REPORT

Conesus Lake SolarBee Pilot Test

2007 Monitoring Program Results

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Table of Contents

Table of Contents (continued)

List of Tables

List of Figures

Executive Summary

The Conesus Lake Watershed Council agreed to implement a pilot test of SolarBee units in Conesus Lake, Livingston County NY during the recreational seasons of 2006 and 2007. Funds for the pilot tests were contributed by Livingston County, the Conesus Lake Association, the Town of Geneseo, the Town of Livonia, the Town of Groveland and the Town of Conesus. Financial support to Livingston County from the Finger Lakes-Lake Ontario Watershed Protection Alliance was directed to the pilot test as well. Other community volunteers and contractors supported this effort, notably Professor Sid Bosch of SUNY-Geneseo and his students David Hoekstra, Lindsey Campana, and Jose Rios, Professor Gregg Hartvigsen of SUNY-Geneseo, and the Livingston County Sheriff's Office Marine Patrol. Special thanks to the Project Team: Don Wetzel, George Coolbaugh, Jack Baldwin, and Gene Bolster.

Conesus Lake, the western-most of New York's Finger Lakes, exhibits degraded water quality conditions. Phosphorus loading and in-lake concentrations are high, and the lake supports abundant macrophytes, phytoplankton, and macroalgae/metaphyton. Elevated bacteria counts, visible sediment plumes, rising chloride concentrations, and proliferation of exotic species are other impairments to the lake's ecology and recreational use. Pump Systems International (PSI) was contracted to install three solar-powered mixing devices (SolarBee®) in nearshore areas of Conesus Lake to test their effectiveness in improving lake water quality conditions: turbidity, abundance of algae and cyanobacteria, bacterial abundance, metaphyton, and macrophytes.

The Conesus Lake SolarBee pilot test described in this document was designed to test specific hypotheses related to the manufacturer's claims of improved water quality and conditions brought about by the machines in Conesus Lake. The interpretations and conclusions are specific to Conesus Lake and may not be applicable to other lakes.

Three units were installed by PSI in Conesus Lake between April 20 and April 23, 2006. The units were left in the lake over the winter and re-started in April 2007. Researchers from area colleges collaborated with Livingston County Planning Department in designing a monitoring program to test hypotheses that reflect specific impairments of Conesus Lake. The resulting water quality monitoring program and public perception survey were conducted in treatment and reference areas of Conesus Lake in 2006 and 2007.

Monitoring was conducted by faculty and students from SUNY-Geneseo. The investigators measured selected water quality parameters in the field and collected water samples for laboratory analysis of other parameters. This team assayed metaphyton density by digital photography and surveyed macrophyte biomass and species composition using quadrat sampling techniques. Water chemistry analyses were completed in a certified laboratory at SUNY-Brockport. A public perception survey was conducted concurrently with the water quality and biological sampling programs.

Results of the first year (2006) monitoring program indicated that the solar-powered mixing devices did not result in statistically significant improvements for the majority of parameters measured. However, some parameters did show improvement in regions of the lake adjacent to the solar-powered mixing devices; notably, turbidity and metaphyton levels in the northern basin of the lake were lower (indicating improved water quality) as compared with reference areas. The measured improvement was supported by public perception of clearer water. The magnitude of improvement was small compared with the variability in these parameters typically measured in Conesus Lake, both spatially and temporally. The conclusion of the 2006 effort was that the SolarBee units did not appear to be an effective alternative for consistent improvements to nearshore areas of Conesus Lake.

The localized improvements in water clarity and reductions in metaphyton cover reported in 2006 were sufficient for the project partners to authorize a second year of deployment and monitoring. Most of the parameters measured in 2006 were measured again in 2007, with the exception of bacteria.

Results of the 2007 program were very similar to 2006. Overall, there were no statistically significant differences between sites where SolarBees were deployed and reference locations (Table 1). The improvements in turbidity and metaphyton at the northern SolarBee location noted in 2006 were not apparent in 2007. There were also no consistent spatial or temporal patterns associated with the SolarBees in 2007 (Table 2). There were statistically significant differences in the transect data at one site (Sacketts Harbor) for one month (August). In addition, there were subtle effects noted for certain variables, suggesting a slight improvement. However, these subtle effects were not statistically significant and therefore cannot be attributed to the SolarBee units.

Water quality conditions at the SolarBee sites are not distinguishable from natural daily and weekly changes in the Conesus Lake system.

Table 1. Summary of 2007 hypothesis testing results.

Variable Measured	Predicted Beneficial SolarBee Effect	Results: SolarBee sites compared to reference sites	Was Result in Direction of Predicted Benefit?	Calculated p-Value	Was Difference statistically Significant (<0.05)?
Turbidity (NTU)	Decrease	SolarBee sites were 0.08 NTU lower than reference sites (1.61 compared to 1.69)	Yes	0.64	No
Chlorophyll-a (ug/L)	Decrease	SolarBee sites were 0.24 ug/L lower than reference sites (3.40 compared to 3.73)	Yes	0.65	No
Phycocyanin (ug/L)	Decrease	SolarBee sites were 0.24 ug/L lower than reference sites (3.65 compared to 3.89)	Yes	0.48	No
Metaphyton Coverage (percent cover)	Decrease	SolarBee sites were 5% lower than reference sites (46% compared to 51%)	Yes	0.11	No
Macrophyte Biomass (grams dry weight/m^2)	Decrease	SolarBee sites were 25 g/m^2 lower than reference sites (190 compared to 215, 12% difference)	Yes	0.25	No
Eurasian watermilfoil Biomass (grams dry weight/m^2)	Decrease	SolarBee sites were 45 g/m^2 lower than reference sites (112 compared to 157, 29% difference)	Yes	0.08	No

Table 2. Summary of 2007 spatial testing results. Expected spatial pattern was that of a second order polynomial curve where lowest values are closest to SolarBees and highest values are farthest away. North End and Sacketts Harbor analyzed separately. Water quality variables sampled once in June, July, and August at both sites (six samples total). Macrophytes and metaphyton sampled once in August at both sites (two samples total).

Variable Measured	Number of Transects with Pattern in Direction Expected	Number of Transects with Statistically Significant Expected Pattern	Number of Transects with Pattern Opposite of Expected	Number of Transects with Statistically Significant Pattern that was Opposite of Expected
Turbidity (NTU)	4 of 6	1 of 6	2 of 6	1 of 6
Chlorophyll-a (ug/L)	3 of 6	2 of 6	3 of 6	0 of 6
Phycocyanin (ug/L)	2 of 6	1 of 6	4 of 6	0 of 6
Metaphyton Coverage (percent cover)	1 of 2	0 of 2	1 of 2	0 of 2
Macrophyte Biomass (g/m^2)	1 of 2	0 of 2	1 of 2	0 of 2
Eurasian Watermilfoil Biomass (g/m^2)	1 of 2	0 of 2	1 of 2	1 of 2

Conesus Lake SolarBee Pilot Test: Year Two

1.0 Background

A pilot test was initiated in 2006 to determine if SolarBee water circulation devices could noticeably improve the condition of selected nearshore areas of Conesus Lake. The units were proposed as a means to help mitigate the impairments caused by the watershed loading and resulting productivity levels: algal blooms, macrophyte growth, elevated coliform bacteria, and metaphyton.

In the spring of 2006, three SolarBee units were placed in sheltered coves in littoral areas along the northern and western shorelines of Conesus Lake. These nearshore areas exhibit reduced water circulation during periods of calm weather. Significant impairment results from proliferation of metaphyton (visible patches of filamentous algae) among the extensive macrophyte beds that characterize the lake's nearshore areas.

Monitoring occurred through the recreational season of 2006 in order to evaluate the effectiveness of the SolarBees in improving conditions at nearshore areas. A public perception survey was also conducted. The results of the 2006 monitoring effort indicated that the units did not consistently improve water clarity, or reduce the abundance of bacteria, algae, or cyanobacteria. There were, however, positive results for some important parameters. These effects were small compared with the variation typical of lake conditions. The conclusion of the 2006 effort was that the SolarBee units were not likely to be an effective alternative for improving conditions in Conesus Lake. The localized improvements in nearshore conditions documented in 2006 were sufficient for the project partners to authorize a second year of deployment and monitoring.

As a result of dialogue among the project partners and SUNY scientists, it was determined that the 2007 monitoring program would focus on key indicator parameters; these parameters include water clarity (as measured by turbidity), macrophyte biomass, metaphyton coverage, chlorophyll-a (measure of green algae), and phycocyanin (measure of cyanobacteria). It was also decided that statistical testing would serve as the basis for differentiating natural variation from the effects of the devices. If, for a second year, the effect of SolarBees could not be statistically differentiated

from background variability, the conclusion would be reached that the SolarBee units are not effective in Conesus Lake.

2.0 SolarBee Technology

SolarBee units utilize an array of solar panels to capture solar energy and convert it to electrical energy. The electrical energy is sent to a small motor that drives an impeller assembly. Rotation of the impeller assembly induces subtle water flow upward through a flexible tube. The tube is set below the water surface at a depth that can be adjusted for optimal conditions. Water drawn from deeper in the water column is brought to the surface where it gently mixes with the water near the surface.

The net effect of the SolarBee is to increase water circulation. This is accomplished by increasing both direct and induced flow. According to the manufacturers, the increased circulation will improve water quality by enhancing natural biological and chemical processes.

3.0 Methods

The three SolarBee units deployed in Conesus Lake in 2006 remained in the lake over the winter, although they were not active. The machines were reactivated in April 2007 and moored close to their original locations (Figures 1 and 2). An extensive monitoring program was conducted in treatment and reference areas to address two related questions: do the machines affect water quality in a significant way, and if so, what is the spatial extent of the effect. Researchers from area colleges collaborated with Livingston County Planning Department and its consultant in designing a monitoring program to provide the data and information needed to answer these questions.

