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ASSESSMENT OF THE POTENTIAL EFFECTS OF WATER LEVEL AND FLOW FLUCTUATIONS AND NYPA LAND MANAGEMENT PRACTICES ON RARE, THREATENED, AND ENDANGERED SPECIES OF THE UPPER NIAGARA RIVER TRIBUTARIES - PHASE II

Niagara Power Project
FERC No. 2216

Prepared for:

New York Power Authority

Prepared by:

Riveredge Associates, LLC

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PREFACE

The subject of this report is the second phase of investigations into the potential effects of water level and flow fluctuations and NYPA land management practices on rare, threatened, and endangered species. The first phase report was entitled "Assessment of the Potential Effects of Water Level and Flow Fluctuations and Land Management Practices on Rare, Threatened, and Endangered Species at the Niagara Power Project" (Riveredge 2005a) and was released in draft in January 2004. This second investigation phase has the same objectives and goals as the first, but includes areas that were not examined previously. These areas, collectively referred to hereafter as the "expanded investigation area", include the upper Niagara River between Strawberry Island and the Peace Bridge, the ice boom storage area, and additional upper Niagara River tributaries that may be influenced by water level fluctuations in the upper Niagara River.

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ABBREVIATIONS

Agencies

FERC	Federal Energy Regulatory Commission
INBC	International Niagara Board of Control
NOAA	National Oceanic and Atmospheric Administration
NYSCD	New York State Conservation Department
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
NYHP	New York Natural Heritage Program
NYPA	New York State Power Authority
OMNR	Ontario Ministry of Natural Resources
OPG	Ontario Power Generation
USFWS	United States Fish and Wildlife Service

Units of Measure

C	Celsius, Centigrade
cfs	cubic feet per second
cm	centimeter
F	Fahrenheit
fps	feet per second
ft	feet
IGLD	1985 International Great Lakes Datum 1985
in	inch
m	meter
mm	millimeter
MW	Megawatt
USLSD	U.S. Lake Survey Datum 1935

Environmental

EAV	emergent aquatic vegetation
SAV	submerged aquatic vegetation

EXECUTIVE SUMMARY

Riveredge Associates examined records of federal and state RTE species and significant occurrences of natural communities in the expanded investigation area and performed a literature-based assessment of the potential effects of water level and flow fluctuations and NYPA land management practices on these species and communities. All species known to occur in or near the expanded investigation area that are currently designated T or E by NYSDEC or USFWS were included in this analysis. In addition, those species designated as special concern (SC) or rare (R) by NYSDEC were also included. Some unprotected (U) species and significant occurrences of natural communities were included in this analysis because they are unusually rare, declining, or exceptionally important or unique to the local ecology. Unprotected species and natural communities considered in this analysis include significant natural communities and all extant occurrences of rare freshwater mussels.

Factors that could affect RTE species and significant occurrences of natural communities include fluctuations in water level and flow, sedimentation, and erosion. Water level and flow fluctuations in the upper Niagara River and its tributaries are caused by a number of factors in addition to the operation of the Niagara Power Project (NPP). These include water withdrawals for the production of electricity by Ontario Power Generation (OPG), flow variations from Lake Erie, regional and long-term precipitation patterns that affect lake levels, control of Niagara Falls flow for scenic purposes, the operation of the New York State Barge Canal, wind effects, boat wakes, inflow from upstream sources in the tributaries, and other natural and anthropogenic factors. It is not possible to accurately determine the extent of water level and flow fluctuation attributable to each factor. For this investigation, the analysis of potential effects was conducted by considering all causal factors of water level and flow fluctuations combined. Water level fluctuations in the upper Niagara River from all causes are normally less than 1.5 feet per day.

One fish species, state-listed as threatened, and nine rare but unprotected species of native mussels are found in the expanded investigation area. A geographic information system (GIS) analysis was used to compare the occurrence records of these RTE species to the portions of the investigation area influenced by water level and flow fluctuations. To determine where areas of potential Project effects might occur, documented occurrences of RTE species were compared with water level and flow data from permanent and temporary gauges established in the upper river and its tributaries. A literature search was conducted to determine the potential effects of water level and flow fluctuations on the natural history or habitat requirements of the RTE species in the expanded investigation area.

The state-listed fish (threatened) is the longear sunfish (*Lepomis megalotis*). The nine rare unprotected native mussel species are *Amblema plicata*, *Fusconaia flava*, *Lampsilis ovata*, *Leptodea fragilis*, *Ligumia recta*, *Potamilus alatus*, *Ptychobranchus fasciolaris*, *Truncilla truncata* and *Villosa iris*. These species occur in Tonawanda Creek and Mud Creek (a tributary to Tonawanda Creek) over 13.5 miles upstream of the confluence of the Niagara River and Tonawanda Creek. No RTE species are known to occur in the lower 13.5 miles of the creek, 11.6 miles of which are part of the New York State Barge Canal system. In addition, no extant RTE species occurrences were found in the remainder of the expanded investigation area.

At the confluence of the Niagara River and Tonawanda Creek, the median water level fluctuation during the 2003 tourist season was 0.58 feet at the Tonawanda Island gauge (URS et al. 2005a). Water level fluctuations in the Barge Canal and Tonawanda Creek are less at all points upstream of this gauge, and decrease to zero at or near two riffle sections (located approximately 13.6 and 14.1 miles upstream of the upper Niagara River and just west of Transit Road at Millersport, New York) that likely act as hydraulic controls to the influence of water levels from the upper Niagara River.

The longear sunfish and the rare native mussels are most vulnerable to periods of naturally occurring low water levels that could leave sunfish nests or the native mussels exposed or stranded due to dewatering. Longear sunfish spawn in August, typically the period of lowest water level and flow in this reach of Tonawanda Creek. The analysis conducted for this investigation revealed that during August the minimum water surface elevation of the upper Niagara River is lower than the water surface elevation of Tonawanda Creek at the site of occurrence of these RTE species (URS et al. 2005b). This means that minimum water levels where these RTE species occur are likely controlled more by the water level and flow in the upper reaches of Tonawanda Creek and less by water levels in the upper Niagara River.

During August, the maximum extent of influence for the minimum August elevation of the upper Niagara River (USLSD 1935 564.96 or NGVD 564.45) is 13.5 miles upstream of the mouth of Tonawanda Creek. This was estimated by drawing a straight line from the known water surface elevation of the river to a point where it intersects the creek bottom based on FEMA stream bottom profiles. This point is downstream of the known area of occurrence of the RTE species in Tonawanda Creek. The extent of influence for the August median elevation (USLSD 1935 566.10 or NGVD 565.59) is greater and approaches the area of occurrence of RTE species in Tonawanda Creek, but the topography of the stream channel rises relatively rapidly in the riffle areas compared to the flat hydraulic slope of the dredged Barge Canal, and a one foot increase in water level may only extend the area of influence 0.1 miles upstream, still below the area of occurrence of these RTE species. Therefore, fluctuations in water level and flow in the upper Niagara River likely have no effect on RTE species where they occur in Tonawanda Creek and Mud Creek.

NIAGARA POWER PROJECT (FERC NO. 2216)
ASSESSMENT OF THE POTENTIAL EFFECTS OF WATER LEVEL AND FLOW FLUCTUATIONS ON RTE SPECIES OF THE UPPER NIAGARA RIVER TRIBUTARIES

1.0 INTRODUCTION

The Niagara Power Project (NPP) in Lewiston, Niagara County, New York, is one of the largest non-federal hydroelectric facilities in North America. It is constructed on the Niagara River, a 37-mile strait connecting Lakes Erie and Ontario. In 1957, a 50-year license for operation of the NPP was issued by the Federal Power Commission (now the Federal Energy Regulatory Commission, or FERC) to the Power Authority of the State of New York (now also known as the New York Power Authority, or NYPA). The NPP first produced electricity in 1961. The operating license for the NPP expires in August 2007. As part of its relicensing process, NYPA is conducting a number of ecological, engineering, and other investigations in the vicinity of the NPP.

