ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Niagara Power Project

(FERC No. 2216)

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EXECUTIVE SUMMARY

The New York Power Authority is in the process of applying for a new federal license to operate the Niagara Power Project in New York. At the request of stakeholders, this study was completed to describe the ecological condition of Fish, Gill, and Cayuga Creeks using available aquatic and riparian habitat, fish community, surface and groundwater hydrology, water quality, and land use information. In addition, this study summarizes the primary issues and concerns affecting each creek. Due to the many constraints and impediments inherit in each watershed, restorative actions to improve the ecological and geomorphic function of the creeks are not addressed in this study.

Major issues affecting the ecological condition of Fish, Gill, and Cayuga Creeks include sediment contamination, groundwater flow patterns, stream channelization, natural and man-made fish barriers, and land use and management practices.

Dioxin and PCB contaminated sediment has been dredged from the lower reaches of Gill and Cayuga Creeks. Both Gill (from its mouth upstream to Hyde Park Dam) and Cayuga Creek (from its mouth upstream to Walmore Road) are on the state's Priority Waterbodies List for "fish consumption precluded" due to toxic and contaminated sediment (NYSDEC 2000). Cayuga Creek is also under a fish consumption advisory from the NYSDOH to "eat none" due to dioxin contamination (NYSDOH 2003).

Lewiston Reservoir acts as a local area of groundwater recharge, and seepage from Lewiston Reservoir acts to increase flow in both Fish and Gill Creeks. Groundwater is pumped from Redland Quarry, located in the headwaters of the Cayuga Creek watershed, and discharged to a tributary of Cayuga Creek. This circumstance acts to increase streamflow within the tributary, and the cycling of water withdrawals may result in relatively minor water fluctuations

In the lower portion of Fish Creek, reaches have been diverted underground and lined with concrete to facilitate water conveyance through a golf course and recreational park. Fish Creek was also realigned to allow for the construction of Lewiston Reservoir by NYPA. Similarly, the lower reaches of

Gill Creek have been channelized to increase water conveyance through industrial areas, including significant sections that have been lined with concrete. Near residentially and commercially developed areas, Gill Creek has been culverted for significant distances. Gill Creek was also realigned to allow for the construction of Lewiston Reservoir by NYPA. In the Cayuga Creek headwaters, several tributaries have been ditched to facilitate drainage from agricultural fields. Reaches in the lower portion of the watershed have been straightened and armored in an effort to reduce shoreline erosion and flooding near residentially and commercially developed area. Also, Cayuga Creek has been realigned and conveyed through culverts to allow for the construction of the Niagara Falls airport runways and related facilities.

Along Fish Creek, six fish barriers (3 culverts, 2 small check dams, and a ATV trail) were identified. Within Gill Creek, two culverts and four small check dams represent barriers to fish movement. Hyde Park Lake Dam prevents movement of fish upstream from the Niagara River as well. In Cayuga Creek, three culverts and several woody debris jams inhibit fish movement.

In the upper portion of the Fish, Gill, and Cayuga watersheds, land use is principally agricultural with some residential development, while the Village of Lewiston is a center of residential and commercial development in the lower portion of the Fish Creek watershed. The City of Niagara Falls is a heavily developed area within the Gill and Cayuga watersheds. Heavy industrial activity is located along the southern part of the city near the mouths of Gill and Cayuga Creeks.

ABBREVIATIONS

Agencies

EC	Environment Canada
FERC	Federal Energy Regulatory Commission
INBC	International Niagara Board of Control
NYSDEC	New York State Department of Environmental Conservation
NYSDOT	New York State Department of Transportation
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

Units of Measure

C	Celsius, Centigrade
cfs	cubic feet per second
ft	feet
L	liter
µ	micro (prefix for one-millionth)

mg	milligram
MW	megawatt
NTU	Nephelometric Turbidity Unit

Regulatory

SPDES	State Pollution Discharge Elimination System

Environmental

DO	dissolved oxygen
EAV	emergent aquatic vegetation
PCB	polychlorinated biphenyl
SAV	submerged aquatic vegetation

1.0 INTRODUCTION

1.1 Niagara Power Project Description

The New York Power Authority (NYPA) is engaged in the relicensing of the Niagara Power Project in Lewiston, Niagara County, New York. The present operating license of the plant expires in August 2007. As part of its preparation for the relicensing of the Niagara Project, NYPA is developing information related to the ecological, engineering, recreational, cultural, and socioeconomic aspects of the Project. This report is part of that effort.

The 1,880-MW (firm capacity) Niagara Power Project (NPP) is one of the largest non-federal hydroelectric facilities in North America. The Project was licensed to the Power Authority of the State of New York (now the New York Power Authority) in 1957. Construction of the Project began in 1958, and first electricity was produced in 1961.

The Project has several components. Twin intakes are located approximately 2.6 miles above Niagara Falls. Water entering these intakes is routed around the Falls via two large low-head conduits to a 1.8-billion-gallon forebay, lying on an east-west axis about 4 miles downstream of the Falls. The forebay is located on the east bank of the Niagara River. At the west end of the forebay, between the forebay itself and the river, is the Robert Moses Niagara Power Plant (RMNPP), NYPA's main generating plant at Niagara. This plant has 13 turbines that generate electricity from water stored in the forebay. The east end of the forebay is the Lewiston Pump Generating Plant (LPGP). Under non-peak-usage conditions (i.e., at night and on weekends), water is pumped from the forebay via the plant's 12 pumps into the 22-billion-gallon Lewiston Reservoir, which lies east of the plant. During peak usage conditions (i.e., daytime Monday through Friday), the pumps are reversed for use as generators, and water is allowed to flow back through the plant, producing electricity. The forebay therefore serves as headwater for the RMNPP and tailwater from the LPGP. South of the forebay is a switchyard, which serves as the electrical interface between the Project and its service area.

For purposes of generating electricity from Niagara Falls, two seasons are recognized: tourist season and non-tourist season. By the 1950 Niagara River Water Diversion Treaty, at least 100,000 cfs must be allowed to flow over Niagara Falls during tourist season (April 1 – October 31) daytime and evening hours, and at least 50,000 cfs at all other times. Canada and the United States are entitled by international treaty to produce hydroelectric power with the remainder, sharing equally.

1.2 Study Objective and Approach

The objectives of this study were to gather scientific information to describe the current ecological condition of Fish, Gill, and Cayuga Creeks. Over time, the Fish, Gill, and Cayuga watersheds have been impacted by several human activities. These activities are associated with social and infrastructural influences in the study area, and to a certain extent power production.

Non-power production influences include the construction of dams and other instream barriers, industrial and municipal waste disposal practices, stream channelization, as well as land use conversion/development. These activities are a direct result of the social, institutional, and infrastructural pressures in the area and may represent significant constraints to restoring the ecological condition of the watersheds. Power production related influences include water level fluctuations, flow diversions, alterations to groundwater flow patterns, and stream channelization.

Section 2.0 of this report describes the ecological condition of Fish, Gill, and Cayuga Creeks in terms of water quality, surface and groundwater hydrology, fish community, land use and ownership, and aquatic and riparian habitat conditions. Section 3.0 describes the influences currently affecting the ecological integrity of each creek. Restorative actions to improve the ecological and geomorphic function of the creeks are not addressed in this study. Due to the many constraints and impediments inherit in each watershed; restorative actions to improve the ecological and geomorphic function of the creeks are not addressed in this study.

2.0 FISH, GILL, AND CAYUGA CREEK AQUATIC AND RIPARIAN CONDITIONS

2.1 Geographic and Geologic Setting

The investigation area includes the watersheds of Fish, Gill, and Cayuga Creeks (Figure 2.1-1). Fish Creek drains a 4.7 square mile watershed and flows westerly approximately 4 miles before emptying into the Lower Niagara River. Elevations in the watershed range from approximately 620 feet at the headwaters, located on the Tuscarora Nation, to approximately 530 feet at the Niagara River confluence in the Town of Lewiston.

The 7.6 mile long Gill Creek originates on the Tuscarora Nation and has a total drainage area of 13.9 square miles. Gill Creek flows south before emptying into the Upper Niagara River approximately 1,000 feet downstream of the NYPA water intake structures. Elevations in the watershed range from approximately 620 feet at headwaters to approximately 560 feet at the Niagara River confluence in the City of Niagara Falls.

The headwaters of the 10.9 mile long Cayuga Creek originate in the Town of Lewiston before flowing through the Tuscarora Nation. The watershed has a total area of 38.6 square miles, and elevations range from approximately 620 feet at the headwaters to approximately 560 feet at the Niagara River confluence in the City of Niagara Falls. Cayuga Creek flows southerly before emptying into the Upper Niagara River via the Little River. Bergholtz Creek, a major tributary, joins Cayuga Creek from the east approximately 5,000 feet upstream from its mouth. The Bergholtz Creek subwatershed has a total drainage area of 14.3 square miles.

The Fish, Gill, and Cayuga watersheds include lands of the Tuscarora Nation and the City of Niagara Falls, Town of Niagara, Town of Wheatfield, Town of Lewiston, and the Village of Lewiston (see Figure 2.1-1). The communities vary in population density from the highly urbanized City of Niagara Falls to less populated areas such as the Towns of Lewiston and Niagara. The lower portions of both Gill and Cayuga Creek flow through heavily urbanized portions of the City of Niagara Falls.

The watersheds are generally located within the central lowlands province of the interior plains physiographic division, near the northern limit of the large Allegheny sedimentary basin, with the Precambrian Shield to the north and the Appalachian tectonic front to the south. The Fish, Gill, and Cayuga watersheds lie between the Niagara Escarpment to the north and Onondaga Escarpment to the south. The land surface between the escarpments is poorly drained and relatively flat.

The Fish, Gill, and Cayuga watersheds are underlain by rocks of the Lockport Dolomite Formation. This middle Silurian aged formation consists of five members: the DeCew, Gasport, Goat Island, Eramosa, and Oak Orchard. The formation is light to medium gray, thin to thick bedded, and contains occasional gypsum or calcite. It is fine to coarsely crystalline, moderately hard, with numerous shale partings.

Soils formed in lake-laid clays and silts cover the majority of the study area, with lesser amounts of soils formed in glacial till and lake-laid silts and very fine sands covering the remaining area.

2.2 Water Quality

The waters of Fish, Gill, and Cayuga Creeks are classified as Class C by the NYSDEC. According to NYSDEC standards, the best usage for Class C waters is fishing. In addition, the standards state "the water quality shall be suitable for fish propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes" (NYSDEC 1998).

Segments of Gill and Cayuga Creek are on the New York State's Priority Waterbodies List (NYSDEC 1998). Specifically, Cayuga Creek from Walmore Road to its mouth, and Gill Creek from Hyde Park Dam to its mouth are rated as precluded. A precluded listing indicates that frequent/persistent water quality, or quantity conditions and/or associated habitat degradation prevent all aspects of the waterbody use. These segments of Gill and Cayuga Creeks are classified as precluded due to fish consumption advisories. The cause of fish contamination is primarily priority organic pollutants from contaminated sediment (NYSOH 2003).

Several water quality parameters were monitored during the period from April to November of 2003 (URS et al., Surface Water Quality report, in prep.). Discrete measurements of dissolved oxygen (DO) and turbidity data were collected during both wet and dry conditions from April to November 2003, while continuous temperature data were collected for the same period.

2.2.1 Fish Creek

Fish Creek had two water quality sampling sites along its 4.7-mile length (Figure 2.2.1-1). The Fish Creek-01 sampling site (TFC-01) was located adjacent to, and directly east of, the Lewiston Reservoir just before the creek is diverted northward around the reservoir. Four total samples were taken at TFC-01 from May to July 2003 and the data are summarized in Table 2.2.1-1. The creek at this site is often visibly brown and turbidity at this site is high at an average of 18.9 NTU. Dissolved oxygen at site TFC-01 averaged 6.2 mg/L (59.7% saturation) and dropped to an extremely low level on 6/26/03 with a minimum measurement of 0.6 mg/L (5.6% saturation). This was due to extremely low flow conditions at the sampling site. Average monthly temperature ranged from 9.4°C (April) to 21.5°C (July). Sampling stopped in July because Fish Creek went dry upstream of Garlow Road (URS et al., Surface Water Quality report, in prep).

The Fish Creek-02 site (TFC-02), where 17 DO/turbidity samples were collected from April to November (Table 2.2.1-1), is located to the north of the Lewiston Reservoir as the creek flows west, about 1.5 miles downstream of site TFC-01 (Figure 2.2.1-1). Turbidity at this site is also high at an average of 17.2 NTU, but DO is higher relative to TFC-01 with an average of 9.2 mg/L (88.2% saturation) and a minimum of 7.7 mg/L (74.3% saturation). Average monthly temperature ranged from 8.3°C (November) to 16.5°C (July & August). Temperature at the downstream site TFC-02 is consistently lower than at TFC-01. This was especially true during the summer months of June and July when monthly average water temperatures were 3.5 to 5.0°C cooler at TFC-02.

2.2.2 Gill Creek

The 7.6 mile long Gill Creek also has two sampling sites located adjacent to the reservoir (Figure 2.2.1-1). The Gill Creek-02 site (TGLC-02) is located directly east of the Lewiston Reservoir just before the creek is diverted south around the reservoir. Turbidity at this site is high with an average of 15.7 NTU (Table 2.2.2-1). DO at GC-02 averaged 7.6 mg/L (73.4% saturation) with a low of 4.1 mg/L (39.8% saturation). Average monthly temperature ranged from 7.6°C (November) to 21.0°C (July). The TGLC-02 site was moved approximately 10,000 feet downstream just above the confluence with the flow augmentation channel on July 10 due to low flow conditions at the original site.

The Gill Creek-01 site (TGLC-01) is located within the flow augmentation channel along the south side of the reservoir approximately 1.5 miles downstream of the original site TGLC-02. Water from Lewiston Reservoir is discharged to Gill Creek through the augmentation channel to supplement naturally occurring flow conditions. This augmentation flow from Lewiston Reservoir ranges from a high of approximately 3 cfs in the summer and falls to zero in the winter and spring. In 2003, flow from the Lewiston Reservoir was supplied to Gill Creek from June 2 through September 23. The purpose of the augmentation flow is to enhance recreational use of Gill Creek in the Hyde Park area.

DO in the flow augmentation channel is higher than in the main stream channel with an average of 9.2 mg/L (91.8% saturation) and turbidity is lower at an average of 4.6 NTU (Table 2.2.2-1). The minimum DO measurement at TGLC-01 was 7.2 mg/L (69.4% saturation). Average monthly temperature ranged from 9.1°C (April) to 23.3°C (August).

2.2.3 Cayuga Creek

Cayuga Creek is the longest of the three creeks at 10.9 miles and had three sampling locations (Figure 2.2.1-1). Cayuga Creek-03 (CC-03) is the most upstream site, located just below Porter Road, where turbidity averaged 16.6 NTU and DO levels averaged 9.6 mg/L (96.7% saturation) with a minimum of 6.6 mg/L (73.2% saturation) (Table 2.2.3-1). Average monthly temperature ranged from 11.6°C (April) to 21.6°C (August).

The next station is Cayuga Creek-02 (CC-02) located approximately 1.4 miles downstream from CC-03 at the confluence with Bergholtz Creek. Turbidity at this site is higher than at CC-03 (average 36.4 NTU) and DO is slightly lower averaging 5.6 mg/L (57.2% saturation) with a minimum of 3.8 mg/L (41.1% saturation). This effect is likely due to the inflow of the slow-moving and turbid Bergholtz Creek. Average monthly temperature ranged from 11.4°C (April) to 21.6°C (August).

The most downstream site is Cayuga Creek-01 (CC-01) and it is located at the mouth of the creek in the Little River. Turbidity levels averaged 16.1 NTU and DO averaged 7.3 mg/L (76.5% saturation) with a minimum of 5 mg/L (55.7% saturation). Average monthly temperature ranged from 8.5°C (April) to 24.4°C (August). Overall, temperatures at the three sites are very similar with the exception of August and September at CC-01 remaining approximately 3ºC higher than at the upstream gages.

2.3 Surface and Groundwater Hydrology

There are no historic flow data available for Fish, Gill, and Cayuga Creeks. However, annual and monthly (10%, 30%, 50%, 70%, and 90%) flow exceedances for Fish, Gill, and Cayuga Creeks were estimated using a multiple regression analysis (between drainage area and precipitation) based on observed average daily flows at thirteen USGS gage stations located on unregulated streams in the Niagara River region (URS et al., Tributary Backwater report, in prep). The results of this analysis are described below, as well as other characteristics related to the groundwater hydrology of several areas within the Fish, Gill, and Cayuga watersheds (URS et al., Groundwater Flow report, in prep).

2.3.1 Fish Creek

Table 2.3.1-1 illustrates the estimated flow exceedances for Fish Creek at its confluence with the Lower Niagara River. The estimated annual median flow (50% flow exceedance) for Fish Creek is 3.7 cfs, while the median monthly flow ranges from a low of 0.7 cfs (October) to a high of 13.2 cfs (March). These flows would be the expected total runoff at the mouth of Fish Creek, absent any wastewater discharges or other man-made inputs. Fish Creek is not influenced by water level fluctuations in the lower Niagara River due to a steep man-made outfall at the mouth of the creek just before it enters the

river. The outfall is located above the elevation of the lower Niagara River; therefore, the river flow does not backwater the creek.

The construction of Lewiston Reservoir has resulted in increased groundwater table elevations in the immediate vicinity of the reservoir. Specifically, Lewiston Reservoir acts as a local area of groundwater recharge. This situation has acted to increase groundwater input to Fish Creek near the reservoir; thus, increasing streamflow (URS et al., Groundwater Flow report, in prep). The streamflow estimates described in the previous paragraph do not reflect additional groundwater input attributable to Lewiston Reservoir.

2.3.2 Gill Creek

Estimates of flow exceedance for Gill Creek at its confluence with the Upper Niagara River are depicted in Table 2.3.2-1. The estimated annual median flow (50% flow exceedance) is 10.4 cfs, while the median monthly flow ranges from 2.5 cfs (September and October) to 35.7 cfs (March). These flows would represent total runoff at the mouth of Gill creek, absent any wastewater discharges or other man-made inputs.

There are no official water level data available along Gill Creek and it is not known how far upstream Niagara River water level fluctuations affect Gill Creek. The upstream extent of water level fluctuations will depend on the discharge and channel slope of Gill Creek and will not extend farther than approximately 7,000 feet where the Hyde Park Dam serves as a barrier.

Water from Lewiston Reservoir is discharged to Gill Creek to augment naturally occurring flow conditions. The purpose of this augmentation is to enhance the recreational use of Gill Creek as it flows through Hyde Park by reducing stagnation and improving the appearance of the creek. The augmentation flow of approximately 3 cfs is typically provided annually from early June to late September. For instance in 2003, flow from the Lewiston Reservoir was supplied to Gill Creek from June 2 through September 23.

Similar to Fish Creek, Gill Creek in the vicinity of Lewiston Reservoir also receives additional streamflow from increased groundwater input (URS et al., Groundwater Flow report, in prep). The streamflow estimates described in the previous paragraphs do not reflect additional groundwater input or flow augmentation attributable to Lewiston Reservoir.

2.3.3 Cayuga Creek

Shown in Table 2.3.3-1 are the estimated flow exceedances for Cayuga Creek at its confluence with the Upper Niagara River. The estimated annual median flow (50% flow exceedance) is 27.5 cfs, while the median monthly flow ranges from a low of 7.1 cfs (September) to a high of 91.3 cfs (March). The estimate includes contributions made from Bergholtz Creek, which enters Cayuga Creek approximately 5,600 feet upstream of Cayuga Creek's confluence with the Upper Niagara River (Table 2.3.3-2). The annual median flow is 17.7 cfs at Bergholtz Creek, while the monthly median flows ranged from 4.4 cfs (September) to 59.6 cfs (March). These flows would represent total runoff at the mouth of each creek, absent any wastewater discharges or other man-made inputs.

Hydraulic modeling of Cayuga Creek indicates that Upper Niagara River flow fluctuations affect approximately 10,800 feet of the creek under annual median flow conditions (27.5 cfs). This length would extend to a point approximately 2,000 feet downstream of the Porter Road bridge crossing. In addition, Upper Niagara River fluctuations would influence Bergholtz Creek water levels for approximately 10,950 feet for annual median flow conditions (17.7 cfs) (URS et al., Tributary Backwater report, in prep).

Based on sampling conducted during 2003, near the mouth of Cayuga Creek and extending upstream to Bergholtz Creek, water levels fluctuate about 1 foot daily. Water level information collected further upstream near Porter Road indicated fluctuations of around 0.3 feet daily (URS et al., Surface Water Quality report, in prep).

Water withdrawn from the Redlands Quarry is discharged into Cayuga Creek via a small tributary that enters within the Niagara Falls Naval Air Station. This circumstance acts to increase streamflow

within the tributary, and the cycling of water withdrawals may result in relatively minor water fluctuations. The streamflow estimates described in the previous paragraphs do not reflect inputs attributable to the Redlands Quarry discharge.

2.4 Fish Community

Surveys of fish have been conducted by several state and federal agencies in the last 15 years, and a survey was also conducted by the State of New York Conservation Department in 1928. NYPA has not conducted any formal surveys of the fish communities in the three creeks, but observations of several fish species were made during the habitat mapping described in Section 2.5. In general, Gill and Cayuga Creeks have a warmwater fish community that is dominated by forage fish species (e.g., minnows). Some sport fish species (e.g., northern pike, bass, perch, bullhead, and crappie) reside in Gill and/or Cayuga Creeks as well. Fish Creek appears to contain minnow species as well, but less is known about the fish species that are present in Fish Creek.

2.4.1 Fish Creek

No surveys of the fish community in Fish Creek have been conducted by state or federal agencies. While conducting the habitat mapping of Fish Creek (Section 2.5), minnows (Cyprinidae family) were observed although no fish were identified to the species level.

2.4.2 Gill Creek

During a survey of Gill Creek in 1928, several fish species were collected (Greeley 1929). These species were "common sunfish" (pumpkinseed sunfish, *Lepomis gibbosus*), grass pickerel (*Esox americanus vermiculatus*), golden shiner (*Notropis cornutus*), bluntnose minnow (*Pimephales notatus*), white sucker (*Catostomus commersoni*) and brown bullhead (*Ictalurus nebulosus*). NYSDEC collected fish at the mouth of Gill Creek in 1988 as part of a "Statewide Toxics Monitoring Program" (NYSDEC 1988). Only three fish species (*Cyprinus carpio*, common carp; *Aplodinotus grunniens*, freshwater drum;

and *Moxostoma spp.*, redhorse species) were caught in the 100 feet of 4 inch gill net. Because the gill net mesh was large (4 inches), small individuals (less than <approximately 16 inches) would not likely have been caught. Therefore, smaller species would not have been documented during this survey. Currently, crappies (*Pomoxis spp.*), bullheads (*Ictalurus spp.*), and other panfish (presumably *Lepomis spp.*) are stocked into Hyde Park Lake (NCDPDT 2001).

While conducting the habitat mapping of Gill Creek (Section 2.5), several fish species were observed. A single yellow perch (*Perca flavescens*) and a small school of approximately a dozen suckers around 12" in length were observed where the augmentation channel enters the creek. The suckers were likely either white suckers or northern hog suckers (*Hypentelium nigricans*). Common carp were also observed in the section below the rail yard and through the Hyde Park Golf Course.

2.4.3 Cayuga Creek

Several fish collections have been made in various locations in Cayuga from 1928 to 2001 by state and federal agencies. The present fish community is dominated by warm water forage species. Very few sport fish species are found in Cayuga Creek, and those species are represented by very few individuals. Table 2.4.3-1 lists the fish species collected in Cayuga Creek since 1928.

While conducting the habitat mapping of Cayuga Creek (Section 2.5), several fish species were observed. In the upper reaches (on the Tuscarora Nation to around Lockport Road), there were isolated pools which contained small fish.. Some of the fish found associated with these isolated pools were found dead. The fish species observed in these areas were brook stickleback (*Culaea inconstans*), central mudminnow (*Umbra limi*), and unidentified minnow species. Also observed was a dead sunfish, most likely a green sunfish (*Lepomis cyanellus*) or a rock bass (*Ambloplites rupestris*). In Cayuga Creek on the Niagara Falls Airport, a large (approximate size) northern pike (*Esox lucius*) was observed. Also, in the airport vicinity, fish were observed that were most likely common carp.

2.5 Aquatic Habitat and Riparian Corridor

For the purposes of this study, Fish, Gill, and Cayuga Creeks and their tributaries can be divided into several discrete reaches based on distinctive physical characteristics, surrounding land use, and human alterations made to each stream. The aquatic and riparian habitat conditions of each reach within the study creeks are discussed below. This discussion is based on reconnaissance level habitat mapping of the creeks that occurred during the summer of 2003. For each creek, the entire reach of stream was walked with the exception of Bergholtz Creek, and the unnamed tributary of Gill Creek. For the two tributaries, a desktop analysis using 2002 digital orthophotos was conducted to estimate average stream width, riparian buffer widths, and potential fish barriers. For both tributaries, additional habitat information described below was gathered at road crossings and also to verify the orthophoto interpretations.

Habitat types were designated as riffle, run, pool, dry streambed, and wetland habitats, based on visual flow, turbulence, depth, gradient, and vegetation. Habitats or "stream sections" were mapped for a distance of 656 feet (200 meters), or until the habitat type changed. Stream section length, average wetted width, average depth, gradient, substrate, bank slope (mean for both sides of the creek in percent slope), turbidity, water odor, average riparian buffer width (mean for both sides of the creek), dominant riparian vegetation type and species, and species of emergent and submergent aquatic vegetation were measured or estimated for each section. Stream section length was measured from the upstream to downstream end of each section using GPS. Depth was measured at three transects within the stream section (middle of the habitat and the upstream and downstream quarter points) and across each transect at three locations (thalweg, non thalweg river right, non thalweg river left). Measurements were then averaged to determine a mean depth for each stream section. Gradient was measured with a clinometer from the upstream to downstream end (water surface) of each section. Dominant substrates, average riparian buffer width, bank slope (percent slope), turbidity, and dominant instream cover were estimated visually as an average over the entire stream section. Substrate categories are described in Table 2.5-1 and dominant riparian vegetation types are described in Table 2.5-2. Bank slopes were grouped into four categories shallow (<30% slope), moderate (30-50% slope), steep (>50% slope), and undercut, and turbidity was classified according to four categories (clear, opaque, slightly turbid, and turbid)

2.5.1 Fish Creek

2.5.1.1 Reach F0-Mouth of Fish Creek to the Niagara Falls Country Club

Reach F0 begins at the Niagara Falls Country Club and continues downstream approximately 1,400 feet to where it empties into the Niagara River Gorge (Figure 2.5.1-1). The entire reach from the Country Club to the gorge is diverted underground through a culvert. The only portion not underground is where the creek descends into the gorge over a waterfall referred to as the Slime Chute (Figure 2.5.1-2). The steep drop into the gorge isolates Fish Creek from any water level fluctuations that occur within the lower river, and prevents any fish movement upstream into Fish Creek from the Niagara River. Due to its nature, this reach was not mapped in any detail during the habitat reconnaissance portion of the study.

2.5.1.2 Reach F1-Niagara Falls Country Club

Reach F1 located just upstream of where Fish Creek goes underground at the Robert Moses Parkway, traverses approximately 1,900 feet through the Niagara Falls Country Club Golf Course (Figure 2.5.1-3). This is a highly altered portion of Fish Creek. The creek parallels Lewiston Road through 400 feet of straightened stream channel with one small road crossing consisting of approximately 20 feet of corrugated culvert pipe (Figure 2.5.1-4). The creek then bends 90 degrees to the west and continues under Lewiston Road approximately 100 feet through another corrugated culvert pipe. The remaining stream section through the golf course is characterized by a concrete lined stream channel that extends downstream nearly 1,400 feet (Figure 2.5.1-5). Within the reach there are no barriers or obstructions that would prevent fish movement; however, water depths within the concrete lined portion of the channel are most likely not sufficient to support fish.

The channelized section of creek along Lewiston Road is comprised of 50% riffle and 50% run habitat types. The average wetted width in the riffle sections was 7.9 feet, and the average depth 0.3 feet. Sections identified as run habitat had an average wetted width of 9.3 feet and an average depth of 0.5 feet. Stream banks along the right side of the creek are shallow while banks on the left side of the creek along Lewiston Road are moderately steep; however, both sides of the creek are devoid of forested riparian

buffers. Stream banks are dominated by Kentucky bluegrass (*Poa pratensis*), redtop (*Agrostis gigantea*), and purple loosestrife (*Lythrum salicaria*) a common invasive species. This section also supports two species of submerged aquatic vegetation including water milfoil (*Myriophyllum spp*.), and elodea (*Elodea spp*.), Watercress (*Rorippa nasturtium-aquaticum*), a species of emergent aquatic vegetation, is also found. Substrate is dominated by small and large cobble which appears to be broken concrete and riprap from alongside Lewiston Road. Cobble is also the most dominant instream cover within this portion of the reach.

The concrete lined portion of the reach is also devoid of forested riparian buffers and supports no aquatic vegetation. Riparian vegetation consists primarily of Kentucky blue grass and yellow clover (*Trifolium aureum*) that is mowed to the edge of the concrete channel. The habitat type within the concrete lined channel was classified as a riffle with an average wetted width of 14.0 feet, and an average depth of 0.2 feet. Water depth across the channel is uniform, and instream cover is completely absent.

2.5.1.3 Reach F2-Neighborhood Section between the Golf Course Sections

Reach F2 is located between two portions of the Niagara Falls Country Club (Figure 2.5.1-6). The approximately 2,500 feet of meandering stream reach crosses under Military Road for a distance of 55 feet, and continues downstream through a forested section, and behind a residential neighborhood on Meadow Brook Road. Within the neighborhood portion of the reach, some residential properties directly abut the stream channel (Figure 2.5.1-7). In this section, individual management practices vary greatly, ranging from rip-rap and plantings to grasses mowed to the edge of the stream; however, nothing within the reach was identified as a potential barrier to fish movement.

Habitat within the reach is a mix of 67% run, 25% riffle, and 8% pool habitat types. Runs, riffles, and pools had an average wetted width of 9.8, 10.6, and 10.4 feet, and an average depth of 0.6, 0.4, and 0.8 feet respectively. There is little gradient throughout the reach (generally <1%), and stream banks are mostly shallow except for a short (approximately 265 feet) rip-rapped portion with steep banks located in the residential section. Riparian buffers dominated by a mix of tree, shrub and herbaceous species are generally less than 50 feet in width. Within the reach, five invasive species including common buckthorn

(*Rhamnus cathartica*), garlic mustard (*Alliaria petiolata*), multiflora rose (*Rosa multiflora*), Norway maple (*Acer platanoides*), and tartarian honeysuckle (*Lonicera tatarica*) were identified. Aquatic vegetation was generally sparse with a few sections containing Lizard's Tail (*Saururus cernuus*), water milfoil and curly leaf pond weed (*Potamogeton crispus*), an invasive species in New York. Substrate is a mix of large and small cobble except at the upstream end of the reach near the golf course where substrate is dominated by silt. The dominant instream cover is a mix of large cobble and overhanging cover.

2.5.1.4 Reach F3-Upstream Section of Niagara Falls Country Club Golf Course

Located upstream of Military Road, reach F3 flows through the upstream section of the Niagara Falls Country Club Golf Course (Figure 2.5.1-8). The reach, slightly less than 1,400 feet in length, crosses under four small golf cart path bridge crossings. Unlike reach F1 discussed above, this portion of stream channel has not been concrete lined. Throughout the reach no obstructions that may inhibit fish movement were identified.

Habitat within the reach consisted of a series of low gradient (<0.5%) runs with an average wetted width of 7.6 feet and an average depth of 0.8 feet. Stream banks have a shallow slope and riparian buffers dominated by herbaceous vegetation are all less than 25 feet in width. Similar to reach F1, riparian buffers along the creek are mowed to the edge of the stream (Figure 2.5.1-9). Two invasive species including multiflora rose and purple loosestrife were also identified within the reach. Emergent aquatic vegetation consists of watercress, and spike rush (*Eleocharis palustris*), while submergent species include elodea, water milfoil, coontail (*Ceratophyllum demersum*), and curly leaf pond weed an invasive species. The aquatic vegetation was the only instream cover within the reach, and no overhanging cover was available for stream shading. Substrate is dominated by silt and muck, and very turbid water was noted throughout the reach at the time of sampling.