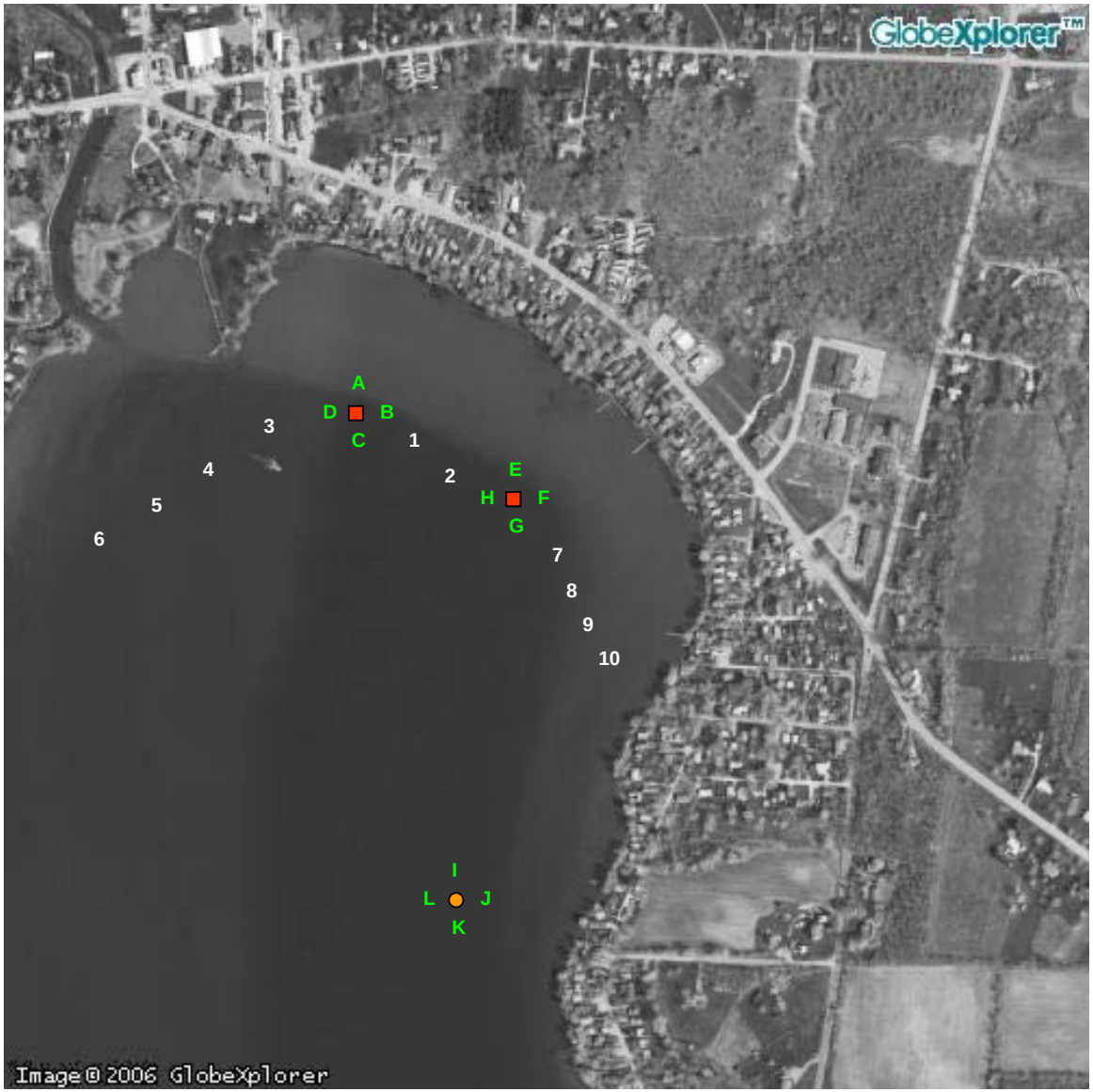


Figure 1. North end SolarBee, reference site and monitoring locations

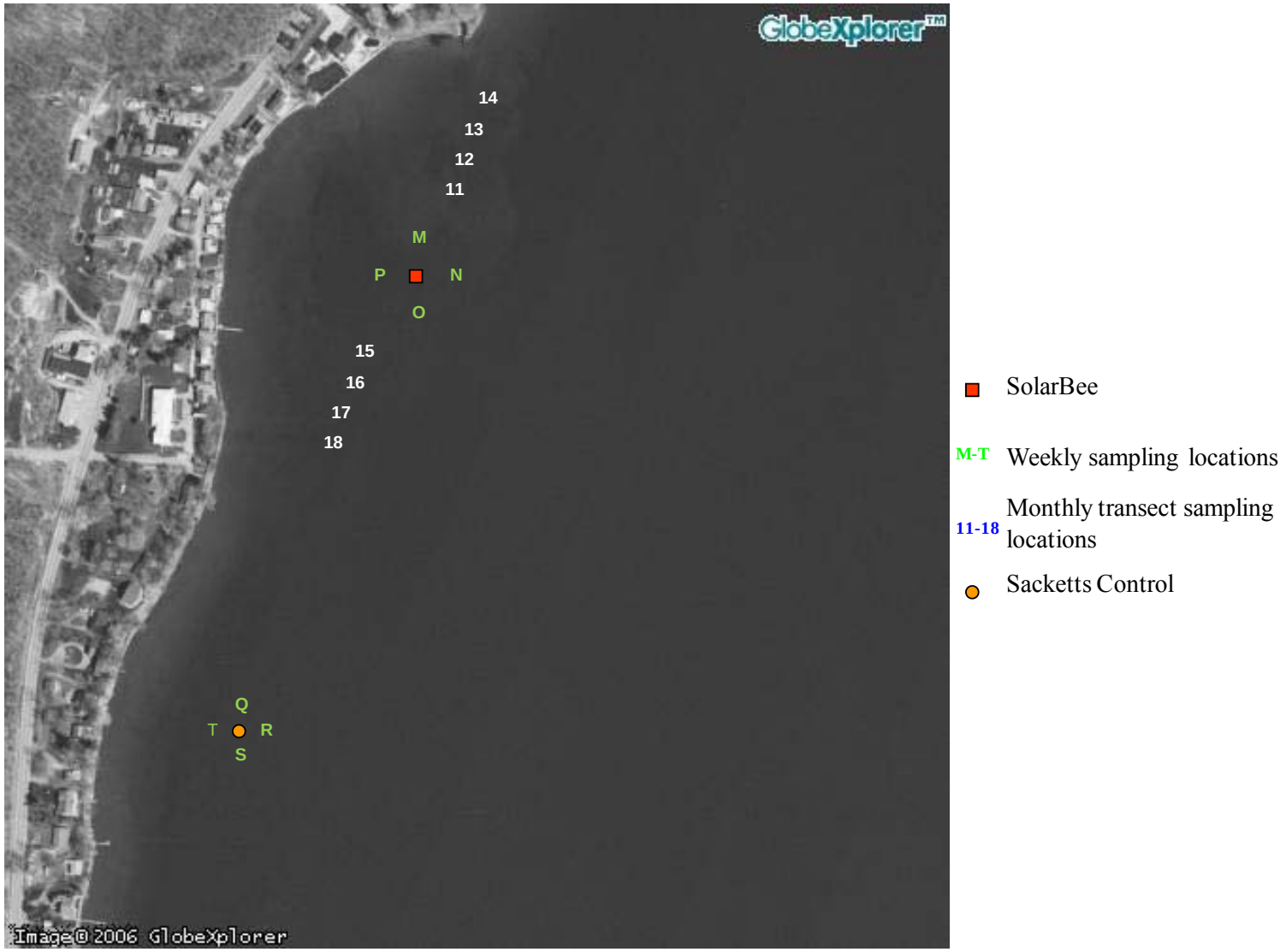


Figure 2. Sacketts Harbor SolarBee, reference site and monitoring locations

The monitoring program extended from May 22 – August 21, 2007. Researchers and students from SUNY-Geneseo measured some parameters in the field and collected water samples for laboratory analysis of other parameters. This team assayed metaphyton density using digital photography techniques. The Geneseo researchers surveyed macrophyte biomass and species composition using their standard quadrat sampling techniques. Water chemistry analyses were completed in certified laboratories at SUNY-Brockport. A public perception survey was conducted concurrently with the water quality and biological sampling programs.

3.1 Location of Sites

Two SolarBees were located along the north shore of the lake and one in Sacketts Harbor. The locations of the SolarBee sites were the same in both 2006 and 2007. The north end units were placed along the northern shoreline near Vitale Park, in approximately seven feet of water, and approximately 700 feet from shore. The units were roughly 900 feet from one another. The Sacketts Harbor unit was located north of Wadsworth Cove in about seven feet of water and approximately 450 feet from shore. The spatial coordinates for these locations were*:*

Northend west unit	N 42.83239 degrees	W 077.70512 degrees
Northend east unit	N 42.83151 degrees	W 077.69885 degrees
Sacketts Harbor unit	N 42.79273 degrees	W 077.71989 degrees

3.2 Monitoring Locations

Sampling design during 2007 was comparable to the 2006 program; that is, treatment and reference sites are in the same locations. The sampling design used a reference/treatment and transect approach as there are no historical data at spatial and temporal scales adequate for a before /after design. Reference sites were the same as 2006 and were located outside of the projected area of influence of the mixing devices, in regions of comparable water depth.

Reference/treatment samples were collected in replicates of four. Location of replicates was typically evenly spaced around a 25m radius from the units or center point of reference sites (Figure 1 and 2). This allowed for an estimation of variance around the units/reference. Transect sampling was also completed at points 50m, 100m, 150m, and 200m away from either side of SolarBee units (note: macrophyte and metaphyton

sampling terminated at 150m from the unit) (Figure 1 and 2). This transect length encompassed the probable zone of influence of the units. It should be noted that the vendor does not make any claims regarding spatial gradient associated with the SolarBees. Spatial analysis was carried out based on observations of turbidity in 2006. Transects were roughly parallel to the shoreline at the 5 ft. depth contour in order to minimize the effect of water depth on parameters (this is particularly of concern with the macrophyte measurements).

3.3 Monitoring Parameters

The parameters evaluated during the field assessment program are directly related to the impairments evident in Conesus Lake: metaphyton, algae, macrophytes, and water clarity (Table 3). Turbidity is the primary indicator of water clarity; phycocyanin is the indicator of cyanobacteria; and chlorophyll-a is an indicator of algal abundance. Total suspended solids were also collected to help explain any documented clearing/turbidity events. Water samples were collected at a water depth of 1-meter below the surface in replicates of four around a 25 m radius located at each site weekly from mid-May through August. In addition, samples were collected along transects on a monthly basis in June, July, and August.

Metaphyton was sampled once near the time of peak density at the end of July. Samples (digital images) were collected from quadrats within a radius of 25 m around the SolarBees and the two reference sites, and also at two transects at each SolarBee site at points 50m, 100m, and 150m away on either side of the SolarBee units.

Macrophytes were collected once in mid-August, which was near the peak biomass time based on observations by the field team. Four replicates quadrat samples were collected around a 25m radius around each SolarBee unit and at each reference site. Samples were also collected along transects; three replicates along each of two transects with points at 50m, 100m, and 150m, on either site of the SolarBees. For each quadrat the dry biomass of all species in the quadrat was determined.

Table 3. Monitoring parameters and sample design summary.

Impairment Variable	Parameter	Sample Design	Start	Frequency
Metaphyton	Digital imaging of cover	Treatment vs. Reference	July	Once
	Digital imaging of cover	Transect	July	Once
Cyanobacteria	Phycocyanin	Treatment vs. Reference	Mid-May	Weekly
	Phycocyanin	Transect	Mid-May	Monthly
Macrophytes	Biomass	Treatment vs. Reference	August	Once
	Biomass	Transect	August	Once
Water Clarity	Turbidity	Treatment vs. Reference	Mid-May	Weekly
	Turbidity	Transect	Mid-May	Monthly
	Chlorophyll-a	Treatment vs. Reference	Mid-May	Weekly
	Chlorophyll-a	Transect	Mid-May	Monthly
	Total Suspended Solids	Treatment vs. Reference	Mid-May	Weekly
	Total Suspended Solids	Transect	Mid-May	Monthly

3.4 Sampling Duration

The 2007 sampling program was centered on the summer period when blooms of algae and cyanobacteria, abundant metaphyton, and dense beds of macrophytes impair recreational use of the lake. Water clarity and phytoplankton sampling extended over 14 discrete events from May 22 through August 21, 2007. Macrophytes and metaphyton were sampled during a single event in mid August 2007. The timing of that sampling was determined by Dr. Sid Bosch based on observation of when the plant growth was approaching its annual maximum.

3.5 Statistical Procedure

A "repeated measures analysis of variance (ANOVA)" was selected as the primary statistical test of the effectiveness of the solar-powered mixing devices. This test combines data from SolarBee sites and compares it with combined data for the reference sites. Sampling dates are considered replicates. This test was chosen because, in the strictest sense, the multiple measurements collected around the SolarBees are not true independent replicates; therefore any comparison of a SolarBee site directly to its reference site is not technically valid. An average of the sample collected around the units and reference locations can be used to provide a better estimate of turbidity, but they are not truly independent and thus cannot be treated as replicates in a statistical analysis. Therefore, the Sacketts data cannot be compared to the Sacketts control unless dates are used as replicates. Data from the two experimental sites were pooled, as were data from the two reference sites.

A second order polynomial test was applied to evaluate the spatial extent of any influence of the devices on ambient water quality conditions. This analysis assumes that improvements would be more pronounced close to the units and would diminish with distance. Note, however, that the vendor made no claims of an expected gradient in water quality conditions with distance from the units.

Finally, a linear regression of water quality conditions over the course of the summer 2007 monitoring period was applied to evaluate whether conditions at the test sites improved over time.

3.6 Hypothesis Testing

The overall hypothesis to be tested is that SolarBees positively affect lake condition where the units are present. To test this hypothesis, specific variables that are important to Conesus Lake impairment were measured. The hypotheses used to test the specific claims presented in the SolarBee proposal developed for Conesus Lake were:

(1) Water clarity (as measured by turbidity)
    a. There is a statistically significant increase in water clarity (lower turbidity) in treatment areas.
    b. There is a statistically significant decrease in water clarity (increase in turbidity) with distance from SolarBee units.
(2) Abundance of algae and cyanobacteria (as measured by chlorophyll-a and phycocyanin)
    a. There is a statistically significant reduction in the abundance of algae and/or cyanobacteria in treatment areas.
    b. There is a statistically significant increase in the abundance of algae and/or cyanobacteria with distance from SolarBee units.
(3) Metaphyton
    a. There is a statistically significant reduction in percent cover of metaphyton in treatment areas.
    b. There is a statistically significant increase in percent cover of metaphyton with distance from SolarBee units.
(4) Macrophytes
    a. Treatment areas have statistically significant reduced biomass of macrophyte and Eurasian watermilfoil as compared to reference sites.
    b. There is a statistically significant increase in biomass of macrophytes and Eurasian watermilfoil with distance from SolarBee units.