2.0 BACKGROUND

In 2001, Riveredge Associates, LLC (Riveredge) contracted with NYPA to conduct literature reviews and field surveys for rare (including species of special concern (SC)), threatened, and endangered (RTE) species and significant occurrences of natural communities in the vicinity of the NPP (Riveredge 2002). The existence of RTE species and significant occurrences of natural communities was determined through the review of New York Natural Heritage Program (NYNHP) inventory records (NYNHP 2001), original NYNHP field survey forms, published museum records, discussions with selected knowledgeable individuals in the region, and field surveys. As part of that study, field surveys were conducted to confirm existing NYNHP records. Field surveys for native mussels were conducted for a separate study (Riveredge 2005b).

These studies documented species listed as RTE by the New York State Department of Environmental Conservation (NYSDEC) in the vicinity of the NPP. One of these species, the bald eagle (*Haliaeetus leucocephalus*), is the only one that is also federally listed (threatened) by the United States Fish and Wildlife Service (USFWS). These studies also documented a number of species and significant occurrences of natural communities on the NYNHP active inventory list (NYNHP 2003b). Although these species and significant occurrences of natural communities are considered unprotected under New York law, they may be protected under other legislation such as the federal Migratory Bird Treaty Act.

Riveredge (2002) noted that most RTE species and significant occurrences of natural communities known to occur in the vicinity of the NPP are plants of the Niagara River gorge and Niagara escarpment, wetland birds found in Buckhorn Island State Park, grassland birds found at and near the Niagara Falls Air Reserve Station (NFARS), or species associated with the Niagara River and its tributaries.

In 2002, Riveredge was contracted to conduct a literature-based analysis of the potential effects of water level and flow fluctuations and land management practices on RTE species and significant occurrences of natural communities (Riveredge 2005a). Where data were lacking, limited field surveys were conducted to gather new information on the distribution of species and the potential effects of Niagara Power Project operations. In particular, the analysis included field surveys for grassland birds and the monitoring of nests of the threatened pied-billed grebe (*Podilymbus podiceps*). The investigation area for that study included lands within New York State adjacent to the Niagara River, the Niagara River proper, and tributaries of the river (within New York State) from just upstream of the southern tip of Grand Island downstream to the river mouth at Lake Ontario, as well as all NYPA-owned lands near the Project facilities, forebay, and reservoir. At the time, this investigation area was thought to fully encompass the area influenced by U.S./Canadian power generation (Riveredge 2005a). However, subsequent analysis revealed this influence can extend to somewhere between Frenchman's Creek and the Peace Bridge in the mainstem (URS et al. 2005a) and further upstream in several creeks than originally thought (URS et al. 2005b). Therefore, a subsequent investigation (Phase II) was conducted to determine the potential presence of RTE species and significant occurrences of natural communities in those additional areas ("expanded investigation area") and to determine whether they are affected by the water level and flow fluctuations of the upper Niagara River. This report is the subject of the Phase II investigation and includes a description of the NPP and water level and flow fluctuations, results from a review of records on the occurrence of RTE species and significant occurrences of natural communities in the expanded investigation area, descriptions of the natural history and habitat requirements of RTE species in the expanded investigation area, and an assessment of the potential effects of water level and flow fluctuations on these RTE species. The expanded investigation area is described in Section 4.1.

3.0 DESCRIPTION OF PROJECT AND WATER LEVEL FLUCTUATIONS

The 1,880-MW (firm power output) Niagara Power Project 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 1958. Construction of the Project began in 1958, and electricity was first produced in 1961.

The Project has several components, including water intakes, conduits, a forebay, a reservoir and two generating plants. Twin water intakes on the Niagara River are located approximately 2.6 miles above Niagara Falls. Water entering these intakes is routed around the Falls via two large underground conduits to a forebay, lying on an east-west axis about four 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, NYPA's main generating plant at Niagara. This plant has 13 turbines that generate electricity from water stored in the forebay. Head is approximately 300 feet. At the east end of the forebay is the Lewiston Pump Generating Plant. Under non-peak-usage conditions (i.e., at night and on weekends), water is pumped from the forebay via the plant's 12 pumps/generators into the 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 Robert Moses plant and tailwater from the Lewiston Plant. 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 the Niagara River, two seasons are recognized: tourist season and non-tourist season. By international treaty, at least 100,000 cubic feet per second (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 treaty to produce hydroelectric power with the remainder.

According to a 1993 Directive of the International Niagara Board of Control (INBC), water level fluctuations in the Chippawa-Grass Island Pool (in the upper Niagara River, i.e., above Niagara Falls) are limited to 1.5 feet per day within a three foot range for normal conditions. For extreme conditions (i.e. high flow, low flow, ice, etc.), the allowable range of Chippawa-Grass Island Pool water levels is extended to four feet.

NYPA has conducted a comprehensive study of water level and flow fluctuations at the Project (URS et al. 2005a). This investigation examined water level data from gauges in the upper and lower Niagara River for the past 12 years (1991-2002) as well as data from a number of temporary gauges established in the upper and lower river during 2001 and 2002. Additionally, water level data were gathered from the U.S. tributaries to the Niagara River using temporary gauges in 2003 (URS and Gomez and Sullivan 2005).

Water level fluctuations in both the upper and lower Niagara River are caused by a number of factors in addition to the operation of the Niagara Power Project. These include wind, natural flow and ice conditions, regional and long-term precipitation patterns that affect lake levels, control of Niagara Falls flow for scenic purposes, operation of power plants on the Canadian side of the river, and the backwater effect from Lake Ontario. Water level fluctuations in the upper Niagara River from all causes are normally less than 1.5 feet per day (Stantec et al. 2005).

4.0 METHODS

4.1 Expanded Investigation Area

The expanded investigation area includes the waters of the upper Niagara River from Strawberry Island to the Peace Bridge, the ice boom storage area, and waters of the mainland tributaries of upper Niagara River that may be affected by water level fluctuations in the upper Niagara River. The mainland tributaries include Tonawanda Creek, Ellicott Creek, Sawyer Creek, Bull Creek, Ransom Creek, Black Creek, and Got Creek. The reaches of each tributary examined are described in URS et al. (2005b) and in the tributary mapping and habitat characterization study (Gomez and Sullivan and E/PRO 2005). Transit Road in Millersport was the limit of investigation for Tonawanda Creek upstream of its confluence with the New York State Barge Canal. Transit Road is upstream of two riffle sections that likely act as hydraulic controls limiting the upstream influence of Niagara River water level fluctuations due to U.S./Canadian power generation on creek water levels. The first riffle is located 13.6 miles upstream of the mouth and the second 14.1 miles upstream of the mouth. Transit Road crosses Tonawanda Creek at the upstream end of the second riffle.

4.2 Occurrence Records for the Expanded Investigation Area

The occurrences of RTE species and natural communities in the expanded investigation area were documented through an examination of records of the New York Natural Heritage Program (NYNHP 2004), a literature review, and limited field surveys. The presence of RTE species and significant occurrences of natural communities was determined through a review of NYNHP inventory records (NYNHP 2001, NYNHP 2003a, NYNHP 2004), original NYNHP field survey forms, NYNHP reports (Evans et al. 2001a, 2001b, 2001c) published museum records, discussions with selected knowledgeable individuals in the region, Christmas bird counts (BirdSource 2003), and field surveys for RTE grassland birds, native mussels (Riveredge 2005b), and pied-billed grebe. In addition to the earlier data provided by NYNHP (NYNHP 2001, NYNHP 2003a), an updated data set provided by NYNHP (NYNHP 2004) that covered much of Erie and Niagara Counties was reviewed for the preparation of this report.

Field surveys for rare native mussels were conducted in July (July 26, 27), August (August 28) and September (September 25, 26) 2004 in Ellicott Creek, Sawyer Creek, Bull Creek, Ransom Creek, Black Creek, Got Creek, Tonawanda Creek and Mud Creek. Selected mussel shells were forwarded to Dr. David Strayer of the Institute for Ecosystem Studies for confirmation of species identifications.

Location information and details about RTE species occurrences are considered sensitive. In accordance with the policies of NYNHP and the Endangered Species Unit of NYSDEC, this report contains no additional specific location information for sensitive RTE species in the expanded investigation area beyond what has been published by NYSDEC or other readily available published sources.

Species in this report are referred to by their scientific names, common names, or both. The use of scientific names and common names follows accepted usage. Some taxa, such as fish, are primarily referred to by their common names. Native mussels are primarily referred to by their scientific names.

