MALCOLM PIRNIE | ARCADIS

Appendix 6-1: WQS Correspondence from the NYSDEC (July 16, 2007)

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BUFFALO SEWER AUTHORITY
2007 JL 17 PM 1:05

Alexander B. Grannis
Commissioner

July 16, 2007

Mr. David Comerford
General Manager
Buffalo Sewer Authority
1038 City Hall
Buffalo, New York 14202-3310

Dear Mr. Comerford:

Long Term Control Plan (LTCP)
Combined Sewer Overflow (CSO)
Abatement Planning
SPDES No. NY0028410

This is to summarize the proposal for moving forward on BSA's Long Term Control Plan, presented at the May 8, 2007 meeting by the regulatory agencies (NYSDEC, NYSAG, USEPA, USDOJ), and to provide clarification on other related issues.

The agencies recognize the need for a phased approach towards implementing selected CSO control projects. The phased approach will allow BSA to proceed with certain projects in Phase 1 that all parties to these negotiations agree can proceed immediately while allowing additional information to be gathered and evaluated to support the selection of Phase 2 projects. The agencies envision that the projects comprising phase 1 will be implemented in a period of approximately five years. The Phase 1 projects should be projects that have the greatest benefit/cost ratio, will be able to be expanded to achieve higher levels of CSO control if necessary, and can be implemented regardless of how certain other issues such as applicability of water quality standards for bacteria and disinfection requirements are resolved. The amount of money expended in Phase 1 should be substantial, but we recognize that significant additional work will be needed in Phase 2. The agencies believe approximately $30 to $50 million is an appropriate figure for Phase 1, depending on the number and cost of projects which meet the above criteria. Attached is a list of projects which the agencies believe will be appropriate for Phase 1. BSA is requested to review the attached list and propose additional or alternative Phase 1 projects that meet the above criteria. At the next meeting, BSA should be prepared to discuss these proposals and its selection rationale.

Phase 1 of the LTCP must also include development and implementation of a revised sewer system Operation and Maintenance program with the goal of maximizing the use and capabilities of the existing sewer system while capital improvements are made. The O&M program should include the 15 CSO Best Management Practices from the SPDES permit (Nine Minimum Controls) and utilize the Capacity, Management, Operation, and Maintenance (CMOM) approach. In particular, there should be a more comprehensive system assessment program, the development of an asset management approach to system repair and replacement, and the development of a short-to-mid term staffing plan that will help address BSA's impending loss of critical staff. In conjunction with this, work must continue towards developing an approvable Wet Weather Operating Plan and resolving the related issues as identified in DEC's letter dated May 11, 2007. Additionally, early in Phase 1, BSA must post signs in areas where primary contact recreation may be precluded due to CSO discharges, to warn the public of the potential dangers of contact with the water. The agencies anticipate that the Phase 1 projects can proceed while the parties are negotiating a consent decree that will be developed as the formal enforcement mechanism for implementation of BSA's LTCP.

The additional information that we believe is necessary to support the selection of Phase 2 projects consists primarily of water quality monitoring and modeling of the receiving waters to characterize the effects that CSO discharges have on water quality. This effort would build on work that BSA has already done in the preparation of the 2004 LTCP. It would use data that has been collected to characterize the pollutant levels (especially bacteria, BOD, and effects on dissolved oxygen) in the combined sewage and use the hydraulic model of the CSS. Some additional monitoring of ambient waters affected by CSO discharges would also be required. The attached summary entitled "Proposed Approach for Additional Analysis of Water Quality Impacts of BSA's CSOs", provides some clarification on the approach anticipated for the analysis to be included in Phase 2. The monitoring and modeling of the receiving waters will also have to account for other sources of pollutants (bacteria) in the watersheds. A goal of BSA's receiving water monitoring and modeling is to ascertain whether discharges from CSOs preclude the attainment of water quality standards for bacteria while recognizing the impact from other sources in the watershed. Another area where we believe that additional information is necessary to support the selection of Phase 2 projects is public participation. The agencies want BSA to enhance the public participation effort to seek input from other stakeholders as to what the designated uses of the receiving waters should be. The agencies believe that with the City of Buffalo's emphasis on waterfront redevelopment and the potential for expanded uses of these waters, it is important to promote public involvement in this process. The agencies envision that the water quality monitoring and modeling and the enhanced public outreach efforts can be completed within one year of approval of the Phase 1 LTCP.

For Phase 2 of the LTCP, we cannot specify at this point what the total cost or implementation schedule might be. These issues will necessarily depend on the results of the water quality monitoring and modeling effort and the enhanced public participation effort and whether those efforts identify the need for higher levels of CSO control. However, Phase 2 must be implemented within a reasonable time frame. Total costs for implementation of both phases will likely be significantly more than the BSA's Recommended Plan. We envision that phase 2 will commence before Phase 1 is complete and that the early parts of Phase 2 will be implemented concurrently with the latter parts of Phase 1.

An issue that requires clarification is the applicability of the water quality standards for bacteria in the Class C receiving waters. The LTCP asserts, based on previous communication between BSA's consultant (Malcolm Pirnie) and DEC Region 9, that the NYS water quality standards for bacteria do not apply to the Class C receiving waterbodies in the BSA study area because they do not have designated primary contact uses requiring disinfection. However, this does not represent a final determination by DEC. A determination of whether bacteria standards should apply will be made after completion of the water quality monitoring and modeling and the enhanced public participation efforts. These efforts will provide us all with more information about the water quality impacts of the CSO discharges and better recognition of the community's goal for these waterbodies.

The financial capability analysis in the LTCP includes only City of Buffalo residents in the calculation of median household income which, because of the demographics, tends to skew the median household income toward the low end of the scale. The agencies believe that this analysis should also include residents in the satellite communities. By including the satellite communities, the analysis will provide a truer picture of what the users of the system can afford. In addition, the agencies want BSA to provide additional information on the sewer use rate structure, including the annual per capita charges for both City and non-City users. We also want information on BSA's bonding authority and the procedures for increasing the bonding limits if that should become necessary.

Relative to the status of the LTCP document submitted in July 2004, the agencies expect that at the end of these negotiations a revised document will be submitted that includes appropriate updates to current conditions and specifically addresses a list of Phase 1 projects, including an implementation schedule, that has been approved by the agencies. The revised document must also include a proposal for a monitoring and modeling program for the receiving waters and an enhanced public participation program as described above. A revised sewer system O&M program must also be submitted.

Nothing in this letter should be construed as a settlement offer or as agreement regarding the terms of any consent decree or Long Term Control Plan. As with all agency discussions, the terms of any settlement are subject to approval by management at the Department of Environmental Conservation, the New York Attorney General, the Environmental Protection Agency and the United States Justice Department. We look forward to further discussions on these topics at our next meeting scheduled for July 23, 2007.

Sincerely,

Gerard A. Palumbo

Gerard A. Palumbo, P.E.
Regional Water Engineer

GAP/jm

cc: Daniel David, NYSDEC, Region 9
Terri Mucha, NYSDEC, Region 9
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SUGGESTED BSA LTCP PHASE 1 PROJECTS

Project Description	Receiving Water	Type of Project	Est. Cost ($)
CSO 003/ SPPs 4, 11 & 185	Black Rock Canal	Weir Modification	15,000
CSO 003: SPPs 3, 4, 5, 7, & 8	Black Rock Canal	Orifice Plate Removal	15,000
Tie CSO 005 SPP14A overflow into Bird Avenue Trunk Sewer	Black Rock Canal	Flow Redirection	100,000
Tying CSO 008 SPP 19 overflow into Scajacquada Tunnel Int.	Black Rock Canal	Flow Redirection	55,000
CSO 007 Sewer Separation	Black Rock Canal	Sewer Separation	300,000
CSO 009 Sewer Separation	Black Rock Canal	Sewer Separation	100,000
CSO 010 (SPP 21) Sewer Separation	Black Rock Canal	Sewer Separation	5,210,000
SPP 304 Underflow from Swan Trunk to South Interceptor	Black Rock Canal	Flow Redirection	832,500
Front Park (CSO 063) Sewer Separation	Black Rock Canal	Sewer Separation	999,000
		Subtotal	***7,626,500***
Hamburg Drain Screens	Buffalo River	Floatables Control	10,000,000 (approx.)
North of Buffalo River SPPs Modifications	Buffalo River	Weir Modification	470,700
SPP 123a Modification	Buffalo River	Supplemental Capacity	1,875,000
South Buffalo ~~River~~ SPPs Modifications	Buffalo River	Weir Modification	223,900
Swan Trunk SPPs Modifications	Buffalo River, Erie Basin Marina, Black Rock Canal	Weir Modification	224,600

SUGGESTED BSA LTCP PHASE 1 PROJECTS

Project Description	Receiving Water	Type of Project	Est. Cost ($)
SPP 42 Underflow from Swan Trunk to South Interceptor	Erie Basin Marina	Flow Redirection	100,000
Retain flow in Swan Trunk at Skyway & Charles St.	Erie Basin Marina	Flow Redirection	843,700
		Subtotal	***13,737,900***
Cazenovia Creek-B	Cazenovia Creek - B	Complete Sewer Separation	4,057,450
Cazenovia SPP 121	Cazenovia Creek	Supplemental Capacity	400,000
		Subtotal	***4,457,450***
CSO 057, SPP 195	Scajaquada Creek	Weir Modification	5,000
CSO 058, SPP 213	Scajaquada Creek	Weir Modification	5,000
CSO 057, SPPs 10, 11, 195	Scajaquada Creek	Orifice Plate Removal	9,000
CSO 058, SPP 213	Scajaquada Creek	Orifice Plate Removal	3,000
CSO 059, SPPs 183, 184, 185	Scajaquada Creek	Sewer Separation	775,000
CSO 060, SPP 240	Scajaquada Creek	Sewer Separation	1,020,000
CSO 053, SPPs 335a, 156, 334a, 334b, 229, 247, 156a, 156b	Scajaquada Creek	Sewer Separation	1,382,000
		Subtotal	***3,199,000***
Total Phase 1 Project Costs			**29,020,850**

Proposed Approach for Additional Analysis of the Water Quality Impacts of BSA's CSOs

INTRODUCTION

The Buffalo Sewer Authority (BSA) operates a combined sewer system that has 58 permitted CSO discharge points that overflow to (either directly or indirectly) to the following receiving waters: Lake Erie, the Niagara River, the Black Rock Canal, Scajaquada Creek, the Buffalo River, Cazenovia Creek, and Cornelius Creek (which effectively is the Niagara River). BSA's Draft LTCP does not go far enough in evaluating the impacts of its CSOs on its receiving waters.

BSA needs to undertake a more thorough evaluation of CSO impacts in all its receiving waters. The following is a "streamlined" yet technically sound approach to the assessment of BSA's CSO water quality impacts. This proposed additional approach to the evaluation of CSO water quality analyses is described briefly below.

PROPOSED APPROACH

The following analysis of BSA's CSO impacts on receiving water quality is appropriate, and should be implemented by BSA in order to finalize its CSO LTCP:

1. As presented in Appendix 5-2 of the 2004 "System-wide Long Term Control Plan for CSO Abatement," BSA has as part of its LTCP development process looked at dissolved oxygen (D.O.) impacts in the Buffalo River. This 2004 effort utilized an updated version of a Buffalo River water quality model originally developed by University of Buffalo (UB) in the 1990s. In brief, the result of that effort was a determination that CSOs had a relatively small impact on river D.O. levels compared to Sediment Oxygen Demand (SOD). We believe a valid extension of this analysis requires the characterization of BSA's CSO contribution to SOD, and how SOD may change as a result of increased CSO control levels. We expect that such an effort would continue to utilize the aforementioned UB Buffalo River model, with the post-CSO control versions of the model further refined to incorporate appropriate estimates of CSO-control-related SOD reduction. Such SOD reduction estimates would be based upon a combination of local data and information drawn from the technical literature.

2. BSA must develop modeling capability to characterize the effects that CSO discharges have on the water quality of the Buffalo River. This may be achieved by expanding the aforementioned Buffalo River model's capabilities to include the evaluation of CSO bacteria impacts. We do not have sufficiently detailed information about the existing UB Buffalo River model to know exactly what this effort would entail; however, the

incorporation of bacteria simulation capability into that model should be possible, and use of the 2001 water quality monitoring data may allow that effort to proceed with little or no additional water quality monitoring. Such a revised model should be used to consider CSO impacts on bacteria levels under both current ("historical") and reduced background (i.e., "TMDL-like") future conditions.

3. BSA should also carry out analyses of the potential impacts of its CSOs on the Inner Harbor and on the Niagara River.

   a. This analysis will need to consider the impact of the Buffalo River and Inner Harbor CSOs on the Inner Harbor and on the Niagara River at the boundary of the Class A portion of the river. Rather than attempt to model the complex flow patterns within the Inner Harbor, it may be acceptable for BSA to utilize a reasonably simple model of the Inner Harbor to simulate water quality both in the Inner Harbor as well as at the points of discharge of the harbor into the Niagara River. It is expected that this model would assume a fixed outflow pattern from behind the breakwater. It is further assumed that existing WQ data (see the BSA February 2001 "Water Quality Monitoring Program Analytical Results") will be used to support the development of this additional capability, and that additional monitoring efforts will be limited to the extent possible. BSA should use this model in conjunction with the Buffalo River model, to assess both bacteria and D.O. impacts in the Inner Harbor area and to characterize bacteria and BOD loads to the Niagara River from the Buffalo River.

   b. Buffalo should further characterize the impacts (from bacteria and dissolved oxygen) of its Scajaquada Creek CSOs on the Class B portion of the Creek, as well as their bacterial load to the Niagara River. This analysis likewise need not involve explicit modeling of the creek, but could instead be based on a relatively simple "spreadsheet" analysis of expected CSO impacts on bacteria concentrations vs time in the Creek, and loads to the Niagara River. Buffalo should also carry out an analysis of the bacteria loads discharged during various events directly to the Niagara River by its CSOs. These analyses may be based on the conservative assumption that all Buffalo River, Scajaquada Creek and direct CSO loads flow along the east side of Bird Island and enter the Niagara River at the northern end of Bird Island. Various dilution scenarios could then be used to characterize the magnitude of BSA's impact on the Niagara River.

4. Given the volume of flow in the Niagara River, it may be advantageous for BSA to utilize a water quality model of the river, rather than relying upon simpler, but more conservative analyses of CSO impacts upon the Class A portion of the river. It is recognized that to be most representative, a model of the Niagara River in the Buffalo area will likely need to be a two-dimensional model. This is because of the width to depth

ratio in the Niagara in the Buffalo Region, and the likelihood of BSA's discharges and the Buffalo River "hugging" the eastern bank of the Niagara River for some distance. Development of such a model would be a substantial undertaking. One alternative is for BSA to use an existing model developed by others. The University of Buffalo, USGS and the New York Power Authority have all carried out work in the area; it may be worth exploring what models have already been developed, BSA's ability to access those models, and their possible utility.

5. If BSA is not required to develop a full two-dimensional Niagara River model, and if the analyses described above are developed largely using data gathered by BSA in its 2001 water quality monitoring effort, it may be possible for BSA to carry out the analyses described above in a period of one year.

Appendix 6-2: Watershed Recreational Use Survey

Imagine the result

Buffalo Sewer Authority

Long-Term Control Plan for CSO Abatement

Watershed Recreational Use Survey

Revised October 2011

Imagine the result

Buffalo Sewer Authority

Watershed Recreational Use Survey

Revised October 2011

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1. Introduction

As requested by the United States Environmental Protection Agency and the New York State Department of Environmental Conservation, the Buffalo Sewer Authority completed a watershed recreational use study to ascertain the water-use based recreational pursuits undertaken and available to the residents of, and visitors to, the City of Buffalo.

1.1 Study Area

The study area for the recreational use survey includes the watersheds tributary to the following waterbodies within the City of Buffalo (refer to the Index Map and Maps 1 through 5 at the end of this report for the locations of each of these waterbodies):

- **Scajaquada Creek** – From Combined Sewer Overflow (CSO) 053 to Black Rock Canal (Map 2)
- **Buffalo River** – from City Border at CSO-066 to confluence with Lake Erie (Maps 4 and 5)
- **Niagara River** – Bounded by CSO-054 near the Border with the Town of Tonawanda, extending south to the Outer Harbor (Maps 1 through 5)
- **Lake Erie** – eastern shore from confluence with Niagara River to Outer Harbor (Maps 4 and 5)

Figure 1: Outer Harbor (Public Domain photo from http://en.wikipedia.org/wiki/File:Buffalo_New_York_aerial_view.jpg)

- **Black Rock Canal** – located along the Niagara River bordered by Squaw/Bird Island to the west and the mainland City of Buffalo on the east (Map 2)
- **Cazenovia Creek** – from City Border with the Town of West Seneca to the confluence with the Buffalo River (Map 5)

Each of these waterbodies is classified according to water quality standards (WQS), as defined in the New York Department of Environmental Conservation (NYSDEC) Part 701 Regulations as follows:

- **Class A-Special fresh surface waters (§701.4).** Best uses of this class include: drinking water, culinary/food processing, primary and secondary contact recreation, and fishing. This classification is also given to international waters that receive treatment equivalent to coagulation, sedimentation, filtration and disinfection that meets New York State Department of Health drinking water standards and are safe for consumption as a potable water source.

- **Class B fresh surface waters (§701.7).** Best uses of this class include primary and secondary contact recreation and fishing.

- **Class C fresh surface waters (§701.8).** Best use of this class includes fishing. This water is also suitable for primary and secondary contact recreation, although other factors may limit the use for those purposes.

The appropriate classification and water quality standards for each of the waterbodies are summarized in Table 1 below.

Table 1 Classification of City of Buffalo Waterbodies

Receiving Water Body	Receiving Water Body Description	NYSDEC Classification
Lake Erie including Erie Basin	Waters southerly of line from Buffalo Harbor Light #6 to south end of Bird Island Pier; easterly of line from south end of Bird Island Pier to north end of north breakwater; easterly of north breakwater; easterly of line from south end or north breakwater to north end of old or middle breakwater and northerly end of line from north end of old or middle breakwater to south pier light at US Coast Guard Station.	C
Lake Erie Outer Harbor, North	Waters easterly of old or middle breakwater and south breakwater between line from northern end of old or middle breakwater to south pier light at US Coast Guard station and line represented by extension of Tifft Street to south end of south breakwater.	B
Niagara River (American side)	Waters from international boundary to the American shore above line due west from south end of Bird Island Pier.	A (special)
Buffalo River	Downstream of confluence with Cayuga Creek to the mouth.	C

Receiving Water Body	Receiving Water Body Description	NYSDEC Classification
Cazenovia Creek	Reach 1 - From the Cazenovia Street Bridge upstream to the junction of the East and West Branches of Cazenovia Creek.	B
Cazenovia Creek	Reach 2 - From the Cazenovia Street Bridge downstream to the confluence with Buffalo River.	C
Scajaquada Creek	Reach 1 - From the crossing on Main Street in the City of Buffalo upstream to "tributary 4", which is in line with continuation of Frederick Drive, Town of Cheektowaga (underground portion).	C
Scajaquada Creek	Reach 2 - From the crossing on Main Street in the City of Buffalo downstream to mouth of Scajaquada Creek at the Niagara River.	B
Black Rock Canal	Waters east of Squaw Island and Bird Island Pier between canal locks and a line from the south end of Bird Island Pier to Buffalo Harbor Light #6.	C
Source: Water Quality Regulations, Surface Water and Groundwater Classifications and Standards, New York State Codes, Rules, and Regulations, Title 6, Chapter X, Part 837, NYSDEC.		

1.2 Study Objectives

Goals of the survey were to characterize existing recreation uses within the study area. More specific objectives included:

- Characterizing current types and levels of recreational use.
- Quantifying frequency of use.
- Identifying specific locations where the various types of recreational uses take place.
- Identifying primary and secondary contact recreation including, but not limited to swimming, wading, fishing, boating, and other water sports.

While the frequency of use is quantified in general terms, the study did not intricately quantify number of uses nor did it specifically quantify fish consumption or waterway conditions. Waterway conditions are included elsewhere as part of the overall water quality modeling efforts. Fish consumption studies were not germane to this effort and are therefore not included.

2. Recreational Use Survey

2.1 Survey Dates and Times

The recreational use survey was conducted during the summer of 2010 when recreational activity near the waterbodies was expected to be at its peak. Table 2 below lists the dates and locations included within the survey. Each of the locations has been correlated to a specific map for easier reference.

Table 2 Survey Days, Locations and Weather Conditions

Date	Location	Weather Conditions at Time of Survey
August 11, 2010 WEDNESDAY	Black Rock Canal, Rich's Marina (MAP 2)	Sunny, upper 70s in morning, high of 85 in afternoon.
	Foot of Scajaquada Creek, near foot of Ontario Boat Launch (MAP 1)	
	Erie Basin Marina, Mouth of Black Rock Canal, Terminus of Buffalo River (MAPS 3 & 4)	
August 15, 2010 SUNDAY	Buffalo River from Cazenovia Creek to Lake Erie (MAP 4)	Sunny, 80s
	Cazenovia Creek Park, moving west (MAP 5)	
	Scajaquada Creek, Delaware Lake (MAP 2)	
August 18, 2010 WEDNESDAY	Black Rock Canal (MAP 2)	Mid 80s, high of 87 in the afternoon
	North of Rich's Marina, Towpath Park (MAP 1)	
August 19, 2010 THURSDAY	Cornelius Creek, Foot of Ontario Street (MAP 1)	Sunny, 80s
August 28, 2010 SATURDAY	Niagara River near Col. Ward Water Treatment Plant (MAP 3)	Sunny, 80s
	Erie Basin Marina (MAPS 3 AND 4)	

2.2 Documentation of Recreational Use

Several forms were used to document recreational use within the study area:

- Water Use Documentation (included as Appendix A)
- Interview Data Compilation (included as Appendix B)

The surveyors used these forms at the various locations to record observations of the various types of recreational activities taking place, as well as the frequency of such observations. The Interview Data Compilation form was used to interview various people at each of the locations regarding their outdoor activities, especially when it came to fishing. The interviewers were also asked for their opinion on water quality within the watershed.

2.3 Types of Recreational Use Observed

The observed recreational activities were categorized into the following categories and include the associated activities:

- **Fishing** – Includes fishing from both the landside and from boats in the various rivers, creeks, and Lake Erie.
- **Sailing** – Found primarily in Lake Erie and the Niagara River. The Buffalo Yacht Club and other boat storage and docking facilities are located in areas bordering the Niagara River. (MAPS 1 THROUGH 4)
- **Motorboats** – Ranges from personal watercraft, including jet skis and motorboats, to larger boats, including the Miss Buffalo, which offers cruises to the public.
- **Kayaking/Canoes** – Refers to any boat or watercraft in which paddling is required, including larger crew boats. The Buffalo Rowing Club has facilities along the Niagara River north of the Water Treatment Plant (MAP 3).
- **Passive Recreation** – Passive recreation observed includes anything from walking, hiking, golfing, sunbathing, playing within designated play areas, and other activities where contact with the water is typically not a part of the activity.
- **Swimming** – Includes traditional swimming as well as SCUBA diving.

The observed activities primarily take place in Buffalo in the warmer months, from approximately May to October; although passive recreational activities and fishing can extend further into the colder periods of the year. As shown on Figure 2 below, most of these activities are enjoyed at average temperatures higher than 50^{o} F and generally define the "boating season".

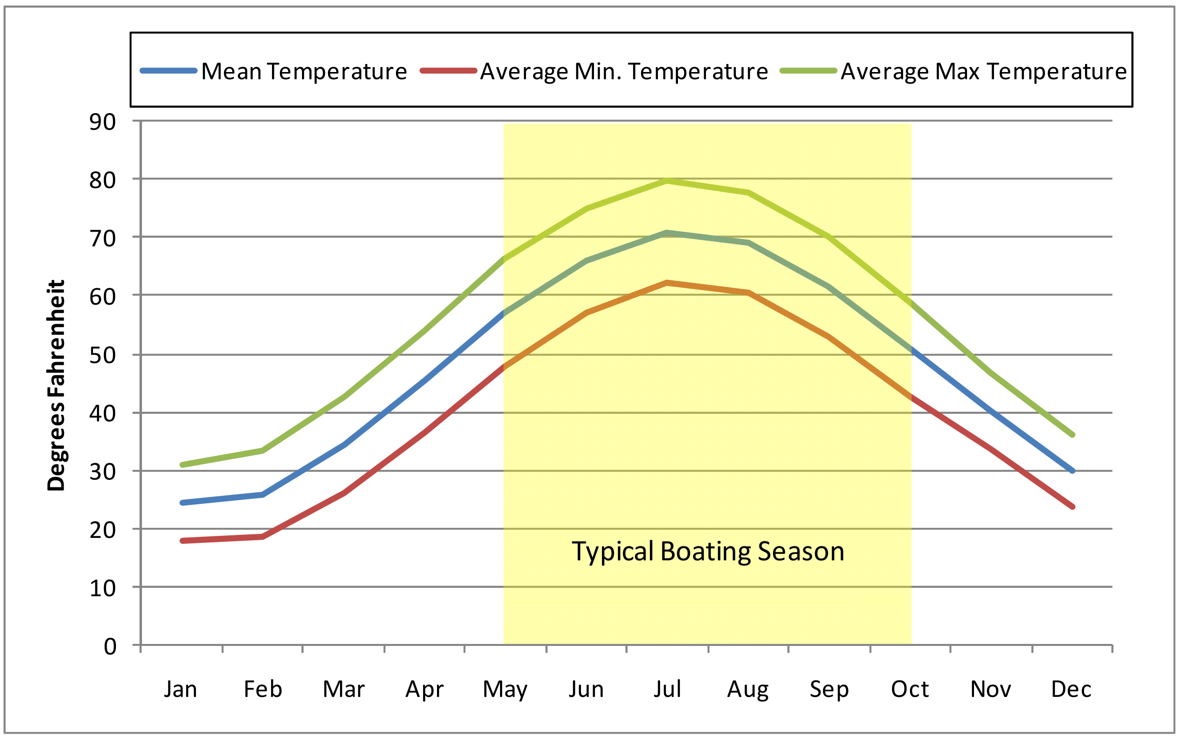


Figure 2: Average Monthly Temperatures for Buffalo, New York (based on Climatography No. 81 data for Buffalo, New York)

While minimal, there is some contact with Buffalo-area waterbodies in the winter months through ice fishing, primarily in the area of the Erie Basin Marina and the Outer Harbor (Maps 3 and 4). In addition, specific recreational activities, including the annual Labatt Blue Pond Hockey Tournament, typically use the Erie Basin Marina area. With these activities, the major contact is with the ice surface and the water associated with caught fish.

2.4 Summary of Recreational Activities within Study Area

The results of the recreational use study are shown on Maps 1 through 5, included at the end of this report. Each of the recreational categories discussed above are represented by a symbol as shown on the legend followed by a two-letter designation indicating the frequency of use as observed during the site visits:

- FR – Frequent activity observed during site visits.
- LT – Limited activity observed during site visits.

If the activity was not observed, the activity was not shown on the Maps.

Fishing was frequently observed in all parts of the City. Fishing was especially common along the Niagara River in several locations (along Black Rock Canal, West Side of Bird Island near the Wastewater Treatment Plant, Tow Path Park, Lake Erie, and within Cazenovia Creek at its confluence with the Buffalo River). Fishing was less likely to occur in Scajaquada Creek, because of limited access.

The Interview Data Compilation form was used to interview various people during the course of the site visits, most of them engaged in fishing activities. These questions were asked to ascertain how often people fished or performed other recreational activities, how much contact with the water they usually have, whether or not they release the fish they catch, or whether they consume the fish. The questions also asked what types of fish they fish for as well as the public's perception of water quality where they fish.

Figure 3: Fishing on Lake Erie (photo courtesy of J. Richert)

Fishermen that were interviewed as part of the Recreational Use Study indicated that they enjoy fishing quite often, from 3 to 7 days per week, extending from the spring all the way into the fall. At least one fisherman interviewed indicated that he enjoys fishing year-round. Typical species fished, as indicated by the fishermen interviewed, included perch, bass, silver bass, walleye, and sheepshead.

Figure 4 also shows the types of fish present in this same area. Many of the fisherman interviewed consume the fish that they've caught (depending on what species of fish they catch), while others catch and release fish to the waterbody.

Overall, swimming was not frequently observed, except on the Niagara River on the west side of Bird Island and near the Ontario Street Boat Launch. A family interviewed indicated that they swim almost every day from spring extending into fall. Swimming and related full water contact activities were observed frequently in Lake Erie in conjunction with boating activities. In general, no swimming was observed in park areas, other than at the beach at the Erie Basin Marina.

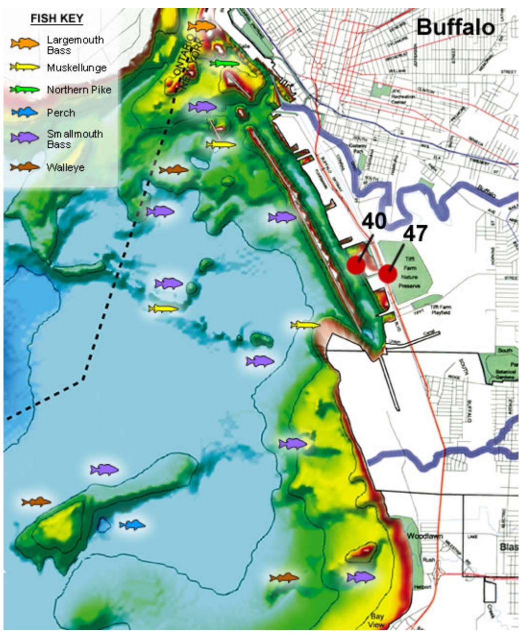


Figure 4: Greater Niagara Fishing Map (courtesy of http://www.erie.gov/hotspot/buffalo_harbor_map.phtml)

The other popular activities in the Niagara River and Lake Erie were kayaking, canoeing, rowing and motorboating. Black Rock Canal is popular for kayaking, canoeing, and rowing, especially as the West Side Buffalo Rowing Club (the nation's largest rowing club) is located just south of the southern end of the canal. Other areas where canoes and kayaks were observed were in Scajaquada Creek, Cazenovia Creek (limited areas downstream of the small waterfall located near Cazenovia Street). Other kayakers and rowers preferred the Buffalo River, where the NYSDEC has a boating access point upstream of the mouth of the river and access is provided at several upstream points in neighboring towns. The use of motorboats was primarily confined to Lake Erie and the Niagara River. Sailboats and motorboats were generally observed within Lake Erie with launch sites located at the Erie Basin Marina, the Ontario Street Boat Launch, the NFTA Boat Harbor, and the South End Marina (the latter two launches are located along Lake Erie south of Interstate I-190 and the mouth of the Buffalo River).