Note: Hypotheses were tested at an alpha level of 0.05 that was decided on by the Conesus Lake Watershed Council in consultation with the project biostatistician, Dr. Gregg Hartvigsen of SUNY Geneseo. The alpha level represents the probability of making a Type 1 error; that is, concluding that the SolarBees are effective in Conesus Lake when improvements were due to chance.

3.7 Perception Survey

The objective of the Conesus Lake perception survey was to gather data regarding how the general public viewed water quality conditions in regions of Conesus Lake both within and outside of the zone of influence of the mixing devices. This survey was designed to be similar to lake surveys used by natural resource management agencies in several states (New York, Vermont, and Minnesota).

A total of 138 perception surveys were completed between July and early September, 2007. Similar to the 2006 surveys, the majority were completed in July and August.

Four zones were identified for the perception survey. These zones were:

- Zone 1 – SolarBee treatment area at northern basin (North SolarBee)
- Zone 2 – Control adjacent to northern basin (North reference)
- Zone 3 – SolarBee treatment area at western shoreline (Sacketts Harbor SolarBee)
- Zone 4 – Control adjacent to western basin (Sacketts Harbor reference)

4.0 Results and Discussion

4.1 Comparison of 2006 and 2007 Monitoring Results

The side-by-side comparisons of 2006 and 2007 results in Appendix 1 demonstrate the spatial and interannual variability in water quality conditions in Conesus Lake. For example, turbidity, metaphyton and macrophytes at the northern SolarBee sites were lower than at reference site in 2006, but were essentially identical in 2007. Phycocyanin concentrations were an order of magnitude lower at all sites in 2007. Macrophyte growth was also lower at all but one site in 2007.

4.2 2007 Overall Effect of SolarBees

The pilot test of SolarBee units in Conesus Lake was designed to test specific hypotheses related to the manufacturer's claims of improved water quality and conditions brought about by the machines. Results of the first year of the pilot testing (2006) indicated that the SolarBee units were not effective at significantly improving quality in areas they were deployed due to the dominant effect of lake variability. There were some subtle positive effects associated with the units, therefore a second year of monitoring was conducted.

It was determined prior to the 2007 monitoring period that SolarBees would be considered a viable solution to the lake's water quality problems if they met the following criteria;

1. They produced improved water quality conditions near the units as compared to reference sites distant from the units. Improvement would be determined by statistical testing at an alpha level of 0.05.
2. Any statistically significant improvements were of a magnitude that would be readily noticeable by lake users.
3. Any statistically significant improvements were also spatially and temporally robust; i.e., the area around the units exhibiting improved water quality conditions was large enough and their duration long enough to justify the expense of the remedial measure.

Summary statistics for the individual sites are presented in Table 4. Monitoring result for SolarBee sites were compared to reference locations using a repeated measures ANOVA for water quality variables that were sampled weekly (turbidity, TSS, chlorophyll-a, and phycocyanin) and a single sided t-test for biotic variables collected during a single sampling event (metaphyton and macrophytes).

The results of these analyses are shown in Table 5. The table shows the mean values for SolarBee and reference sites, the difference between the SolarBee sites and reference sites, and the p-value from the statistical tests of significance (a p-value less than 0.05 indicates the difference between sites was statistically significant). Eurasian watermilfoil exhibited the largest overall difference between SolarBee and reference sites (29% lower milfoil biomass at SolarBee sites) but the result was not statistically significant (p-value= 0.08). The reduction in milfoil was limited to a very small area. Similarly, differences between variables at grouped SolarBee locations and reference sites were small and not statistically significant (p-value range 0.75 to 0.11). None of the differences between SolarBee site and reference locations were statistically significant ($p > 0.05$ for all tests).

In addition to the pre-determined statistical testing, the spatial and temporal patterns were examined to evaluate whether the units were exerting localized effects. Additional analyses were completed using a second order polynomial analysis to detect spatial patterns, and a linear regression was used to identify temporal patterns.

Table 4. Summary statistics of measured parameters, Conesus Lake, summer 2007.

Parameter Group	Parameter	Sample Location	Statistics			
			N	***Mean***	***Median***	***Range***
Water Quality	Turbidity (NTU)	Northwest Unit	14	1.8	1.6	1.1 - 3.4
		Northeast Unit	14	1.6	1.3	1.0 - 5.0
		North End Reference	14	1.7	1.4	0.8 - 3.2
		Sacketts Unit	14	1.6	1.4	0.7 - 2.5
		Sacketts Reference	14	1.7	1.6	0.6 - 3.5
	Total Suspended Solids (mg/L)	Northwest Unit	14	2.8	1.9	0.8 - 12
		Northeast Unit	14	1.8	1.6	0.4 - 5.1
		North End Reference	14	1.5	1.4	0.4 - 2.9
		Sacketts Unit	14	1.6	1.7	0.5 - 3.2
		Sacketts Reference	14	2.2	1.7	0.6 - 5.1
Algae and cyanobacteria	Chlorophyll-α (ug/L)	Northwest Unit	14	4.3	4.4	1.5 - 8.4
		Northeast Unit	14	2.9	2.0	1.0 - 7.9
		North End Reference	14	3.2	3.5	1.1 -5 .3
		Sacketts Unit	14	3.4	2.8	1.4 - 6.2
		Sacketts Reference	14	4.3	3.7	1.6 - 13
	Phycocyanin (ug/L)	Northwest Unit	14	3.6	3.6	2.2 - 5.0
		Northeast Unit	14	3.2	2.0	2.0 - 5.0
		North End Reference	14	3.9	4.1	1.3 - 6.0
		Sacketts Unit	14	3.9	3.5	1.4 - 7.4
		Sacketts Reference	14	3.9	3.4	1.8 - 7.0
	Metaphyton (%Cover)	Northwest Unit	11	52	52	5 - 68
		Northeast Unit	10	29	27	15 - 55
		North End Reference	15	46	45	34 - 60
		Sacketts Unit	18	51	52	35 - 68
		Sacketts Reference	7	60	63	42 - 84
Macrophytes	Biomass, Macrophytes (dry wt, g/m^2)	Northwest Unit	4	221	222	163 - 277
		Northeast Unit	3	204	206	189 - 217
		North End Reference	7	178	132	88 - 447
		Sacketts Unit	4	150	139	120 - 202
		Sacketts Reference	5	265	256	170 - 325
	Biomass, Milfoil (dry wt, g/m2)	Northwest Unit	4	133	127	100 - 179
		Northeast Unit	3	86	75	6.9 - 186
		North End Reference	7	114	113	27 - 241
		Sacketts Unit	4	118	118	90 - 147
		Sacketts Reference	5	224	246	95 - 308

Notes:
N - indicates the number of samples.

Table 5. Results of repeated measures ANOVA (turbidity, TSS, Chlorophyll-a, and phycocyanin) and one sided T-test (macrophytes and metaphyton) on grouped SolarBee and Reference sites. Difference between sites is considered statistically significant if p is less than 0.05.

Variable	Site	Mean	Percent Difference	P Value
Turbidity (NTU)	SolarBee Sites	1.61	-5%	0.64
	Reference Sites	1.69		
TSS (mg/L)	SolarBees Sites	1.96	+5%	0.75
	Reference Sites	1.87		
Chlorophyll-a (ug/L)	SolarBees Sites	3.49	-6%	0.65
	Reference Sites	3.73		
Phycocyanin (ug/L)	SolarBees Sites	3.65	-6%	0.48
	Reference Sites	3.89		
Macrophytes (grams dry weight/m^2)	SolarBees Sites	190	-12%	0.25
	Reference Sites	215		
Eurasian Watermilfoil (grams dry weight/m^2)	SolarBees Sites	112	-29%	0.08
	Reference Sites	157		
Metaphyton (% Cover)	SolarBees Sites	46%	-10%	0.11
	Reference Sites	51%		

4.3 2007 Spatial Analysis

In addition to the samples collected adjacent to the SolarBee units and at reference locations, samples were collected monthly along transects with distance from the mixing devices. The hypothesis was that water quality improvement would be more evident closer to the units, and would diminish with distance. Transect data were analyzed using a second order polynomial; this tests for the presence and significance of a spatial pattern consistent with highest water quality conditions closest to the unit (Figure 3).

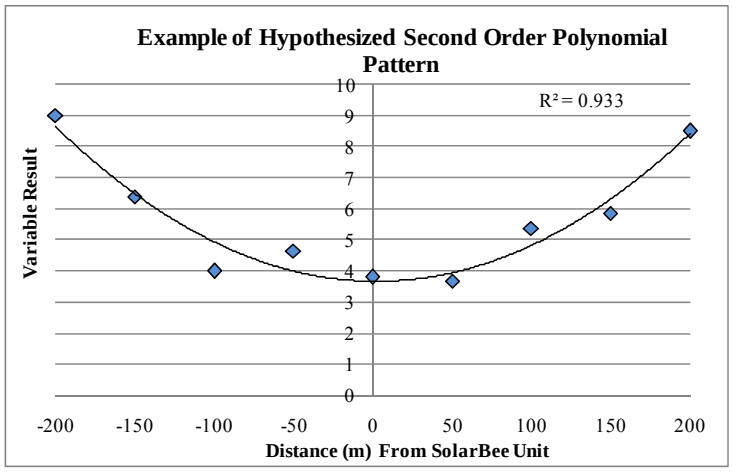


Figure 3. Example of second order polynomial relationship.

The results of the second order polynomial test are shown in Table 6. Results of the three transect sampling events (June, July, and August) are presented. The r-square value reported in this table measures how well the line approximates the data points (scale is 0 to 1.0). The r-square value is reported with a "-" if the relationship was opposite of the expected (i.e., curve is convex, not concave). The p value is a measure of whether the observed relationship is due to chance. Similar to the rest of the analyses, a p value of 0.05 was used as the threshold of statistical significance.

In June, none of the variables at any of the SolarBee sites exhibited a statistically significant second order polynomial pattern. Five of the eight transects exhibited relationships that were the opposite of what was hypothesized (i.e., the curve fit to the data points was convex not concave), but none of these relationships were statistically significant.

In July, two variables, each at a single location, showed a statistically significant pattern that was in the direction expected; TSS at the North sites, and chlorophyll-a at the Sacketts Harbor site. Turbidity also showed a statistically significant pattern but it was in the opposite direction than hypothesized. The lack of correlation between TSS and turbidity is not explained.

At Sacketts Harbor in August chlorophyll-a and phycocyanin concentrations showed a statistically significant second order polynomial pattern. In addition, there was a similar statistically significant pattern for turbidity, apparently indicating that lower algal

abundance resulted in increased water clarity around the unit during the August sample (Figure 4). This effect appears to have been generally limited to Sacketts Harbor and to the August event, although there was an additional strong positive relationship observed for chlorophyll-a at the North End sites in July (Figure 5).

The only other statistically significant second order polynomial pattern was a highly significant (R^2= 0.93, p< 0.005) pattern for Eurasian water milfoil biomass at the North End sites, however this pattern was opposite of the result expected (highest values near the SolarBee units). It is unlikely that the SolarBee units caused the increase in milfoil, the result is likely due to natural variability.

Overall, there were 27 separate spatial pattern analyses completed, half showed patterns in the direction hypothesized (increasing concentration with distance from the unit) and half showed patterns in the opposite direction. Of the results showing the expected pattern, five were statistically significant. There was no consistent spatial pattern of improved water quality associated with proximity to the SolarBee units.

Table 6. Second order polynomial summary statistics for regressions of transect data.

