

APPENDIX 3. List and Descriptions of Aquatic Habitat Types of the Lower St. Louis River and Their Ecological Values

Habitat type	Description	Ecological values
<p>Type 5a: Large Riverine Reach (Location: from Fond du Lac Dam to downstream end of Nekuk Island)</p>	<p>General morphology: Large riverine reach with riffle-pool-run structure</p> <p>Water velocity: This habitat type has relatively high water velocity compared to other habitats in the estuary; depending on location relative to islands, velocity ranges from very high in some parts to very low velocity slackwater in other areas.</p> <p>Substrate: Substrate is variable and includes bedrock, cobble, some sand, and fine-textured materials; in general, there is more coarse substrate in this habitat type than in other types in the estuary; fine-textured substrate in slackwater areas; interstices are not filled in with fine sediments—this is likely a sign of sediment starvation resulting from the upstream impoundment(s).</p> <p>Clarity: Water clarity (color) depends on conditions in the upper watershed; water may be bog stained due to dissolved organic matter discharged from upstream peatlands, especially in high-water periods. Turbidity: Lower turbidity and sediment load than other habitats in the estuary</p> <p>Vegetation: Not much emergent or submergent vegetation, except in some of the sheltered areas that have fine sediments and low water velocity. These areas may have pondweeds (<i>Potamogeton spp.</i>), cattails, and rushes.</p> <p>Islands: This habitat type includes several sandstone-based islands covered with large woody debris; islands are frequently rock-armored on the upstream side (either natural or rip-rap) islands are shrinking due to gradual rising of water levels in the estuary.</p> <p>Additional descriptive information: This reach is bound by Fond du Lac Dam on the upstream end (although this barrier is artificial, there was historically a natural barrier near the dam); the downstream boundary is variable and is determined by how far the seiche goes upstream (generally around the downstream end of Nekuk Island). This reach is typical of a fifth- to sixth-order (medium to large) river. The river channel is restricted. Definitive characteristics of this habitat type are the water velocity, substrate, riffle-pool-run structure and the fact that this habitat type is not seiche-influenced. Water is well-oxygenated. The reach from Fond du Lac dam to the Carlton Co. (MN)-Douglas Co. (WI) boundary is a sanctuary.</p>	<p>Ecological values:</p> <p>This habitat type includes most of the spawning habitat for fish species that use high velocity waters over coarse substrates to spawn (including lake sturgeon, longnose sucker, white sucker, and walleye. Smallmouth bass also spawn here, although they also use other areas in the estuary). A significant percentage of the Lake Superior walleye population is believed to spawn here.</p> <p>There are several macroinvertebrate taxa (for example, net spinning caddisflies) that are found only in this part of the estuary because of the riverine characteristics of the habitat type.</p> <p>The Eastern Elliptio mussel (<i>Elliptio complanata</i>) is found in this habitat type.</p> <p>Migrating waterfowl, including raptors, use this habitat type because it is one of the first areas in the estuary to open up (i.e. become ice-free) in spring.</p> <p>This habitat may provide some of the only habitat within the estuary that is suitable for riverine-obligate fish taxa, including riverine darters and non-game species.</p> <p>Other comments:</p> <p>This habitat also contains the primary spawning site for the non-native sea lamprey.</p>

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<p>Type 5b: Upper Estuarine (Undredged) River Channel (Location: drowned river channel from below Neku Island to Stryker Bay)</p>	<p>General morphology: Drowned river channel Water velocity: Moderately high velocity relative to other habitat types in the estuary (although lower than velocity of the large riverine reach habitat around Hwy 23 bridge); velocity in the channel is higher than adjacent upper estuary flats; velocity is high enough to maintain sediment transport. Substrate: Substrate is generally firm and granular; includes some gravel and cobble, some sand, and a lot of compacted clay; substrate is fairly uniform throughout the habitat type. Turbidity: The Red River adds some suspended clay, but flow from the Red River is usually sufficient to wash the suspended load out to the main channel, where there is sufficient velocity to move the suspended load downstream. Therefore, very little clay remains in the water column in this habitat type. Vegetation: The channel has almost no emergent or submergent vegetation. There is some dislodged vegetation from adjacent wetlands, but almost no rooted vegetation due to moderately high water velocity and lack of light penetration to the bottom. The flow and morphology of the river channel has allowed the development of an underwater “levee”; vegetation grows on the bank side of this levee, but not within the channel itself. Clarity: Water clarity (color) depends on conditions in the upper watershed. Additional descriptive information: This habitat type includes both natural channel and dredged channel that is no longer maintained. The seiche and the downstream flow maintain the channel. The channel includes deep, scoured holes on the outside bends where shoreline is steep. The upstream boundary is variable and is determined by how far the seiche goes upstream (generally around the downstream end of Neku Island); the downstream end of the habitat type extends to where dredging begins, and this boundary could change if the area that is actively dredged changes. In this reach, the river less constricted than in the upstream habitat type; the drowned river channel habitat is surrounded by sheltered bays and upper estuary flats. The connectivity between the channel and adjacent quiet waters and wetlands is important because fish use both habitat types. The channel acts as a sediment transport mechanism for adjacent wetlands.</p>	<p>Ecological values: Spawning habitat for channel catfish, stonecat, and burbot. Wintering area for many fish species High concentration of predatory fish Important area for juvenile sturgeon (likely to be feeding on invertebrates living in gravel substrate) High abundance of invertebrates in gravel substrate High mussel abundance</p>

