Whitney Point Adaptive Management Plan

A Five-Year Summary

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Whitney Point Lake is a 1,200-acre U.S. Army Corps of Engineers (USACE) reservoir located on the Otselic River in Broome County, New York (Figure 1), that was completed in 1942 primarily for flood control purposes. Starting in mid-1990s, the Susquehanna River Basin Commission (Commission), USACE, and New York State Department of Environmental Conservation (NYSDEC) began discussions about a water management and environmental restoration project in Whitney Point Lake that would allow for water storage in the lake to be used for low flow augmentation releases. Over the following decade, discussions, negotiations, and planning continued until in 2008, a lake modification and environmental restoration plan was completed. This agreement called for not only the elimination of winter drawdown, replaced by a maintained year-round water level in Whitney Point Lake, but also provided for environmental releases from the lake to augment low flow conditions downstream in the Otselic, Tioughnioga, Chenango, and, ultimately, Susquehanna Rivers. Other supplemental improvements were also made to the lake and surrounding park area including constructed wetlands, wildlife habitat improvements, and updated recreational facilities. In order to monitor the ecological ramifications of the lake modifications and restoration plan, a five-year Adaptive Management Plan (AMP) was also established in 2008 as part of the environmental restoration plan which was to be carried out from 2009-2013. The long-term goal of the monitoring portion of the AMP was to document potential impacts of flow augmentation on aquatic communities in Whitney Point Lake and the surrounding watersheds. The expectations were that supplemental flows would help to reduce ecological stress on the downstream river ecosystems, providing measurable benefits to fish and macroinvertebrates. A technical team, with representatives from the Commission, USACE, NYSDEC, U.S. Fish and Wildlife Service, Broome County Parks, and local county soil and water conservation districts, was formed to provide annual oversight and approve adjustments to the monitoring plan as needed. In accordance with the guidelines in the AMP and Quality Assurance Project Plan (QAPP), an interim data report was produced each year and was available for review prior to any sampling the following year.

As the lead for the field monitoring portion of the AMP, Commission staff has been conducting annual routine monitoring in the Otselic, Tioughnioga, and Chenango Rivers at 12 river sampling locations (Table 1) and in Whitney Point Lake since 2009. The overall ecological goals of the AMP included: (1) assessing the chemical and biological condition of Whitney Point Lake and the surrounding watersheds (Tioughnioga, Otselic, Chenango); (2) documenting changes in stream quality over various flow regimes; (3) identifying side channel/backwater habitats that may be critical for fish and macroinvertebrate populations and assessing their usage of these areas; (4) monitoring submerged aquatic vegetation (SAV) growth in the lake; and (5) assessing establishment of constructed wetlands. In addition to annual baseline sampling in early summer, the second key component of the AMP was preparation for flow augmentation from Whitney Point Lake in times of low flow. A specified low flow at two reference gages, Chenango River at Chenango Forks and Susquehanna River at Waverly, were used to define this targeted low flow condition. If flows dropped to less than 700 cfs at Waverly or less than 150 cfs at Chenango Forks for three consecutive days, a plan was in place to begin to incrementally release water from Whitney Point Lake to augment river flows. During the course of the five-year AMP, flows did not reach those targeted low flows, and as a result, no environmental releases were made from 2009-2013. However, a planned USACE maintenance drawdown of Whitney Point Lake in 2012 allowed for in-lake sampling during a drawn down scenario and also provided an opportunity to assess the downstream impact of a release at both reference gages.

This report will summarize the results and general findings of the monitoring conducted by the Commission from 2009-2013 in the Whitney Point study area. Although flow conditions over the past five years did not trigger any water releases from Whitney Point Lake, valuable baseline data were collected that were previously unavailable. Furthermore, the Commission has a strong commitment to low flow protection issues and intends to continue a routine monitoring program within the Whitney Point study area.

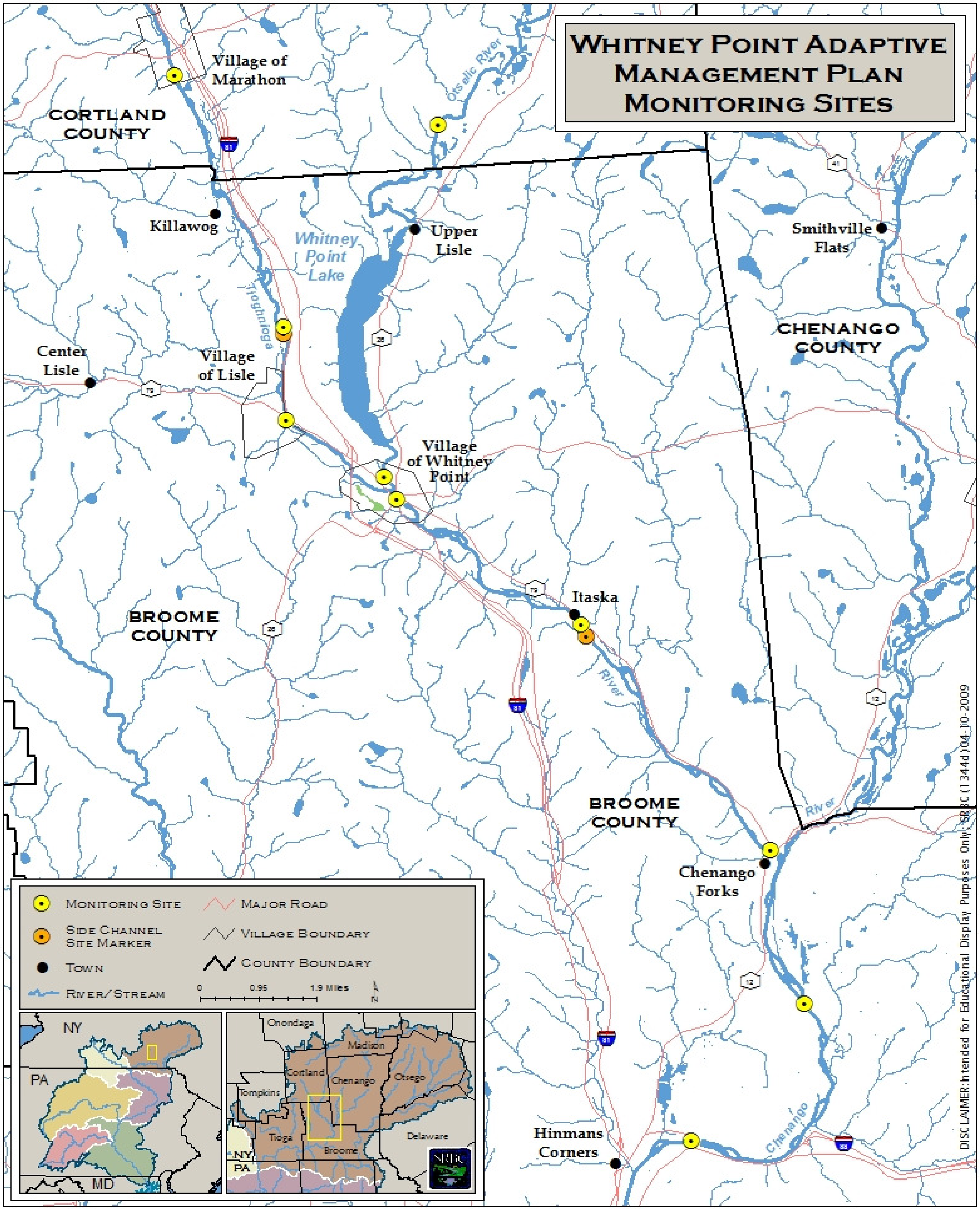

Figure 1. Sampling Site Locations

Methods

Sampling design and site placement were based on the goal of documenting baseline conditions on the Tioughnioga River above and below the Otselic confluence, above and below Whitney Point Lake on the Otselic River, and on the Chenango River (Figure 1 and Table 1). In addition, a side channel reach was identified on the Tioughnioga River both above and below the Otselic River. As a result, there were three instream sites and one side channel site on the Tioughnioga River both above and below the Otselic confluence. Two sites were located on the Otselic River, one five miles upstream of Whitney Point Lake and one directly below the dam outfall near the mouth. Both river sites on the Chenango were below the confluence of the Tioughnioga River.