4.3 Literature Review of Natural History and Habitat Requirements

Literature searches were conducted to establish the natural history characteristics and habitat requirements of species documented in the expanded investigation area. Breeding bird atlases were consulted for New York and Ontario, as well as species dossiers from NYSDEC. General references such as Scott and Crossman (1973) and DeGraaf and Rudis (1986) were consulted, as were specific references on the conservation of endangered species, such as Schneider and Pence (1992). Detailed, technical literature was also reviewed, such as the species accounts of The Birds of North America volume produced by the Academy of Natural Sciences and The American Ornithologists Union. In addition, sources with information specific to the Niagara region were reviewed. Summaries of the natural history and habitat requirements of species documented in the expanded investigation area are included in this report.

4.4 Determination and Description of Legal Status

In New York, all plant and animal species that are federally listed are automatically included on NYSDEC's lists of threatened and endangered species. The RTE species laws in New York State consider plant and animal species according to different criteria and laws. NYSDEC's species lists are passed into law by the state legislature after a period of public comment.

For animals, endangered (E), threatened (T), and special concern (SC) species are defined and designated in Title 6 of the New York Code of Rules and Regulations (6 NYCRR) Part 182. Threatened and endangered animal species are protected by Environmental Conservation Law of New York, Section 11-0535. Special Concern animal species do not receive legal protection under this law.

Plant species are defined as endangered (E), threatened (T), rare (R) or exploitably vulnerable (V) in 6 NYCRR Part 193 and are protected under Environmental Conservation Law Section 9-1503. Plants included on the New York State list of "Protected Native Plants" are protected under New York State Environmental Conservation Law Section 9-1503. It is a violation of this law to knowingly pick, pluck, sever, remove, damage by the application of herbicides or defoliants, or carry away, any protected plant without the prior consent of the landowner.

In New York, significant occurrences of natural communities are designated by NYNHP but have no formal protected legal status under the New York Code of Rules and Regulations or under the Environmental Conservation Law of New York.

It is important to note that species or natural communities listed as unprotected in this report only means they are unprotected under the specific laws and legislation pertaining to RTE species as described above. Species listed as unprotected may be protected by other laws. For example, migratory birds are protected by the Federal Migratory Bird Treaty Act. Mussels are shellfish and are protected by specific laws governing shellfish harvest. Fish are protected by laws governing seasons and harvest limits, and natural communities are often in protected State Parks. The legal status of each species was determined by consulting the current list of designated RTE species (NYSDEC 2001).

4.5 Effects Analysis

This qualitative analysis of the potential effects of water level and flow fluctuations and NYPA land management practices on RTE species and significant occurrences of natural communities began by assessing (1) which species and significant occurrences of natural communities occur in the expanded investigation area, (2) the extent of water level and flow fluctuations (from all causes) in the expanded investigation area, (3) where RTE species or significant occurrences of natural communities occur relative to water level and flow fluctuations and land management practices, and (4) the potential effects of these water level and flow fluctuations and land management practices on the natural history or habitat of these species and communities.

4.5.1 Species and Natural Communities Included in the Analysis

NYPA is required to investigate the potential effects of water level and flow fluctuations and land management practices on threatened and endangered species as part of FERC relicensing. All species known to currently occur in or near the expanded investigation area that are currently designated threatened or endangered by NYSDEC or USFWS were included in this analysis. In addition, those extant species designated as special concern or rare by NYSDEC were also included in this analysis. Some unprotected species and all significant occurrences of natural communities were included in this analysis because they are unusually rare, declining, or exceptionally important or unique to the local ecology. Unprotected species considered in this analysis include all extant occurrences of rare freshwater mussels.

4.5.2 Potential Effects Included in this Analysis

Included in this analysis were all potential effects of water level and flow fluctuations and land management practices in the expanded investigation area. Factors that cause water level fluctuation in the upper Niagara River include water withdrawals for electrical production by the Niagara Power Project and Ontario Power Generation, flow variations from Lake Erie, wind, boat wakes, and other anthropogenic and natural factors. Because it is not possible to determine the exact extent to which each factor influences water levels, all contributing factors were considered in the analysis of the potential effects of water level fluctuations on RTE species and their habitats.

Several factors have been identified related to water level and flow fluctuations that could affect RTE species and significant occurrences of natural communities. These factors include but are not limited to fluctuations in water level or flow and erosion and sedimentation. The causes and extent of water level and flow fluctuations in the Niagara River were examined in two reports: Niagara River Water Level and Flow Fluctuations Study (URS et al. 2005a) and the Upper Niagara River Tributary Backwater Study (URS et al. 2005b). In addition, areas and causes of erosion and sedimentation were assessed for the upper river tributary investigation area. (Baird 2005).

The water level and flow study (URS et al. 2005a) estimated the relative effects of regulation and natural conditions on water level fluctuation in the Niagara River using hourly maximum water level and flow data from 1991 to 2002. The large database (over 5 million entries) included hourly data for 15 permanent and temporary water level gauges and three flow gauges in the upper and lower Niagara River. The second study examined the potential extent of water level fluctuations in the upper Niagara River tributaries caused by changes in upper Niagara River water levels through the development of backwater models for each tributary (URS et al. 2005b). The upstream limits of potential influence of Niagara River water levels on water levels in Tonawanda and Ellicott Creeks were not determined as part of that study. Water levels in both creeks are not solely influenced by upper Niagara River water levels. For both tributaries, dredging and flow diversions, for the purposes of navigation and flood control, have altered their hydraulics and hydrology and hence their relationship to the upper Niagara River. Instead, estimates of the extent of influence were based on the annual hourly maximum Niagara River water level and stream bottom profiles. These estimates of the extent of influence were considered conservative because the annual hourly maximum Niagara River water level occurred during a storm surge from Lake Erie and is not representative of the range of daily water levels due to U.S./Canadian power generation (URS et al. 2005b). Subsequent field work conducted to map and characterize the riparian habitats along these tributaries (Gomez and Sullivan and E/PRO 2005) and field surveys of Tonawanda Creek conducted for this investigation suggest that two riffles located at 13.6 miles and 14.1 miles upstream of the mouth likely act as hydraulic controls limiting the upstream influence of Niagara River water level fluctuations caused by the normal water level fluctuation due to U.S./Canadian power generation

4.6 Interactions of Species or Natural Communities and Project Operations

A geographic information system (GIS) analysis was used to compare the occurrence records of RTE species to the areas influenced by operation of the NPP. GIS coverages of the occurrences of RTE species and significant occurrences of natural communities from NYNHP (2004) were reviewed and compared to water level and flow data from permanent and temporary gauges established in the upper river (URS et al. 2005a), and activities in the ice boom storage area. The period of record for gauge data was 1991 to 2002. These gauges recorded water level fluctuations that occurred in the river from all causal factors; the relative contributions of natural and anthropogenic factors cannot be determined.

5.0 RESULTS

5.1 Extant RTE Species in the Expanded Investigation Area

Records of extant RTE species in the expanded investigation area were obtained from NYNHP (2004), other sources (e.g., Strayer and Jirka 1997, Marangelo and Strayer 2000, Carlson 2001, Eckel 2003, NYSDEC 2003), and limited field surveys conducted in 2004.

Riveredge examined almost 200 records for extant and historical RTE species and significant occurrences of natural communities in the northern Erie County and southern Niagara County region. Many of these records were for areas considered in the earlier assessment report (Riveredge 2005a) and some were for areas well outside the combined investigation areas for the earlier assessment and this investigation. All of these records were examined for extant occurrences of RTE species and significant natural communities in the expanded investigation area.

No records of extant RTE species or significant occurrences of natural communities were found for the Niagara River between Strawberry Island and the Peace Bridge, nor for the ice boom storage area. No extant RTE records were found for Ellicott Creek, Sawyer Creek, Bull Creek, Ransom Creek, Black Creek, or Got Creek within the investigation area. No significant occurrences of natural communities are located within the expanded investigation area.

All records of extant RTE species in the expanded investigation area are from Tonawanda Creek and its short tributary Mud Creek. These records include one state-threatened fish and nine species of rare but unprotected native mussels (Table 5.1-1). The fish, longear sunfish (*Lepomis megalotis*), has been repeatedly documented in Tonawanda Creek within the expanded investigation area (Carlson 2001).

