



**Common Tern Habitat Improvement Project:  
2012 Buffalo Harbor Tern Colony  
Enhancements and Status Assessment**

**Niagara Power Project (FERC No. 2216)**

PREPARED BY:

**RIVEREDGE ASSOCIATES**

PREPARED FOR:

**NEW YORK POWER AUTHORITY**

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**Please Contact:**

Stephen M. Schoenwiesner  
Licensing Manager  
New York Power Authority  
123 Main Street  
White Plains, NY 10601  
(914) 287-3457  
[Steve.Schoenwiesner@nypa.gov](mailto:Steve.Schoenwiesner@nypa.gov)

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## 1.0 INTRODUCTION

The New York Power Authority (NYPA) is pursuing several habitat improvement projects (HIPs) benefiting birds and other wildlife as part of the Niagara Power Project Comprehensive Relicensing Settlement Agreement and the new 50-year license for the Niagara Power Project (NPP). HIPs were identified and prioritized with the help of the Niagara Ecological Standing Committee (ESC) which is composed of local groups and governmental agencies. One of the HIPs involves enhancing the nesting habitat of the Common Tern (*Sterna hirundo*) within the outer harbor in Buffalo, NY.

The Common Tern is a state-listed threatened species whose numbers have declined primarily due to loss of suitable nesting habitat. In Buffalo Harbor, Common Terns nest on three breakwaters operated by the U.S. Army Corps of Engineers. The number of nesting pairs of terns on these breakwaters comprises the largest tern colony in the Great Lakes. Although terns nest in great numbers on the concrete surface of the breakwaters, productivity of these nests is often low due to a lack suitable nesting substrate. The goal of the Common Tern HIP was to replace seasonally-deployed, gravel-filled, nesting boxes and enclosures on the breakwaters with more substantial and permanent gravel nesting substrate, which will help increase tern breeding productivity and aid the recovery of this threatened species. In 2009, two experimental habitat improvements were made to tern nesting habitat in the harbor. The first improvement involved the installation of a 12" high containment structure, perimeter fence and gravel substrate on an existing cement-surfaced breakwater which terns use as a nesting site. The second experimental improvement was the creation of new nesting habitat on a barge moored to a breakwater. Although both enhancements successfully provided suitable and productive nesting habitat for Common Terns in 2009 ([Riveredge Associates, 2010](#)), the results indicated that the breakwater enhancement was a more effective long-term method of restoring this threatened species ([Riveredge Associates, 2010](#)).

In 2010, the gravel filled containment structure on the breakwater was again monitored for use by nesting terns and was again successful at providing productive habitat ([Riveredge Associates, 2011](#)). The demonstrated success of this end cell enhancement served as a model for three additional enhancements that were subsequently constructed on the Buffalo Harbor breakwaters after the

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breeding season ended in fall 2010. The New York State Department of Environmental Conservation (NYSDEC) was able to use a grant from the NPP's Habitat Enhancement and Restoration Fund (HERF) to cover an additional 128 linear feet (approximately 1,800 square feet) of tern nesting habitat on one of the breakwaters. The area improved via NYSDEC's HERF grant has been fully incorporated into NYPA's maintenance and monitoring program. The completion of these additional enhancements marked the end of the construction phase of the Common Tern HIP. In total, approximately 10,570 square feet of enhanced nesting area was created for terns (Table 1-1) on the breakwaters of Buffalo Harbor (Figure 1-1).

This report summarizes efforts to operate the Common Tern HIP in 2012. In addition, it documents monitoring efforts at all four enhancement areas during the 2012 breeding season, the second year of five years of post-construction monitoring of tern nesting.

TABLE 1-1. LOCATIONS AND AREA OF ENHANCEMENTS COMPLETED IN 2009 AND 2010

<b>Nesting Area ID</b>	<b>Buffalo Harbor Breakwater</b>	<b>Other Names for this Breakwater</b>	<b>Portion of Breakwater</b>	<b>Approx. Area (square feet)</b>	<b>Date Installed</b>	<b>First Year Enhancement Available for Nesting Terns</b>
CT-01	North Breakwater	Donnelly's	Crest on South end	2,325	October 2010	2011
CT-02	Old Breakwater North	Short	Crest on North end	3,175†	October 2010	2011
CT-03	Old Breakwater North	Short	Endcell on South end	2,100	April 2009	2009
CT-04	Old Breakwater South	South	Double Endcell on North end	2,975	October 2010	2011
Total Improved Nesting Area:				10,575 (0.25acres)		

† - includes area improved via NYSDEC's HERF project



**Figure 1-1: Location of Common Tern Nesting Improvements in Buffalo Harbor**



**Legend**

-  Common Tern Nesting Improvement



## **2.0 BACKGROUND**

In the Great Lakes region, the Common Tern is considered an endangered species in Ohio, Illinois, Wisconsin and Vermont; a threatened species in New York, Michigan and Minnesota; and an extirpated species in Pennsylvania and Indiana (Cuthbert *et al.*, 2003).