2.5.1.5 Reach F4-Forested Section of Fish Creek between the Golf Course and Reservoir

Reach F4 begins where Fish Creek is diverted around the Lewiston Reservoir and extends downstream approximately 6,900 feet to the Niagara Falls Country Club (Figure 2.5.1-10). This is one of

the least impacted and most natural reaches on Fish Creek (Figure 2.5.1-11). Within the reach there are three road crossing including, Upper Mountain Road (approximate culvert length 50 feet), Bronson Drive (approximate culvert length 65 feet), and Country Club Trail (approximate culvert length 60 feet). The road crossing at Upper Mountain Road is a potential barrier to fish passage. Though the two culverts are not hanging (i.e., a culvert outlet that is elevated above the stream), flow through the culverts during periods of low water is most likely not sufficient to allow fish to passage.

The reach consists of a series of run (85%), riffle (8%), and pool (7%) habitats with average wetted widths of 8.0, 6.5, and 8.8 feet and average depths of 0.5, 0.2, 0.7 feet respectively. Stream banks range from shallow to moderate and have riparian buffers that generally exceed 100 feet on both sides of the creek. Overall riparian vegetation is dominated by shrub, tree, and herbaceous species with several invasives including, common buckthorn, garlic mustard, multiflora rose, purple loosestrife, and tartarian honeysuckle identified as dominant species within the reach. Aquatic vegetation was present throughout the reach. Species of emergent aquatic vegetation included, swamp smartweed (*Polygonum coccineum*), watercress, narrow leaf cattail (*Typha angustifolia*), softstem bullrush (*Scirpus validus*), spike rush, and fox sedge (*Carex vulpinoidea*), while submergent species included, water milfoil, variable milfoil (*Myriophyllum heterophyllum*), elodea, water moss (*Fontinalis spp.)*, coontail, and the invasive curly leaf pond weed. Substrate throughout the reach is mixed, however generally consists of silt, gravel and cobble. Water turbidity increased from clear at the upstream portion of the reach near the reservoir to turbid at the downstream end near the Golf Course. Overall this section of Fish Creek was shallow (<1 foot average depth) with variable gradient (ranging from 0 – 2%). Overhanging cover was the most dominant instream cover type followed by cobble, aquatic vegetation, and woody debris.

2.5.1.6 Reach F5-Channelized Section around Lewiston Reservoir

Reach F5 is the most highly altered section of Fish Creek. The reach begins upstream at Garlow Road and continues along the Northeast side of the Lewiston Reservoir for approximately 7,250 feet (Figure 2.5.1-12). The entire reach consists of low gradient (<0.5%) manmade channelized streambed that was created to reroute Fish Creek for construction of the Lewiston Reservoir (Figure 2.5.1-13). The current streambed consists of a trapezoidal channel lined with rock. Land use surrounding the creek

includes the Lewiston Reservoir along the south side of the creek and a power line corridor along much of the north side. Within the reach, three sites were identified as potential barriers to fish movement. Two of the barriers consist of small rock check dams that extend across the channel (Figure 2.5.1-14). The third barrier is an ATV bridge constructed across the creek.

The reach is a mix of run (80%), pool (18%), riffle (1%), and wetland (1%) habitat types. Wetland habitat types include dry portions of the stream where a defined channel was no longer evident. Within the reach, runs, pools, and riffles had an average wetted width of 7.5, 12.8, and 5.4 feet and an average depth across the transect of 0.5, 0.7, and 0.2 feet respectively. Steam banks and riparian buffers varied greatly between the right and left bank. Right stream banks have moderate slopes and riparian buffers of varying width generally ranging from 26-100 feet dominated by shrub and herbaceous species. Stream banks on the left side of the creek have steep banks and narrow riparian buffers (<25 feet wide) also dominated by shrub and herbaceous species. Three invasive species including purple loosestrife, glossy buckthorn, and common buckthorn (*Rhamnus cathartica*) were identified as dominant species in the reach. Of the three, purple loosestrife was the most common occurring in 17 out of 20 sections. Eight species of emergent aquatic vegetation were identified including, common arrowhead (*Sagittaria latifolia*), narrow leaf cattail, northern water plantain (*Alisma trivale*), reed canary grass (*Phalaris arundinacea*), softstem bullrush, spike rush, sweet flag (*Acorus americanus*), and water smartweed (*Polygonum amphibium*), while submergent aquatic vegetation included, the invasive curly leaf pond weed, elodea, naiad (*Najas spp*.), water milfoil, and duckweed (*Lemna spp.*). The dominant instream cover type within the reach included aquatic vegetation and overhanging cover. Pebble and cobble is the dominant substrate except for the section just downstream of Garlow Road where silt and muck is the dominant substrate.

2.5.1.7 Reach F6-Wetland Swale Upstream of Garlow Road

Reach F6 begins at Susies Lane and extends downstream approximately 14,000 feet to Garlow Road (Figure 2.5.1-15). Between Susies Lane and Garlow Road there are two additional road crossings. At both road crossings the creek is diverted under the road through a culvert. In early July of 2003 when the habitat reconnaissance was completed, both culverts were hanging, making them potential barriers to

fish movement. Although the majority of the reach was dry when the habitat reconnaissance was completed, in early spring of wet years when the creek still has water, the road crossings likely inhibit fish movement through the reach. In addition, the culverts have an unusual orientation in relation to the channel that seems to contribute to sediment deposition and flooding issues in the upper portion of the reach.

The majority of the reach was classified as a wetland swale rather than a stream reach (Figure 2.5.1-16); therefore, certain portions of the reach could not be mapped. For the entire reach, only 2,300 feet had a defined stream channel. Sections of the reach that were mapped consisted of dry streambed (76%), run (23%), and pool (<1%) habitat types. The two runs within the reach averaged 3.5 feet in width and 0.3 feet in depth, while the single identified pool had an average wetted width of 4.2 feet and an average depth of 0.4 feet. Stream banks were shallow and riparian buffers within the mapped section were variable ranging from less than 25 feet wide to greater than 100 feet; however, overall riparian buffers were generally greater than 100 feet in width. Most sections were forested with tree and shrub species the dominant vegetation type. Stream gradient was extremely shallow (approximately 0), and the substrate consisted primarily of silt and muck. Overhanging cover and aquatic vegetation were the dominant instream cover types. Though turbidity was not a problem at the time the survey was completed, three large field drains constructed just upstream of Garlow Road would likely cause significant sediment loading during storm flow events (Figure 2.5.1-17). The drains are designed to transport storm water from the fields directly to the creek channel.

2.5.2 Gill Creek Mainstem and Tributary

2.5.2.1 Reach G1-Industrialized Section of Gill Creek

Reach G1 begins at Buffalo Avenue and continues downstream nearly 1,600 feet to the mouth of Gill Creek (Figure 2.5.2-1). This section of Gill Creek lies within a chemical industrial complex and was not surveyed during the habitat reconnaissance due to security/access reasons. All physical descriptions of the habitat are based on information extracted from 2002 digital orthoimagery and site photographs. The reach has five bridge crossings including the Robert Moses Parkway at the mouth of the creek,

Dupont Drive, Buffalo Avenue and two unnamed roads. Land use in the vicinity of the creek is industrial with plants owned by Olin Chemical & Chlor Alkali Inc, and Dupont E I De Nemours & Company on both sides of the creek. The stream channel from the mouth of the creek upstream for approximately 820 feet has been concrete lined. The remaining portion of the creek is channelized (trapezoidal in cross section with natural substrate) streambed with narrow riparian buffers dominated by shrub and herbaceous species (Figure 2.5.2-2).

2.5.2.2 Reach G2-Gill Creek below Hyde Park Lake

Reach G2 begins just below the spillway at Hyde Park Lake and continues downstream approximately 5,200 feet through the city of Niagara Falls to Buffalo Avenue (Figure 2.5.2-3). Land use around the stream is primarily residential housing, and recreational fields. Within the reach there are six road crossings which including Pine Avenue (approximate length of crossing 75 feet), Hyde Park Boulevard (approximate length of crossing 170 feet), Ferry Avenue (approximate length of crossing 125 feet), Niagara Street (approximate length of crossing 60 feet), Packard Road (approximate length of crossing 70 feet), and Buffalo Avenue (approximate length of crossing 45 feet). Together the road crossings account for approximately 11% of the total stream length within the reach. In addition, 1,500 feet of Fish Creek parallels Hyde Park Boulevard with either minimal (<25 feet) or no riparian buffer separating the creek from the road. A small dam approximately two feet high located just upstream of Walnut Avenue acts as a barrier to fish movement during summer low flow conditions.

The habitat consists of a series of runs and a single pool. The average run within the reach had a wetted width of 40.5 feet and the only pool identified had an average wetted width of 36.2 feet. Average depth across the channel was not determined due to safety concerns from poor water quality. Stream banks throughout the reach have moderate slopes and riparian buffers less than 25 feet in width dominated by a mix of sapling, shrub, and herbaceous species (Figure 2.5.2-4). Common buckthorn, glossy buckthorn (*Rhamnus frangula*), multiflora rose, and purple loosestrife all invasive species in New York State were identified within the riparian buffers. Species of Emergent Aquatic Vegetation (EAV) found within the reach included narrow leaf cattail, softstem bullrush, and spike rush, while Submergent Aquatic Vegetation (SAV) included water milfoil, and wild celery (*Vallisneria americana*). Gradient

throughout the reach is shallow (<0.5%), and the substrate primarily silt and large cobble. Instream cover consists primarily of overhanging cover, and turbid water was noted throughout the reach.

2.5.2.3 Reach G3-Hyde Park Lake

Gill Creek is impounded just upstream of Pine Avenue creating the 30 acre Hyde Park Lake. The upstream extent of the impoundment begins at Porter Road and continues downstream approximately 5,100 feet. In addition the impoundment is fed by a small tributary at the northeast end (described below) (Figure 2.5.2-5). The spillway provides a significant barrier to any fish movement upstream from the river. Land use around the lake is generally recreational fields consisting of Hyde Park, and the Hyde Park Golf Course. The park around the lake is heavily used and the lake receives some fishing pressure.

The shoreline has shallow slopes and only minimal riparian buffers (<25 feet wide) dominated by herbaceous species with a few saplings and tree species present (Figure 2.5.2-6). In many locations the area adjacent to the lake is mowed to the edge of the water eliminating the riparian buffer. Invasive species including common buckthorn, glossy buckthorn, Norway maple, purple loosestrife, and tartarian honeysuckle were present around the lake. Several species of emergent aquatic vegetation including sweet flag, narrow leaf cattail, and common burreed (*Sparganium spp*.) were identified; however, submerged aquatic vegetation in the lake was sparse with only water milfoil present. Water in the lake was very turbid and may have inhibited the growth of submergent vegetation. Several areas of eroding banks that are likely sources of sediment loading were noted along the shoreline.

2.5.2.4 Reach G4-Forested Section of Hyde Park Golf Course

Reach G4 is a low gradient (<0.5%) meandering section of Gill Creek that flows just over 4,600 feet through a forested section of Hyde Park Golf Course (Figure 2.5.2-7). Throughout the reach three golf cart paths cross the creek and two areas provide potential barriers to fish movement. A small log jam in the downstream portion of the reach may prevent fish movement upstream during low flow conditions; however, it is probably not a barrier during high flow conditions. The most upstream barrier is a small

dam with an approximately one foot vertical drop (Figure 2.5.2-8). The dam likely prevents some fish species from Hyde Park Lake from traveling further upstream.

The reach consists of run (76%), and pool (24%) habitats. This was one of the deeper sections of Gill Creek, with the average run 1.5 feet in depth and 23.0 feet wide, and the average pool 2.1 feet deep, and 39.1 feet wide. The stream banks along the creek are shallow with riparian buffers generally 51 – 100 feet in width dominated by tree and shrub species (Figure 2.5.2-9). Four invasive species including common buckthorn, garlic mustard, purple loosestrife, and tartarian honeysuckle were present within the reach. Overall aquatic vegetation was sparse. Narrow leaf cattail and common arrowhead were the only emergent species found, while the only submergent species included water milfoil and pondweed. Silt and mud are the dominant substrates, and woody debris and overhanging cover the most dominant instream cover type. Turbid water was also noted for the entire length of the reach.

2.5.2.5 Reach G5-Hyde Park Golf Course

Reach G5 is a highly altered, low gradient (average gradient < 1%) section of Gill Creek consisting of a series of riffles and runs that flow just over 1,300 feet through Hyde Park Golf Course (Figure 2.5.2-10). The reach which starts below a small pond, flows 635 feet through a channelized section of stream before entering 700 feet of concrete lined channel (Figure 2.5.2-11). No barriers to fish movement were noted; however, a single golf cart path crosses the concrete lined portion of the creek.

Habitats within the channelized section of the creek included two riffle sections with an average wetted width of 13.7 feet and an average depth of 0.6 feet, and a single run with an average wetted width of 17.9 feet and a depth of 1.8 feet. Stream banks along the creek are shallow and devoid of any forested riparian buffers. Riparian buffers dominated entirely by herbaceous species provide a small stream buffer, however much of this consists of purple loosestrife (Figure 2.5.2-12). Aquatic vegetation within the reach was sparse. Emergent aquatic vegetation included reed canary grass, and spike rush, and submerged aquatic vegetation included the invasive curly leaf pondweed, elodea, and water milfoil. The dominant substrate and instream cover within the channelized section consisted primarily of boulders and large cobble.

The concrete lined portion of the creek was classified as a run with an average wetted width of 16.8 feet and an average depth of 0.8 feet. Some silt was present in the concrete portion of the channel, especially at the downstream end just before the creek makes a sharp bend to the northwest. This area creates a small hydraulic constriction that backs up water and deposits sediment. Overall the entire reach was very turbid.

2.5.2.6 Reach G6-Pond below the Rail Yard

Reach G6 consists of a short section of stream channel (145 feet in length) and a turbid 1.75 acre man-made pond just downstream of the rail yard (Figure 2.5.2-13). The pond is the result of a small dam located just upstream of where Gill Creek enters Hyde Park Golf Course (Figure 2.5.2-14). The dam also serves as a barrier to fish movement. Land use around the pond is primarily vacant lands associated with the rail yard.

The stream channel portion of the reach consists of a single run with an average wetted width of 14.8 feet and average depth of 1.2 feet across the channel. Stream banks have moderately steep slopes and extensive riparian buffers (>100 feet) dominated by herbaceous vegetation. Within the riparian buffers, two invasive species including common reed, and purple loosestrife were identified as dominant species. Emergent aquatic vegetation including purple loosestrife, and soft stem bullrush were sparse within the stream channel. Submerged aquatic vegetation including water milfoil and curly leaf pond weed were more abundant. Aquatic vegetation was the most dominant instream cover and large cobble and pebbles the dominant substrate.

The pond within the reach consists of a 1.75 acre man-made impoundment with an average wetted width of 95.8 feet. Both average depth and dominant substrate were not determined. Stream banks along the pond are moderately sloped along the left shoreline and shallow along the right. The entire shoreline of the pond has extensive riparian buffers greater than 100 feet in width dominated by herbaceous species consisting of crown vetch (*Coronilla varia*), wild garlic (*Allium vineale*), and thistle species (*Cirsium spp*.). Emergent aquatic vegetation was absent from the pond, and the only submerged aquatic vegetation was water milfoil.

2.5.2.7 Reach G7-Rail Yard

Reach G7 includes the portion of Gill Creek that goes underneath an active rail yard just downstream of Lockport Road (Figure 2.5.2-15). The creek passes under the Rail Yard approximately 660 feet through a concrete culvert divided into two sections. This reach was not mapped during the habitat reconnaissance portion of the study.

2.5.2.8 Reach G8-Isherwood Drive to the Rail Yard

Reach G8 begins just downstream of the residential neighborhood along Isherwood Drive and continues downstream approximately 3,000 feet to where the creek goes under the Rail Yard (Figure 2.5.2-16). Within the reach, Interstate 190 and Lockport Road cross Gill Creek. The crossing at Interstate 190 consists of two separate corrugated culvert pipes that extend 175 feet downstream, while Lockport Road is a smaller road crossing consisting of a single channel extending downstream approximately 60 feet. Neither of the road crossings appeared to be an impediment to fish movement. No additional barriers to fish movement were identified. Land use around the creek consists of open vacant lands, power line corridors, and the Town of Niagara – Lockport Road Landfill. The landfill, used in the past primarily for domestic waste, is currently closed.

Habitat within the reach consists of a series of runs with an average wetted width of 13.2 feet and depth of 0.9 feet. Stream banks are moderately steep with riparian buffers generally exceeding 50 feet in width. Riparian vegetation is dominated by a mix of tree, shrub and herbaceous species. Three invasive species including common buckthorn, common reed (*Phragmites australis*), and purple loosestrife were identified in the riparian buffers. Emergent aquatic vegetation was absent within the reach; however, five species of submerged aquatic vegetation including, water milfoil, elodea, sago pondweed (*Potamogeton pectinatus*), duckweed (*Lemna spp.*), and the invasive curly leaf pond weed were present. Substrate throughout the reach is a mix of silt, gravel, and some large cobble, and the dominant instream cover type is overhanging cover (Figure 2.5.2-17). Water within the reach was turbid, and several sections were described as having a sewage and petroleum odor.

2.5.2.9 Reach G9-Hewitt Road to Isherwood Drive

Reach F9 is a highly impacted section of Gill Creek that begins just upstream of Hewitt Road and continues approximately 6,000 feet to just downstream of Isherwood Drive (Figure 2.5.2-18). Four roads including Hewitt Road, Military Road, Witmer Road, and Isherwood Drive cross Gill Creek within the Reach. The Hewitt Road crossing consists of a single corrugated culvert pipe approximately 65 feet in length. At Military Road, Gill Creek enters a concrete culvert that extends 600 feet downstream underneath Military Road and a parking lot before coming out just upstream of Witmer Road. At the time of field reconnaissance the upstream extent of the culvert was clogged with woody debris and may have impeded fish movement. The creek then crosses underneath Witmer Road through a concrete culvert that extends 40 feet downstream. The final road crossing within the reach is a culvert that extends approximately 35 feet in length under Isherwood Drive. Nearly 12% of Gill Creek within reach G9 is directed through some type of culvert. Land use within the reach is primarily single family residential, commercial, vacant lands, and public recreational lands.

The mapped portion of Gill Creek within the reach is a series of run (90%), riffle (8%), and pool (2%) habitat types with average wetted widths of 13.8, 12.3, and 15.0 feet and average depths of 0.8, 0.6, and 1.5 feet respectively. Upstream of Military Road in the residential portion of the reach, stream bank slopes are generally shallow on the left side of the creek and moderate on the right. On average, riparian buffers are less than 25 feet in width along both sides of the creek. Similar to sections of Fish Creek where the creek directly abuts residential properties, riparian management practices varied widely ranging from rip-rap and vegetative plantings to grasses mowed to the edge of the stream (Figure 2.5.2-19). Downstream of Witmer Road, bank slopes are variable ranging in slope from shallow to steep, and riparian buffers are greater than 50 feet in width. Throughout the reach, riparian buffers were dominated by tree, sapling and shrub vegetation types. Four invasive species including common buckthorn, glossy buckthorn, purple loosestrife, and tartarian honeysuckle were identified. Emergent aquatic vegetation was absent within the reach; however, three species of submerged aquatic vegetation including sago pondweed, elodea, and the invasive curly leaf pond weed were present. Substrate throughout the reach is a mix of silt, gravel, pebble and small cobble, and the primary instream cover type is overhanging cover. Water was clear at the most upstream end of the reach; however, water became more turbid below Military Road. Water in sections below Witmer Road was described as having a sewage and sulfur odor.

2.5.2.10 Reach G10-Flow Augmentation and Natural Section near the Reservoir

Reach G10 includes 2,030 feet of forested stream channel just south of Lewiston Reservoir, and 625 feet of forested flow augmentation channel from the Reservoir to the mainstem Gill Creek (Figure 2.5.2-20). Although some sections of stream channel in the upstream portion of the reach were moved south during the construction of the Lewiston Reservoir, the reach appears relatively natural (Figure 2.5.2-21). Within the reach there are no major road crossings; only a small ATV path that crosses directly through the streambed. Land use around both the mainstem channel and the flow augmentation channel consists of vacant brushland and forest.

The main channel consisted of pool (51%), run (31%), and riffle (18%) habitat types with average wetted widths of 13.0, 10.8, and 9.1 feet, and average depths of 0.9, 0.4, and 0.3 feet respectively. The flow augmentation channel consisted of run (64%) and riffle (36%) habitat with average wetted widths of 9.7, and 7.5 feet, and average depths of 0.5, 0.6 feet respectively. The flow augmentation created some deep water pool habitat for fish both upstream and downstream of where the flow augmentation enters the channel. Stream banks along both portions of the reach are shallow, and have extensive riparian buffers greater than 100 feet in width dominated by tree and shrub species. Within the riparian buffers four invasive species including common buckthorn, multiflora rose, purple loosestrife, and tartarian honeysuckle were present. Emergent aquatic vegetation was sparse with only broad leaf cattail present in the main channel, and watercress present in the flow augmentation channel. Submerged aquatic vegetation was also sparse with none present in the flow augmentation, and only naiad species (*Najas spp.*) and curly leaf pond weed present in the main channel of Gill Creek. Gradient in the main channel is shallow (<0.5%) and the substrate dominated by large and small cobble. Gradient in the flow augmentation channel is shallow (approximately 1%) and the substrate dominated by sand and gravel. In both sections, overhanging cover was the dominant instream cover type. At the time of sampling, water in both sections of the creek was clear.

2.5.2.11 Reach G11-Channelized Section around Lewiston Reservoir

Reach G11 is the most highly altered section of Gill Creek. The reach begins at Garlow Road and continues downstream along the southeast side of Lewiston Reservoir for approximately 8,850 feet (Figure 2.5.2-22). The entire reach consists of low gradient (<0.5%) manmade channelized streambed (trapezoidal in cross section and lined with stone) created to reroute Gill Creek for construction of the Lewiston Reservoir. Land use around the reach consists of the Lewiston Reservoir directly adjacent to the right stream bank, and a power line corridor on the left (Figure 2.5.2-23). Parts of the reach are deeply incised with steep rock walls on both sides. The only road crossing is Garlow Road at the very beginning of the reach, consisting of a concrete culvert approximately 55 feet in length. Within the reach, 18 possible barriers to fish movement were identified. The barriers appear to be small rock footings that extend across the creek channel (Figure 2.5.2-24). Most if not all the barriers will only impede fish movement during low flow conditions similar to what was observed in early July of 2003.

Habitat types within the reach consist of run (80%), pool (16%), riffle (3%), and dry streambed (1%) with average wetted widths of 8.4, 7.6, and 5.4 feet, and average depths of 0.5, 1.0, and 0.4 feet respectively. Stream banks and riparian buffers varied greatly from right bank to left bank. Banks on the right have slopes that vary from moderate to steep along the reservoir, while riparian buffers were all less than 25 feet in width. Stream bank slopes on the left were more variable ranging from shallow to steep while riparian buffers varied significantly ranging in width from zero to greater than 100 feet. Riparian buffers on both sides of the creek were dominated by shrub and herbaceous species including common buckthorn, glossy buckthorn, purple loosestrife, and tartarian honeysuckle, all invasive species in New York State. Within the reach five species of emergent aquatic vegetation were present including broad leaf cattail, common burred (*Sparganium spp*.), Northern water plantain, purple loosestrife, and swamp smartweed, and three species of submerged aquatic vegetation including elodea, naiad species, and curly leaf pond weed were identified. Substrate in the reach varies from the upstream to downstream end. In the upstream section from Garlow Road downstream approximately 1,600 feet to where the creek bends to the east, substrate is dominated by muck and large boulders, while the rest of the reach is dominated by boulders and large cobble. Water ranged from clear to slightly turbid and the dominant instream cover type included overhanging cover, and large boulders.

2.5.2.12 Reach G12-Wetland Swale Upstream of Garlow Road

Reach G12 begins just upstream of Walmore Road and continues downstream approximately 16,000 feet to Garlow Road (Figure 2.5.2-25). The creek drains a large forested wetland complex within the Tuscarora Nation Lands. In early July of 2003 when the habitat reconnaissance was conducted, Gill Creek within this reach was completely dry and no defined stream channels were present; however, it is likely that channel flow is present during higher water conditions (Figure 2.5.2-26). Due to the low water conditions, the entire reach was not mapped in detail and classified as a wetland swale rather than a stream reach.

2.5.2.13 Reach GT1-Gill Creek Tributary - Hyde Park Golf Course Section

Reach GT1 is a highly altered section that flows just over 3,700 feet through Hyde Park Golf Course (Figure 2.5.2-27). The reach begins at the upstream edge of the golf course and continues downstream approximately 1,130 feet before being routed underneath a golf course fairway through 60 feet of culvert. The channel above the culvert has stream banks with shallow slopes and average wetted widths of approximately 6.8 feet. Substrate in this section is dominated by silt, and in late September of 2003 when the survey was completed, the channel was clogged with broad leaf cattail (*Typha latifolia*) (Figure 2.5.2-28). Below the culvert, the creek continues 635 feet through a concrete lined stream channel to Porter Road (Figure 2.5.2-29). This section has an average wetted width of 6.5 feet and is crossed by a single golf cart path. The creek continues under Porter Road nearly a 100 feet through a concrete culvert divided into two sections. Below Porter Road the creek continues downstream approximately 400 feet before entering a small forested section within the golf course. Between Porter Road and the forested section, the creek is traversed by another golf cart path and has an average wetted width of 13.3 feet, and shallow sloped stream banks. Substrate within this section is dominated by silt, and the creek channel clogged with broad leaf cattail. Everything upstream of where the creek enters the small forested section is mowed golf course turf with riparian buffers less than 25 feet in width. Within the riparian buffers, purple loosestrife was the only invasive species noted. The forested section extends downstream approximately 535 feet, with riparian buffers 51 – 100 feet in width on both sides of the

creek. Downstream of the forested section the creek flows nearly 800 feet through another concrete lined channel to where it empties into Hyde Park Lake.

2.5.2.14 Reach GT2-Gill Creek Tributary - Hyde Park Golf Course to Interstate 190

Reach GT2 begins just upstream of Interstate 190 and continues downstream approximately 4,385 feet to where the creek enters Hyde Park Golf Course (Figure 2.5.2-30). The creek flows under Interstate 190 through a culvert approximately 325 feet in length before entering lands owned by the New York Power Authority, a rail yard operated by Consolidated Rail Corporation, and a power line corridor owned by Niagara Mohawk Power Corporation. Within this area, the creek is routed underneath the rail yard 560 feet through a culvert, and underneath an access road an additional 60 feet through the Niagara Mohawk property. Within the reach, just less than 950 feet of stream channel is diverted underground through culverts. This accounts for almost 17% of the creek. Within the reach riparian buffers are extensive. Buffers dominated by herbaceous species generally exceed 100 feet in width; however, similar to the section in Hyde Park Golf Course, portions of the creek channel were heavily vegetated by emergent aquatic vegetation consisting of cattail species (*Typha spp*.) (Figure 2.5.2-31).

2.5.2.15 Reach GT3-Gill Creek Tributary: Residential Section from Lockport Road to Interstate 190

Reach GT3 begins just upstream of the intersection at Lockport and Military Road, and continues downstream 2,585 feet to Interstate 190 (Figure 2.5.2-32). Land use throughout the reach consists of residential neighborhood, commercial properties, public recreational lands, and a railroad corridor. Within the reach, the creek is diverted under three road crossings and a set of railroad tracks. At the upstream end of the reach, the creek crosses under the intersection of Lockport and Military Road for a distance of approximately 260 feet. Further downstream the creek is diverted under a set of railroad tracks (approximate distance 135 feet), and twice under North Whitham Drive (approximate distance 60 and 75 feet).

Habitat within the reach consists of a series of pools and slow runs, and the average wetted width of the reach is 8.5 feet. Stream banks along the creek have shallow slopes with riparian buffers less than 25 feet in width dominated by herbaceous and shrub species (Figure 2.5.2-33). Invasive species present within the reach included common reed, and purple loosestrife. Submerged aquatic vegetation was absent from the reach; however, emergent aquatic vegetation including clotbur (*Xanthium strumarium*), narrow leaf cattail, northern water plantain, and softstem bullrush were the dominant instream cover type. Substrate within the reach is dominated by silt and bedrock, and at the time of reconnaissance, the water was slightly turbid.

2.5.2.16 Reach GT4-Gill Creek Tributary: Upstream of Lockport Road

Reach GT4 begins just south of Grauer Road at the tributary headwaters, and extends downstream 3,600 feet to Lockport Road (Figure 2.5.2-34). Major land use surrounding the tributary includes vacant lands owned by the town of Niagara, New York State Electric & Gas, and Niagara Mohawk, and a utilities corridor owned by the New York Power Authority. In 2003, the Town of Niagara converted some of their vacant land to a public park. Construction of the park also included the creation of a small rip-rap lined pond on the tributary (Figure 2.5.2-35). Within the entire reach there are two small road crossings both located just upstream of Lockport Road. The upstream crossing is a small unpaved access road leading to the transmission line corridor. The crossing consists of a single corrugated culvert pipe approximately 12 feet in length. The most downstream crossing is a driveway to a private residence. The crossing consists of two corrugated culvert pipes 25 feet in length (Figure 2.5.2-36). The culvert invert elevation downstream of the crossing appears lower than the elevation upstream of the crossing. This crossing is likely a barrier to fish movement during low water periods.

In late September of 2003 when the reconnaissance was completed, the creek channel upstream of Lockport Road was almost entirely dry streambed dominated by silt substrate with only a few small isolated pools of water. Additionally, the pond constructed upstream in the park contained water. The water level in the pond was controlled by a fixed level culvert structure. Banks along the channel have shallow slopes, and riparian buffers of variable widths. Riparian buffers along the right stream bank ranged from zero to over a hundred feet in width, with the average buffer 26 -50 feet in width. Riparian

buffers along the left stream bank were also variable, however most were greater than 50 feet in width. Buffers on both stream banks were dominated by shrubs with some tree and herbaceous species present. Invasives identified within the reach include common buckthorn, and purple loosestrife. As a result of the dry streambed no aquatic vegetation or instream cover was present.

2.5.3 Cayuga Creek Mainstem and Tributary

2.5.3.1 Reach C1-Tuscarora Drive to the Niagara River

Reach C1 begins at Tuscarora Drive where Bergholtz Creek empties into Cayuga Creek, and continues downstream 5,740 feet to where Cayuga Creek empties into the Niagara River (Figure 2.5.3-1). Cayuga Creek downstream of the confluence of Bergholtz Creek is much larger than other portions of the creek and is navigable by small watercraft. Land use surrounding Cayuga Creek within the reach is almost entirely single family residential housing. Many of the houses are located on the water's edge with boat docks extending into the creek (Figure 2.5.3-2). Within the reach six roadways cross Cayuga Creek including 88th Street, Buffalo Avenue, LaSalle Expressway, South Military Road, Lindbergh Avenue, and Pear Avenue. Unlike road crossings in Gill and Fish Creeks, crossings within this portion of Cayuga Creek are elevated bridges rather than small culverts (Figure 2.5.3-3), so none of the crossings are potential barriers to fish movement.

The entire reach is comprised of very low gradient, slightly turbid pool habitat with an average wetted width of 68.0 feet, and an average depth of 6.0 feet. Stream banks have moderate slopes and narrow riparian buffers generally less than 25 feet in width. Buffers were dominated by tree and herbaceous species, including garlic mustard, Norway maple, and purple loosestrife, all invasive species in New York State. Emergent aquatic vegetation was absent within the reach; however, five species of submerged aquatic vegetation including duckweed, sago pondweed, variable milfoil (*Myriophyllum heterophyllum*), wild celery (*Vallisneria americana*), and water milfoil were present. Thick mats of duckweed covered the water surface throughout much of the reach. Substrate is dominated by silt and hard clay, while the prominent instream cover type is a mix of overhanging cover, woody debris, submerged aquatic vegetation, and man-made structures (boat docks).

2.5.3.2 Reach C2-Residential Section Upstream of Tuscarora Drive

Reach C2 consists of 5,890 feet of low gradient stream channel located upstream of the confluence of Bergholtz Creek (Figure 2.5.3-4). Unlike Reach C1, this portion of Cayuga Creek is much smaller, with only the most downstream portions navigable by watercraft; however, land use surrounding the creek is similar. Much of the creek is surrounded by single-family residential housing, and a few commercial properties. In some portions of the reach, residential properties directly abut the creek channel. Pine Avenue and Tuscarora Drive are the only two roads that cross the creek within the reach. Similar to reach C1, both crossings are elevated bridges rather than culverts, and do not interfere with fish movement in the creek.