Variable	Location	June		July		August	
		R2	P Value	R2	P Value	R2	P Value
Turbidity	North End	0.22	0.48	0.40	0.22	-0.00	0.99
	Sacketts Harbor	0.54	0.10	-0.74	0.02	0.66	0.04
TSS	North End	-0.11	0.69	0.79	0.01	0.07	0.81
	Sacketts Harbor	0.09	0.74	-0.45	0.16	0.58	0.07
Chlorophyll-a	North End	-0.28	0.37	0.93	0.0003	0.47	0.15
	Sacketts Harbor	-0.37	0.25	-0.41	0.21	0.66	0.04
Phycocyanin	North End	-0.46	0.16	-0.20	0.51	0.40	0.22
	Sacketts Harbor	-0.19	0.53	-0.18	0.55	0.71	0.02
Macrophyte Biomass	North End	-	-	-	-	-0.13	0.76
	Sacketts Harbor	-	-	-	-	0.69	0.10
Milfoil Biomass	North End	-	-	-	-	-0.93	0.005
	Sacketts Harbor	-	-	-	-	0.65	0.12
Metaphyton	North End	-	-	-	-	0.02	0.94
	Sacketts Harbor	-	-	-	-	-0.08	0.78

Note: Macrophytes and metaphyton were only sampled a single time; August.

Table Notes: R-square is the statistical measure of how well a regression line approximates the data points. Values range from 0 to 1.0. An R-squared of 1.0 means that all variability on the transect is completely explained by distance from the SolarBee units. An R-square of zero means the data are distributed at random. Negative R-square indicates spatial pattern was opposite of expected. The polynomial relationship is considered statistically significant if the P Value is less than 0.05. Significant positive polynomial patterns are shaded.

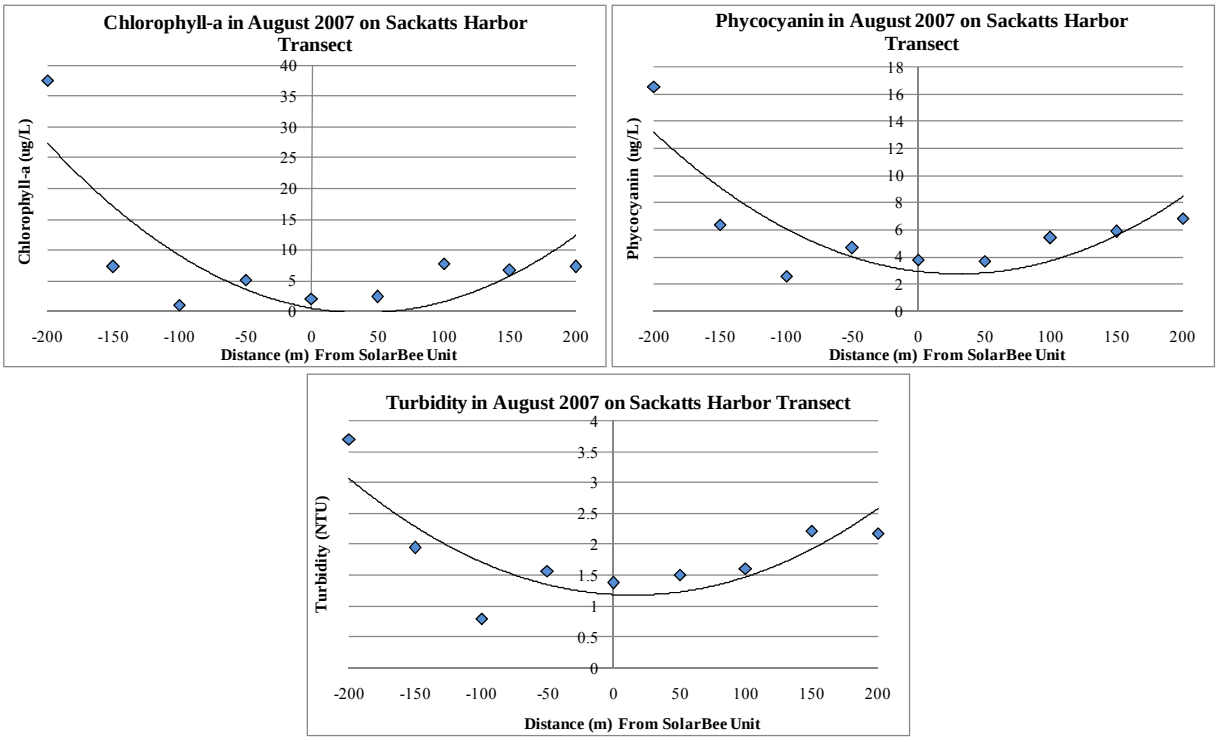


Figure 4. Second order polynomial regressions for chlorophyll-a, phycocyanin and turbidity at transects from Sacketts Harbor in August 2007.

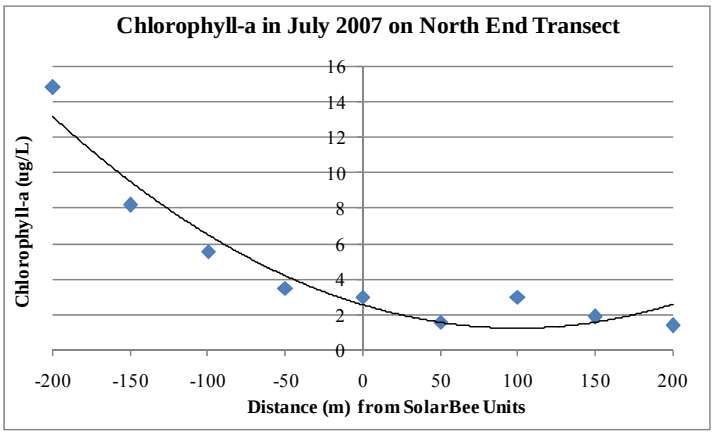


Figure 5. Second order polynomial regressions for chlorophyll-a, at transects from the North End in July 2007.

4.4 2007 Temporal Analysis

Trends in water quality conditions over time were examined using linear regression analysis to evaluate whether SolarBee sites exhibited improving water quality conditions as the summer progressed compared to reference locations. Only variables that were measured weekly (turbidity, TSS, chlorophyll-a, and phycocyanin) were analyzed with this technique.

Results indicate that for most variables both SolarBee locations and reference locations showed increasing trends (poorer water quality conditions) as the summer progressed (Table 7). Only turbidity and chlorophyll-a at the north SolarBee locations showed a downward trend (improving conditions) over the summer, but those trends were not statistically significant.

Although SolarBee sites did not show decreasing trends for most variables, they generally did not exhibit as pronounced degradation in water quality over the summer, as compared with the reference sites. This finding was particularly notable for algae-related variables. Chlorophyll-a at both the North End and Sacketts Harbor reference location, and phycocyanin at the North End reference location increased significantly over time but the comparable SolarBee location showed a decreasing trend (north end chlorophyll-a) or did not increase to the degree of the reference location (all other sites). Temporal plots of weekly data in Figure 6 graphically depict these relationships. The Sacketts Harbor chlorophyll-a result was due to a few high values at the reference location at the end of the sample period, and not related to a consistent temporal pattern. The main effect at the North End sites for both phycocyanin and chlorophyll-a (SolarBee sites less than reference site) was limited to July. The north end reference site started low then increased in July while the SolarBee sites remain relatively consistent through much of the summer. This accounted for the stronger positive trend at the reference location.

The SolarBee locations in the north end exhibited poorer water quality conditions early in the season (June) compared to the reference locations for the algae-related parameters. This is attributed to variability in lake conditions.

Table 7. Results of trend analysis for each water quality variable over time at SolarBee sites and Reference locations. Note that north end SolarBee sites were combined. Pearson correlations indicates the strength and direction of a linear relationship (0.0 to 1.0), so a negative Pearson correlation indicates that the measured variable decreased over time, positive values indicate measured variable increased over time. R-square is the statistical measure of how well a regression line approximates the data points. Values range from 0 to 1.0. An R-squared of 1.0 means that all variability completely explained by the data points. Statistically significant trends have p values less than 0.05 and are shaded.

Variable	Site	Pearson Correlation	R^2	P Value
Turbidity	North SolarBees	-0.37	0.14	0.18
	North Reference	0.41	0.16	0.15
	Sacketts SolarBee	0.56	0.31	0.04
	Sacketts Reference	0.64	0.41	0.01
TSS	North SolarBees	0.003	0.9e-5	0.99
	North Reference	0.41	0.17	0.15
	Sacketts SolarBee	0.59	0.35	0.03
	Sacketts Reference	0.48	0.23	0.08
Chlorophyll-a	North SolarBees	-0.23	0.08	0.34
	North Reference	0.56	0.31	0.04
	Sacketts SolarBee	0.33	0.11	0.25
	Sacketts Reference	0.61	0.37	0.02
Phycocyanin	North SolarBees	0.15	0.02	0.62
	North Reference	0.76	0.57	0.002
	Sacketts SolarBee	0.68	0.46	0.008
	Sacketts Reference	0.72	0.52	0.003

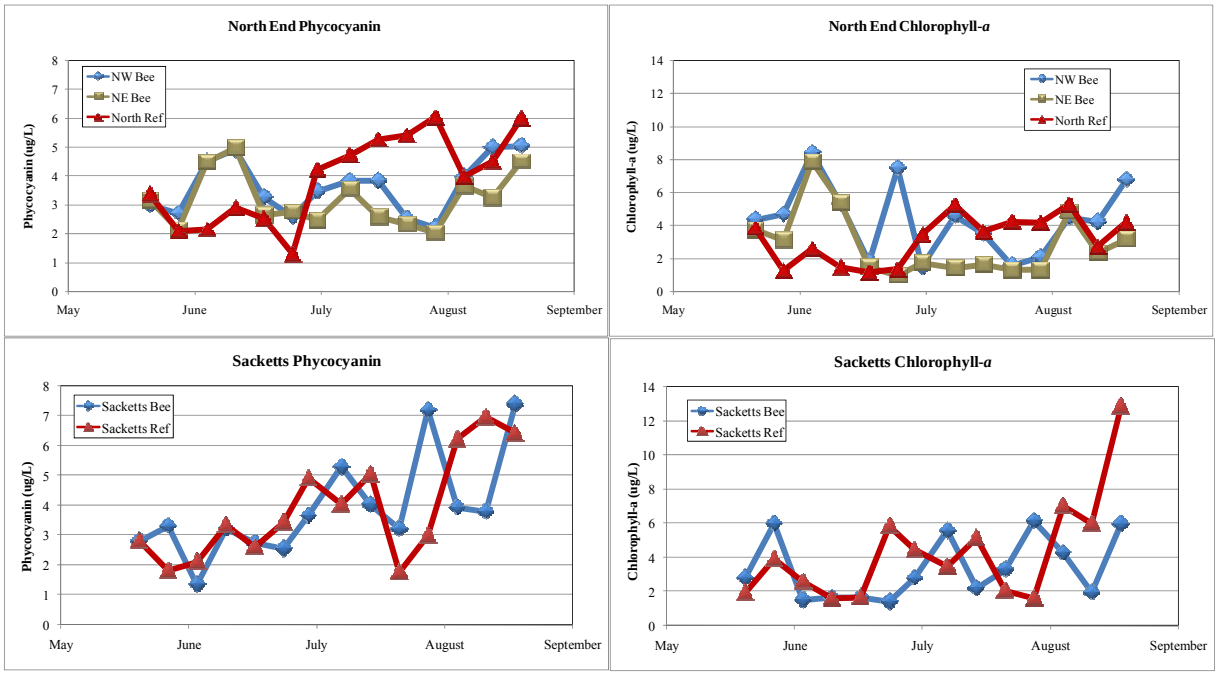


Figure 6. Temporal plots of phycocyanin and chlorophyll-a at both the North End and Sacketts Harbor locations in 2007.

4.5 2007 Perception Survey

The perception survey was designed to gather the subjective opinions of the respondents to two questions about the lake's quality. The first related to water clarity the second to recreational use.

4.5.1 Water Clarity

Respondents were asked to select from five options how the physical condition of the lake appeared to them on the day of the survey. Description options ranged from "crystal clear" to "terrible". The breakdown of responses in 2006 and 2007 are provided in Figure 7. The most significant result of the 2006 survey was the unambiguous perception that lake water was clearer water at the North SolarBee sites compared to the reference location. The perceived difference in water clarity in 2006 was consistent with measured turbidity data.

In 2007, lake users reported similar water clarity conditions at the treatment and control sites. At the SolarBee (treatment) locations, 84% of lake users considered the water "crystal clear or not quite crystal clear", while at the reference site 85% of the results

were in this category. Again, the survey data were consistent with results of water quality monitoring (Table 4).

At the Sacketts Harbor deployment site, lake users reported similar water clarity conditions between treatment and reference sites during the 2006 survey. This result was consistent with the measured turbidity data. In contrast, respondents perceived higher water clarity at the treatment site in 2007 as compared to the reference location, a result that was not consistent with the measured data.