NYSDEC has monitored and managed inland Common Tern colonies on the St. Lawrence River, Oneida Lake, and the Niagara Frontier since the late-1980s. The decline in New York's inland tern population and the low number of terns currently nesting on New York's Great Lakes can be attributed to the loss of nesting habitat and low breeding productivity due to predation, poor nesting substrate, and human disturbance. The loss of nesting habitat is primarily due to an increase in ring-billed gulls (NYSDEC, 2013).

Since 1990, Riveredge Associates has managed St. Lawrence River Common Tern colonies in an attempt to increase the number of nesting pairs of terns in the region. In 2004, Riveredge Associates was contracted by NYSDEC to monitor and manage Common Tern colonies in Buffalo Harbor and the Niagara River as well (Harper and Adams, 2005; Harper *et al.*, 2006; 2007; 2008; 2010). Riveredge and NYSDEC management efforts have attempted to increase the amount of available nesting habitat for terns, decrease the amount of competition for nest sites with gulls, decrease the amount of predation on adults, chicks and eggs, and increase public awareness to reduce human disturbance at tern nesting sites.

### **2.1 Tern Nesting and Nesting Monitoring**

On the Niagara Frontier, Common Terns nest on breakwaters in Buffalo Harbor and potable water intakes and power tower cribs on the upper Niagara River. Annual monitoring of Common Tern nesting on the Niagara Frontier was started in 1986 (Adams and Batcheller, 1987) and conducted almost annually since. Riveredge was contracted by NYSDEC to conduct the monitoring of Common Tern nesting colonies on the Niagara Frontier for five years from 2004 through 2008. In 2009, 2010, 2011, and again in 2012, Riveredge was contracted by NYPA to monitor the Common Tern habitat enhancements in Buffalo Harbor as part of NYPA's Common Tern HIP.

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On the Niagara Frontier, Common Terns have nested at 13 sites on eastern Lake Erie and the upper Niagara River since 1986 ([Harper et al., 2008](#)). In and near Buffalo Harbor, these sites have included breakwaters and lighthouses such as the North Breakwater (also called Donnelly's Breakwall), Reef Lighthouse, Old Breakwater North (also called Short Breakwater), and Old Breakwater South (also called South Breakwater). On the Niagara River these sites have included potable water intake structures, power tower cribs, and islands associated with water control structures for generating hydroelectric power. Beginning in 2003, terns were displaced from four of the nesting sites in Buffalo Harbor and on the Niagara River by gulls and cormorants.

Currently, the majority of Common Terns nest on three Buffalo Harbor breakwaters (North Breakwater, Old Breakwater North, Old Breakwater South). These breakwaters are multi-level structures of concrete and armor stone. Prior to the implementation of this HIP, the nesting substrate was composed largely of broken concrete chips where the breakwaters are weathering. There was little or no cover on these structures, and tern nests and chicks were exposed to wind, waves, and weather. The sides of these concrete breakwaters are vertical, and chicks perish when they fall off the breakwater when disturbed or frightened because they cannot re-access the structure.

### **2.2 Recent Tern Management Efforts in Buffalo Harbor**

Since 2004, tern management activities have included the construction of seasonal gravel nesting boxes, the installation of perimeter fences, the deployment of chick shelters, and the posting of informational signs on the Buffalo Harbor breakwaters ([Harper and Adams, 2005](#), [Harper et al., 2006](#); [2007](#); [2008](#); [2010](#); [Riveredge Associates, 2010](#)). Wooden, gravel-filled nesting boxes and enclosures were built each year to provide better nesting substrate for terns and to increase egg hatching and chick fledging rates. As many as 36 nesting boxes were built and installed on the three Buffalo Harbor breakwaters in one or more years for five years from 2004 to 2008 ([Harper and Adams, 2005](#); [Harper et al., 2006](#); [2007](#); [2008](#)). In addition, plastic perimeter fencing was installed to enclose approximately half of all tern nests to increase chick survivorship by preventing chicks from jumping off the structures. Plywood chick shelters were