From the survey, much of the passive recreation was observed in the parks, especially in the larger city parks, such as LaSalle Park, Riverside Park, Cazenovia Park, and

Delaware Park. These parks contain amenities such as trails, ballfields, tennis courts, playgrounds, picnic shelters, and golf courses, which encourage more passive recreational activities, such as walking, running, playing sports, golfing, etc. in which there is little to no water contact.

A summary of the major public park areas near water within the City of Buffalo and associated recreational uses is included below in Table 3.

Table 3: Summary of Major Recreational Areas in the City of Buffalo

Facility	Map No.	Public Amenities
PUBLIC PARKS		
Riverside Park	1	Baseball and soccer fields, tennis and basketball courts, playground, ice rink, swimming pool, picnic facilities, biking, walking
Ontario Street Boat Launch	1	Boat launch, fishing, walking
Towpath Park	1	Fishing, biking, walking, picnic facilities
Squaw Island Park	2	Fishing, walking, biking, picnic facilities
Bird Island Pier	2	Fishing, walking
Delaware Park	2	Golf course, baseball and soccer/football/rugby fields, lawn bowling courts, tennis and basketball courts, rowboats/paddle boats, playground, picnic areas, walking
Front Park	3	Playground and picnic facilities, biking, walking (no water access)
LaSalle Park	3	Walking, biking, baseball and soccer fields, playground, amphitheatre
Erie Basin Marina	3	Boat launch, fishing, sunbathing beach, public cruises, walking
Conway Park	4	Fishing, playground
NFTA Small Boat Harbor	4	Boat launch
Houghton Park	5	Walking, playgrounds, fishing, biking, basketball courts, swimming pool, baseball fields, tennis courts
Cazenovia Park	5	Baseball and soccer fields, tennis and basketball courts, playground, ice rink, golf course, swimming pool, limited fishing
PRIVATE FACILITIES		
Buffalo Yacht Club	3	Boat launch

Facility	Map No.	Public Amenities
West Side (Buffalo) Rowing Club	3	Boat launch

It should be noted that the activities observed during this survey correlate well with results of a recreational use survey conducted in the Buffalo River over the summers of 2003 and 2004 by Dr. K.N. Irvine of Buffalo State College (see Appendix C for survey summary article). In the survey, Dr. Irvine noted the following activities and the percentage of total “person-days” (note, a person-day is defined as a single person participating in an activity for at least a portion of the day, if not the whole day):

- Boating (28%) – includes power boating, canoeing, kayaking, sailing, rafting, and rowing
- Fishing (27%)
- Hanging out (22%) – includes eating lunch, reading, talking with friends, walking trails, sunning, or relaxing
- Working (14%)
- Other (6%)
- Swimming (3%)

From this survey and Dr. Irvine’s previous survey, boating and fishing are observed to be major activities within the City of Buffalo, especially along the larger waterways (i.e., Lake Erie, Niagara River, Buffalo River) with a fair share of people also pursuing passive recreational activities, such as walking, hiking, biking, or participating in sports or relaxation activities. Swimming was a very minor use at only 3 percent of the total person-days observed.

2.5 Perceptions of Watershed Water Quality

As part of the interviews, people were asked for their perceptions of water quality. It was noted that the fisherman who consume the fish that they catch generally feel the water is of pretty good quality, including one who commented that it is “better than it used to be”. This sentiment was echoed by the family interviewed while swimming who indicated that no one had gotten sick from swimming in that particular area. Another family who regularly kayaked, canoed, and fished in the Black Rock Channel indicated that they felt the water quality was “improved”.

Figure 5: Beach at Erie Basin Marina (photo courtesy of A. Hintz)

People observed pursuing more passive recreation activities such as walking, biking, or sunbathing were more likely to rate the water quality less favorable, including “muddy” (Cazenovia Creek within the confines of Cazenovia Park) or “poor” (along Scajaquada Creek).

It should be noted that our observations were made on prime days for water recreational use (sunny, temperatures in the range of 70 – 90 deg F, no rain). Use of waterways during storm events and for some period of time afterwards would be significantly reduced for a variety of reasons (i.e., rough waters, cooler temperatures, etc.). Therefore, secondary contact activities would be reduced during and immediately after storm events.

3. Potential Future Development Affecting Recreational Watershed Use

This Watershed Recreational Use Survey was developed to assist in developing sensitive areas in accordance with the USEPA CSO Control Policy. Of primary concern is the potential for future development near Buffalo waterbodies. At the request of the USEPA, several agencies were contacted regarding the extent and types of future development expected along Buffalo waterbodies.

Buffalo Niagara RiverKeeper (BNRK)

The Buffalo Sewer Authority has involved the Buffalo Niagara Riverkeeper as a major stakeholder in the LTCP development. The Buffalo Niagara Riverkeeper, in their 2005 Status Report for the Buffalo River Remedial Action Plan, indicated that numerous projects, involving many local companies and organizations are underway or planned for the Buffalo River. While expanding recreational opportunities for the public through the implementation of new pedestrian/bicycle paths, Riverfest Park, and local waterfront revitalization, these projects do not involve increasing the frequency or means to engage in primary contact recreation.

New York State Department of Transportation (NYSDOT)

The proposed Scajaquada Corridor Project involves reconstruction of the existing Scajaquada Expressway into more of a parkway. Per project documents found on the New York State Department of Transportation’s website, this project will not involve implementing any public water access points to the Scajaquada Creek.

Erie County Department of Health (ECDOH) and New York State Department of Environmental Conservation (NYSDEC)

The public shorelines, especially at the Erie Basin Marina and Inner Harbor, provide the best opportunity for future project development as the City of Buffalo seeks to expand the waterfront. However, according to a representative contacted at the Erie County Department of Health (ECDOH) and the New York State Department of Environmental Conservation (NYSDEC), there are currently no projects that they are aware of that are currently under review by the agencies. The ECDOH indicated that the only projects that they were reviewing were outside the City of Buffalo (i.e., improvements at Woodlawn Beach, which is located upstream of the City of Buffalo and improvements to a campground in Grand Island, whose project involves a separate swimming pool and does not involve access to the natural waterbodies) and are not impacted by CSOs. The NYSDEC was aware of several projects involved with both the Scajaquada Creek and the Buffalo River; however, as indicated above, the future plans for the Buffalo River mostly involve the creation of parks, wetlands, and other recreational areas to promote outdoor activities like biking, walking, sunning, and picnicking.

A news release by the NYSDEC (August 25, 2010, included as part of the documentation in Appendix D) also indicated that there is a push to improve water quality within Hoyt Lake and the Scajaquada Creek by boosting oxygen levels through a recirculation pumping system.

Buffalo Urban Development Corporation (BUDC)

The Buffalo Urban Development Corporation (BUDC) is a not-for-profit local development corporation sponsored by the City of Buffalo and affiliated with the Erie County Industrial Development Agency (ECIDA). While involved with numerous projects throughout the City promoting local economic development, only one new BUDC project is contemplated for the area surrounding the waterfront at this point. Currently the BUDC has completed initial planning efforts for a multi-use commercial and industrial development called RiverBend, located along the Buffalo River in the area of South Park Avenue (see MAP 4). According to BUDC staff, this development would ultimately involve the conversion of a 260-acre brownfield site located along the south shore of the Buffalo River into commercial/light industrial development with associated green-space and parkland throughout. Fully integrated green infrastructure is planned for the site, which will result in zero additional stormwater contribution, as well as a reduction in the existing stormwater flows, to the adjacent combined sewer system. The full buildout of this property is estimated to take place within a 40 year period; however, the schedule for development is predicated on other ongoing projects. In particular, the BUDC is currently marketing the remainder of the property in a recently completed development (Buffalo Lakeside Commerce Park) and indicated that the pace of development in portions of RiverBend, particularly the RiverBend Commerce Park area of the project, may be impacted by absorption in Buffalo Lakeside Commerce Park.

Key components of the planned RiverBend development include areas for light industrial, warehousing and distribution, incubator or scale-up manufacturing sites, an indoor sport arena, and office, retail and limited multi-unit residential areas. More specifically identified areas planned as part of the development include:

- *Republic Park* which includes the indoor sports arena, research and development and/or office space, and a hotel.
- *RiverBend Promenade* includes space for research and development and retail development, including a café, restaurant, boathouse, and other maritime-related small-scale uses.
- *South Park Village* includes spaces for office, residential and space for small business incubators.
- *RiverBend Promenade South* consists of multi-unit residential areas and research and development space, including a marina on the Buffalo River.
- *RiverBend Commerce Park*, located at the south end of the site, is reserved for larger parcels for light industrial purposes.

The RiverBend development incorporates implementation using a flexible phasing plan, with plenty of open green space and areas for passive recreation, with walking trails following the river's edge. The BUDC does not envision any additional water access associated with the project and no primary contact areas (beaches, etc.) are planned.

Erie County Department of Environment & Planning (ECDEP)

The County's Department of Environment & Planning has been working closely with the Black Rock-Riverside Good Neighbors Planning Alliance (BRRGNPA) and a more focused group, the Black Rock Canal Park Steering Committee, to further develop the Black Rock Canal Park. This Erie County park would be located at the current location of the Ontario Street Boat Launch at the terminus to Cornelius Creek.

In 2006, the BRRGNPA prepared an award-winning Concept Plan for Black Rock Canal Park, which combines three, adjacent, waterfront recreational facilities: Cornelius Creek Park, Ontario Street Boat Launch and a section of the Riverwalk multi-use trail. The original plan has been expanded with the evaluation of a Modified Plan and an Alternative Plan – a final implementation plan has not yet been selected. The stated goals of the park are to promote connections between areas of the City, develop a regional attraction, promote activities such as boating and fishing, and provide a green natural area of the riverfront, while providing a more pronounced gateway to the City from the North. The proposed phases for implementation of this project include:

1. Improved park entry from Niagara Street
2. Improved parking facilities and addition of a scenic overlook and brick-lined waterfront walkway.
3. Re-routing and reconstruction of the access road within the park, and the addition of plantings to promote **m**ore public green space.
4. Construction of a Boardwalk along the canal, which may or may not include overhangs over the east side of the Canal, depending on the plan chosen.
5. Construction of a Mixed Use Building, containing at the very minimum, concessions and restrooms.
6. Improvements to the Boat Launch & Pier at the foot of Ontario Street, include a northward extension of the pier, with slips for 18 or 35 boats, depending on the plan chosen for implementation
7. Improvements to the South End, which is the area bordering Cornelius Creek, to incorporate picnic areas and a dog park.
8. Restoration in the Cornelius Creek area, to either cover the creek or implement plantings on the side slopes to discourage access.

Erie County currently has sufficient funds in hand to implement Phases I and II of the project, with further phases dependent on discussions with other organizations having jurisdiction. Erie County also recognizes that the plan for implementation will ge gradual and is heavily dependent upon available funding for the park. No estimated timetable for complete buildout is given in the recently-developed Feasibility Study nor was one provided during conversations with Erie County staff.

City of Buffalo/ Buffalo Urban Renewal Agency (BURA)

The City of Buffalo and BURA are currently in the process of developing a future land use plan for the City. Our understanding is that the draft document is currently under review by the City. While this document is not yet available to the public, the Land Use Plan is focused on creating areas that encourage economic and social development within City parcels. Development of the plan involved conversation and coordination amongst numerous civic organizations and individuals from within the community to establish future planning priorities through 2032 with the overall goal of the creation of new jobs. Therefore, most of the proposed future land use is aimed at creating jobs through the establishment of commercial, retail, and light industrial use developments. Based on discussions with the Executive Director of the Office of Strategic Planning, Brendan Mehaffy, there are currently no concepts within the land use plan which involve enhancement of recreational water use opportunities throughout the city and on the waterfront and the Buffalo River, in particular.

In addition, the City of Buffalo is currently in the process of developing a Green Code, which would involve enacting requirements for new development and for redevelopment of existing properties and brownfields that would serve to prevent new runoff from entering the combined system and in many cases reduce storm runoff currently entering the system through the use of green infrastructure, such as drainage swales, rain barrels, and detention ponds. At this time, according to City officials, the Green Code is approximately 18 months away from approval and implementation. Note again that the proposed timeframe of the Land Use Plan is 20 years minimum.

Erie Canal Harbor Development Corporation (ECHDC)

The Canal Side Land Use Improvement Project is being currently undertaken by the New York State Urban Development Corporation (doing business as the Empire State Development Corporation [ESDC]) and the ECHDC. This project is currently ongoing and will ultimately consist of various improvements along the Buffalo Waterfront along Lake Erie, and the Erie Basin Marina (see MAP 3) that build upon the cultural history of the area, including:

- Restaurants
- Entertainment Venues
- Retail Outlets
- Cultural Attractions
- Public Spaces

Water features (i.e., 18-inch deep canals emulating the Erie Canal) will provide year-round water use such as ice skating, row boating, and the areas alongside the canals will be for biking, walking, and sunbathing. The ECHDC intends to use a treatment system located in the basement of the former Memorial Auditorium site to treat the lake water and/or stormwater from the Hamburg Drain to provide the water for these features. In addition, the development includes extensive capturing of stormwater via drainage swales, streetscaping, and permeable pavement. Within the overall development concept, no additional water access points or changes to the current water usage are contemplated.

4. Summary

Overall, residents of the City of Buffalo and nearby municipalities enjoy a wide variety of outdoor activities along Buffalo's waterways during the summer months. Numerous parks throughout the City encourage outdoor recreation, including walking, running, sunbathing and sports. For parks like Delaware Park and Cazenovia Park (both of which are two of the larger City parks located inland), most of the outdoor recreational activities observed were considered passive recreation with minimal contact with water.

Significant water contact was observed mostly along the major shorelines of Lake Erie and the Niagara River with fishing, boating (motorboats, sailboats, personal watercraft, kayaks, and canoes), and limited swimming.

Fishing was by far the most frequently observed activity, with fishermen setting up base in most areas within the City where waterways were found. Popular spots appeared to be along the Buffalo River, Lake Erie and the Niagara River as well as select spots along Cazenovia Creek and Scajaquada Creek. Extensive fishing was observed along the Buffalo River despite limited access due to large commercial/industrial sites. Limited access along much of Cazenovia Creek within the City limits with the use of concrete flood control embankments limited the amount of fishing in that location. Likewise, limited access to Scajaquada Creek due to highways (Scajaquada Expressway) and residential neighborhoods resulted in limited observations of fishing in that area.

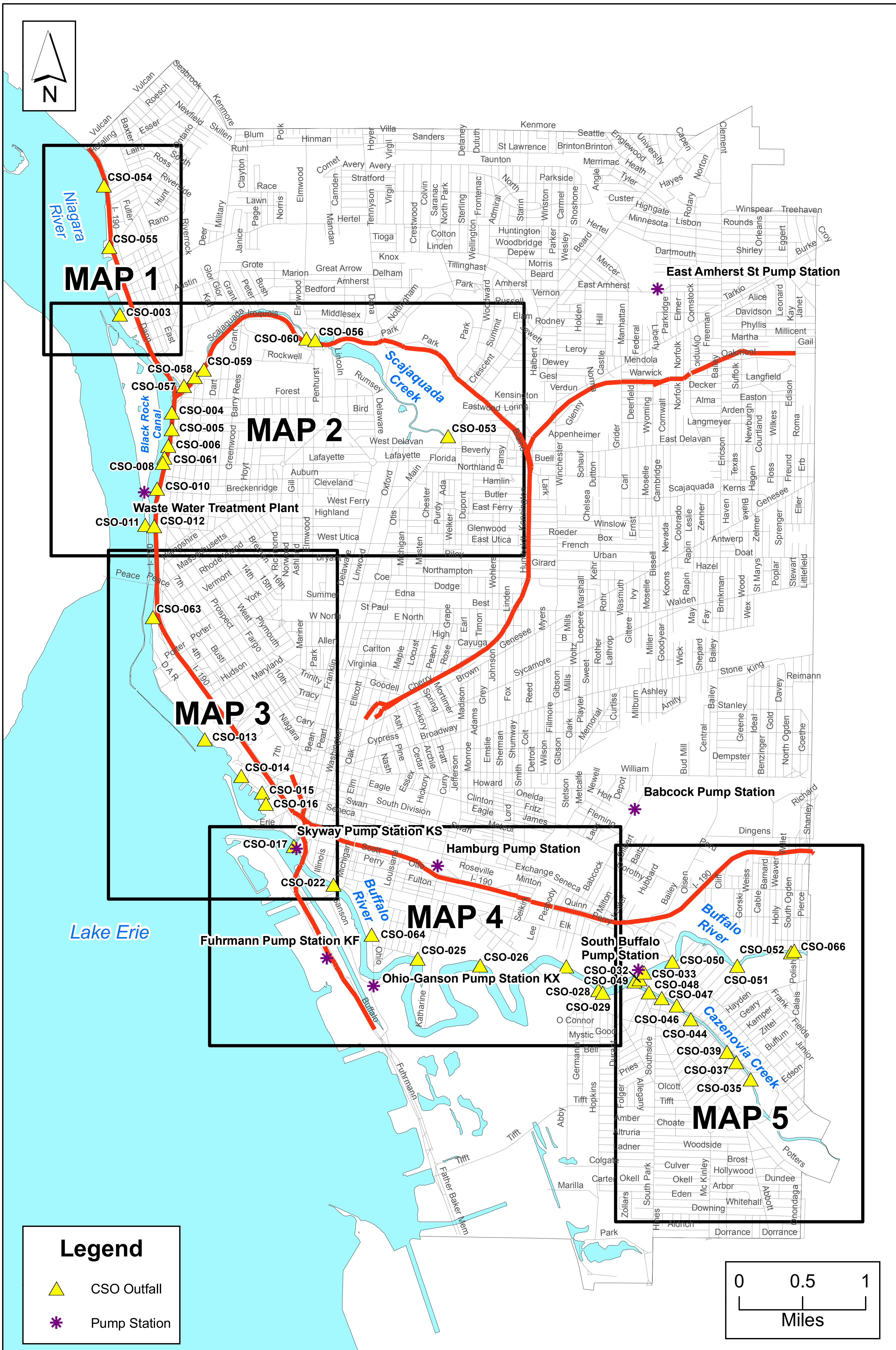
Figure 6: Public Areas at the Erie Basin Marina (photo courtesy of A. Hintz)

Most of the people interviewed as part of this study were fishermen who had contact with the water and the fish that they caught. Their overall impressions of water quality were favorable and were strengthened by the fact that many of the fishermen consumed the fish that were caught. No one interviewed mentioned the presence of

CSO outfalls in their impressions of the water quality, most likely they may not have been aware of their presence.

5. Conclusions

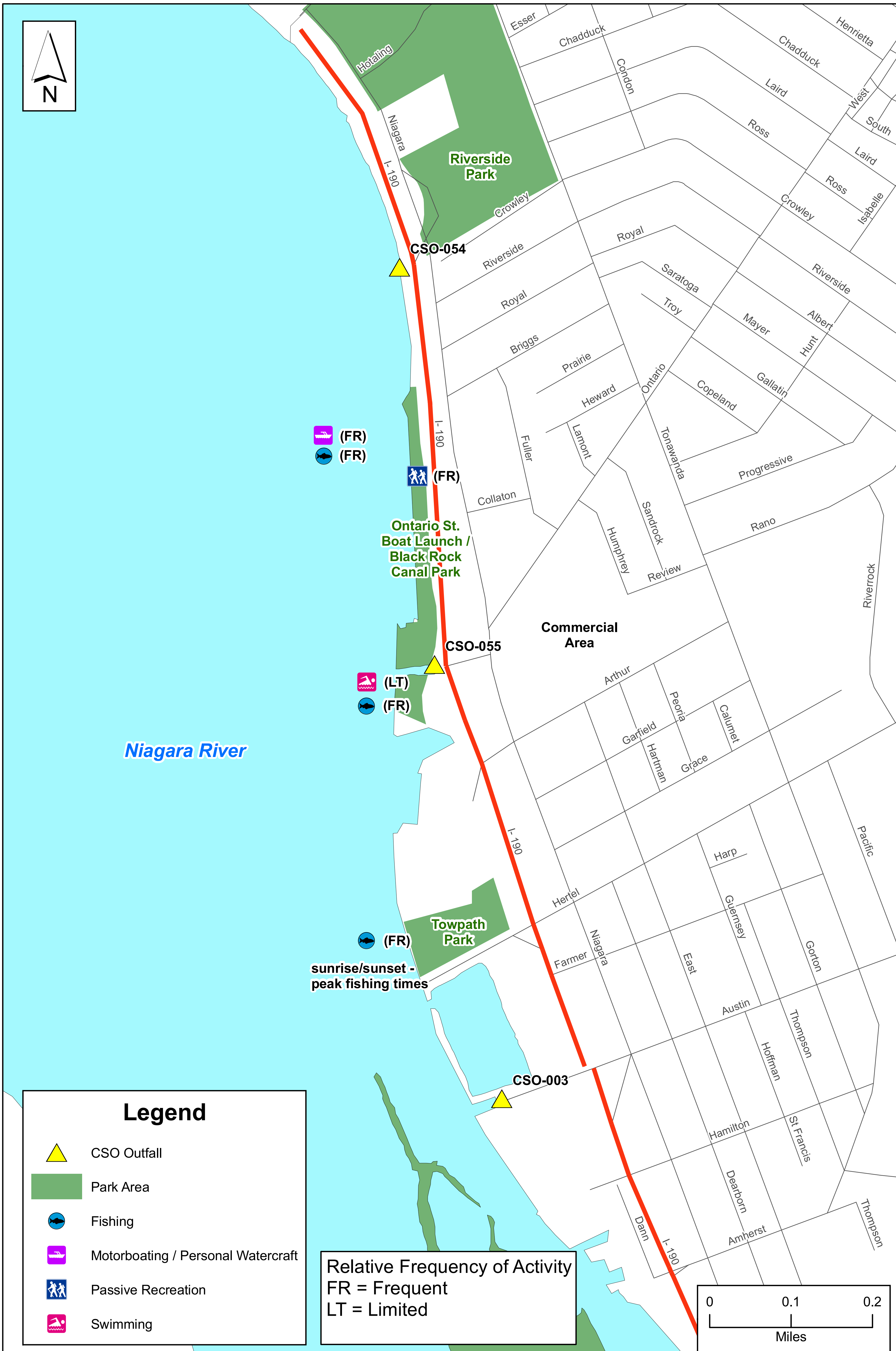
The types of recreational uses observed and currently available are predominantly secondary contact with receiving waters. These findings were consistent with the previous 2003-2004 study and both studies show that limited primary contact swimming activity occurs and was only documented along Lake Erie, Niagara River, and Erie Basin Marina. Anticipated future development suggests that more public space is planned for recreational activities, including dining, shopping, walking, biking, and enjoying the outdoors rather than facilities aimed at enhancing access to the waterways for swimming. The survey results will be used in conjunction with the current stream designated uses and water quality standards to establish CSO control objectives for the BSA receiving streams. The approach of the Long Term Control Plan has been to establish cost-effective levels of control for capture and/or treatment of combined flows that would minimize CSO-related water quality impacts. During and following LTCP implementation in areas where overflows persist in close proximity to recreational activity, CSO signs may be an appropriate measure in conjunction with public education and awareness programs. Information materials could be made available to park management and other organizations (fishing clubs, tackle shops, yacht clubs, and rowing clubs) that describes the CSO program and the Potential impacts of remaining CSO discharges.