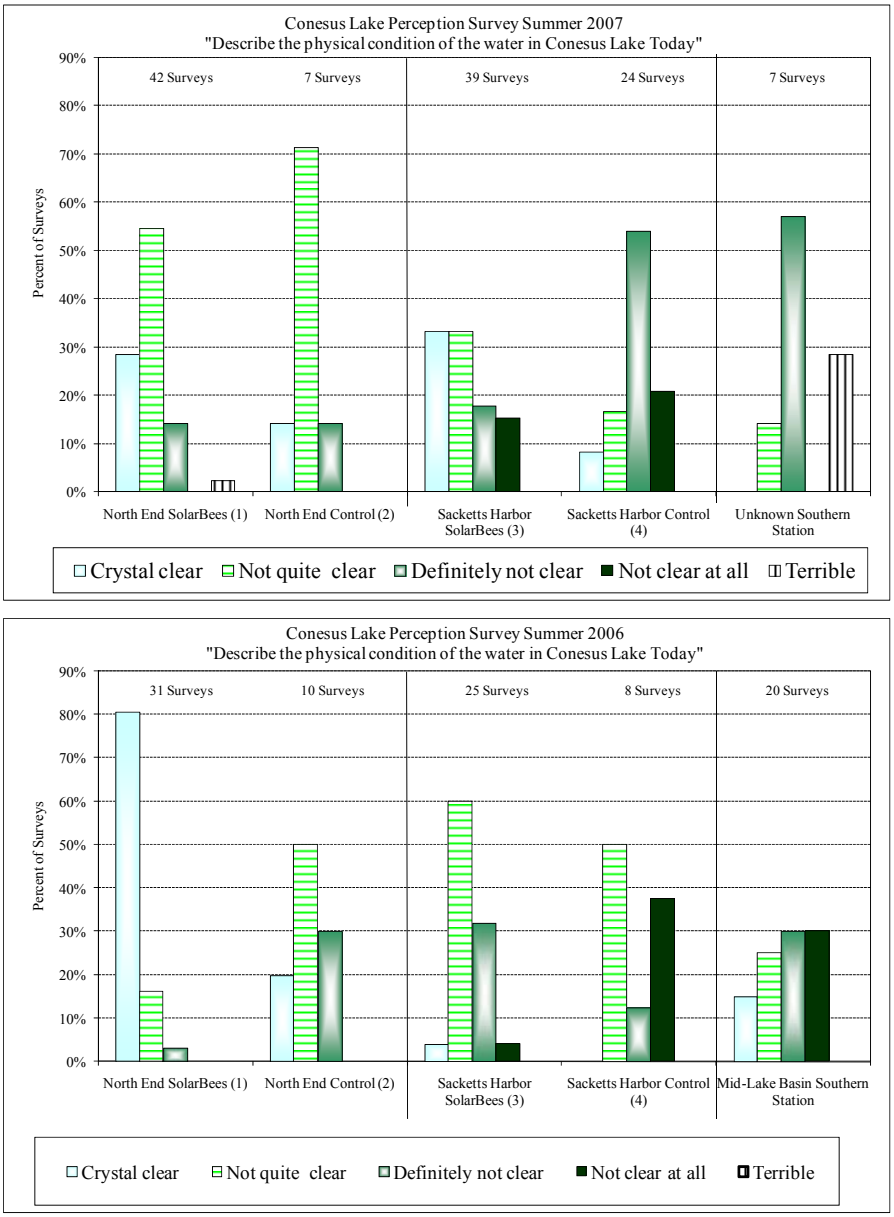


Figure 7. 2006 and 2007 water quality perception survey results.

4.5.2 Recreational Suitability

Respondents were asked which of five options best described their opinions of the lake's recreational suitability. Descriptions options ranged from "beautiful; could not be better" to "recreational enjoyment nearly impossible" The responses in 2006 and 2007 are displayed in Figure 8. In general, the responses in 2007 were more closely related to perceived water quality than in 2006, where respondent tended to see "crystal clear" water but report minor problems or slightly impaired conditions; this was particularly notable at SolarBee locations. There were some exceptions to this in 2007 however; at the north end Reference sites 14% of respondent reported that the water was "crystal clear" (Figure 7) but no one reported that this site was "beautiful" (Figure 8).

In 2007, the majority of survey respondents reported better water quality conditions at the treatment sites compared with reference sites. The perceived improvement was not consistent with the statistical analysis of measured water quality data; as summarized in Table 4. It appears that lake users were able to discern the small effects that were below the threshold of statistical significance.

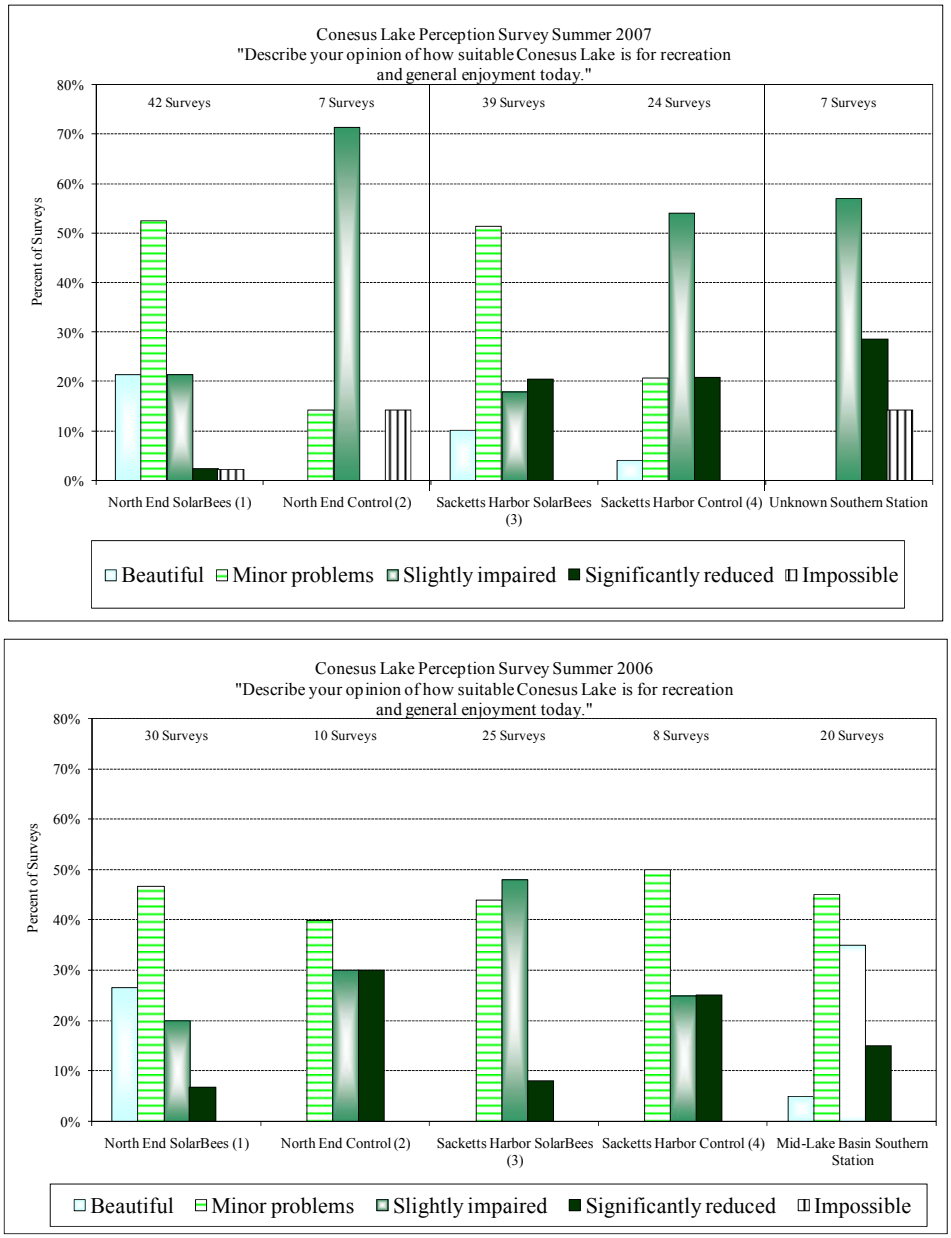


Figure 8. 2006 and 2007 recreation usability perception survey results.

5.0 Conclusions

Results of the 2006 and 2007 pilot program have been analyzed in a quantitative manner. Overall, the SolarBee units did not result in statistically significant improvement in water quality conditions, with minor exceptions. There were statistically significant differences in algae-related parameters measured with distance from the unit detected at one site (Sacketts Harbor) during one sampling event (August). While there were some indications of improved water quality parameters, the differences in treatment and control areas could not be conclusively attributed to the units. These positive effects were generally small and evident only in limited areas and for a short duration.

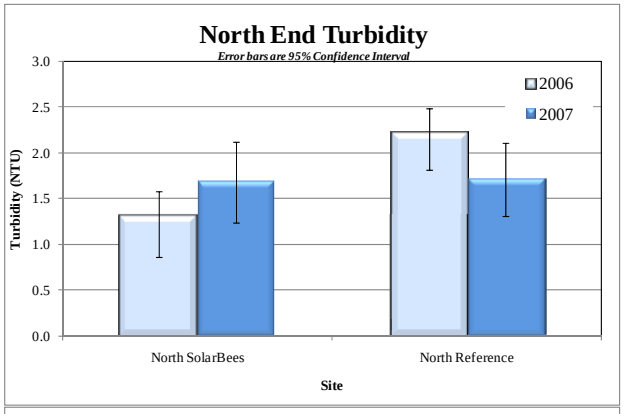
Water quality conditions in the nearshore environment of Conesus Lake are highly variable, both spatially and temporally. The mixing effects of SolarBee units do not appear able to overcome the natural variability seen in this large lake. Ultimately, improved water quality in Conesus Lake will result from reduced input and cycling of nutrients, reduced sediment loading from the watershed, and reduced bacterial inputs. The measured effects of SolarBee units did not meet the criteria for success originally stipulated by the SolarBee working group. It is concluded that this technology is not effective for improving the lake's impaired water quality conditions.

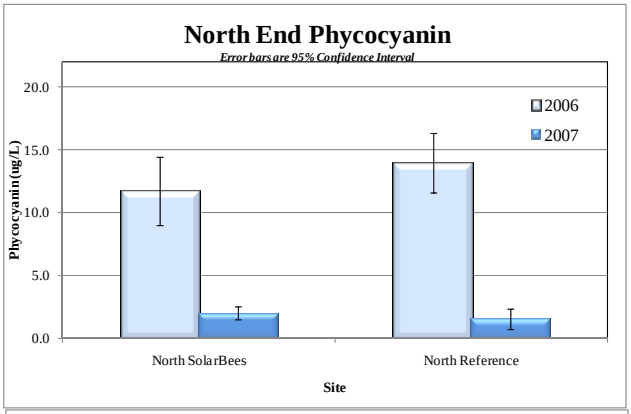
Appendices

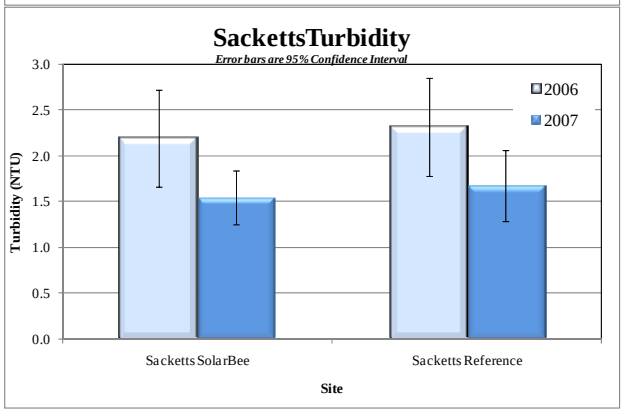
1. **2006-2007 Summary Figures**
2. **Perception Survey Report**