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deployed to protect tern chicks from weather, territorial adults, and predators, and encourage chicks to remain near their nest for a longer period of time. Finally, informational signs were posted to inform the public of the nesting terns and to limit human disturbance. These NYSDEC Restricted Area signs list the New York State and Federal Statutes prohibiting the disturbance of Common Terns and indicate that the tern is a designated threatened species under New York State Environmental Conservation Law. Human disturbance can cause a great deal of chick mortality on the Buffalo Harbor breakwaters. If anglers or recreational boaters approach the breakwaters too closely, chicks may panic and run, becoming separated from their parents or falling off the structures and perishing. These management measures resulted in increased tern productivity on the Buffalo Harbor breakwaters from 2004 to 2008, particularly on the North Breakwater and the Old Breakwater North.

As noted in Section 1, more substantial and permanent improvements to nesting habitat on the breakwaters were initiated in 2009 and 2010 through the Common Tern HIP. The enhancements installed by the Common Tern HIP resulted in even greater increases in nest numbers and productivity as discussed later in this report.

## 3.0 METHODS

### 3.1 Operation and Maintenance of Enhanced Areas

As described in the Common Tern HIP Operation and Maintenance Plan (Kleinschmidt Associates and Riveredge Associates, 2012a), annual operation of the Common Tern HIP involves preparing the nesting area for the arrival of terns each year (*e.g.*, raking gravel level; pulling weeds; installing perimeter fence; and placing internal dividers, driftwood logs, and plywood chick shelters), maintaining the enhancements to replace missing or damaged components, and storage of temporary components at the end of the nesting season (*e.g.*, off-site storage of fencing, dividers, and chick shelters; moving driftwood away from edges of breakwaters).

In late March 2012, before terns had arrived in Buffalo Harbor from their wintering grounds, the four enhanced areas of the Buffalo Harbor breakwaters were inspected to determine maintenance needs. Gravel that had been displaced by winter storms was raked and shoveled back to the edge of the containment frame on the lake side of the breakwater so that no areas of bare cement remained. Lumber (2x4, 2x6, and 1x3 lath), 3/16" mesh plastic fencing, and chick shelters were transported to each area to prepare them for the nesting season. The lumber and fencing were used to divide the enhanced area into subsections. Boards were screwed together and lath uprights and tensioning rope were used to support the plastic fencing for interior dividers. Dividing each nesting area into subsections facilitated counting nests and chicks and prevented chicks from moving too far from their natal nest site during the breeding season. Driftwood, stored away from the edge of the breakwaters over the winter, was moved back into place on the gravel to provide additional structure and separation among nesting terns. A plastic perimeter fence was installed to prevent chicks from jumping off the nesting area when disturbed and to reduce the chance chicks might be blown off the structure by strong winds. As tern eggs began to hatch, chick shelters were placed adjacent to nests to provide cover for chicks from adverse weather and predators.

After the breeding season, in late August or early September, the plastic fencing, lumber, and chick shelters were transported to shore for storage. Some items, such as driftwood, were left on site during the winter.

### **3.2 Monitoring of Enhanced Nesting Areas**

In 2012, monitoring of the Common Tern HIP documented the number and productivity of Common Tern nests on the enhanced areas of the breakwater. Each nesting site was surveyed regularly from late April through late-July, and periodically checked in August as well. Monitoring followed the methods outlined in the Common Tern HIP 5-year Monitoring Plan (Kleinschmidt Associates and Riveredge Associates, 2012b) and used for recent surveys (Harper et al., 2010; Riveredge Associates, 2010, 2011, 2012). These methods were consistent with the “Protocol for Surveying, Monitoring and Managing at Common Tern Colonies in Upstate New York” developed by NYSDEC (NYSDEC, 2004). Monitoring activities were coordinated with NYSDEC.

Tern colonies were surveyed weekly as weather and colony conditions permitted. Two to six people participated in each site survey. During periods where tern chicks were highly mobile, the frequency of colony surveys was reduced to limit the number of chicks that might jump off the breakwaters. Surveys were not conducted on windy days when older chicks are close to flying age. Chicks over 15 days old can be blown off the colony simply by opening their partially feathered wings. At this age, their flight feathers are long but the chicks are not yet capable of flight. If strong winds blow the chicks off the colony, they fall in the water and die. Mid-to-late June surveys were often shortened or canceled due to the potential to lose a great number of chicks off the breakwaters.

Field notes collected during each monitoring event included the date of each observation, general weather conditions, the number of nests counted, the number of live chicks and eggs present, the number of dead chicks and broken eggs present, and other pertinent information.