Table 1. Instream Monitoring Locations for the AMP

Site	Stream Name	Location	Latitude	Longitude
OTSL 8.7	Otselic River	Upstream of lake at Landers Corners	42.42250	-75.94861
OTSL 0.1	Otselic River	At mouth at Whitney Point	42.33073	-75.96607
TIOU 18.8	Tioughnioga River	At Marathon	42.44070	-76.03560
TIOU 13.2	Tioughnioga River	Along Rt. 11, approximately 1.5 miles north of Lisle	42.37050	-75.99981
TIOUB 13.2	Tioughnioga River	Side channel/backwater area at TIOU 13.2	42.37050	-75.99981
TIOU 11.8	Tioughnioga River	Upstream of Otselic River at Lisle	42.35075	-75.99982
TIOU 9.5	Tioughnioga River	Downstream of Otselic River at Rt. 11 bridge at Whitney Point	42.33083	-75.96694
TIOU 5.7	Tioughnioga River	Downstream of Otselic River at Itaska	42.29870	-75.90900
TIOUB 5.4	Tioughnioga River	Side channel/backwater area about 0.3 miles downstream of TIOU 5.7	42.29528	-75.90587
TIOU 0.1	Tioughnioga River	Upstream of Rt. 12 bridge at Chenango Forks	42.23833	-75.84750
CHEN 11.9	Chenango River	Downstream of Tioughnioga River at gaging station near Chenango Forks	42.21880	-75.84860
CHEN 7.0	Chenango River	Downstream of Rt. 12A	42.16578	-75.87293

At each site sampling included lab water chemistry, in-situ field chemistry, macroinvertebrate collection, fish survey, physical habitat assessment, and discharge at select locations. However, in 2013, due to unusually high flows during the entire summer, the rivers were not wadeable, and sampling had to be scaled back. Water chemistry was collected at all river sampling sites, macroinvertebrates were collected at a majority of sites, but fish were surveyed at only one location. No sampling was conducted in either side channel reach during 2013, as they could not be accessed due to the high flows.

General methods included the following: tote barge fish electroshocking, macroinvertebrate collection with a NYSDEC standard aquatic net and a petite ponar dredge in the lake, discharge measurements using USGS methods (Buchanan and Somers, 1969), depth-integrated water quality sampling, field chemistry measurements done in-situ using a multi-parameter meter, habitat assessments using RBP protocols, SAV surveys (in-lake), and wetland monitoring. More detailed information about sampling protocols and procedures can be found in the QAPP (Commission, 2008). Analysis of water quality data includes a comparison of results to NYSDEC water quality standards as well as general aquatic life levels of concern and background concentrations. Biological data were reduced and compared using a variety of metrics including those used by NYSDEC in their biomonitoring program (Bode and others, 2002). See Tables 2 and 3 for explanations of the metrics used for fish and macroinvertebrate data analysis. Nonmetric multidimensional scaling (NMDS) was used as a visual comparative tool to gauge the similarity of biological data over the five years at the same locations.

Table 2. Explanation of Fish Metrics

Species Richness, weighted: Total number of species present in the sample, weighted by stream size. Streams over 20 meters wide are total number minus four and anything over 14 species is given the maximum value of 10.
Percent Non-Tolerant Individuals: Percentage of total individuals belonging to the species considered intolerant or moderately intolerant to environmental perturbations.
Percent Tolerant Species: Similar to percentage non-tolerant individuals but calculated for species.
Percent Model Affinity: The highest percentage of similarity of any of five models of non-impacted fish communities, by trophic class.

Table 3. Explanation of Macroinvertebrate Metrics

Taxonomic Richness: Total number of taxa in the sample. Number decreases with increasing stress.
Hilsenhoff Biotic Index: A measure of organic pollution tolerance. Index value increases with increasing stress.
Ephemeroptera/Plecoptera/Trichoptera (EPT) Index: Total number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa present in a sample. Number decreases with increasing stress.
Percent Model Affinity: Measure of similarity between collected sample and model (non-affected) sample based on percent abundance of seven major groups. Percentage decreases with increasing stress.
Percent Contribution of Dominant Taxa: Percentage of the taxon with the largest number of individuals out of the total number of macroinvertebrates in the sample. Percentage increases with increasing stress.
Percent Ephemeroptera: Percentage of Ephemeroptera (mayflies) in the sample divided by the total number of individuals in the sample. Percentage decreases with increasing stress.
Percent Chironomidae: Percentage of Chironomidae individuals out of the total number of macroinvertebrates in the sample. Percentage increases with increasing stress.
Shannon-Wiener Diversity Index: A measure of the taxonomic diversity of the community. Index value decreases with increasing stress.

*Metrics in bold make up the NYSDEC assessment methodology

Results

Water Quality

Water quality is one of the most basic ways to monitor rivers and streams, and it is vitally important to know what constituents are in the water, as that drives not only many chemical processes but also plays a critical role in determining the quality of the biota that are supported. Throughout the Whitney Point study area, water quality was generally very good, especially for larger river systems, which can often be degraded by wastewater, commercial, or industrial discharges. Water quality samples were analyzed annually for a basic suite of water quality parameters, primarily nutrients, at every sampling location (Table 4).

No sampled lab parameter exceeded NYSDEC water quality standards. Nutrients, such as nitrogen and phosphorus, were the primary concern coming into the project as much of the land use in these watersheds is agricultural. Slight year-to-year fluctuations were common, but in general, the Tioughnioga River, particularly the upstream sites, had higher nutrient concentrations than the Otselic or the Chenango Rivers.

Table 4. List of Lab and Field Water Chemistry Parameters

Lab Parameters	Field Parameters
Alkalinity	Temperature
Ammonia-N T	pH
Biological Oxygen Demand	Dissolved Oxygen
Chloride	Specific Conductance
Total Kjeldahl Nitrogen	Turbidity
Total Nitrate-N	
Total Nitrite-N	
Total Nitrogen	
Orthophosphate	
Total Phosphorus	
Total Organic Carbon	
Total Suspended Solids	

Background concentration levels of nitrogen and nitrate are considered to be 1.0 mg/l and 0.6 mg/l, respectively (USGS, 1999). Total nitrogen exceeded 1.0 mg/l at nearly 60 percent of all samples taken in the Tioughnioga compared to only 7 percent of the samples in the Chenango and Otselic. A large majority of the total nitrogen in these rivers is found in the form of nitrate, which exceeded 0.6 mg/l at greater than 75 percent of all the samples taken in the Tioughnioga but never exceeded in the Otselic or Chenango (Figure 2). Phosphorus concentrations remained consistently below background levels of 0.1 mg/l (USGS, 1999) at all sites throughout the five-year sampling period.

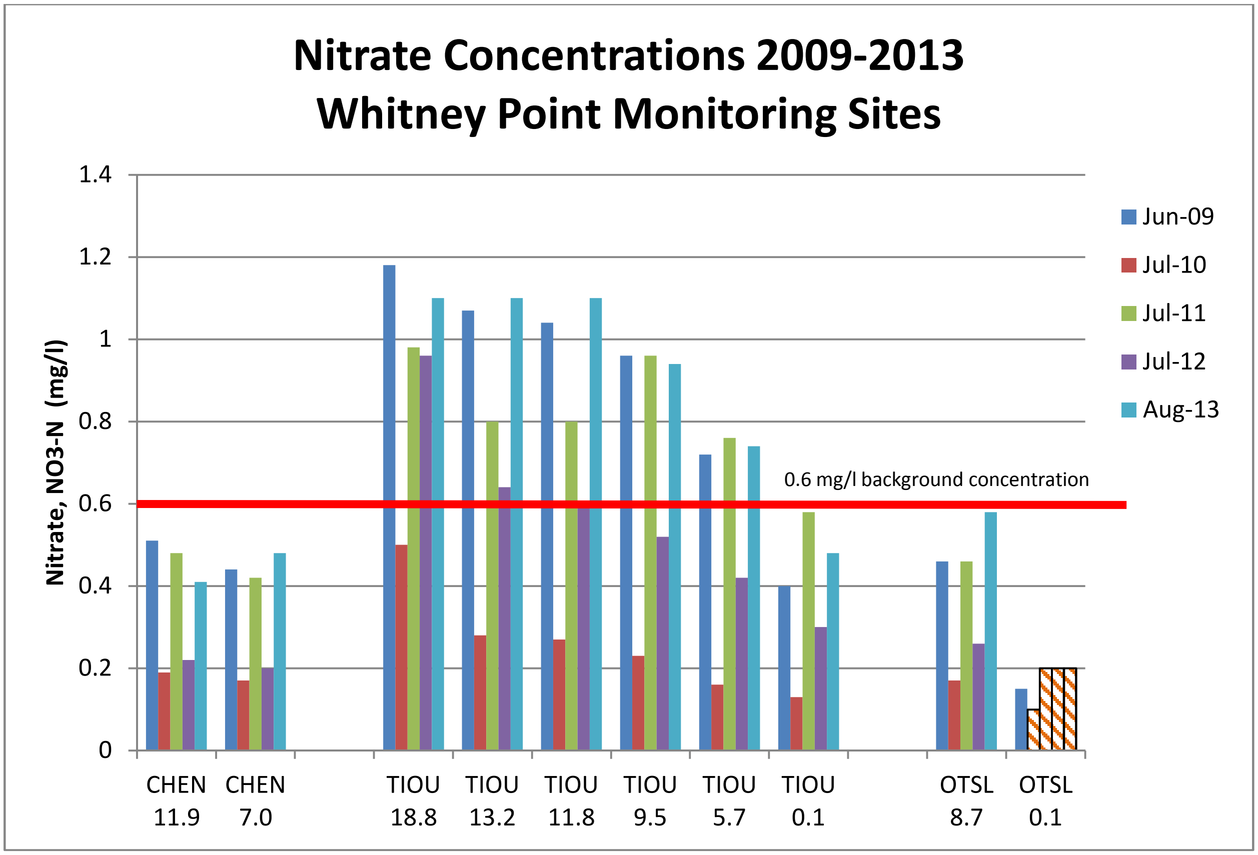

Figure 2. ***Nitrate Concentrations at Each Monitoring Site by Year (Hatched bars indicate presence below detection limit.)***