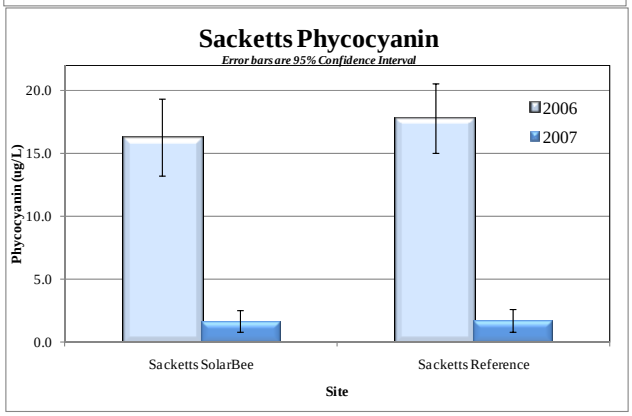
Appendix 1

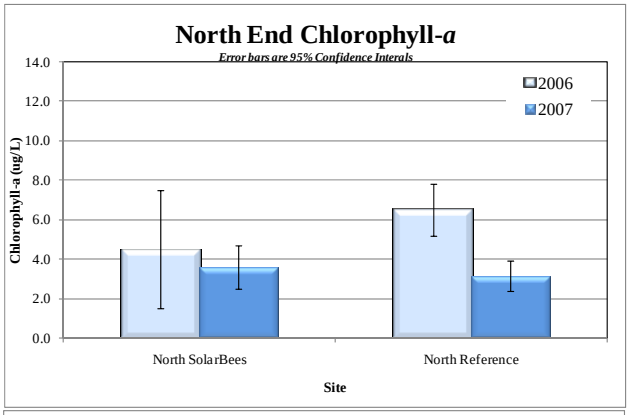
Summary Graphs of 2006 and 2007 Results


North End Turbidity
Error bars are 95% Confidence Interval
2006
2007
Turbidity (NTU)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
North SolarBees
North Reference
Site


North End Phycocyanin
Error bars are 95% Confidence Interval
2006
2007
Phycocyanin (ug/L)
20.0
15.0
10.0
5.0
0.0
North SolarBees
North Reference
Site


SackettsTurbidity
Error bars are 95% Confidence Interval
2006
2007
Turbidity (NTU)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Sacketts SolarBee
Sacketts Reference
Site


Sacketts Phycocyanin
Error bars are 95% Confidence Interval
2006
2007
Phycocyanin (ug/L)
20.0
15.0
10.0
5.0
0.0
Sacketts SolarBee
Sacketts Reference
Site


North End Chlorophyll-a
Error bars are 95% Confidence Interals
2006
2007
Chlorophyll-a (ug/L)
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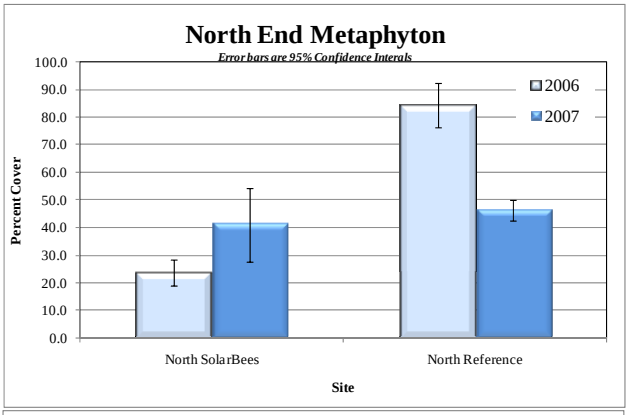
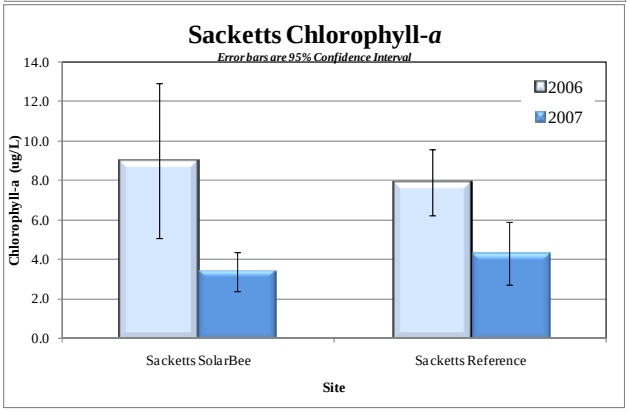
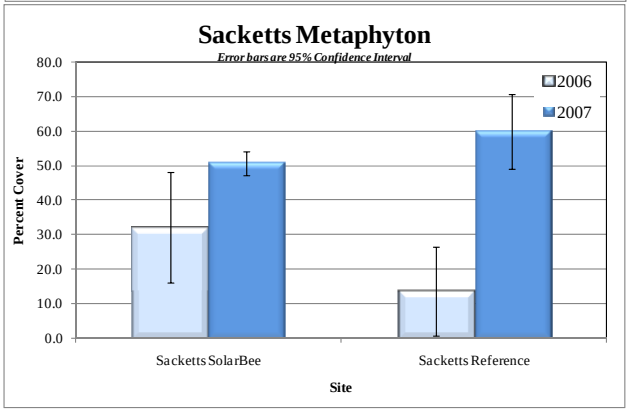
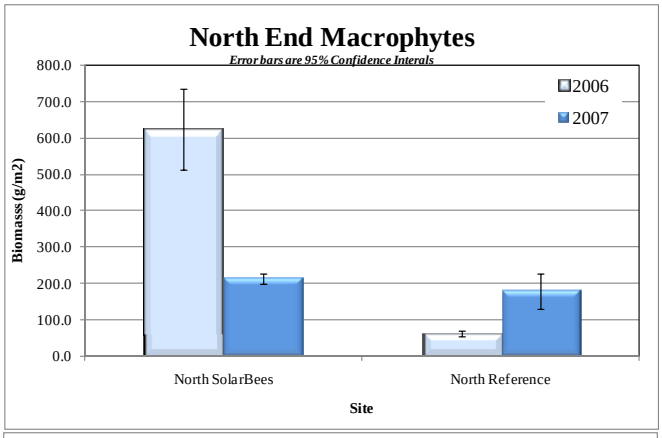
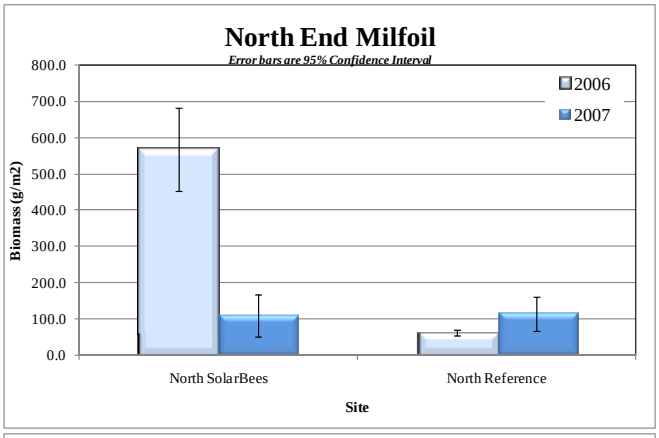
12.0
10.0
8.0
6.0
4.0
2.0
0.0
North SolarBees
North Reference
Site

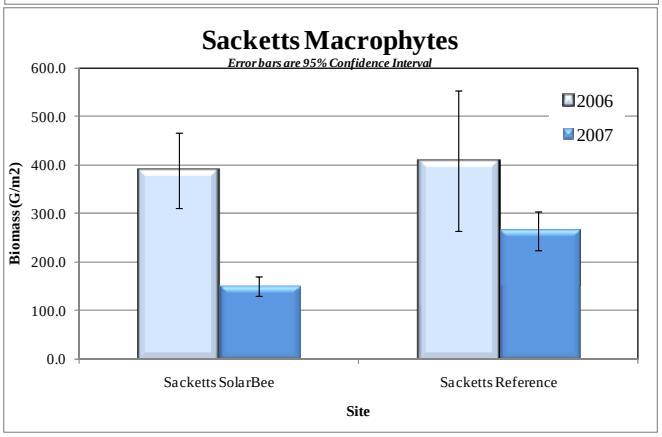

North End Metaphyton
Error bars are 95% Confidence Interals
2006
2007
Percent Cover
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
North SolarBees
North Reference
Site

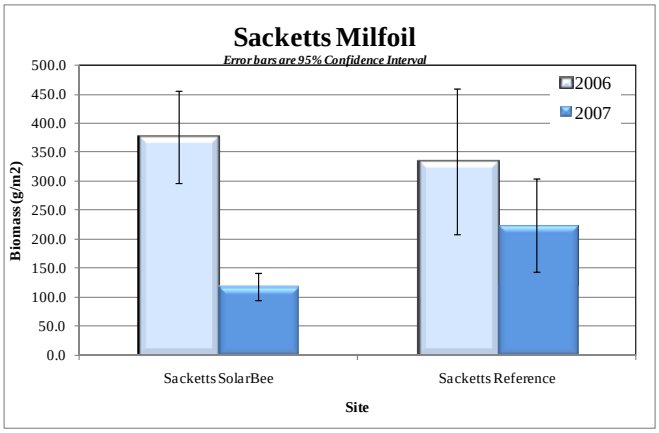

Sacketts Chlorophyll-a
Error bars are 95% Confidence Interval
2006
2007
Chlorophyll-a (ug/L)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Sacketts SolarBee
Sacketts Reference
Site


Sacketts Metaphyton
Error bars are 95% Confidence Interval
2006
2007
Percent Cover
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Sacketts SolarBee
Sacketts Reference
Site


North End Macrophytes
Error bars are 95% Confidence Interals
Biomasss (g/m2)
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
2006
2007
North SolarBees
North Reference
Site


North End Milfoil
Error bars are 95% Confidence Interval
Biomass (g/m2)
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
2006
2007
North SolarBees
North Reference
Site


Sacketts Macrophytes
Error bars are 95% Confidence Interval
Biomass (G/m2)
600.0
500.0
400.0
300.0
200.0
100.0
0.0
2006
2007
Sacketts SolarBee
Sacketts Reference
Site


Sacketts Milfoil
Error bars are 95% Confidence Interval
Biomass (g/m2)
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
2006
2007
Sacketts SolarBee
Sacketts Reference
Site

Appendix 2

2007 Perception Survey Report

Table of Contents

List of Tables:

List of Figures:

Appendix E
Conesus Lake Perception Survey

The water quality and biological sampling on Conesus Lake during the summer of 2007 was supplemented with a recreational user perception survey (Attachment 1). Perception surveys are used to evaluate perceived suitability of the lake for recreational use. NYSDEC and comparable natural resources management agencies in other states use such surveys as part of their citizens monitoring programs. In NY, this survey is part of the Citizens Statewide Lake Assessment Program (CSLAP).

The overall objective of the 2007 Conesus Lake Perception Survey was to gather public perception data of water quality conditions in the SolarBee zone of influence, and compare this perception to the public perception of water quality conditions outside of the zone of influence. This Survey was re-designed from the 2006 Survey to be more user-friendly, and is similar to lake surveys used by natural resource management agencies in several states (New York, Vermont, and Minnesota).

As in the 2006 Survey, respondents in the 2007 Survey were asked two basic questions: (1) How does the lake appear to you today? (2) How attractive is the lake for recreational use today? In addition, the 2007 Survey asked respondents whether they were aware, before completing the survey, that water circulation technology was being tested in the lake.

The Conesus Lake Association (CLA) coordinated implementation of the user survey. The Planning Department worked with the CLA to designate the sites and create a map to display the sites. The CLA enlisted volunteers in areas around the lake to report on their perception of the lake's attractiveness and suitability for recreational use. The CLA distributed surveys and ensured that the completed surveys were returned to the Planning Department. The Planning Department sent the completed surveys to EcoLogic LLC for data analysis and reporting.

1. Program Design

The 2007 Survey program design called for once-a-week surveys during the period of water quality monitoring (June through August). There were no surveys in June 2007; otherwise, the 2007 Survey program met the minimum one-a-week target. The temporal distribution of the

2007 user perception surveys, with comparison to the 2006 temporal distribution, is presented in Table 1.

Table 1. Temporal distribution of user perception surveys, 2006 and 2007.