During each survey, nests in selected subsections of each enhanced area were monitored to determine the number of chicks that hatched and fledged. Individual nests were numbered with permanent marker and the numbers of eggs or chicks in the nest were recorded. In addition,

live chicks were counted and banded on each survey, and dead chicks were counted and removed from the colony.

A subset of tern chicks was banded with incoloy (stainless steel) leg bands. Chicks were banded at approximately five days of age and older. Efforts were made to band all chicks within selected sections of the enhancement area of the breakwater to provide an accurate total chick count and to provide data on productivity, survivorship, and post-fledging dispersal.

Monitoring of tern nests, productivity, and chick survivorship on the enhanced areas was also conducted with the use of time-lapse and/or motion-triggered cameras. These cameras were deployed in an effort to identify the predator or predators that have lowered tern breeding productivity in previous years ([Riveredge, 2010](#), [2011](#), [2012](#)). Mink have been observed on one or more of the Buffalo Harbor breakwaters annually since 2010 and are known to prey on tern eggs and chicks on the breakwaters ([Riveredge, 2011](#), [2012](#)). In an effort to limit mink depredation on terns, NYSDEC issued a nuisance mink permit and mink traps were deployed on two breakwaters.

### **3.3 Data Analysis**

The number of tern nests and the number of tern chicks that survived to fledging were used to assess the success of the enhanced nesting areas. Average productivity, based on the sections monitored, was calculated by counting the total number of tern chicks fledged and dividing this value by the number of tern nests that produced these chicks to calculate the average number of chicks fledged per nest. Productivity for this year was compared to the productivity of these breakwaters from previous years (*e.g.*, [Harper \*et al.\*, 2010](#); [Riveredge Associates, 2010](#), [2011](#), [2012](#)) and used to assess the success of the tern nesting habitat improvements. In addition to determining productivity, maintenance and monitoring needs (*e.g.* number of shelters, needed repairs) were also noted to assist with future implementation of the Common Tern HIP.

## 4.0 RESULTS

### 4.1 Operation and Maintenance of Enhanced Areas

The first inspection of the enhanced areas of the breakwaters was conducted on March 25, two weeks earlier than in 2011. All of the containment frames were found in good condition, although significant displacement of gravel had taken place over the winter. The amount of displaced gravel was the greatest amount since the enhancements were constructed.

On the lake side of each structure, gravel had been moved away from the containment frame by winter storms. The amount of gravel displaced ranged from little or none on the north end of the Old Breakwater North to over half of all the gravel on the North Breakwater. On the North Breakwater, approximately 60% of the enhanced area was bare cement (approximately 1,395 square feet) ([Figure 4-1](#)). Gravel was piled to the top of the 12" containment frame on the harbor side of the structure. Some gravel was likely washed off the structure as well. On the end cell at the south end of Old Breakwater North approximately 100 square feet of bare cement was exposed, and approximately 500 square feet of bare cement was exposed on Old Breakwater South ([Figure 4-2](#)).

At all four improved areas, displaced gravel was raked back over any areas of bare concrete and re-distributed to provide nesting substrate of suitable depth. During installation, the design depth for gravel (3") had been doubled to 6" to allow for the loss of material. When gravel raking had been completed on North Breakwater, at least 95% of the nesting area had gravel to a minimum depth of 3"; most of the area had 4" of gravel or more ([Figure 4-3](#)), and some areas had over 6" of gravel. Displaced gravel at the three other sites was raked back into place to a depth well above the minimum design depth, indicating that little gravel had been lost.

Perimeter fencing, interior fencing, and driftwood were installed at each of the enhanced areas ([Figure 4-3](#), [Figure 4-4](#)). The circular end cell on the south end of the Old Breakwater North was divided into pie-shaped sections using 2x6 lumber and plastic perimeter fencing. The north end of the Old Breakwater North was divided into 11 rectangles of approximately equal area. The enhanced area of the Old Breakwater South was divided into six sections with interior

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dividers (two more than in 2011). The rectangular enhanced area on the North Breakwater (Donnelly's Breakwater) was divided into five sections of approximately equal area. At each site, driftwood and/or chick shelters were added to provide structure and cover. The interior dividers and chick shelters were visible on publically available aerial photos on the internet (such as those at [www.bing.com](http://www.bing.com) taken in April 2011) and in photos taken from a chartered plane in May 2011 ([Figure 4-5](#)). All fencing was installed by April 15.

