>Stuckenia pectinata</i> <i>Vallisneria americana</i> <i>Zosterella dubia</i> |
| 4 | Silt - D (off-shore) Boulder - D (near-shore) | Submersed veg. - A Boulder - A | >25 | Up to 10 ft (~3 ft at riprap edge) | Lacustrine riprap/artificial shore Mowed lawn | <i>Myriophyllum spicatum</i> <i>Potamogeton crispus</i> <i>Stuckenia pectinata</i> <i>Vallisneria americana</i> <i>Zosterella dubia</i> |
| 5 | Silt - D (off-shore) Sand - D (to 4-ft depth) Gravel - SD (to 4-ft depth) | Submersed veg. - A Log/stump/root - P | >25 | Up to 10 ft (veg. in <5 ft) | Successional shrubland | <i>Myriophyllum spicatum</i> <i>Potamogeton nodosus</i> <i>Stuckenia pectinata</i> <i>Vallisneria americana</i> <i>Zosterella dubia</i> |

Table 1. Continued.

| Habitat Unit | Substrate | Cover | % Cover | Depth (ft) | Shoreline Covertypes(s) | Noted Aquatic Vegetation |
|--------------|--|---|---------|-----------------------------------|---|---|
| 6 | Silt - D (off-shore) Sand - D (to 4-ft depth) Gravel - SD (to 4-ft depth) Cobble - SD (to 4-ft depth) | Submersed veg. - A Log/stump/root - P | >25 | Up to 11 (veg. in <5) | Successional shrubland Successional northern hardwoods | <i>Myriophyllum spicatum</i> <i>Potamogeton nodosus</i> <i>Stuckenia pectinata</i> <i>Vallisneria americana</i> <i>Zosterella dubia</i> |
| 7 | Silt - SD (off-shore) Sand - D | Submersed veg. - A Emergent veg. - A Log/stump/root - P | >25 | Mostly 2-4, but up to 8+ | Successional shrubland Mowed lawn Shallow emergent marsh | <i>Cladophora</i> sp. <i>Iris pseudacorus</i> <i>Myriophyllum spicatum</i> <i>Potamogeton nodosus</i> <i>Schoenoplectus</i> <i>tabernaemontani</i> <i>Stuckenia pectinata</i> <i>Typha</i> sp. <i>Vallisneria americana</i> |
| 8 | Silt - SD (north end) Sand - D | Docks - A Shading - A Submersed veg. - S | 10-25 | Up to 9 (3-4 ft near shore) | Lacustrine riprap/artificial shore Lacustrine submerged structure | <i>Vallisneria americana</i> |
| 9 | Silt - SD (off-shore) Sand - D | Submersed veg. - A Boulders (riprap) - P Fallen tree/brush - S Shading - S | >25 | Mostly 2-4, but up to 8+ | Lacustrine riprap/artificial shore Successional shrubland Mowed lawn with trees | <i>Stuckenia pectinata</i> <i>Vallisneria americana</i> |
| 10 | Sand - D (off shore) Gravel - SD (near shore) Cobble - SD (near shore) Boulder - SD (near shore) | Submersed veg. - A | 10-25 | Up to 8 | Successional shrubland Mowed lawn with trees | <i>Myriophyllum spicatum</i> |

Table 1. Continued.

| Habitat Unit | Substrate | Cover | % Cover | Depth (ft) | Shoreline Covertypes(s) | Noted Aquatic Vegetation |
|--------------|---|--|---------|--------------------------------|---|---|
| 11 | Sand - D Gravel - SD (at north end) Cobble - SD (at north end) | Submersed veg. - A Boulders (riprap) - P Fallen tree/brush - P | >25 | Mostly 2-4 but up to 5+ | Successional northern hardwoods | <i>Stuckenia pectinata</i> <i>Vallisneria americana</i> |
| 12 | Sand - D Gravel - SD (at north end) Cobble - SD (at north end) | Submersed veg. - A Fallen tree/brush - A Shading - A | >25 | Mostly 2-5, but up to 8+ | Successional northern hardwoods Shallow emergent marsh (little) | <i>Myriophyllum spicatum</i> <i>Sagittaria latifolia</i> <i>Stuckenia pectinata</i> <i>Typha</i> sp. <i>Vallisneria americana</i> <i>Zosterella dubia</i> |
| 13 | Sand - D Silt - SD | Shading - A Fallen tree/brush - P Log/stump/root - P | 10-25 | 0.5-4, mostly ≤ 3 | Successional northern hardwoods | None observed |
| 14 | Silt - D | Submersed veg. - A Fallen tree/brush - P Emergent veg. - S | 10-25 | 1-4, mostly ≤ 3 | Successional shrubland Successional northern hardwoods Shallow emergent marsh (little) | <i>Stuckenia pectinata</i> <i>Typha</i> sp. <i>Vallisneria americana</i> |
| 15 | Sand - D (off shore) Gravel - SD (near shore) Cobble - SD (near shore) Boulder - SD (near shore) | Submersed veg. - A Fallen tree/brush - P (near shore at west end) | >25 | Mostly 1-4, but up to 6 | Riprap/artificial lake shore Successional northern hardwoods Mowed lawn with trees | <i>Lemna minor</i> <i>Myriophyllum spicatum</i> <i>Potamogeton crispus</i> <i>Potamogeton richardsonii</i> <i>Stuckenia pectinata</i> <i>Vallisneria americana</i> |

Table 1. Continued.

| Habitat Unit | Substrate | Cover | % Cover | Depth (ft) | Shoreline Covertypes(s) | Noted Aquatic Vegetation |
|--------------|--|--|---------|---------------------------------------|---|--|
| 16 | Sand - D (off shore) Silt - SD (off shore) Cobble - SD (near shore) Boulder - SD (near shore) | Shading - A Fallen tree/brush - P | 10-25 | 1-7 | Successional northern hardwoods | None observed |
| 17 | Gravel - SD (near shore) Cobble - SD (near shore) Boulder - SD (near shore) | Boulders (riprap) - P Docks - P | 1-10 | 5+ (steep bottom near shore) | Lacustrine riprap/artificial shore Mowed lawn | None observed |
| 18 | Silt - D Sand - SD | Emergent veg. - P Shading - P Log/stump/root - P Submersed veg. - S | 10-25 | 1-3 | Mowed lawn Successional northern hardwoods Shallow emergent marsh (southern segment only) | <i>Lemna minor</i> <i>Myriophyllum spicatum</i> <i>Nuphar luteum</i> <i>Nymphaea odorata</i> <i>Sagittaria latifolia</i> |
| 19 | Gravel - SD Cobble - SD Boulder - SD | Boulder - A Log/stump/root - P Emergent veg. - S | 10-25 | Up to 9 (4-5 near shore) | Lacustrine riprap/artificial shore Successional northern hardwoods | <i>Nymphaea odorata</i> |
| 20 | Sand - D | Fallen tree/brush - P Log/stump/root - P | 1-10 | 1-4 | Successional northern hardwoods Successional shrubland | None observed |
| 21 | Gravel - D Cobble - SD | None observed | <1 | 1-4 | Unpaved road | None observed |
| 22 | Sand - D Silt - SD | Fallen tree/brush - A Log/stump/root - A Shading - A Submersed veg. - S | >25 | 1-5 | Successional northern hardwoods Mowed lawn (at south end) | <i>Vallisneria americana</i> |