The reach consists of pool (78%), run (21%), and riffle (1%) habitat types, with an average wetted width of 22.1, 15.0, and 15.9 feet, and average depth of 1.8, 0.8 0.5 feet respectively. Stream banks along the downstream half of the reach have shallow to moderate slopes; however, banks along the upstream portion are generally steep or undercut. Many of the steep and undercut banks show evidence of erosion, especially those sections with residential properties directly abutting the creek (Figure 2.5.3-5). In these areas stream banks are either armored with rip-rap or severely eroding. Overall, erosion is prevalent throughout most of the upstream portions of the creek. Riparian buffers are variable; however, with the exception of a short forested section (approximately 1,400 feet), buffers were typically less than 25 feet in width. Within the riparian buffers, four invasive species including garlic mustard, multiflora rose, purple loosestrife, and tartarian honeysuckle were present. No submerged aquatic vegetation was present; however, three species of emergent aquatic vegetation including common arrowhead, softstem bullrush, and watercress were present. Substrate throughout the reach is dominated by a mix of variable sized cobble, silt, and clay, while instream cover consisted primarily of overhanging cover and woody debris. Just upstream of the forested section within the reach, extensive woody debris created a log jam that could potentially effect fish movement during low water conditions (Figure 2.5.3-6). Water throughout the reach was slightly turbid and several sections near residential areas were described as having a strong sulfur smell.

2.5.3.3 Reach C3-Forested Section below Porter Road

Reach C3 consists of nearly 1,700 feet of forested stream channel located just downstream of Porter Road (Figure 2.5.3-7). Although the reach is primarily forested, nearly 80% of creek channel has been straightened. Land use around the creek is almost entirely vacant brush lands owned by a single land owner (Joseph Weber Inc.). This is one of the few sections of Cayuga Creek that does not contain any road crossings.

The reach consists of pool (51%) and run (49%) habitat types with average wetted widths of 15.6, and 16.1 feet, and average depths of 1.6, and 1.1 feet respectively. In the upstream portion where the creek has not been straightened, stream banks have shallow slopes; however, stream banks in the straightened portion of the reach are undercut and experiencing some erosion (Figure 2.5.3-8). Most of the reach is heavily forested with extensive riparian buffers greater than 100 feet in width. Within the riparian buffers, three invasive species including garlic mustard, multiflora rose, and tartarian honeysuckle were present. Similar to previous reaches, submerged aquatic vegetation was absent; while only sparse patches of emergent aquatic vegetation including common arrowhead, great burreed (*Sparganium eurycarpum*), and watercress were present. Substrate was dominated by a mix of clay, silt, and coble, and woody debris was the dominant instream cover type. Water throughout the reach was clear; however, water had a strong sulfur odor, and the furthest downstream section had what was described as "a very strong putrid odor."

2.5.3.4 Reach C4-Niagara Falls Airport

Reach C4 begins at Walmore Road at the edge of the Niagara Falls Airport and continues downstream just over 12,000 feet through the airport to Porter Road just outside the airport boundary (Figure 2.5.3-9). The highly altered reach within the airport boundary has been extensively straightened and diverted under several runway crossings. Within the reach, just over 1,300 feet or nearly 11% of the stream channel is diverted beneath four airport runways. Additionally, Walmore Road crosses the upstream portion of the creek, and Porter Road the downstream portion. None of the airport runways or road crossings were identified as potential barriers to fish movement. Two small tributaries that appear to

drain airport lands also empty into the mainstem Cayuga Creek in the downstream portion of the airport property. Neither tributary was mapped.

The stream reach is very low gradient (<0.5%) consisting of run (59%), pool (36%), and riffle (5%) habitat types with average wetted widths of 12.4 feet, 17.7 feet, and 11.1 feet, and average depths of 0.7, 1.0, and 0.3 feet respectively. Stream banks within the upstream portion of the reach have shallow slopes and riparian buffers less than 25 feet wide. Stream banks along the downstream portion of the reach have steep slopes, and buffers that often exceed 100 feet in width. Within the airport, riparian buffers along portions of the creek are cut or mowed on a regular basis for airport security reasons. As a result, riparian vegetation along the creek is dominated by shrub and herbaceous species (Figure 2.5.3-10). Invasives within the reach consisted of common reed, garlic mustard, Japanese knotweed (*Polygonum cuspidatum*), multiflora rose, purple loosestrife, and tartarian honeysuckle. Both emergent and submergent aquatic vegetation were common throughout the reach. Nine species of emergent aquatic vegetation were present within the reach including broad leaf cattail, blue flag iris (*Iris versicolor*), common arrowhead, great burreed, mild water pepper (*Polygonum hydropiperoides*), purple loosestrife, softstem bull rush, watercress, and water purslane (*Ludwigia palustris*), and six species of submerged aquatic vegetation including coontail, curly leaf pond weed, elodea, naiad, water milfoil, and water moss. Aquatic vegetation and overhanging cover were the dominant instream cover types. Substrate throughout the reach was extremely variable ranging from bedrock and silt to areas of small and large cobble. Water within the reach was clear in several of the most upstream portions of the reach; however, the majority of the reach was slightly turbid. Bank erosion was not a major problem throughout the reach; however, just downstream of the airport property landscaping material including soil and grass clippings are being dumped along stream banks (Figure 2.5.3-11). Also noted was a small oil boom to prevent oil spill run-off from the airport. This was located on the downstream portion of the reach at the edge of the airport property.

2.5.3.5 Reach C5-Eastern Tributary of Cayuga Creek to Walmore Road

Reach C5 begins at the confluence of the unnamed eastern tributary of Cayuga Creek, and continues downstream just over 5,300 feet to Walmore Road (Figure 2.5.3-12). The section does not

appear extensively altered, and remains fairly natural. Land use surrounding the creek consists primarily of agricultural fields and open space with Lockport Road and a set of railroad tracks crossing Cayuga Creek. At both Lockport Road and the railroad crossing, the creek is diverted through culverts for a distance of 56 feet. Neither of the stream crossings are a barrier to fish movement; however, four fish barriers were identified within the reach. In the section downstream of Lockport Road three large woody debris jams were identified as possible barriers to fish movement (Figure 2.5.3-13). Additionally just upstream of Lockport road a small bedrock ledge approximately one foot high was also identified (Figure 2.5.3-14). Under low flow conditions the woody debris jams have the potential to interfere with fish movement both upstream and downstream; however, the bedrock ledge will limit only fish migration upstream.

From the start of the reach downstream 1,900 feet, the creek consists of a mix of dry stream bed and isolated pools. Below this point an apparent ground water discharge supplements flow in the remaining portions of the reach. Similar to other reaches, Reach C5 has a low gradient (0.5%) and is comprised of pool (52%), run (46%), and riffle (2%) habitat types with an average wetted width of 11.5, 10.0, and 11.7 feet, and an average depth of 0.7, 0.5, and 0.4 feet respectively. Stream banks throughout the reach primarily have shallow slopes, with a short section (66 feet) identified as undercut and eroding (Figure 2.5.3-14). Riparian buffers along the left stream bank exceeded 50 feet in width throughout the reach except at the most downstream section near Walmore Road where buffers were less than 25 feet. The right stream banks were more variable. The upstream portions of the reach have wider buffers exceeding 50 feet in width, and the downstream sections have narrower riparian buffers less than 50 feet. Riparian vegetation is dominated by shrub and herbaceous species including common buckthorn, Japanese knotweed, and purple loosestrife, all invasive species. Aquatic vegetation was found throughout much of the reach. Six species of emergent aquatic vegetation including common arrowhead, great burreed, northern water plantain, smartweed, softstem bullrush, and watercress, and three species of submergent aquatic vegetation including elodea, pond weed, and water moss were identified within the reach. Substrate is dominated primarily by large and small cobble, and the dominant instream cover is a mix of overhanging cover, woody debris, and aquatic vegetation. Water turbidity in all sections of the reach was clear.

2.5.3.6 Reach C6-Western Tributary of Cayuga Creek to the Eastern Tributary of Cayuga Creek

Reach C6 extends from the confluence of the unnamed western tributary of Cayuga Creek downstream 3,700 feet to the confluence of the unnamed eastern tributary (Figure 2.5.3-15). Unlike reach C5, upstream portions of the creek have been extensively straightened. Land use surrounding the reach consists primarily of agriculture and a few residential and commercial properties including a cement factory located along a portion of the creeks edge. Three roads including Corey Drive (culvert length approx. 45 feet), Walmore Drive (culvert length approx. 55 feet), and a small unnamed access road, and a set of railroad tracks cross Cayuga Creek within the reach. The small access road and the railroad crossing consist of elevated bridges; however, both were identified as potential barriers to fish movement. At the access road, fish movement is impeded by an approximately one foot hanging culvert (Figure 2.5.3-16), while at the railroad bridge, the stream channel below the bridge is old damaged concrete (Figure 2.5.3-17) that may provide a barrier to fish movement during low water conditions.

The reach consists of pool (56%), dry streambed (29%), riffle (9%), and run (6%) habitat types. Sections of dry streambed were located in the lower section of the reach just upstream of the confluence of Cayuga Creek and its eastern tributary. Water upstream of the dry sections was observed flowing into a crack in the bedrock, suggesting that portions of the reach go underground. Pools, riffles, and runs have an average wetted width of 10.6, 7.5, and 8.5 feet, and an average depth of 0.7, 0.2, and 0.4 feet respectively. Stream banks have shallow slopes throughout the reach on both sides of the creek, while riparian buffers are variable. Riparian buffers on the left side of the creek are very narrow (<25 feet) throughout most of the reach while buffers along the right stream bank are less than 25 feet in width in the upstream portion of the reach above the railroad tracks, and wider (>51 feet) downstream of the tracks. Riparian buffers were dominated by herbaceous, shrub, and tree species. Purple loosestrife was the only invasive species identified within the buffer. Emergent aquatic vegetation including common arrowhead, great burreed, northern water plantain, rice cutgrass (*Leersia oryzoides*), spike rush, and watercress were found throughout the reach; however, submergent aquatic vegetation including only algae and duckweed were sparse. The dominant substrate consists of clay and silt with some cobble present. Water within the reach was clear, and emergent aquatic vegetation was the most dominant instream cover type.

2.5.3.7 Reach C7-Upstream of Saunders Settlement Road to the Confluence of the Western Tributary of Cayuga Creek

Reach C7 begins just upstream of Saunders Settlement Road on Tuscarora Lands and continues downstream 5,900 feet to where the unnamed western tributary joins Cayuga Creek (Figure 2.5.3-18). Land use surrounding the creek consists primarily of agriculture fields and some residential properties outside Tuscarora lands, and vacant brushland within Tuscarora lands. Within the reach, the creek is diverted through five culverts, including Saunders Settlement Road (culvert length 65 feet), a power line corridor (culvert length 15 feet), two unnamed dirt roads (culvert lengths 18 and 20 feet), and Walmore Road (culvert length 35 feet). None of the stream crossings were identified as barriers to fish movement.

The majority of Cayuga Creek within the reach was dry in early September when the habitat reconnaissance was completed (Figure 2.5.3-19). Habitat types mapped consisted of dry streambed (71%), dry streambed/intermittent pools (22%), and pools (7%). Pools within the reach have an average wetted width of 12.8 feet and an average depth of 0.9 feet. Stream banks have shallow slopes with riparian buffers that are variable in width ranging from almost no buffer to over 100 feet. Riparian vegetation within the buffers is dominated by herbaceous and shrub species. Emergent aquatic vegetation was abundant throughout the reach. Submergent aquatic vegetation was sparse. The dominant substrate throughout the stream channel is silt, clay, and cobble, and the dominant instream cover type was emergent aquatic vegetation.

2.5.3.8 Reach C8-Headwaters of Cayuga Creek

Reach C8 begins at the headwaters of Cayuga Creek where it drains a two acre man-made impoundment, before continuing downstream approximately 10,800 feet through vacant brushlands, and agricultural fields (Figure 2.5.3-20). Much of the reach is extensively altered with long section that were straightened and channelized. Near the downstream portion, there are three side channels branching off from the mainstem channel. They appear to be remnants of the original creek channel before it was straightened, suggesting that the creek meandered considerably within the reach. Within the reach only one road crosses Cayuga Creek. At Chew Road water is diverted through a culvert approximately 85 feet

long. In September when the habitat reconnaissance was completed, the streambed at the crossing was completely dry extending nearly 100 feet upstream. In addition to the crossing at Chew Road, two additional barriers to fish movement were identified further upstream. Two hanging culverts approximately 1.5 feet above the streambed are located at a pump house used to drain agricultural fields and force water downstream also act as a barrier to fish movement within the reach.

In early September when the mapping was completed, the majority of the low gradient reach was dry (Figure 2.5.3-21). Habitat types consisted of dry stream channel (86%), and several isolated pools (14%). Pools within the reach had an average wetted width of 7.5 feet and an average depth of 0.5 feet. Stream banks throughout the reach have shallow slopes, and extensive riparian buffers, most of which exceed 100 feet in width. Riparian buffers are dominated by tree and shrub species. Emergent aquatic vegetation was abundant. Submerged aquatic vegetation was sparse within the pools. Substrate is a mix of silt and clay, and the dominant instream cover type consisted of overhanging cover, woody debris, and emergent aquatic vegetation. Water present within the reach was opaque to slightly turbid with several sections described as having a sulfur and petroleum odor.

2.5.3.9 Reach CET1-Cayuga Creek: Unnamed Eastern Tributary

Reach CET1 begins at the edge of a residential neighborhood on West Street and continues downstream nearly 12,200 feet to the confluence of Cayuga Creek (Figure 2.5.3-22). The entire tributary has been extensively channelized, and currently serves as drainage ditch for the agricultural fields surrounding the creek. Many of the fields have a series of channels leading directly into the tributary to improve drainage. These drainage channels act as a direct pathway for sediment and other nutrients to enter the creek. As a result, portions of the creek are clogged with excessive sediment. In late September 2003 when mapping for the tributary was completed, the Town of Lewiston was actively dredging nearly 4,000 feet of dry stream channel between West Street and the Railroad crossing (Figure 2.5.3-23). Only portions of the tributary downstream of the railroad crossing were mapped as part of the study. Within the reach the creek is diverted under three crossings including a set of railroad tracks (culvert length 100 feet), and two field access roads (culvert lengths both approximately 30 feet). Culverts at both field access crossings pose a potential problem to fish movement. Both culverts were clogged with debris and

the most downstream culvert was hanging approximately one foot at the downstream end (Figure 2.5.3-24).

Lower portions of the reach included a mix of dry streambed (49%), pool (32%) and run (19%) habitat types. Pools and runs within the reach had an average wetted width of 8.0 and 5.1 feet and an average depth of 0.3 and 0.1 feet respectively. Stream banks along the creek have shallow slopes with narrow riparian buffers (<25 feet). Sections closer the confluence of Cayuga Creek have wider riparian buffers; however, most were still less then 50 feet in width. Within the riparian buffers several invasive species including garlic mustard, purple loosestrife, and tartarian honeysuckle were identified. Emergent aquatic vegetation including broad leaf cattail, great burreed, mild water pepper, Northern water plantain, rice cutgrass, softstem bullrush, and watercress was abundant within the reach. The sections of dry streambed, which were mostly located in the upstream portion of the reach, were choked with emergent aquatic vegetation; however, submerged aquatic vegetation was absent in the wetted portions of the creek. Dominant substrate throughout the reach consists of silt with a small portion of the reach near the confluence of Cayuga Creek containing some cobble. Instream cover was dominated by emergent aquatic vegetation throughout much of the reach.

2.5.3.10 Reach CWT1-Cayuga Creek: Unnamed Western Tributary

Reach CWT1 begins south of a residential neighborhood along Saunders Settlement Road and continues downstream 5,900 feet to where it empties into the main channel of Cayuga Creek (Figure 2.5.3-25). In September 2003 when the mapping was completed, the entire tributary was dry with a defined stream channel evident only in the lower portions of the tributary (Figure 2.5.3-26). Only 2,560 feet of defined channel upstream of the confluence was mapped as part of the study. The remaining portion of the creek was excluded from the habitat mapping. Similar to the Eastern Tributary on Cayuga Creek, the Western Tributary also serves as a drainage ditch for the agricultural fields surrounding the creek, with drainage channels carrying sediment and nutrients from the fields directly into the tributary. The lack of water within the tributary was the only barrier to fish movement noted, and no roads cross the tributary.

The only habitat type within the reach at the time of mapping was dry streambed. Stream banks within the mapped portion of the creek have shallow slopes, and riparian buffers exceeding 100 feet in width that are dominated by tree and shrub species. None of the dominant vegetation included invasive species. Although no submergent aquatic vegetation was present within the reach, six species of emergent aquatic vegetation including broad leaf cattail, dark green bullrush (*Scirpus atrovirens*), narrow leaf cattail, northern water plantain, rice cutgrass, and softstem bullrush were identified within the tributary. Dominant instream cover within the mapped portion of the reach included emergent aquatic vegetation, and woody debris, while the dominant substrate was silt.

2.5.3.11 Reach BZ1-Cayuga Creek Tributary: Bergholtz Creek through the City of Niagara Falls

Reach BZ1 begins west of Williams Road and continues downstream approximately 6,200 feet through the city of Niagara Falls to the confluence of Cayuga Creek (Figure 2.5.3-27). Land use surrounding the creek consists primarily of residential properties some of which directly abut the creek. Within the reach, the creek flows under 91st Street and a small foot bridge, both of which are elevated bridges rather than culverts. No barriers to fish movement were identified within the reach.

Habitat consists of a series of slow moving runs with an average wetted width of 38.5 feet (Figure 2.5.3-28). Unlike the rest of Bergholtz Creek, this portion is navigable by small watercraft. Stream banks within the reach have moderate slopes and narrow riparian buffers less than 50 feet in width dominated by a mix of herbaceous, shrub, and tree species. Norway maple, and purple loosestrife, both invasive species in New York were identified with the riparian buffers. Great burreed was the only emergent aquatic vegetation identified within the reach. Submerged aquatic vegetation was also sparse with only two species including sago pondweed, and water milfoil identified. Overhanging cover is the most dominant instream cover type, and silt and cobble are the most dominant substrate types.

2.5.3.12 Reach BZ2-Cayuga Creek Tributary: Residential and Agricultural Sections of Bergholtz Creek

Reach BZ2 begins west of Hoover Road and continues downstream approximately 26,000 feet to the city of Niagara Falls (Figure 2.5.3-29). This portion of the creek is narrower than BZ1 and is generally not navigable by watercraft (Figure 2.5.3-30). The surrounding land use is a mix of residential neighborhoods, commercial properties, and agricultural fields. Many of the residential and commercial properties directly abut the stream channel. Throughout the reach there are 12 road crossings including Williams Road (culvert length 35 feet), Plaza Drive (culvert length 65 feet), Cayuga Drive (culvert length 65 feet), Walmore Road (culvert length 30 feet), Niagara Falls Boulevard (culvert length 75 feet), Rohr Street (culvert length 33 feet), Luther Street (culvert length 33 feet), Hunt Street (culvert length 25 feet), Thornwoods Drive (culvert length 30 feet), Niagara Road (culvert length 55 feet), Ward Road (culvert length 50 feet), and Hoover Road (culvert length 28 feet). In addition, the creek is crossed by a set of railroad tracks (culvert length 60 feet), and a small unnamed access bridge (culvert length 15 feet). None of the bridge crossings within the reach were identified as barriers to fish movement.

Habitat within the reach consists of a series of runs with an average wetted width of 16.2 feet. Stream banks are highly variable with slopes ranging from shallow to moderate. Riparian buffers are also extremely variable with many sections less than 25 feet in width. Vegetation is dominated by a mix of herbaceous, shrub, and tree species. Within the buffers, five invasive species including common buckthorn, garlic mustard, multiflora rose, purple loosestrife, and tartarian honeysuckle were identified. Several species of emergent aquatic vegetation including broad leaf cattail, common arrowhead, great burreed, narrow leaf cattail, softstem bullrush, and watercress were identified, while submerged aquatic vegetation included, coontail, elodea, and the invasive curly leaf pondweed. The dominant instream cover type was overhanging cover, and the dominant substrate type was silt and cobble.

2.5.3.13 Reach BZ3-Cayuga Creek Tributary: Agricultural Sections of Bergholtz Creek

Reach BZ3 begins at the headwaters of Bergholtz Creek and extends downstream over 29,000 feet to Hoover Road (Figure 2.5.3-31). This section of Bergholtz Creek narrows down to a small channel

choked with emergent aquatic vegetation. Land use surrounding the creek is primarily agricultural fields with a few residential properties. Within the reach, the creek is crossed by a set of railroad tracks (culvert length 65 feet) and a total of six road crossings including Lockport Road (culvert length 50 feet), Raymond Road (culvert length 40 feet), Saunders Settlement (culvert length 45 feet), Baer Road (culvert length 50 feet), Human Road (culvert length 85 feet), and Shawnee Road (culvert length 75 feet). The road crossings are not barriers to fish movement, however some of the upstream portions of the reach had low water levels and were choked with vegetation in early October when the habitat mapping was conducted.

Habitat ranges from slow runs in the downstream portion of the reach (Figure 2.5.3-32), to dry streambed overgrown with vegetation in the upper portion of the reach (Figure 2.5.3-33). The average width of the stream channel estimated from 2002 digital orthophotos is 11.2 feet. Stream banks along the reach have shallow slopes, and riparian buffers of variable width. Along the right stream bank approximately 52% of the riparian buffer is less than 25 feet wide and 24% of the buffer is greater than 100 feet wide. Buffers along the left stream bank are also variable with 32% of the buffer less than 25 feet and approximately 35% of the buffer greater than 100 feet. Both sides of the creek are dominated by herbaceous vegetation with some tree and shrub species present. Within the riparian buffer, multiflora rose and purple loosestrife were the only invasive species identified. Submerged aquatic vegetation was absent from the reach, while emergent aquatic vegetation including mild water pepper and purple loosestrife was present; however, generally sparse throughout the reach. Instream cover consisted primarily of overhanging cover, and emergent aquatic vegetation, and the dominant substrate throughout the reach was silt.

2.6 Land Use and Ownership

Land management practices can have an important bearing on the health and integrity of aquatic and riparian habitat as well. The land use and ownership characteristics of the Fish, Gill, and Cayuga Creek corridor are described below.

2.6.1 Fish Creek

The majority of land along Fish Creek is privately owned. Significant tracts of NYPA-owned land exist along Fish Creek near Lewiston Reservoir (Reach F5-owned by NYPA) and east of the Robert Moses Parkway (Reach F1-owned by the Niagara Frontier Parks Commission).

Land use along the Fish Creek corridor is variable from the headwaters to the mouth (Figure 2.6.1-1). The upper reaches (F6, F5, and F4) are dominated by agricultural use, forest, and wet shrubland. In the lower portion of the Fish Creek corridor the nature of land use changes dramatically with reaches F1 dominated by recreational use (golf course) and reach F2 and F3 consisting of residential development. The final approximately 1,200 feet of Fish Creek (Reach F0) is diverted underground beneath the Robert Moses Parkway and exits via a concrete spillway into the lower Niagara River.

2.6.2 Gill Creek

Gill Creek flows through a slightly greater amount of private land than it does public. The majority of the public land consists of the Hyde Park Golf Course, located in reaches G2-G6 (City of Niagara Falls) and NYPA owned land adjacent to the Lewiston Reservoir section of Gill Creek (reach G11). Most of the remainder of the private land consists of residential or industrial owned properties.

The land use characteristics of Gill Creek are similar to those along the Fish Creek corridor Figure 2.6.2-1. Gill Creek (reach G12) begins in the Tuscarora Reservation in a mix of wetland, forest, and agricultural land, before transitioning to grassland and forested use (reaches G11 and G10). The Gill Creek corridor then winds through areas principally dominated by residential use (reach G9), shrubland and a landfill (reach G8), transportation use (reaches G7), and a recreational use in the form of a golf course (reaches G6-G3). The remaining sections of the Gill Creek corridor are dominated by residential (reach G2) and industrial use (G1). The three most abundant land uses in the Gill Creek corridor are agricultural and open space (approximately 37%), forest (approximately 14%), and residential properties (approximately 13%).

2.6.3 Cayuga Creek

The majority of the land along the Cayuga Creek corridor is privately owned, primarily by the Tuscarora Nation and the Niagara Falls Airport. The remaining private land consists of residential property owners in the towns of Niagara and Niagara Falls. Publicly owned land is located near Cayuga Drive toward the mouth of Cayuga Creek and Niagara Falls Naval Air Station (owned by the Niagara Falls Transportation Authority).

As seen in Figure 2.6.3-1, the Cayuga Creek corridor begins in an area characterized by heavy agricultural use and wetlands (reaches C8-C5), before moving into areas (reach C4) typified by heavy commercial use (Niagara Falls airport). As Cayuga Creek exits the airport it flows through forested wetland and residential neighborhoods (reach C3) getting progressively more urban as the creek nears its end (reaches C2 and C1). Among all land use categories Cayuga Creek passes most frequently through agricultural and open space land (including the airport it is about 53%) and residential property (approximately 12%).

Land use and ownership information was very limited for Bergholtz Creek. In general, land use in the lower reach is typified by residential development, while the upper reaches exhibit agricultural use. Property ownership along the Bergholtz Creek corridor is primarily privately held.

TABLE 2.2.1-1

2003 WATER QUALITY DATA FOR FISH CREEK

TFC-01	**Turbidity**	**DO**	**%**					
Minimum	3.9	0.6	5.6					
Maximum	35.1	9.1	85.2					
Average	18.9	6.2	59.7					
N	4	4	4					
TFC-02	**Turbidity**	**DO**	**%**					
Minimum	3.3	7.7	74.3					
Maximum	50.7	10.8	109.6					
Average	17.2	9.2	88.2					
N	17	17	17					
Temperature	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**
TFC-01								
Minimum	-0.1	8.5	10.6	15.7	--	--	--	--
Maximum	18.7	20.5	23.0	28.3	--	--	--	--
Average	9.4	14.0	16.9	21.5	--	--	--	--
TFC-02								
Minimum	0.2	9.0	11.0	11.9	11.9	9.1	6.2	2.9
Maximum	18.0	19.3	23.6	23.1	21.6	19.8	16.0	13.3
Average	8.8	13.1	13.4	16.5	16.5	14.7	10.4	8.3

TABLE 2.2.2-1

2003 WATER QUALITY DATA FOR GILL CREEK

TGLC-01	**Turbidity**	**DO**	**%**					
Minimum	0.6	7.2	69.4					
Maximum	44.7	14.8	136.6					
Average	4.6	9.2	91.8					
N	16	16	16					
TGLC-02	**Turbidity**	**DO**	**%**					
Minimum	1.2	4.1	39.8					
Maximum	134.0	11.1	111.3					
Average	15.7	7.6	73.4					
N	17	17	17					
Temperature	**April**	**May**	**June**	**July***	**August***	**September***	**October***	**November***
TGLC-01								
Minimum	2.3	8.0	9.5	19.4	21.5	7.3	8.1	6.6
Maximum	15.4	15.5	19.7	23.2	24.7	23.0	13.1	12.7
Average	9.1	10.6	15.3	21.3	23.3	18.8	10.1	9.2
TGLC-02								
Minimum	-0.1	7.4	10.8	13.8	15.2	9.5	6.7	2.6
Maximum	18.7	20.6	26.0	29.5	23.2	19.4	13.0	12.1
Average	8.7	13.7	16.9	21.0	19.6	15.9	9.6	7.6

*TGLC-02 was moved 10,000 feet downstream on July 10, 2003 due to low flow conditions upstream.

TABLE 2.2.3-1

2003 WATER QUALITY DATA FOR CAYUGA CREEK

CC-01	**Turbidity**	**DO**	**%**				
Minimum	2.2	5.0	55.7				
Maximum	67.5	9.4	105.3				
Average	16.1	7.3	76.5				
N	17	17	17				
CC-02							
Minimum	6.9	3.8	41.1				
Maximum	113.0	7.2	79.5				
Average	36.4	5.6	57.2				
N	17	17	17				
CC-03							
Minimum	1.1	6.6	73.2				
Maximum	35.3	11.4	119.0				
Average	16.6	9.6	96.7				
N	18	18	18				
Temperature	**April**	**May**	**June**	**July**	**August**	**September**	**October**
CC-01							
Minimum	4.2	6.9	11.9	19.8	22.1	13.9	10.8
Maximum	15.1	18.0	22.9	25.5	26.9	23.7	17.4
Average	8.5	13.4	17.4	22.6	24.4	20.5	14.0
CC-02							
Minimum	6.7	9.8	12.0	17.9	18.4	12.4	8.6
Maximum	15.3	18.8	25.1	25.6	24.5	21.3	16.1
Average	11.4	14.0	17.9	21.1	21.7	17.7	12.0
CC-03							
Minimum	5.6	9.1	11.5	16.7	15.8	10.7	7.3
Maximum	18.0	21.2	25.9	26.3	26.9	22.8	17.8
Average	11.6	14.1	18.2	21.0	21.7	17.6	11.8

TABLE 2.3.1-1

ESTIMATED FLOW EXCEEDENCES (CFS) FOR FISH CREEK

Month	10% Flow Exceedance	30% Flow Exceedance	50% Flow Exceedance	70% Flow Exceedance	90% Flow Exceedance
January	23.1	9.0	6.2	5.0	3.8
February	35.2	13.4	7.6	6.6	4.6
March	36.9	20.2	13.1	8.4	7.3
April	22.1	10.0	6.7	5.8	5.2
May	7.0	3.5	3.1	2.5	2.7
June	3.7	1.8	1.8	1.9	1.5
July	1.7	1.5	1.3	1.1	1.0
August	2.1	1.4	1.2	1.0	0.7
September	2.6	0.9	0.8	0.8	0.6
October	4.9	1.4	0.7	0.7	0.9
November	10.7	4.3	2.4	1.8	1.4
December	21.4	9.1	5.4	3.9	2.4
Annual	15.2	6.0	3.7	1.8	0.9

TABLE 2.3.2-1

ESTIMATED FLOW EXCEEDENCES (CFS) FOR GILL CREEK

Month	10% Flow Exceedance	30% Flow Exceedance	50% Flow Exceedance	70% Flow Exceedance	90% Flow Exceedance
January	62.0	24.5	16.6	13.0	9.2
February	88.4	33.5	19.4	15.9	10.7
March	104.6	55.6	35.7	22.8	18.0
April	67.4	31.7	21.3	17.5	14.5
May	24.0	11.9	9.7	7.8	7.4
June	12.9	6.0	5.4	5.3	4.0
July	5.9	4.5	3.8	3.1	2.6
August	6.6	4.0	3.3	2.6	1.9
September	8.2	3.1	2.5	2.2	1.7
October	15.2	4.7	2.5	2.1	2.3
November	31.6	13.2	7.6	5.4	3.7
December	56.8	25.1	15.3	10.9	6.5
Annual	44.1	17.3	10.4	5.2	2.5

TABLE 2.3.3-1

ESTIMATED FLOW EXCEEDENCES (CFS) FOR CAYUGA CREEK

Month	10% Flow Exceedance	30% Flow Exceedance	50% Flow Exceedance	70% Flow Exceedance	90% Flow Exceedance
January	157.0	62.6	42.1	31.5	21.2
February	210.6	78.9	46.8	36.3	23.5
March	278.9	143.8	91.3	58.3	41.9
April	193.1	93.6	62.9	49.0	37.9
May	76.0	37.4	28.7	22.3	19.2
June	41.3	18.7	15.5	13.9	10.0
July	19.4	13.0	10.4	8.1	6.3
August	19.3	11.2	8.7	6.8	4.7
September	23.9	9.4	7.1	5.9	4.4
October	44.0	14.5	7.9	6.1	5.6
November	87.9	38.2	22.3	15.0	9.3
December	142.3	64.9	40.8	28.4	16.6
Annual	120.1	47.1	27.5	13.9	6.5

TABLE 2.3.3-2

ESTIMATED FLOW EXCEEDENCES (CFS) FOR BERGHOLTZ CREEK

Month	10% Flow Exceedance	30% Flow Exceedance	50% Flow Exceedance	70% Flow Exceedance	90% Flow Exceedance
January	103.1	40.9	27.7	21.1	14.5
February	142.1	53.5	31.4	24.9	16.5
March	178.9	93.5	59.6	38.1	28.6
April	119.9	57.3	38.5	30.7	24.5
May	45.1	22.3	17.6	13.8	12.5
June	24.3	11.1	9.6	9.0	6.6
July	11.3	8.0	6.6	5.2	4.2
August	11.9	7.1	5.6	4.4	3.1
September	14.7	5.7	4.4	3.8	2.9
October	27.2	8.7	4.7	3.8	3.7
November	55.3	23.6	13.7	9.4	6.1
December	93.8	42.2	26.2	18.4	10.9
Annual	76.3	30.0	17.7	8.9	4.2

TABLE 2.4.3-1

FISH SPECIES COLLECTED IN CAYGUA CREEK 1928-2001

Species Common Name	Species Scientific Name	1928	1970s-1980s	1997-2001
Banded killifish	*Fundulus diaphanous*		X	
Bluegill	*Lepomis macrochirus*		X	X
Bluntnose minnow	*Pimephales notatus*	X	X	X
Brook stickleback	*Culaea inconstans*		X	X
Brown Bullhead	*Ictalurus nebulosus*	X[1]	X	X
Central Mudminnow	*Umbra limi*	X	X	X
Common carp	*Cyprinus carpio*	X	X	X
Common Shiner	*Notropis cornutus*		X	X
Creek chub	*Semotilus atromaculatus*		X	X
Emerald shiner	*Notropis atherinoides*		X	X
Fathead minnow	*Pimephales promelas*			X
Gizzard shad	*Dorosoma cepedianum*	X[2]	X[2]	
Golden shiner	*Notemigonus crysoleucas*	X	X	X
Goldfish	*Carassius auratus*		X	X
Grass pickerel	*Esox americanus vermiculatus*	X	X[2]	
Green sunfish	*Lepomis cyanellus*			X
Hornyhead chub	*Nocomis biguttatus*	X		
Johnny darter	*Etheostoma nigrum*		X	X
Largemouth bass	*Micropterus salmoides*		X	X
Northern pike	*Esox lucius*	X	X	
Pirate perch	*Aphredoderus sayanus*	X	X[1]	
Pumpkinseed sunfish	*Lepomis gibbosus*		X	X
Redhorse sp.	*Moxostoma sp.*		X	

TABLE 2.4.3-1 (CONT.)