Records of the nine species of rare but unprotected native mussels came from NYNHP (2004), Strayer and Jirka 1997, Marangelo and Strayer (2000), and field surveys conducted in 2004. Comparison of mussel records from these sources suggested that one NYNHP (2004) record was erroneous and listed a species that is not known to occur in New York State (Strayer and Jirka 1997). This was confirmed and the record is not included in this report. In addition, 2004 field surveys located a number of recently spent shells of *Truncilla truncata,* a species found alive further upstream in Tonawanda Creek at Rapids (Marangelo and Strayer 2000, NYNHP 2004). This species is included here as one that occurs in the expanded investigation area. Combined, these records suggest that nine rare native mussels occur in the expanded investigation area (Table 5.1-2). Seven of these species were documented in the original investigation area (Riveredge 2002, 2005a). As recently as 1998, Marangelo and Strayer (2000) documented 19 species of rare and common native mussels in Tonawanda Creek, 16 represented by live animals.

These surveys revealed spent shells or live animals of seven rare species (Table 5.1-2) and five common species (Table 5.1-3). These spent shells and live specimens were observed in Tonawanda Creek and its tributaries in areas where these species had been previously documented (Strayer and Jirka 1997, Marangelo and Strayer 2000, NYNHP 2004). Live animals were only found in Tonawanda Creek (Table 5.1-2 and Table 5.1-3). No live animals or recent shells of rare species were found in Ellicott Creek.

None of the rare native mussels documented in the expanded investigation area are listed as threatened or endangered species by USFWS or NYSDEC (NYNHP 2004). Several other NYNHP-listed species, including one NYSDEC-listed species, *Lampsilis fasciola* (threatened), are known to occur in Tonawanda Creek upstream of the investigation area (Strayer and Jirka 1997, Marangelo and Strayer 2000, NYNHP 2004). The closest known occurrence of the threatened species *Lampsilis fasciola* is in Genesee County, approximately 15 miles east of the expanded investigation area. In addition, the redfin shiner (a fish species of special concern) is known to occur in Tonawanda Creek upstream of the expanded investigation area (Carlson 2001).

The threatened longear sunfish and nine species of unprotected but rare native mussels occur in portions of Tonawanda Creek that potentially could be affected by water level and flow fluctuations of the upper Niagara River. Unprotected native mussels were included in this study because they are generally rare in New York and appear to be declining. Although native mussels are considered unprotected under the conservation laws governing T&E and SC species in New York, they are protected under other laws as mentioned in Section 4.4.

For information on the effects of water level and flow fluctuations on common species and their habitats, please refer to the report Stantec et al. (2005).

5.2 Natural History and Habitat Requirements of RTE Species

The natural history and habitat requirements of the one threatened fish species and nine rare but unprotected native mussel species found within the expanded investigation area are discussed below. The native mussels are discussed as a group because they have similar natural history and habitat requirements at their site of occurrence in Tonawanda Creek. Additional details for specific species can be found in Strayer and Jirka (1997).

5.2.1 Bivalve Mollusks (Native Mussels)

Freshwater mussels live on the bottoms of lakes, streams, and rivers. Those that belong to the family Unionidae are sometimes called pearly mussels because of the lustrous nacre or mother of pearl that is found inside their shells. Before plastics became widely available, people collected shells to make buttons. In some parts of their range mussels are still collected commercially but for a different purpose. Today their shells are exported to Japan where they are used to make nuclei that seed pearl oysters for the manufacture of cultured pearls.

Mussels are filter feeders that spend most of their lives partially or completely buried in the bottom sediments of rivers, streams, and lakes. Unionids extract the materials they need to sustain life from their surrounding aquatic environment. They pump water into their bodies through the incurrent siphon. Once inside the shell, the water bathes the body tissues and the gills extract both oxygen and organic nutrients. Water is pumped out through the excurrent siphon.

When mussels are ready to reproduce, at an age that varies from one to ten years, males release sperm into the water where the gametes enter the female through a siphon. The eggs are fertilized in the gills where they develop into an immature stage called a glochidium. The glochidia are released into the water where they attach to the gills or fins of a host species, which is usually, but not always, a fish. One mussel, the salamander mussel (*Simpsonaias ambigua*), is known to use a salamander as a host. Some unionids are host-specific; they can complete their development only on one species, but other mussel species can mature and metamorphose on a variety of fish. A growing body of evidence shows that a number of mussels have evolved elaborate displays and adaptations for attracting appropriate hosts (Barnhart and Roberts 1996, Hartfield and Hartfield 1996). The hosts of some unionids are poorly documented or in some cases completely unknown. The glochidia complete their development attached to the host over a period of time that varies from a few days to several months but they eventually drop off onto the stream or river bottom as young mussels.

Freshwater mussels exhibit two basic seasonal breeding patterns. Some species are short-term brooders (tachytictic) and others are long-term brooders (bradytictic). In tachytictic species mating occurs in the spring and the glochidia mature and fall off the hosts as juvenile mussels in late summer. In the alternative pattern found among bradytictic species, the mussels produce gametes and breed in late summer but the glochidia overwinter on the hosts and young unionids are not released until the next spring.

The modern distribution of pearly mussels in New York strongly reflects the state's geologic history of glaciers and drainage connections (Strayer and Jirka 1997). The last glacier covered most of the state, and those areas that were not covered with ice were probably too cold to support mussels. Thus, today's distribution of species depends greatly on the dispersal of these animals and their host fish species along the waterways that existed after the last glacier began its retreat approximately 18,000 years ago. New York's mussels came from two refugia south of the glacial boundary: parts of the Ohio and Mississippi River basins (interior basin) and the Atlantic slope. Most, but not all, of the mussels found in the Niagara River region came to New York from refugia in the interior basin.

Besides opportunities for post-glacial dispersal into a region, mussel distributions may also be affected by the presence of fish hosts, competition for resources, and environmental factors both natural and anthropogenic. Much of the existing literature on the habitat requirements of freshwater mussels is based on habitat characteristics at collection sites (Strayer and Jirka 1997). These types of data are probably biased toward the conditions at sites that are selected by and accessible to malacologists. However, Strayer and Jirka (1997) state that mussels need permanent waters and that running waters, such as streams and rivers, usually support greater mollusk diversity than lakes and ponds. There is also a relationship between the size of the stream and the number of species present with large rivers supporting the most diverse mussel assemblages. Even in streams where mussels are present, we do not have a clear understanding of the factors that govern their distribution. Current velocity, the size of particles that make up the streambed, substrate stability, and water chemistry are probably important under some conditions but most of these factors have not been carefully investigated.

Freshwater mussels are one of the most imperiled groups of animals in North America (Wilcove et al. 1998). Strayer and Jirka (1997) present data that show that several species have been eliminated from New York, and that human activities have reduced the ranges of some species, eliminated the mussel community from many sites, and reduced the diversity of certain streams.

Pollution in many forms can kill mussels. Industrial wastes, organic pollutants, agricultural runoff, toxic metals, and even chlorine from wastewater treatment plants have all played a role in eliminating mussels from some habitats (Goudreau et al. 1993). Some pollutants poison mussels directly but others simply create eutrophic conditions where mussels are starved for oxygen. Mussels need clean water, although the level of contaminants they can tolerate and still maintain healthy, viable populations is unknown.

Mussel populations typically decrease when streams are physically altered by the construction of dams, channelization, or clearing of the stream banks. Impoundments convert streams to lakes, and these habitats are typically less diverse. Impoundments, especially those with excessive amounts of silt, are detrimental to mussels. On some rivers, dams have caused the extirpation of 30-60% of native mussels (Williams and Neves 1995). Below dams, streams are usually regulated and seasonal changes in flow are muted. The bottom sediments above and below dams are altered over time and fish hosts cannot move freely. In developed areas streams are often rerouted and straightened through ditches and culverts. This practice ignores the fact that streams are naturally dynamic systems that move around in the floodplain. These movements create riffles, pools, and midchannel bars, microhabitats that may be essential to mussel survival.

In many areas, especially in agricultural settings and places where roads parallel waterways, the natural vegetation that borders streams is reduced to a narrow strip of trees. Where streams pass through residential sites the floodplains are sometimes cleared and mowed. Under these circumstances the link between the floodplain forest and the aquatic system is damaged or broken. The cleared areas cannot absorb nutrients or protect the stream from excessive runoff. Fewer leaves fall into the water to provide organic nutrients for the organisms below, and water temperatures rise because of a lack of shade.