Field chemistry parameters including stream temperature, pH, dissolved oxygen, specific conductivity, and turbidity were measured in-situ during each sampling event. The only field parameter to occasionally exceed NYSDEC water quality standards was pH. In the Tioughnioga River, pH exceeded 8.5 on a few occasions, although the geometric mean over the five years at all stations was within water quality standards. Table 5 summarizes mean field chemistry values for each sampling location. Conductivity was considerably lower in the Otselic than either the Chenango or Tioughnioga, which had the highest conductivity. The lower mean dissolved oxygen and higher mean turbidity at OTSL 0.1 is likely a function of the proximity of that site to the dam outlet works.

Table 5. Mean Values for Field Chemistry Parameters per Site

Site Name	Dissolved Oxygen (mg/l)	pH	Specific Conductivity (umhos/cm)	Turbidity (NTU)	Water Temperature (deg C)
CHEN 11.9	8.5	8.2	327.0	6.0	21.4
CHEN 7.0	7.5	7.8	328.4	5.0	20.5
OTSL 8.7	8.1	7.6	189.0	6.2	21.1
OTSL 0.1	6.9	7.6	161.1	10.2	21.3
TIOU 18.8	9.4	8.2	447.7	4.7	20.9
TIOU 13.2	10.1	8.3	438.9	5.3	20.8
TIOU 11.8	10.5	8.3	418.7	5.1	22.7
TIOU 9.5	8.9	8.1	418.0	5.3	21.6
TIOU 5.7	9.3	8.2	370.8	5.0	22.1
TIOU 0.1	9.2	8.2	325.1	5.8	22.1

Macroinvertebrates

Benthic macroinvertebrates are often used as indicators of water quality conditions because of their high numbers, known pollution tolerances, limited mobility, wide range of feeding habits, and varied life spans. Water quality can change rapidly but, as aquatic residents, macroinvertebrate composition can be affected by either periodic episodes of poor water quality or continuous poor water quality. Assessment of macroinvertebrate communities can help evaluate overall conditions in rivers and streams.

In the Whitney Point study area, macroinvertebrate communities were generally good, especially for large river systems, which tend to be less diverse. Over the course of the five sampling years, a large majority (94 percent) of the collected macroinvertebrate communities were either nonimpaired or slightly impaired. Table 6 summarizes select macroinvertebrate metrics at each location, showing the mean value over the five sampling seasons. The macroinvertebrate assemblage at OTSL 8.7 is excellent and comparable to reference conditions based on other Commission sampling in equivalent size drainage areas in the Upper Susquehanna Subbasin. The results were repeatedly higher than other sites in taxa richness, Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa, and species diversity, while also having more taxa that were intolerant of organic pollution, as noted by the lower Hilsenhoff Biotic Index (HBI) score. The only site to score as moderately impaired a few times over the five years was the site below the dam at the mouth of the Otselic River (OTSL 0.1). This was not unexpected as the community was consistently representative of genera seen downstream of impoundments in New York

State (Bode and others, 2002). The dominant taxon was the tolerant caddisfly genera *Cheumatopsyche,* averaging nearly 60 percent of the sample over the five years. This site also showed lowest species diversity, fewest taxa, and fewest EPT taxa along with the greatest proportion of organic tolerant taxa, as noted by the highest HBI score. Macroinvertebrate communities at both Chenango River sites were very similar, and Tioughnioga River macroinvertebrate communities tended to decline slightly moving downstream.

Table 6. Mean Values for Select Metrics from 2009-2013

	Label ID for Figures 3 & 4	Taxa Richness	HBI	EPT Taxa	% Model Affinity	Species Diversity	% Dominant Taxa
Chenango River							
CHEN 11.9	C11	20	4.07	14	66.2	2.32	26.2
CHEN 7.0	C7	18	4.04	12	66.4	2.27	27.9
Otselic River							
OTSL 8.7	O8	24	3.88	15	64.7	2.54	23.2
OTSL 0.1	O1	13	5.40	5	46.0	1.42	58.6
Tioughnioga River							
TIOU 18.8	T18	23	4.29	14	62.5	2.47	25.1
TIOU 13.2	T13	19	4.41	12	61.2	2.30	24.3
TIOU 11.8	T11	21	4.28	13	71.3	2.39	25.9
TIOU 9.5	T9	23	4.92	11	73.5	2.36	31.9
TIOU 5.7	T5	20	4.45	10	63.5	2.28	33.2
TIOU 0.1	T1	18	3.98	11	54.3	2.15	34.2
Side Channels (Tioughnioga River)							
TIOUB 13.2	TB13	22	3.88	13	67.6	2.48	21.1
TIOUB 5.4	TB5	22	4.04	13	59.2	2.38	23.7

NMDS (Field, 1982; Clarke, 1993) was used to visually compare biological data in each individual river system. NMDS is a distance-based ordination method generated on similarity. Bray-Curtis similarity indices were calculated to compare taxa and abundance data at each site over the five years of sampling. The resulting matrix was plotted using NMDS, and sites that fall near each other on the NMDS ordination plot are most similar. This analysis was completed using the R statistical software package.

Macroinvertebrate community data were grouped by river system, and every site and each year were compared to each other with interesting results. Sites were broken down into upper Tioughnioga River sites (those upstream of the confluence of the Otselic River), lower Tioughnioga River sites (those below the Otselic), Chenango River, and Otselic River. For the eight sites on the Tioughnioga River and the two sites on the Chenango River, differences in macroinvertebrate community structure grouped together by year not site. For example, all samples collected on the upper Tioughnioga in 2010 were more similar to each other than all the samples at T1 over the five-year period. Figure 3 shows the NMDS plot, and as each year is plotted in the same color, it is easy to see how the years largely group together. This pattern of similarity seems to suggest that when physical habitat conditions are similar, as they are at the Tioughnioga and Chenango sites (Figures 3A, 3C, 3D), annual climatic variables may be more of a driving force than site specific variables. These climatic variables may include water temperature, air temperature, warming days before sampling was conducted, flow, or precipitation.

The Otselic River was the only instance where site-specific differences regardless of year seemed to be the driving factor between differences in macroinvertebrate community similarity. This is not unexpected given the marked differences in these two sites as OTSL 0.1 is directly downstream of the dam at Whitney Point Lake and has very poor macroinvertebrate habitat, while OTSL 8.7 is above Whitney Point Lake and is a fairly undisturbed stream reach with well-developed riffle-run habitat units. Figure 3B shows how these two sites support very distinct macroinvertebrate communities and group by site regardless of year. One other interesting note in the Otselic River plot (Figure 3B) is the differences in macroinvertebrate communities at O1 (plotted on the left side) when flows coming out of the dam were relatively higher (2009 and 2013) and when they were lower (2010, 2011, and 2012).