MALCOLM PIRNIE

1777114 SEPTEMBER 2011

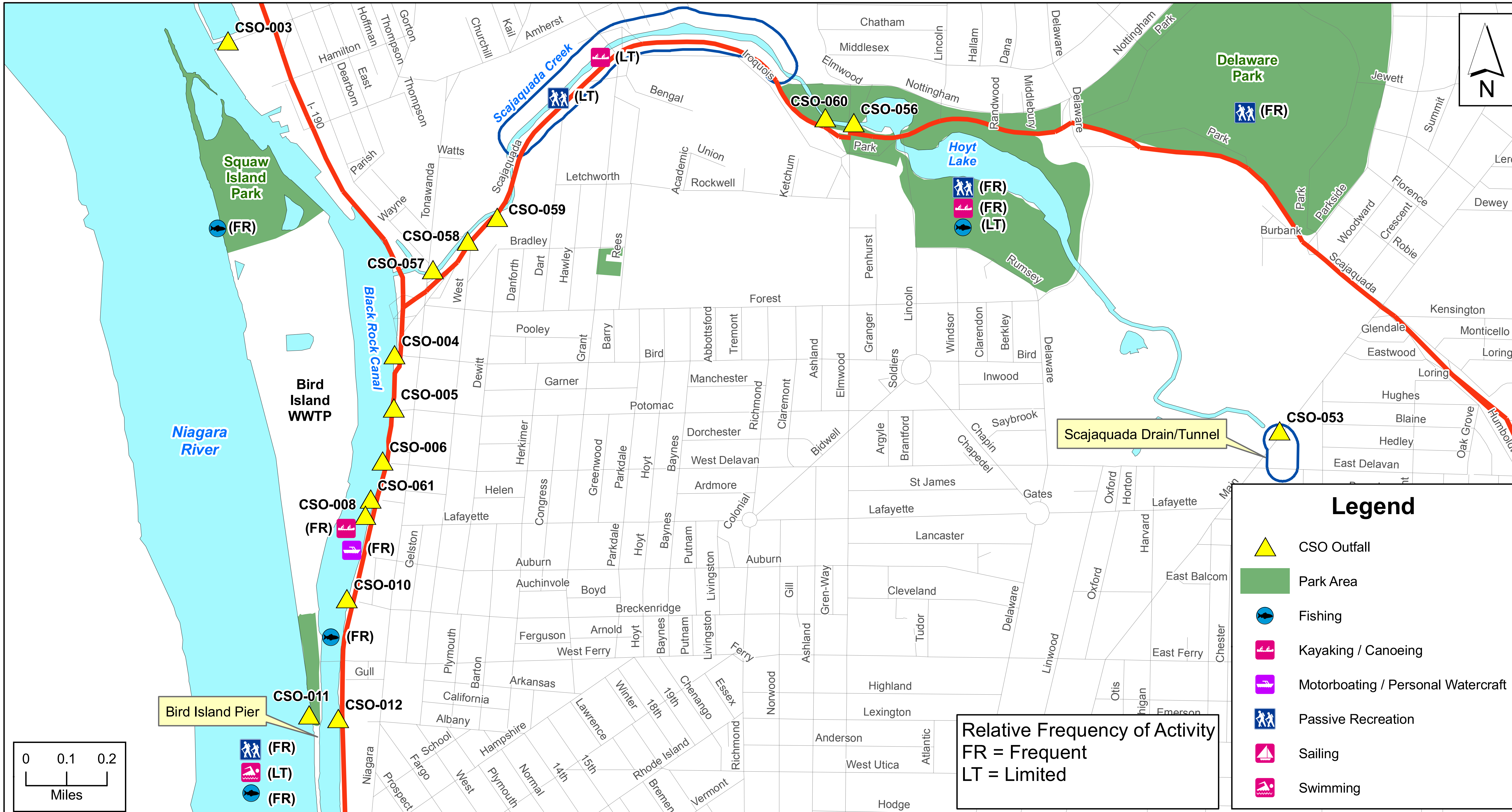
INDEX MAP



MALCOLM PIRNIE

MAP 1

1777114 SEPTEMBER 2011



MAP 2

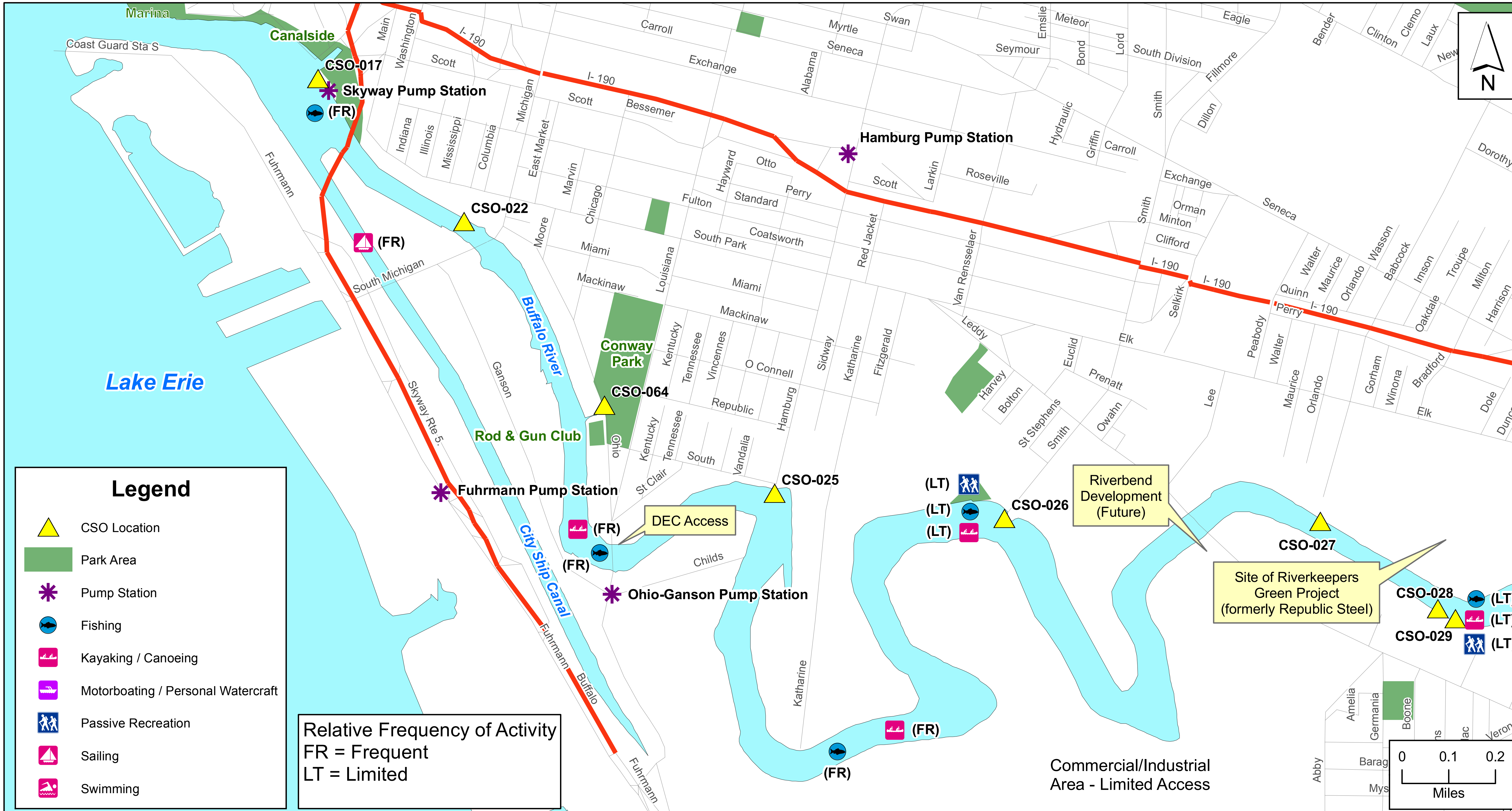
MALCOLM PIRNIE

1777114 SEPTEMBER 2011

MALCOLM PIRNIE

MAP 3

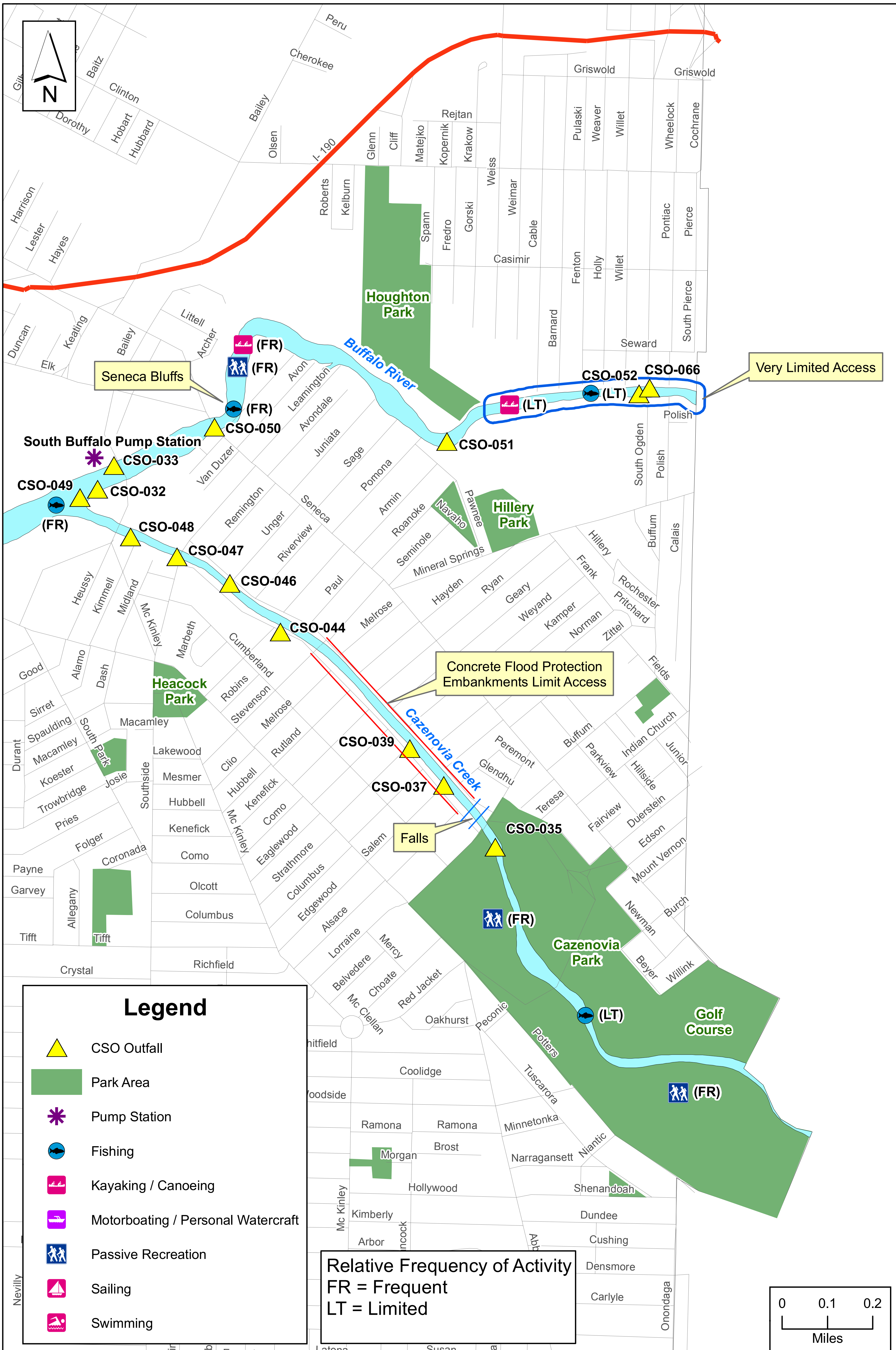
1777114 SEPTEMBER 2011



MALCOLM PIRNIE

MAP 4

1777114 SEPTEMBER 2011



MALCOLM PIRNIE

MAP 5

1777114 SEPTEMBER 2011

Appendix **A**

Water Use Documentation

Buffalo Sewer Authority

Watershed Recreational Use Study

Water Use Documentation

Date and Weather Conditions

8/11/2010 , SUNNY , UPPER 70s IN MORNING

Location (Waterbody and location on waterbody)?

PIER ALONG BLACK ROCK CANAL

Activity Observed/Reported

WALKING ALONG BLACK ROCK CHANNEL WALL

Frequency of Activity Reported/Observed

VERY FREQUENT

Comments/Notes

TJW

Buffalo Sewer Authority

Watershed Recreational Use Study

Water Use Documentation

Date and Weather Conditions

8/11/2010 , SUNNY UPPER 70s IN MORNING

Location (Waterbody and location on waterbody)?

BLACK ROCK CANAL, OBSERVED FROM BIRD ISLAND

Activity Observed/Reported

SWIMMING @ PARKING LOCATION SOUTH OF WWTP

FISHING FROM PEACE BRIDGE, NORTH THE EXTENT OF BIRD ISLAND ON THE WESTSIDE, EASTSIDE OF BIRD ISLAND FROM PEACE BRIDGE TO THE WWTP

Frequency of Activity Reported/Observed

VERY FREQUENT

Per David Comerford of the Buffalo Sewer Authority, fishing was frequently observed, while only limited swimming was observed (10/17/2011)

Comments/Notes

INTERVIEWED WALKERS, SWIMMERS & FISHERMEN

TJW

Buffalo Sewer Authority

Watershed Recreational Use Study

Water Use Documentation

Date and Weather Conditions

8/11/2010 MID-80s SUNNY

Location (Waterbody and location on waterbody)?

NORTH OF SCAJAQUADA, FOOT OF ONTARIO BOAT LAUNCH

Activity Observed/Reported

FISHING & SWIMMING

Frequency of Activity Reported/Observed

VERY FREQUENT

Per David Comerford of the Buffalo Sewer Authority, only limited swimming was observed, but very frequent fishing was observed in this area.

Comments/Notes

TJW

Buffalo Sewer Authority

Watershed Recreational Use Study

Water Use Documentation

Date and Weather Conditions

8/11/2010 , SUNNY, WARM , UPPER 70s IN MORNING
HIGH OF 85

Location (Waterbody and location on waterbody)?

ERIE BASIN MARINA , BLACK ROCK (MOUTH OF), BUFFALO RIVER (TERMINUS)

Activity Observed/Reported

SWIMMING AT BEACH , SUNBATHING, WALKING , BIKING
BOATS IN DOCK

Frequency of Activity Reported/Observed

ALL FREQUENT ACTIVITIES

Comments/Notes

TJW

Buffalo Sewer Authority

Watershed Recreational Use Study

Water Use Documentation

Date and Weather Conditions

8/11/2010 SUNNY 85°

Location (Waterbody and location on waterbody)?

RICH'S MARINA, BLACK ROCK

Activity Observed/Reported

POWER BOATING

Frequency of Activity Reported/Observed

FREQUENT

Comments/Notes

TJW

Buffalo Sewer Authority

Watershed Recreational Use Study

Water Use Documentation

Date and Weather Conditions

8/15/2010 SUNNY 80s

Location (Waterbody and location on waterbody)?

BUFFALO RIVER FROM CAZ. CK. TO LAKE ERIE

Activity Observed/Reported

FISHING WALKING AT ACCESS PTS.

KAYAKING NO SWIMMING

Frequency of Activity Reported/Observed

VERY FREQUENT

Comments/Notes

DW

Buffalo Sewer Authority

Watershed Recreational Use Study

Water Use Documentation

Date and Weather Conditions

8/15/2010 SUNNY 80s

Location (Waterbody and location on waterbody)?

CAZENOVIA CK. PARK & MOVING WEST

Activity Observed/Reported

LITTLE TO NO ACTIVITY, WALKING & BIKING IN PARK
FISHING @ JUNCTION OF CAZ & BUFFALO RIVER

Frequency of Activity Reported/Observed

VERY FREQUENT

Comments/Notes

TJW

Buffalo Sewer Authority

Watershed Recreational Use Study

Water Use Documentation

Date and Weather Conditions

8/15/2010 SUNNY

Location (Waterbody and location on waterbody)?

SCAJAQUADA CK. : DELAWARE LAKE

Activity Observed/Reported

(1) KAYAK IN CK. ; WALKING, PADDLE BOATS, KAYAKS

Frequency of Activity Reported/Observed

LIMITED : FREQUENT

Comments/Notes

TJW

Buffalo Sewer Authority

Watershed Recreational Use Study

Water Use Documentation

Date and Weather Conditions

8/18/2010 SUNNY, MID-80s 87 AT HIGH

Location (Waterbody and location on waterbody)?

BLACK ROCK CANAL

Activity Observed/Reported

KAYAKING, CANOEING, ROWING

Frequency of Activity Reported/Observed

VERY FREQUENT

Comments/Notes

TW

Buffalo Sewer Authority

Watershed Recreational Use Study

Water Use Documentation

Date and Weather Conditions

8/19/2010 87° SUNNY

Location (Waterbody and location on waterbody)?

NORTH OF RICH'S MARINA

TOWPATH PARK

Activity Observed/Reported

FISHING ON NIAGARA RIVER FROM SHORE

Frequency of Activity Reported/Observed

VERY FREQUENT

Comments/Notes

INTERVIEWED HUSBAND + WIFE FISHING

DW

Buffalo Sewer Authority

Watershed Recreational Use Study

Water Use Documentation

8/19/2010

SUNNY, 80°s

Date and Weather Conditions

8/19/2010 , SUNNY

Location (Waterbody and location on waterbody)?

CORNELIUS

FOOT OF ONT.

Activity Observed/Reported

FISHING

Frequency of Activity Reported/Observed

QUITE FREQUENTLY

VERY ACTIVE IN THIS AREA

Comments/Notes

Buffalo Sewer Authority

Watershed Recreational Use Study

Water Use Documentation

Date and Weather Conditions

8/28/2010 SUNNY 80s

Location (Waterbody and location on waterbody)?

NIAGARA RIVER NEAR COL.WARD WTP

Activity Observed/Reported

BOATING WALKING

SHORE FISHING

Frequency of Activity Reported/Observed

VERY FREQUENT

Comments/Notes

TJW

Buffalo Sewer Authority

Watershed Recreational Use Study

Water Use Documentation

Date and Weather Conditions

8/28/2010 SUNNY 80

Location (Waterbody and location on waterbody)?

ERIE BASIN MARINA

Activity Observed/Reported

WALKING, BIKING, SWIMMING & SUNBATHING @ BEACH

BOATING, KAYAKING

Frequency of Activity Reported/Observed

VERY FREQUENT

Comments/Notes

TJW

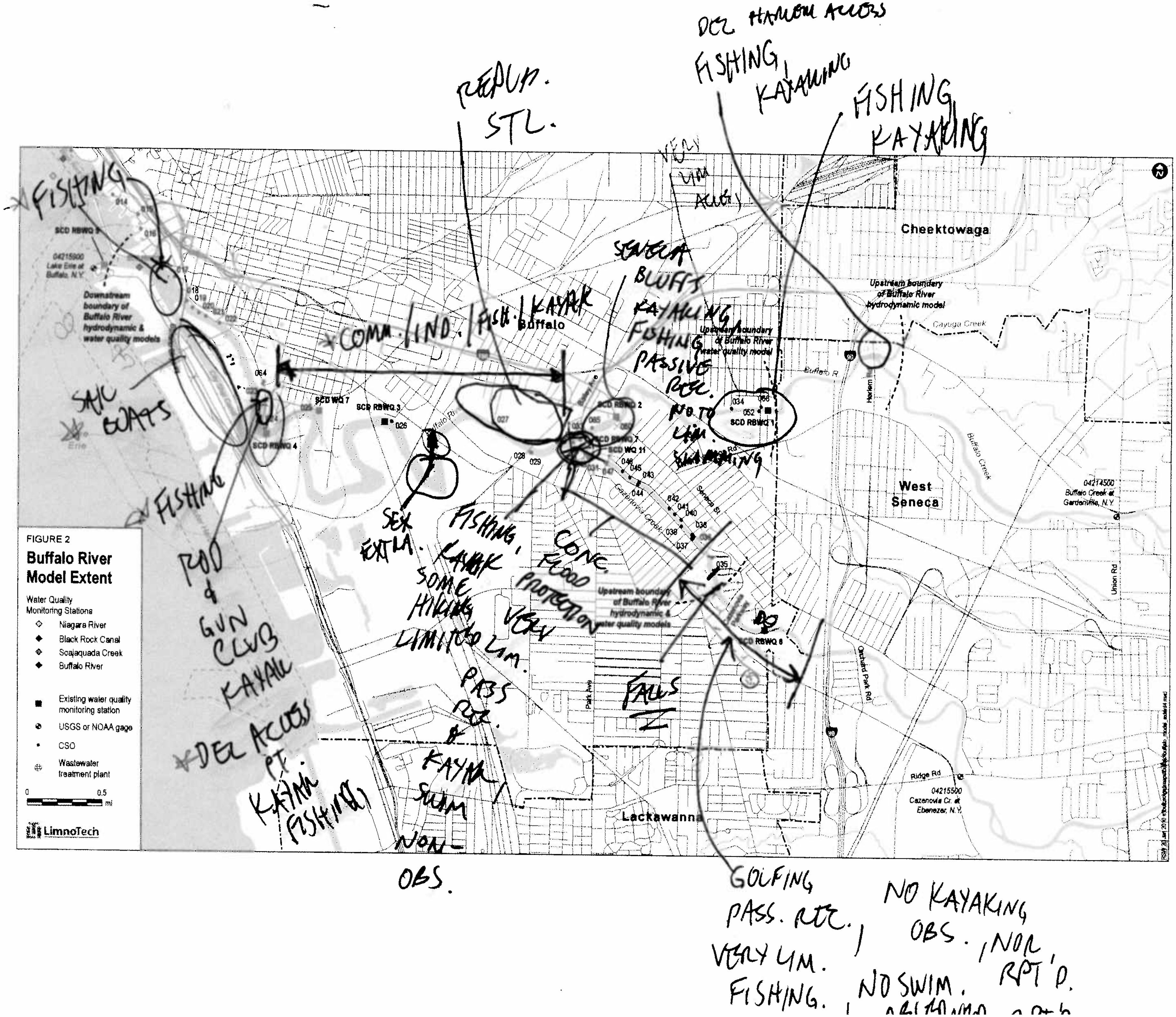


FIGURE 2
Buffalo River Model Extent
Water Quality Monitoring Stations
Niagara River
Black Rock Canal
Scajaquada Creek
Buffalo River
Existing water quality monitoring station
USGS or NOAA gage
CSO
Wastewater treatment plant
0 0.5 mi
LimnoTech
Cheektowaga
Buffalo
West Seneca
Lackawanna
Upstream boundary of Buffalo River hydrodynamic model
Upstream boundary of Buffalo River water quality model
Upstream boundary of Buffalo River hydrodynamic & water quality models
Downstream boundary of Buffalo River hydrodynamic & water quality models
Cayuga Creek
Buffalo Creek
Buffalo R
Cazenovia Creek
Seneca St
Harlem
Orchard Park Rd
Union Rd
Ridge Rd
Park Ave
04215900 Lake Erie at Buffalo, N.Y.
04214500 Buffalo Creek at Gardenville, N.Y.
04215500 Cazenovia Cr. at Ebenezer, N.Y.
SCD RBWQ 1
SCD RBWQ 2
SCD RBWQ 3
SCD RBWQ 4
SCD RBWQ 5
SCD RBWQ 6
SCD RBWQ 7
SCD WQ 7
SCD WQ 11
DEC HAMLIN ACCESS
FISHING, KAYAKING
FISHING, KAYAKING
REPUB. STL.
VERY LIM. ACCESS
SENECA BLUFFS KAYAKING FISHING PASSIVE REC.
NO TO LIM. KAYAKING
COMM. / IND. / FISH. / KAYAK
FISHING
SAIL BOATS
FISHING
ROD & GUN CLUB KAYAK
DEL ACCESS PT. KAYAK FISHING
SEX EXTRA.
FISHING, KAYAK SOME HIKING LIMITED LIM.
CONC. FLOOD PROTECTION
VERY LIM.
PASS REC. & KAYAK / SWIM NON-OBS.
FALLS
GOLFING PASS. REC. VERY LIM. FISHING.
NO KAYAKING OBS. / NOR RPT'D. NO SWIM.

Appendix **B**

Interview Data Compilation

Buffalo Sewer Authority
Watershed Recreational Use Study

Interview Data Compilation

Interview Questions

What types of water recreation activities do you and your friends and family engage in? SWIMMING

How often? ALMOST DAILY

Where? WEST SIDE OF BIRD ISL. ON N.R.

What times of the year? SPRING THRU FALL

When water recreating, do you come into contact with the water?

To what extent? SWIMMING

When you fish, do you practice catch and release, fish for consumption, or a combination of the two?

Please provide details?

N/A

What types of fish do you fish for?

How do you perceive the health of the fishery and watershed?

GOOD

How do you perceive water quality in the areas where you recreate?

Please describe your observations of water quality.

SEEMS FINE

Other information. HAS NOT BEEN SICK

~~THANKS TO~~

Buffalo Sewer Authority
Watershed Recreational Use Study

8/18/2010

Interview Data Compilation

Interview Questions SUNNY

What types of water recreation activities do you and your friends and family engage in?

How often? OFTEN

Where? CORN. CK.

What times of the year?

SPRING → FALL

When water recreating, do you come into contact with the water?

To what extent? NO, JUST FISH CONTACT

When you fish, do you practice catch and release, fish for consumption, or a combination of the two?

Please provide details? MOSTLY

What types of fish do you fish for?

How do you perceive the health of the fishery and watershed?

SHEEPSHEAD

How do you perceive water quality in the areas where you recreate?

Please describe your observations of water quality. FINE, SOME ALGAE

Other information.

Buffalo Sewer Authority
Watershed Recreational Use Study

Interview Data Compilation

Interview Questions

What types of water recreation activities do you and your friends and family engage in?

How often? DAILY

Where? BLACK ROCK EAST, NORTH OF

What times of the year? SPRING → FALL

When water recreating, do you come into contact with the water?

To what extent? JUST WHEN TOUCHING FISH

When you fish, do you practice catch and release, fish for consumption, or a combination of the two?

Please provide details? CONSUMPTION

What types of fish do you fish for? PERCH, BASS

How do you perceive the health of the fishery and watershed?

NOTHING WRONG WITH FISH

How do you perceive water quality in the areas where you recreate? FINE

Please describe your observations of water quality.

Other information.

Buffalo Sewer Authority
Watershed Recreational Use Study

Interview Data Compilation

Interview Questions

What types of water recreation activities do you and your friends and family engage in? FISHING

How often? 3 TO 4 TIMES PER WEEK

Where? NIA. RIVER, WEST SIDE OF BIRD ISL

What times of the year? SPRING & SUMMER

When water recreating, do you come into contact with the water?

To what extent? NO

When you fish, do you practice catch and release, fish for consumption, or a combination of the two?

Please provide details?

What types of fish do you fish for?

How do you perceive the health of the fishery and watershed?

How do you perceive water quality in the areas where you recreate?

Please describe your observations of water quality.

Other information.

Buffalo Sewer Authority
Watershed Recreational Use Study

Interview Data Compilation

Interview Questions

What types of water recreation activities do you and your friends and family engage in?

8/18/2010 How often? FISHING, ALL OVER

Where?

What times of the year? ALL YEAR

BLACK ROCK

When water recreating, do you come into contact with the water?

To what extent? NOT REALLY

When you fish, do you practice catch and release, fish for consumption, or a combination of the two?

Please provide details? BOTH, DEPENDS ON WHAT YOU CATCH

What types of fish do you fish for?

How do you perceive the health of the fishery and watershed?

PERCH, GOOD

How do you perceive water quality in the areas where you recreate?

Please describe your observations of water quality. BETTER THAN IT USED TO BE

Other information.

Buffalo Sewer Authority
Watershed Recreational Use Study

Interview Data Compilation

Interview Questions

What types of water recreation activities do you and your friends and family engage in? FISHING

How often? 4 TO 6 TIMES / WEEK

Where? ALL ALONG WATERFRONT

What times of the year? SPRING - FALL

TOUR PATH PK

When water recreating, do you come into contact with the water?

To what extent? NO

When you fish, do you practice catch and release, fish for consumption, or a combination of the two?

Please provide details? CONSUMPTION

What types of fish do you fish for? PERCH, BASS, SILVER B, WALLEYE

How do you perceive the health of the fishery and watershed?

OK

How do you perceive water quality in the areas where you recreate? PRETTY GOOD

Please describe your observations of water quality.

Other information.

Buffalo Sewer Authority
Watershed Recreational Use Study

Interview Data Compilation

Interview Questions

What types of water recreation activities do you and your friends and family engage in?

How often? KAYAKING / CANOEING / FISHING

Where? BLACK ROCK /

What times of the year?

When water recreating, do you come into contact with the water?

To what extent? SOMETIMES

When you fish, do you practice catch and release, fish for consumption, or a combination of the two?

Please provide details?

What types of fish do you fish for?

How do you perceive the health of the fishery and watershed?

How do you perceive water quality in the areas where you recreate?

Please describe your observations of water quality. IMPROVED

Other information.

Buffalo Sewer Authority
Watershed Recreational Use Study

Interview Data Compilation

Interview Questions

What types of water recreation activities do you and your friends and family engage in? WALKING, PASSIVE RECREATION, BIKE

How often? 3 TO 4 TIMES /WK.

Where? SCAS. PATH

What times of the year?

ALL YR.

When water recreating, do you come into contact with the water?

To what extent?

NONE

When you fish, do you practice catch and release, fish for consumption, or a combination of the two?

Please provide details?

What types of fish do you fish for?

How do you perceive the health of the fishery and watershed?

How do you perceive water quality in the areas where you recreate?

Please describe your observations of water quality.

POOR

Other information.

Buffalo Sewer Authority
Watershed Recreational Use Study

Interview Data Compilation

CAZ. CREEK

Interview Questions

What types of water recreation activities do you and your friends and family engage in?

PARK EMPLOYEE

NONE

How often?

Where?

What times of the year?

When water recreating, do you come into contact with the water?

To what extent? PASSIVE RECREATION

NO SWIM. OR KAY. OBSERVED

INFREQUENT/SPORADIC FISHING ~~ABOVE~~ "BELOW" FALLS

When you fish, do you practice catch and release, fish for consumption, or a combination of the two?

Please provide details?

NO

What types of fish do you fish for?

How do you perceive the health of the fishery and watershed?

NO

How do you perceive water quality in the areas where you recreate?

Please describe your observations of water quality.

OK, A LITTLE MUDDY

Other information.

Appendix **C**

"6. Use Surveys" by Dr. K.N. Irvine

6. USE SURVEYS

K.N. Irvine

6.1 Introduction

A variety of different recreational uses of Buffalo River water and riparian zones have been observed informally over the past 20 years, including swimming, canoeing, kayaking, power boating, fishing, walking along trails, and sitting at observation areas. However, the level of activity has never been quantified. This study provided a preliminary evaluation of activity level related to the 10 habitat sites, as well as other locations along the river, within the defined study area. This survey was not meant to be as detailed as those outlined, for example, by the Statewide Comprehensive Outdoor Recreation Plan (SCORP) prepared by the New York State Office of Parks, Recreation and Historic Preservation (OPRHP) (2002). The SCORP assesses both the supply and demand of recreation resources that includes consideration of geographic area, a variety of demographic information, use surveys, and impact on the environment. However, the survey reported here does provide insight as to the type of recreational uses that are prevalent, the level of activity, and the locations of highest activity along the river.

6.2 Methodology for Recreational Use Survey

It was necessary to conduct the recreational use survey by boat because many of the sites are more readily (and rapidly) observed from the water. The survey team consisted of two people, one to operate the 14 foot Boston Whaler and the second to complete the survey sheets. The surveys were done during randomly selected time slots (7-9 am; 9am-12 pm; 12 pm-3 pm; 3-6 pm) on randomly selected days of the week. All days and all time slots were sampled during the two year study. The survey was completed on 34 dates between June 18 and September 7, 2003 and on 39 dates between June 7 and September 3, 2004 (a total of 73 dates).

On each sample date, the survey was completed for 15 pre-determined sites. These sites were selected based on the author's 17 years of experience on the river. The 15 pre-determined sites were:

- Kotter Fireboat
- Great Lakes Fishing Club
- Ohio Basin Habitat Remediation Site and Canoe Launch
- Bison City Rod and Gun Club
- Foot of Hamburg St.
- Cargill's Grain Elevator
- Concrete Central Grain Elevator
- First CSX Railway Bridge
- Smith St. Habitat Remediation Site
- Smith St. CSO
- Second CSX Railway Bridge

- Third CSX Railway Bridge
- Boone St. CSO
- Old Bailey Woods
- Seneca Bluffs

A photo of each of these sites is provided in Appendix 6.1. The survey also was completed for each of the 10 habitat sites. The Old Bailey Woods site, listed above, is part of Habitat Project Site 1, but for the use survey it was considered separately because of its physical disconnect from Cazenovia Point. In addition to the 25 fixed sites, any activity that occurred at other locations within the study area was noted and the location was referenced with GPS.

6.3 Results and Discussion for Recreational Use Survey

A total of 887 person-days of activity were observed on the 73 sample days, 2003-04. Following the work done by Johns et al. (2003), this study defines a person-day as one person participating in an activity for a portion or all of a day. A summary of the activities observed in 2003-04 is provided in Figure 6.1. Clearly, fishing, boating, and "hanging out" were the predominant activities. In this case, boating includes, power boating, canoeing, kayaking, sailing, rafting, and rowing. "Hanging out" was a category used to classify general riparian activity that might include eating lunch, reading, talking with friends, walking trails, sunning, or relaxing (but *not* fishing).

The frequency of swimming, as shown in Figure 6.1, is lower than had been anticipated and there may be several explanations for this observation. Mean temperature data from the Buffalo Airport for 2003 and 2004 are shown in Figure 6.2, together with the 30-year norms (1961-1990). In both years, June and July were cooler than average, as was August, 2004. August, 2003 was warmer than average. Furthermore, there were no days greater than 90 ^{o}F (32.2 ^{o}C) in any of the surveyed months, 2003 or 2004. Historically, the mean number of days greater than 90 ^{o}F (32.2 ^{o}C) at the Buffalo Airport is 1 for June, 2 for July, 1 for August, and 0.5 for September. Monthly mean rainfall data from the Buffalo Airport for 2003 and 2004 are shown in Figure 6.3, together with the 30-year norms (1961-1990). June and August of both years were drier than average, while July and September of both years were wetter than average. In particular, July, 2004 had nearly twice the average monthly precipitation.

It might be argued that the study years were slightly cooler (both the mean temperature and days greater than 90 ^{o}F (32.2 ^{o}C)) and wetter at critical times (e.g. July) than average, which could negatively impact the frequency of swimming. Alternatively, because this is the first quantitative measure of swimming frequency, previous qualitative perceptions could be inaccurate and swimming frequency in fact may not have declined. If previous qualitative perceptions are correct and there has been a decrease in swimming activity, other possible explanations may include a shift in demographics (e.g. fewer children in the neighborhoods surrounding the Buffalo River), alternative available activities, or improved communications regarding the risk of swimming in the Buffalo

River (e.g. Buffalo Niagara Riverkeeper community outreach; posting of CSO locations). It is beyond the scope of this study to assess these alternative interpretations of the data.

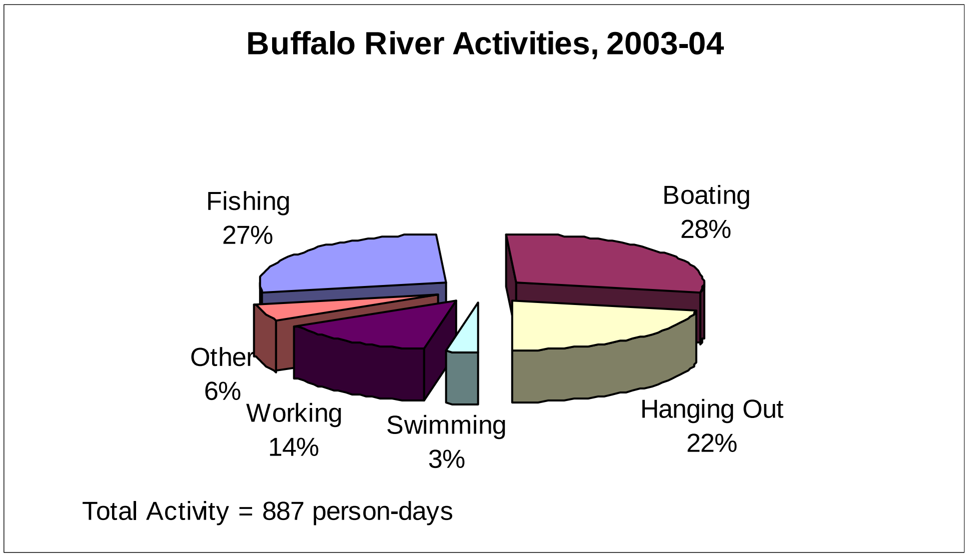


Figure 6.1 Summary of Buffalo River activities, 2003-04

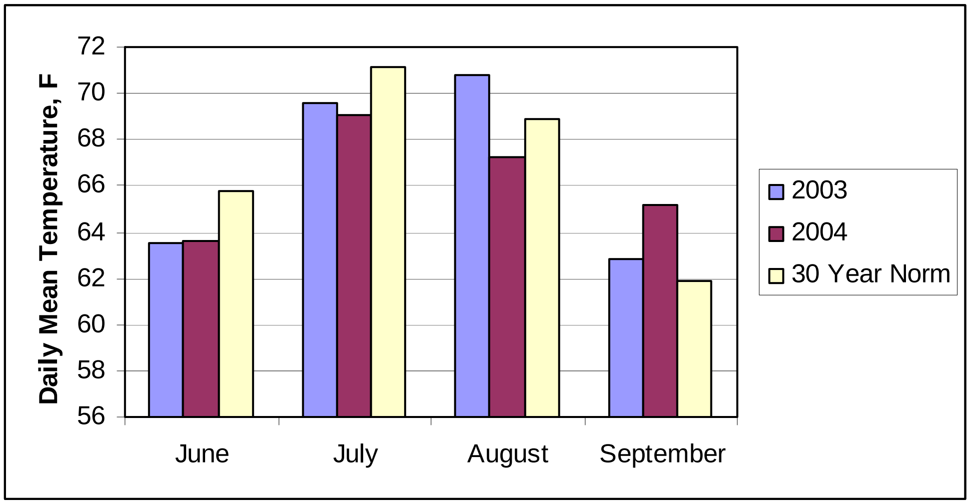


Figure 6.2 Daily mean temperature data from the Buffalo Airport

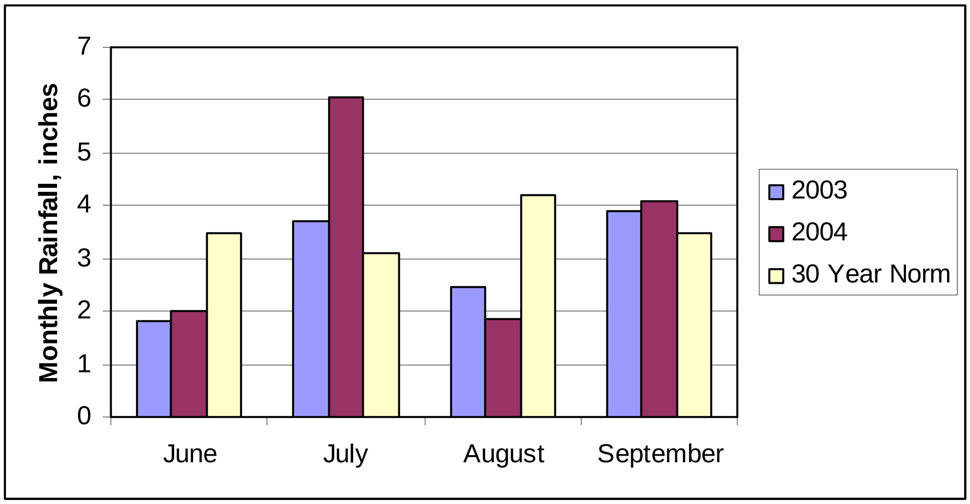


Figure 6.3 Monthly rainfall data from the Buffalo Airport

In 2003 there was a significant correlation (α=0.05) between time of sample and air temperature (r=0.53); time of sample and number of people observed in activity (r=0.60); and air temperature and number of people observed in activity (r=0.41). In 2004, correlations were weaker. The correlation between time of sample and air temperature was not significant (r=0.20) and neither was the correlation between number of people observed in activity and air temperature (r=0.002). The correlation between time of sample and number of people observed in activity was significantly correlated (r=0.32). Sunday tended to be the day of heaviest use in both 2003 and 2004; Saturday had the highest mean use of any day in 2003, but Saturday use was considerably lower in 2004. There appears to be some significant temporal trends in the level of activity, as use tends to increase through the day and, not surprisingly, is highest on weekends. The activity of fishing did not appear to attract people early in the morning.