The zebra mussel (*Dreissena polymorpha*) has recently emerged as a new and pervasive threat to freshwater unionid mussels. This invasive European bivalve arrived in the Great Lakes about 1985 (Hebert et al. 1989). Habitat analyses have shown that we can expect this animal to occupy most New York waters except for small streams, calcium-poor sites and areas with soft sediments (Mellina and Rasmussen 1994, Ramcharan et al. 1992, Strayer 1991). A growing body of evidence has shown that native mussels can be smothered or starved by zebra mussels, leading to dramatic population declines (Schloesser et al. 1996, Strayer and Smith 1996, Strayer and Jirka 1997). Zebra mussels are already present in Lake Erie, the Niagara River, and many of its tributaries. Zebra mussels can quickly smother and kill native mussels (Schloesser et al. 1996) and probably represent the single greatest threat to them in these areas (Strayer and Jirka 1997). In wetland areas of the Great Lakes, native mussels may be able to persist where they can bury themselves is soft sediments that zebra mussels cannot tolerate (Nichols and Wilcox 1997).

In New York, Tonawanda Creek is known to have a rich and diverse mussel population (Strayer and Jirka 1997, Marangelo and Strayer 2000). In the expanded investigation area, none of the rare mussels are listed as threatened or endangered by NYSDEC or USFWS (NYNHP 2004).

5.2.2 Longear Sunfish

The longear sunfish (NYSDEC Threatened, USFWS Unlisted) occurs in Tonawanda Creek (Carlson 1999, 2001; NYSDEC 2003; NYNHP 2004). The longear sunfish (*Lepomis megalotis*) is a small, thin, deep-bodied, colorful fish that averages 4.0 to 4.5 inches in length (Carlson 1999, Kraft et al. 2003). Its range extends from southern Quebec, Ontario, and Minnesota through the eastern United States and west to Oklahoma, Texas New Mexico and north central Mexico. In New York State the longear sunfish has been reported from the Lake Ontario plain and in tributaries north of Skaneateles and Oneida lakes (Kraft et al. 2003). At the present time, however, in New York State longear sunfish are only known to occur in Tonawanda Creek (Carlson 1999, NYSDEC 2003).

The longear sunfish prefers densely weeded areas with a gravel or sand bottom. It avoids strong currents and silt. Snails, leeches, and aquatic insects make up the bulk of its diet. Prior to spawning, males move into water 0.6 to 11 feet deep, establish territories and build nests (Boyer and Vogele 1971). Males construct saucer-shaped nests in areas with sand or gravel bottoms. Nests are generally built close together to form colonies. In New York, longear sunfish spawn in August (NYSDEC 2003). Male longear sunfish remain with the nest to care for and protect the eggs and young (NYSDEC 2003).

Although no accurate population statistics are available for New York's longear sunfish population, it apparently has declined in the State. Biologists attribute the decline to several causes including water quality deterioration, siltation, and hybridization with other sunfish such as the pumpkinseed or green sunfish (Carlson 1999, NYSDEC 2003). NYSDEC has the goal of protecting several self-sustaining populations of the longear sunfish in New York, and it will continue to monitor the status of the population found in Tonawanda Creek.

5.3 Water Level and Flow Fluctuations and the Occurrences of RTE Species

One of the factors that could affect RTE species in the expanded investigation area is water level and flow fluctuations in the upper Niagara River and water level and flow fluctuations in Tonawanda Creek. Fluctuations in Tonawanda Creek are caused by the operation of the New York State Barge

Canal, variations in the level and outflow of the upper reaches of Tonawanda Creek itself, and fluctuations in the upper Niagara River.

5.3.1 Fluctuations Due to the Use of Upper Niagara River Water to Generate Electricity

The principal effect of the use of Niagara River water to generate electricity is to contribute to water level and flow fluctuations in the Niagara River. Flow and water level fluctuations in the upper Niagara River result from a combination of natural and anthropogenic factors that often act simultaneously. These include regional and long-term precipitation patterns that affect the level of Lake Erie, wind events, flow surges, ice conditions, regulation of Niagara River flows for scenic purposes, hydro operations on the U.S. and Canadian sides, and boat wakes (URS et al. 2005a).

5.3.1.1 Flow Regulation for Scenic and Power Generation Purposes

The Niagara River Water Diversion Treaty of 1950 specifies that flow over Niagara Falls must be 100,000 cfs during tourist season daytime hours (April 1 through October 31). During nighttime hours all year, and during daytime hours from November 1 through March 31, the minimum Treaty-mandated flow is 50,000 cfs. The purpose of the regulation of water levels in the Chippawa-Grass Island Pool, just upstream of Niagara Falls, is to ensure the availability of sufficient flows to satisfy the requirements of the Treaty while still providing water for power production and for the maintenance of water levels in the pool within the specifications of a 1993 Directive of the International Niagara Board of Control.

The 1993 Directive of the International Niagara Board of Control requires that the International Niagara Control Structure (a linear array of sluice gates regulating flow between the Chippawa-Grass Island Pool and the Falls itself) be operated to ensure a specified operational long-term average pool level. It also establishes certain tolerances for the pool's water level as measured at the Material Dock gauge, located on the Canadian shore of the Chippawa-Grass Island Pool. The Directive, applicable to both U.S. and Canadian hydropower operations, permits a daily fluctuation of surface water levels of up to 1.5 feet as measured at the Material Dock gauge. This daily fluctuation must occur within a normal three-foot range, extendable to four feet under special conditions (e.g., high flow, low flow, ice) (URS et al. 2005a).

5.3.1.2 The Contribution of Natural Factors to Upper River Fluctuations

There are natural causal factors that contribute to water level and flow fluctuation in the upper and lower Niagara River. Contributing natural factors include regional and long-term precipitation patterns that affect the level of Lake Erie, wind events, flow surges, and ice conditions. These factors often act simultaneously, and, because of this, their effects cannot be clearly differentiated (URS et al. 2005a).

Because the Niagara River serves as the main outlet channel of Lake Erie, water levels and rate of flow in the river depend greatly on the elevation of Lake Erie. The elevation of Lake Erie fluctuates on a seasonal and, due to wind effects, a daily basis. Wind-caused variations can occur over the course of just a few hours. Strong southwest winds blowing along the long axis of the lake can raise the water level at Buffalo by eight feet or more, increasing river flow at the same time. This increased flow can result from sustained winds alone, without any input from snowmelt, high rainfall, or ice conditions, although these can and frequently do contribute (URS et al. 2005a).

Despite being subject to all these natural and anthropogenic influences, water level fluctuation in the upper Niagara River from all causes amounts to less than 1.5 feet per day (URS et al. 2005a). Impact of water level regulation at the Chippawa-Grass Island Pool on Fort Erie water levels (near the river's head at Lake Erie) is undetectable (URS et al. 2005a).

5.3.2 Fluctuations Due to the Operation of the Barge Canal

Flows and levels of Tonawanda Creek have been modified since the early 1800s by development, agricultural activities, and the construction and operation of the Erie Canal (now known as the New York State Barge Canal). After building a dam to raise the level of Tonawanda Creek, construction of the canal began through Tonawanda in 1823. The canal opened in the spring of 1825 and was later enlarged in 1918. These excavations, and the construction of deep ditches to drain farmland along the creek's margins, dramatically altered the hydrology of Tonawanda Creek.

Today, the operation of the New York State Barge Canal still affects the level and flow of Tonawanda Creek. Water may flow into or out of the Niagara River at the mouth of Tonawanda Creek depending on the level of the Niagara River, on whether the lock gate (also called a guard gate) to the canal is open, and on the discharge from the upper reaches of Tonawanda Creek. During the navigation season (April through November), the level of the Barge Canal is lower than that of the Niagara River and the opening of the guard gate can cause the flow of the Barge Canal portion of Tonawanda Creek to be reversed. When the gate is open, 1,100 cfs flows from the Niagara River and the upper portion of Tonawanda Creek through the canal to the east, toward Lockport. Tonawanda Creek flows west to the river when the canal is closed to navigation from December through March.