FISH SPECIES COLLECTED IN CAYGUA CREEK 1928-2001

Species Common Name	Species Scientific Name	1928	1970s-1980s	1997-2001
River chub	*Nocomis micropogon*			X
Rock Bass	*Ambloplites rupestris*			X
Smallmouth bass	*Micropterus dolomieui*		X	
Spottail shiner	*Notropis hudsonius*		X	X
Striped shiner	*Notropis chrysocephalus*	X[2]	X[2]	
White Bass	*Morone chrysops*		X	
White sucker	*Catostomus commersoni*	X[1]	X	X

Notes: Data from NYSDEC 1988, USACE 2002, and New York State Museum holdings for 1928 (Greeley 1929).

[1]Collected in Bergholtz Creek, a tributary of Cayuga Creek.

[2]cited as "Other Fish Species Found in Previous Sampling Studies", Table 13 of USACE 2002, year of collection is unknown.

TABLE 2.5-1

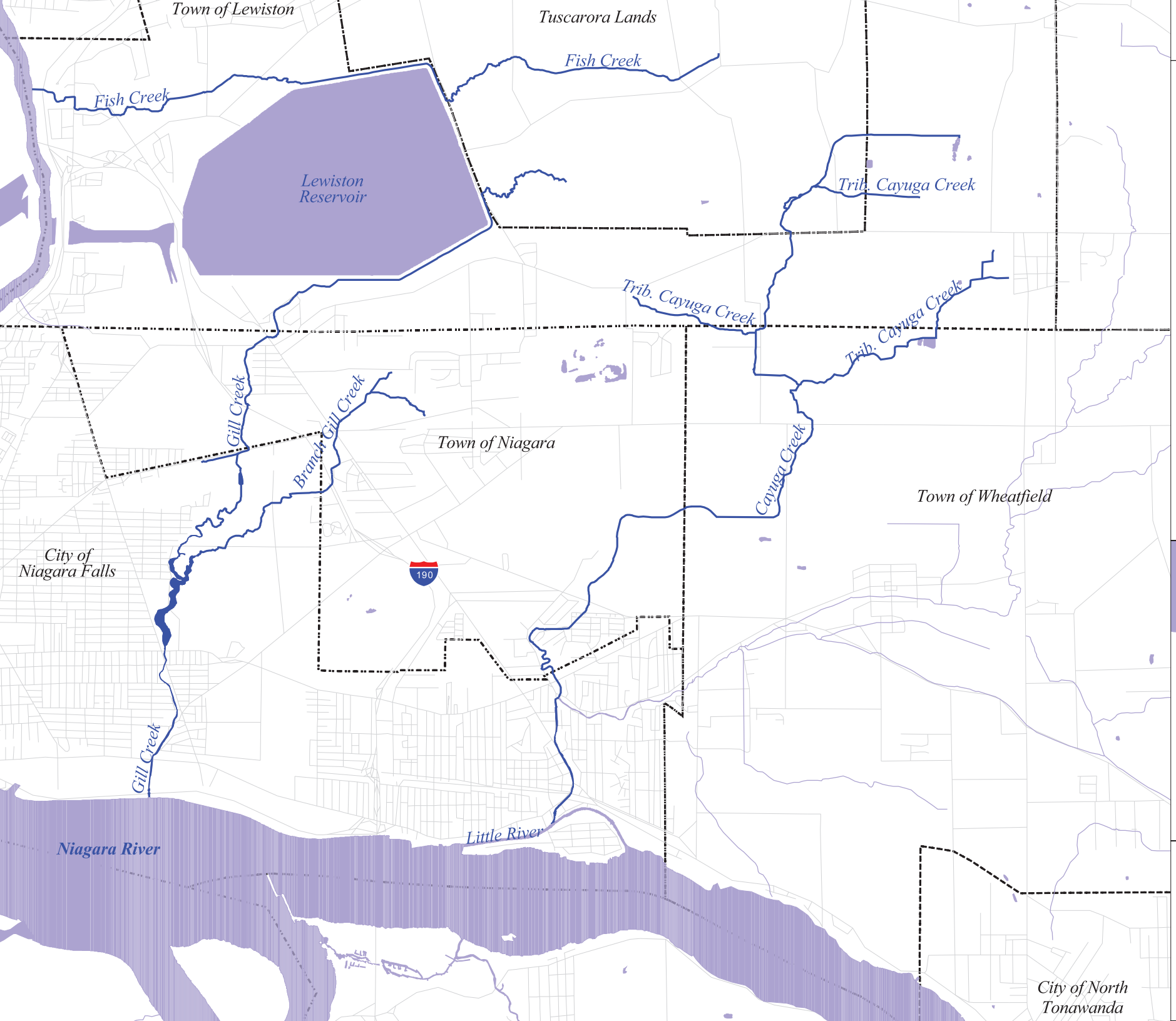
SUBSTRATE CLASSIFICATIONS

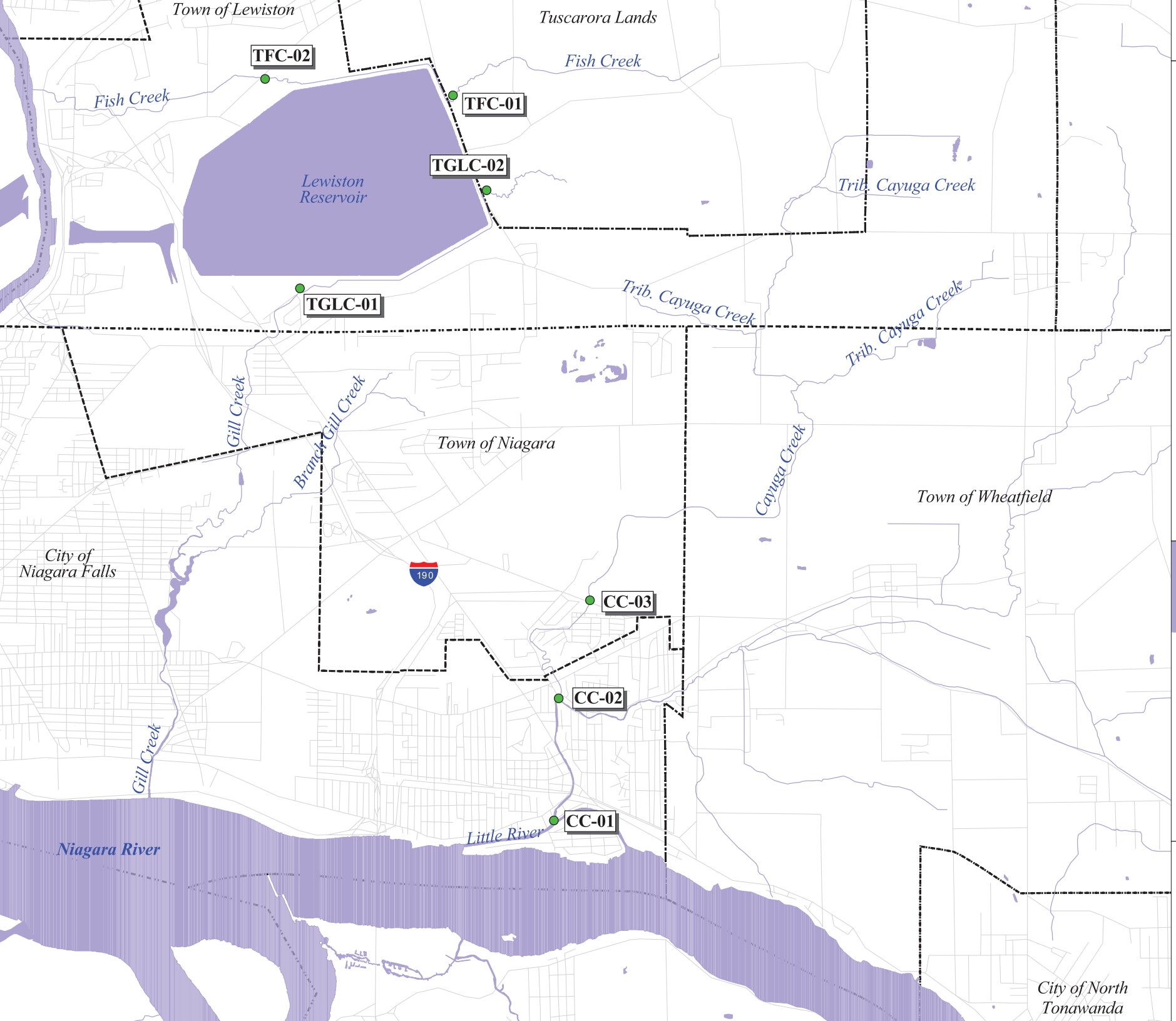
Substrate Type	Particle Size
Bedrock	
Boulder	Greater than 10 inches
Large Cobble	5.0 – 10.0 inches
Small Cobble	2.5 – 5.0 inches
Pebble	0.625 - 2.5 inches
Gravel	0.08 - 0.625 inches
Sand	0.002 – 0.079 inches
Silt	Less than 0.002 inches
Hard Clay	Not easily erodible
Mud Clay	Easily erodible
Organic Fibric	e.g. peat
Organic Sapric	e.g. muck

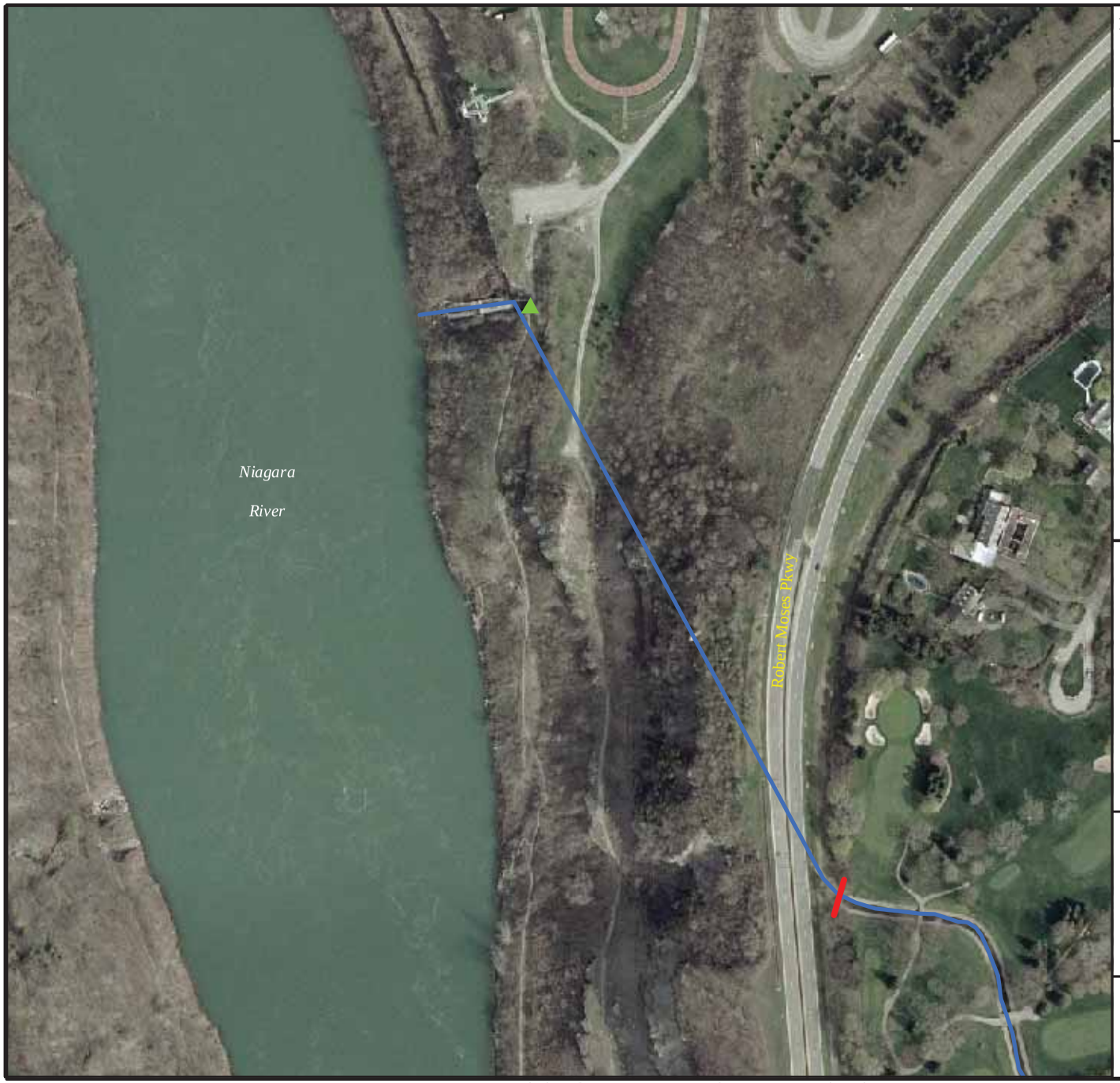
TABLE 2.5-2

RIPARIAN VEGETATION CLASSIFICATIONS

Vegetation Type	Description
Tree Strata	≥ 5 inches DBH and ≥ 20 feet in height
Sapling Strata	< 5 inches DBH and ≥20 feet in height
Shrub Strata	Woody vegetation ≤ 5 inches DBH and ≤ 20 feet in height
Herbaceous Strata	Non-woody vegetation
Lianas	Woody and non-woody vines


Town of Lewiston
Tuscarora Lands
Fish Creek
Fish Creek
Lewiston Reservoir
Trib. Cayuga Creek
Trib. Cayuga Creek
Trib. Cayuga Creek
Gill Creek
Branch Gill Creek
Town of Niagara
Cayuga Creek
Town of Wheatfield
City of Niagara Falls
190
Gill Creek
Niagara River
Little River
City of North Tonawanda


Town of Lewiston
Tuscarora Lands
TFC-02
Fish Creek
Fish Creek
TFC-01
TGLC-02
Lewiston
Reservoir
Trib. Cayuga Creek
TGLC-01
Trib. Cayuga Creek
Trib. Cayuga Creek
Gill Creek
Branch Gill Creek
Town of Niagara
Cayuga Creek
Town of Wheatfield
City of
Niagara Falls
190
CC-03
CC-02
Gill Creek
CC-01
Little River
Niagara River
City of North
Tonawanda

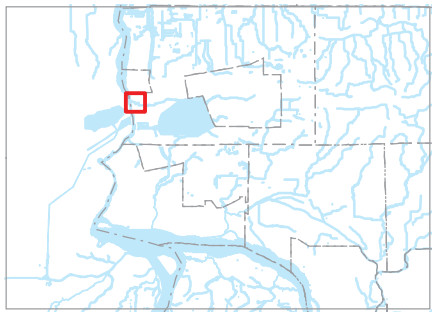


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach F0, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Fish Creek
- Reach Extent



0 125 250 500 Feet

1" = 250'

FIGURE 2.5.1-1

N

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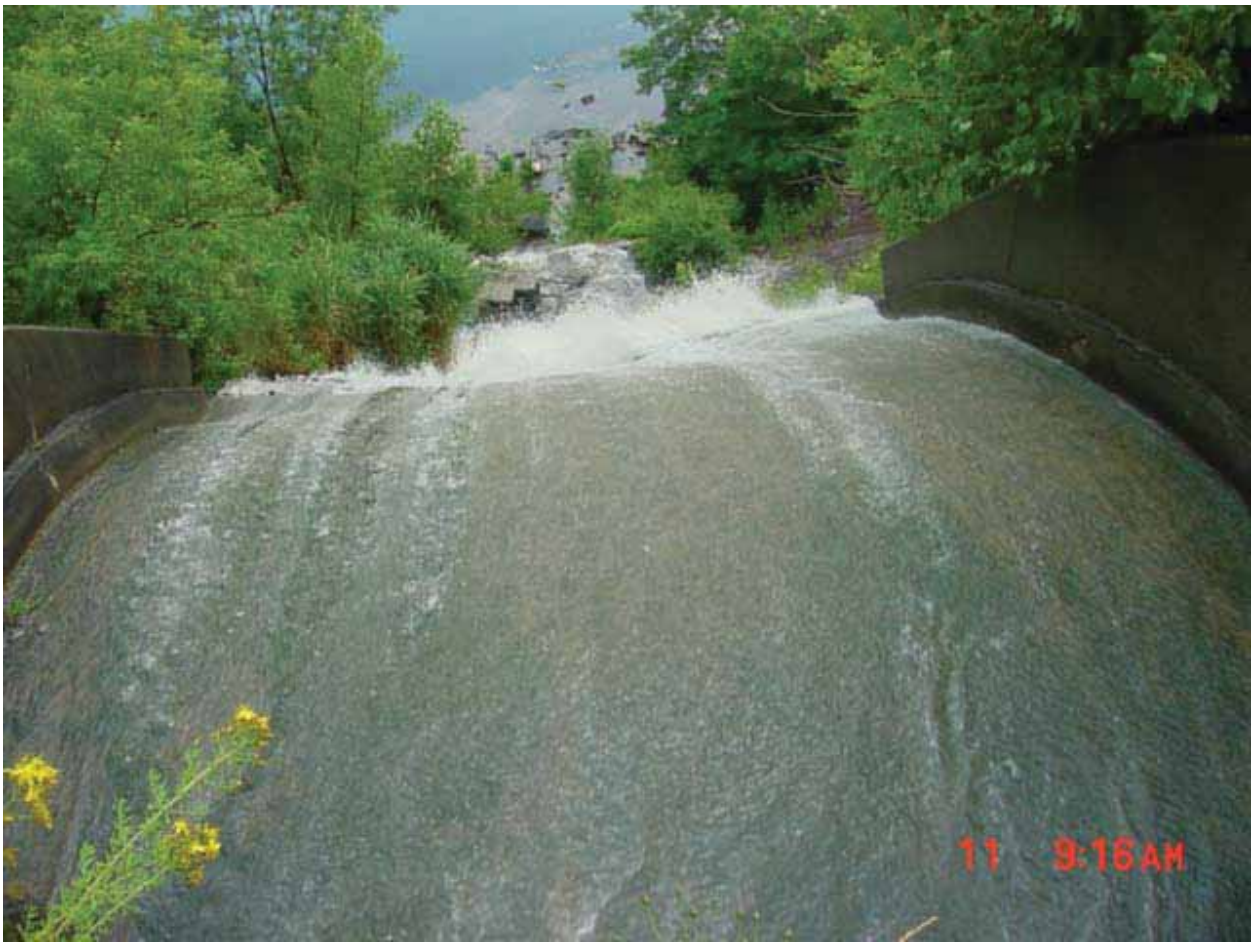
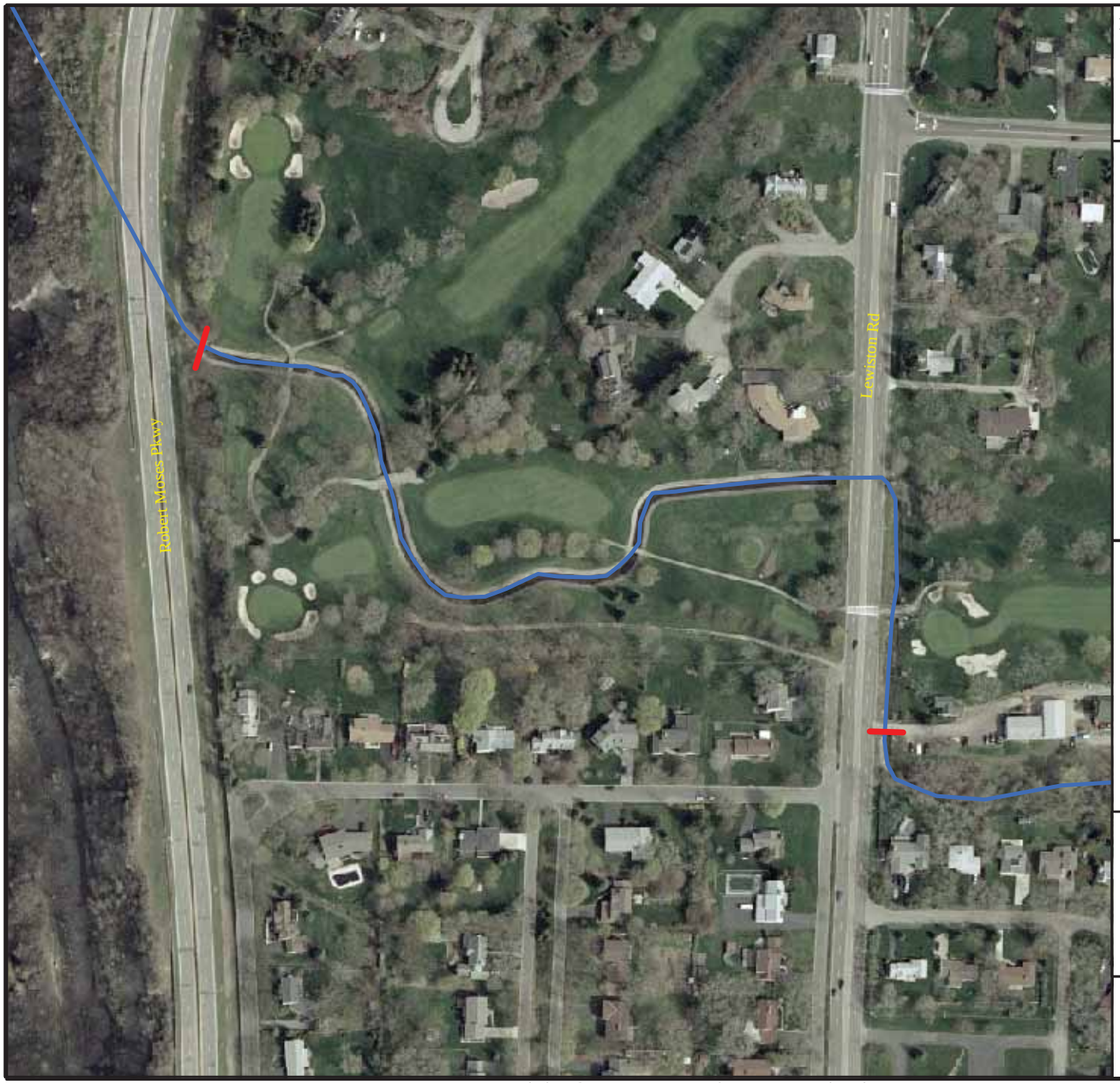
FIGURE 2.5.1-2

SLIME CHUTE AT THE MOUTH OF FISH CREEK



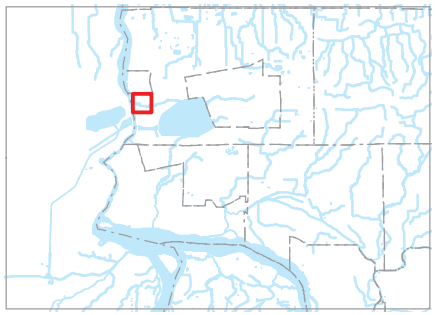


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach F1, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Fish Creek
- Reach Extent



0 125 250 500 Feet

1" = 250'

FIGURE 2.5.1-3

N

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NIAGARA POWER PROJECT

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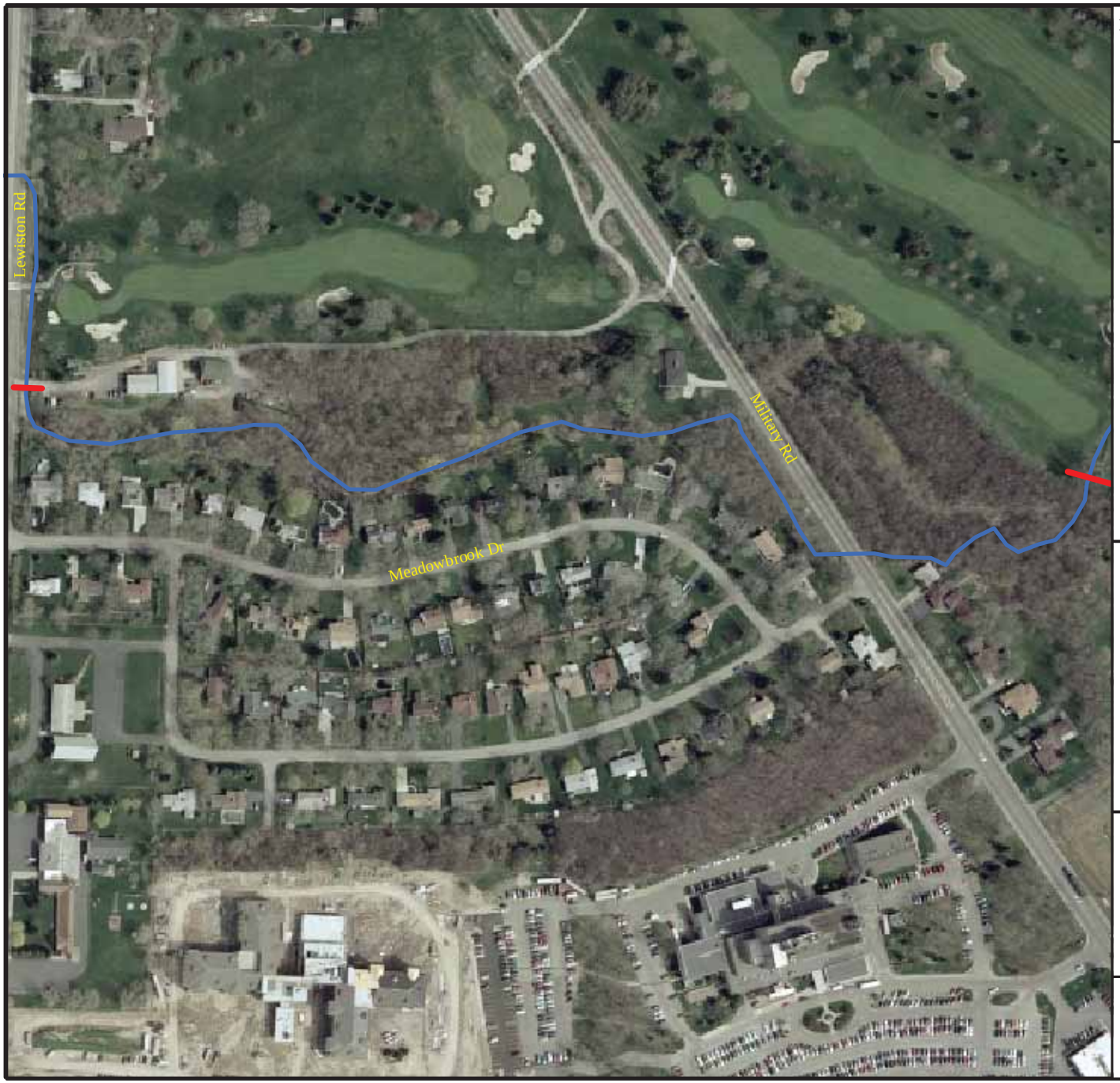
FIGURE 2.5.1-4

REACH F1 ALONG LEWISTON ROAD

FIGURE 2.5.1-5

CONCRETE LINED STREAM CHANNEL THROUGH THE NIAGARA FALLS COUNTRY CLUB IN REACH F1



NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach F2, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Fish Creek
- Reach Extent

0 150 300 600 Feet

1" = 300'

FIGURE 2.5.1-6

N

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FIGURE 2.5.1-7

REACH F2 BEHIND RESIDENTIAL PROPERTIES ON MEADOW BROOK ROAD

NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach F3, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Fish Creek
- Reach Extent

0 100 200 400 Feet

1" = 200'

N

FIGURE 2.5.1-8

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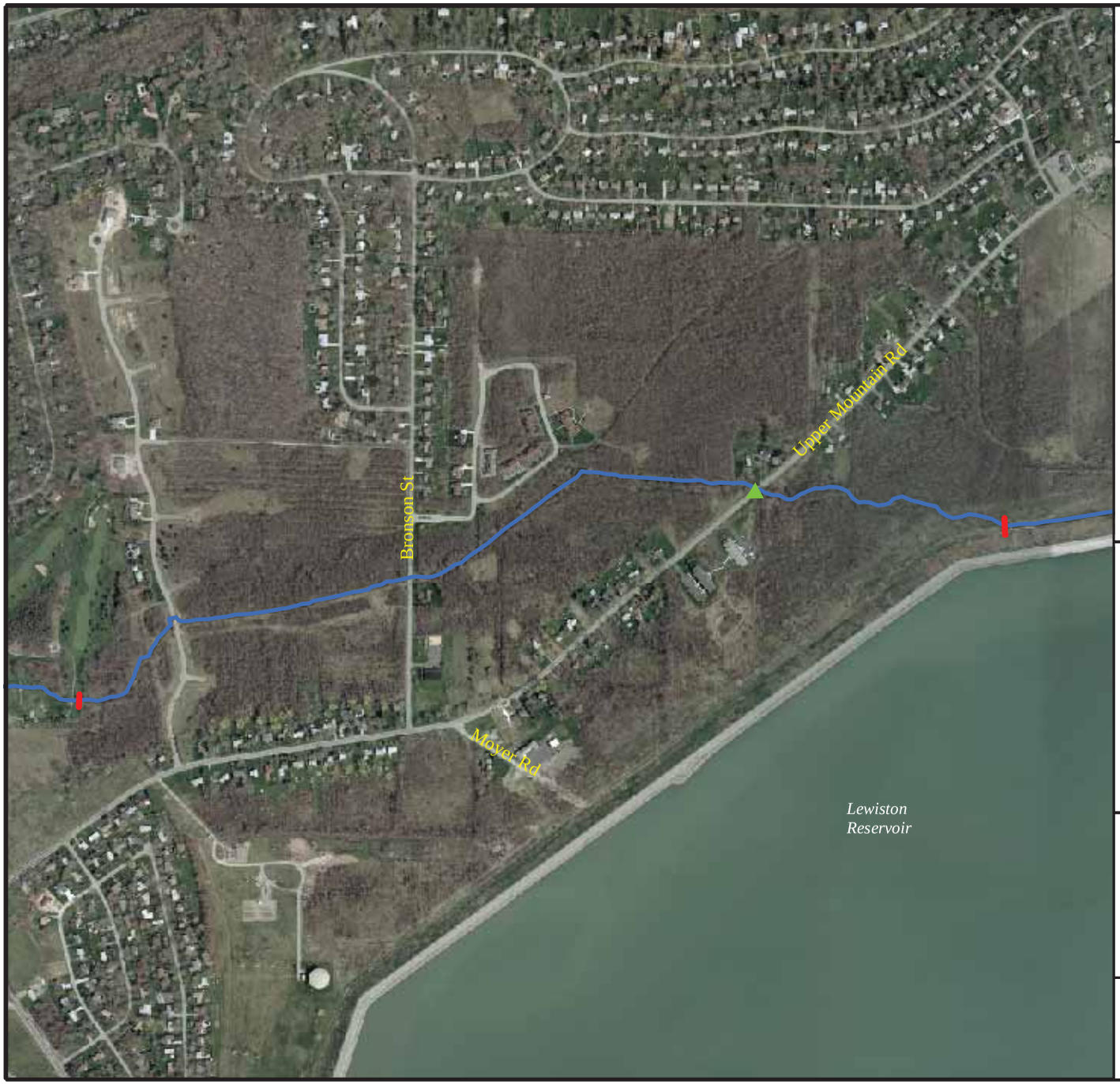
FIGURE 2.5.1-9