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<p>Type 5c: Lower Estuarine (Dredged) Channel (Location: from Stryker Bay to Superior Entry)</p>	<p>General morphology: Dredged channel</p> <p>Water velocity: Moderate to low velocity compared to other habitat types in the estuary; there is a pronounced seiche effect.</p> <p>Substrate: Substrate is firm material, made up of mostly sand and clay; covered, in places, with thick organic muck; there is almost no gravel; the fine particles on the surface (organic layer and uncompacted clay) are easily disturbed; the dredged channel holds steep sides because the firm, compacted clay does not slough readily; the channel does not fill quickly after dredging.</p> <p>Turbidity: Turbidity is influenced somewhat by upstream inputs of fine sediments, but mostly locally by active resuspension of sediments; in the upstream habitats turbidity is mostly river influenced, but in this habitat type, turbidity is locally-influenced by ships that stir up and resuspend sediments.</p> <p>Vegetation: Very little, if any, emergent or submergent vegetation. The channel is too deep, dredged, and disturbed by ships using the channel.</p>	<p>Ecological values:</p> <p>This is unnatural habitat; dredging creates deepwater habitat and fishes use the resulting pelagic zone. However, this deepwater habitat is frequently disturbed.</p> <p>Deep areas are an important wintering area for many fish species.</p> <p>Pelagic fish—including shiners—school in this deepwater habitat and flocks of birds, specifically terns, feed on these schools. So habitat may be an important feeding area for fish-eating birds</p> <p>Other comments:</p> <p>Water in this habitat may have generally higher contaminant levels than most other habitats in the estuary, due to resuspension of contaminated sediments.</p>

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<p>Type 5d: Sheltered Bays (Location: along Minnesota and Wisconsin shoreline from below Neku Island to Stryker Bay)</p>	<p>General morphology: Sheltered bays Water velocity: Velocity is low compared to other habitat types, but variable currents are created by winds, seiche, and dam releases; water levels change seasonally and are influenced by the Lake Superior water level. Substrate: Substrate is variable; these are depositional habitats; a few boulders may be present, but most of the bays have an organic muck component over firm sand and clay. Turbidity: Turbidity is driven by conditions in the upstream watershed. Vegetation: Most bays have emergent and submergent vegetation; emergent vegetation can extend a long way from shore; several of these emergents need firm substrate (e.g. bulrush) ; <i>Potamogeton spp.</i> and water lilies can be found in finer, less compacted substrate; wild rice uses organic substrate; floating-leaf vegetation is common; vegetation stabilizes banks and substrate. Additional descriptive information: These bays are examples of a pulse-stable wetland community maintained by riverine and seiche flow (River and seiche flow maintain deepened openings or channels into the bays. Water moves, or pulses, in and out of the bay. Because of this movement of water and sediment, the wetland does not fill in with sediment over time.) Most bays are less than 5 feet deep. Recreational use is low. These bays are depositional areas, and vegetation contributes to deposition by trapping suspended sediments. These bays are associated with the estuarine (undredged) river channel, which acts as a sediment transport mechanism for the bays. Long-term lake levels are important to water levels and the range of variation of water levels is important to vegetation species composition. These are dynamic habitats.</p>	<p>Ecological values: Many high-quality wetlands are present. Many on the Wisconsin side are protected, but bays on the Minnesota side are threatened by increased development.</p> <p>Sheltered bays are critical spawning habitat for many species, including forage and non-game species. Species that spawn here include northern pike, muskellunge, bluegill, black crappie, smallmouth bass, and yellow perch.</p> <p>Highest diversity of fish species and the highest abundance of fish; critical habitat for obligate wetland species</p> <p>Highest diversity of vegetation</p> <p>Among embayments, this habitat type has relatively high diversity and abundance of macroinvertebrates.</p> <p>High density of burrowing mayflies (specifically <i>Hexagenia spp.</i>)</p> <p>Wild rice is present in some bays.</p> <p>Provides nesting and feeding habitat for wading birds, including geese and ducks .</p> <p>Other comments: Lake level stabilization would threaten the process that maintains the pulse-stable wetland community.</p>