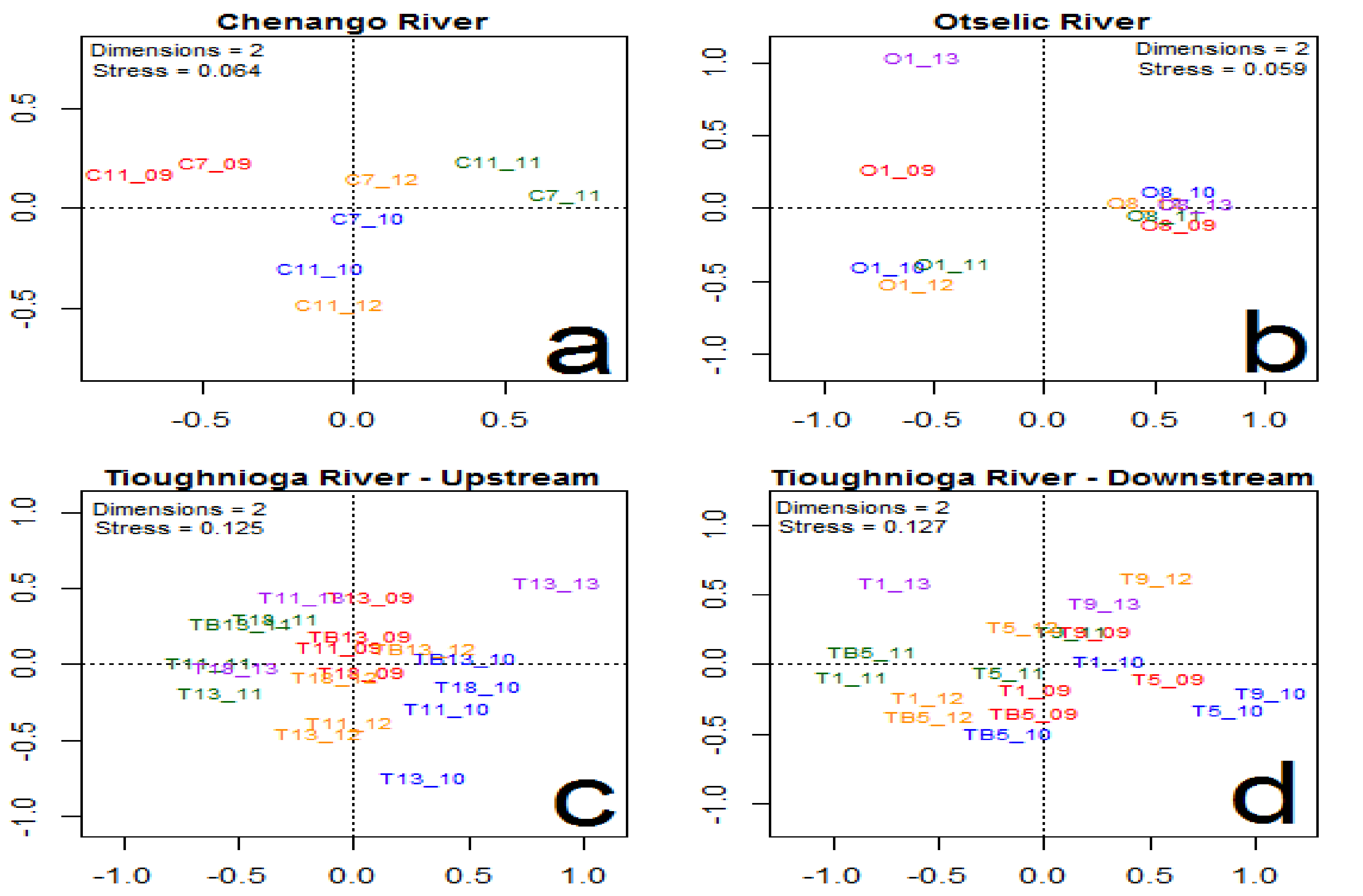

Figure 3. NMDS Plot of Macroinvertebrate Community Similarity in the Whitney Point Study Area. Labels indicate site ID followed by year (i.e., O8_11 is Otselic River 8.7 in 2011, see Table 6 for site label ID)

Fish

Fish are another important bioindicator, although less often used than macroinvertebrates, in the evaluation of river conditions and quality. Because of their multi-year life-spans and mobility, fish species can be good indicators of long-term effects and larger-scale habitat conditions. Fish communities include a range of species, pollution sensitivities, and trophic levels, which can reflect relative degree of environmental disturbance. In addition, fishes are of greater immediate concern to people due to their potential for food and recreation.

In the Whitney Point study area, fish were surveyed each year at all sites (except in 2013 due to high flows), and fish communities were found to be generally healthy and fairly consistent over the five years. Forty fish species were documented in total, the most frequently collected species was *Ambloplites rupestris (*rock bass). Rock bass and *Micropterus dolomieu* (smallmouth bass) were the two most commonly collected game species. Appendix A lists all fish species collected from 2009-2013 in order of abundance along with the number of individuals of each species that were collected. When using the NYSDEC fish metrics, 98 percent of the fish communities over the five-year period ranked as either nonimpaired or slightly impaired. The metric that most often scored the lowest was percent model affinity, which compares the surveyed fish community to various model communities. The upstream site on the Otselic River (OTSL 8.7) was unique in that only native fish species were collected at this site over the five-year sampling period. Rivers of this size are difficult for surveying fish as they are too shallow for boat-electroshocking and too large to sufficiently cover by wading tote barge methods. In all cases, the best available wadeable habitat was sampled but especially at some of the larger sites, the species list may not be complete as not all habitats were able to be sampled. This limitation could impact not only species richness but also percent model affinity. Table 7 provides a summary of mean values for select fish community metrics over the five-year sampling period.

Table 7. Mean Values for Selected Fish Community Metrics

	Species Richness	percent intolerant/moderately tolerant species	percent intolerant/moderately tolerant individuals	% model affinity
CHEN 11.9	18	78.1	77.5	56.8
CHEN 7.0	13	56.8	63.0	25.9
OTSL 8.7	19	87.4	78.1	52.8
OTSL 0.1	14	83.8	72.3	55.6
TIOU 18.8	14	89.2	79.6	45.3
TIOU 13.2	21	59.7	75.8	59.2
TIOU 11.8	15	88.2	84.8	52.1
TIOU 9.5	11	75.9	76.8	49.6
TIOU 5.7	16	76.4	77.5	47.5
TIOU 0.1	13	92.8	86.9	48.0

NMDS was also used to visually compare fish community data at each sampling location. Stations were grouped the same way as with the macroinvertebrate analysis, with sites on the same river being plotted together. Unlike the macroinvertebrates, fish community similarity generally clustered by site, not by year (Figure 4). Sites in all three river systems followed this pattern. In Figure 4, site names are shown in the same color regardless of year, and it is fairly easy to see the groupings. This suggests that for fish communities, site-specific variables, such as available habitat, water quality, instream cover, and water depth may be more important drivers to fish community dynamics than annual climatic fluctuations as seen in the macroinvertebrate communities. One interesting observation within these groupings can be seen in Figure 4C - the upstream side channel site (labeled TB13) shows a very different community of fish in 2009 and 2010 than in 2011 and 2012. This can likely be attributed to the significant bed load shift that happened between the 2010 and 2011 sampling seasons and cut the side channel almost entirely off from the main channel during summer flows. Fish surveys in 2011 and 2012 in this side channel were conducted in the isolated pools and small runs that remained.