FISH CREEK THROUGH NIAGARA FALLS COUNTRY CLUB GOLF COURSE IN REACH F3

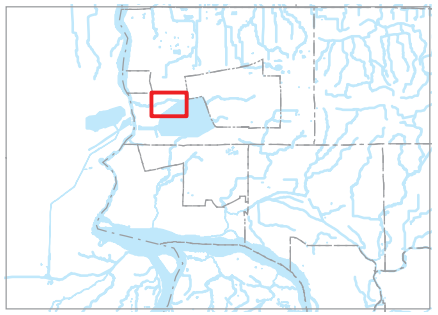


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach F4, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Fish Creek
- Reach Extent



0 500 1,000 2,000 Feet

1" = 1,000'

N

FIGURE 2.5.1-10

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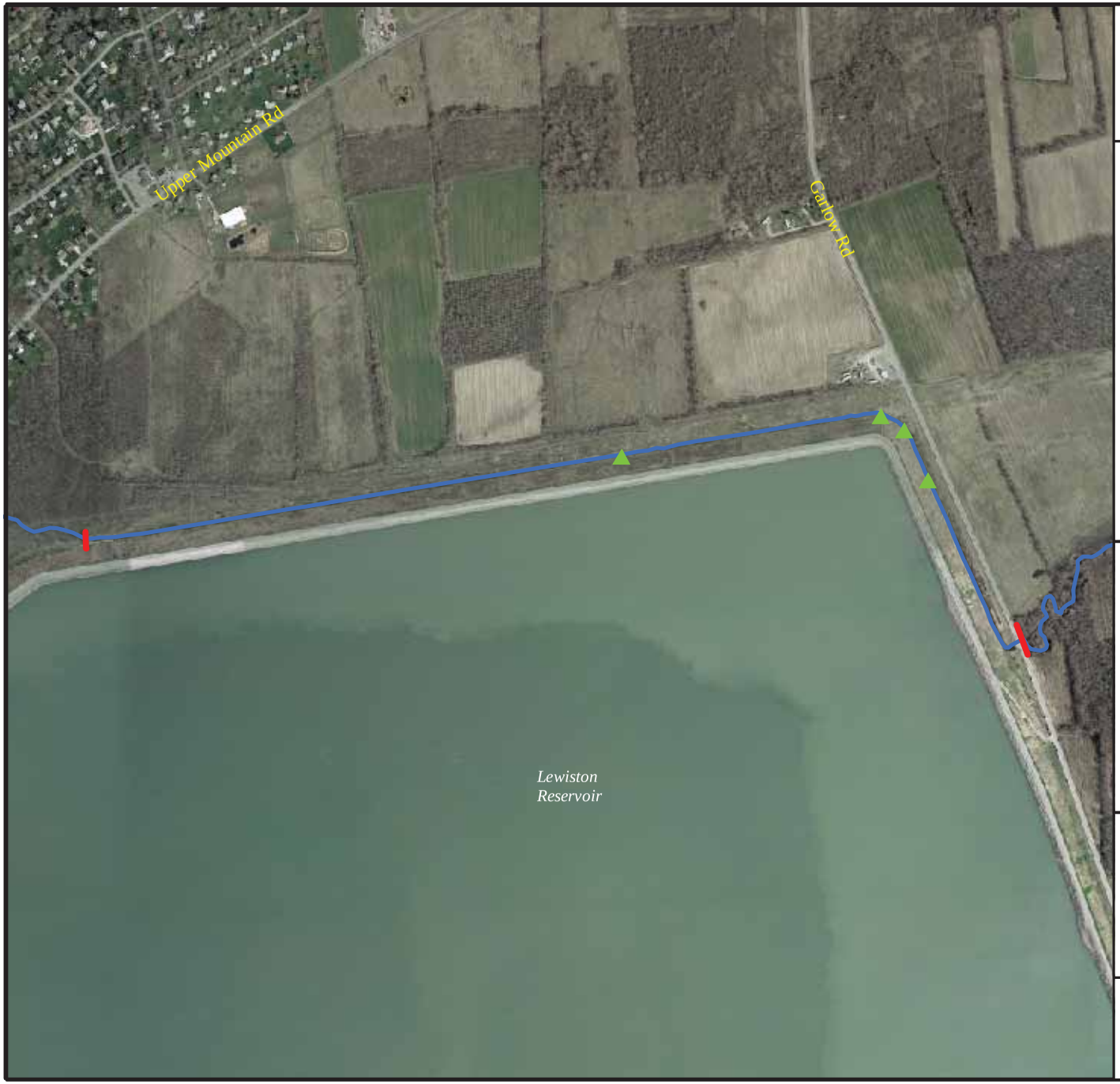
FIGURE 2.5.1-11

A REPRESENTATIVE PORTION OF REACH F4

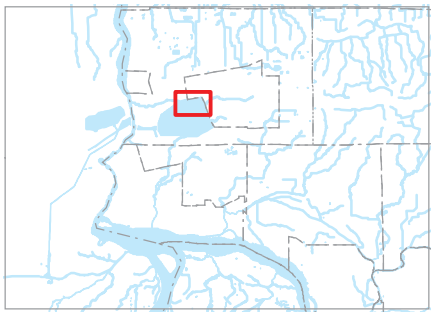


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach F5, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Fish Creek
- Reach Extent



0 500 1,000 2,000 Feet

1" = 1,000'

N

FIGURE 2.5.1-12

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FIGURE 2.5.1-13

A CHANNELIZED SECTION OF FISH CREEK ALONG THE LEWISTON RESERVOIR

FIGURE 2.5.1-14

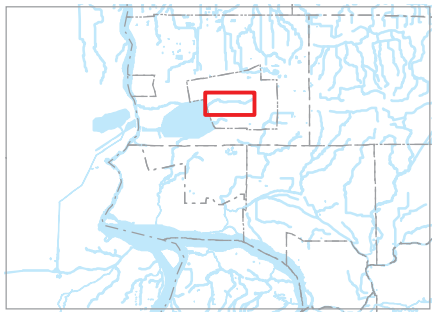
SMALL ROCK DAM ALONG THE LEWISTON RESERVOIR IN REACH F5

NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach F6, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Fish Creek
- Reach Extent



0 800 1,600 3,200 Feet

1" = 1,600'

FIGURE 2.5.1-15

N

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NIAGARA POWER PROJECT

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FIGURE 2.5.1-16

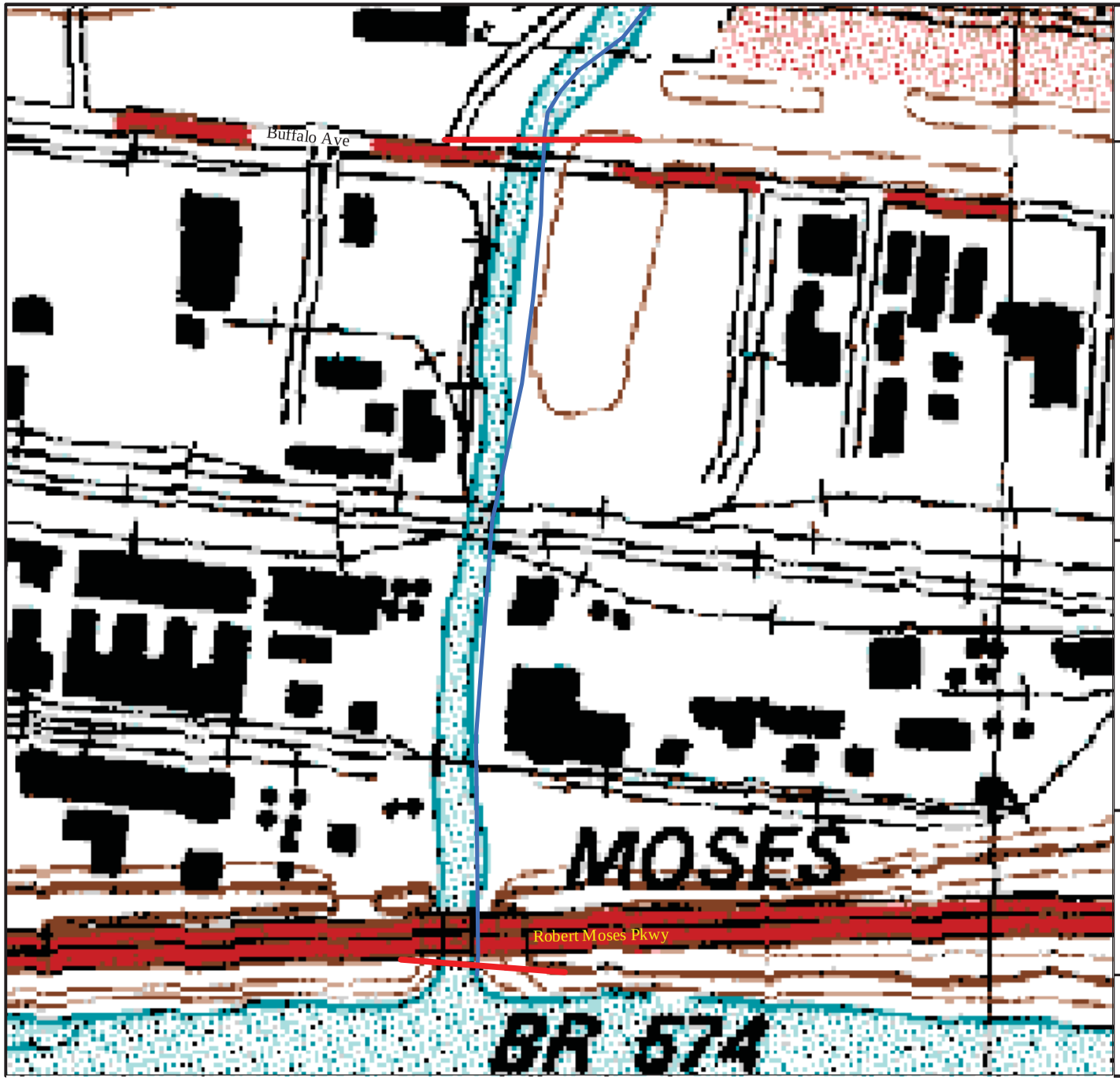
FISH CREEK UPSTREAM OF GARLOW ROAD

Nonpublic information – withheld at the request of and out of respect for the privacy of the Tuscarora Nation. Copies of this figure have been supplied to FERC as well as the state and federal resource agencies.

FIGURE 2.5.1-17

ONE OF THREE FIELD DRAINS LOCATED UPSTREAM OF GARLOW ROAD ON FISH CREEK

Nonpublic information – withheld at the request of and out of respect for the privacy of the Tuscarora Nation. Copies of this figure have been supplied to FERC as well as the state and federal resource agencies.



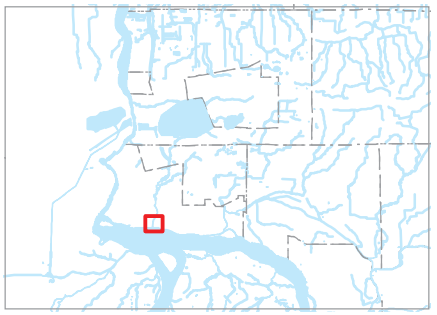
NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach G1, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent

Note:
USGS Topographic Quadrangles used in place of aerial imagery



0 150 300 600 Feet

1" = 300'

FIGURE 2.5.2-1

N

New York Power Authority

NIAGARA POWER PROJECT

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FIGURE 2.5.2-2

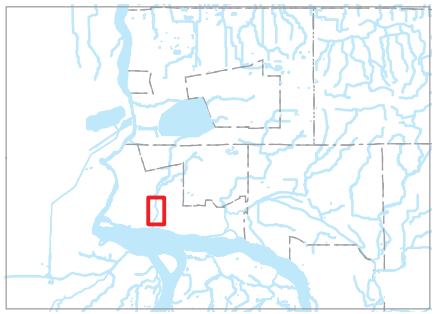
INDUSTRIAL FACILITIES ALONG GILL CREEK IN REACH G1

NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach G2, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent



0 500 1,000 2,000 Feet

1" = 1,000'

N

FIGURE 2.5.2-3

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FIGURE 2.5.2-4

GILL CREEK THROUGH REACH G2

NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach G3, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent

0 400 800 1,600 Feet

1" = 800'

N

FIGURE 2.5.2-5

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FIGURE 2.5.2-6

A PHOTO OF HYDE PARK LAKE SHOWING THE LACK OF RIPARIAN BUFFERS SURROUNDING THE LAKE

NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach G4, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent

0 200 400 800 Feet

1" = 400'

FIGURE 2.5.2-7

N

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NIAGARA POWER PROJECT

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FIGURE 2.5.2-8

SMALL DAM LOCATED UPSTREAM OF HYDE PARK LAKE IN REACH G4

FIGURE 2.5.2-9

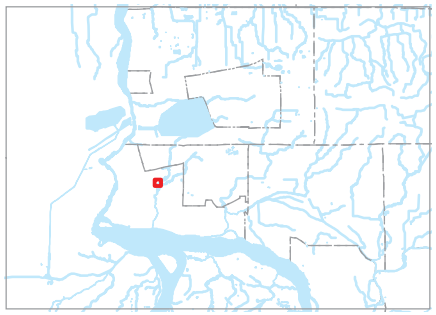
FORESTED RIPARIAN BUFFERS ALONG GILL CREEK IN REACH G4

NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach G5, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent



0 100 200 400 Feet

1" = 200'

N

FIGURE 2.5.2-10

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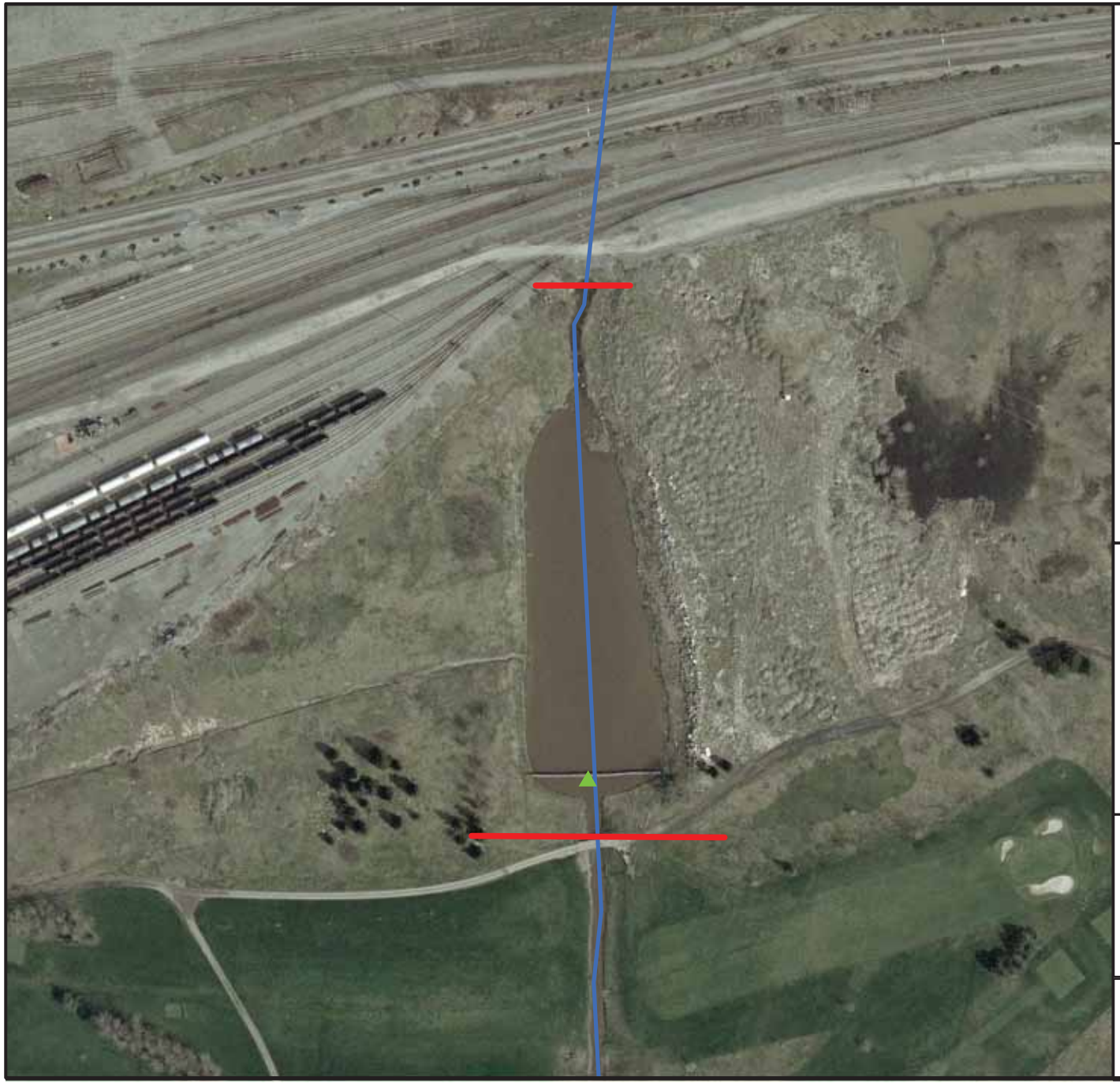
FIGURE 2.5.2-11

CONCRETE LINED PORTION OF STREAM CHANNEL IN THE HYDE PARK GOLF COURSE

FIGURE 2.5.2-12

HERBACEOUS RIPARIAN BUFFERS ALONG PORTIONS OF GILL CREEK IN REACH G5

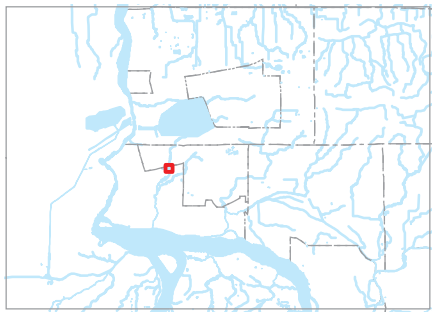


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach G6, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent



0 100 200 400 Feet

1" = 200'

N

FIGURE 2.5.2-13

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NIAGARA POWER PROJECT

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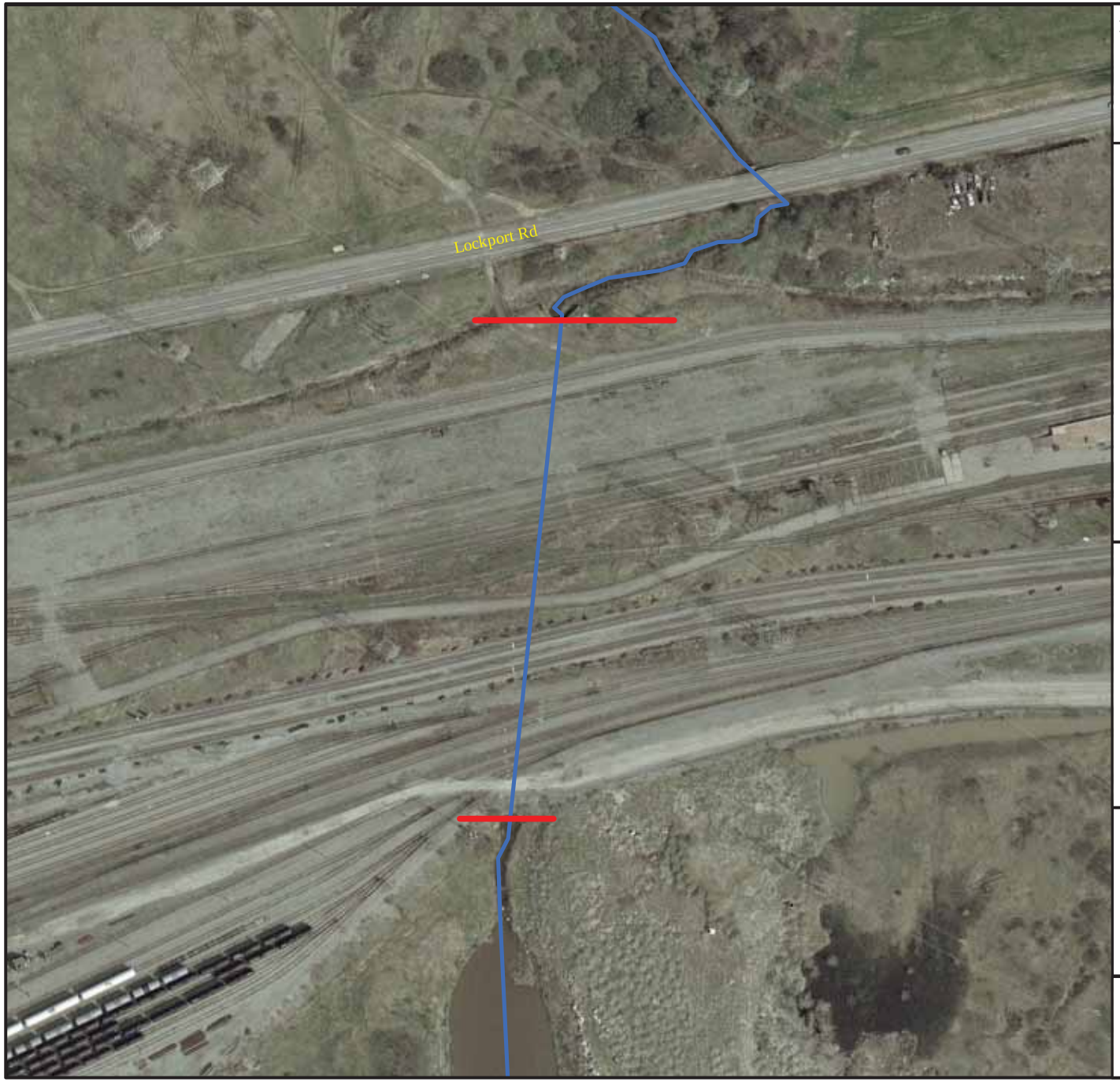
FIGURE 2.5.2-14

SMALL POND ON GILL CREEK LOCATED JUST DOWNSTREAM OF THE RAIL YARD

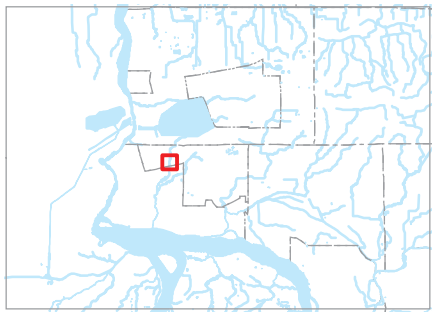


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach G7, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent



0 100 200 400 Feet

1" = 200'

N

FIGURE 2.5.2-15

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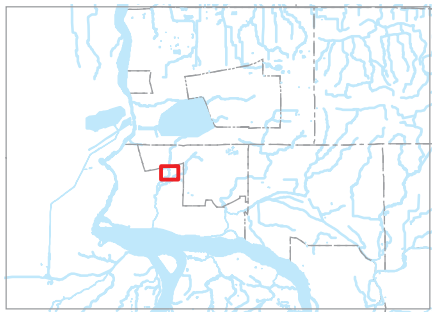
NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach G8, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent



0 200 400 800 Feet

1" = 400'

FIGURE 2.5.2-16

N

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FIGURE 2.5.2-17

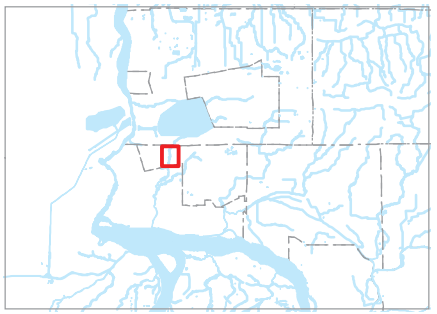
OVERHANGING COVER ALONG GILL CREEK IN REACH G8

NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach G9, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent



0 350 700 1,400 Feet

1" = 700'

N

FIGURE 2.5.2-18

New York Power Authority

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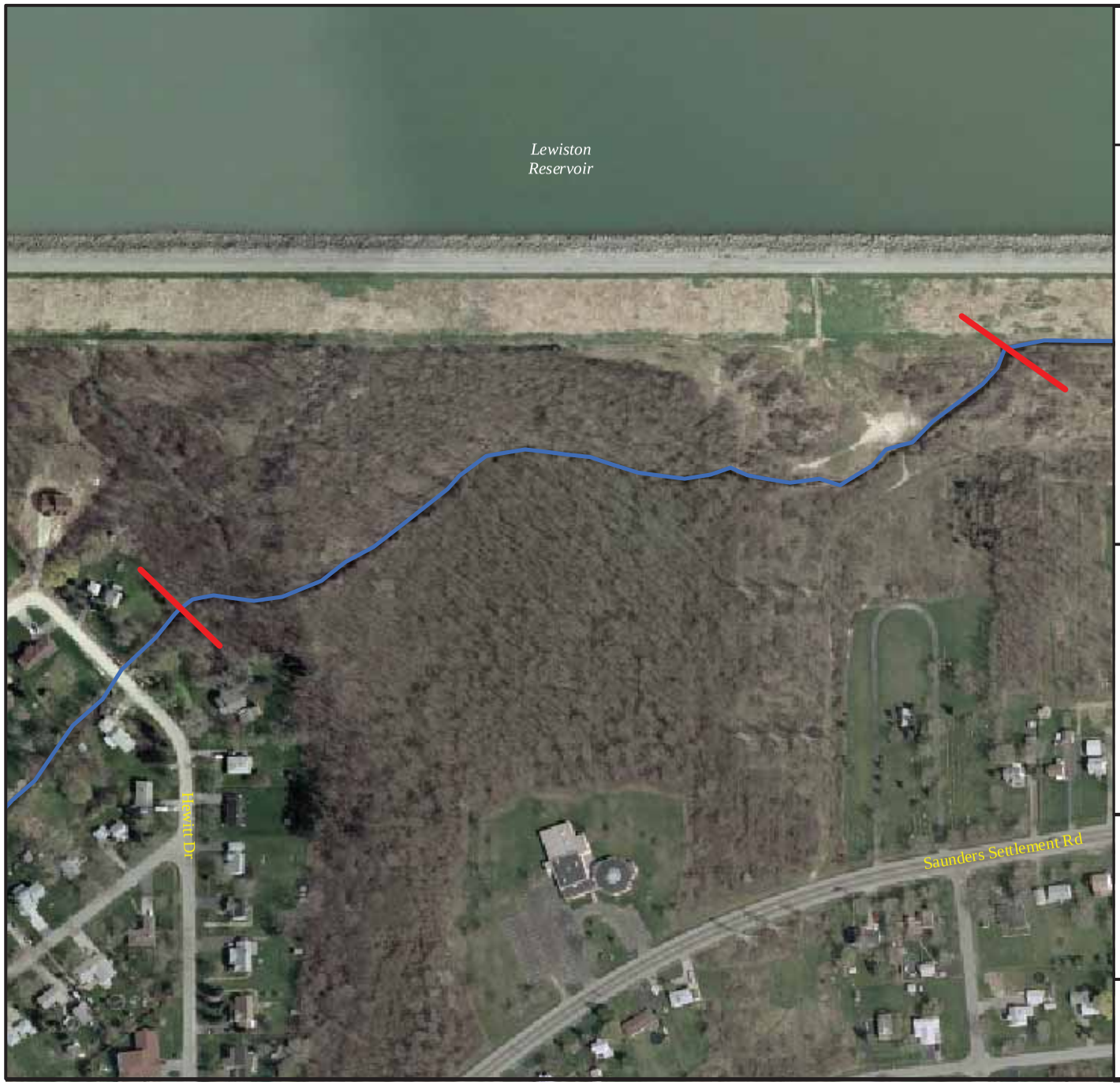
FIGURE 2.5.2-19

MOWED RIPARIAN BUFFERS ALONG RESIDENTIAL SECTIONS OF GILL CREEK IN REACH G9

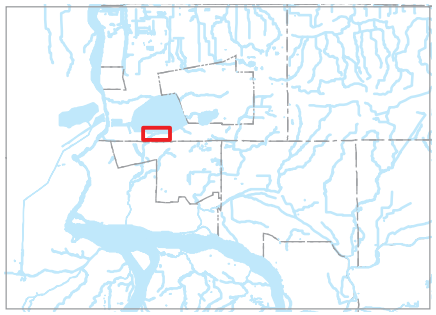


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach G10, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent



0 150 300 600 Feet

1" = 300'

FIGURE 2.5.2-20

N

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FIGURE 2.5.2-21

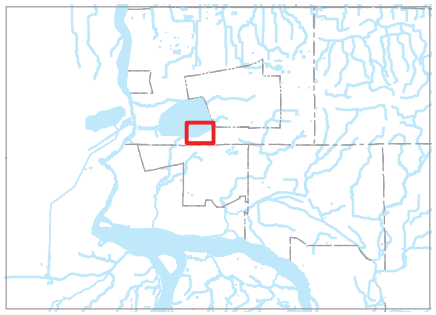
FORESTED RIPARIAN BUFFERS ALONG GILL CREEK IN REACH G10

NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach G11, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent



0 500 1,000 2,000 Feet

1" = 1,000'

N

FIGURE 2.5.2-22

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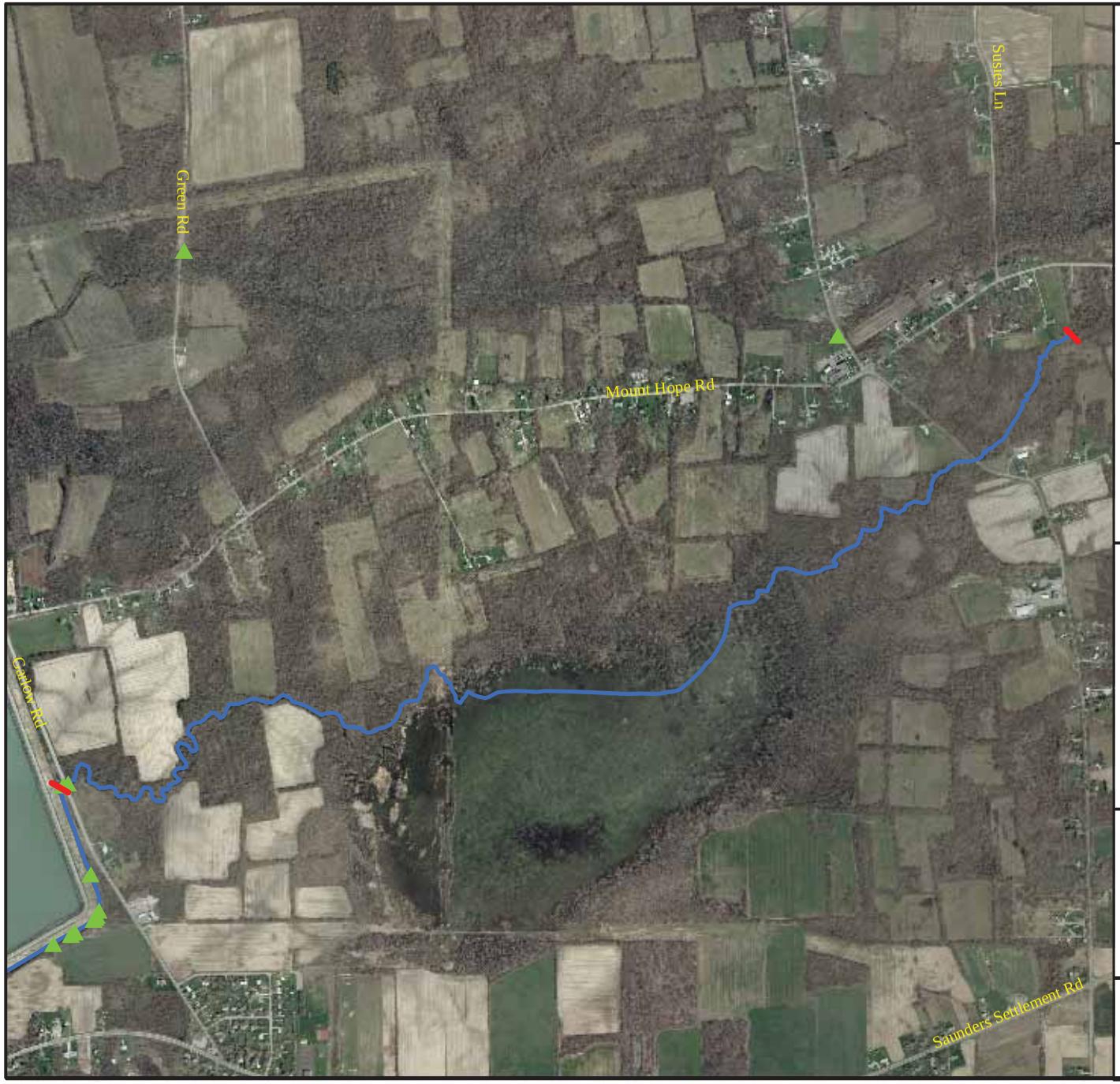
FIGURE 2.5.2-23

CHANNELIZED SECTION OF GILL CREEK ALONG THE LEWISTON RESERVOIR

FIGURE 2.5.2-24

SMALL ROCK DAM ACROSS GILL CREEK IN REACH G11

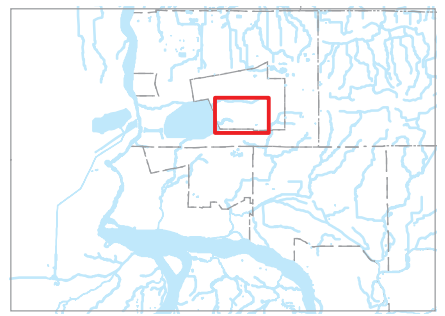


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach G12, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent



0 800 1,600 3,200 Feet

1" = 1,600'

FIGURE 2.5.2-25

N

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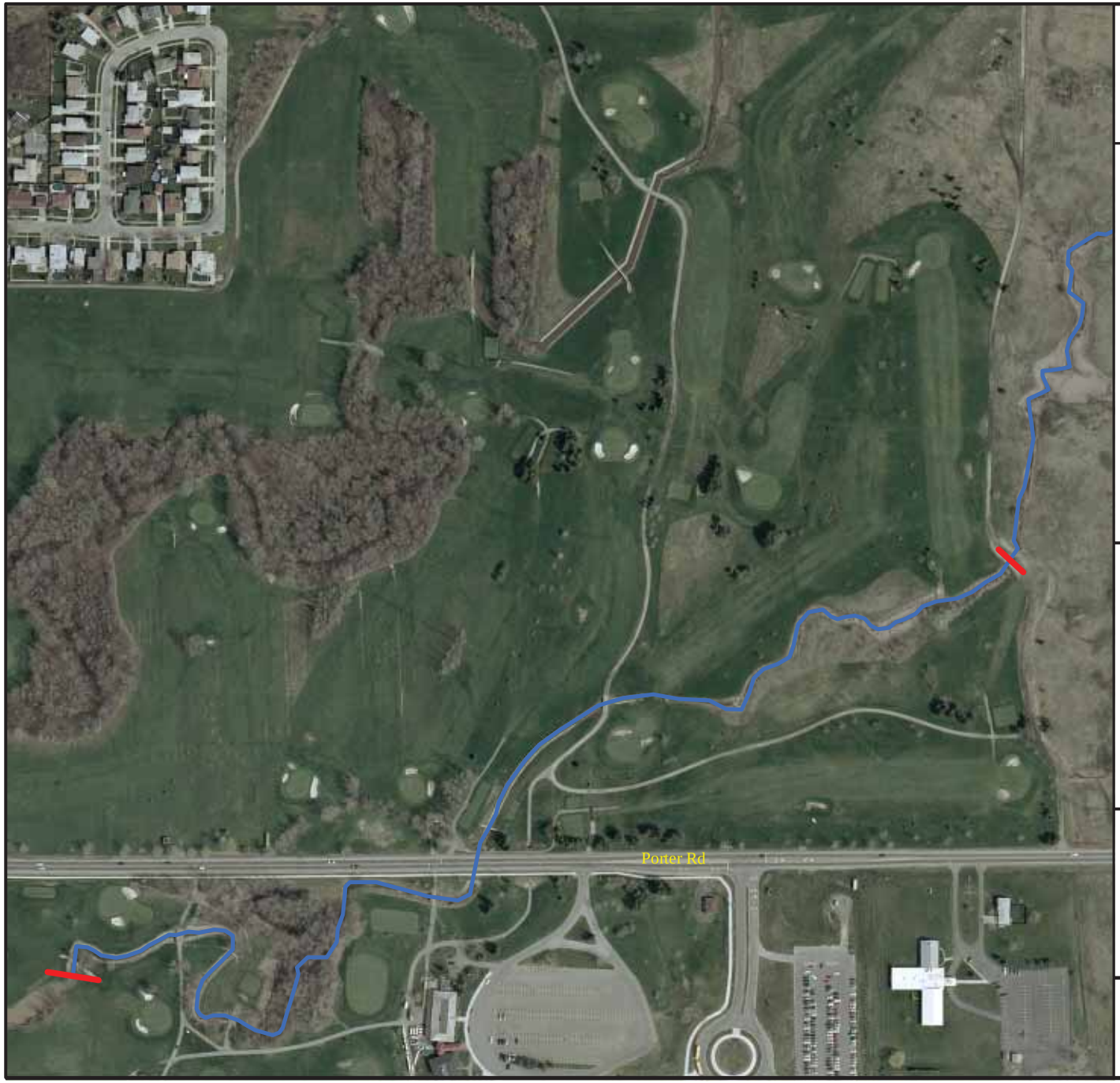
FIGURE 2.5.2-26

GILL CREEK UPSTREAM OF GARLOW ROAD

Nonpublic information – withheld at the request of and out of respect for the privacy of the Tuscarora Nation. Copies of this figure have been supplied to FERC as well as the state and federal resource agencies.