The observed activity level of 887 person-days underestimates actual activity because it only represents a three hour segment on each of the 73 sample dates. Brother and Moore (1994) noted that samples of recreational activity should be adjusted to account for the entire period of activity. Adjustments to the estimates should consider the peak use periods, duration of the use, facility availability, resident or non-resident, and the turnover rate of the activity (Brother and Moore, 1994). Our survey data indicated that there were temporal trends in the level of activity. Given the types of activity recorded for the survey, we assumed that the turnover rate would be within the three hour time period of each survey. In our case, activity level also might have been adjusted for air temperature, but because the correlation was not significant in 2003, it was decided not to make this adjustment. A "representative" activity level for each survey time slot and each day was calculated from the observed data for each year. The representative level typically was calculated as the mean person-days from the observed data. These representative levels were used to adjust the estimate of 887 person-days for the period June through September 15 of each year. For time slots that had observed data, these were used in place of the representative level. Following this procedure, the adjusted activity level for 2003 was 6,862 person-days and for 2004 was 5,922 person-days. By way of comparison, Erie County parks totaled 120,000 visits in 2000 (i.e. Buffalo River activity was 5-6% of the Erie County park activity).

Both “formal” and “informal” spaces were used in the different activities represented in Figure 6.1. Generally, however, the “formal” spaces had the highest level of activity. Bison City Rod and Gun Club had the highest activity over the two year period, followed in order by Habitat Project Site 1 (fishing and hanging out at the “point” was popular), Ohio Basin Canoe Launch and Park, and Smith St. Habitat Remediation and Park. Habitat Project Sites 3, 4, 5, 6, 8, and 10 had the lowest level of activity of all survey sites, with each of these sites being 8 or less person-days (unadjusted numbers) over the entire two year period.

OPRHP (2002) calculated a relative index of needs on a county basis for different recreational activities observed within New York state. The index indicates the degree to which additional facilities are needed to meet future demand. A value of five indicates that for a given activity, the projected supply/demand ratio in the year 2020 will be at the statewide average. The scale ranges from 1 to 10. A value of one indicates a large availability of recreation resources relative to demand, with little or no crowding. A value of 10 indicates the opposite; most sites are heavily used. The relative index of needs for Erie County are: Swimming – 7; Walking – 7; Boating – 6; Fishing – 7. For these recreational activities OPRHP (2002) has indicated that Erie County will have pressure to meet the public demand. These activities already are observed for the Buffalo River. With improved habitat areas, the Buffalo River could have an increased capacity to meet this demand.

6.4 Land Ownership – Riparian Zone

Land ownership of the habitat sites are shown in Appendix 6.2. Clearly, some sites are entirely privately owned while other sites have mixed public and private ownership. It is unknown at this point whether any of the owners would be willing to consider a riparian restoration project on their property.

6.5 References

Brother, G. and Moore, R. 1994. Economic Impact of Assessment of Recreation Based Tourism. NCRPS Conference, Asheville, NC.

Johns, G.M., Leeworthy, V.R., Bell, F.W., and Bonn, M.A. 2003. *Socioeconomic Study of Reefs in Southeast Florida*, Report to NOAA.

Office of Parks, Recreation and Historic Preservation (OPRHP), 2002. *Final Statewide Comprehensive Outdoor Recreation Plan and Final Generic Environmental Impact Statement for New York State, 2003.* Albany, NY.

APPENDIX 6.1
FIXED RECREATIONAL USE SURVEY SITES

Kotter Fireboat

Great Lakes Fishing Club

Ohio Basin Habitat Remediation Site and Canoe Launch

Bison City Rod and Gun Club

Foot of Hamburg Street

Cargill's Grain Elevator

Concrete Central Grain Elevator

First CSX Railway Bridge

Smith St. Habitat Remediation Site

Smith St. CSO

Second CSX Railway Bridge

Third CSX Railway Bridge

Boone St. CSO

Old Bailey Woods

Seneca Bluffs

Seneca Bluffs (Continued)

Appendix **D**

Sensitive Areas Determination Documentation List

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APPENDIX D

SENSITIVE AREAS DETERMINATION

DOCUMENT LIST

- City of Buffalo land use map
- Buffalo Olmsted Parks Conservancy. January 2008. *“The Buffalo Olmsted Park System: Plan for the 21st Century”*.
- Buffalo Niagara Riverkeeper. October 2005. *“Buffalo River Remedial Action Plan – 2005 Status Report”*.
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- New York State. Department of Environmental Conservation. August 25, 2010. *“Improvements at Hoyt Lake, Scajaquada Creek Slated to Get Underway”.*
- New York State. Department of Environmental Conservation. February 1, 2011. *“New York’s Great Lakes Basin: Framework for Action 2011”*.
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- New York State. Department of Environmental Conservation. October 15, 1987. *“Coastal Fish & Wildlife Habitat Rating Form – North Buffalo Harbor”*.
- New York State. Department of Environmental Conservation. Regulations, Chapter X, Part 701: Classifications – Surface Waters and Groundwaters. <www.dec.ny.gov/regs/4592.html>
- New York State. Department of Environmental Conservation. Regulations, Chapter X, Part 837: Lake Erie (East End) – Niagara River Drainage Basin. <www.dec.ny.gov/regs/4566.html>

- New York State. Department of Environmental Conservation. September, 2010. *"The Niagara River/Lake Erie Basin Waterbody Inventory and Priority Waterbodies List".*
- New York State. Department of Transportation. "Scajaquada Corridor". 2011. <www.nysdot.gov/scajaquadacorridor>.
- New York State. Office of Parks, Recreation and Historic Preservation. December 10, 2008. *"Statewide Comprehensive Outdoor Recreation Plan (SCORP) – Executive Summary"*.
- Pawenski, Christopher. Erie County Department of Environment & Planning. Telephone conversation. August 30, 2011.
- Peter J. Smith & Company, Inc., Black Rock Canal Park Feasibility Analysisk. November 2010.
- United States Environmental Protection Agency-Region 2 and the New York State Department of Environmental Conservation-Region 9. December 2010. "*Status Update for Reduction of Toxics Loading to the Niagara River from Hazardous Waste Sites in the United States".*

Telephone Conversation Record

Date / Time:	June 8, 2011 / 10:20 am
Spoke With:	Dave Denk, Permitting
Of:	New York State Dept. of Environmental Conservation
Phone No.:	716-851-7070
Prepared By:	Angela M. Hintz
Project / Project No.:	Buffalo Sewer Authority Long-Term Control Plan / 1777122
Re:	Development along Waterbodies in Buffalo

Rob Locey had talked to Dave Denk following our conversation on 6/7/2011 and Dave left me a voicemail on the morning of 6/8/2011. I subsequently returned his call on 6/9/2011 at 10:20 am.

Dave indicated that there were several projects that he was aware of involving both the Buffalo River and the Scajaquada Creek Area. When asked if there were any reports on the projects that he could refer me to, he pointed toward the Buffalo Niagara Riverkeeper website for information on projects along the Buffalo River and to the New York State Dept. of Transportation on the Scajaquada Creek project (i.e. Scajaquada Parkway plans). He indicated that there might be some additional information on the DOT website.

I indicated that the Buffalo Sewer Authority has been working along with the Buffalo Niagara Riverkeepers and was aware of the Buffalo River projects and indicated I would follow up with the DOT website on any development for Scajaquada Creek.

He was not aware of any other projects or proposed development other than the two areas listed above.

Telephone Conversation Record

Date / Time:	June 6, 2011 / 2:18 pm
Spoke With:	Rob Locey
Of:	New York State Dept. of Environmental Conservation
Phone No.:	716-851-7070
Prepared By:	Angela M. Hintz
Project / Project No.:	Buffalo Sewer Authority Long-Term Control Plan / 1777122
Re:	Development along Waterbodies in Buffalo

Initially left voice mail message for Rob on 6/6/2011. Call was returned by Rob on 6/7/2011 at 4:42 pm. He was initially drawing a blank when asked if there were any written plans that he was aware of outlining projects that may impact water quality in the Buffalo area. He was also not aware of any department-led efforts. He indicated that David Denk of his office may also be of some assistance, as Dave deals with permitting and would know of any shoreline development projects that are taking place.

Telephone Conversation Record

Date / Time:	June 6, 2011 / 2:10 pm
Spoke With:	Delores Funke, PE
Of:	Erie County Health Department
Phone No.:	716-961-6832
Prepared By:	Angela M. Hintz
Project / Project No.:	Buffalo Sewer Authority Long-Term Control Plan / 1777122
Re:	Development along Waterbodies in Buffalo

Delores had indicated that there was currently not a lot of development taking place in the area, at least that she was aware of. She personally was not aware of any development that might affect future waterbody uses in the future; although she indicated that she personally does not review these projects unless water main or sewer main extensions are involved. She indicated that she would check with some of her colleagues in the Department and get back to me.

Received 2nd call from Delores on June 7, 2011 at 10:40 am. She was calling to report her findings from her colleagues. She talked with Rick Wojcik who deals with water-related permitting and also emailed John Finster. Rick indicated that the only projects he was aware of were expansion of activities at Woodlawn Beach (outside and upstream of the City of Buffalo) and a new camping area in Grand Island. However, it was noted that the new camping area would not involve any increased recreation on area waterbodies as an inland pond was proposed for this and a swimming pool is also planned. Therefore, there are no impacts on waterbodies such as the Niagara River.

Delores also reported that she has not received any concerns with the water intakes for the Town of Tonawanda and the Erie County Van de Water Treatment Plants in the Niagara River. An increase in turbidity is observed during wet weather events, but other than that, raw water quality does not reflect any issues associated with CSO discharges.

MALCOLM PIRNIE

Telephone Conversation Record

Date / Time:	August 30, 2011
Spoke With:	Christopher Pawenski, Coordinator of Industrial Assistance Programs
Of:	Erie County Department of Environment & Planning
Phone No.:	716-858-6716
Prepared By:	Angela M. Hintz
Project / Project No.: 01777122.0000	Buffalo Sewer Authority Long Term Control Plan /
Re:	Black Rock Canal Park

Spoke with C. Pawenski regarding the implementation of a new County Park (Black Rock Canal Park) to be located near the area of the Ontario Street Boat Launch and the confluence of Cornelius Creek with the Niagara River.

Prior to phone conversation, found documentation on this park on www.erie.gov. to prepare for the conversation. Found document prepared by peter j. smith and company, inc., who prepared the feasibility study for Erie County.

Park concept was originally generated by the Black Rock neighborhood to provide public amenities includes mixed use building, reconfigured parking, more green space, playground, improved bike path, boardwalk, improved entrance road, and a covered creek. The original Black Rock neighborhood plan was considered in the Feasibility study along with two other alternatives:

- Modified Plan – 300-ft pier with 35 slips
- Alternate Plan – 70-ft pier with 18 slips and paddleboat launch

The County currently has funding for some initial work including improvements to the entrance road and improvements to the parking area. They have not decided on the ultimate plan (Modified vs. Alternate Plan). The subsequent phases will not be worked on until funding is raised and also the plans for Cornelius Creek have been finalized.

Home » Public Involvement and News » News » Press Releases » 2010 Press Releases » Improvements at Hoyt Lake, Scajaquada Creek Slated to Get Underway

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- Regulations and Enforcement
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For Release: Wednesday, August 25, 2010

Improvements at Hoyt Lake, Scajaquada Creek Slated to Get Underway

Repairs Will Boost Oxygen Levels - Improving Water Quality, Reducing Algae

New York State Environmental Conservation Commissioner Pete Grannis joined state legislators today to announce a new initiative to bring immediate water quality improvements Hoyt Lake and the Scajaquada Creek waterway, a vital urban stream leading to the Niagara River.

A $150,000 state grant will be used to upgrade groundwater wells and three pumps along the lake. The project is designed to provide up to 1.85 million gallons per day of fresh, clean water to the lake - boosting oxygen levels in the lake and providing immediate water-quality improvements.

The grant comes from the state's Environmental Protection Fund and is a direct result of a previous initiative to study pollution problems at the lake and the creek. Commissioner Grannis was joined by Senator Antoine Thompson and Assemblyman Sam Hoyt at a news conference in Buffalo to announce that repair work is slated to begin by mid- to late-fall.

"One of the findings of the study was that the wells had begun to fail and that the pumps required serious maintenance," Commissioner Grannis said. "With a little work, we can make an immediate impact. By boosting oxygen levels, we can reduce nuisance algae and odor problems - and improve aquatic habitat at this popular fishing spot. This will provide a first step toward making long-term improvements at Hoyt Lake and Scajaquada Creek."

Contact for this Page

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Commissioner Grannis thanks Senator Thompson and Assemblyman Hoyt, whose support made the EPF grant possible.

"The people of Buffalo deserve water bodies where they can fish, swim, boat and relax. Cleaning up Scajaquada Creek and Hoyt Lake is a major priority in our community," Senator Thompson said. "That was made clear at the Scajaquada Summit I held last week, attended by 75 representatives of various organizations and agencies. I want to thank Commissioner Grannis for making this funding available, and I look forward to improved water quality. As Chair of the Senate Environmental Conservation Committee, I am dedicated to bringing the day when Hoyt Lake and Scajaquada Creek are odor free and perfectly safe to fish, swim and boat in."

"Hoyt Lake is the centerpiece of Frederick Law Olmsted's magnificent design for the Buffalo park system," said Assemblyman Sam Hoyt. "Nearly 40 years ago, my father spearheaded the environmental remediation of the lake. I know that dad would be pleased that his good friend, Commissioner Grannis, has taken a leadership role in assuring that it remains a priority to keep it clean for the people of Western New York to enjoy."

"I am pleased to see this grant being used for a project that will have such a fundamental impact on our city," said Mayor Byron W. Brown. "Water quality improvement is crucial - for our environment, ecosystem, and residents' quality of life. These bodies of water are instrumental in Buffalo's economic well-being, tourism, and international relations. The benefit of this initiative will reach beyond the local level, as part of the global movement towards making water systems healthier and smarter."

"Hoyt Lake and Scajaquada Creek are well loved City of Buffalo waterways," said Julie Barrett O'Neill, Executive Director of Buffalo Niagara Riverkeeper. "Of course, there is much work needed to clean up the water in support of new habitat and recreational improvements. This project is one of the first of what we hope will be many investments in restoring the creek for generations to come."

Scajaquada Creek, including Hoyt Lake, are listed in the Department of Environmental Conservation's (DEC) statewide "List of Impaired Waters" because of concerns with bacteria, low dissolved oxygen and sewage from sewer overflows. DEC is working with the City of Buffalo, the Buffalo Sewer Authority and upstream municipalities to address the sewer overflow problems.

Appendix 6-3: Technical Memorandum: Baseline Water Quality Modeling For Buffalo River, Scajaquada Creek, Niagara River, and Black Rock Canal(LTI)

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Technical Memorandum: Baseline Water Quality Modeling For Buffalo River, Scajaquada Creek, Niagara River, and Black Rock Canal

Prepared On Behalf Of
The Buffalo Sewer Authority

March 30, 2012

LimnoTech
Water | Environment | Scientists | Engineers

Ann Arbor, Michigan
www.limno.com

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LIST OF APPENDICES

1. INTRODUCTION

This technical memo describes modification of water quality models of the Niagara River, Buffalo River, Black Rock Canal, and Scajaquada Creek, to simulate typical year baseline conditions in these water bodies. The development and calibration of the models discussed herein were documented in a separate report submitted to USEPA (LimnoTech, 2010). LimnoTech prepared this technical memo on behalf of the Buffalo Sewer Authority (BSA), under subcontract to Arcadis/Malcolm Pirnie.

1.1 OBJECTIVE

The objective of the work described in this technical memo was to develop modified versions of the calibrated hydrodynamic and water quality models, to allow their use in evaluating combined sewer overflow (CSO) control alternatives for the typical hydrologic year used in BSA’s Long-Term Control Plan (LTCP). The modifications included revised model inputs for upstream boundary conditions, CSO loads, storm water loads, point source loads, and direct climate model inputs, for the typical year selected for analysis of CSO control alternatives.

1.2 TYPICAL YEAR

The typical year selected for use in evaluating CSO control alternatives in this analysis is referred to as the 1993 typical year (TY93). This typical year was determined and defined by Arcadis/Malcolm Pirnie. A summary description of the 1993 typical year is presented in Section 2.1 of this memo.

1.3 MEMO ORGANIZATION

This technical memo is organized as follows:

- Section 2 of this memorandum describes modifications made to the calibrated water quality models for the Niagara River, Buffalo River, Black Rock Canal, and Scajaquada Creek to support a set of alternative scenario runs based on a selected typical year.
- Section 3 of this memorandum includes the graphical and statistical results of four typical year baseline simulations: 1) Baseline, 2) Baseline with reduced background loads, 3) No CSOs, and 4) No CSOs with reduced background loads.
- Section 4 provides a summary of the work presented in the memo.
- Appendices A through D provide detailed model results of the four scenarios as maps and plots.

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2. MODIFICATION OF CALIBRATED MODEL FOR USE WITH TYPICAL YEAR

As documented by LimnoTech (2010), water quality models of the Buffalo River, Scajaquada Creek, Black Rock Canal, and Niagara River were calibrated to historical conditions. In order to run this set of water quality models for a 1993 "typical year" (TY) condition, it was necessary to revise model inputs for upstream boundary conditions, CSO loads, storm water loads, point source loads, and direct climate model inputs.

2.1 UPSTREAM BOUNDARY CONDITIONS

The 1993 TY analysis required establishment of boundary condition flows and concentrations for the following model upstream boundary locations:

- Scajaquada Creek just upstream of the entrance to Scajaquada Drain
- Cazenovia Creek at the water fall in Cazenovia Park (near Cazenovia St.)
- Buffalo River at the confluence of Buffalo and Cayuga Creeks

The 1993 TY is based on the 1993 precipitation year with the following modifications made to the precipitation data set[1]:

- Removed the 1/3/93 (1.6") event.
- Added a 1.24" event on 5/6/93 that corresponds to a historical event that occurred on 5/6/85.
- Removed the 6/9/93 (0.8") event.
- Added a 0.52" event on 7/7/93 that corresponds to a historical event that occurred on 7/7/61.
- Added a 0.77" event on 7/28/93 that corresponds to a historical event that occurred on 7/28/73.
- Added a 0.60" event on 8/19/93 that corresponds to a historical event that occurred on 8/19/73.
- Removed the 8/20/93 (1.46") event.
- Removed the 9/25/93 (1.26") event.

2.1.1 Flow Boundary Conditions

Arcadis/Malcolm Pirnie provided an upstream boundary hydrograph for Scajaquada Creek for the modified 1993 hyetograph which was developed directly from collection system model output.

Upstream flows for the Buffalo River and Cazenovia Creek were developed based on historical 1993 USGS flow data which were adjusted to reflect storms added or removed during development of the 1993 TY. Flow boundary conditions for the Buffalo River and Cazenovia Creek were first established based on daily average flow data from USGS gage stations located upstream of the model boundary locations

[1] Pers. Communication J. Hothem, January 10, 2012.

defined for each tributary. The boundary condition flows for the Buffalo River were calculated as the sum of flows from Buffalo Creek and Cayuga Creek. The historical data measured at each gage station were scaled up to account for the additional watershed drainage area between the gage and the model boundary (Table 2-1).

Table 2-1. USGS Gage Stations and Scale Factors

River	Gage	Scale Factor
Cayuga Creek	04215000	1.33
Buffalo Creek	04214500	1.02
Cazenovia Creek	04215500	1.02

Periods of additional flow were added to the time series flow files for both the Buffalo River and Cazenovia Creek to reflect additional rainfall that was added to the collection system model inputs to establish the 1993 TY. First, a hydrograph separation technique was used to separate base flow from runoff flow for each historical time series. Then, the runoff portion of each hydrograph was increased for each day that additional rainfall was added. The size and duration of the increase was determined based on the historical hydrographs for 5/6/85, 7/7/61, 7/28/73, and 8/19/73, the corresponding precipitation events that were added to as part of the 1993 TY construction.

As compared to 1993 historical precipitation records, the "typical year" precipitation time series includes several instances where precipitation was removed. When establishing upstream flow boundary conditions, the runoff portion of the hydrograph was removed for these events. Table 2-2 summarizes the original and new daily average flow for Buffalo River and Cazenovia Creek for the eight altered precipitation events.

Table 2-2. Summary of original and modified daily average flows for Buffalo River and Cazenovia Creek.

		Buffalo Flow (cfs)		Cazenovia Flow (cfs)		Rainfall Change	
Event	Date	Original	New	Original	New	Add/Remove	Rain (in)
1	1/3/1993	439	439	245	245	Remove	1.6
	1/4/1993	993	354	1005	112		
	1/5/1993	4397	354	2898	112		
2	5/6/1993	276	679	120	444	Add (5/6/85)	1.24
	5/7/1993	208	402	93	118		
3	6/9/1993	488	354	148	112	Remove	0.8
4	7/7/1993	28	28	17	17	Add (7/7/61)	0.52
5	7/28/1993	25	25	12	12	Add (7/28/73)	0.77
6	8/19/1993	22	22	18	18	Add (8/19/73)	0.6
7	8/20/1993	19	19	26	26	Remove	1.46
8	9/25/1993	27	27	20	20	Remove	1.26
	9/26/1993	132	132	86	86		

As was done during the initial model development and calibration, upstream flow conditions for the Niagara River model were driven by historical data obtained from the National Oceanic and Atmospheric Administration (NOAA). Year 1993 water surface elevation measurements at station 9063020 (Buffalo, NY) were converted to hourly flow data using a rating curve developed by the USGS. Hydrodynamics at the downstream boundary of the Niagara River model were driven using year 1993 hourly water surface elevation measurements at NOAA station 9063009 (American Falls, NY).

2.1.2 Upstream Water Quality Boundary Conditions

Observed data from 2000 (Buffalo River) and 2008-2009 (Scajaquada Creek) were used to establish upstream water quality boundary conditions for fecal coliform bacteria and biochemical oxygen demand (BOD). Flow vs. water quality regression plots of these data were determined to not be useful. Therefore, available data were "averaged" to establish reasonable concentrations.

Bacteria and BOD samples were divided into three groups representing distinct hydrologic regimes: dry weather, rising limb wet weather and falling limb wet weather. "Dry" was assigned only to those samples collected during dry weather, and wet weather event samples were divided into "rising" and "falling" regimes.

Various types of averages (arithmetic mean, median, geometric mean [for bacteria only] and harmonic mean) were then calculated for each group of results. Non-detects were handled two different ways: either included in the averaging at half the detection limit, or excluded entirely from the averaging. This had notable impacts for BOD because of the large number of non-detects; for fecal coliform, most samples were detectable.

After examination of model sensitivities to these various options for calculating upstream WQ boundary conditions, the following approach was chosen: 1) calculate upstream BOD concentrations as the median of all data with non-detect measurements assumed to be equal to 0.5 of the detection limit; and 2) calculate upstream fecal coliform concentrations as the geometric mean of all data with non-detect measurements excluded. Table 2-3 summarizes the concentrations used for each model input.

Table 2-3. Upstream WQ Boundary Conditions for Each Model Input

	Scajaquada		Cazenovia		Buffalo	
Hydrograph period	Fecal (#/100 mL)	BOD (mg/L)	Fecal (#/100 mL)	BOD (mg/L)	Fecal (#/100 mL)	BOD (mg/L)
Dry	531	1	148	2.5	345	2.5
Rising	5,945	7.6	15,017	2.5	11,462	2.5
Falling	5,218	2.6	7,126	2.5	4,145	2.5

Fecal coliform bacteria and BOD EMCs were consistent with values used in the model calibration. A summary of concentrations is provided in Table 4.

Background (Lake Erie) fecal coliform concentrations for the Niagara River model were consistent with values used in the model calibration. A fecal coliform concentration of 10 #/100mL was selected based on available monitoring data from the Buffalo Water Authority intake on Lake Erie near the mouth of the Niagara River, as described in the model development and calibration report (LimnoTech, 2010).

2.2 CSO LOADS

Arcadis/Malcolm Pirnie provided LimnoTech with CSO hydrographs corresponding to the 1993 TY. These CSO flows were applied as inputs to corresponding CSO discharge locations within each model. The concentration of CSO discharges to each water body was based on EMCs which were consistent with values used in the model calibration (LimnoTech, 2010). A summary of concentrations is provided in Table 2-4.

Table 2-4. Summary of EMCs for CSO Inputs

Parameter	Scajaquada Creek (above Grant Street Dam)	Buffalo River	Black Rock Canal (and Scajaquada Creek below Grant Street Dam)	Niagara River
Fecal Coliform (#/100 / mL)	200,000	150,000	100,000	100,000
BOD (mg/L)	26	24	40	n/a

2.3 STORMWATER LOADS

In-area separate storm water flows for the 1993 TY were generated by the collection system model and input to each of the four receiving water quality models as discrete time series inputs. Arcadis/Malcolm Pirnie provided LimnoTech with storm water hydrographs corresponding with the 1993 TY. These storm water flows were applied as inputs to corresponding storm water discharge locations within each model. The concentration of storm water discharges to each water body was based on EMCs which were consistent with values used in the model calibration (LimnoTech, 2010). A summary of concentrations is provided in Table 2-5.

Table 2-5. Summary of EMCs for Storm Water Inputs

Parameter	Scajaquada Creek (above Grant Street Dam)	Buffalo River	Black Rock Canal (and Scajaquada Creek below Grant Street Dam)	Niagara River
Fecal Coliform (#/100 / mL)	150,000 / 1,000[1]	10,000	10,000	10,000
BOD (mg/L)	30 / 2[1]	12	8	n/a

[1] The first value was applied for initial 2 hours of storm and second value was applied for balance of the storm.

2.4 POINT SOURCE LOADS

As described in the water quality calibration report, both the Buffalo River and Niagara River receive point source discharges; however, there are no permitted point source discharges directly to Scajaquada Creek or Black Rock Canal.

For the Buffalo River, a total discharge of 10.4 MGD was applied to the model cell at river mile 5 to account for PVS Chemical (NY0110043) and Buffalo Color Corp (NY0002470). This value represents the most recent annual discharge on record, corresponding to the year 2006. These two permitted facilities withdraw water from Lake Erie through the Buffalo River Improvement Corporation (BRIC) intake and discharge non-contact cooling water into the Buffalo River. Concentrations of dissolved oxygen (DO), BOD, and bacteria for the discharge were assumed to be the same as Lake Erie. These model inputs are consistent with what was used for the model calibration (LimnoTech, 2010).

Data for the Bird Island Wastewater Treatment facility, which discharges to the Niagara River, were obtained from the Buffalo Sewer Authority (BSA, 2011). The data included daily measurements of flow and fecal coliform geometric mean concentrations for outfalls 001 (primary treatment only) and 002 (secondary treatment) for the year 2006.

2.5 TYPICAL YEAR CLIMATE DATA

Meteorological data obtained from three separate sources were used to define climate boundary conditions for the various models for the 1993 typical year. Hourly surface air pressure data were obtained from the National Buoy Data Center (NBDC) for the station Buf N6. Daily relative humidity and dry bulb temperature data were obtained from the National Data Center (NCDC) for the Buffalo Niagara International Airport (COOP ID 725280). Cloud cover was calculated as a function of precipitation, dew point temperature, and average temperature from NCDC daily data. Hourly solar radiation values were obtained from the National Solar Radiation Database (NSRDb) for the Buffalo Niagara station for the year 1993. This differs from the approach used in calibration, where typical year solar radiation data was obtained from Capella Energy (Capella Energy, 2010) due the unavailability of solar radiation data at surrounding climate stations during the calibration period.