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<p>Type 5e: Clay-Influenced River Mouths (Location: long, narrow river mouths on Wisconsin side of estuary, most between Oliver Bridge and Bong Bridge)</p>	<p>General morphology: Clay-influenced river mouths Water velocity: Velocity is low compared to other habitat types in the estuary, but winds and seiches create variable currents. Substrate: Mostly dominated by firm clay with some organic material. Turbidity: High, especially after rain events; turbidity in the bays is lingering and persistent; fine clay particles stays in suspension and the tributary streams (including the Pokegama River, Little Pokegama River, etc.) do not flush the particles out to the main channel of the St. Louis River). Vegetation: With exception of Little Pokegama Bay, these clay-influenced river mouths do not have much emergent or submergent vegetation, due to low light penetration, water depth, and possibly because the clay is too compacted. There may be a narrow ring of vegetation, but water depth drops off quickly, and beyond this ring there is no vegetation. Additional descriptive information: In these clay-influenced river mouths, the shoreline is convoluted, steep, and highly erodible. Water depth drops off quickly. The suspended clay limits the abundance of submerged vegetation and consequently, limits fish abundance. In Pokegama Bay, there is a seasonal anoxic zone.</p>	<p>Ecological values: Wetlands at river mouths</p> <p>Wild rice is present in some areas.</p> <p>Fish diversity is similar to sheltered bays (that are not clay-influenced) but abundance is lower (abundance may be limited by lack of vegetation and associated benthic food organisms)</p>
<p>Type 5f: Industrially-Influenced Bays (Location: along shoreline of St. Louis Bay and Superior Bay)</p>	<p>General morphology: Industrially-influenced bays Water velocity: Water velocity is low. Substrate: Bottom substrates are generally firm and include sand, compacted clay, and an organic component. Many bays are cluttered with industrial debris (e.g. trash, tires, rebar [steel used to reinforce concrete], concrete, wood). Turbidity: Turbidity is lower than open channels because the bays are more protected. Vegetation: Emergent and submergent vegetation is not widespread but may be found in occasional patches. These bays are usually 4-5 feet deep and do not have very many submerged macrophytes. Wave-influenced disturbance frequently stirs up the bottom. Pondweeds (<i>Potamogeton spp.</i>) cannot root in the firm substrate here. Some bays have wetlands near the heads of the bays. Additional descriptive information: These bays are heterogeneous and it is difficult to generalize about them—each one is different. Bays are contaminated with a wide range of contaminants, including PAHs (Polycyclic Aromatic Hydrocarbons), mercury, lead, metals, and PCBs (Polychlorinated Biphenyls).</p>	<p>Ecological values: Many taxonomic groups (including fish, macroinvertebrates, waterfowl, and vegetation) used these habitats in spite of their contamination. By using these habitats, they are exposed to and bioaccumulate contaminants, which they carry to uncontaminated habitats. Therefore, these habitats are often the source for contaminants found in fishes (and other taxa) throughout the estuary.</p> <p>These bays have the potential to be like other sheltered bays.</p>

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<p>Type 5g: Industrial Slips (Location: along shoreline of St. Louis Bay and Superior Bay)</p>	<p>General morphology: Industrial slips Water velocity: These slips have a lot of water movement as a result of ships moving in and out, but very little flow or current. Substrate: Substrate is generally firm. Turbidity: Turbidity is associated with ship movement. Active slips are frequently disturbed; inactive slips are seldom disturbed. Vegetation: These slips do not contain very much emergent or submergent vegetation, although there may be some wetlands at the heads of the slips. Additional descriptive information: Some of these slips are active (used by shipping traffic) and some are inactive. In general, they are deep and have steep sides with pilings. They are fairly homogenous. They may be good places for fish to forage because benthic (bottom dwelling) macroinvertebrates may be stirred up by ship traffic. Slips have a lot of debris. This habitat type is the most vulnerable to being filled to create more land.</p>	<p>Ecological values: This habitat type provides deepwater habitat, although it is frequently disturbed deepwater habitat.</p> <p>Other comments: Ballast water discharge most commonly occurs in this habitat type</p>
<p>Type 5h: Upper Estuary Flats (Location: Flats from Oliver bridge to Grassy Point)</p>	<p>General morphology: Upper estuary flats Water velocity: Water velocity is low. Wind and wave action have more influence on water movement than riverine current does. Most current restricted to the river channel. Substrate: Spirit Lake has considerable sand. These are depositional habitats; fine sediments organic materials that are stirred up in other habitats are often deposited here. Turbidity: The upper estuary flats are relatively undisturbed in comparison with the industrial harbor flats downstream. Vegetation: Spirit Lake has emergent vegetation around the shoreline and fairly extensive submergent vegetation. <i>Vallesnaria spp.</i> is common. Additional descriptive information: This habitat type was originally grouped with the industrial estuary flats, but eventually separated because of the different ecological values. The upper estuary flats have predominately natural shoreline and are not as influenced by sedimentation from harbor operation and maintenance.</p>	<p>Ecological values: High abundance of (especially spottail) shiners.</p> <p>High abundance of panfish, including bluegill, pumpkinseed, and black crappie.</p> <p>Waterfowl use the open water in high numbers.</p>