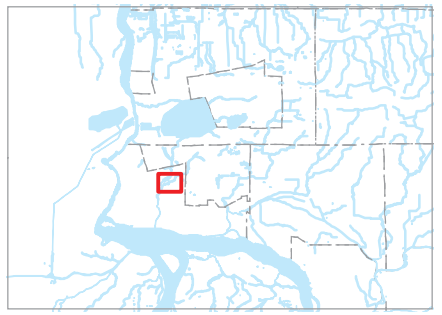


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach GT1, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent



0 200 400 800 Feet

1" = 400'

FIGURE 2.5.2-27

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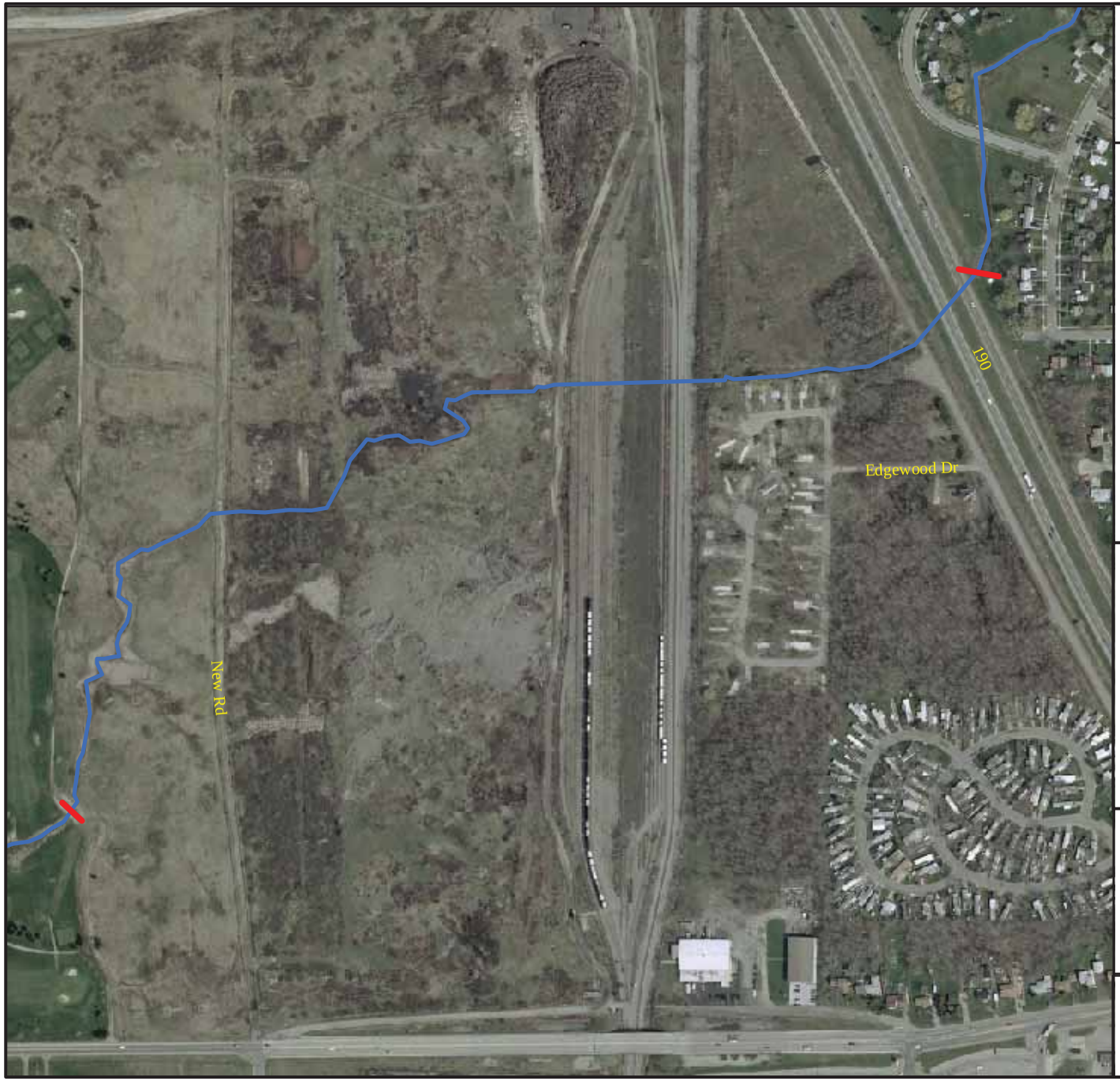
FIGURE 2.5.2-28

A SECTION OF THE GILL CREEK TRIBUTARY OVERGROWN WITH BROAD LEAF CATTAIL

FIGURE 2.5.2-29

CONCRETE LINED STREAM CHANNEL THROUGH THE HYDE PARK GOLF COURSE IN REACH GT1

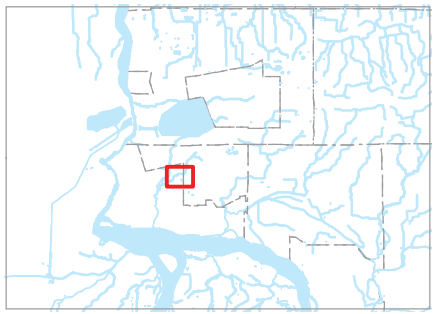


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach GT2, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent



0 250 500 1,000 Feet

1" = 500'

FIGURE 2.5.2-30

N

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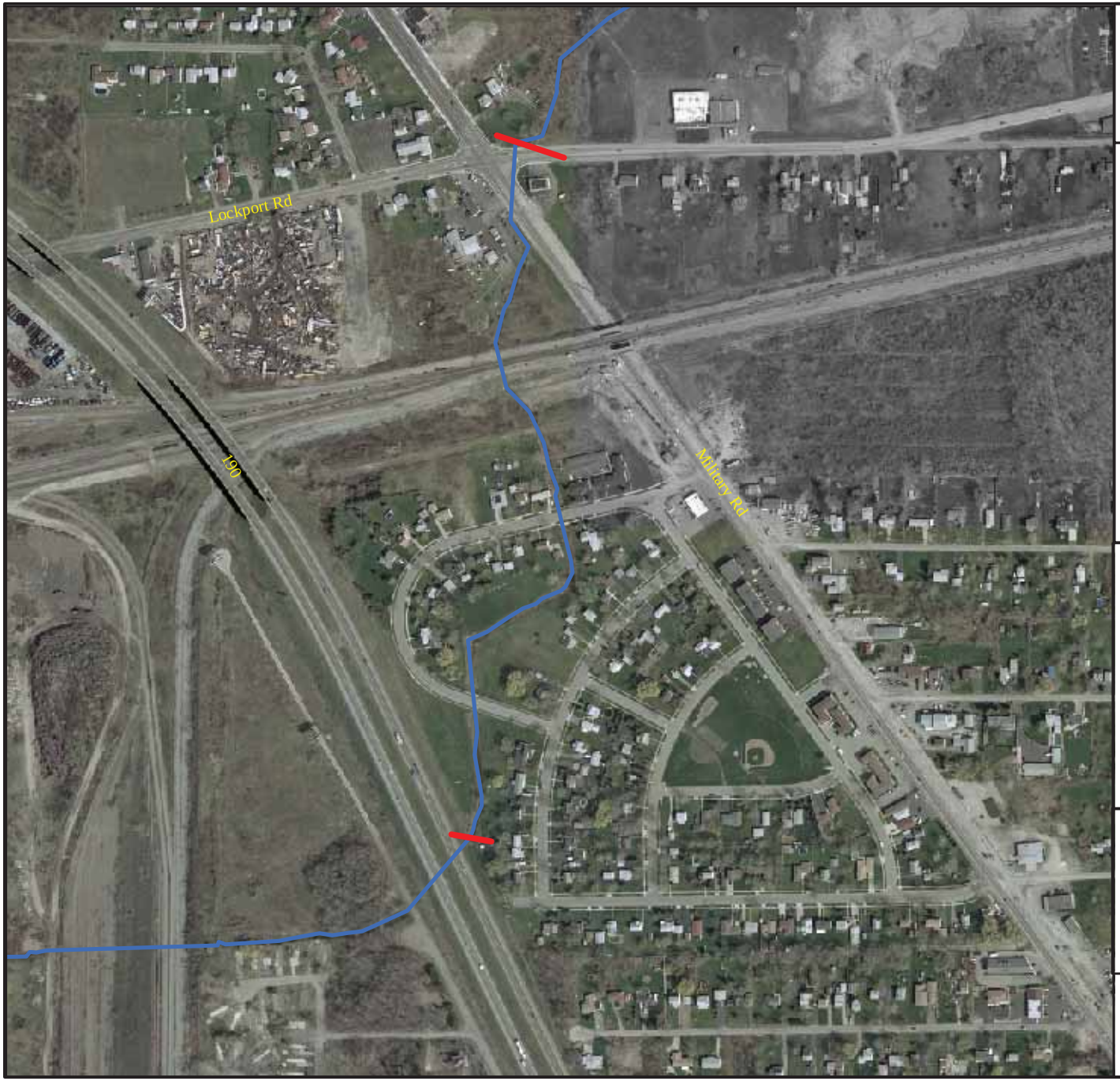
FIGURE 2.5.2-31

A SECTION OF STREAM CHANNEL IN GT2 HEAVILY VEGETATED BY CATTAIL SPECIES

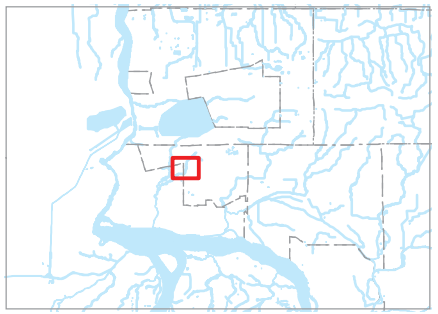


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach GT3, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent



0 250 500 1,000 Feet

1" = 500'

N

FIGURE 2.5.2-32

New York Power Authority

NIAGARA POWER PROJECT

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FIGURE 2.5.2-33

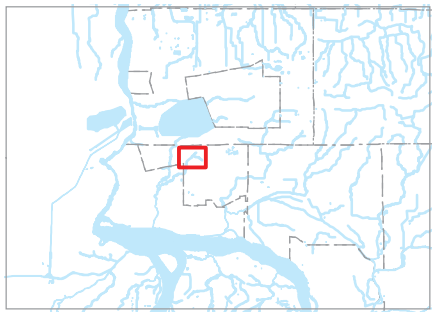
NARROW RIPARIAN BUFFERS ALONG THE GILL CREEK TRIBUTARY IN REACH GT3

NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach GT4, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Gill Creek
- Reach Extent



0 250 500 1,000 Feet

1" = 500'

FIGURE 2.5.2-34

N

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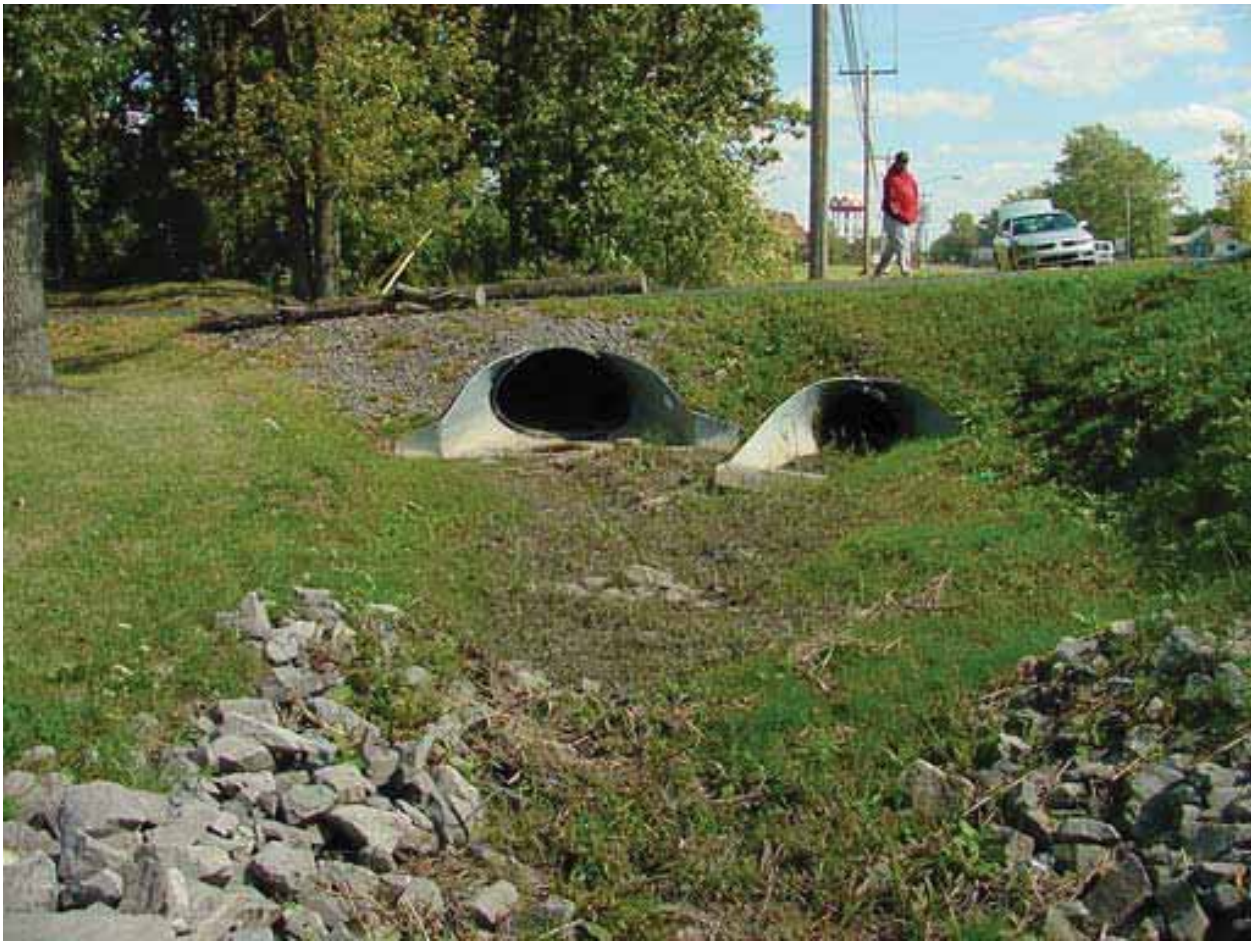
FIGURE 2.5.2-35

NEWLY CREATED POND ON THE HEADWATERS OF THE GILL CREEK TRIBUTARY

FIGURE 2.5.2-36

DRIVEWAY CROSSING OVER THE GILL CREEK TRIBUTARY IN REACH GT4

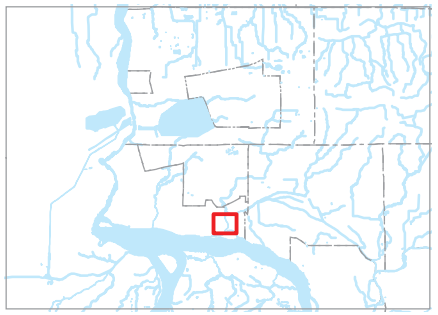


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach C1, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Cayuga Creek
- Reach Extent



0 400 800 1,600 Feet

1" = 800'

N

FIGURE 2.5.3-1

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NIAGARA POWER PROJECT

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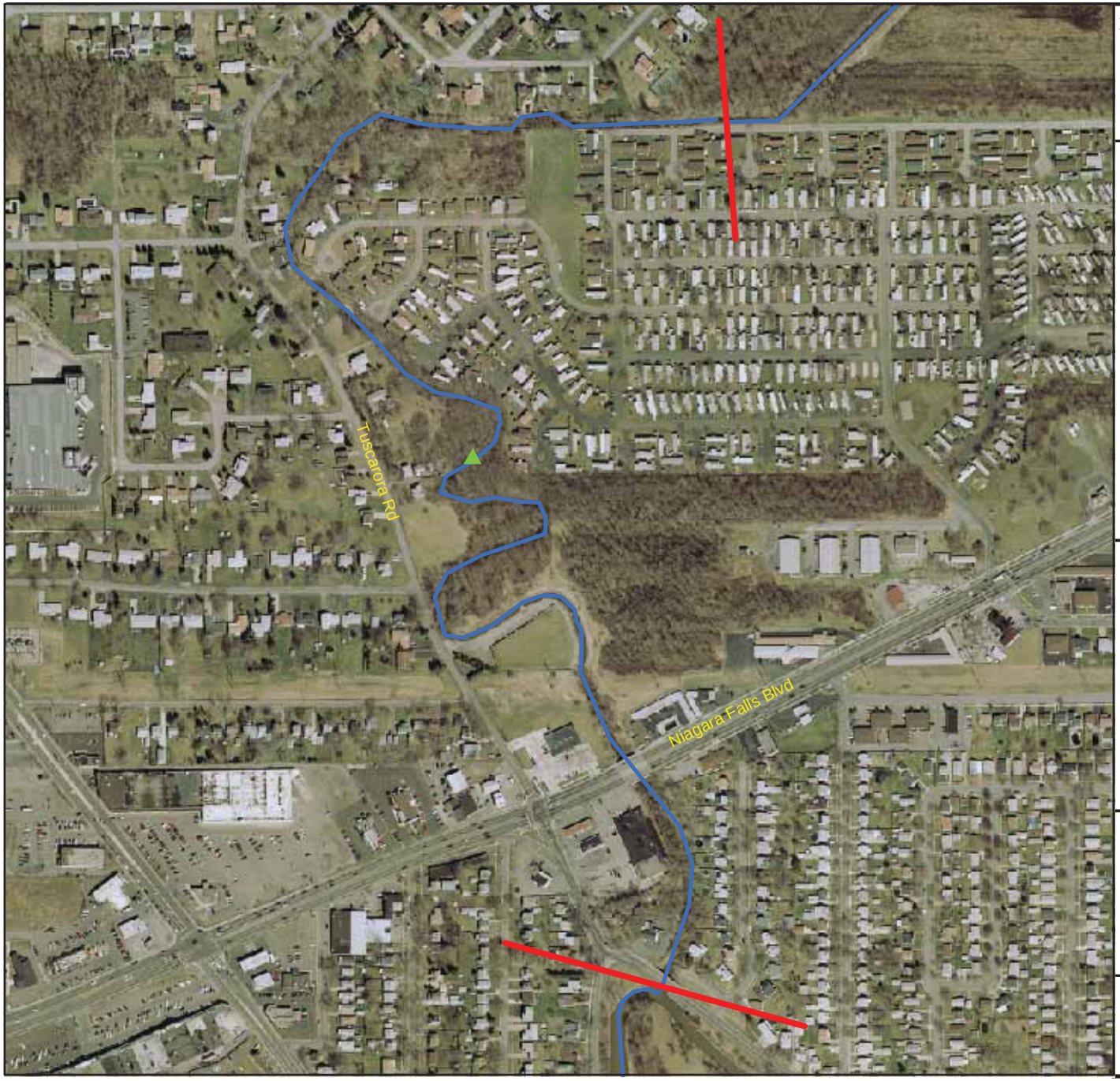
FIGURE 2.5.3-2

HOUSES AND BOAT DOCKS ALONG CAYUGA CREEK IN REACH C1

FIGURE 2.5.3-3

TYPICAL ROAD CROSSING OVER CAYUGA CREEK IN REACH C1

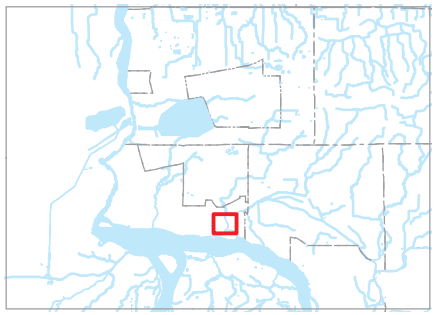


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach C2, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Cayuga Creek
- Reach Extent



0 250 500 1,000 Feet

1" = 500'

FIGURE 2.5.3-4

N

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NIAGARA POWER PROJECT

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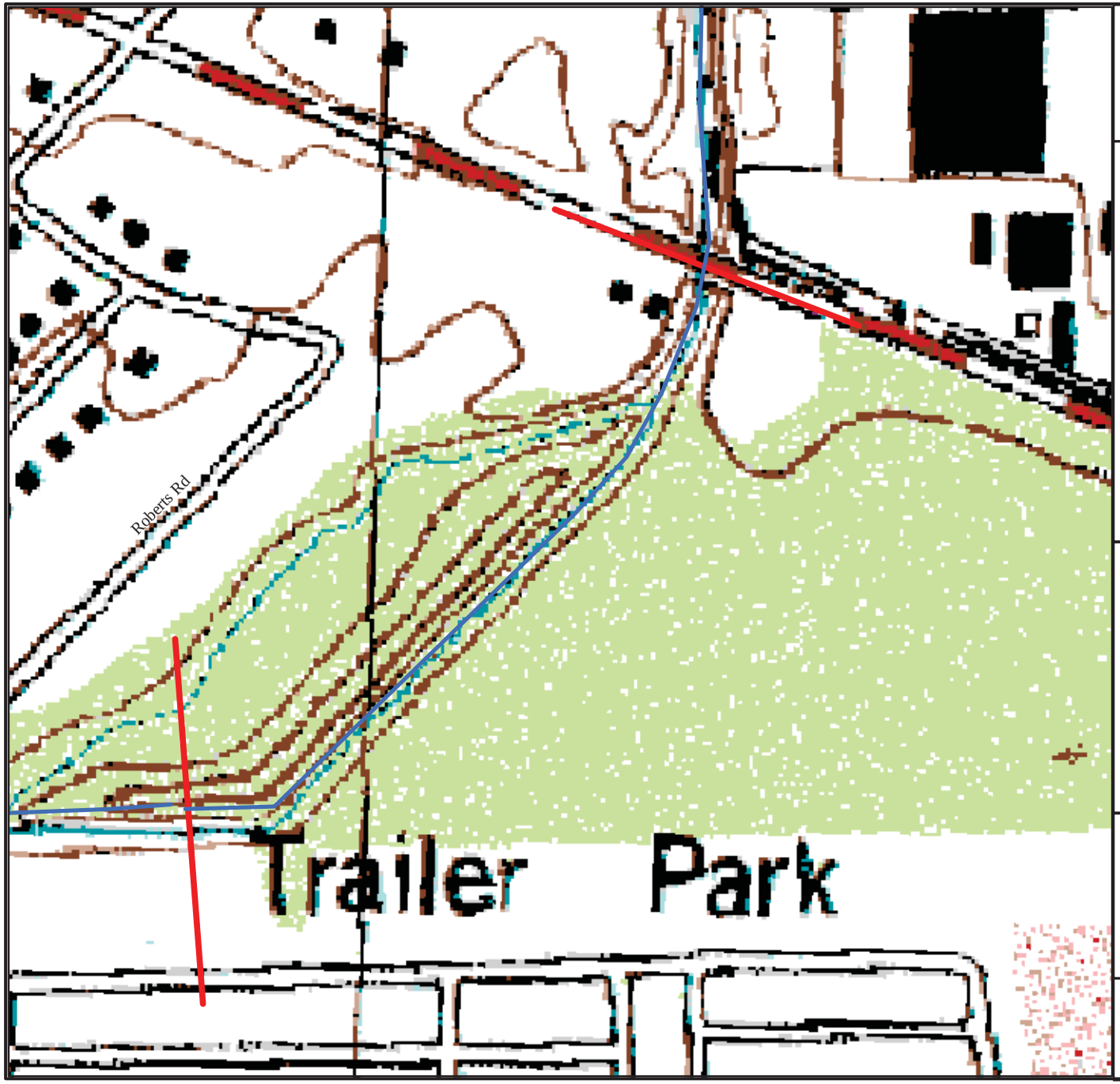
FIGURE 2.5.3-5

ERODING STREAM BANKS ALONG SECTIONS OF CAYUGA CREEK IN REACH C2

FIGURE 2.5.3-6

WOODY DEBRIS JAM ON CAYUGA CREEK IN REACH C2



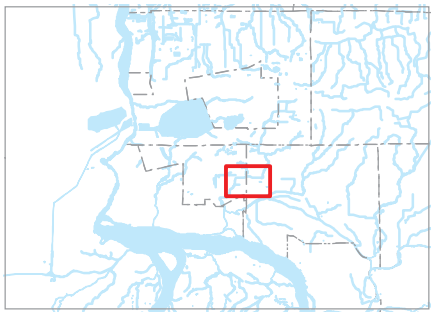
NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach C3, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Cayuga Creek
- Reach Extent

Note:
USGS Topographic Quadrangles used in place of aerial imagery



0 150 300 600 Feet

1" = 300'

FIGURE 2.5.3-7

N

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NIAGARA POWER PROJECT

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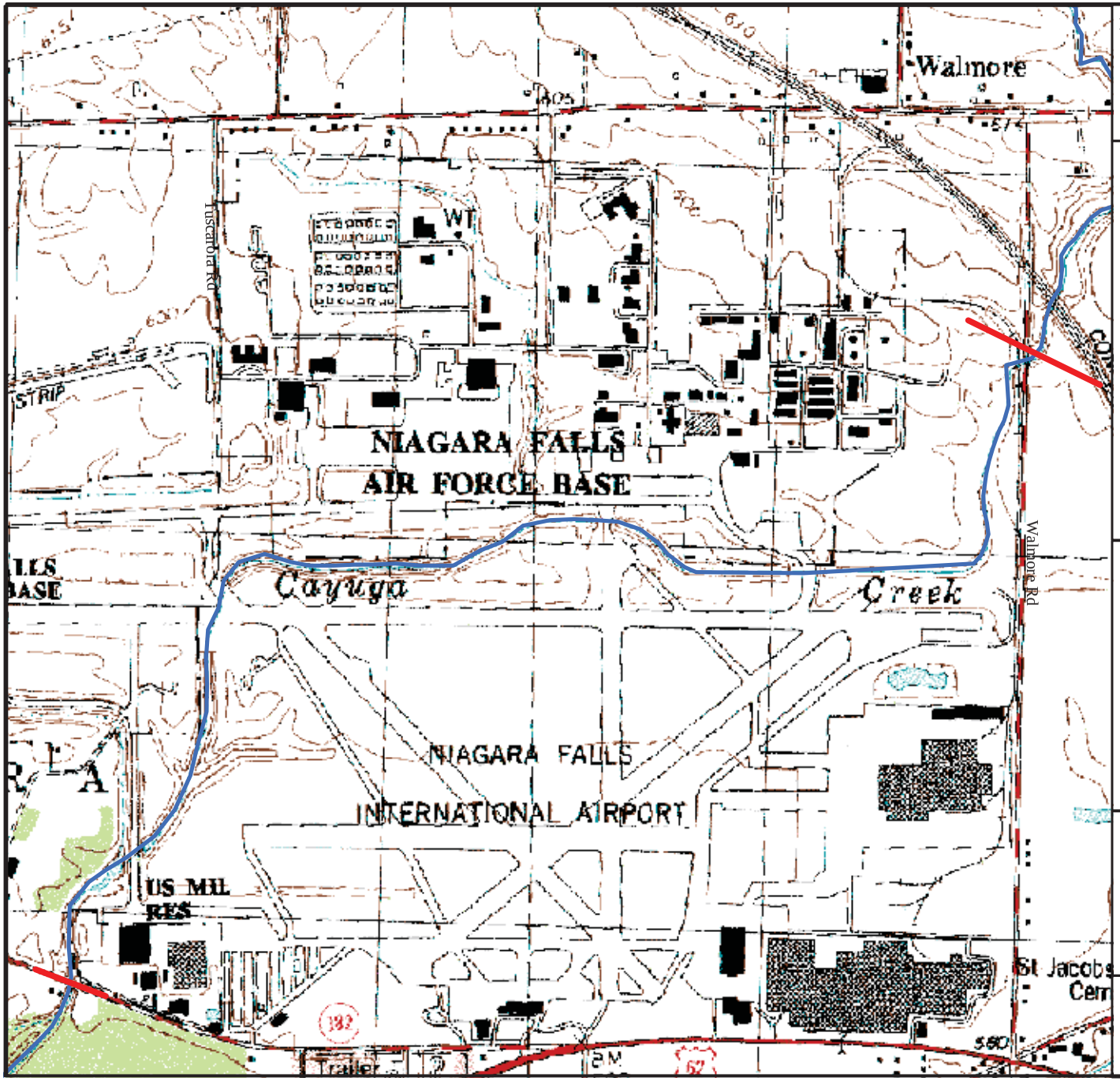
FIGURE 2.5.3-8