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3. BASELINE MODEL RESULTS

3.1 BASELINE SCENARIO ASSUMPTIONS

Once the water quality models were adapted to simulate the 1993 TY, a set of four baseline scenarios were run to explore the water quality response under a range of conditions:

- **Baseline:** Flows and concentrations of all sources are consistent with existing conditions for the 1993 TY.
- **Baseline – Background 75% of WQS:** CSO flows and concentrations are consistent with existing conditions for the 1993 TY. Flows for background sources (storm water and upstream boundaries) are consistent with existing conditions. Water quality for background sources are reduced to a condition of: 1)150 #/100 mL (bacteria), and 2) 75% of existing conditions (BOD).
- **No CSOs:** CSO flows and concentrations are set to zero. Background flows and concentrations are consistent with existing conditions for the 1993 TY.
- **No CSOs – Background 75% of WQS:** CSO flows and concentrations are set to zero. Flows for background sources (storm water and upstream boundaries) are consistent with existing conditions. Water quality for background sources are reduced to a condition of: 1) 150 #/100 mL (bacteria), and 2) 75% of existing conditions (BOD).

The suite of water quality models were run for each scenario described above, moving in sequence from upstream to downstream. Hourly model output for bacteria and dissolved oxygen were post-processed for each water body and compared with existing New York surface water quality standards (WQS) to assess water body attainment.

Table 3-1 describes the fecal coliform and dissolved oxygen water quality standards for each water body and modeling domain. These standards are consistent with standards set for water body classifications A-Special, B, and C.

Table 3-1. Classification and Surface Water Quality Standards for Water Bodies and Constituents of Interest

Water body	Segment / Location	Water body Classification	Numeric Criteria (Fecal Coliform)*	Numeric Criteria (Dissolved Oxygen)
Black Rock Canal	From locks to south end of Bird Island Pier	C	Monthly geomean ≤ 200/100 mL (N ≥ 5)	Minimum daily average ≥ 5 mg/L. Concentration may never be less than 4 mg/L.
Buffalo River/ Cazenovia Creek	Buffalo River from mouth to City of Buffalo-West Seneca town line and including Buffalo Ship Canal	C	Monthly geomean ≤ 200/100 mL (N ≥ 5)	Minimum daily average ≥ 5 mg/L. Concentration may never be less than 4 mg/L.
	Cazenovia Creek from mouth at Buffalo River to Cazenovia Street Bridge (just d/s of waterfall)	C	Monthly geomean ≤ 200/100 mL (N ≥ 5)	Minimum daily average ≥ 5 mg/L. Concentration may never be less than 4 mg/L.
Niagara River (U.S regions only)	Modeled portions of Niagara River <u>west</u> of breakwaters located to the south of Bird Island Pier	A-Special	30-day geomean ≤ 200/100 mL (N ≥ 5)	*Not applicable – dissolved oxygen not modeled in this water body*
	Modeled portions of Niagara River <u>east</u> of breakwaters located to the south of Bird Island Pier	B, C	Monthly geomean ≤ 200/100 mL (N ≥ 5)	*Not applicable – dissolved oxygen not modeled in this water body*
Scajaquada Creek	From mouth to Cheektowaga town line	B, C	Monthly geomean ≤ 200/100 mL N ≥ 5)	Minimum daily average ≥ 5 mg/L. Concentration may never be less than 4 mg/L.

(*) The total and fecal coliform standards for classes B, C, D, SB, SC and I shall be met during all periods:
(1) when disinfection is required for SPDES permitted discharges directly into, or affecting the best usage of, the water; or
(2) when the department determines it necessary to protect human health.

3.1.1 Calculation of Bacteria Attainment

The following bullet points summarize how WQS attainment was calculated for fecal coliform bacteria:

- Hourly model output was averaged to a daily value for each simulation day;
- For Niagara River (Class A-Special), a ***rolling 30-day*** geometric mean was calculated for each time period and compared to the criterion of 200 CFU / 100 mL;
- For all other water bodies of interest (Classes B or C), a ***monthly*** geometric mean was calculated and compared to the criterion of 200 CFU / 100 mL (one geometric mean for each month in the 12-month typical year);
- The percent attainment, reflective of the entire "typical year" simulation period, was calculated for each model cell and either mapped or shown as a longitudinal plot. For the rolling 30-day geometric mean, the percent attainment was calculated as the number of results < 200 divided by 335. For the monthly geometric mean, the percent attainment will be calculated as the number of monthly geometric means < 200 divided by 12; and
- In model domains with multiple vertical cells (e.g., Black Rock Canal, lower end of Buffalo River), the fecal coliform concentrations for the surface model cell was used to determine percent attainment.

3.1.2 Calculation of Dissolved Oxygen Attainment

The following bullet points summarize how WQS attainment was calculated for DO:

- Hourly model outputs were used to compute both daily average and daily minimum DO concentrations for each model cell and simulation day;
- For all applicable water bodies (Classes B or C), the daily ***average*** DO concentration was compared to a criterion of 5 mg/L;
- For all applicable water bodies (Classes B or C), the daily ***minimum*** DO concentration was compared to a criterion of 4 mg/L;
- The percent attainment, reflective of the entire "typical year" simulation period, was calculated in reference to both daily average and daily minimum WQS. Both results were compiled for each model cell and either mapped or shown as a longitudinal plot; and
- In model domains with multiple vertical cells (e.g., Black Rock Canal, lower end of Buffalo River), the most critical cell was mapped or plotted.

3.2 RESULTS

The following sections contain summary results for the four scenarios in terms of attainment of bacteria and dissolved oxygen water quality standards.

3.2.1 Bacteria WQS Attainment

Table 3-2 provides a summary of annual percent attainment of bacteria water quality standards for all modeled water bodies and all four baseline scenarios. Attainment was first calculated for each model segment and then spatially averaged across each water body.

When considering all water bodies collectively, the *No CSO - Background at 75% of WQS* scenario provides the greatest attainment of WQS and the *Baseline* scenario provides the least attainment.

Upper Scajaquada Creek, Lower Scajaquada Creek, and the Buffalo River demonstrated increased attainment for the reduced background scenarios (*Bkgd 75% of WQS* and *No CSO – Bkgd 75% of WQS*) as compared to scenarios with existing conditions for background sources (*Baseline* and *No CSO*). Black Rock Canal showed a slight increase in attainment with the reduced background scenarios as compared to existing conditions for background sources, whereas Erie Basin showed no increase in attainment (all scenarios resulted in 100% attainment). All water bodies (with the exception of Erie Basin) demonstrated a slight increase in attainment for the No CSO scenarios (*No CSO* and *No CSO – Bkgd 75% of WQS*) as compared to scenarios with Baseline CSO loading (*Baseline* and *Bkgd 75% of WQS*). For all scenarios, 100% attainment of water quality standards was calculated for the Niagara River and Erie Basin

Table 3-2. Water Quality Standards for Bacteria, Baseline Scenarios (Averaged across Water Body and Typical Year)

Bacteria						
Scenario	Annual Percent Attainment (%) of WQS					
	Upper Scajaquada Creek	Lower Scajaquada Creek	Buffalo River	Black Rock Canal	Erie Basin	Niagara River
1993 TY - Baseline	47.6	4.6	33.6	84.0	100.0	100.0
1993 TY - Bkgd 75% of WQS	98.9	77.0	93.1	85.5	100.0	100.0
1993 TY - No CSO	49.4	8.0	49.1	95.2	100.0	100.0
1993 TY - No CSO - Bkgd 75% of WQS	100.0	100.0	100.0	100.0	100.0	100.0

Figures 3-1 to 3-4 provide a month-by-month graphical comparison between all four baseline scenarios for area-weighted monthly attainment of bacteria water quality standards.

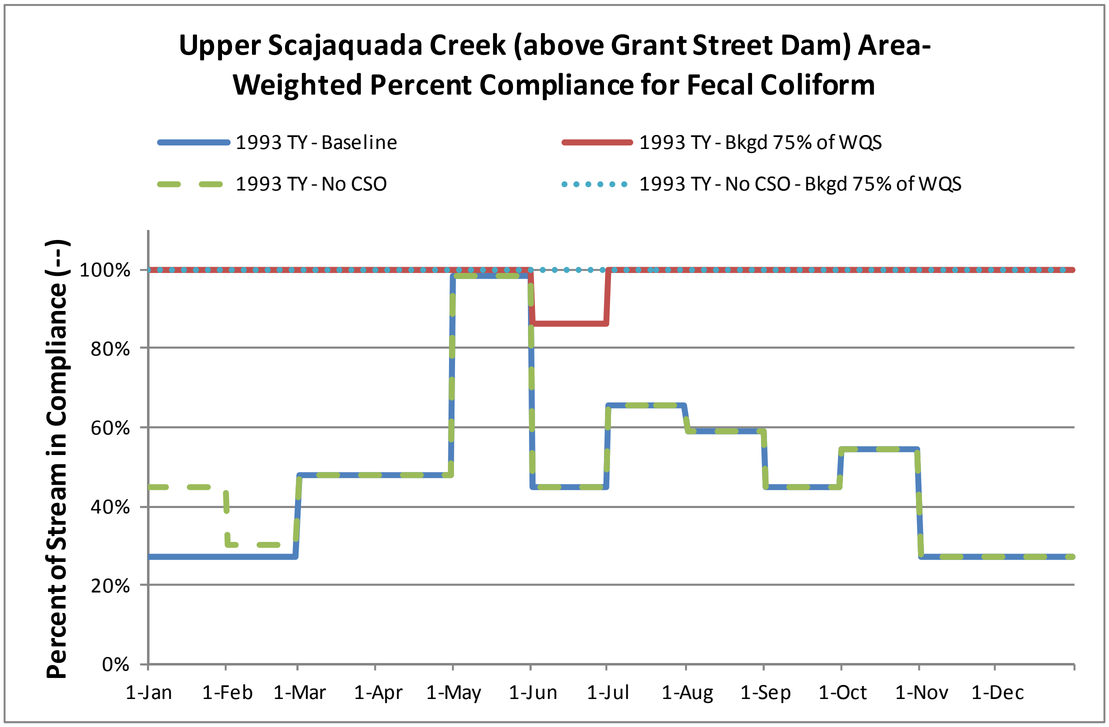

Figure 3-1. Upper Scajaquada Creek Area-Weighted Fecal Coliform Monthly Attainment, All "Baseline" Scenarios

For Upper Scajaquada Creek, the "No CSO, Background at 75% of WQS" scenario provides the greatest attainment of WQS, at 100%. The "Baseline" scenario provides the least attainment, ranging from 27% in winter months to nearly 100% in May; the balance of the summer and fall months range from 40% to 60%. The greatest increase in WQS attainment is observed when background concentrations are set at 75% of the WQS, where all months except June reach 100% attainment. Eliminating CSOs increased attainment slightly in January and February, but not as greatly as the reduced background concentrations scenario.

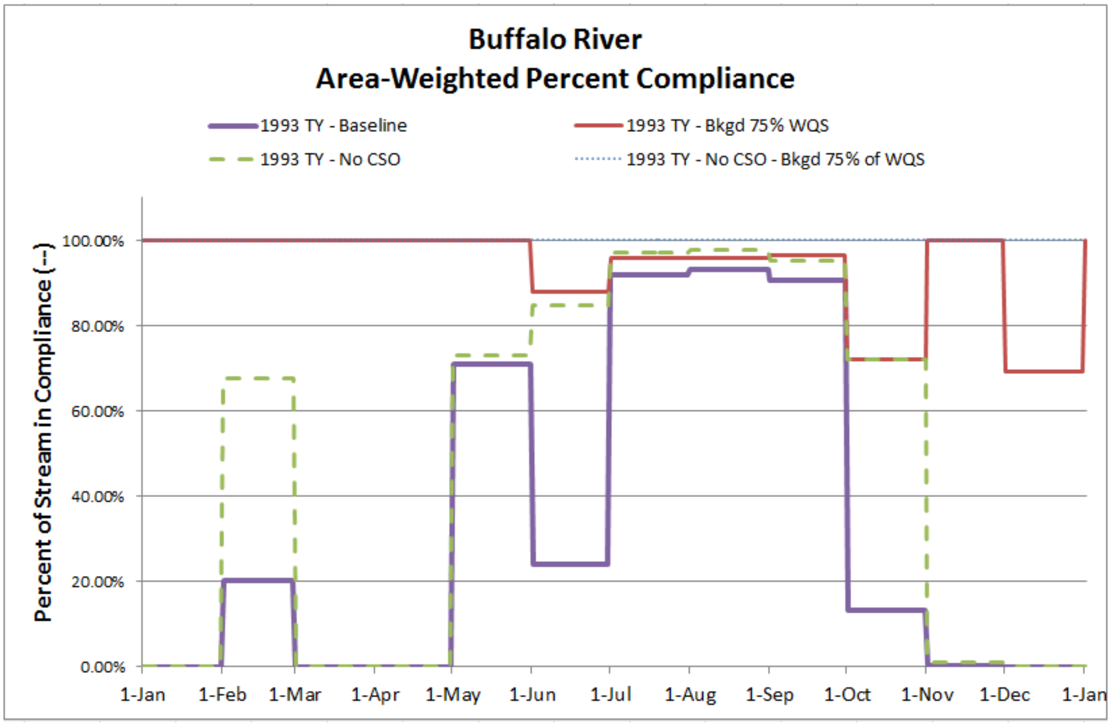

Figure 3-2. Buffalo River Area-Weighted Fecal Coliform Monthly Attainment, All "Baseline" Scenarios

For the Buffalo River, the "No CSO, Background at 75% of WQS" scenario provides the greatest attainment of WQS, at 100%. The "Baseline" scenario provides the least attainment, between 0% in winter months and 93% in August. The greatest increase in WQS attainment is observed when background concentrations are set at 75% of the WQS, where six of twelve months reach 100% attainment. Eliminating CSOs increased attainment primarily in non-winter periods (with the exception of February), but not as greatly as the reduced background concentrations scenario.

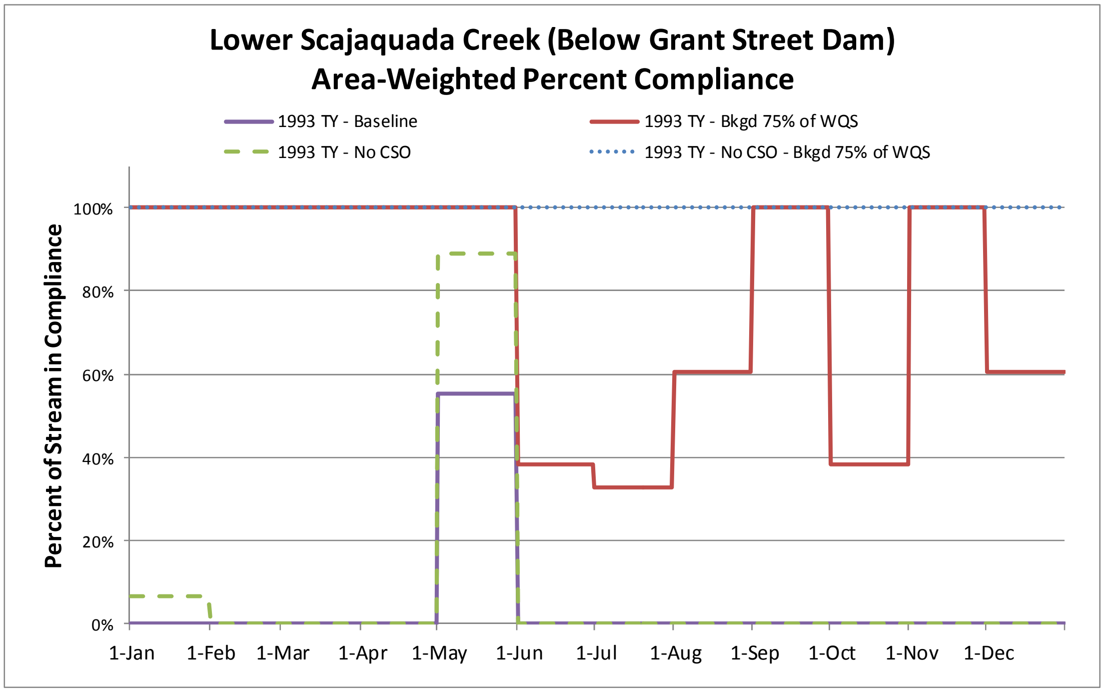

Figure 3-3. Lower Scajaquada Creek Area-Weighted Monthly Attainment, All "Baseline" Scenarios

For Lower Scajaquada Creek, the "No CSO, Background at 75% of WQS" scenario provides the greatest attainment of WQS, at 100%. The "Baseline" and "No CSO" scenarios provide the least attainment; the "Baseline" scenario showed 0% attainment for all months except May, and the "No CSO" scenario showed 0% attainment in all months except for January and May. The greatest increase in WQS attainment is observed when background concentrations are set at 75% of the WQS. A combination of reduced background sources and elimination of CSOs resulted in 100% attainment for all months.

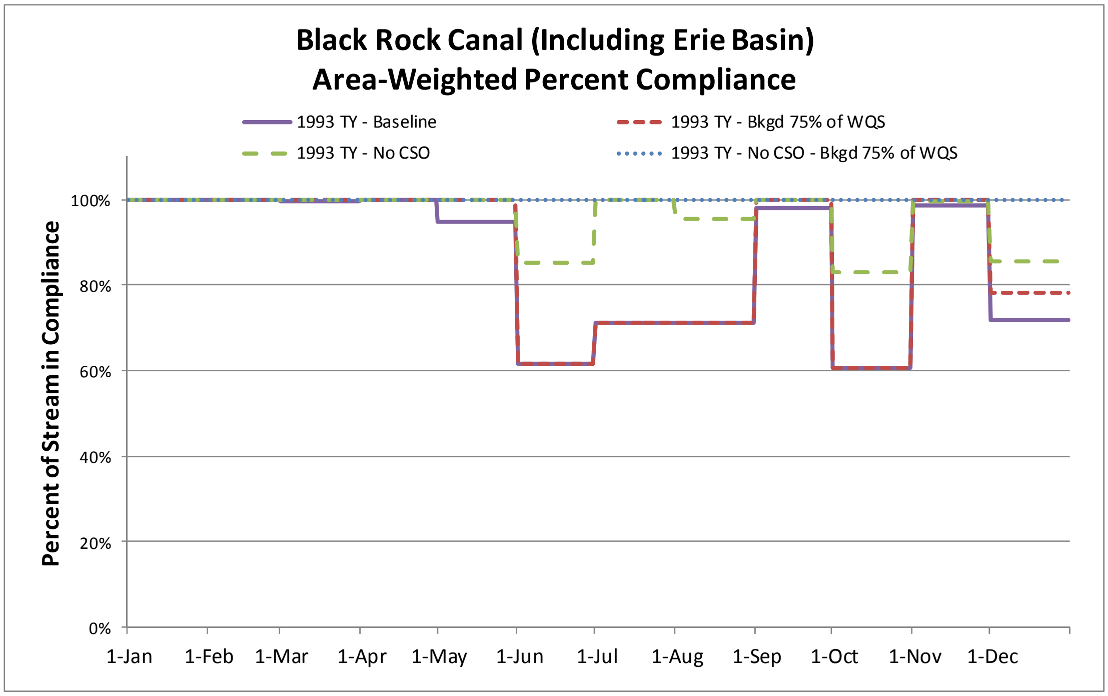

Figure 3-4. Black Rock Canal Area-Weighted Monthly Attainment, All "Baseline" Scenarios (Includes Erie Basin)

For Black Rock Canal, the "No CSO, Background at 75% of WQS" scenario provides the greatest attainment of WQS, at 100%. The greatest increase in WQS attainment is observed when CSOs are eliminated compared to the baseline.

Detailed results for each water body can be found in Appendices A (Upper Scajaquada Creek), B (Buffalo River), C (Lower Scajaquada Creek, Black Rock Canal), and D (Niagara River).

3.2.2 Dissolved Oxygen WQS Attainment

Tables 3-3 and 3-4 provide summaries of annual percent attainment of dissolved oxygen water quality standards for all modeled water bodies and all four baseline scenarios. Attainment was first calculated for each model segment and then spatially averaged across each water body.

In general, dissolved oxygen attainment is very high and similar for each scenario for Upper Scajaquada Creek, Lower Scajaquada Creek, and Black Rock Canal. For all water bodies, the "No CSO, Background at 75% of WQS" scenario provides the greatest attainment of WQS. However, the improvement relative to the "Baseline" scenario is slight.

Detailed results for each water body can be found in Appendices A (Upper Scajaquada Creek), B (Buffalo River), C (Lower Scajaquada Creek, Black Rock Canal) and D (Niagara River).

Table 3-3. Annual Percent Attainment of Water Quality Standards for Daily Average Dissolved Oxygen, Baseline Scenarios, All Modeled Water Bodies

Dissolved Oxygen, Daily Average (Critical Cell)				
Scenario	Annual Percent Attainment (%) of WQS			
	Upper Scajaquada Creek	Lower Scajaquada Creek	Buffalo River	Black Rock Canal
1993 TY - Baseline	90.1	99.6	73.3	98.9
1993 TY - Bkgd 75% of WQS	90.6	99.8	74.3	98.9
1993 TY - No CSO	91.1	99.8	73.5	98.9
1993 TY - No CSO - Bkgd 75% of WQS	91.7	99.9	74.3	98.9

Table 3-4. Annual Percent Attainment of Water Quality Standards for Daily Minimum Dissolved Oxygen, Baseline Scenarios, All Modeled Water Bodies

Dissolved Oxygen, Daily Minimum (Critical Cell)				
Scenario	Annual Percent Attainment (%) of WQS			
	Upper Scajaquada Creek	Lower Scajaquada Creek	Buffalo River	Black Rock Canal
1993 TY - Baseline	94.6	99.8	78.1	99.1
1993 TY - Bkgd 75% of WQS	95.6	99.9	77.7	99.1
1993 TY - No CSO	97.3	100.0	78.1	99.2
1993 TY - No CSO - Bkgd 75% of WQS	98.3	100.0	78.5	99.2

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4. SUMMARY

The previously calibrated water quality models of the Buffalo River, Scajaquada Creek, Black Rock Canal, and Niagara River were modified for use in evaluating CSO control alternatives using the 1993 TY. The modified model input conditions included upstream boundary conditions, CSO loads, storm water loads, point source loads, and direct climate model inputs. Four baseline simulations were run for the 1993 TY:

- **Baseline**: Flows and concentrations of all sources are consistent with existing conditions for the 1993 TY.
- **Baseline – Background 75% of WQS**: CSO flows and concentrations are consistent with existing conditions for the 1993 TY. Flows for background sources (storm water and upstream boundaries) are consistent with existing conditions. Water quality for background sources are reduced to a condition intended to represent future upstream improvements in water quality: 1)150 #/100 mL (bacteria), and 2) 75% of existing conditions (BOD).
- **No CSOs**: CSO flows and concentrations are set to zero. Background flows and concentrations are consistent with existing conditions for the 1993 TY.
- **No CSOs – Background 75% of WQS**: CSO flows and concentrations are set to zero. Flows for background sources (storm water and upstream boundaries) are consistent with existing conditions. Water quality for background sources are reduced to a condition of: 1) 150 #/100 mL (bacteria), and 2) 75% of existing conditions (BOD).

The water quality models were run for each of these scenarios and the hourly model output for bacteria and dissolved oxygen were compares to current New York State WQS. The results of this comparison are tabulated in Tables 4-1 through 4-3 below. It should be noted that the significant figures presented in these percentage results are intended to allow differentiation between results that rounding might obscure, and do not necessarily represent the actual level of accuracy of the models.

Table 4-1. Water Quality Standards for Bacteria, Baseline Scenarios (Averaged across Water Body and Typical Year)

Bacteria						
Scenario	Annual Percent Attainment (%) of WQS					
	Upper Scajaquada Creek	Lower Scajaquada Creek	Buffalo River	Black Rock Canal	Erie Basin	Niagara River
1993 TY - Baseline	47.6	4.6	33.6	84.0	100.0	100.0
1993 TY - Bkgd 75% of WQS	98.9	77.0	93.1	85.5	100.0	100.0
1993 TY - No CSO	49.4	8.0	49.1	95.2	100.0	100.0
1993 TY - No CSO - Bkgd 75% of WQS	100.0	100.0	100.0	100.0	100.0	100.0

Table 4-2. Annual Percent Attainment of Water Quality Standards for Daily Average Dissolved Oxygen, Baseline Scenarios, All Modeled Water Bodies

Dissolved Oxygen, Daily Average (Critical Cell)				
Scenario	Annual Percent Attainment (%) of WQS			
	Upper Scajaquada Creek	Lower Scajaquada Creek	Buffalo River	Black Rock Canal
1993 TY - Baseline	90.1	99.6	73.3	98.9
1993 TY - Bkgd 75% of WQS	90.6	99.8	74.3	98.9
1993 TY - No CSO	91.1	99.8	73.5	98.9
1993 TY - No CSO - Bkgd 75% of WQS	91.7	99.9	74.3	98.9

Table 4-3. Annual Percent Attainment of Water Quality Standards for Daily Minimum Dissolved Oxygen, Baseline Scenarios, All Modeled Water Bodies

Dissolved Oxygen, Daily Minimum (Critical Cell)				
Scenario	Annual Percent Attainment (%) of WQS			
	Upper Scajaquada Creek	Lower Scajaquada Creek	Buffalo River	Black Rock Canal
1993 TY - Baseline	94.6	99.8	78.1	99.1
1993 TY - Bkgd 75% of WQS	95.6	99.9	77.7	99.1
1993 TY - No CSO	97.3	100.0	78.1	99.2
1993 TY - No CSO - Bkgd 75% of WQS	98.3	100.0	78.5	99.2

As is evident in these results, the effects of complete CSO elimination are relatively small:

- The greatest effect of complete CSO elimination (comparing “baseline” results with “no CSO” results) is observed in the bacteria results for Lower Scajaquada Creek, where predicted attainment nearly doubled (but is still very low). Attainment of the bacteria WQS was not shown to be impacted in the Niagara River or Erie Basin. Bacteria WQS attainment was only modestly improved (marginal increases of 1.8% to 15.5%) in Upper Scajaquada Creek, Buffalo River and Black Rock Canal.
- Slight improvements in DO WQS attainment were observed as a result of CSO elimination, but DO attainment is generally very high throughout the system with the exception of the Buffalo River.

These results indicate that WQS attainment in the systems modeled are more heavily impacted by other factors than by CSOs. This evaluation was not intended to identify or evaluate those other factors, but pollutant loading from upstream sources and other non-CSO point sources are possible factors.

5. REFERENCES

Buffalo Sewer Authority. 2011. Personal correspondence with James Keller, Jr., Treatment Plant Superintendent, Bird Island Wastewater Treatment Plant, Buffalo NY.

Capella Energy. 2010. *Solar Energy Irradiation Data*. http://www.capellaenergy.com/solardata.asp. Accessed 19 June 2010

LimnoTech. 2010. *Water Quality Model Development and Calibration Report For Buffalo River, Scajaquada Creek, Niagara River, and Black Rock Canal.* Prepared on behalf of the Buffalo Sewer Authority. November 23, 2010.

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APPENDIX A: SUPPLEMENTAL UPPER SCAJAQUADA CREEK MODEL RESULTS

The following figures provide a graphical comparison between all four baseline scenarios for fecal coliform and dissolved oxygen water quality standards (WQS) for Upper Scajaquada Creek (above Grant St. Dam). Annual average and minimum dissolved oxygen attainment have been graphed spatially for each of the four baseline scenarios.

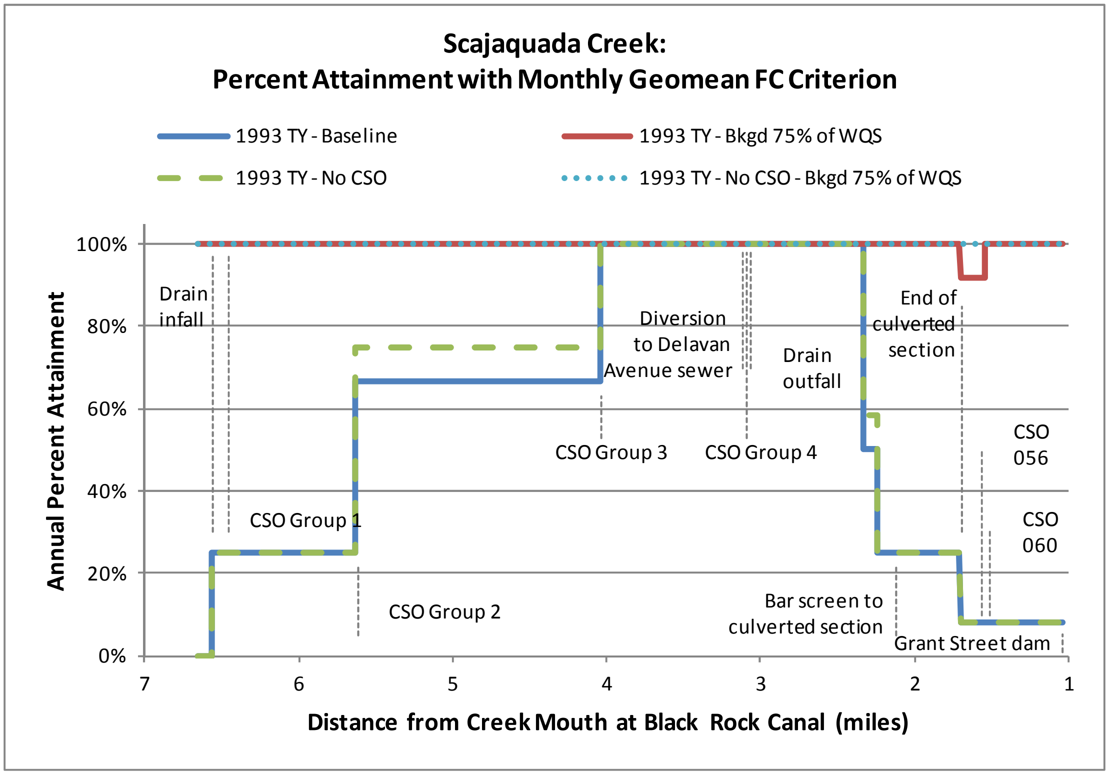

Figure A-1. Upper Scajaquada Creek Annual Fecal Coliform Attainment, All "Baseline" Scenarios

As expected, the "No CSO, Background at 75% of WQS" scenario provides the greatest attainment of WQS, at 100%. The "Baseline" scenario provides the least attainment, between 0% in the upper and lower region of the model domain and 100% between river miles 2 and 4. The greatest increase in WQS attainment is observed when background concentrations are set at 75% of the WQS, where most locations reach 100% attainment. Eliminating CSOs increased attainment in certain areas, but not as greatly as the reduced background concentrations scenario.