The effects of this reversal of flow in the Barge Canal and any water level fluctuations it may cause in the upstream reaches of Tonawanda Creek are unclear, and it is difficult to determine exactly how much of Tonawanda Creek above the Barge Canal might be influenced by canal operations. However, two riffle areas were identified during the mapping and characterization of riparian habitats along this stretch of Tonawanda Creek (Gomez and Sullivan and E/PRO 2005). The first riffle area is 13.6 miles upstream of the mouth of Tonawanda Creek. The second riffle area is located 14.1 miles upstream of the mouth of Tonawanda Creek and just downstream of Transit Road. This second riffle is 2.5 miles upstream of the Barge Canal and likely serves as a hydraulic control that limits the influence of fluctuations in the upper Niagara River or the Barge Canal (Gomez and Sullivan and E/PRO 2005).

5.3.3 Fluctuations Due to Changes in the Level and Flow of Tonawanda Creek

Tonawanda Creek is the longest of the U.S. Niagara River tributaries with a length of 101 miles and a drainage area of 635 square miles (URS et al. 2005a). The upstream portion of the basin is generally rural in character and consists of farms, wetlands, and small residential communities. These upstream portions of Tonawanda Creek are characterized by riffles and rapids. Several other creeks flow into Tonawanda Creek between the barge canal and the eastern edge of Niagara and Erie Counties.

The USGS operates water level gauges in Tonawanda Creek at Attica, Batavia, and Rapids (USGS 2004). Water levels and flows in the upper reaches of Tonawanda Creek closest to the investigation area are best described by data from the USGS gauging station at Rapids. This gauge is located about 8.0 miles upstream of the confluence with the Barge Canal and about 5.5 miles upstream of the riffle below Transit Road in Millersport. Recent and historical data from this gauge are available on-line. The Rapids gauge records water level (in feet) and outflow (in cfs) from an upstream drainage area of 349 square miles (USGS 2004). Data are available back to 1955, although data collected in the last 25 years are more complete. Detailed daily data are available for the last two years (USGS 2004).

In general, flows and levels in Tonawanda Creek are highly variable. Annual mean outflow of the creek in recent years ranged from 286 cfs in 1999 to 643 cfs in 1996, a more than two-fold difference. (USGS 2004). Outflows are highly seasonal. Data have been collected from the Rapids gauge since 1955. These data indicate that mean monthly flows have ranged from a high of 961 cfs in March to a low of 86 cfs in August, a more than ten-fold seasonal difference in the mean monthly outflow of the creek. Storm events and spring runoff can cause tremendous surges in the outflow of Tonawanda Creek. During these events, outflows can reach 3,000 or 4,000 cfs for several days. The maximum recorded outflow of Tonawanda Creek recorded at the Rapids gauge was 6,130 cfs on April 1, 1960.

TABLE 5.1-1

EXTANT RTE SPECIES AND NATURAL COMMUNITIES OF THE UPPER NIAGARA RIVER AND ITS TRIBUTARIES WITHIN THE INVESTIGATION AREA

RTE Species or Significant Occurrence of a Natural Community	USFWS	NYSDEC and NYNHP			Total
	T&E	T&E	SC	U	
Natural Communities					0
Plants					0
Bivalve Mollusks				9	9
Other invertebrates					0
Fishes		1 (threatened)			1
Reptiles and Amphibians					0
Birds					0
Total	0	1	0	9	10

Notes:

Legal Status Codes: E=Endangered, T=Threatened, SC=Special Concern, R=Rare, U=Unprotected under NYS T&E or SC legislation but may be protected by other laws

TABLE 5.1-2

OCCURRENCES OF RARE MUSSELS IN THE UPPER NIAGARA RIVER TRIBUTARY INVESTIGATION AREA

	Species	Records from Marangelo and Strayer (2000) and NYNHP (2004)[2]		2004 Field Surveys[3]	
		Best record	Year	Ellicott Creek	Tonawanda Creek
1	*Amblema plicata*[1]	Live	1998	-	Recent shell
2	*Fusconaia flava*[1]	Old shell	1998	-	Old shell
3	*Lampsilis ovata*	Live	1998	-	Live
4	*Leptodea fragilis*[1]	Live	1998	-	Live
5	*Ligumia recta*[1]	Old shell	1998	-	-
6	*Potamilus alatus*[1]	Live	1987	-	-
7	*Ptychobranchus fasciolaris*[1]	Live	1998	-	Old shell
8	*Truncilla truncata*	Live upstream of investigation area	Not listed	-	Recent shell
9	*Villosa iris*[1]	Recent shell	1998	-	Live

Notes:

1 This species was also recorded during 2001 or 2002 field surveys

2 Species listed by the New York Natural Heritage Program are on the Rare Animal List (NYNHP 2003b) but none are listed as threatened or endangered by NYSDEC or USFWS.

3 No rare mussels were found in Sawyer Creek, Bull Creek, Ransom Creek, Black Creek, or Got Creek

TABLE 5.1-3

OCCURRENCES OF COMMON MUSSELS IN UPPER NIAGARA RIVER TRIBUTARIES FROM 2004 FIELD SURVEYS

	Species	Best Record	Ellicott Creek	Bull Creek	Ransom Creek	Black Creek	Got Creek	Tonawanda Creek
1	*Anodontoides ferussacianus*[1]	Old shell			X			
2	*Lampsilis siliquoidea*[1]	Recent shell	X		X	X		X
3	*Lasmigona costata*	Old shell						X
4	*Pyganodon grandis*[1]	Recent shell	X	X	X	X	X	X
5	*Strophitus undulatus*[1]	Recent shell	X					X

Notes:

1 This species was also recorded during 2001 or 2002 field surveys

2 No rare or common mussels were found in Sawyer Creek

6.0 DISCUSSION

Extant RTE species in the expanded investigation area include one threatened fish species and nine rare but unprotected species of native mussels. These ten species occur in Tonawanda Creek between the Barge Canal and the riffle area just downstream of Transit Road (Strayer and Jirka 1997, Carlson 1999, 2001; Marangelo and Strayer 2000; NYSDEC 2003). Water level and flow fluctuations in this section of the creek are potentially caused by changes in the level of the upper Niagara River, the operation of the New York State Barge Canal, and changes in the level and flow of the upper reaches of Tonawanda Creek. Low water levels and flows in Tonawanda Creek where these RTE species occur could directly affect RTE species by stranding native mussels or exposing shallow water nests of the longear sunfish. High water levels and flows could increase erosion and sedimentation.

The median water level fluctuation in Tonawanda Creek during the 2003 tourist season was 0.58 feet at the Tonawanda Island gauge and 0.56 feet at the temporary water level gauge TC-01 about 4.0 miles upstream of the mouth (URS and Gomez and Sullivan 2005). Upstream of the Barge Canal, water level fluctuations are even less. The upstream extent of water level fluctuations caused by changes in the upper Niagara River and the Barge Canal is likely in the vicinity of the first two riffle sections in Tonawanda Creek, 13.6 miles and 14.1 miles upstream of the mouth. The influence of the upper Niagara River likely does not extend above the second riffle or east of Transit Road for the normal range of water level fluctuations due to U.S./Canadian power generation. The longear sunfish and native mussels occur in the vicinity of these two riffle sections. Although it is not possible to know the exact magnitude of water level fluctuations caused by power production in this section of Tonawanda Creek, given that the median fluctuation is less than seven inches almost ten miles downstream, the fluctuation in this section is typically less than a few inches.

A review of the natural history and habitat requirements of the RTE species in this section of Tonawanda Creek suggests that the annual maximum water level in Tonawanda Creek caused by the upper Niagara River and Barge Canal is negligible. Much more important to these RTE species in Tonawanda Creek are low water levels during critical periods (such as spawning) that might expose the nests of the longear sunfish or leave native mussels stranded and exposed to temperature extremes, dessication, and predators. These low water levels would result from natural flow variability in the upper watershed.