Month	Percent of Surveys by Month		Notes
	2006 Survey	2007 Survey	
May	--	--	no surveys 2006 or 2007
June	1%	--	2006 - one survey on June 22 2007 - no surveys June
July	19%	46%	2006 - 13 survey dates, 18 surveys total - averaging 4 surveys per week (range 2 to 6 surveys per week) 2007 – 23 survey dates, 69 surveys total - averaging 14 surveys per week (range 1 to 24 surveys per week)
August	67%	46%	2006 – 30 surveys dates, 65 surveys total - averaging 15 surveys per week (range 12-18 surveys per week) 2007 – 23 survey dates, 62 surveys total - averaging 14 surveys per week (range 9 to 23 surveys per week)
September	13%	8%	2006 – 4 survey dates, 13 surveys total – ending September 5. 2007 – 4 survey dates, 7 surveys total - ending September 6.

The 2007 Survey program design called for, at a minimum, including these sites in the survey:

- Vitale Park, at SolarBee test and control sites (same sites used for water quality monitoring): 4 locations, weekly surveys
- West shore SolarBee test and control sites: 2 locations, weekly surveys
- Other protected coves along shoreline: east and west: select +/- 8 locations to provide coverage along the shoreline.

The 2007 Survey sites were similar to the sites for the 2006 Survey, as shown in Table 2.

Table 2. Solarbee observation zones defined for the user perception surveys.

Solarbee Observation Zone		N Surveys	
Zone	**Description**	**2006[1]**	**2007[2]**
1	SolarBee treatment area at northern basin (North End)	34	49
2	Control adjacent to northern basin (North End Control)	10	11
3	SolarBee treatment area at western shoreline (Sacketts Harbor)	25	43
4	Control adjacent to western basin (Sacketts Harbor Control)	8	27
5	Mid lake station in the southern basin (deepest part of the lake)	20	-
	Total number of surveys received	**97**	**138**

Notes:
[1]Zone 5 was not included on the map provided with the survey; some respondents marked an area along the eastern shore south of Zone 2 as their survey site; this response was cataloged as "Zone 5" in the survey data set.
[2]No surveys were received for Zone 5. Eight surveys were received where "Southern Basin" was indicated, but a zone number was not provided; therefore it was not clear whether these surveys applied to Zone 3, Zone 4, or Zone 5.

The sites for the survey were identified on a map provided to the respondents on the back of the survey. The first four sites (Zones 1 through 4) are those included in the water quality monitoring program, and the fifth is the mid-lake station (southern basin).

2. Survey Results

The Perception Survey data may be divided into three categories:

1. overall data about the respondents and sampling frequencies by zone;
2. information about the conditions of the survey, including observation point, water depth, and distance from shore
3. opinions concerning the quality of the lake for recreational uses in their survey area.

The Perception Surveys for 2006 and 2007 were conducted over approximately the same time period. More surveys were collected overall for 2007 than for 2006:

	2006	**2007**
Time Period	June 22 through Sept 5	July 2 through Sept 6
Number of Surveys	97	138

2.1 Respondent Summary

Respondents visited the five survey sites at varying frequencies, and distribution for each zone is presented in Table 3. The percents are based on the total number of surveys received each year.

SolarBee Zones 1 and 3 were visited most frequently of the five sites in both years. The number of surveys of Zone 4 increased from 8% in 2006 to 20% in 2007.

Table 3. Distribution of perception surveys by locations.

	Percent of Surveys	
Solarbee Observation Zones	**2006**	**2007[1]**
Zone 1 North Basin SolarBee	35%	36%
Zone 2 North Basin Control	10%	8%
Zone 3 Sacketts Harbor SolarBee	26%	31%
Zone 4 Sacketts Harbor Control	8%	20%
Zone 5 Mid-Lake Basin Southern Station	21%	-
Total	**100%**	**94%**

[1]No surveys were received for Zone 5. Eight surveys (6% of total) were received where "Southern Basin" was indicated, but a zone number was not provided; therefore it was not clear whether these surveys applied to Zone 3, Zone 4, or Zone 5.

Respondents were asked to describe their relationship to Conesus Lake. The majority of respondents identified themselves as year-round residents in both the 2006 and 2007 surveys (Table 4), accounting for more than 90% of surveys in both years.

Table 4. Respondents' self-identification in relation to the lake.

Relationship of respondent	**Percent of surveys**	
to Conesus Lake	**2006**	**2007**
Year-round resident	96%	93%
Seasonal resident	4%	4%
Guest of year-round or seasonal resident	-	1%
Visitor	-	2%
Other	-	na

Note: "na" indicates that the choice "Other" was not provided on the 2007 survey.

Respondents were asked whether they were aware that a test of water circulation technology was being conducted on Conesus Lake before they completed the survey. This question was not asked on the 2006 survey. The majority of surveys (137) indicated awareness of the water circulation technology testing; 1 survey indicated no awareness prior to the survey (this survey indicated the respondent was a guest of a resident).

2.2 Observation Point Summary

Respondents were asked to identify the platform from which they conducted their survey by circling one of four choices: Boat, Shoreline, PWC or Dock. Some respondents did not circle an

option, accounting for 4% of the 2006 and 5% of 2007 surveys. Evaluation of these data was based on the number of surveys with circled choices (Table 5).

More than 95% of the surveys in 2006 were conducted from Boat and Dock observation points. In 2007, more than 88% of surveys were conducted from Boat and Dock observation points. The Boat observation point was the highest percentage on 2006, whereas the Dock was the highest percentage in 2007.

Table 5. Observation point from which surveys were conducted.

	Percent of surveys	
Observation Point	**2006[1]**	**2007[2]**
Number of respondents circling a choice:	*93 of 97*	*131 of 138*
Choices:		
Boat	57%	42%
Shoreline	1%	4%
PWC	-	-
Dock	40%	46%
Other (Swimming)	2%	2%

Notes:
Percent of respondents calculated from the number of respondents who circled a choice.
[1]In 2006, the observation point "Shoreline" was clarified as "Old Orchard Cove". The observation point "Other" was clarified as "Swimming 20ft from 150ft dock".
[2]In 2007, the observation point "Other" was clarified as "Swimming", at distances from 50-80 ft off-shore. Of the responses for "Shoreline", approximately 80% were also circled "Dock".

Some respondents provided data about water depth and distance from shore for their observations (Table 6). In 2007, roughly half of the surveys (51%) contained water depth and/or distance from shore data; in 2006, 53% of surveys contained depth data and 41% contained distance from shore data.

For the surveys where water depth was recorded, the more than 90% of surveys were conducted in depths less than or equal to 10 ft in both 2006 and 2007.

For surveys where distance from shore was recorded, surveys were conducted at a distance less than or equal to 200 ft from shore for the majority of both surveys - 85% of surveys in 2006 and 96% of surveys in 2007.

Table 6. Water depth and distance from shore summary.

		Percent of Surveys	
	Range (feet)	**2006**	**2007**
Depth	<5	31%	54%
	5-10	61%	44%
	11-20	-	3%
	21-30	-	-
	31-40	-	-
	41-50	-	-
	51-60	8%	-
	>60	-	-
Number of surveys		*51 of 97*	*71 of 138*
Distance	<60	-	19%
	60-70	33%	29%
	71-80	3%	7%
	81-90	20%	-
	91-100	8%	10%
	100-150	3%	4%
	151-200	20%	27%
	>200	15%	4%
Number of surveys		*40 of 97*	*70 of 138*

2.3 Water Quality Opinion Summary

The Perception Survey was designed to gather the subjective opinions of the respondents to two questions about the lake's water quality. The responses were guided on a scale from "excellent" to "severely impaired" conditions. Responses that did not conform to the scale were not included in the data evaluation. Examples of invalid responses included respondents who created their own answers rather than selecting one of the choices; and respondents who circled multiple choices.

There was a change in the approach for the 2007 Survey from the 2006 Survey. The survey form for 2007 included a scale bar for the two questions about lake water quality. The question asked the user to place a mark on the scale from 1 to 5 to indicate their choices. This methodology differed from the 2006 methodology in that it allowed the respondents to mark the scale between the index values described for each question, rather than selecting a specific index value. For example, the scale bar with a mark *x* showing the respondent's choice:

1 2 *x* **3 4 5**

In 2007, the respondent placed a mark between index numbers on the scale bar on 19 of the 138 surveys, resulting in ambiguous responses. For this analysis, these ambiguous responses were treated in the same manner as the ambiguous responses in the 2006 surveys were treated. In 2006, the ambiguous data (e.g., where a respondent circled multiple choices or created their own choices) were excluded from the analyses. The ambiguous data represented less than 5% of the 2006 data set, and 14% of the 2007 data set.

2.3.1 Physical Condition

The wording of the questions and lists of choices on the 2007 Survey were modified from those used in the 2006 Survey. A comparison of the questions and lists of choices is shown in Table 7.

Table 7. Comparison of wording of Question C – Physical Condition – from the 2006 and 2007 surveys.

2006 Survey	2007 Survey
C. Please circle the one number that best describes the physical condition of the water in Conesus Lake today.	C. Please place a mark on the scale (below) between 1 and 5 that best describes the physical condition of the water in Conesus Lake today.
1. Crystal clear water	1. Crystal clear water
2. Not quite crystal clear, a little algae visible	2. Not quite crystal clear; a little discoloration visible
3. Definite algal greenness, yellowness or browness apparent	3. Definitely not clear; green, yellow or brown materials visible
4. High algal levels with limited clarity and/or mild odor apparent	4. Not clear at all; limited clarity, mild odor, high levels of green, yellow or brown materials visible
5. Severely high algae levels with one or more of the following: massive floating scums on lake or washed up on shore, strong foul odor, or fish kill	5. Terrible; one of the following is present – sizable floating scums in the water or washed up on shore, strong foul odor, fish kill or other negative factors

Using valid responses for both 2006 and 2007, Figure 1 presents the percent distribution of physical condition responses by survey zone.

In 2006, Zone 1 (North End Solarbee) had the highest percentage (81%) of reports of "crystal clear water". Zones 2 (North End Control), 3 (Sacketts Solarbee) and 4 (Sacketts Control) were dominated by reports of "not quite crystal clear" conditions (50%, 60%, and 50%, respectively). Zone 5 (Mid-lake southern basin) was dominated by reports of "definitely not clear" and "high algal levels" (30% each for a combined total of 60% of surveys).

In 2007, Zones 1 and 2 were dominated by reports of "not quite clear" (55% and 71% respectively). Zone 3 was dominated by reports of "crystal clear" and "not quite clear" (33% each for a combined total of 66% of surveys). Zone 4 and the Unknown Southern Basin station were dominated by reports of "not clear at all" (54% and 57%, respectively).

2.3.2 Recreational Suitability

The wording of the questions and lists of choices on the 2007 Survey were modified from those used in the 2006 Survey. A comparison of the questions and lists of choices is shown in Table 8.

Table 8. Comparison of wording of Question D – Recreational Suitability – from the 2006 and 2007 surveys.