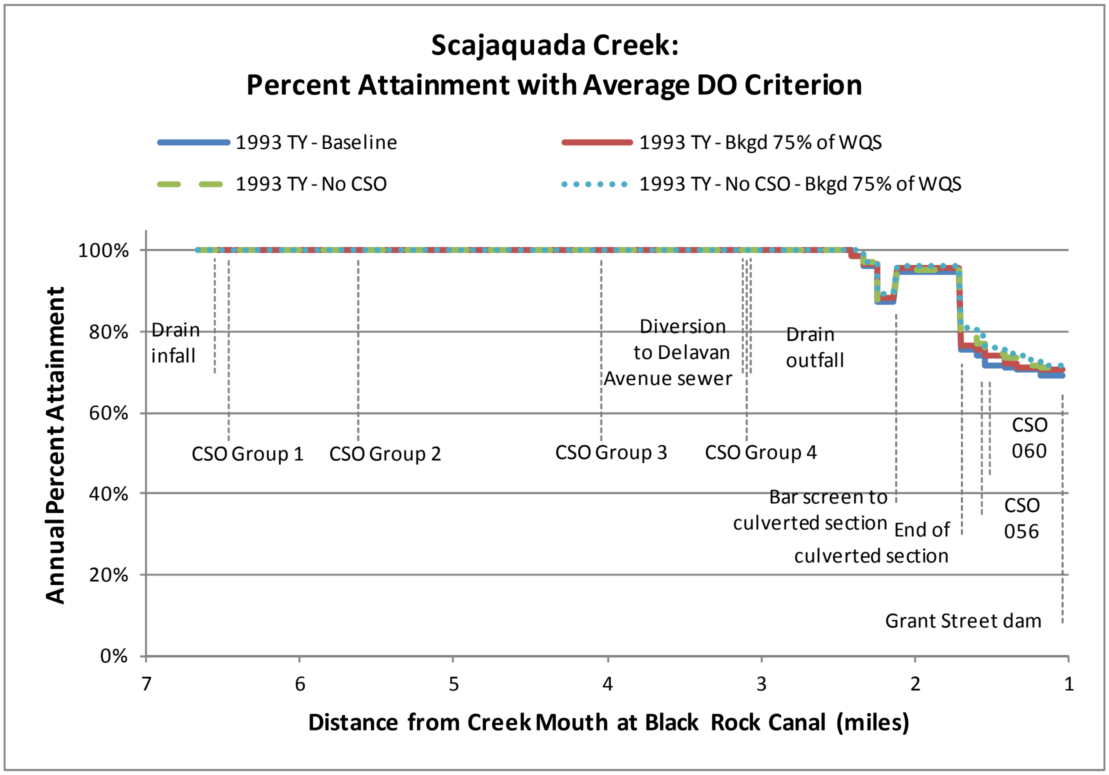

Figure A-2. Upper Scajaquada Creek Annual Percent Dissolved Oxygen Attainment (Daily Average, Most Critical Cell), All “Baseline” Scenarios

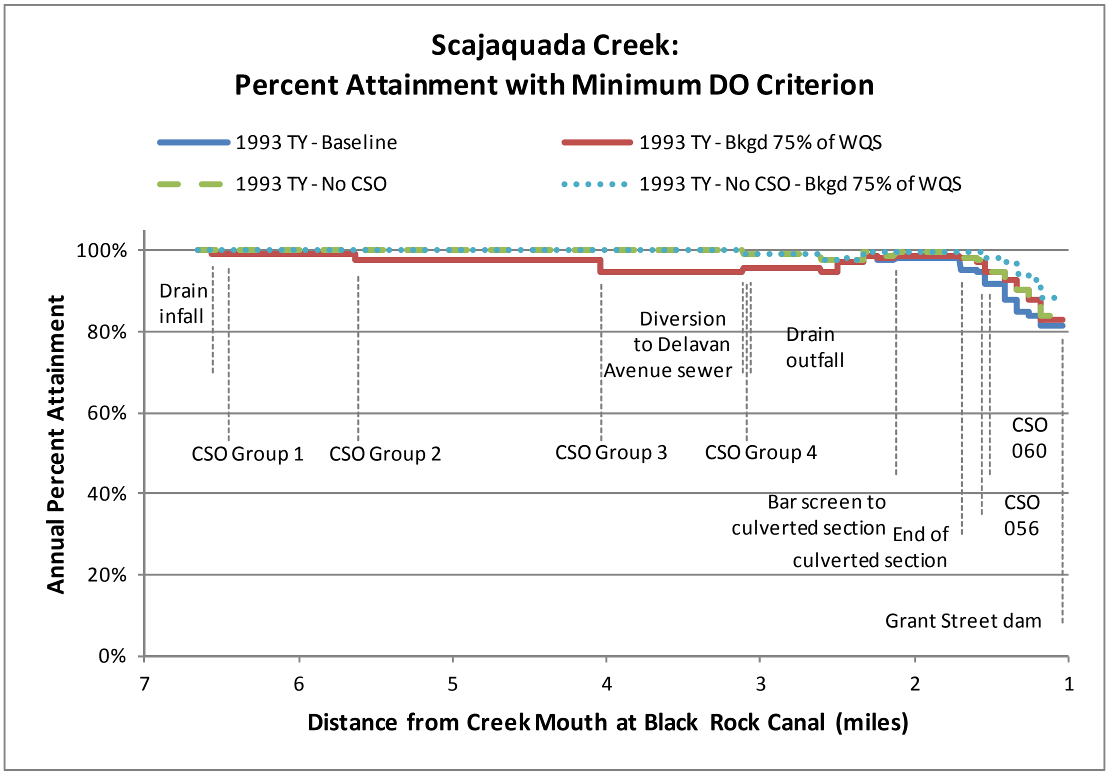

Figure A-3. Upper Scajaquada Creek Annual Percent Dissolved Oxygen Attainment (Daily Minimum, Most Critical Cell), All “Baseline” Scenarios

As expected, the “No CSO, Background at 75% of WQS” scenario provides the greatest attainment of WQS. The “Baseline” scenario provides the least attainment, between 95% in the middle region of the model domain and 100% in the upper region. The greatest increase in WQS attainment is observed when CSOs are eliminated. Setting background conditions to 75% of the WQS increased attainment near the downstream portion, but not as greatly as the reduced background concentrations scenario.

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APPENDIX B: SUPPLEMENTAL BUFFALO RIVER MODEL RESULTS

The following figures present annual percent attainment results for bacteria and dissolved oxygen water quality standards (WQS) for the Buffalo River (including downstream portions of Buffalo and Cazenovia Creeks). Because this model is 3D, attainment for all layers within a cell cannot be represented at once. Therefore, monthly fecal coliform attainment at the surface as well as daily average and daily minimum dissolved oxygen attainment for the most critical layer have been mapped for each of the four baseline scenarios.

Fecal coliform attainment results are mapped in 12 bins, such that each successive bin represents an additional month in attainment, with red representing zero to one month in attainment of the WQS and dark blue representing all twelve months in attainment.

Dissolved oxygen attainment results are mapped in 10 bins, such that annual attainment can be viewed in 10% increments, with red representing 10% or less of days in attainment and dark blue representing 100% of days in attainment.

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Figure B-1. 1993 Baseline, Annual Percent Fecal Coliform Attainment, Buffalo River

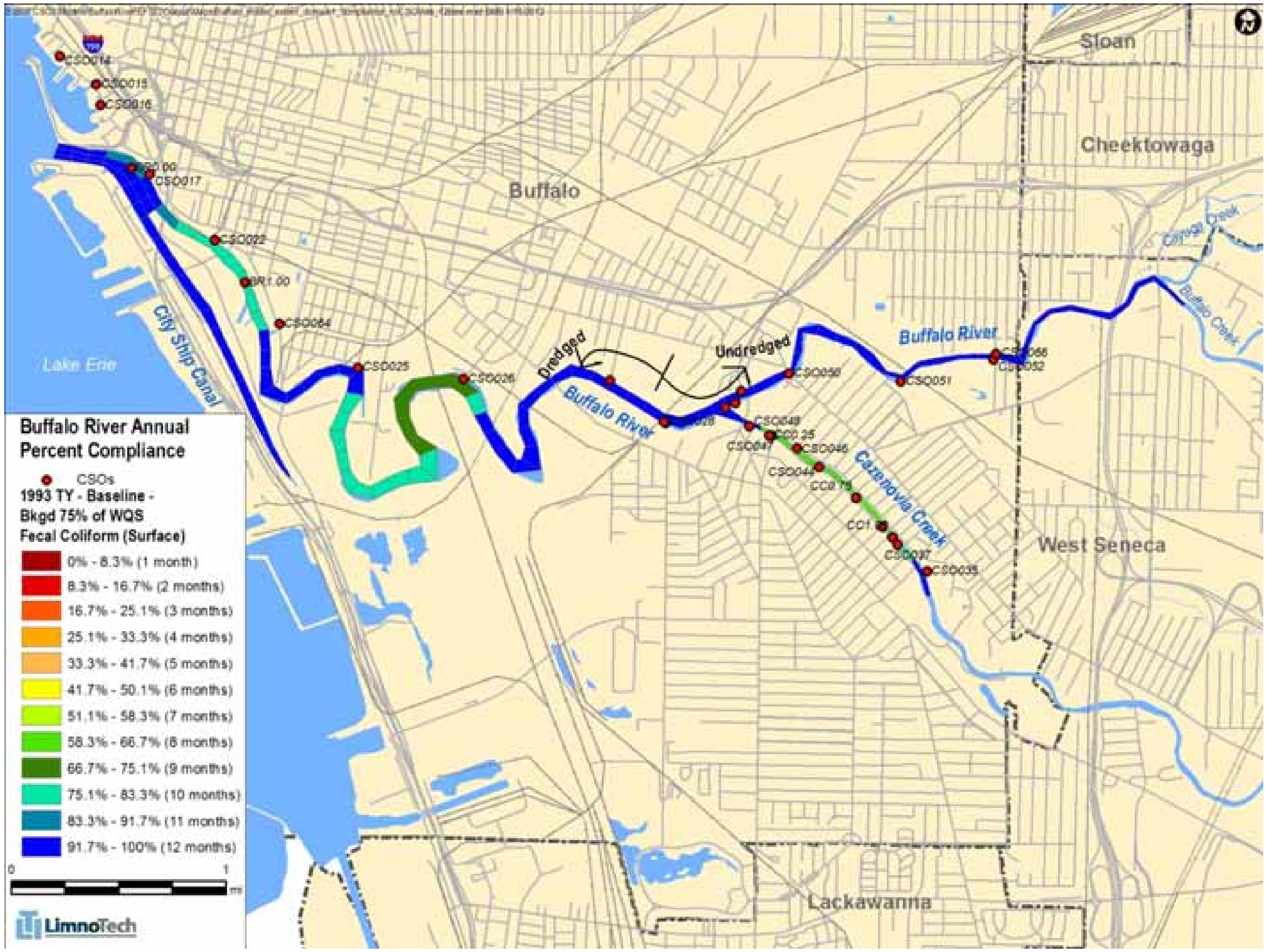

Figure B-2. 1993 – Background 75% of WQS, Annual Percent Fecal Coliform Attainment, Buffalo River

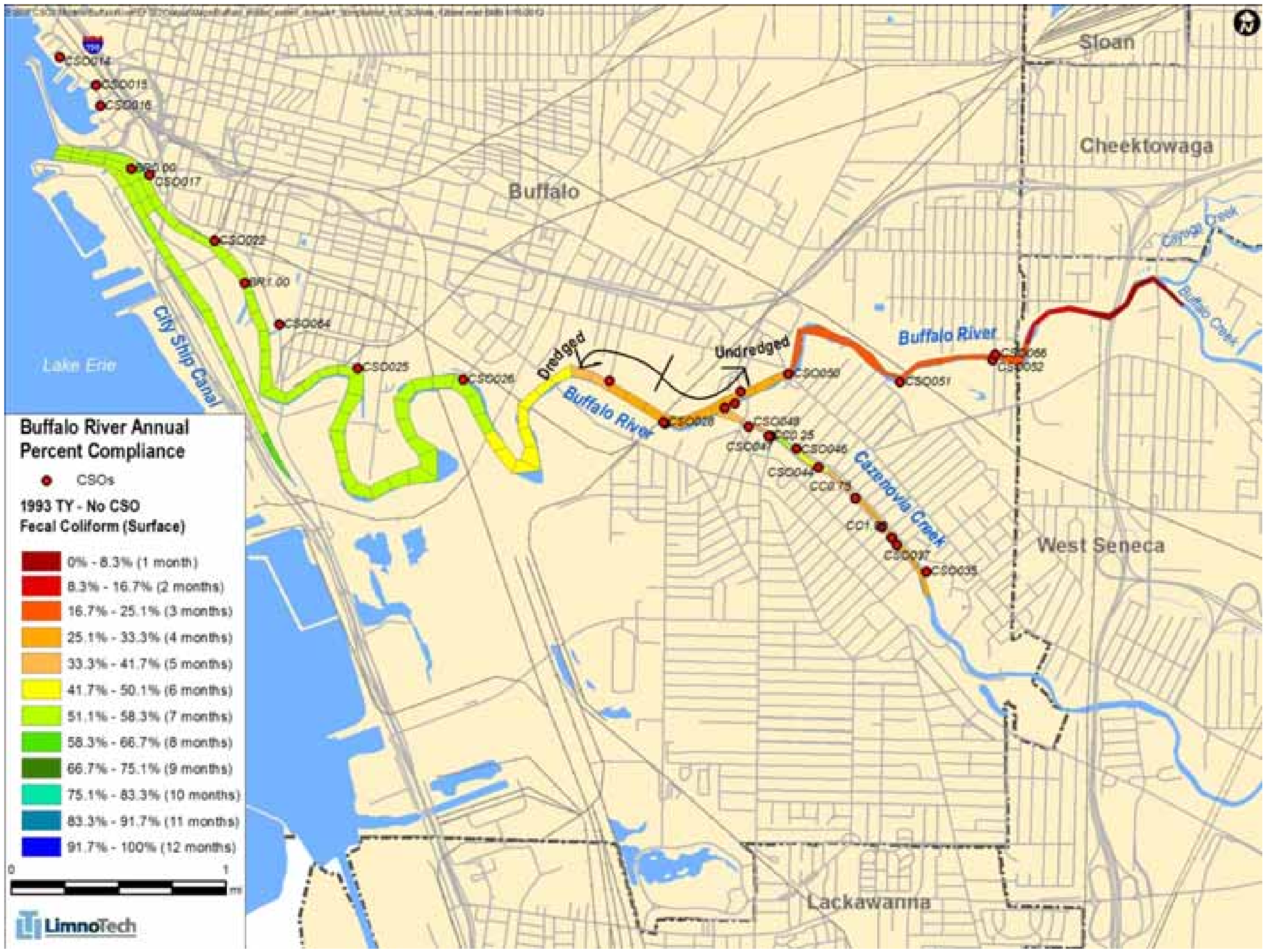

Figure B-3: 1993 – No CSO, Annual Percent Fecal Coliform Attainment, Buffalo River

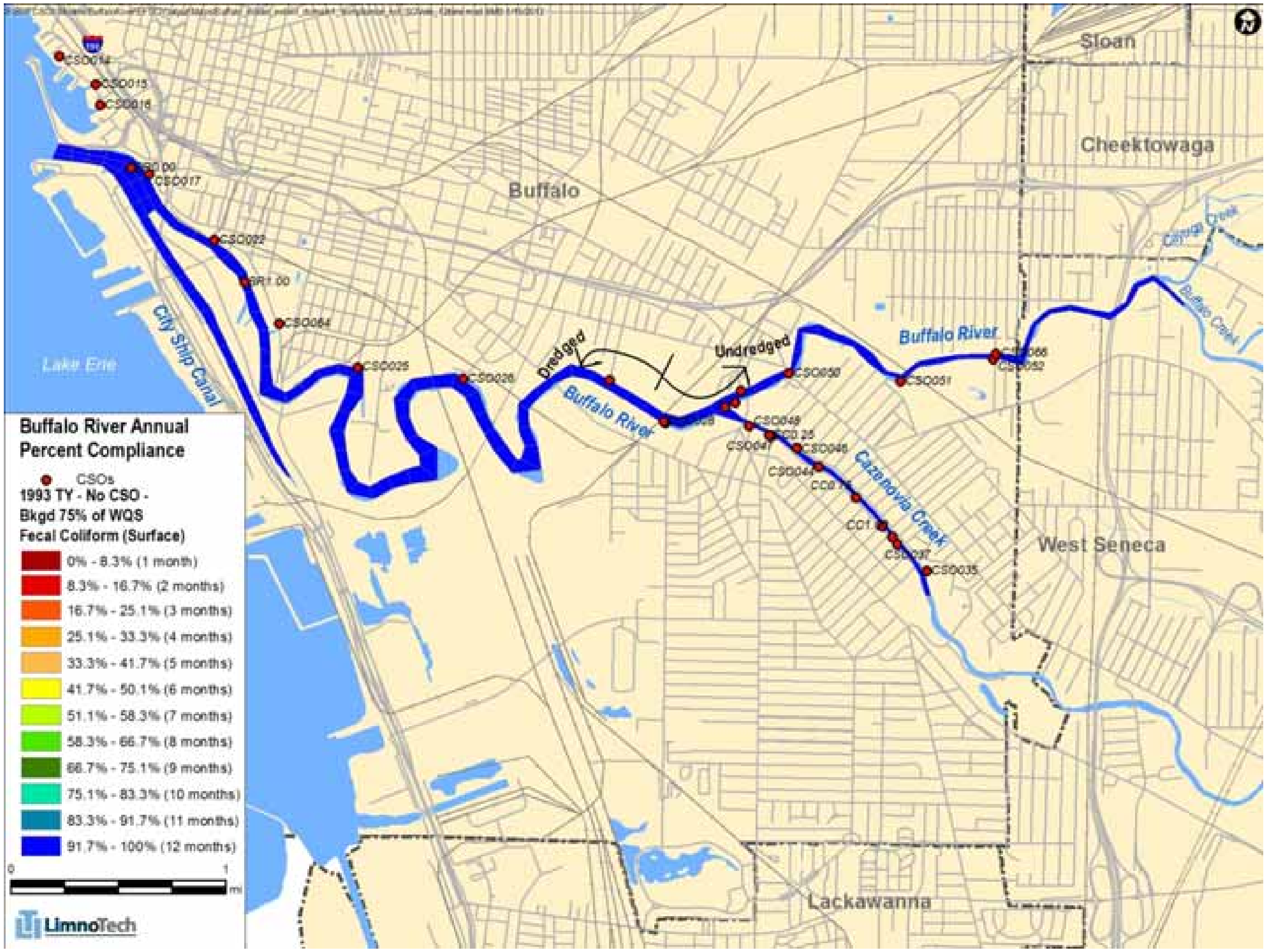

Figure B-4. 1993 – No CSO, Background 75% of WQS, Annual Percent Fecal Coliform Attainment, Buffalo River

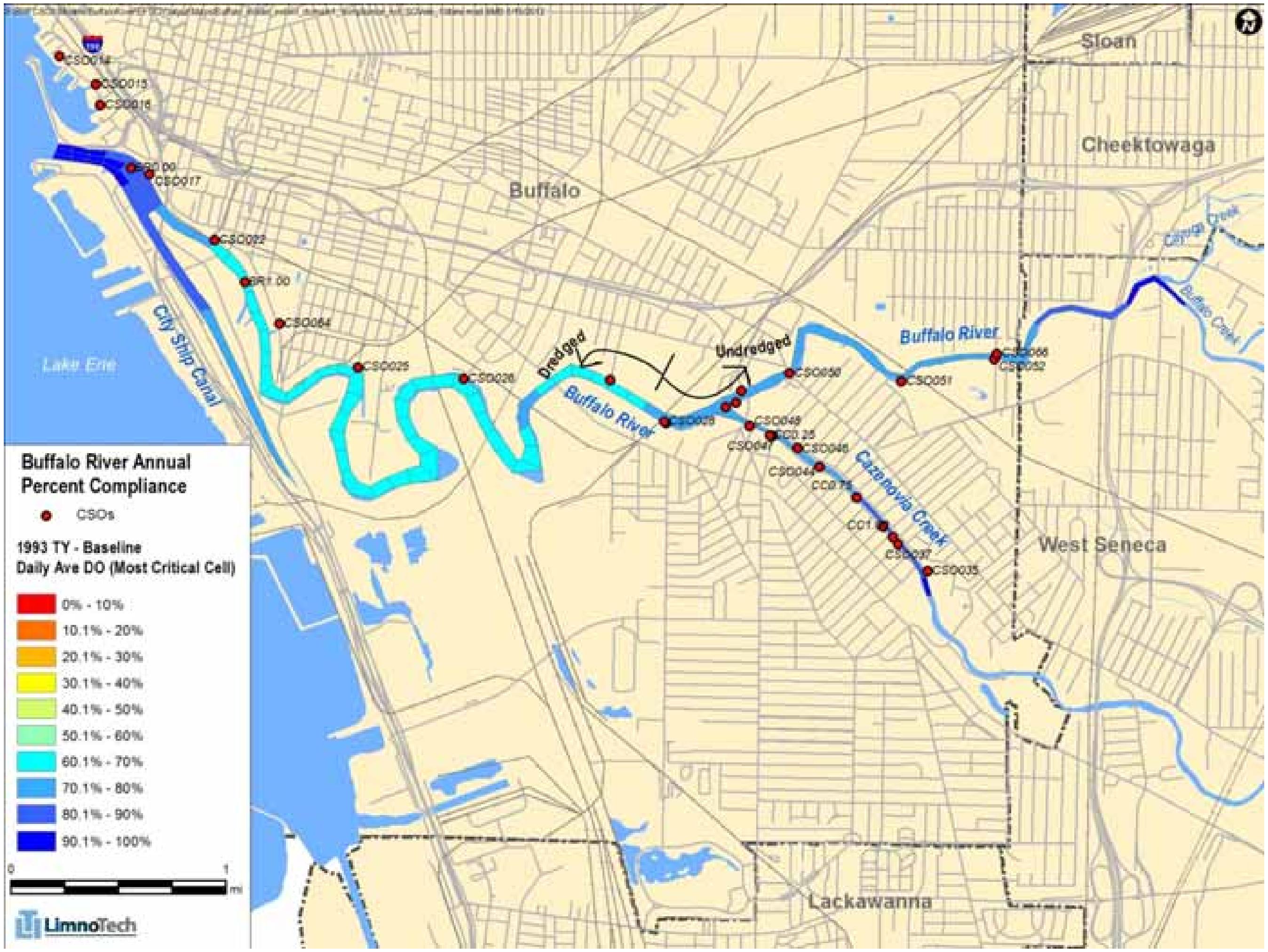

Figure B-5. 1993 Baseline, Annual Percent Dissolved Oxygen Attainment (Daily Average, Most Critical Cell), Buffalo River

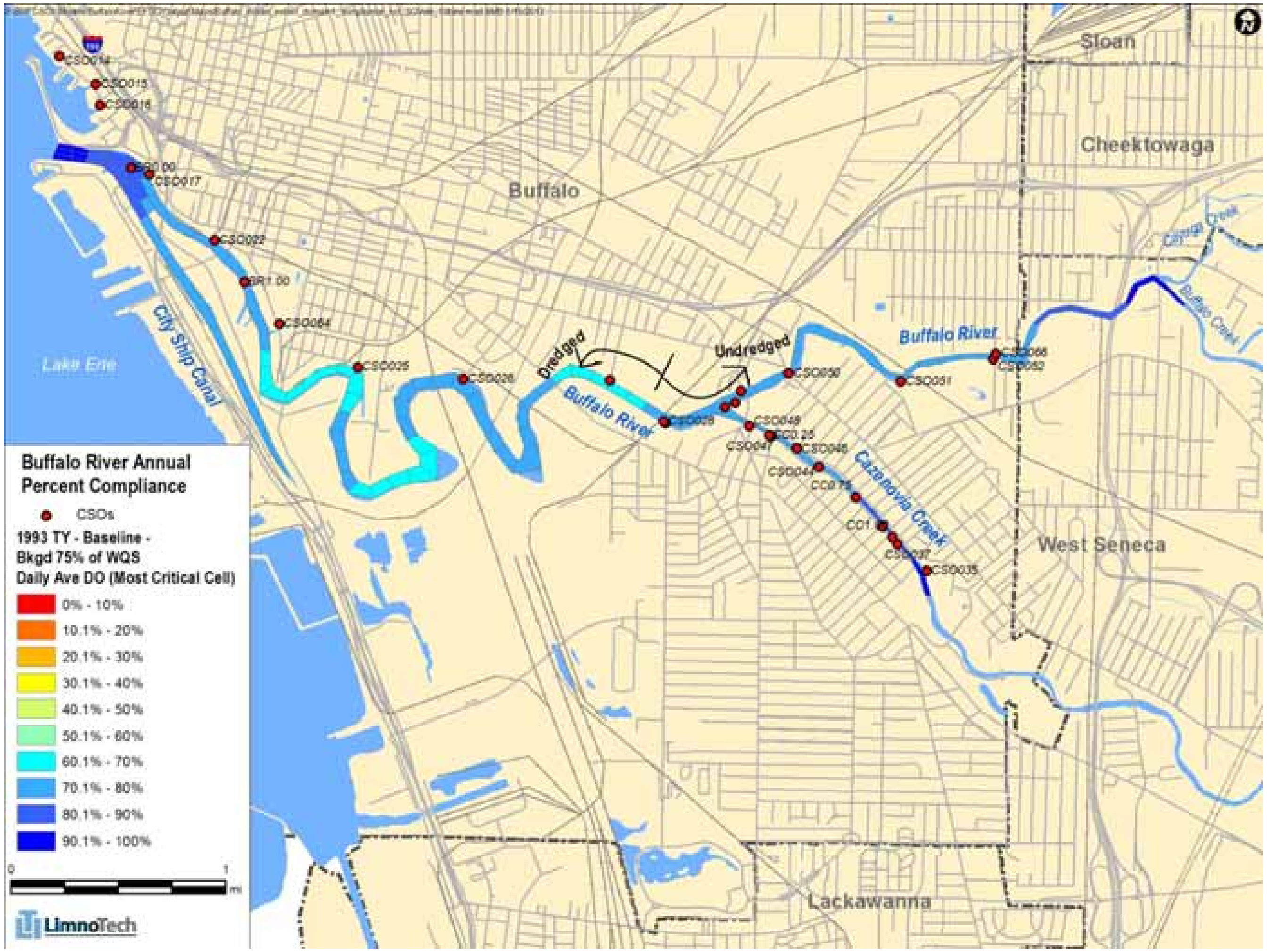

Figure B-6. 1993 – Background 75% of WQS, Annual Percent Dissolved Oxygen Attainment (Daily Average, Most Critical Cell), Buffalo River

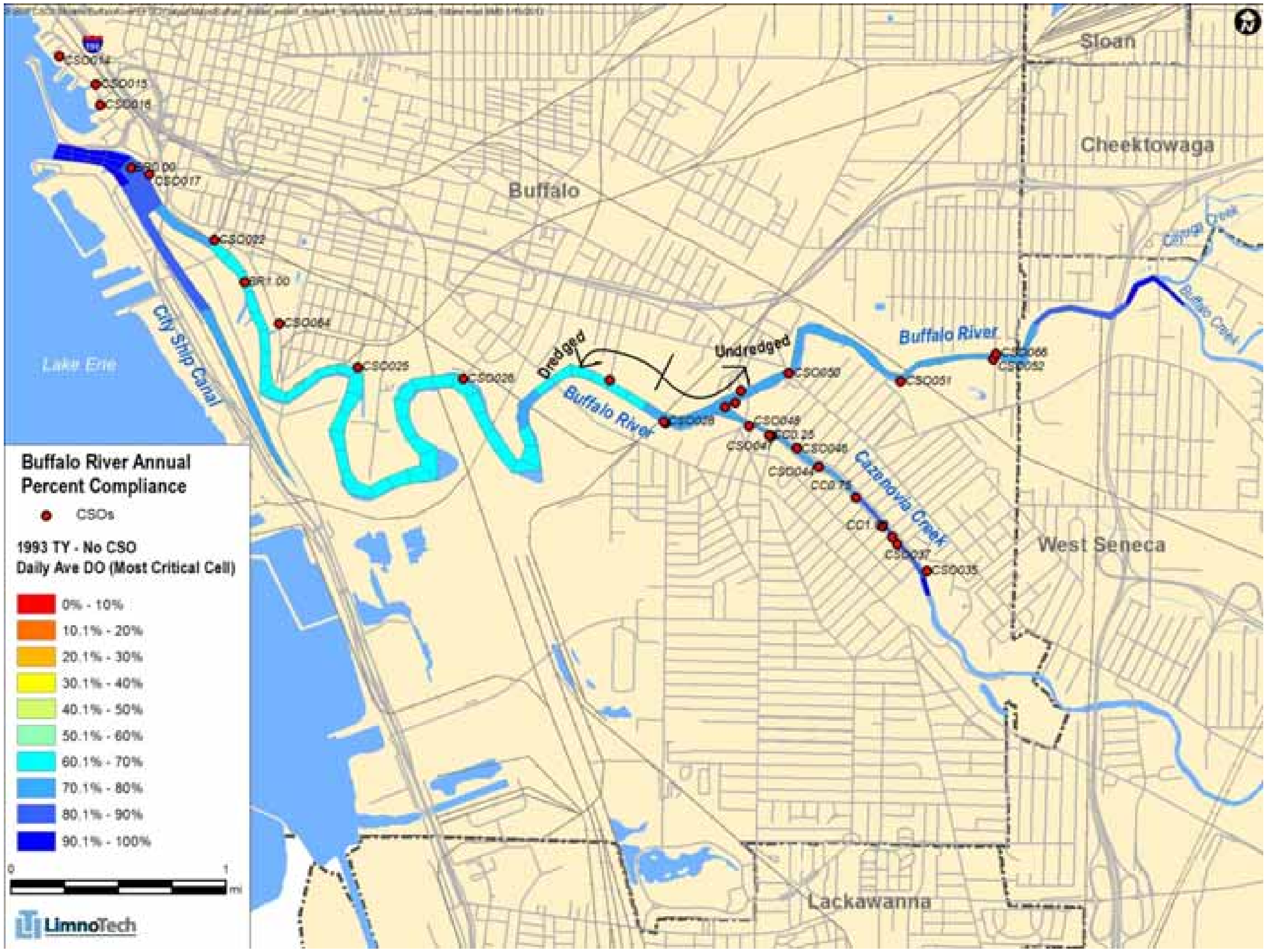

Figure B-7. 1993 – No CSO, Annual Percent Dissolved Oxygen Attainment (Daily Average, Most Critical Cell), Buffalo River