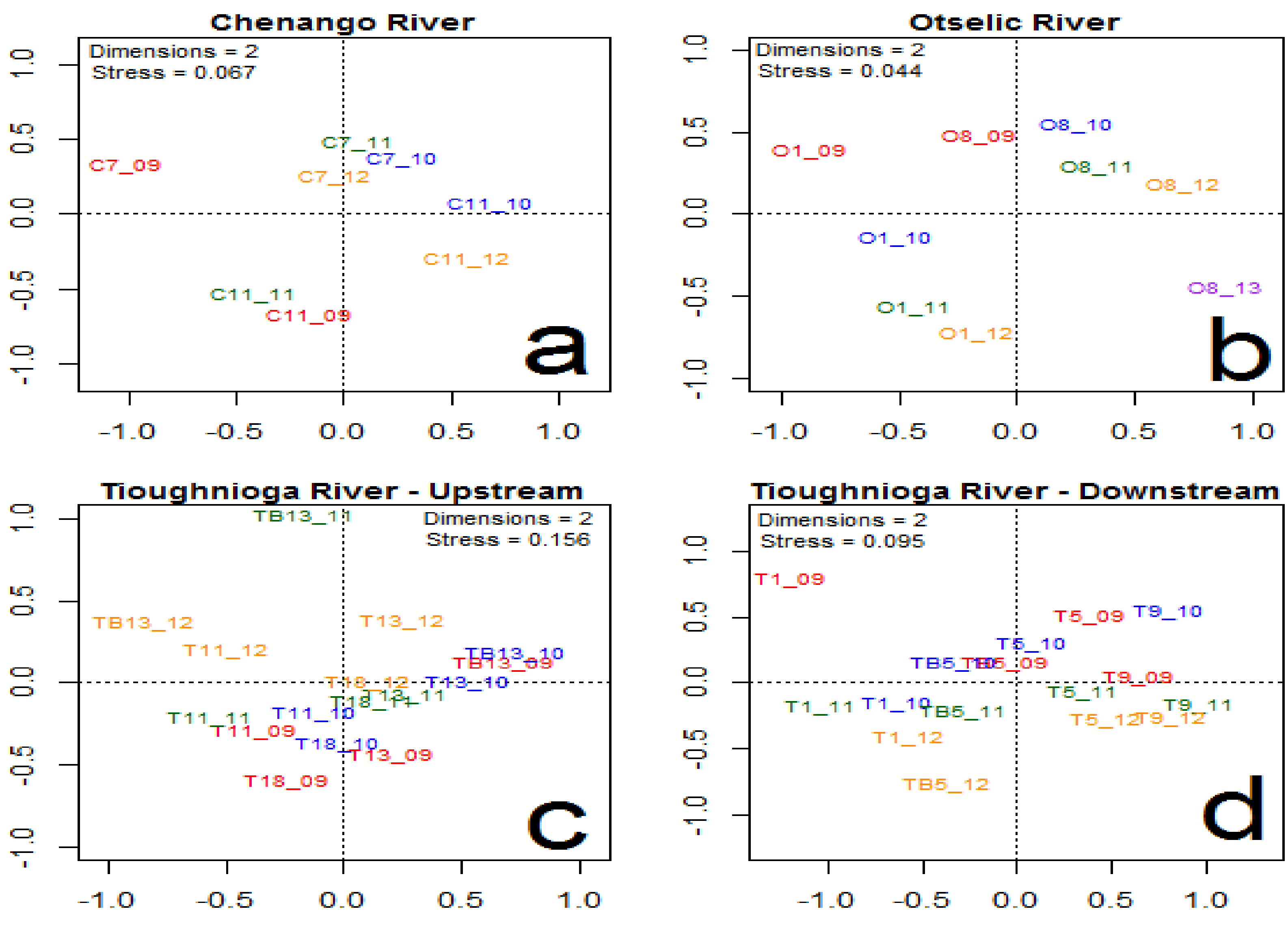

Figure 4. NMDS Plot of Fish Community Similarity in the Whitney Point Study Area. Labels indicate site ID followed by year.

Habitat

A physical habitat assessment (Barbour and others, 1999) at each sampling location was completed annually to generally document stream, bank, and riparian conditions. All habitat scores were considered to be supporting with average scores ranging from 125-160 out of a possible 200. Habitat at each site stayed very much the same over the five-year study period. The most common physical habitat problems across sites were riparian buffer width, condition of banks, and vegetative protective cover with scores that typically fell in the marginal or poor range at many of the sites. Riparian buffer width is generally poor because a majority of the sampled portions of all three rivers have a road running parallel to them. Epifaunal substrate and instream cover, which are indicators for macroinvertebrate and fish habitat quality, respectively, were most often scored between 14-17 out of 20 possible points. The best physical habitat was found at OTSL 8.7, which also corresponded to the best macroinvertebrate communities, while the worst physical habitat was found below the dam at OTSL 0.1 and corresponded to the poorest macroinvertebrate communities.

Side channels

Two side channel reaches were located on the Tioughnioga River within the Whitney Point study area, one upstream and one downstream of the confluence of the Otselic River. The purpose of including side channels in the monitoring plan was to document the ecological importance of these areas, as they would be the first habitat types to be dewatered in an extreme low flow event. Documenting existing conditions and ecological function of side channels and backwater habitats provides additional cause to implement the flow augmentation as called for in the AMP. The sample design included an upstream side channel that would act as an experimental control as it would not receive any flow augmentation from Whitney Point Lake and a downstream side channel that would receive flow from an environmental release. As there were no low flow conditions from 2009-2013 that called for a release from the lake, the suitability of this sampling design was not able to be verified. However, a wealth of data pointing to the ecological importance of side channel habitats to riverine systems was collected. In river systems the size of the Tioughnioga River, it is common for a majority of the riffle habitat that is optimal for macroinvertebrates to be located within side channels. In addition, side channels often provide excellent habitat for young-of-the-year fish and can act as refugia from predators and swift currents. More complex habitat structures are often found in side channels as downed trees and other woody debris get caught along cobble bars, islands, and banks during high flows and create excellent fish habitat. During the five-year study period, the macroinvertebrate communities in the side channels generally had more taxa, higher diversity, more pollution intolerant species, and more EPT taxa than the adjacent main channel river habitat. In addition, a majority of the smallmouth bass collected in the side channels were young-of-year. As alluded to previously, the upstream side channel was almost entirely cut off from the main channel of the Tioughnioga River sometime between sampling in 2010 and 2011 due to bed load shifting. Significant shifting of loose substrate is not uncommon in streams and rivers in the glacial till geology of the southern tier of New York State.

Explanation of flows, 2009-2013

Streamflow in the study portion of the Otselic, Tioughnioga, and Chenango Rivers can be quite variable, and the annual baseline river sampling was done during the summer base flow period when wading was feasible and safe. Flows at the USGS gage on the Chenango River at Chenango Forks were used as a guide to determine when conditions were favorable for sampling, which was typically mid-July. However, in 2013, due to unusually high flows all summer, sampling was delayed until mid-August, and even then, flow was so high that sampling had to be revised, and not all planned sampling could be completed. Figure 5 shows average daily flows for both reference gages used in this project during the study period of June 1, 2009 – October 31, 2013. Also indicated are trigger flow values for an environmental release and notation of when sampling occurred. Note the peak flows during the Hurricane Irene/Tropical Storm Lee event of September 2011, and the consistently high flows throughout 2013. The red dots indicate when sampling was conducted in all five years.

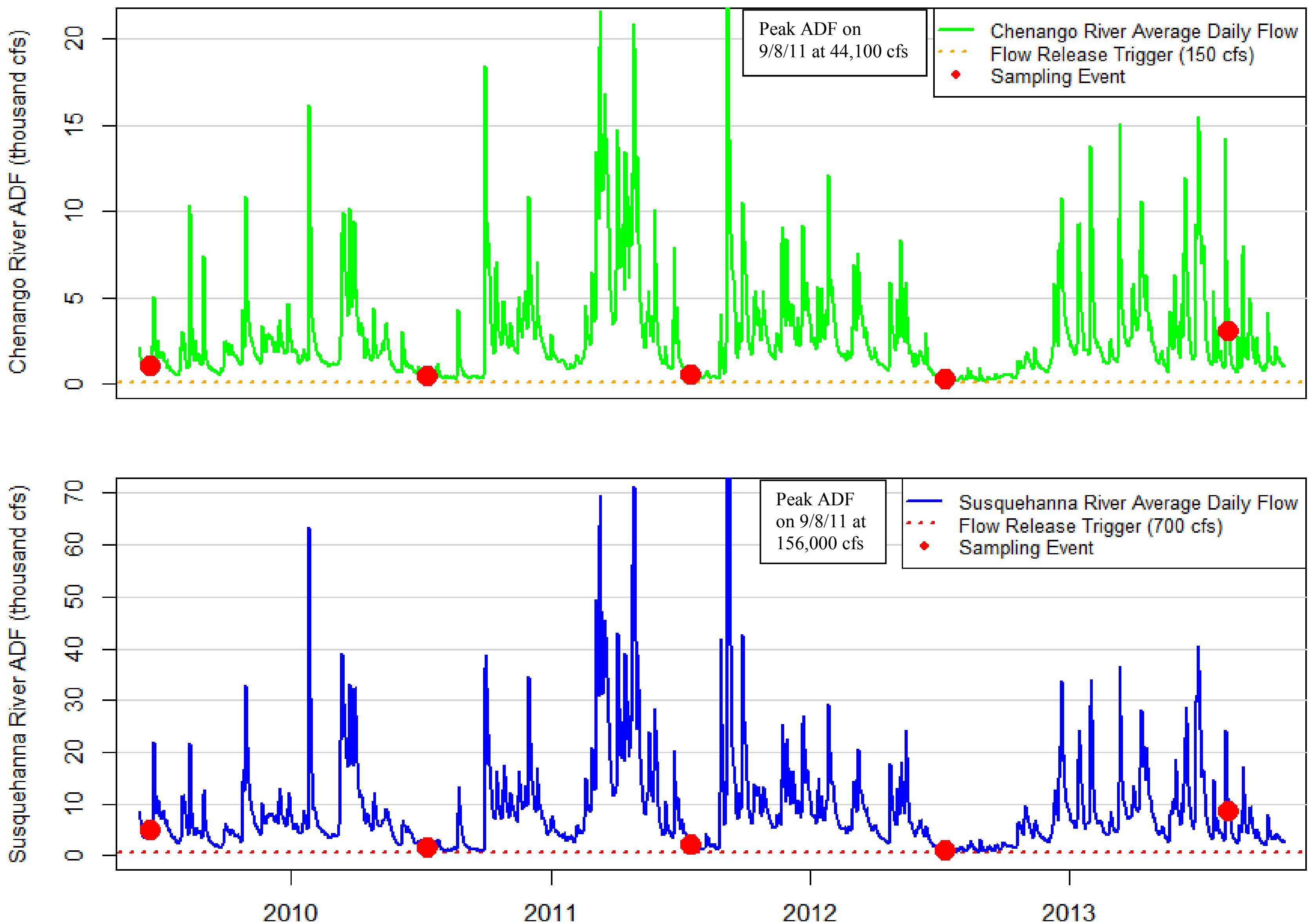

Figure 5. Average Daily Flows at Chenango Forks and Waverly USGS Gages for Project Timeframe, June 1, 2009-October 31, 2013