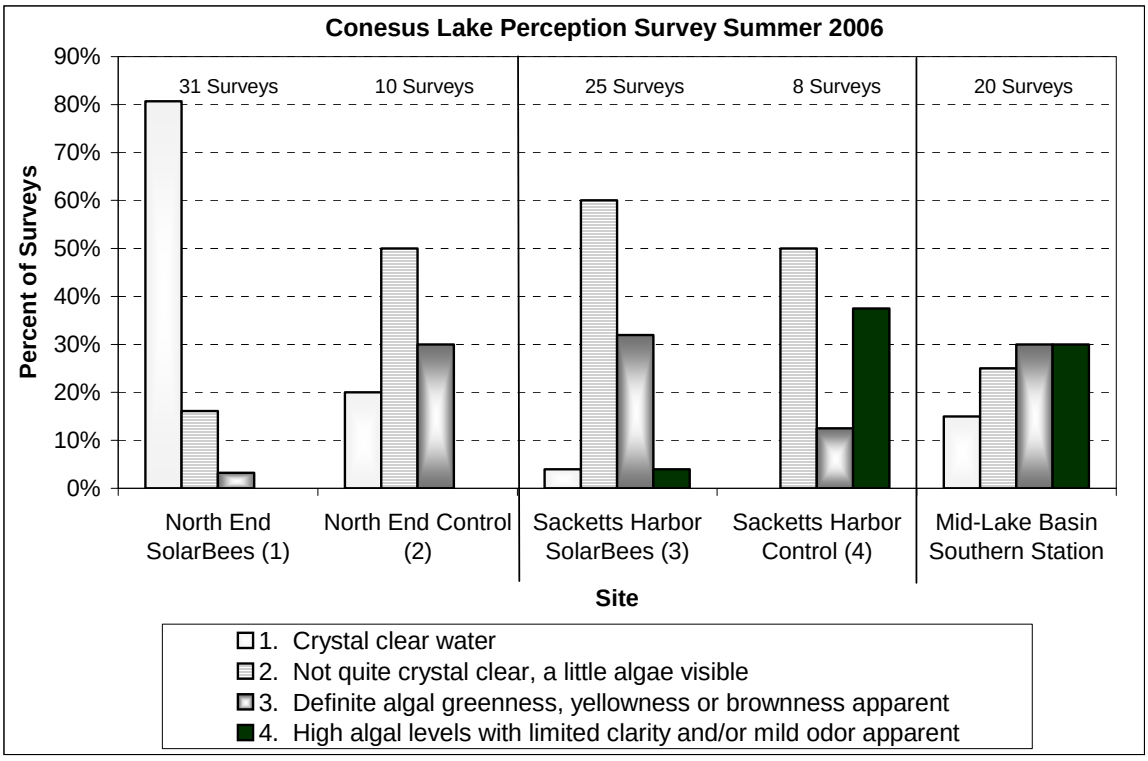
2006 Survey	2007 Survey
D. Please circle the one number that best describes <u>your opinion</u> of how suitable Conesus Lake is for recreation and your general enjoyment today.	D. Please place a mark on the scale (below) between 1 and 5 that best describes <u>your opinion</u> of how suitable Conesus Lake is for recreation and your general enjoyment today.
1. Beautiful, could not be any nicer	1. Beautiful; could not be any nicer
2. Very minor aesthetic problems, excellent for swimming, boating, enjoyment.	2. Very minor aesthetic issues; excellent for swimming, boating, general enjoyment
3. Swimming and aesthetic enjoyment slightly impaired because of algae levels.	3. Swimming and general enjoyment slightly impaired because of water discoloration, odor or other water-related issues.
4. Desire to swim and level of enjoyment of the lake substantially reduced because of algae levels.	4. Desire to swim and level of enjoyment of the lake significantly reduced because of water discoloration, odors, or other water quality-related issues
5. Swimming and aesthetic enjoyment nearly impossible because of algae levels.	5. Swimming and enjoyment of the lake nearly impossible because of water discoloration, odors, or other water quality-related issues

Using valid responses for both 2006 and 2007, Figure 2 presents the percent distribution of recreational suitability responses by survey zone.

In 2006, 40% to 50% of respondents in all five zones indicated very minor aesthetic problems, and that the site was excellent for swimming, boating and enjoyment. Of the five zones, Zone 1 (North End Solarbee) received the highest percentage (27%) of responses indicating the site was beautiful and could not be nicer. Zone 3 (Sacketts SolarBee) received the highest percentage (48%) of responses indicating enjoyment was slightly impaired because of algal levels. Zone 2

(North End Control) received the highest percentage (30%) of responses indicating enjoyment of the lake was substantially reduced because of algal levels. None of the zones were classified as being too impaired for swimming or aesthetic enjoyment due to algal levels.

In 2007, Zones 1 (North End Solarbee) and 3 (Sacketts Solarbee) were reported with "beautiful" to "minor aesthetic issues" for recreational uses (74% and 62%, respectively). Zones 2 (North End Control) and 4 (Sacketts Control) reports were dominated by "slightly impaired" reports (71% and 54%, respectively). The Unknown Southern Station was dominated by reports of "slightly impaired" (57%) and "significantly reduced" or "nearly impossible" enjoyment (43%).



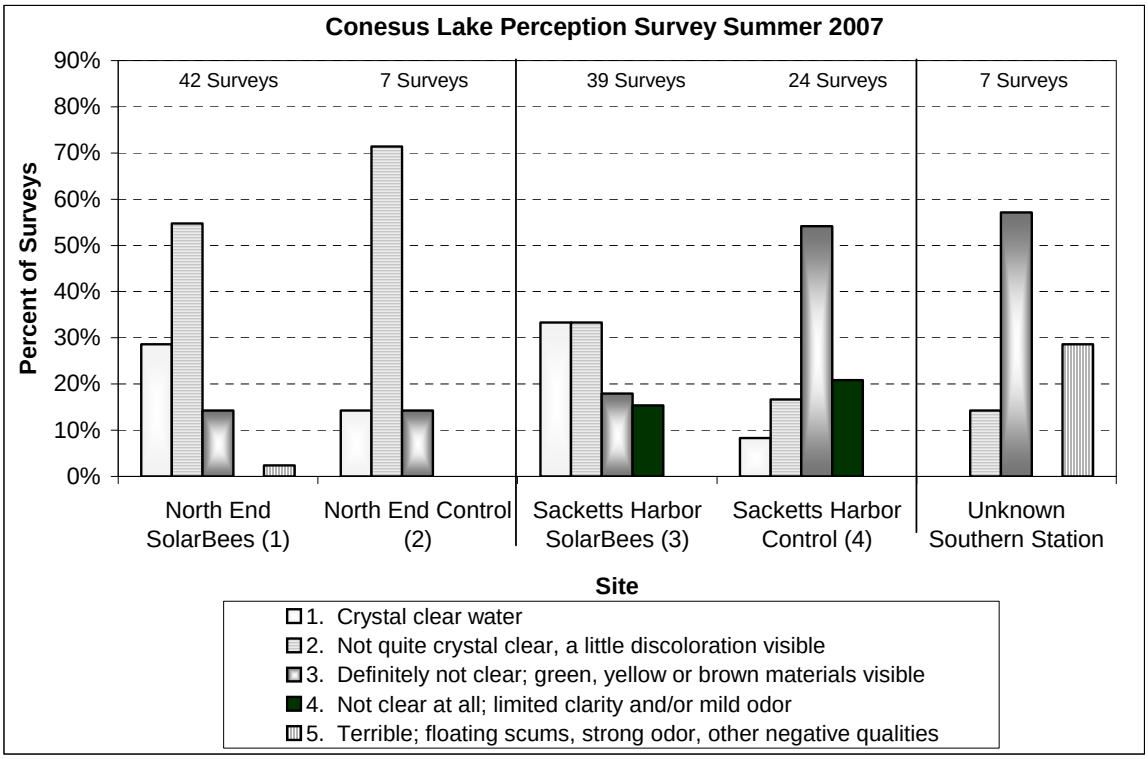
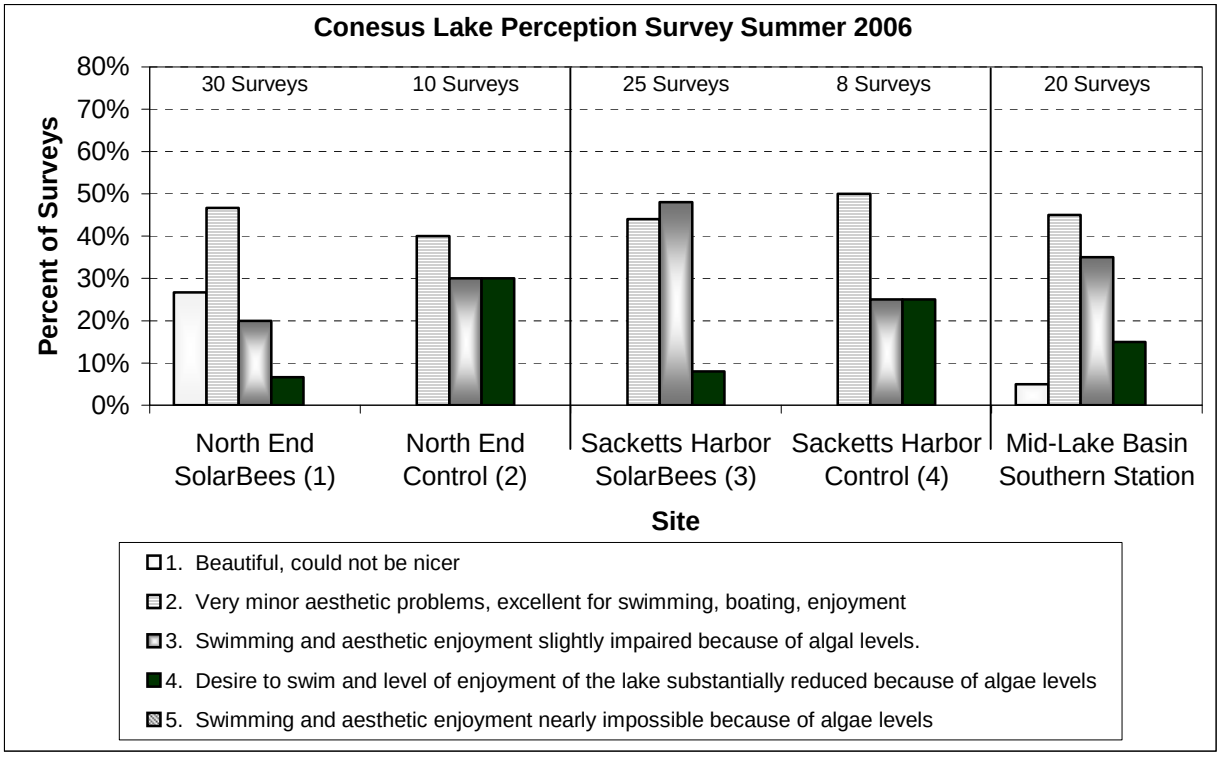


Figure 1. Perception Survey opinions about the physical condition of Conesus Lake.



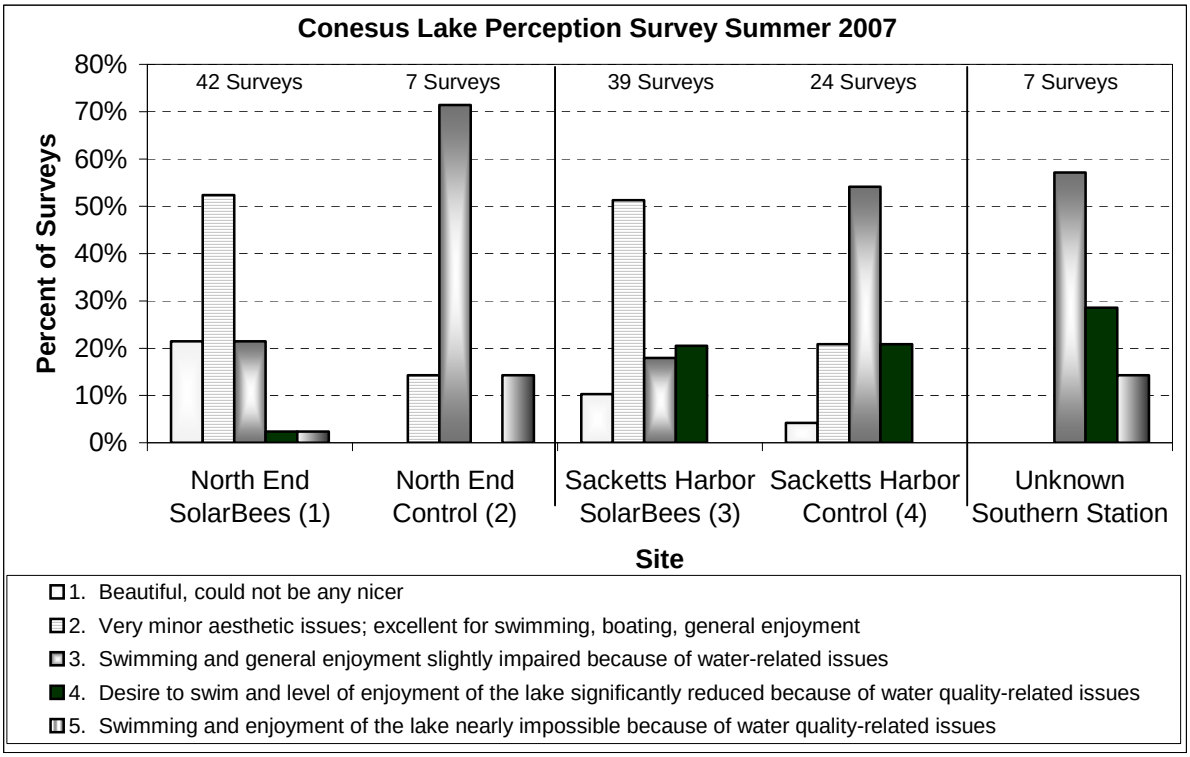


Figure 2. Perception Survey opinions about the suitability of Conesus Lake for recreational uses.