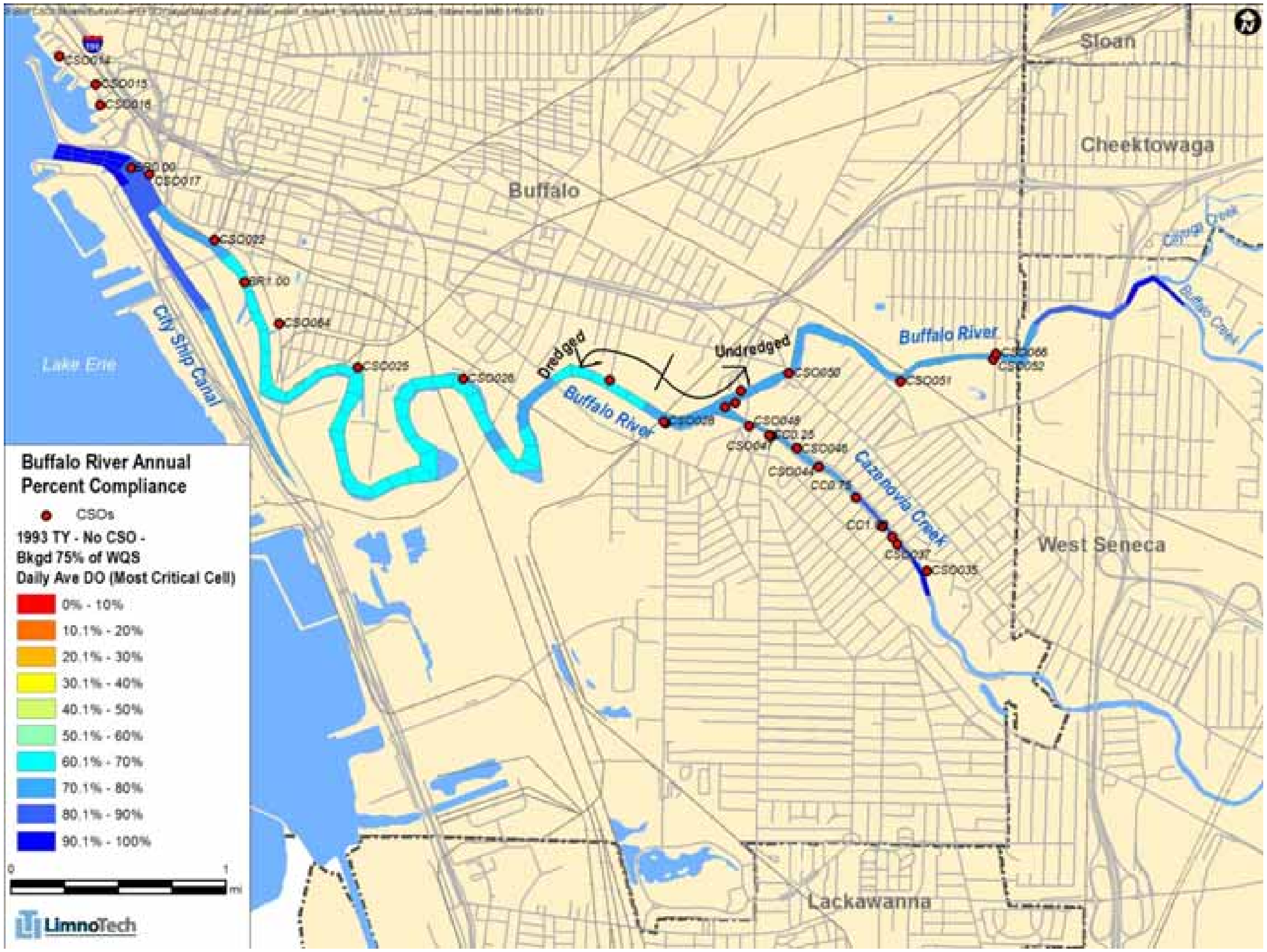

Figure B-8. 1993 – No CSO, Background 75% of WQS, Annual Percent Dissolved Oxygen Attainment (Daily Average, Most Critical Cell), Buffalo River

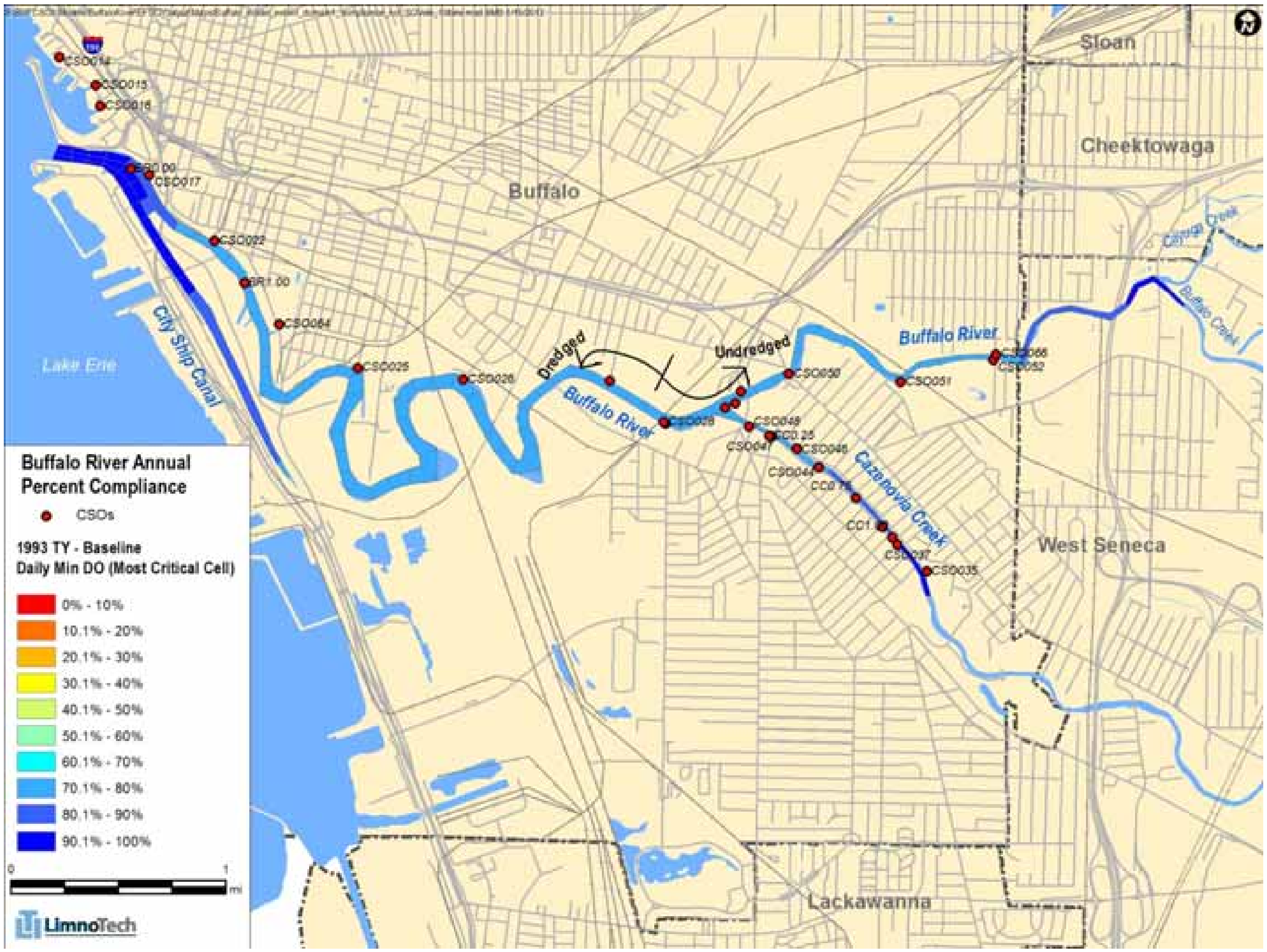

Figure B-9. 1993 Baseline, Annual Percent Dissolved Oxygen Attainment (Daily Minimum, Most Critical Cell), Buffalo River

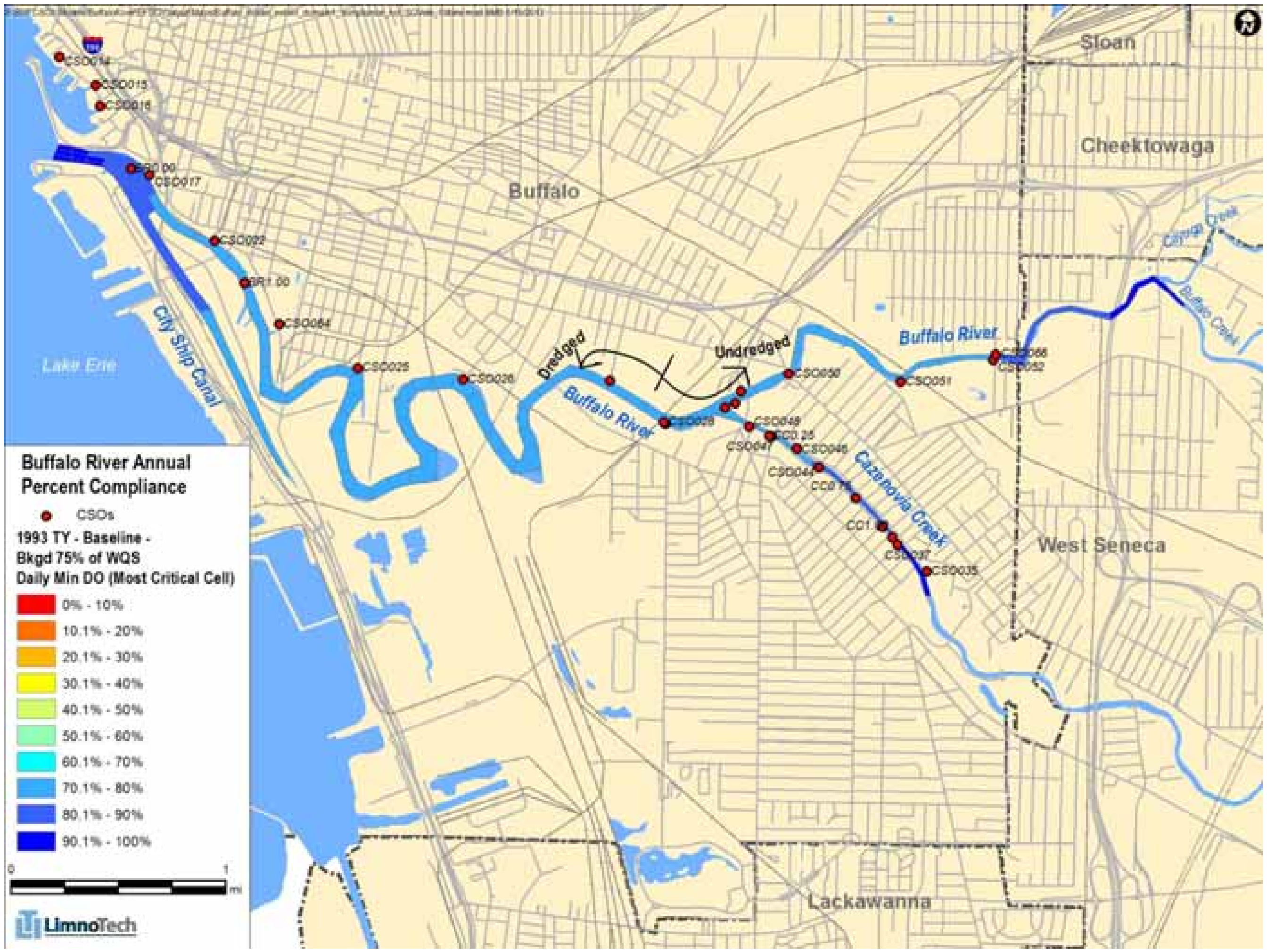

Figure B-10. 1993 – Background 75% of WQS, Annual Percent Dissolved Oxygen Attainment (Daily Minimum, Most Critical Cell), Buffalo River

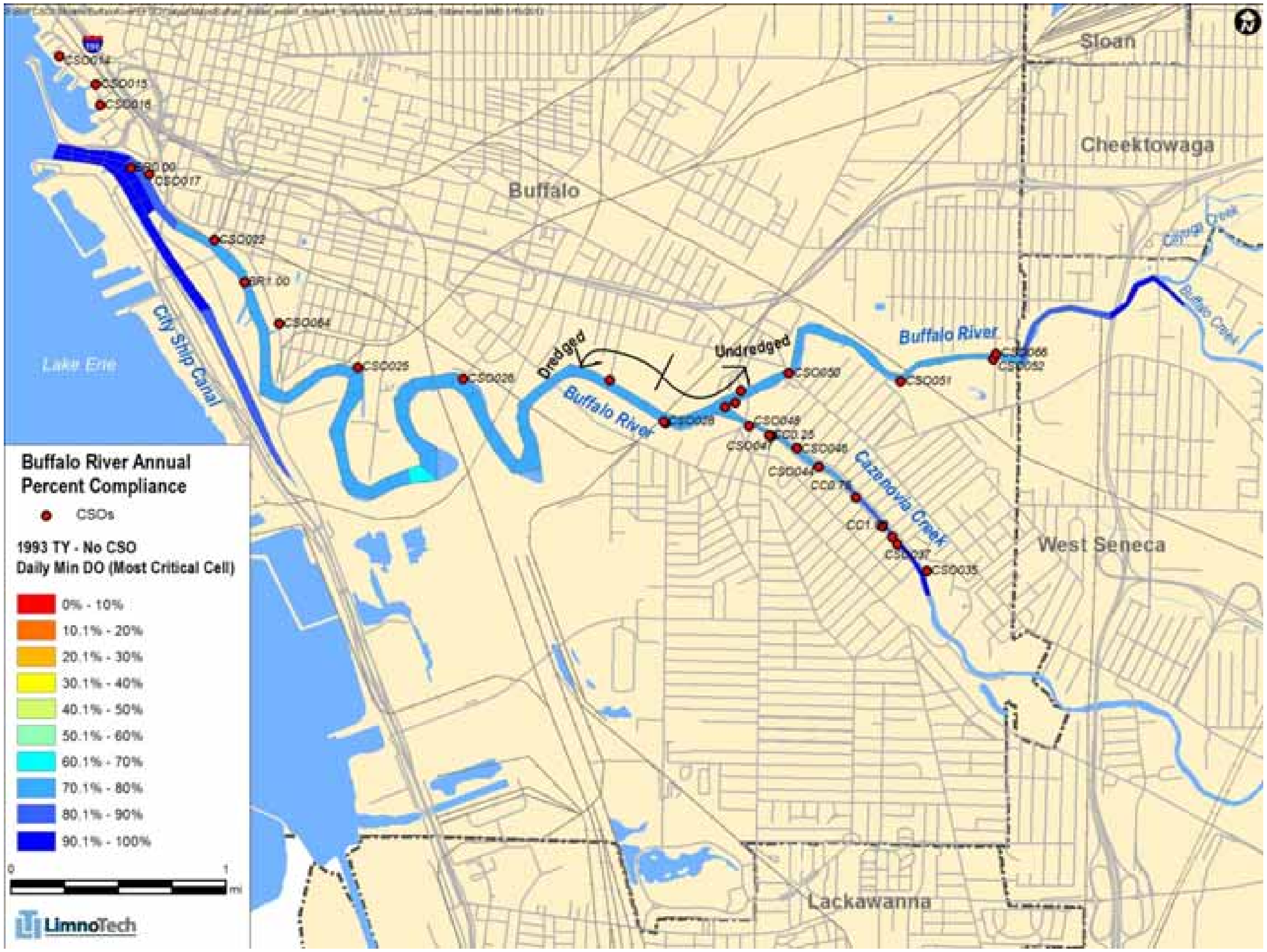

Figure B-11. 1993 – No CSO, Annual Percent Dissolved Oxygen Attainment (Daily Minimum, Most Critical Cell), Buffalo River

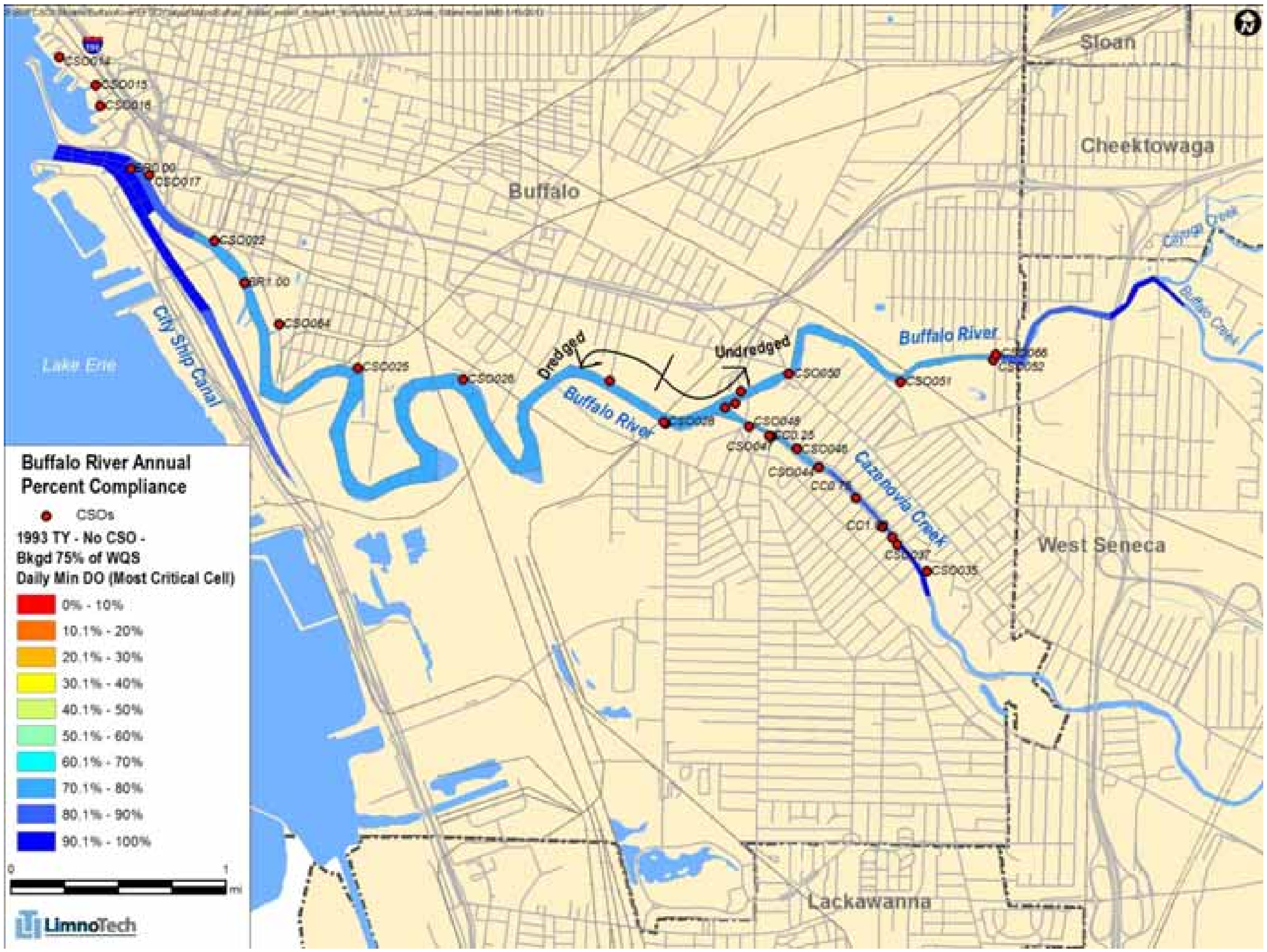

Figure B-12. 1993 – No CSO, Background 75% of WQS, Annual Percent Dissolved Oxygen Attainment (Daily Average, Most Critical Cell), Buffalo River

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APPENDIX C: SUPPLEMENTAL RESULTS FOR LOWER SCAJAQUADA CREEK AND BLACK ROCK CANAL

The following figures present annual percent attainment results for bacteria water quality standards (WQS) for Black Rock Canal (including Erie Basin) and Lower Scajaquada Creek. One map is provided for each of the four scenarios. Attainment results are mapped in color bins such that each successive bin represents an additional month in attainment, with red representing zero to one month in attainment of WQS, and dark blue representing all twelve months in attainment. For clarification purposes, in the maps for the "Baseline" and "No CSO" scenarios (Figures C-1 and C-3, respectively), there are zero months in attainment for Lower Scajaquada Creek.

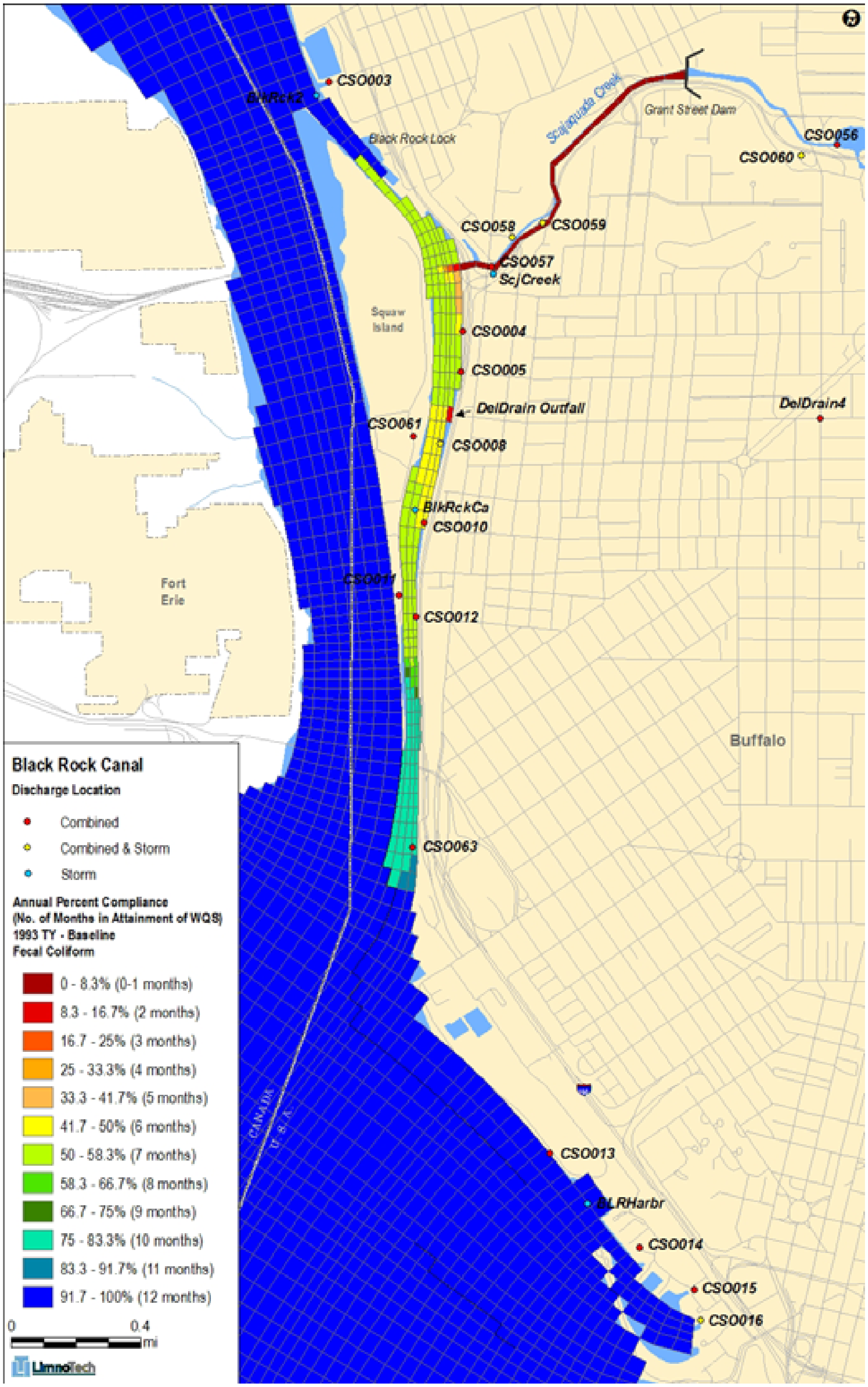

Figure C-1. 1993 Baseline, Annual Percent Fecal Coliform Attainment, Black Rock Canal/Lower Scajaquada Creek (Including Erie Basin)

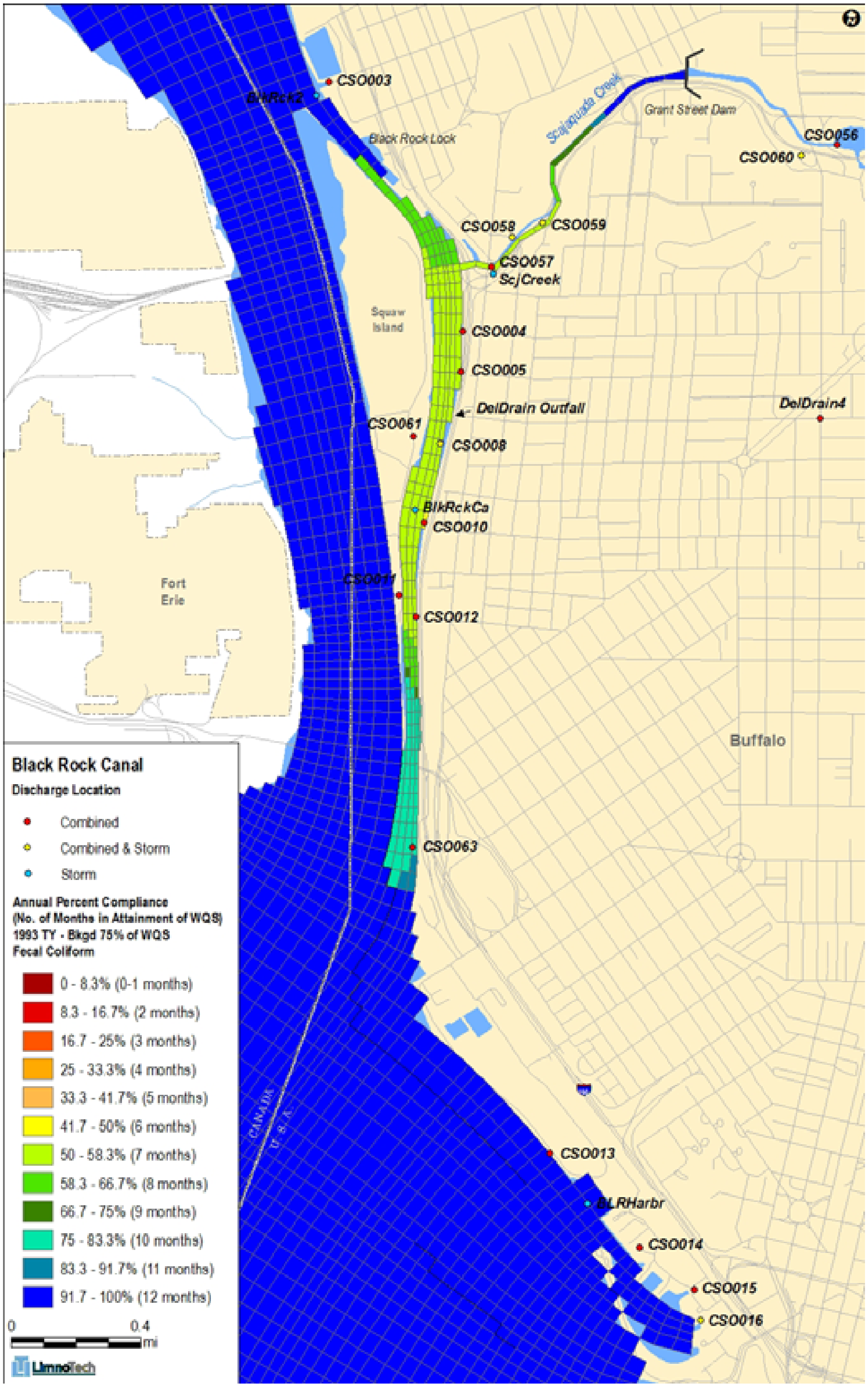

Figure C-2. 1993 – Background 75% of WQS, Annual Percent Fecal Coliform Attainment, Black Rock Canal/Lower Scajaquada Creek (Including Erie Basin)

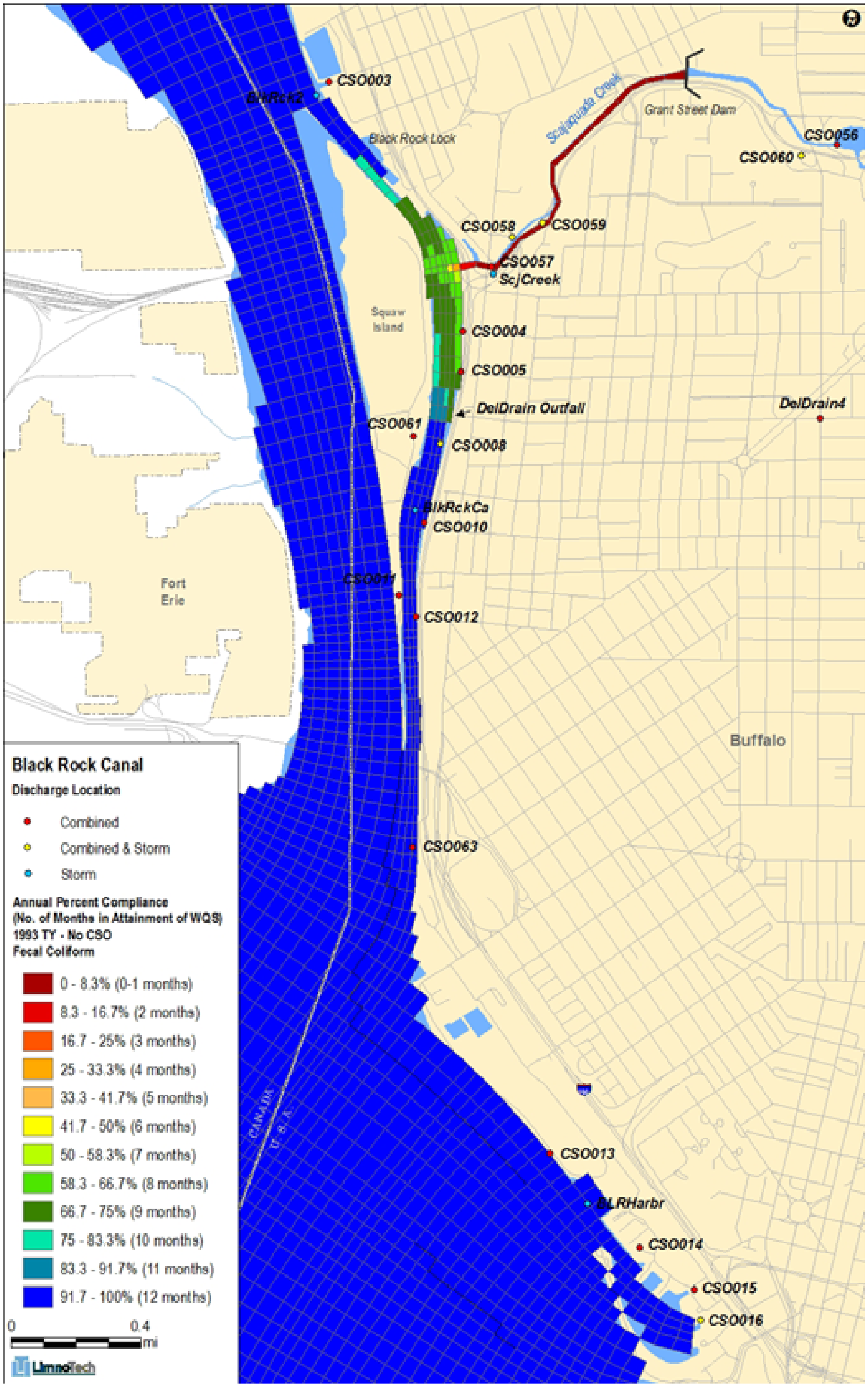

Figure C-3. 1993 – No CSO, Annual Percent Fecal Coliform Attainment, Black Rock Canal/Lower Scajaquada Creek (Including Erie Basin)