Lake

Chemical and biological conditions in Whitney Point Lake were also routinely monitored during the 2009-2013 study period (Figure 6). In addition to allowing for releases from the lake during times of low flow, the environmental restoration project also called for a termination to the historical annual winter drawdown which was replaced by maintenance of a constant year-round lake level. Documentation of lake conditions under this new lake management scheme was important. Baseline seasonal water quality data were collected at three locations in the lake three times between June and October each year. The sampling sites were at historical USACE sampling locations. Macroinvertebrate samples were collected from the littoral zone of the lake twice a year using a combination of methods: a petite ponar dredge at seven locations in the lake and an aquatic kicknet at three locations right along the shoreline. The purpose of the macroinvertebrate sampling was not only to document biological conditions in the lake, but also to confirm the presence of the burrowing mayfly genera *Hexagenia*, as there was some concern over the possible effects of a summer low flow release on this genera which often burrow in fine sediments along the edges of lakes (Merrit and Cummins, 2008). The third indicator that was monitored within Whitney Point Lake was SAV. Because Whitney Point Lake is used heavily for recreation, including swimming, boating, fishing, and kayaking, dense SAV blooms in the lake can potentially be very detrimental. Twice annually, SAV was surveyed at ten monitoring locations, primarily around recreational areas.

Eutrophic conditions in lakes are generally characterized by chlorophyll-a concentrations above 15 µg/l, total phosphorus between 30-50 µg/l, and secchi depths of less than five feet (Wisconsin Department of Natural Resources, 2007; Lillie and Mason, 1983). Samples in Whitney Point Lake met all these criteria about 30 percent of the time, and were more often found at the two deeper sampling points (WPL 2 and WPL 3). Chlorophyll-a concentrations averaged 23 µg/l over the five years of sampling. Total phosphorus exceeded 30 µg/l in 75 percent of the samples and the mean total phosphorus concentration was 51 µg/l. Secchi disk depth in Whitney Point Lake was never greater than four feet during any of the sampling events of the past five years.

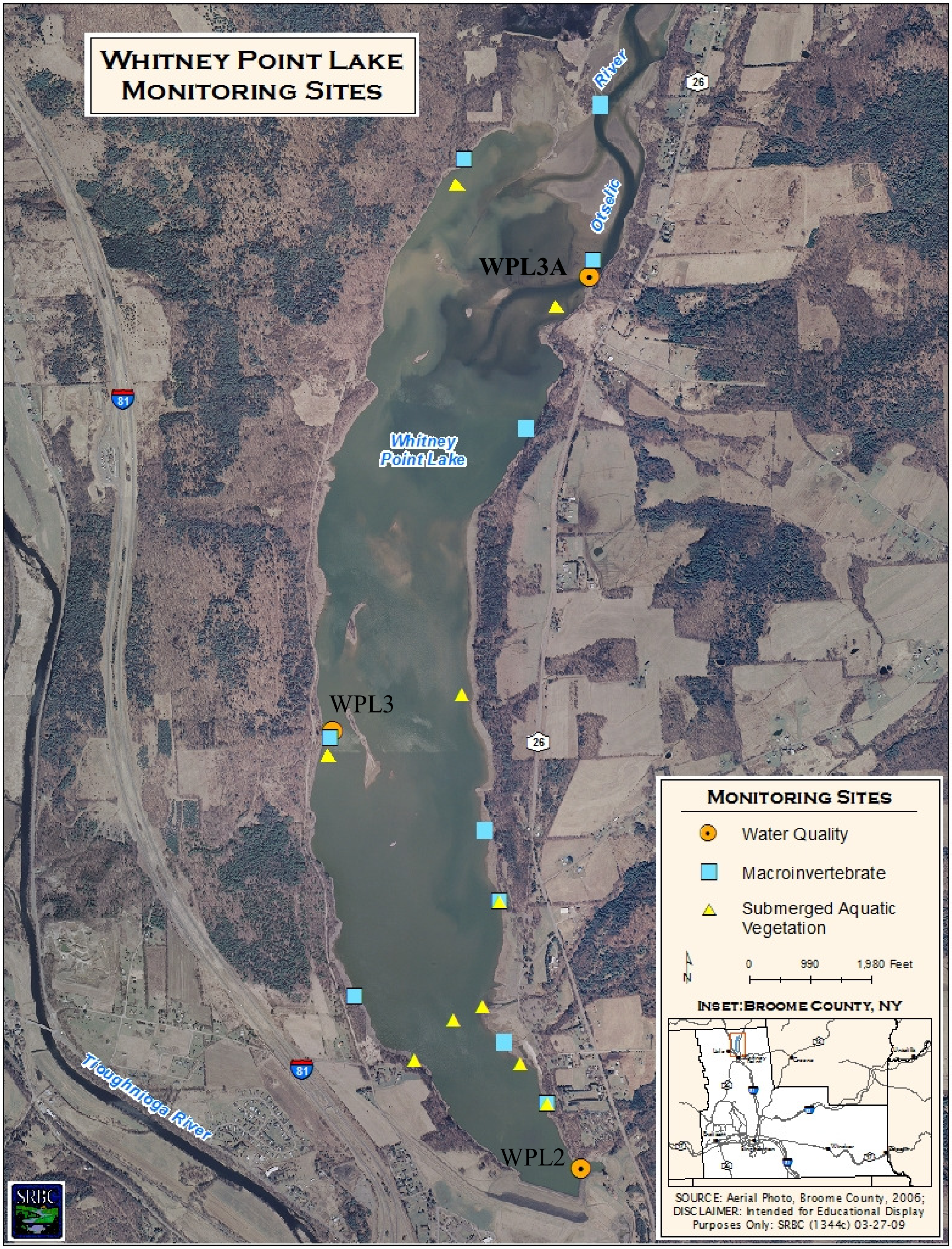

Figure 6. Whitney Point Lake Sampling Locations

One other parameter of concern in the lake over the study period has been biological oxygen demand (BOD), a measure of the amount of oxygen used in the breakdown of organic waste. A BOD over 5 mg/l generally indicates large amounts of organic waste or bacteria in the water. Samples exceeded 5.0 mg/l of BOD in 12 percent of samples taken over the five years but no one site was consistently exceeding. The mean concentration of BOD at each site was about 3.5 mg/l.

Macroinvertebrates were collected in the lake twice annually over the course of the five-year sampling period with mixed results. A petite ponar dredge was used at seven locations in depths of between three and seven feet. These samples varied greatly depending on the substrate as the ponar works best in soft muddy sediments and is difficult to use on rocky substrates. Three lake locations were sampled in depths of two feet or less using a kick and sweep method with an aquatic net. These samples were much more consistent from year to year. The most abundant taxon, at greater than 40 percent of all taxa collected, was Chironomidae, which is typical for lentic macroinvertebrate communities. The second most abundant taxon was the genera of mayfly *Caenis*, which are also often found in lakes as they prefer ponded or slow moving water and are adapted to fine sediments. The burrowing mayfly genera *Hexagenia* comprised about 2 percent of all the organisms collected and were the fourth most abundant. NMDS was used to compare lake macroinvertebrate samples although no clear patterns emerged except for the difference in those samples collected with different methods. Figure 8 shows all lake macroinvertebrate samples collected in July from 2009-2013, ponar samples shown in blue and aquatic net samples shown in red.