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<p>Type 5i: Lower Estuary (Industrial Harbor) Flats (Location: Flats from Grassy Point to Superior Entry)</p>	<p>General morphology: Industrial harbor flats Water velocity: Water velocity is low. Wind and wave action have more influence on water movement than flow does. Most current restricted to the river channel. Substrate: Substrate is variable. The flats near Minnesota and Wisconsin Points have a predominately sand substrate. Flats in the harbor area have been heavily textured and highly manipulated over the last 100 years [this area was naturally one large marsh]. Almost none of the substrate is “native” to the area—most has been modified and/or relocated due to dredging and filling activities. Substrate includes a mixture of slag, wood fill, and wood slabs. Turbidity: These are depositional habitats; fine sediments and organic materials that are stirred up in other habitats are often deposited here. Vegetation: Vegetation growth is limited by wave energy (both wind and ship-induced waves). Submergent vegetation is just found in patches, but the patches seem to be getting larger (this may be related to lower lake levels or increased light penetration) Additional descriptive information: The flats are quite variable. There is considerable subsurface topographic complexity, including old river channels, deep holes, and borrow pits. Shoreline is artificial and modified.</p>	<p>Ecological values:</p> <p>Waterfowl use the open water in high numbers.</p> <p>Historically, the harbor side of Minnesota and Wisconsin Points may have had the highest mussel abundance of any habitat in the estuary. This is one of the only areas in the estuary where native mussel mortality from zebra mussels was observed (although zebra mussels were found in other habitat types).</p> <p>The harbor side of Minnesota and Wisconsin Points is likely to have had the highest native mussel diversity in the estuary. This area may still have the highest native mussel diversity in the area, but there has not yet been sufficient sampling to draw this conclusion.</p> <p>High abundance of (especially emerald) shiners.</p> <p>High abundance of percids (including yellow perch, walleye) and troutperch.</p> <p>Other comments: High concentration of non-native zebra mussels, ruffe, gobies.</p>

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<p>Type 5j: Clay-Influenced Bay (Location: Allouez Bay)</p>	<p>General morphology: Clay-influenced bay Water velocity: Velocity is low compared to other habitat types in the estuary, but winds and seiches create variable currents. Substrate: Clay with organic layer; substrate fairly undisturbed. Turbidity: Turbidity influenced by inputs of fine clay particles from the tributary streams including Bear Creek, and Bluff Creek. The bay gets relatively little boat traffic; this is not a source of turbidity. Vegetation: East end has abundant emergent and submergent vegetation. The greater extent of shallow water associated with the morphology of this bay allows much more extensive emergent and submergent vegetation (compared to the clay-influenced river mouths of Pokegama Bay, Little Pokegama Bay, etc.). More vegetation contributes to greater fish production. Additional descriptive information: This shallow bay attracts waterfowl. It is fairly protected and there is not much water exchange between Lake Superior and Allouez Bay. The bay has similar fish diversity but higher abundance than clay-influenced river mouths. There is at least one deep hole within the bay that has a high concentration of both native and non-native fishes.</p>	<p>Ecological values: High burrowing mayfly (specifically <i>Hexagenia spp.</i>) density.</p> <p>This is the most important fish rearing area in the lower part of the harbor. Many species spawn here, especially forage and non-game species (including northern pike, muskellunge, bluegill, black crappie, smallmouth bass, yellow perch)</p> <p>This is a very important area for both breeding and migratory waterfowl because of the food and shelter provided by the habitat.</p> <p>Other comments: The non-native carp also spawns here.</p>