RTE species in Tonawanda Creek are more likely to be adversely affected by periods of naturally low water levels, when native mussels or sunfish nests may become exposed in the creek shallows. Longear sunfish spawn in August (NYSDEC 2003). Typically, the lowest water levels in Tonawanda Creek occur during August and September. During August, the maximum extent of influence for the minimum August elevation of the upper Niagara River (USLSD 1935 564.96 or NGVD 564.45) is 13.5 miles upstream of the mouth of Tonawanda Creek. This was estimated by drawing a straight line from the known water surface elevation of the river to a point where it intersects the creek bottom based on FEMA stream bottom profiles. This point is downstream of the known area of occurrence of the RTE species in Tonawanda Creek. These water surface elevations are such that the potential limit of the influence of upper Niagara River water level fluctuations is downstream of the area of occurrence of RTE species in Tonawanda Creek. In other words, minimum water levels in the area of occurrence of RTE species in Tonawanda Creek are controlled by the amount of water flowing in the creek itself from the upstream drainage basin, not by any effect of water levels in the upper Niagara River.

The extent of influence for the August median elevation (USLSD 1935 566.10 or NGVD 565.59) is greater and approaches the area of occurrence of RTE species in Tonawanda Creek, but the topography of the stream channel rises relatively rapidly in the riffle areas compared to the flat hydraulic slope of the dredged Barge Canal, and a one foot increase in water level may only extend the area of influence 0.1 miles upstream, still below the area of occurrence of these RTE species. The only potential effect of the water level in the upper Niagara River or Barge Canal on Tonawanda Creek in this area would be to make the water somewhat deeper than it might otherwise be during certain periods of the year. In addition, this slight potential increase in water level would still be much smaller than the annual maximum water level caused by spring runoff and storm events in Tonawanda Creek.

Data from the Rapids gauge for Tonawanda Creek during 2004 illustrate the general pattern of seasonal water levels and flows that are encountered by RTE species living there. During spring snowmelt in March, Tonawanda Creek flows peaked at 3,810 cfs and 11.32 feet on the Rapids gauge on March 8, 2004 (USGS 2004). In August 2004 when water is low, the level of Tonawanda Creek ranged from a minimum of 1.48 feet to a maximum of 4.49 feet at the Rapids gauge. However, during September of 2004 the remnants of Hurricane Frances resulted in a great deal of rain in the region and the Rapids gauge peaked at 12.15 feet and 4,180 cfs on September 12. These patterns are typical of spring and summer water level conditions, and they illustrate the potential magnitude of water level and flow changes associated with unusual storm events. The tremendous changes in flow and levels of Tonawanda Creek due to these natural processes dwarf any potential influence of the upper Niagara River in the area of occurrence of RTE species.

These periods of high runoff and outflow can cause erosion and create considerable turbidity. Tonawanda Creek has high clay banks and is normally quite turbid in the area below the Onondaga escarpment (Marangelo and Strayer 2000, Carlson 2001). NYSDEC 1997 reported that Tonawanda Creek at Rapids "is very turbid having a brown muddy color year round." Data collected in 2001 at the NYSDEC sampling station at Rapids as part of their Rotating Integrated Basin Studies (RIBS) program indicate that turbidity was very high, ranging from 19.2 NTUs to 79.3 NTUs (URS et al. 2005a). In addition, the creek has very high conductivity and hardness. Over half of samples collected had levels of total dissolved solids, ammonia, and iron that exceeded NYS standards for Class B waters (URS et al. 2005a).

Tonawanda Creek has been sampled intensively and almost annually for fish and mussels by NYSDEC and/or NYNHP or their contractors during at least the last seven years. Carlson (2001) sampled 67 locations between 1998 and 2000 specifically targeting RTE species, and Marangelo and Strayer (2000) sampled or inspected over 60 sites in the watershed in 1998. This sampling included the section of Tonawanda Creek where these RTE species occur. Among the threats to these species identified by these authors were deteriorating water quality, turbidity, and siltation. In addition, hybridization with other species was identified as a threat to longear sunfish (Carlson 1999, NYSDEC 2003) and pollution from the small city of Batavia was cited as a potential cause of the decline of native mussels in portions of Tonawanda Creek (Marangelo and Strayer 2000).

Sedimentation is a known threat to native mussels and longear sunfish (Muir et al. 1997, NYSDEC 2003). Longear sunfish generally prefer clear water and avoid silt (NYSDEC 2003). In Wisconsin, longear sunfish are intolerant of turbid water from heavy agriculture activity within their range (Wisconsin DNR 2003).

The loss of riparian habitat from agricultural and urban development along the upper reaches of Tonawanda Creek can increase erosion and sedimentation, especially during periods of precipitation and runoff. Baird (2005) reported that the lower reaches of Tonawanda Creek had relatively little erosion, and the erosion that was occurring was primarily due to boat wakes. In these lower reaches of Tonawanda Creek, high turbidity, poor quality source water, storm water discharges, and non-point source runoff may boost nutrient levels and spur algal blooms that can contribute to localized dissolved oxygen suppression

There are no extant records of RTE species in the lower 13.5 miles of Tonawanda Creek and this section of the creek is largely unsuitable for RTE species. The lower 10 miles of the creek is on the state's Priority Waterbodies List for "aquatic life stressed" due to suspended silt and sediment from stream bank erosion upstream (NYSDEC 2000). Neighboring watersheds, such as the Buffalo River, are similarly stressed and degraded. The Buffalo River drainage once supported at least seventeen species of native mussels but now contains only six, a loss of 65% of the species that formerly occurred there (Strayer et al. 1991, Strayer and Jirka 1997).

Despite the poor quality of the habitat in the lowest reaches of Tonawanda Creek, the creek is known for having one of the highest mussel diversities of any water body in New York State (Strayer and Jirka 1997), Marangelo and Strayer 2000). In the lower Great Lakes, the most serious threat to native mussels is the invasion of the zebra mussel (Strayer and Jirka 1997). Fortunately, no zebra mussels were noted in Tonawanda Creek upstream of the Barge Canal during 2004 field surveys. In much of New York, native unionid mussel populations are declining and are expected to continue to decline (Strayer and Jirka 1997). The native mussel diversity in Tonawanda Creek is remarkable and regionally significant (Marangelo and Strayer 2000).

7.0 CONCLUSIONS

Tonawanda Creek is the only part of the expanded investigation area where RTE are found. These species include one state-threatened fish and nine species of rare but unprotected native mussels. All ten of these species occur very close to the point where the upper Niagara River has no influence on water levels in Tonawanda Creek, approximately 14 miles upstream of the mouth.

Water level and flow fluctuations experienced at the site of occurrence of these species primarily are the result of seasonal changes in the level and flow of Tonawanda Creek. Any potential influence of the upper Niagara River is likely a slight increase in water levels, but this potential increase is still several feet less than occurs during spring runoff or storm events. The RTE sunfish and native mussels are most vulnerable to predation or exposure during periods of low water. When the Niagara River is low, it has no influence on the portion of Tonawanda Creek where these RTE species are known to occur. During these periods creek water levels are determined solely by the amount of water flowing in the creek from the upstream drainage basin. Fluctuations in the level or flow of the upper Niagara River likely have no effect on RTE species in Tonawanda Creek.

REFERENCES

Barnhart, M.D. and A. Roberts. 1996. When clams go fishing. Missouri Conservationist 57(2):22-25.

BirdSource. 2003. Christmas Bird Count Data, http://audubon.birdsource.org/CBCOutput/. National Audubon Society and Cornell Lab of Ornithology.

Boyer, R. and L. E. Vogele. 1971. Longear Sunfish Behavior in Two Ozark Reservoirs. In: Reservoir Fisheries and Limnology. ed. G.E. Hall. Washington, DC: pp. 13-25.

Carlson, D. 1999. Endangered and Threatened Fishes of New York. New York State Department of Environmental Conservation, Watertown. http://www.dec.state.ny.us/website/dfwmr/fish/fishspecs/endgtext.html.

Carlson, D. 2001. Tonawanda Creek Survey for Rare Fishes. New York State Department of Environmental Conservation, Watertown. Draft.

DeGraaf, R.M., and D.D. Rudis. 1986. New England Wildlife: Habitat, Natural History, and Distribution. General Technical Report NE-108. U.S. Department of Agriculture, Forest Service.

Eckel, P.M. 2003. Botanical Notes on Squaw Island, Niagara River. Res Botanica, Missouri Botanical Garden. http://ridgwaydb.mobot.org/resbot/Niag/Squaw/SquawIsland.htm.

Evans, D. J., P. G. Novak, and T. W. Weldy. 2001a. Rare Species and Ecological Communities of Beaver Island State Park, prep. for the New York State Office of Parks, Recreation and Historic Preservation. Latham, NY: New York Natural Heritage Program.