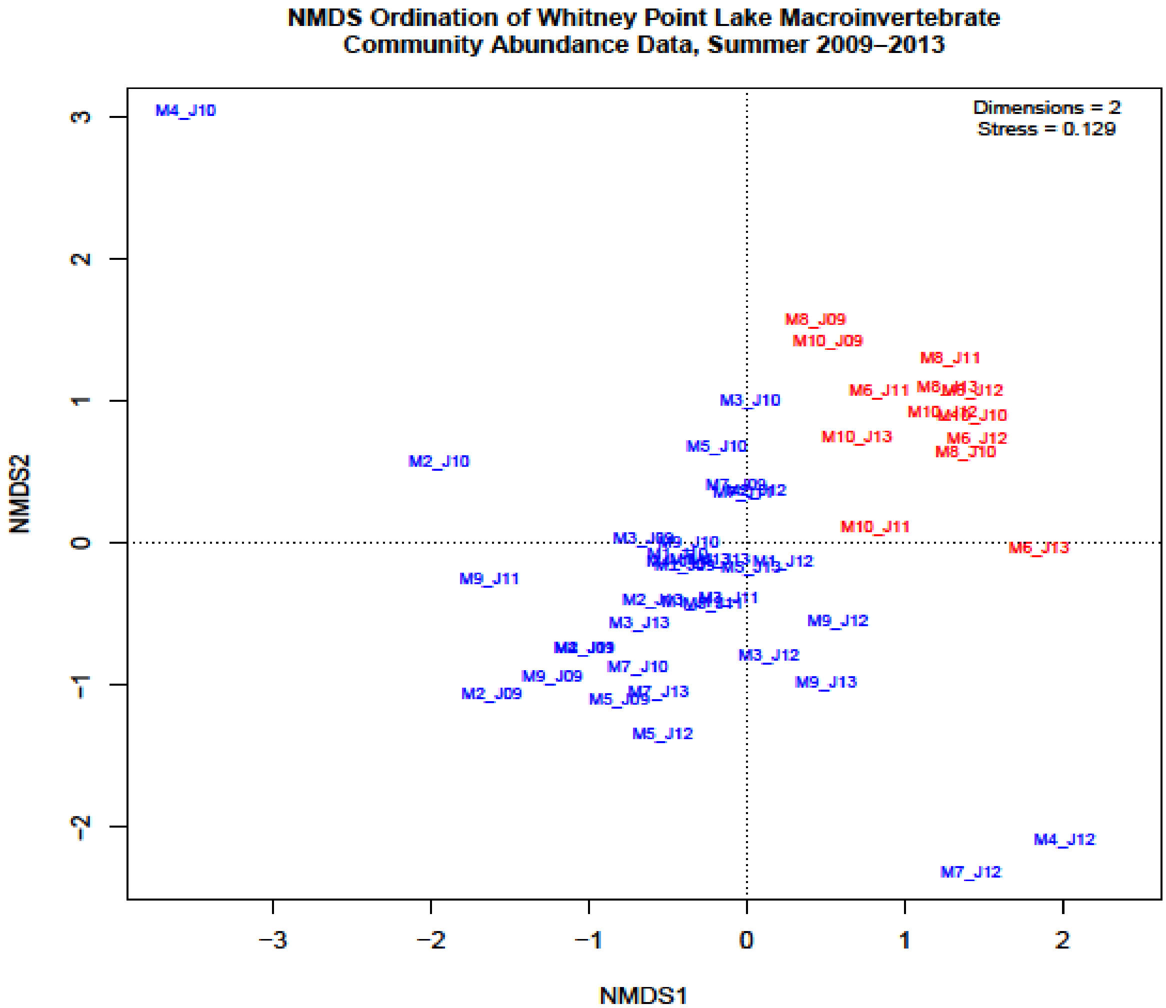

Figure 8. NMDS Plot of Summer Lake Macroinvertebrate Samples for Two Methods

SAV is an important part of lake ecosystems as it provides food, cover, and uptakes excess nutrients. However, it can become a nuisance to recreational activities in highly productive lakes, especially if non-native species are introduced. In Whitney Point Lake, SAV was monitored twice annually, once in early summer and again in late summer, to document species presence, dominance, extent, and general response to climatic conditions. Because of the concern regarding recreational impacts, a majority of the sites were around heavily used recreational areas. There were four species of SAV found in the open water portion of the lake--three of which are non-native species. The most dominant aquatic plant in Whitney Point Lake was *Myriophyllum spicatum,* (Eurasian watermilfoil). Also found were *Najas minor* (European Naiad), *Hydrilla verticillata* (hydrilla), and *Ceratophyllum demersum* (coontail). Coontail is the only native species found in the lake. In general, less than 10 percent of the lake surface is covered in SAV. The primary area where SAV is abundant is in shallow shoreline areas particularly in small cove areas. The highest density of SAV was found in depths of between two and five feet. The density and extent of SAV coverage seemed to change year to year depending on rainfall, temperatures, and other climatic variables, such as wind. Some SAV was found at least one time at all but one of the sampling locations; which was located in the middle of the lake with normal depths up to 22 feet, so SAV would not be expected to occur except in very extreme conditions. SAV seemed to be most prominent in 2012 and virtually absent in 2009 and 2010. Anecdotal notes from recreational lake users confirm 2012 as the worst year in recent memory for nuisance vegetation growth in the lake. *Trapa natans,* water chestnut, was found sporadically in the constructed wetlands area in the northern cove of the lake but never in the open water. NYSDEC conducted annual manual eradication efforts to remove this invasive plant from the wetlands.

In 2012, due to a planned maintenance drawdown of Whitney Point Lake in late September through early October, a unique opportunity to document the effect of a drawdown on lake conditions presented itself. The lake was drawn down at a rate of approximately 150 cfs for three weeks for a total drawdown depth of five feet. As a result, it was possible to not only see the effects of a potential future environmental drawdown (of likely far less magnitude) on conditions in the lake but also track the impact of the flow augmentation at both USGS reference gages. At the Chenango Forks gage on the Chenango River, 12 miles downstream of Whitney Point Lake, the 150 cfs release rate was discernible in the gage hydrograph in terms of both magnitude and duration (Figure 7). However, 52 miles downstream, the additional water being released from the lake was more obscure in the hydrograph for the Waverly gage on the Susquehanna River. This provides some insight into the downstream extent of influence for future low flow augmentation releases from Whitney Point Lake and emphasizes the importance of using both the local Chenango Forks gage as well as the mainstem Waverly gage to trigger low flow augmentation releases. The release schedule from the lake in a low flow event, as outlined by USACE, is dependent on numerous factors but would range from 50-100 cfs, which is lower than the 150 cfs release rate used during the maintenance drawdown.

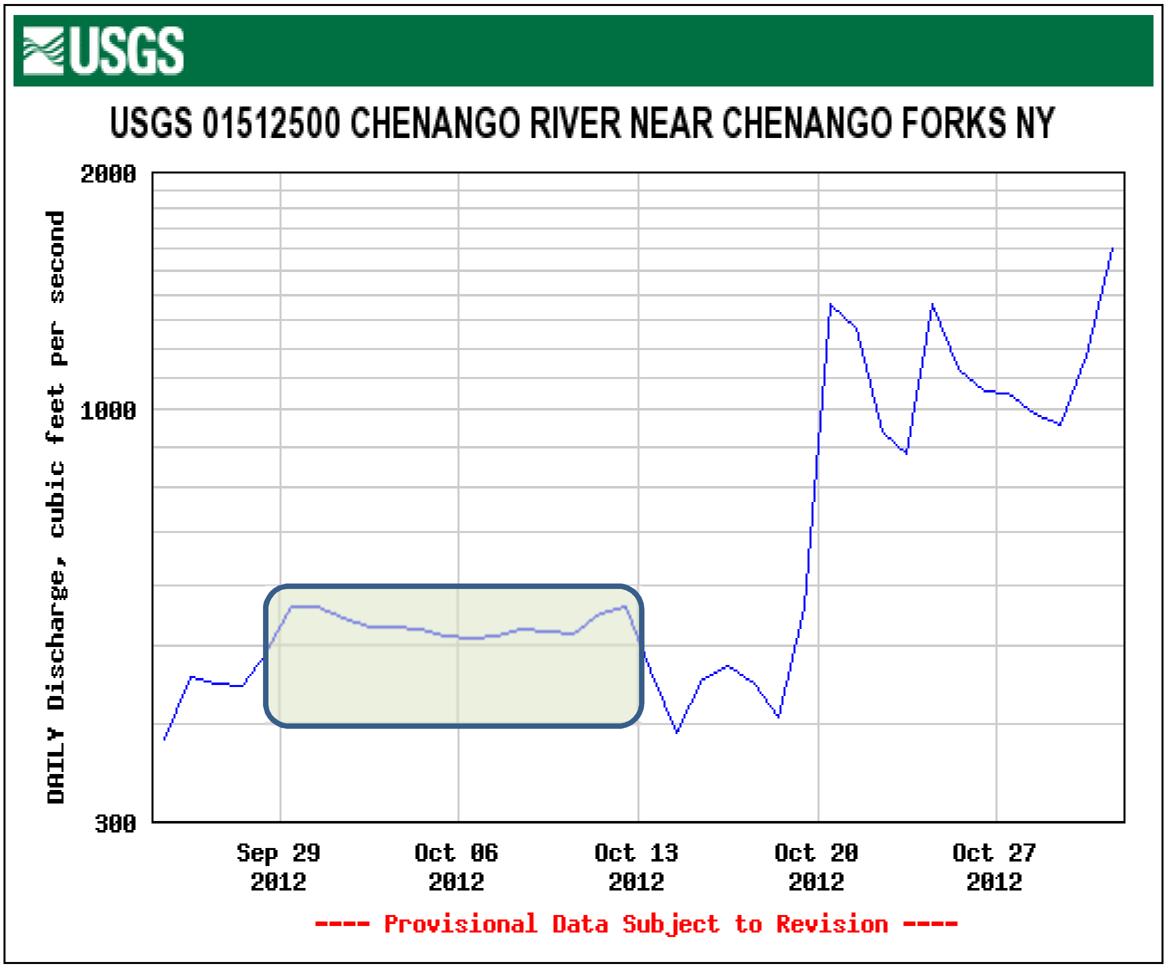

Figure 7. Average Daily Flow at Chenango River Gage during September/October 2012 Maintenance Drawdown of Whitney Point Lake

<u>Wetlands</u>

As part of the Whitney Point environmental restoration project, a two-acre wetland was constructed in the northwestern cove area of the lake (Figure 8) in 2009. A much smaller mid-lake wetland was also planted at the same time (as shown on the inset of Figure 8) but failed to thrive, and few plants survived past the first growing season (Figure 12). This mid-lake wetland was planted in a suboptimal location, and the combination of little sunlight, wave action, and greater water depths were not conducive to a sustainable wetland system. In addition to the wetlands, two islands were constructed between the open water of the lake and the wetlands to provide protection for the wetlands and additional beneficial wildlife and fish habitat.