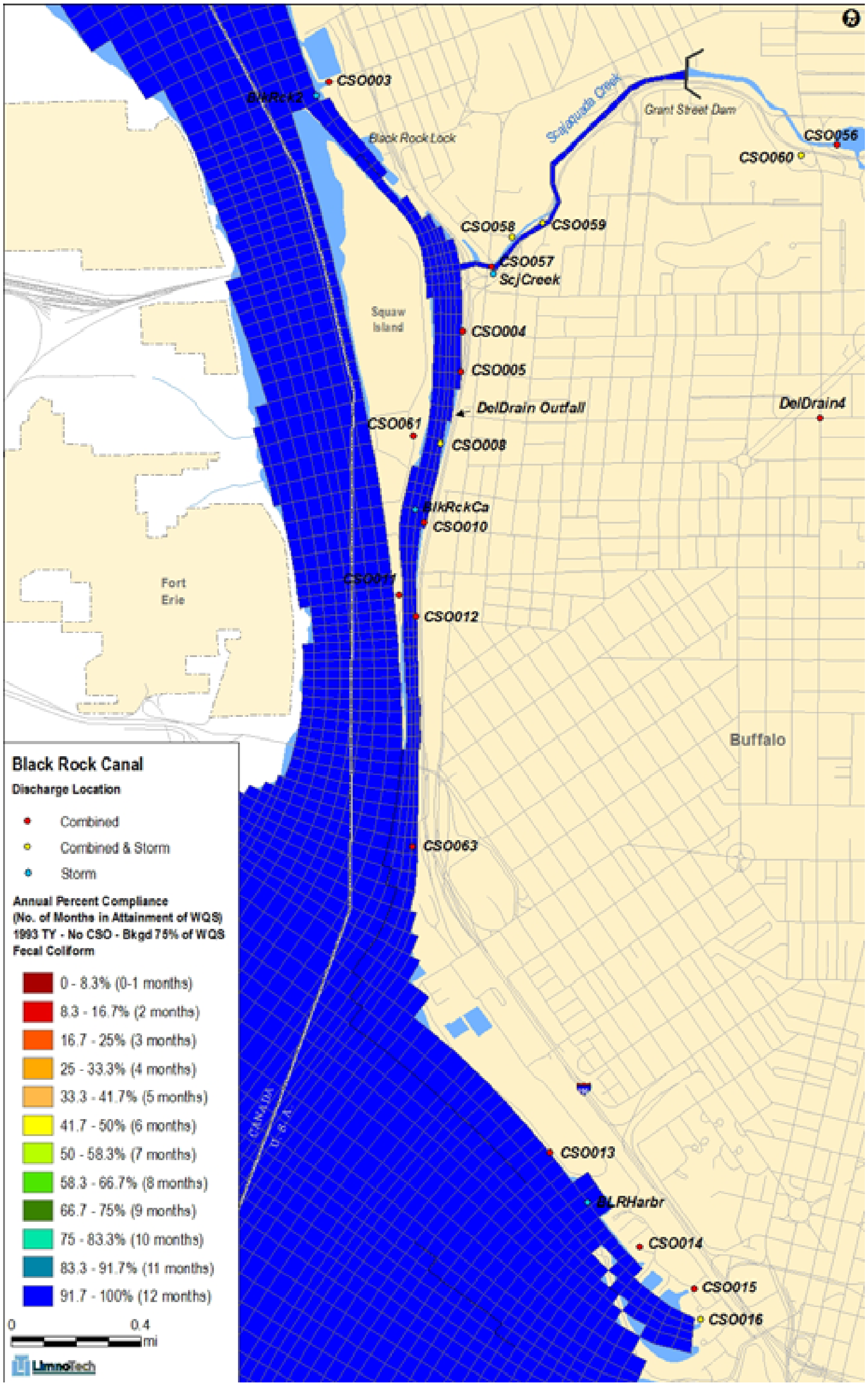

Figure C-4. 1993 – No CSO, Background 75% of WQS, Annual Percent Fecal Coliform Attainment, Black Rock Canal/Lower Scajaquada Creek (Including Erie Basin)

The following figures provide a graphical comparison between all four baseline scenarios for dissolved oxygen water quality standards (WQS) for Black Rock Canal (including Erie Basin) and Lower Scajaquada Creek. Because this model is 3D, attainment for all layers within a cell cannot be represented at once. Therefore, annual average and minimum dissolved oxygen attainment for the most critical layer have been plotted spatially for each of the four baseline scenarios.

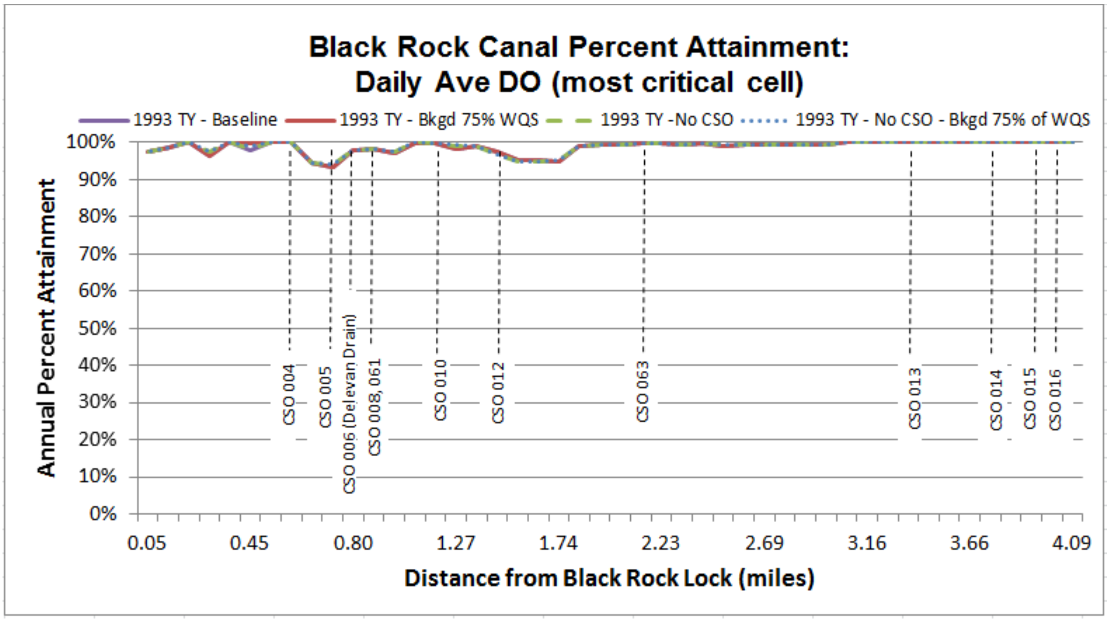

Figure C-5. Black Rock Canal Annual Percent Dissolved Oxygen Attainment (Daily Average, Most Critical Cell), All “Baseline” Scenarios (Includes Erie Basin)

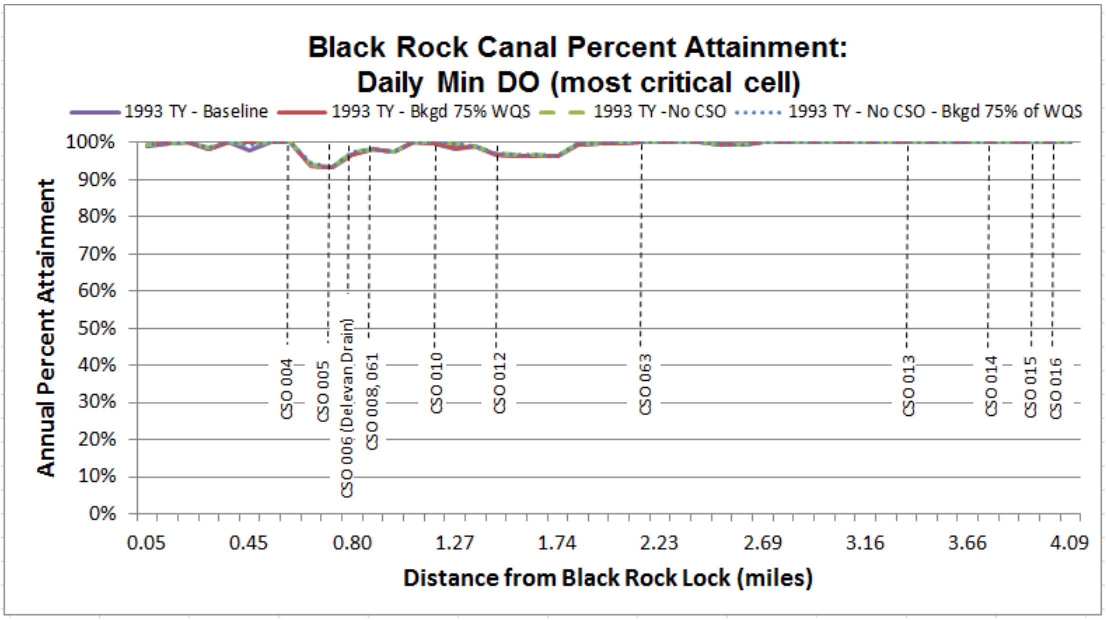

Figure C-6. Black Rock Canal Annual Percent Dissolved Oxygen Attainment (Daily Minimum, Most Critical Cell), All "Baseline" Scenarios (Includes Erie Basin)

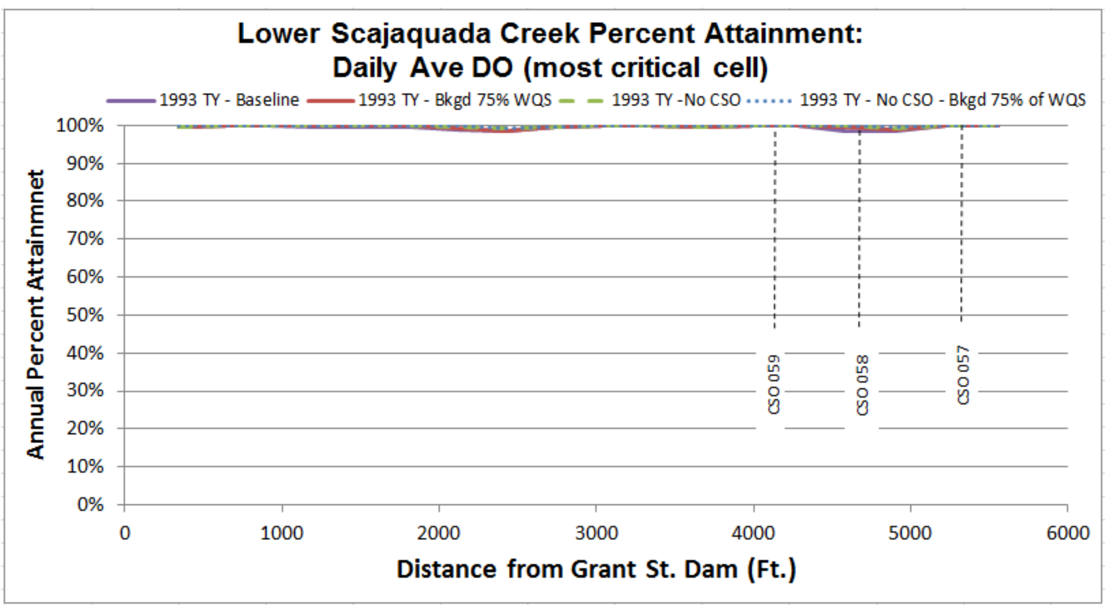

Figure C-7. Lower Scajaquada Creek Annual Percent Dissolved Oxygen Attainment (Daily Average, Most Critical Cell), All "Baseline" Scenarios

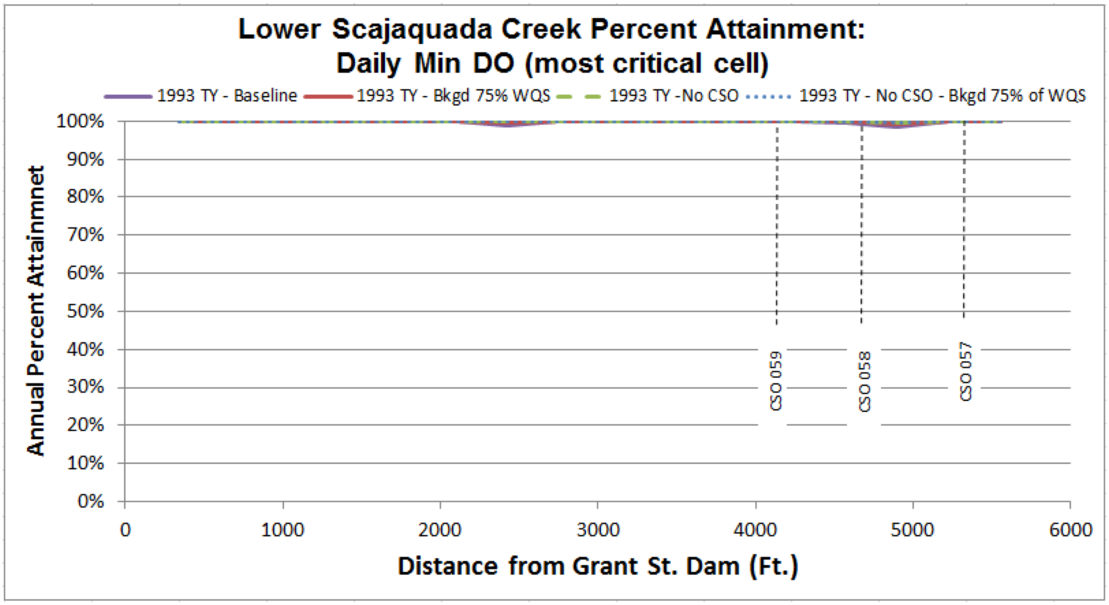

Figure C-8. Lower Scajaquada Creek Annual Percent Dissolved Oxygen Attainment (Daily Minimum, Most Critical Cell), All “Baseline” Scenarios

In general, dissolved oxygen attainment is very high and similar for each scenario for both Black Rock Canal and Lower Scajaquada Creek. For both water bodies, as expected, the “No CSO, Background at 75% of WQS” scenario provides the greatest attainment of WQS. However, the improvement relative to the “Baseline” scenario is slight.

APPENDIX D: SUPPLEMENTAL NIAGARA RIVER MODEL RESULTS

The following figures present annual percent attainment results for bacteria water quality standards (WQS) for the Niagara River. One map is provided for each of the four scenarios. Annual percent attainment of WQS was determined to be 100% for all four scenarios, so more detailed monthly attainment plots are not provided.

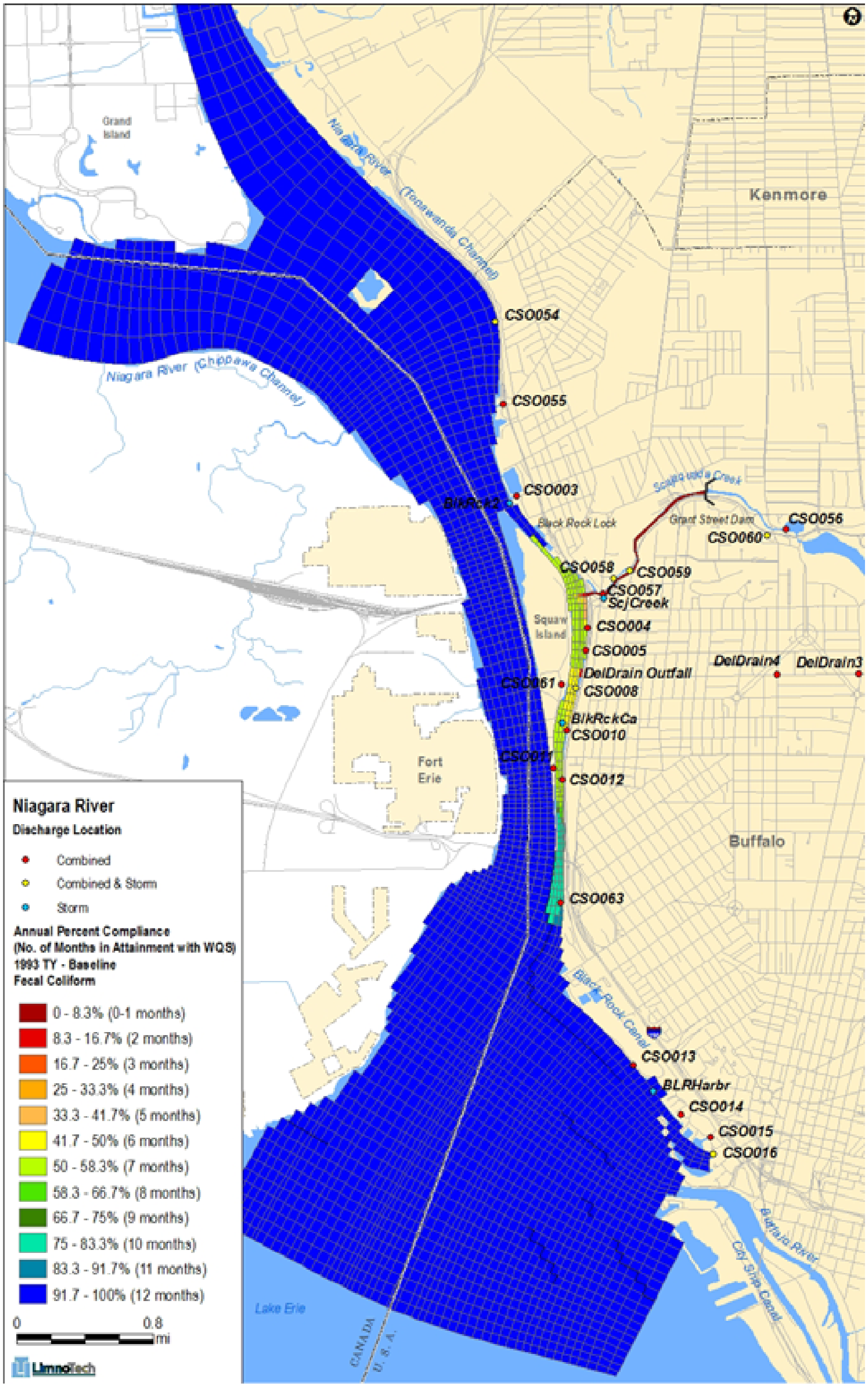

Figure D-1. 1993 Baseline, Annual Percent Fecal Coliform Attainment, Niagara River

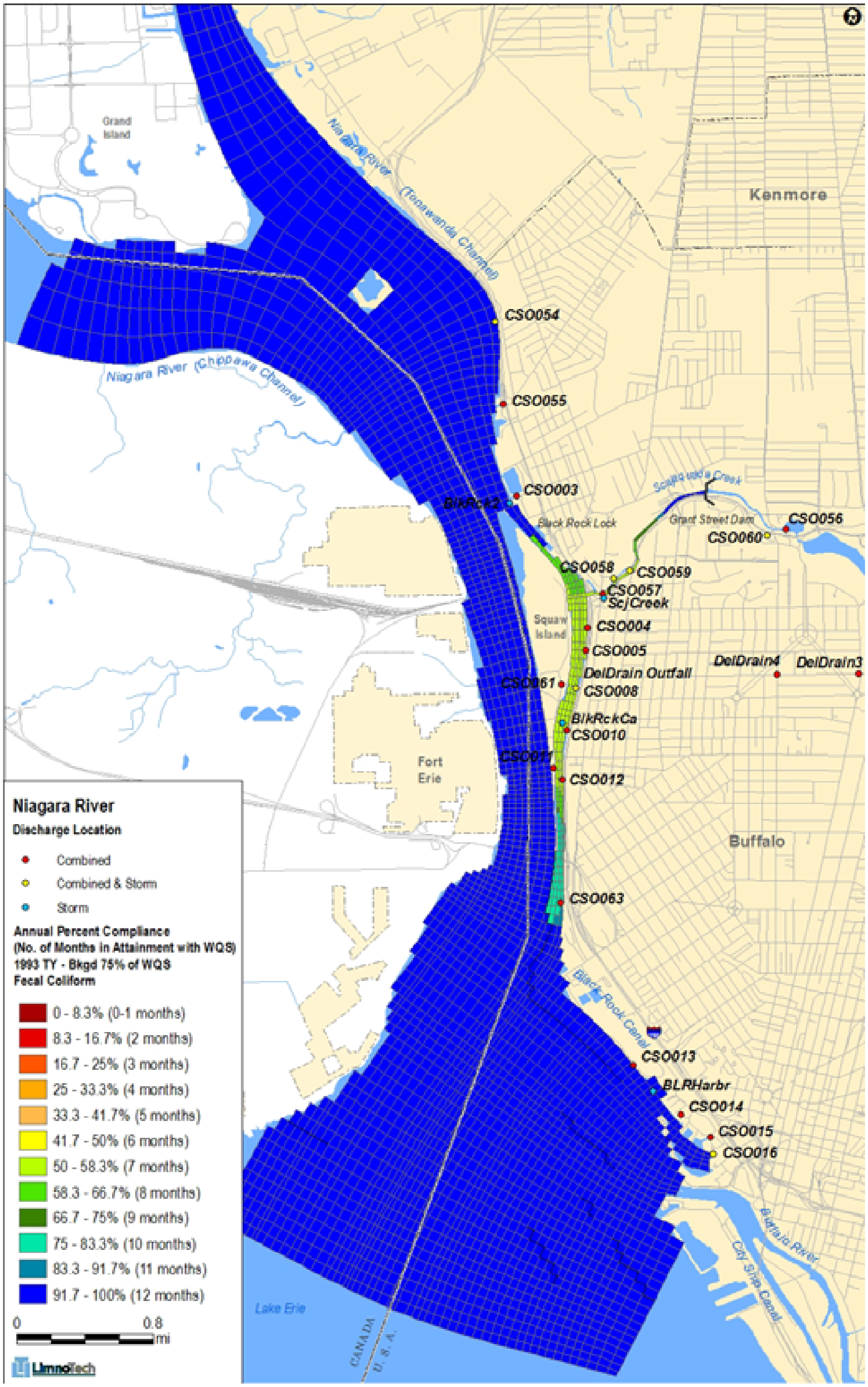

Figure D-2. 1993 – Background 75% of WQS, Annual Percent Fecal Coliform Attainment, Niagara River

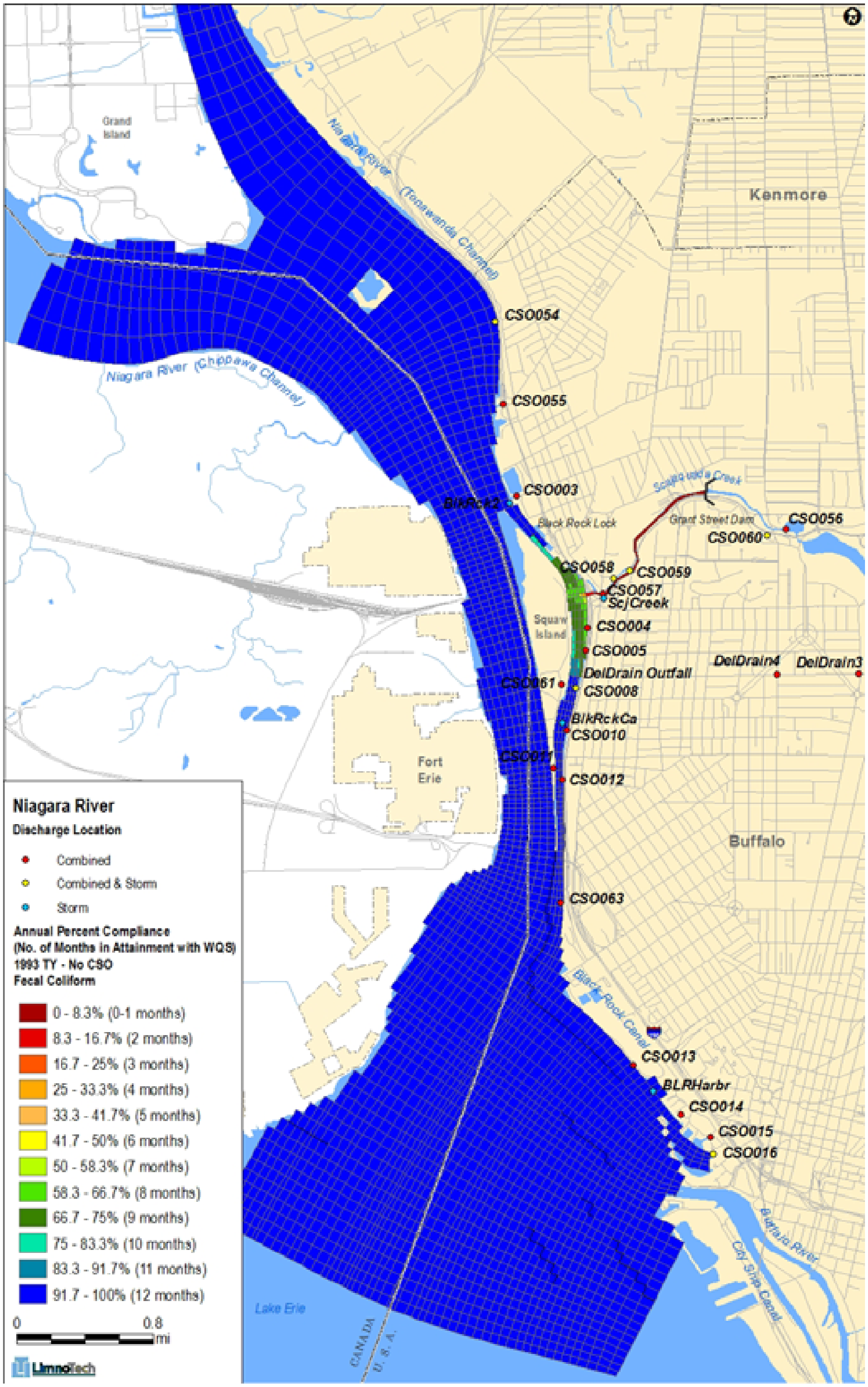

Figure D-3. 1993 – No CSO, Annual Percent Fecal Coliform Attainment, Niagara River

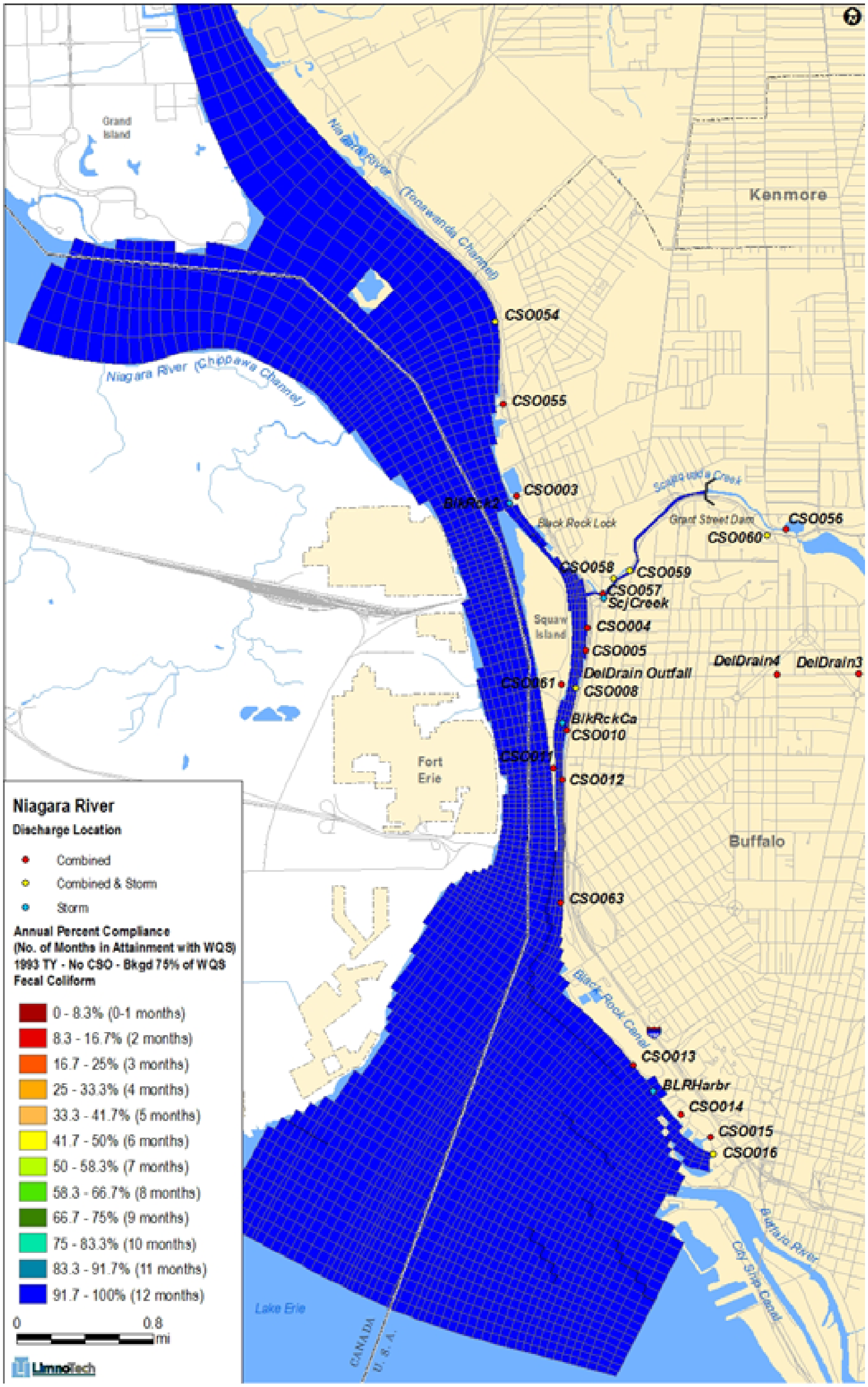

Figure D-4. 1993 – No CSO, Background 75% of WQS, Annual Percent Fecal Coliform Attainment, Niagara River