CAYUGA CREEK THROUGH A CHANNELIZED SECTION IN REACH C3



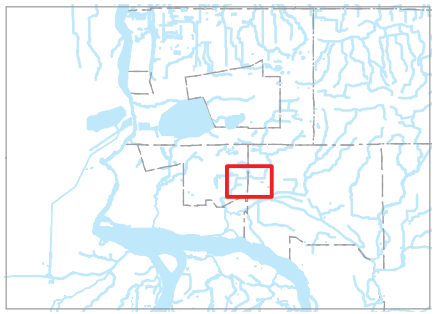
NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach C4, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Cayuga Creek
- Reach Extent

NOTE:
USGS Topographic Quadrangles used as basemap; Aerial imagery unavailable for public use



0 650 1,300 2,600 Feet

1" = 1300'

FIGURE 2.5.3-9

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New York Power Authority

NIAGARA POWER PROJECT

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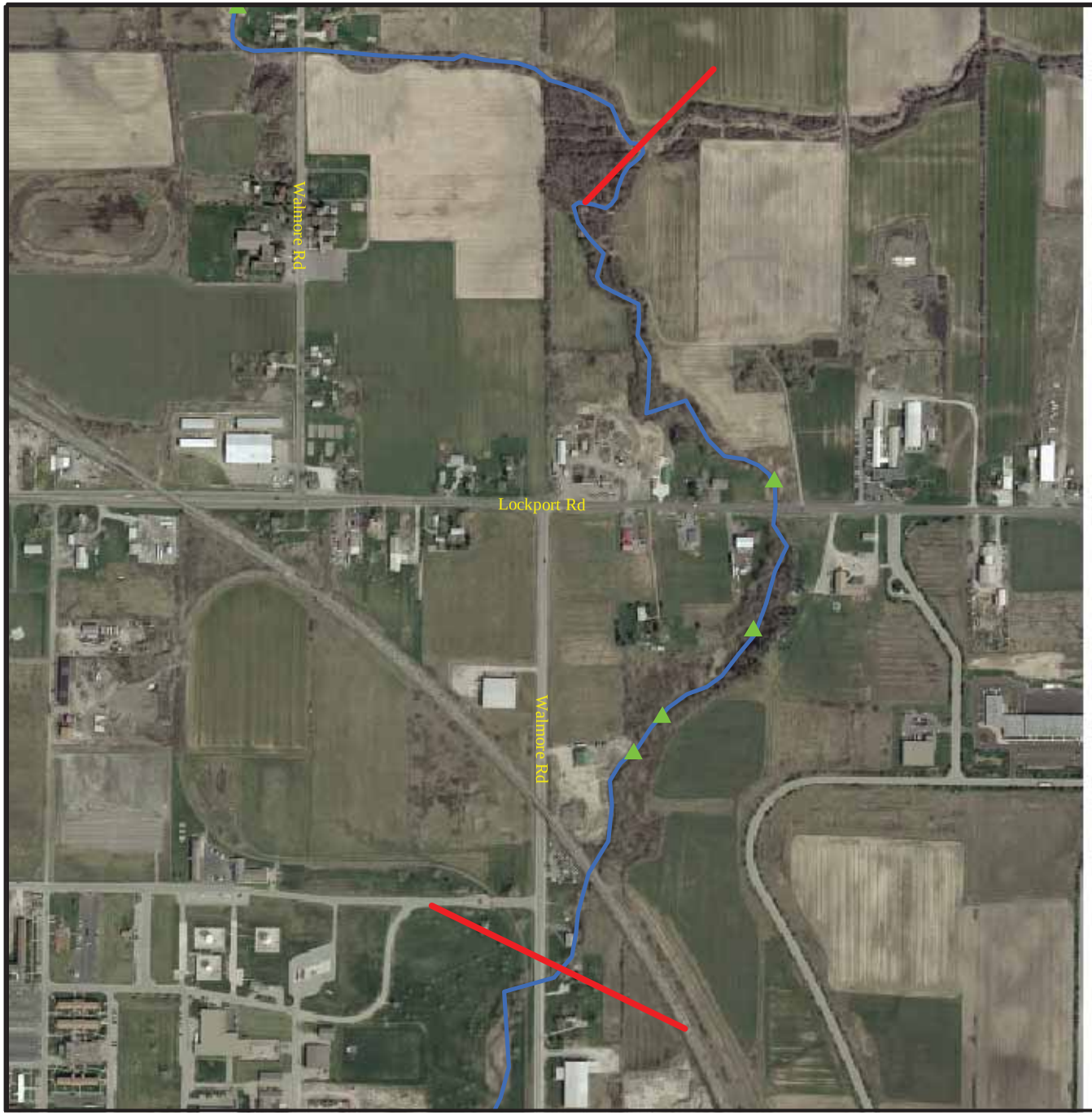
FIGURE 2.5.3-10

RIPARIAN BUFFERS ALONG CAYUGA CREEK IN REACH C4

FIGURE 2.5.3-11

LANDSCAPING MATERIAL DUMPED ALONG CAYUGA CREEK IN REACH C4

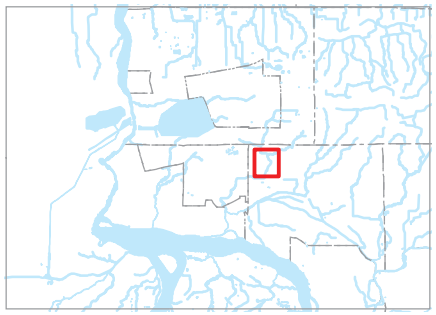


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach C5, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Cayuga Creek
- Reach Extent



0 350 700 1,400 Feet

1" = 700'

FIGURE 2.5.3-12

N

New York Power Authority

NIAGARA POWER PROJECT

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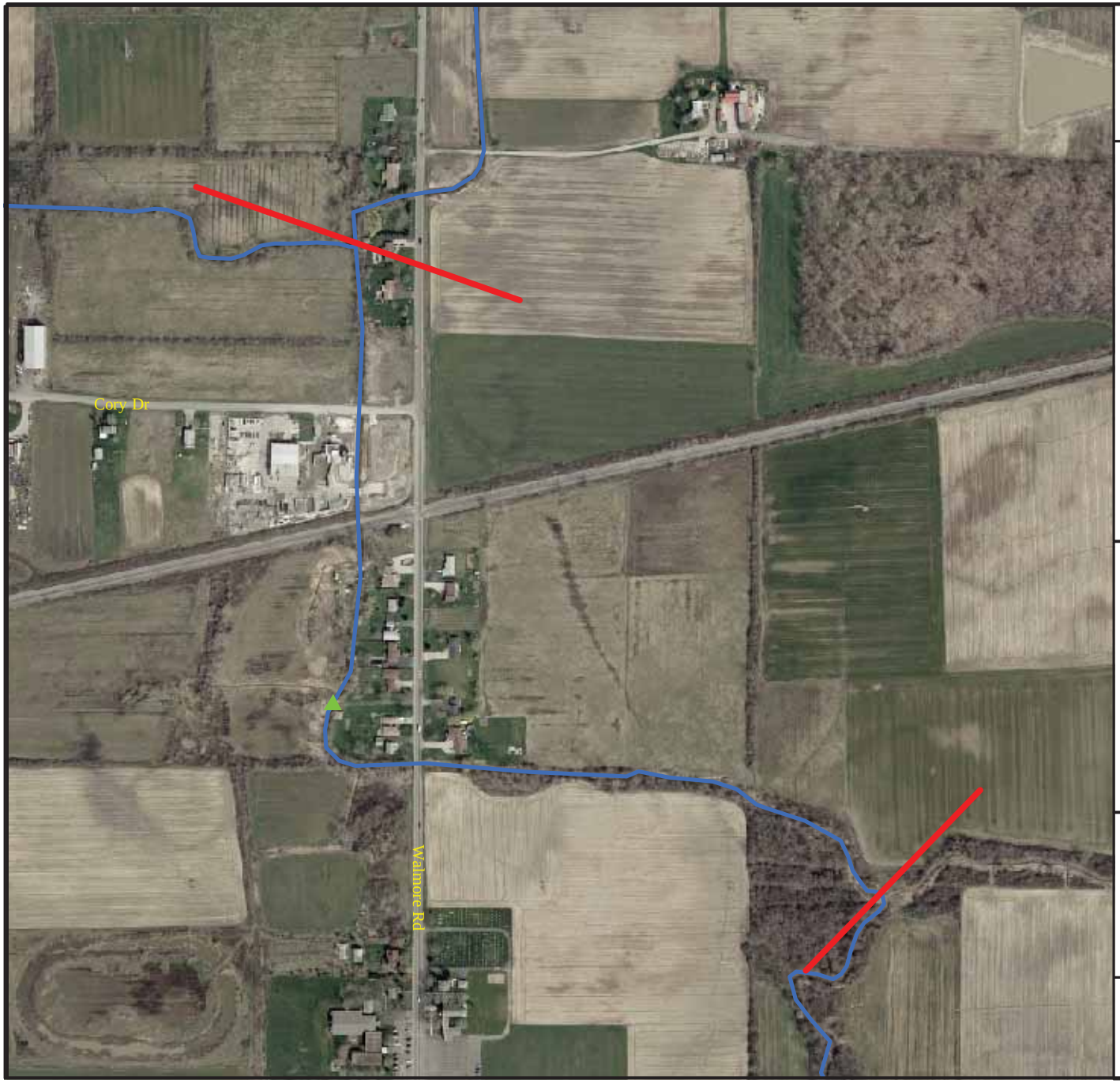
FIGURE 2.5.3-13

ONE OF THREE WOODY DEBRIS JAMS ON CAYUGA CREEK IN REACH C5

FIGURE 2.5.3-14

A SMALL BEDROCK LEDGE ON CAYUGA CREEK IN REACH C5

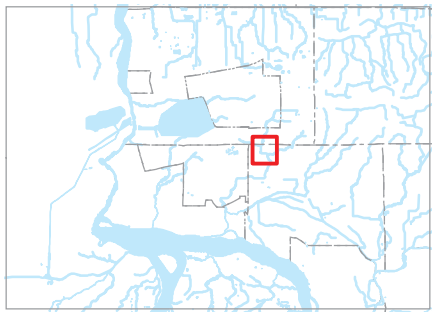


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach C6, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Cayuga Creek
- Reach Extent



0 250 500 1,000 Feet

1" = 500'

N

FIGURE 2.5.3-15

New York Power Authority

NIAGARA POWER PROJECT

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FIGURE 2.5.3-16

HANGING CULVERT ON CAYUGA CREEK IN REACH C6

FIGURE 2.5.3-17

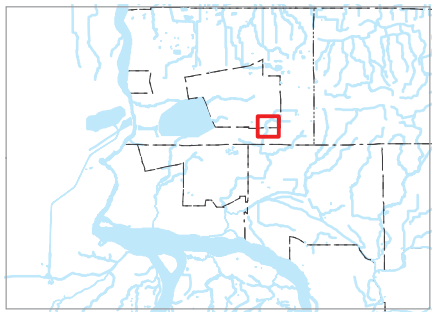
THE RAILROAD BRIDGE OVER CAYUGA CREEK IN REACH C6

NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach C7, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Cayuga Creek
- Reach Extent



0 400 800 1,600 Feet

1" = 800'

FIGURE 2.5.3-18

N

New York Power Authority

NIAGARA POWER PROJECT

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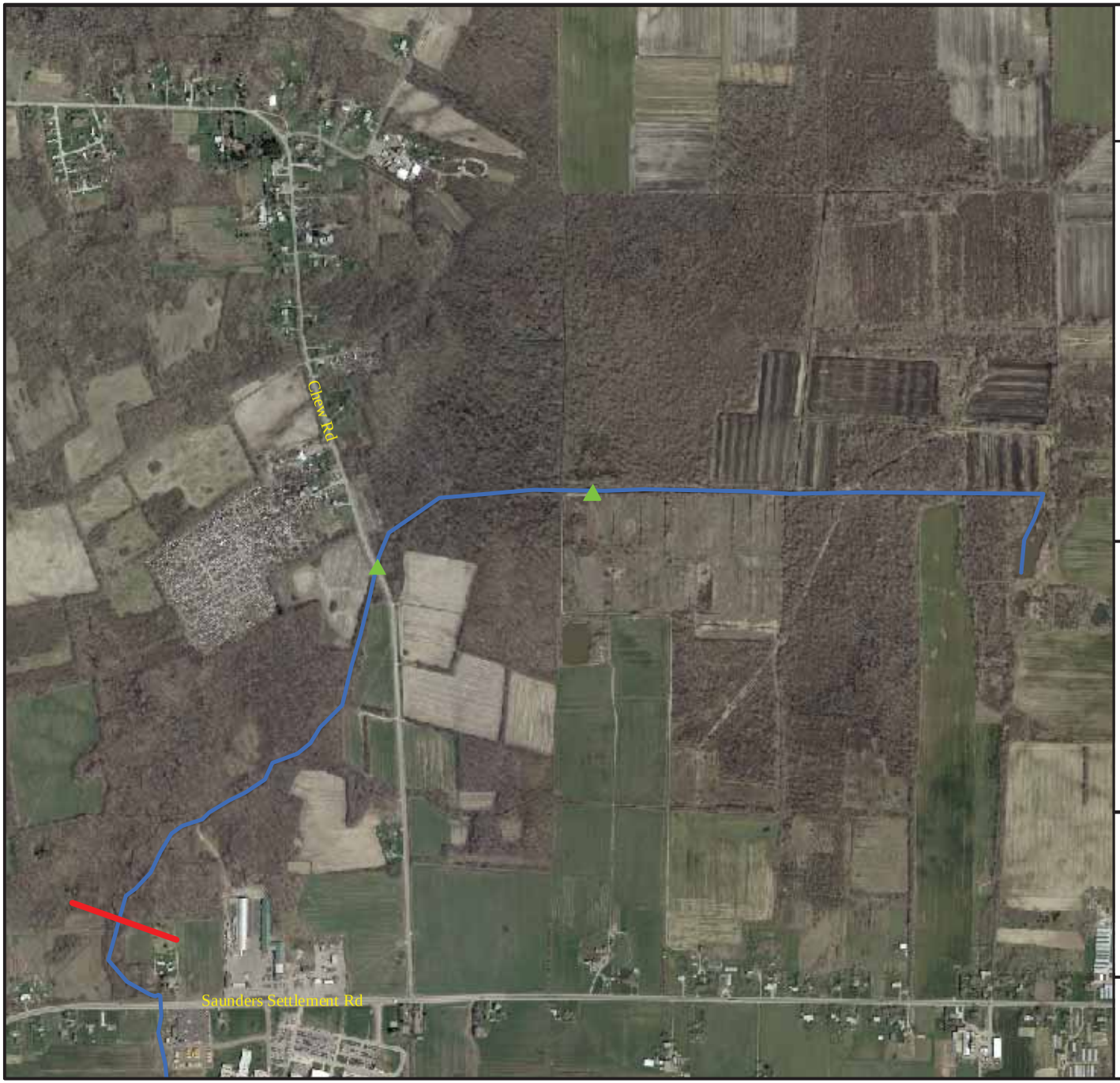
FIGURE 2.5.3-19

A DRY SECTION OF CAYUGA CREEK IN REACH C7

Nonpublic information – withheld at the request of and out of respect for the privacy of the Tuscarora Nation. Copies of this figure have been supplied to FERC as well as the state and federal resource agencies.

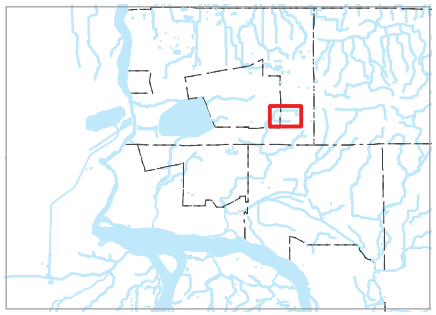


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach C8, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Cayuga Creek
- Reach Extent



0 600 1,200 2,400 Feet

1" = 1200'

FIGURE 2.5.3-20

N

New York Power Authority

NIAGARA POWER PROJECT

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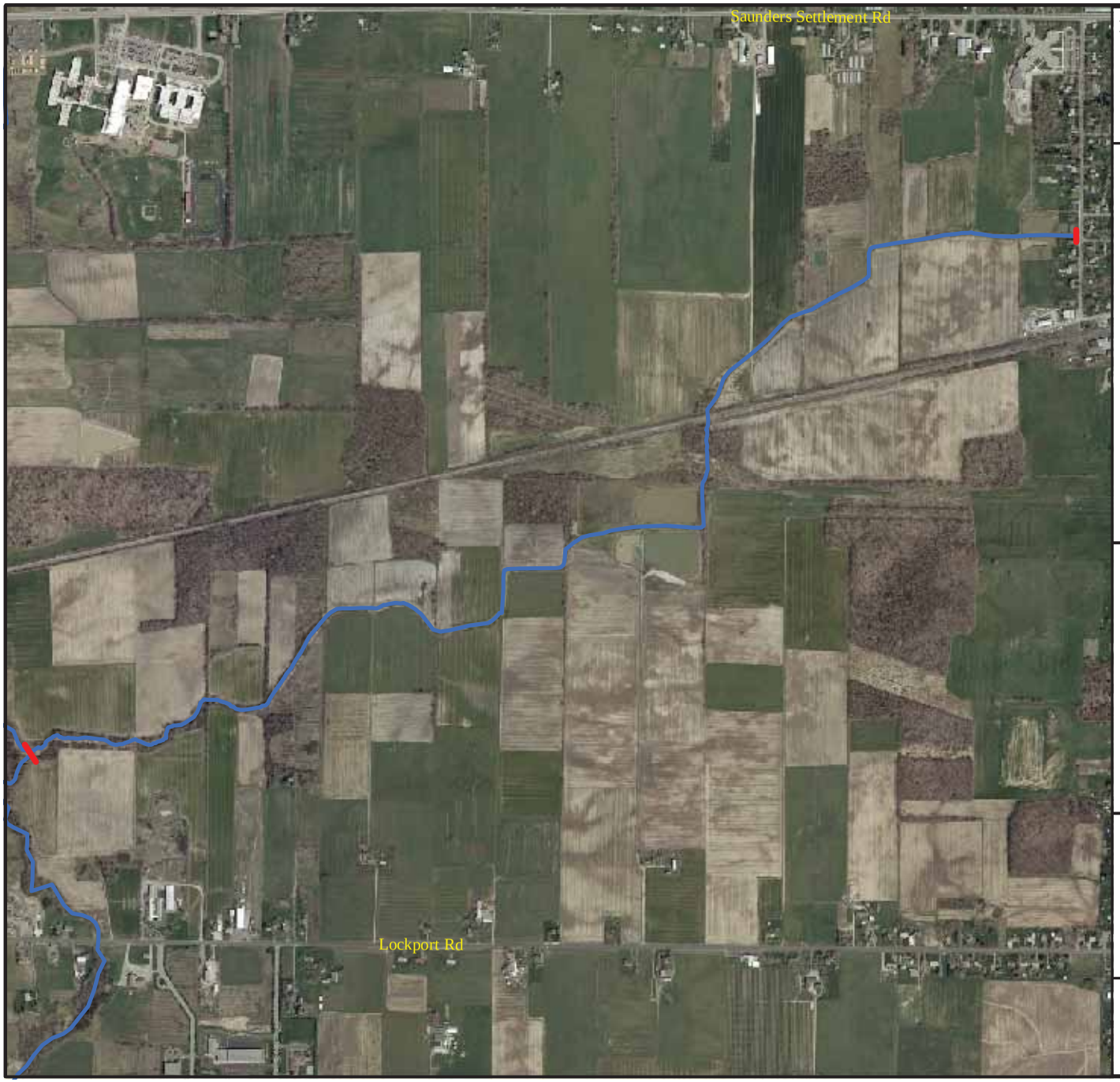
FIGURE 2.5.3-21

REACH C8 IN SEPTEMBER OF 2003

Nonpublic information – withheld at the request of and out of respect for the privacy of the Tuscarora Nation. Copies of this figure have been supplied to FERC as well as the state and federal resource agencies.

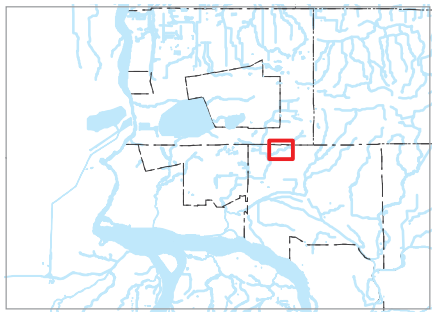


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach CET1, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- East Cayuga Creek
- Reach Extent



0 650 1,300 2,600 Feet

1" = 1,300'

FIGURE 2.5.3-22

N

New York Power Authority

NIAGARA POWER PROJECT

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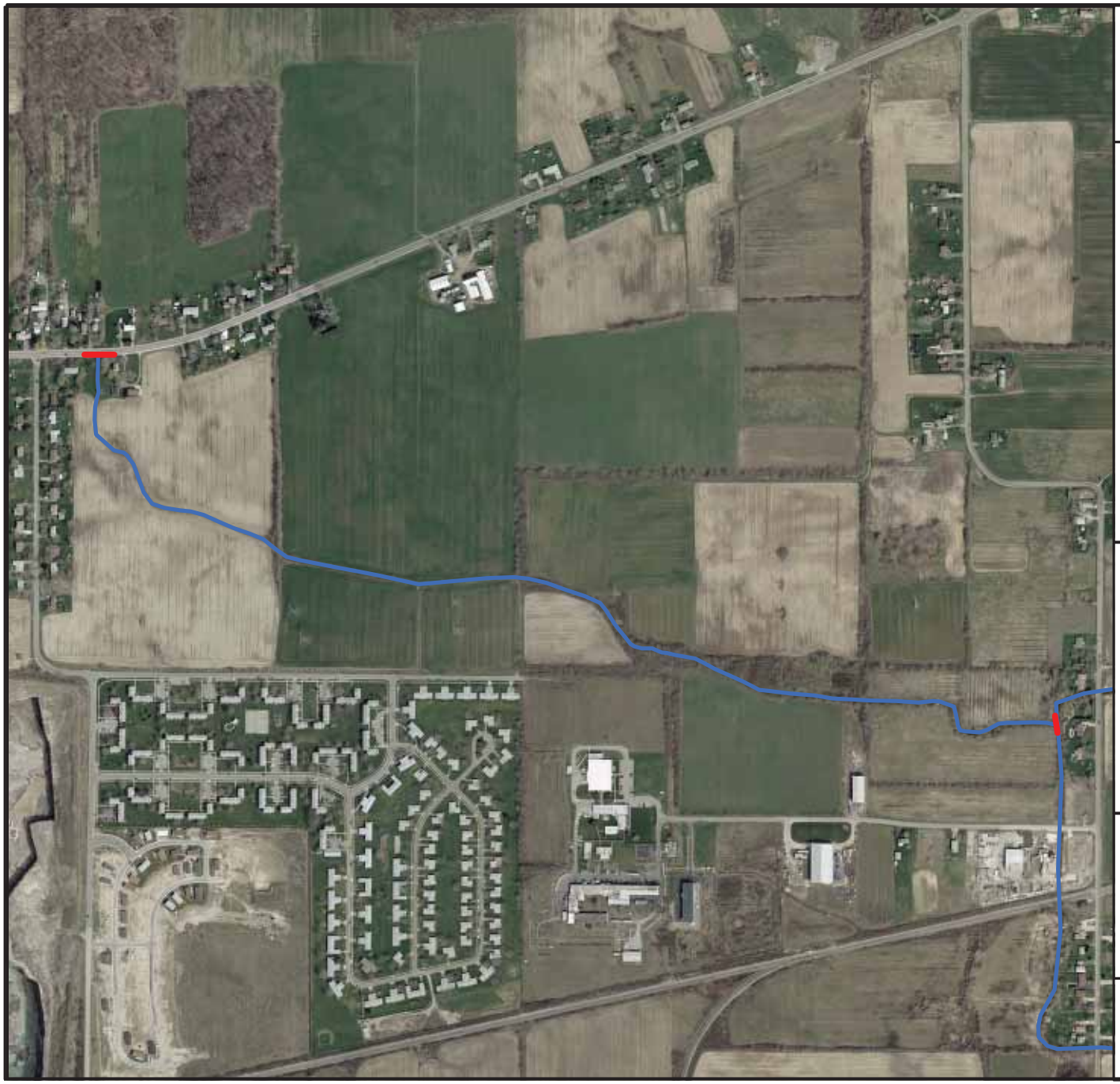
FIGURE 2.5.3-23

A NEWLY DREDGED SECTION OF REACH CET1

FIGURE 2.5.3-24

HANGING CULVERT ON REACH CET1

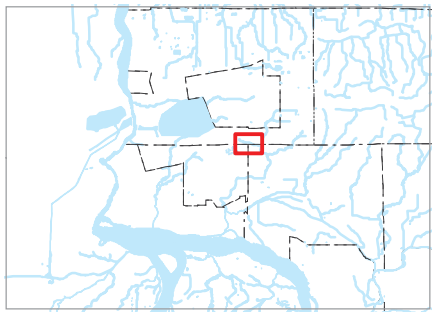


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach CWT1, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- West Cayuga Creek
- Reach Extent



0 400 800 1,600 Feet

1" = 800'

FIGURE 2.5.3-25

N

New York Power Authority

NIAGARA POWER PROJECT

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FIGURE 2.5.3-26

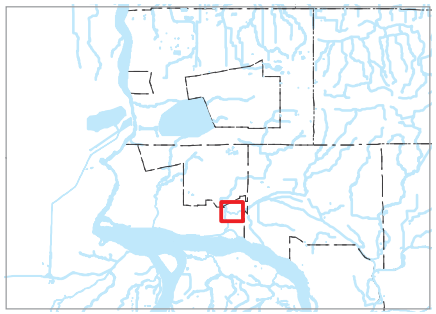
DRY STREAM CHANNEL THROUGH A SECTION OF REACH CWT1

NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach BZ1, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Bergholtz Creek
- Reach Extent



0 400 800 1,600 Feet

1" = 800'

N

FIGURE 2.5.3-27

New York Power Authority

NIAGARA POWER PROJECT

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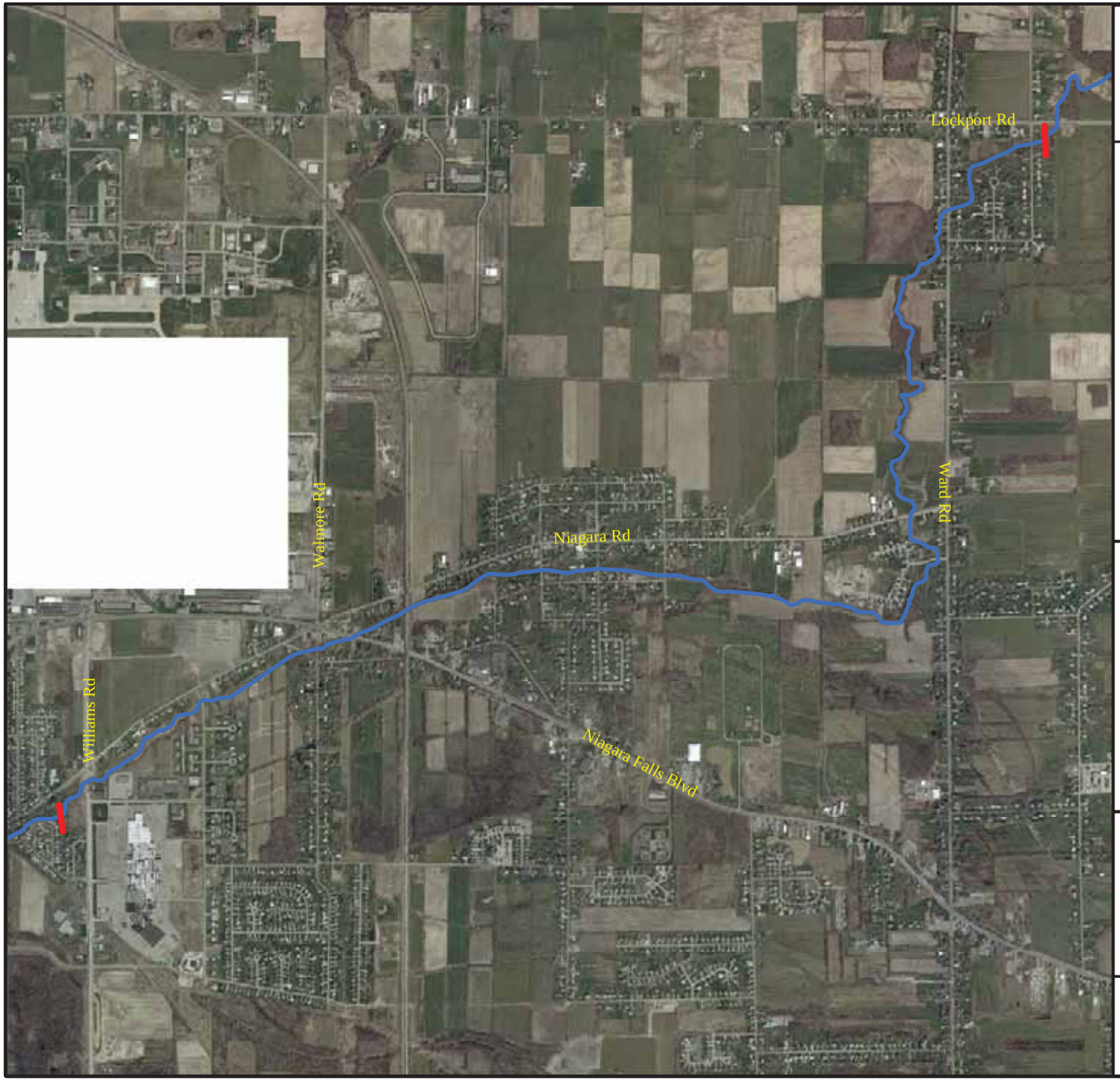
FIGURE 2.5.3-28

BERGHOLTZ CREEK IN REACH BZ1

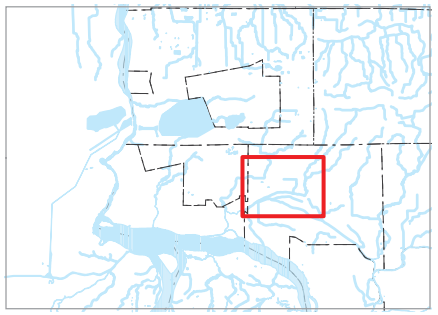


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach BZ2, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Bergholtz Creek
- Reach Extent



0 1,200 2,400 4,800 Feet

1" = 2,400'