Figure 8. Location of Constructed Wetlands and Islands in Whitney Point Lake

Seven types of vegetation were planted in the wetlands and along the perimeter of the two islands:

- *Pontederi cordata* (Pickerel Weed),
- *Schoenoplectus tabernaemontani* (Softstem Bulrush),
- *Juncus effuses* (Soft Rush/Common Rush),
- *Peltandra virginica* (Arrow Arum),
- *Nuphar lutea* (Spatterdock),
- *Sparganium americanum* (American Bur Reed), and
- *Acorus americanus* (American Sweet Flag).

In order to monitor the wetland vegetation, a total of 32 randomly chosen one-by-two meter quadrants were selected in the wetlands and around the two islands. Coordinates were recorded at the center of each quadrant to keep consistent survey locations each year. A vegetation survey was conducted in each quadrant twice a year, in conjunction with the first two lake samples, to determine percent coverage of each species. In addition to the quadrant surveys, water depth, general conditions, and any invasive species were documented.

Vegetation was planted in the wetlands and along the perimeter of the islands in June 2009 (Figure 9). Exclusion fencing was put in place to protect the small vegetation and allow it to establish itself during the first growing season. The wetlands are fully inundated (average depth 10.5 inches) when the lake is at normal pool level.

In September 2009, the 32 quadrants were located and the first vegetation surveys were conducted. The 2009 growing season produced vigorous growth in the cove wetlands and on the upland islands (Figure 10). The vegetation in the mid-lake wetland did not establish as well and only showed minimal growth in the vegetation that did establish itself (Figures 11 and 12). Vegetation was documented in all of the cove wetland quadrants and in three of the four quadrants around each island.

Figure 9. Wetlands Planting – June 2009 ***Figure 10. Vegetation Growth – Sept 2009***

Dominant wetland species included softstem bulrush, pickerel weed, and arrow arum. Common rush was also noted in the quadrants; spatterdock, American bur-reed, and American sweet flag were documented in small stands in portions of the cove wetlands. Soil erosion from water and wind was also noted on the southern side of the islands. The wetland and upland plants helped to alleviate some of the erosion issue, as did erosion control fiber logs that were placed around the islands.

Figure 11. Mid-lake Wetlands – Sept 2009 ***Figure 12. Mid-lake Wetlands – July 2011***

In 2010 and 2011, two vegetation surveys were conducted per year as planned, once in July and then again in September. Substantial plant growth was documented in the cove wetlands during both years with softstem bulrush, pickerel weed, and arrow arum dominating the planted areas (Figure 13). A majority of the cove wetland quadrants had a high percentage of vegetated coverage. The mid-lake wetland and the island perimeters continued to show little plant growth. An invasive species, water chestnut, was documented in the cove wetlands in 2010 and 2011. NYSDEC was notified of the visual sighting of water chestnut and field crews worked on removing all water chestnut plants from the wetlands.

The survey in September 2011 was conducted after Tropical Storm Lee. Whitney Point Lake was used for the purpose of flood control (lake was 25 feet above normal elevation) during Tropical Storm Lee and the wetlands were completely inundated during that time. This was the first time the constructed wetlands had been severely flooded since they were established in 2009. The results of the vegetation survey were similar to past years as abundance remained high, but there were extensive surficial impacts of the flooding on the vegetation (Figure 14).

Figure 13. Vigorous Plant Growth – July 2011

Figure 14. Post Tropical Storm Lee – Sept 2011

There was a substantial difference in vegetation in the wetlands in 2012, which was the first growing season after the flooding from Tropical Storm Lee. Vegetation was noted once again in the majority of the quadrants, but the percent coverage was lower compared to previous years. Most notably impacted was pickerel weed, as large areas in the cove previously dominated by pickerel weed were completely bare during the 2012 surveys. Figures 15 and 16 show the same location prior to flooding in 2011 and then after flooding in 2012. Note the bare open water where pickerel weed had previously been.

A combination of flooding and accelerated sedimentation from the tropical storm likely contributed to the loss of pickerel weed. Pickerel weed uses rhizomes for propagation and these may have gotten buried in the sediment and hindered growth. The average percent coverage for pickerel weed dropped from 41 percent in 2011 to 25 percent in 2012. Softstem bulrush also appeared to be impacted by the flooding, as it was present in more monitoring quadrants but was found in lower densities in 2012. Conversely, arrow arum and spatterdock increased in abundance and density in 2012. Large stands of spatterdock were noted in the cove wetlands that had previously not been seen. Water chestnut was again noted in the cove wetlands during the surveys in 2012.

Figure 15. With Pickerel Weed – 2010

Figure 16. Without Pickerel Weed – 2012

During the planned five-foot maintenance drawdown of Whitney Point Lake in Fall 2012, the wetlands were not inundated for the first time since they had been planted (Figure 17). The wetlands were dewatered for about a month with vegetation experiencing different levels of exposure.

Figure 17. Exposed Substrate and Vegetation in the Constructed Wetlands and Cove Area During Lake Drawdown – October 2012

The vegetation surveys in 2013 showed no measurable impacts, positive or negative, from the wetlands being dewatered in 2012. The vegetation type, density, and abundance were comparable to the 2012 surveys. Areas once covered in pickerel weed before Tropical Storm Lee in 2011 were still bare in 2013. Populations of arrow arum and spatterdock continue to grow and expand. Softstem bulrush and pickerel weed are showing less growth than prior to the tropical storm flooding.

Minimal water chestnut was documented in the wetlands in 2013, and those few plants were removed by SRBC staff during the vegetation survey. The erosion on the islands appears to have stabilized with the upland plants having the most impact on controlling the erosion from water and wind.

Overall, the constructed wetlands and islands have been successful as they have stabilized and continue to display healthy plant growth. Vegetation survey results post-flooding (2012) and in post-drawdown (2013) seem to suggest that flooding has more adverse impacts on the wetlands than dewatering. Short-term dewatering did not seem to impact the wetlands positively or negatively, which is an encouraging sign that the wetlands will survive any future environmental releases from the lake.

Conclusions

Despite the absence of low flows during the 2009-2013 Adaptive Management Plan study period, the five-year monitoring effort yielded very valuable baseline chemical, biological, and habitat data and provided impetus for continued monitoring efforts. The Otselic, Tioughnioga, and Chenango Rivers will likely benefit from flow augmentation in low flow events, which will not only supplement flow in the main channel but will also better maintain the inundation of critical side channel and backwater habitats. Based on the results of the maintenance lake drawdown in 2012, the effects of a low flow augmentation release from Whitney Point Lake are clearly observable and measurable at least as far downstream as the Chenango Forks gage on the Chenango River and depending on basinwide flow conditions, would be observable at the Waverly gage. It will continue to be important to use both the Chenango Forks gage and the Waverly gage to coordinate low flow augmentation releases from Whitney Point Lake. In addition, neither lake conditions nor the wetlands were negatively impacted by a drawdown of that magnitude. Moving forward it will be important to maintain some level of monitoring, especially in the event of low flow conditions to document the extent and impact of various release environmental release events.

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Appendix A
Fish Collected in the Whitney Point Study Area

rock bass	944
white sucker	701
smallmouth bass	656
greenside darter	649
longnose dace	593
central stoneroller	563
banded darter	545
bluntnose minnow	363
cutlips minnow	293
tessellated darter	271
fallfish	267
bluegill	212
sculpin species	202
river chub	160
pumpkinseed	157
shield darter	134
creek chub	133
margined madtom	131
northern hog sucker	92
spotfin shiner	82
yellow perch	77
rosyface shiner	77
largemouth bass	70
spottail shiner	56
walleye	53
golden shiner	41
common shiner	23
eastern blacknose dace	19
northern pike	8
mimic shiner	7
brown bullhead	6
common carp	6
redbreast sunfish	6
banded killifish	5
green sunfish	4
brown trout	3
yellow bullhead	3
white crappie	2
fathead minnow	1
gizzard shad	1