Evans, D.J., P.G. Novak and T.W. Weldy. 2001b. Rare Species and Ecological Communities of Buckhorn Island State Park, prep. for the New York State Office of Parks, Recreation and Historic Preservation. Latham, NY: New York Natural Heritage Program.

Evans, D.J., P.G. Novak and T.W. Weldy. 2001c. Rare Species and Ecological Communities of the Niagara Gorge including Devil's Hole, Earl W. Brydges Artpark, Niagara Reservation and Whirlpool State Parks, prep. for New York State Office of Parks, Recreation and Historic Preservation. Latham, NY: New York Natural Heritage Program.

Gomez and Sullivan Engineers, P.C., and E/PRO Engineering & Environmental Consulting, LLC. 2005. Mapping of Aquatic and Riparian Habitats of Ellicott and Tonawanda Creeks, and Tributaries to Tonawanda Creek. Prep. for the New York Power Authority.

Goudreau, S.E., R.J. Neves, and R.J. Sheehan. 1993. Effects of wastewater treatment plant effluents on freshwater mollusks in the upper Clinch River, Virginia, USA. Hydrobiologia 252:211-30.

Hartfield, P., and E. Hartfield. 1996. Observations on the conglutinates of Ptychobranchus greeni (Conrad 1834) (Mollusca:Bivalvia:Unionoidea). Am. Midl. Naturalist 135:370-75.

Hebert, P.D.N., B.W. Muncaster, and G.L. Mackie. 1989. Ecological and genetic studies on Dreissena polymorpha (Pallas): a new mollusc in the Great Lakes. Can. J. Fish. Aq. Sci. 46:1587-91.

Kraft, C.E., D.M. Carlson, and S.C. Brown. 2003. The On-line Fishes of New York State, Version 2.1. Department of Natural Resources, Cornell University, Ithaca, NY.

Marangelo, P.J., and D.L. Strayer. 2000. The freshwater mussels of the Tonawanda Creek basin in western New York. Walkerana 11:97-106.

Mellina, E., and J.B. Rasmussen. 1994. Patterns in the distribution and abundance of the zebra mussel (Dreissena polymorpha) in rivers and lakes in relation to substrate and other physiochemical factors. Can. J. Fish. Aq. Sci. 51:1024-36.

Muir, T., W. Bryant, and J. Williams (eds.). 1997. Freshwater Molluscs as Indicators of Water Quality. U.S. Geological Survey, Biological Resources Division, and National Water Quality Assessment Program.

New York Natural Heritage Program, New York State Department of Environmental Conservation. 2001. Biodiversity Databases, Element Occurrence Record Digital Data Set. Albany, New York.

New York Natural Heritage Program, New York State Department of Environmental Conservation. 2003a. Biodiversity Databases, Element Occurrence Record Digital Data Set. Albany, New York.

New York Natural Heritage Program, New York State Department of Environmental Conservation. 2003b. New York Rare Plant Status List and New York Rare Animal Lists. http://www.dec.state.ny.us/website/dfwmr/heritage/.

New York Natural Heritage Program. 2004. Biodiversity Databases, Element Occurrence Record Digital Data Set. New York State Department of Environmental Conservation.

New York State Department of Environmental Conservation. 1997. Niagara River-Lake Erie Drainage Basin, Biennial Report 1993-1994. Bureau of Monitoring and Assessment, Division of Water.

New York State Department of Environmental Conservation. 2000. New York State Water Quality 2000. Division of Water.

New York State Department of Environmental Conservation. 2001. List of Endangered, Threatened and Special Concern Fish and Wildlife Species of New York State. www.dec.state.ny.us/website/dfwmr/wildlife/endspec/etsclist.html.

New York State Department of Environmental Conservation. 2003. Longear Sunfish Fact Sheet, March 1, 2003. Division of Fish, Wildlife and Marine Resources. http://www.dec.state.ny.us/website/dfwmr/wildlife/endspec/lngersun.html.

Nichols, S.J. and D.A. Wilcox. 1997. Burrowing saves Lake Erie clams. Nature 389:921.

Ramcharan, C.W., D.K. Padilla, and S.I. Dodson. 1992. Models to predict potential occurrence and density of the zebra mussel, Dreissena polymorpha. Can. J. Fish. Aq. Sci. 49:2611-20.

Riveredge Associates, LLC. 2002. Rare, Threatened, and Endangered Species and Significant Occurrences of Natural Communities at the Niagara Power Project, prep. for the New York Power Authority.

Riveredge Associates, LLC. 2005b. Occurrences of Rare, Threatened, and Endangered Mussel Species in the Vicinity of the Niagara Power Project, prep. for the New York Power Authority.

Riveredge Associates, LLC. 2005a. Assessment of the Potential Effects of Water Level and Flow Fluctuations and Land Management Practices on Rare, Threatened, and Endangered Species and Significant Occurrences of Natural Communities at the Niagara Power Project. Prep. for the New York Power Authority.

Schloesser, D.W., T.F. Nalepa, and G.L. Mackie. 1996. Zebra mussel infestation of unionid bivalves (Unionidae) in North America. Am. Zoologist 36:300-10.

Schneider, K.S., and D.M. Pence. 1992. Migratory Nongame Birds of Management Concern in the Northeast. U.S. Fish and Wildlife Service.

Scott, W.B., and E.J. Crossman. 1973. Freshwater Fishes of Canada, Bulletin no. 184. Fisheries Research Board of Canada.

Stantec Consulting Services, Inc., URS Corporation, Gomez and Sullivan Engineers, P.C., and E/PRO Engineering & Environmental Consulting, LLC. 2005. Effect of Water Level and Flow Fluctuations on Terrestrial and Aquatic Habitat, prep. for the New York Power Authority.

Strayer, D.L. 1991. Projected distribution of the zebra mussel (Dreissena polymorpha) in North America. Can. J. Fish. Aq. Sci. 48:1389-95.

Strayer, David L., Kurt J. Jirka, and Kathryn J. Schneider. 1991. Recent collections of freshwater mussels (Bilvalvia: Unionidae) from western New York. Walkerana 5(13):63-72.

Strayer, D.L., and K.J. Jirka. 1997. The Pearly Mussels of New York State. New York State Museum Memoir 26.

Strayer, D.L., and L.C. Smith. 1996. Relationships between zebra mussels (Dreissena polymorpha) and unionid clams during the early stages of the zebra mussel invasion of the Hudson River. Freshwater Biology 36:771-79.

URS Corporation and Gomez and Sullivan Engineers, P.C. 2005. Surface Water Quality of the Niagara River and its U.S. Tributaries, prep. for the New York Power Authority.

URS Corporation, Gomez and Sullivan Engineers, P.C., and E/PRO Environmental & Engineering Consulting, LLC. 2005a. Niagara River Water Level and Flow Fluctuation Study. Prep. for the New York Power Authority.

URS Corporation, Gomez and Sullivan Engineers, P.C., and E/PRO Engineering & Environmental Consulting, LLC. 2005b. Upper Niagara River Tributary Backwater Study. Prep. for the New York Power Authority.

U.S. Geological Survey. 2004. National Water Information System Web, gauge data for USGS 04218000 Tonawanda Creek at Rapids, New York. http://waterdata.usgs.gov/ny/nwis/uv?04218000.

W. F. Baird & Associates Coastal Engineers Ltd. 2005. Shoreline Erosion and Sedimentation Assessment Study Upstream and Downstream of the Power Project. Prep. for the New York Power Authority.

Wilcove, D.S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States by assessing the relative importance of habitat destruction, alien species, pollution, overexploitation, and disease. BioScience 48(8):607.

Williams, J.D., and R.J. Neves. 1995. Freshwater mussels: a neglected and declining aquatic resource. In: Our Living Resources: A Report to the Nation on the Distribution, Abundance, and Health of the U.S. Plants, Animals, and Ecosystems. ed. E.T. LaRoe, G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac. U.S. Department of the Interior, National Biological Service.

Wisconsin Department of Natural Resources. 2003. Endangered and Threatened Species Fact Sheets: Longear sunfish. July 24, 2003. http://www.dnr.state.wi.us/org/land/er/factsheets/fish/Lngsun.htm.