N

FIGURE 2.5.3-29

New York Power Authority

NIAGARA POWER PROJECT

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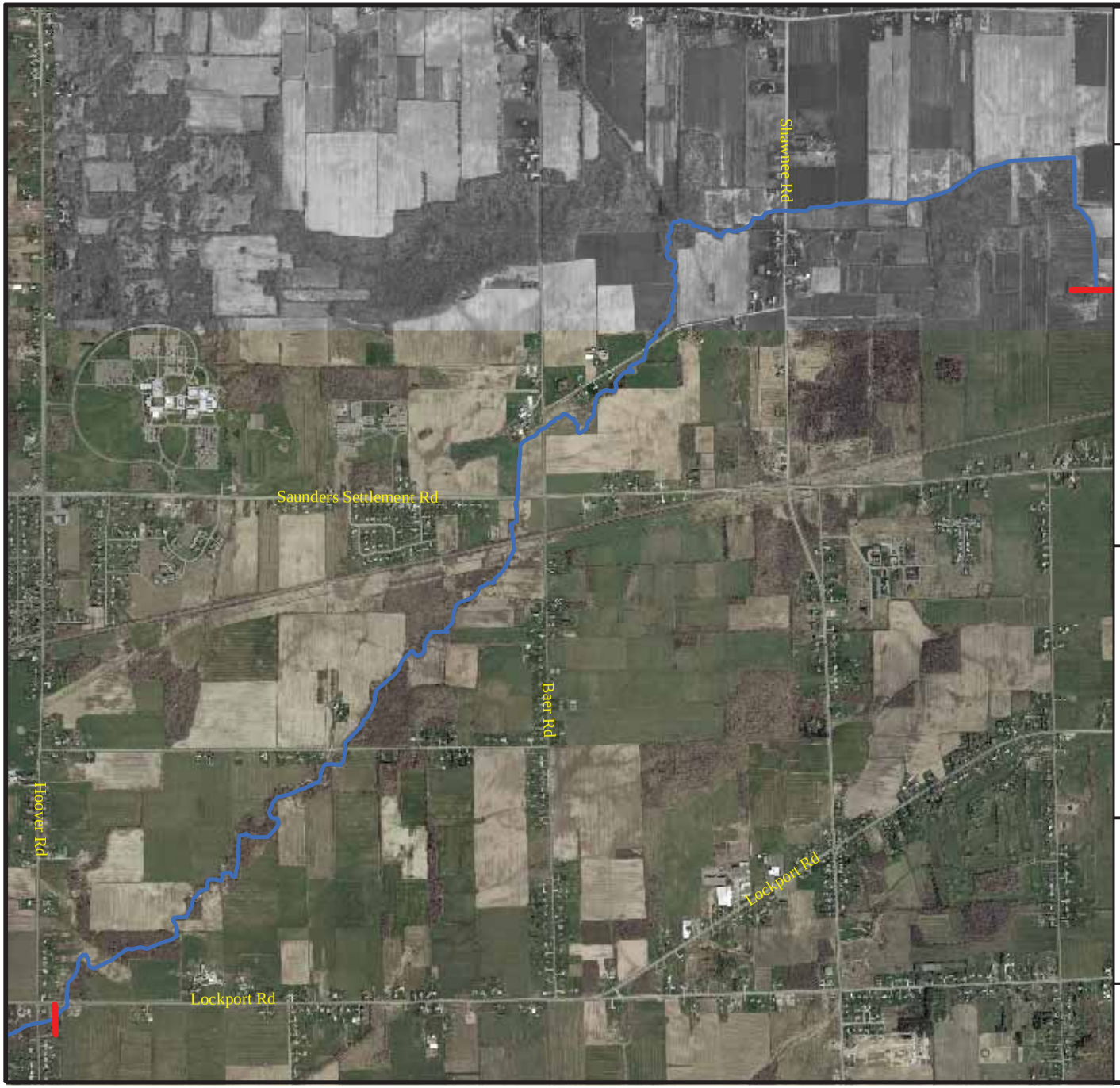
FIGURE 2.5.3-30

BERGHOLTZ CREEK IN REACH BZ2

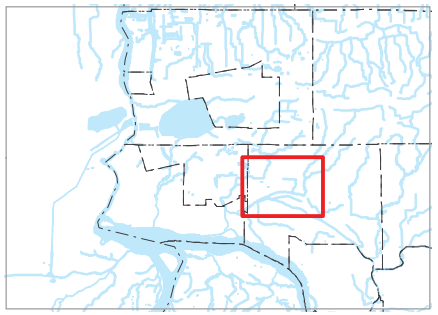


NIAGARA POWER PROJECT (FERC NO. 2216)
DESCRIBE ECOLOGICAL CONDITION OF GILL, FISH, AND CAYUGA CREEKS

Aerial View of Reach BZ3, and the Location of Fish Barriers within the Reach

LEGEND

- Fish Barrier
- Bergholtz Creek
- Reach Extent



0 1,200 2,400 4,800 Feet

1" = 2,400'

FIGURE 2.5.3-31

N

New York Power Authority

NIAGARA POWER PROJECT

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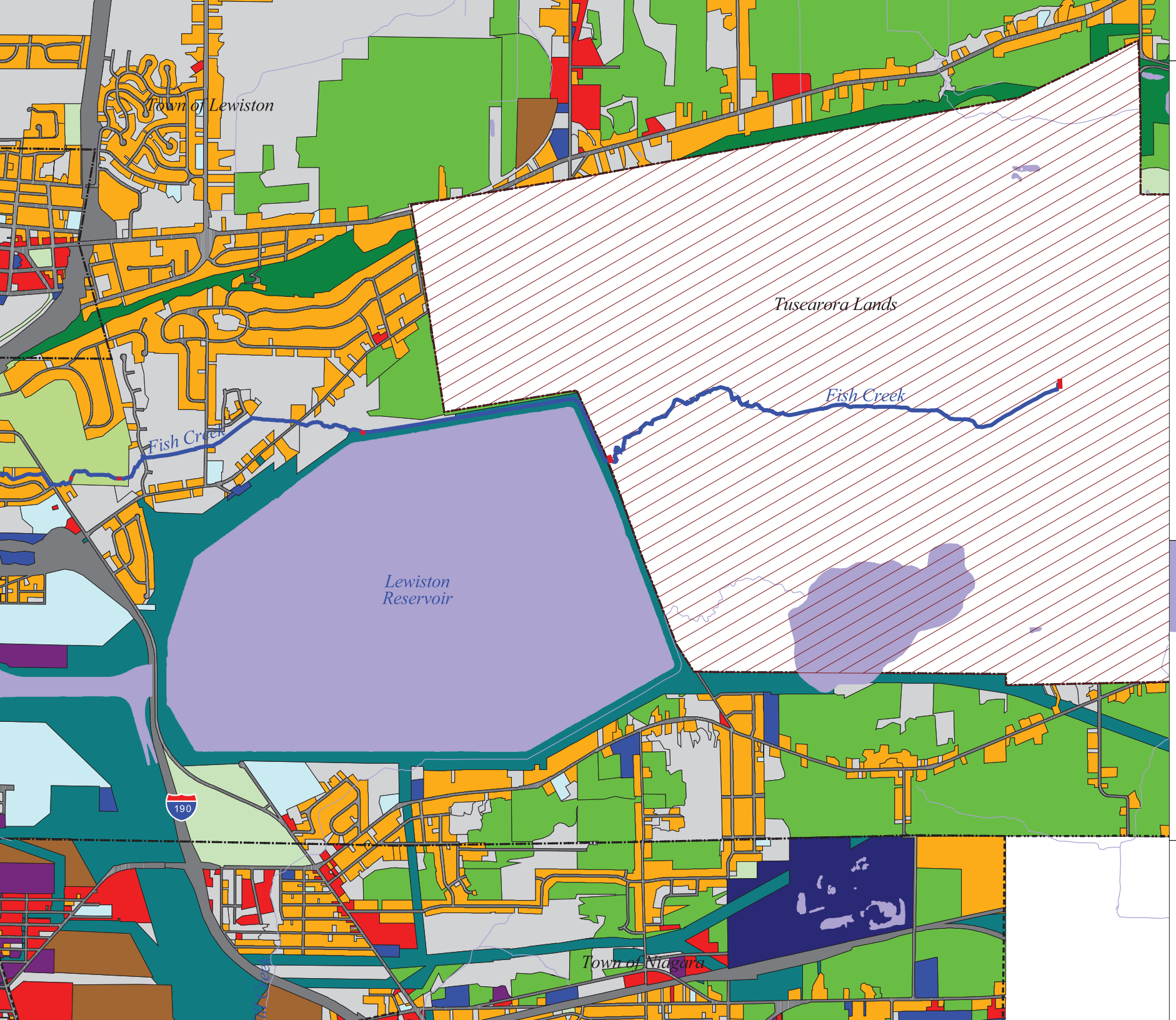
FIGURE 2.5.3-32

NARROW STREAM CHANNEL AND SLOW MOVING WATER IN THE DOWNSTREAM SECTION OF REACH BZ3

FIGURE 2.5.3-33

THE UPSTREAM SECTION OF REACH BZ3 OVERGROWN WITH VEGETATION



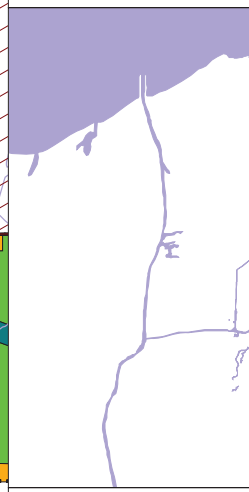
Land Us

LEGEND

Land Use

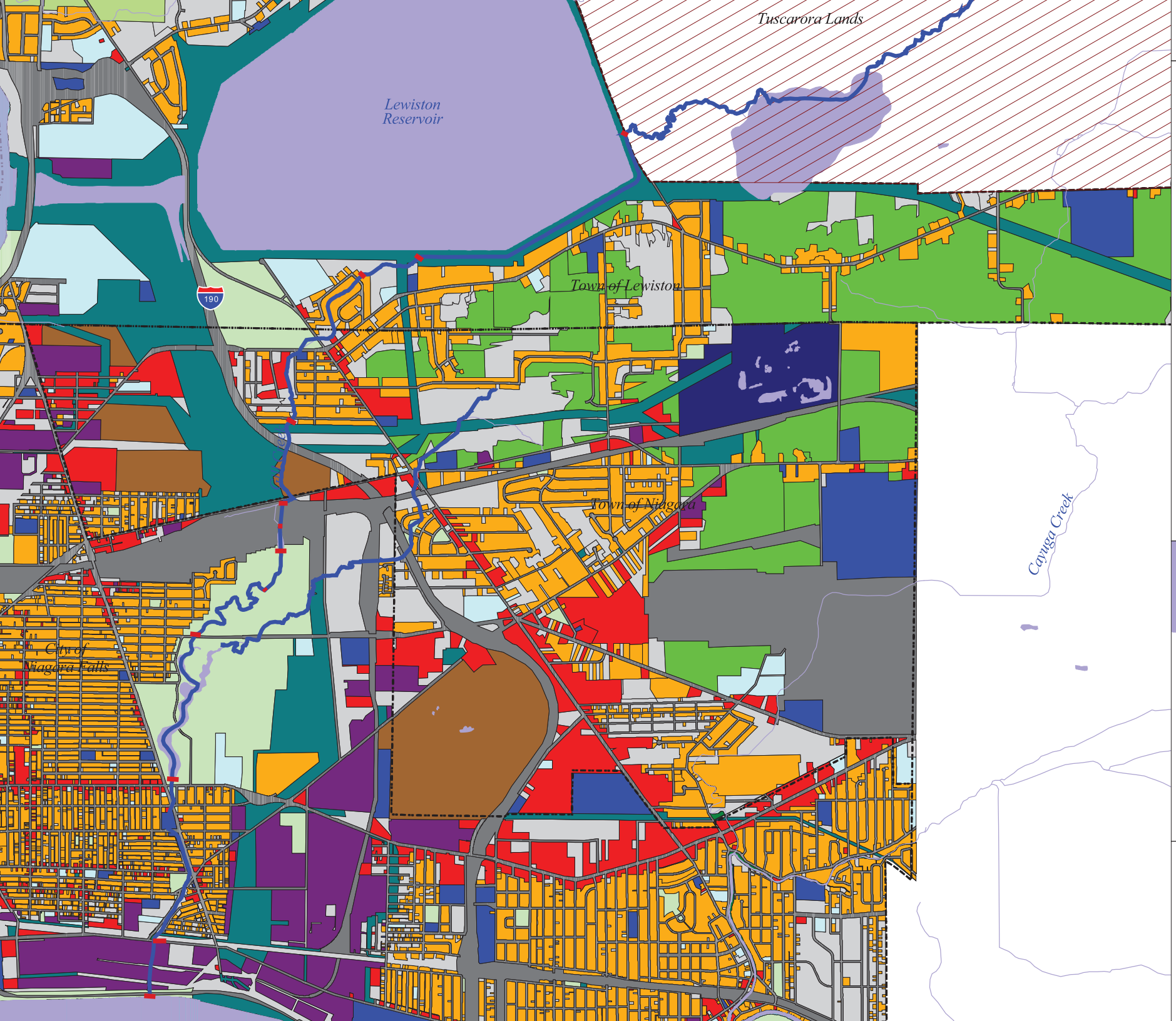
- Agriculture
- Commercial
- Industrial
- Landfill
- Mining
- Mixed-Use
- Open Space
- Open Water
- Private Recr

- Reach
- Fish Creek
- 500 ft Buffer



0 30

1" =



Land U

LEGEND

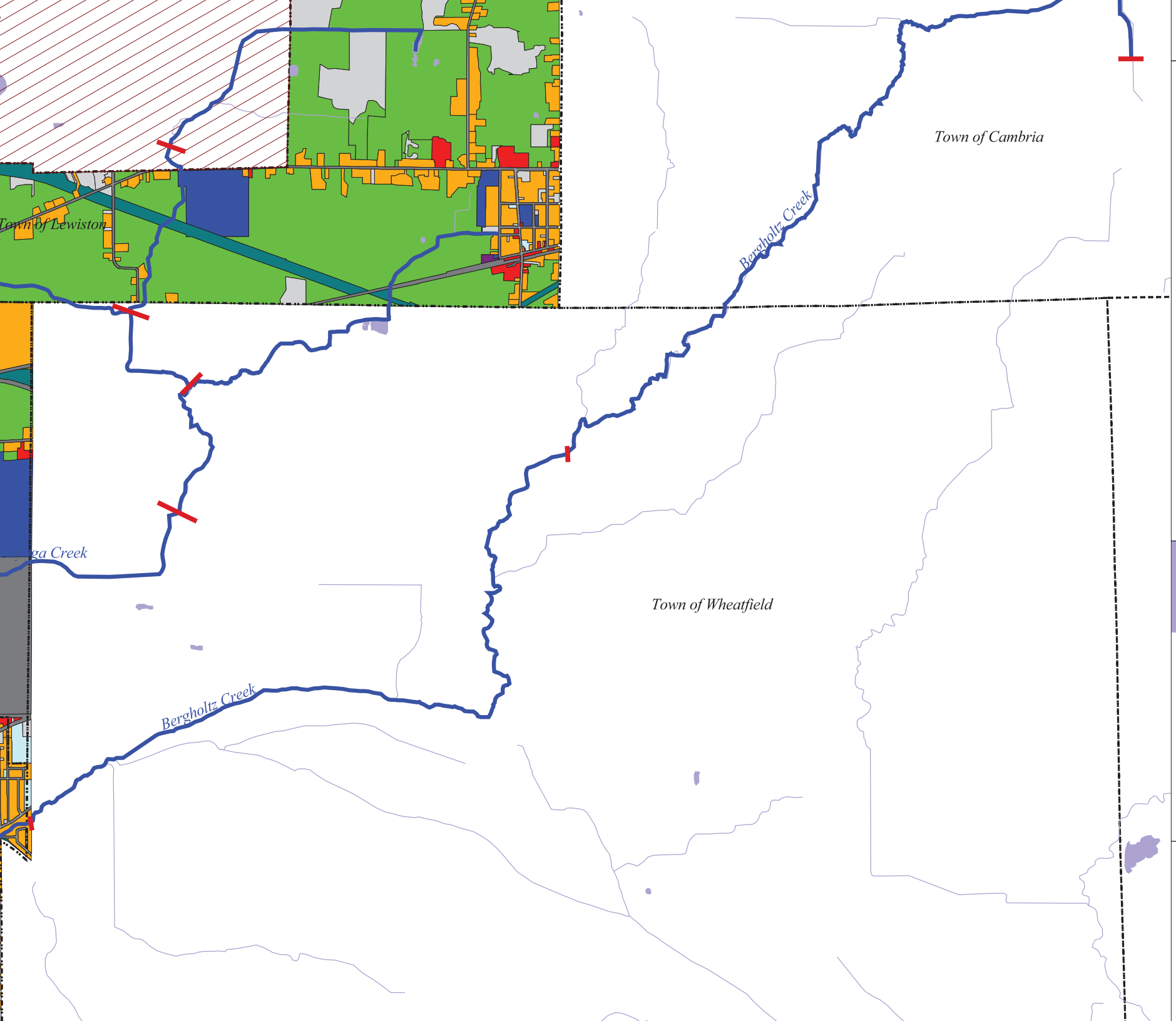
Land Use

- Agriculture
- Commercial
- Industrial
- Landfill
- Mining
- Mixed-Use
- Open Space
- Open Water
- Private Recr

- Reach
- Gill Creek
- 500 ft Buffer

0 3

1" =



Land Use in the C

LEGEND

Land Use

- Agriculture
- Commercial
- Industrial
- Landfill
- Mining
- Mixed-Use
- Open Space
- Open Water
- Private Recr

- Reach
- Cayuga and Bergholtz Cr
- 500 ft Buffer

0 3

1" =

3.0 SUMMARY OF ISSUES IN THE FISH, GILL, AND CAYUGA WATERSHEDS

The investigations described in the previous sections identified several factors affecting the ecological condition of the Fish, Gill, and Cayuga Creek watersheds. The purpose of this section is to summarize the issues affecting each watershed.

3.1 Water Quality

The temperature and dissolved oxygen sampling data collected during 2003 (URS et al., Surface Water Quality report, in prep) within select portions of Fish, Gill, and Cayuga Creeks indicate conditions are adequate to support warmwater fish species. However, agricultural activity within the watershed is extensive and as a result, the water quality sampling results showed relatively high turbidity levels, particularly during wet weather events. In addition, there are significant groundwater and sediment contamination concerns resulting from industrial processes within the lower reaches of Gill and Cayuga Creeks.

Recently completed groundwater studies have shown contamination movement at many hazardous waste sites (Yager 1996). Significant plumes of contamination are associated with the Necco Park and BFI/CECOS landfills, located to the east of Gill Creek; in the vicinity of the Dupont and Olin Buffalo Avenue Plant, located near the mouth of Gill Creek; near the Occidential Chemical Buffalo Avenue and Fontier Chemical Royal Avenue Plants, located to the east of the Gill Creek mouth; and the Occidential Chemical Hyde Park Landfill, TAM Ceramics, and Witmer Road Site, located southwest of Lewiston Reservoir (Figure 3.1-1). Remediation measures are currently underway to control these groundwater plumes (USEPA and NYSDEC 1999).

Contaminated sediment near the lower reaches of Gill and Cayuga Creeks has been remediated in the past. Removal of approximately 8,000 cubic yards of PCB and dioxin contaminated sediment from Gill Creek, between Buffalo Avenue and the confluence with the Niagara River, was completed in

December 1992 (EC et al. 1998). In 1998 and 1999, additional sediment contamination was removed further upstream between Buffalo Avenue and Falls Street.

Dioxin contaminated sediment was dredged from Cayuga Creek in 1989 (USEPA 1997). Sediment has also been dredged from Bergholtz Creek as well. In the late 1980's, dioxin tainted sediment was removed from an area of Bergholtz Creek beginning at its mouth and extending upstream approximately 1.5 miles (NCDPDT 1997). The dredged material was disposed of at an offsite commercial disposal facility.

Both Gill (from its mouth upstream to Hyde Park Dam) and Cayuga Creek (from its mouth upstream to Walmore Road) are on the state's Priority Waterbodies List for "fish consumption precluded" due to toxic and contaminated sediment (NYSDEC 2000). Cayuga Creek is also under a fish consumption advisory from the NYSDOH to "eat none" due to dioxin contamination (NYSDOH 2003).

3.2 Groundwater Flow Patterns

Water from the Upper Niagara River is diverted to the 1,900-acre Lewiston Reservoir via two large underground conduits. Groundwater flow patterns in the Fish and Gill Creek watersheds are influenced by these project operations. The primary effects of the Project on groundwater flow patterns are altered piezometric elevations (generally, elevated near the reservoir and depressed near the conduits). Specifically, Lewiston Reservoir acts as a local area of groundwater recharge, increasing streamflow in both Fish and Gill Creeks.

In addition, the Redland Quarry (operated by SOHIO Electro Mineral), located approximately 7,500 feet southeast of the Lewiston Reservoir in the Cayuga watershed, affects groundwater flow patterns. Water is extracted from the 140 foot deep limestone mine and discharged to a tributary of Cayuga Creek. A maximum permitted discharge of 432,000 gallons of water per day (300 gallons per minute) to Cayuga Creek is allowed.

3.3 Fish Barriers

Within Fish, Gill, and Cayuga Creeks there are several types of fish barriers, which prevent movement of fish between different sections of each creek for spawning purposes, and in times of low water may prevent fish from moving to more suitable habitat.

Specifically, in Fish Creek low flow through a culvert at Upper Mountain Road in Reach *F4 – Forested Section of Fish Creek between the Golf Course and the Reservoir,* two hanging culverts at Green Road and Walmore Road in reach *F6 - Wetland Swale Upstream of Garlow Road,* and two small rock check dams in reach *F5 – Channelized Section around Lewiston Reservoir* prevent fish movement both upstream and downstream during periods of low water. Additionally, an ATV crossing also in reach *F5 – Channelized Section around Lewiston Reservoir* acts like an additional rock check dam.

Within Gill Creek low flow through culverts are a problem at Garlow Road in reach *G11 - Channelized Section around Lewiston Reservoir*, and at a driveway to a private residence in reach *GT4 - Gill Creek Tributary - Upstream of Lockport Road.* Rock check dams and other small dams are an issue in reach *G2 - Gill Creek below Hyde Park Lake*, reach *G4 - Forested Section of Hyde Park Golf Course*, reach *G6 - Pond below the Rail Yard*, and reach *G11 - Channelized Section around Lewiston Reservoir.* Additionally a larger dam impounding Hyde Park Lake (a 484 acre impoundment) in reach *G3 – Hyde Park Lake* prevents movement of fish upstream from the Niagara River. The dam was constructed in the 1950's and the impoundment is used for a variety of water based recreation purposes.

In Cayuga Creek, hanging culverts are a problem in reach *C6 - Western Tributary of Cayuga Creek to the Eastern Tributary of Cayuga Creek*, reach *C8 - Headwaters of Cayuga Creek*, and reach *CET1 - Cayuga Creek – Unnamed Eastern Tributary*. Additionally, woody debris jams and a bedrock ledge approximately a foot high in reach *C5 - Eastern Tributary of Cayuga Creek to Walmore Road* inhibit fish movement.

3.4 Stream Channelization

Varying degrees of stream channelization are prevalent within Fish, Gill, and Cayuga Creeks. In many cases, these types of channel management activities result in impairment of ecological and geomorphic function.

In Fish Creek, reach *F0-Mouth of Fish Creek to the Niagara Falls Country Club* has been diverted underground to facilitate water conveyance to the lower Niagara River. The majority (1,400 feet) of Reach *F1-Niagara Falls Country Club* consists of a man-made trapezoidal, concrete lined channel; presumably to prevent channel movement, erosion, and facilitate water conveyance through the golf course. Reach *F5-Channelized Section around Lewiston Reservoir* was realigned to allow for the construction of Lewiston Reservoir, and for the conveyance of water (i.e., local runoff, seepage) away from the Reservoir for operational and safety purposes. The current streambed consists of a trapezoidal shaped channel, lined with rock.

Within Gill Creek, extensive portions of reaches *G1-Industrialized Section of Gill Creek* (1,600 feet), have been straightened; presumably to increase water conveyance and reduce the potential for flooding. Approximately 800 feet of this reach consists of a trapezoidal, concrete lined channel. Reaches *G7-Rail Yard*, *G9-Hewitt Road to Isherwood Drive,* and *GT2-Gill Creek Tributary-Hyde Park Golf Course to Interstate 190* have been culverted for significant distances. Reaches *G5 Hyde Park Golf Course* (700 feet) and *GT1-Gill Creek Tributary - Hyde Park Golf Course Section* (635 feet) are trapezoidal shaped and concrete lined; presumably to prevent channel movement, erosion, and facilitate water conveyance through the golf course. Reach *G11-Channelized Section around Lewiston Reservoir,* was realigned (8,850 feet) to allow for the construction of Lewiston Reservoir, and for the conveyance of water (i.e., local runoff, seepage) away from the Reservoir for operational and safety purposes. The current streambed consists of a trapezoidal shaped channel, lined with rock.

In the Cayuga Creek headwaters, several tributaries have been "ditched" or realigned to facilitate drainage from agricultural fields. Reach C1-Tuscarora Drive to the Niagara River has been straightened and armored in an effort to reduce shoreline erosion. A significant portion of Reach *C3-Forested Section*

below Porter Road has been straightened to increase water conveyance and reduce the potential for flooding within a residential area. Reach *C4-Niagara Falls Airport* has been realigned and conveyed through culverts to allow for the construction of the airport runways and related facilities.

3.5 Shoreline Erosion

Shoreline erosion in Fish, Gill, and Cayuga Creeks was assessed in a separate study (Baird 2003). Select locations within the lower half of Fish Creek were assessed, and no major erosion was observed. Some erosion protection structures exist near bridge abutments as well as through the Hyde Park Golf Course, where the creek has been replaced by the aforementioned concrete channel. As part of the habitat mapping conducted for this study, high stream sedimentation from adjacent agricultural land runoff was noted in *Reach F6-Wetland Swale Upstream of Garlow Road*.

Gill Creek was assessed from its mouth upstream to Hyde Park Dam. Approximately 55% of Gill Creek is protected with an assortment of erosion control structures. According to the Baird study, approximately 1% of Gill Creek was considered to be actively eroding. Many areas (approximately 25%) have a 6-inch to 1-foot high scarp along the streambanks, which was interpreted as a natural response to the current flow regime and indicative of a slow bank erosion rate.

Erosion along Cayuga Creek was assessed from its mouth upstream to Porter Road as part of the Baird study. Approximately 17% of the shoreline has some form of erosion protection, with the majority of the structures existing downstream of the confluence of Cayuga and Bergholtz Creeks. Only 1% of the streambanks along Cayuga Creek are actively eroding and less than 5% feature a small erosion scarp. Several log jams and other debris/garbage were noted, and were thought to artificially raise the level of flooding in Cayuga Creek during the spring freshet and large rainfall events. As part of the habitat mapping conducted for this study, minor erosion sites, sedimentation, and debris jams in the headwaters of Cayuga Creek, particularly in *Reach C5-Eastern Tributary of Cayuga Creek to Walmore Road* were noted.

3.6 Water Level Fluctuations

Water level fluctuations in both the upper and lower Niagara River are caused by a number of factors, including the operation of the Niagara Power Project, wind, natural flow and ice conditions, regional and long-term precipitation patterns that affect lake levels, control of the Niagara Falls flow for scenic purposes, operation of power plants on the Canadian side of the river, and the effects of backwater from Lake Ontario (URS et al. 2003).

Water-level fluctuations in the Upper Niagara River affect both Gill and Cayuga Creeks. From the mouth of Cayuga Creek to the confluence of Bergholtz Creek (approximately 5,700 feet) water levels fluctuate approximately 1 foot daily. Water level information collected further upstream near Porter Road indicated fluctuations of around 0.3 feet daily (URS et al., Surface Water Quality report, in prep).

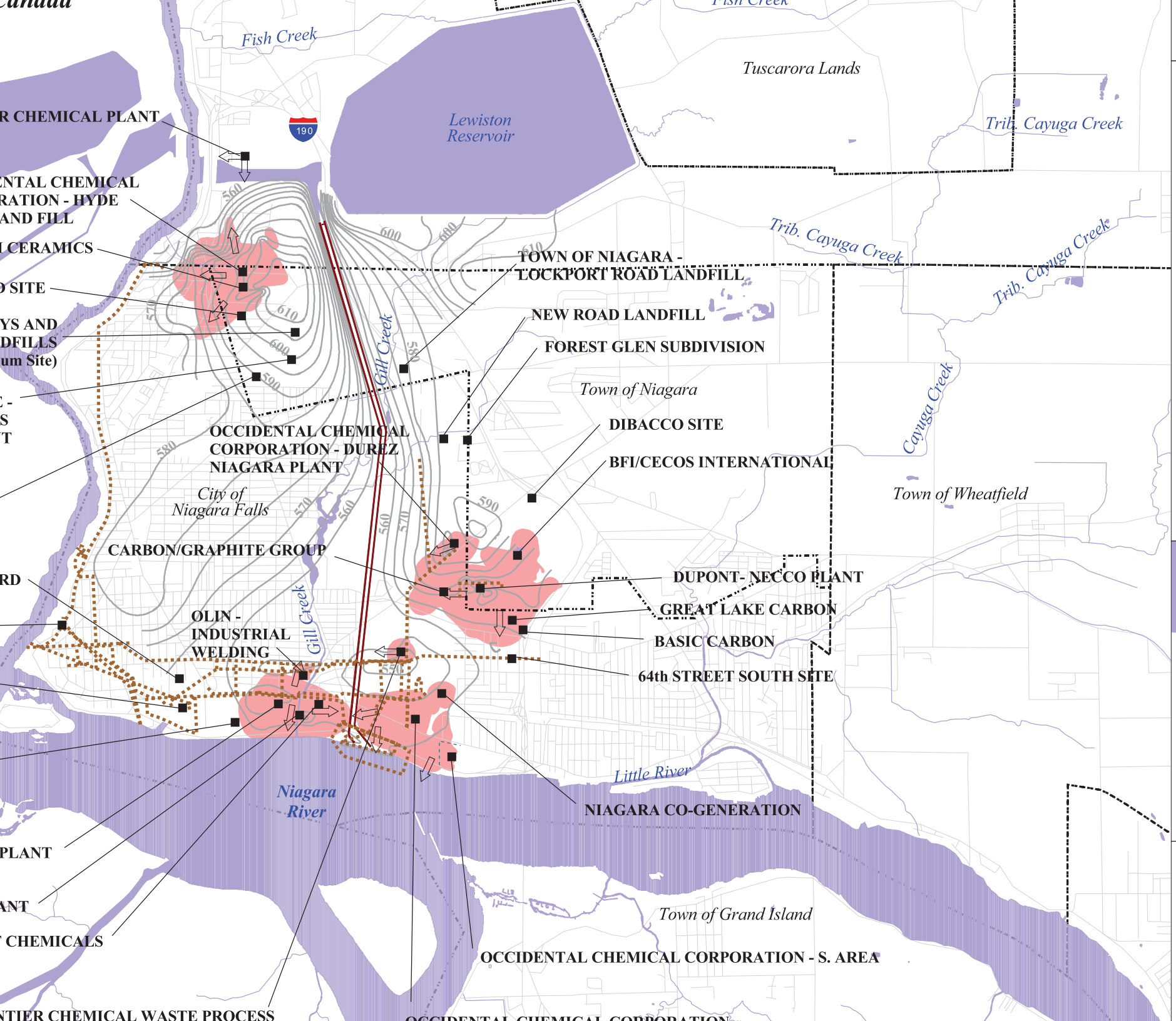
There are no official water level data available along Gill Creek and it is not known how far upstream Niagara River water level fluctuations affect Gill Creek. The upstream extent of water level fluctuations will depend on the discharge and channel slope of Gill Creek and will not extend farther than approximately 7,000 feet where the Hyde Park Dam serves as a barrier.

3.7 Land Use Conversion/Development

Prior to Project construction, land uses were predominantly low-density residential development, agriculture, and undeveloped fields and forests. During the intervening time period, conversion of some of these land uses has occurred with increased residential and industrial development. The Village of Lewiston is a center of residential and commercial development in the lower portion of the Fish Creek watershed. In the upper portion of the Fish, Gill, and Cayuga watersheds, land use within the Town of Lewiston and Tuscarora Nation is principally agricultural with some residential development.

The City of Niagara Falls represents the most heavily developed area within the Gill and Cayuga watersheds. Heavy industrial activity is located along the southern part of the city near the mouths of Gill

and Cayuga Creeks. Residential and commercial development typifies areas of the Gill and Cayuga watersheds in the Town of Niagara. Land use in the Town of Wheatfield in the Bergholtz Creek tributary headwaters is primarily agricultural with some residential development.


Fish Creek
Tuscarora Lands
Lewiston Reservoir
Trib. Cayuga Creek
R CHEMICAL PLANT
ENTAL CHEMICAL
RATION - HYDE
AND FILL
I CERAMICS
O SITE
YS AND
DFILLS
um Site)
TOWN OF NIAGARA -
LOCKPORT ROAD LANDFILL
NEW ROAD LANDFILL
FOREST GLEN SUBDIVISION
Gill Creek
Town of Niagara
DIBACCO SITE
BFI/CECOS INTERNATIONAL
OCCIDENTAL CHEMICAL
CORPORATION - DUREZ
NIAGARA PLANT
City of
Niagara Falls
Cayuga Creek
Town of Wheatfield
CARBON/GRAPHITE GROUP
DUPONT- NECCO PLANT
GREAT LAKE CARBON
OLIN -
INDUSTRIAL
WELDING
BASIC CARBON
64th STREET SOUTH SITE
Niagara
River
Little River
NIAGARA CO-GENERATION
PLANT
ANT
CHEMICALS
Town of Grand Island
OCCIDENTAL CHEMICAL CORPORATION - S. AREA
NTIER CHEMICAL WASTE PROCESS
LEGEND
Data Source:
Niagara Falls
CRA/WCC,
Datum: USL
0
1" =

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