During the breeding season, it was occasionally necessary to refasten the plastic perimeter fence where it was blown down by strong winds. At the end of the breeding season, all fencing, all chick shelters, and most of the lumber were removed from the breakwaters for over-winter storage. Driftwood was piled on the sheltered sides of the breakwaters and left there for the winter.



FIGURE 4-1. EARLY SPRING CONDITIONS ON NORTH BREAKWATER



FIGURE 4-2. EARLY SPRING CONDITIONS ON OLD BREAKWATER SOUTH



FIGURE 4-3. GRAVEL WAS RESTORED TO THE NORTH BREAKWATER

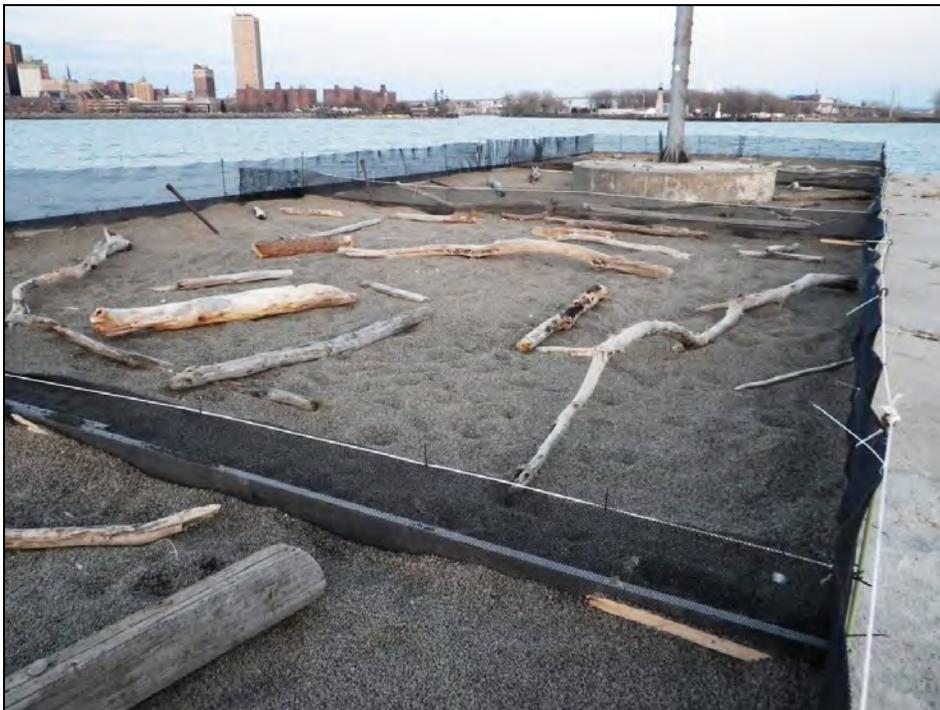


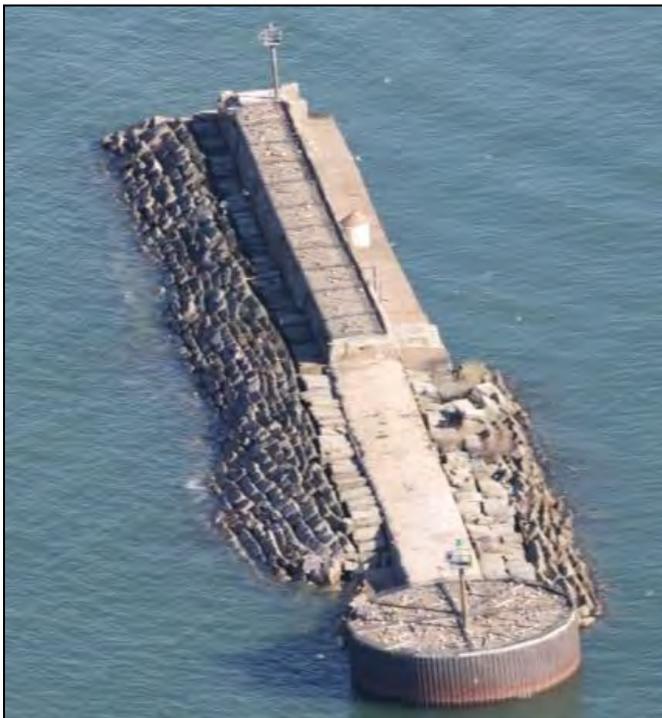
FIGURE 4-4. OLD BREAKWATER NORTH (TOP) AND NORTH BREAKWATER (BOTTOM) READY FOR TERNS



North (Donnelly's) Breakwater (2011)



Old Breakwater South (2011)  
(South Breakwater; divided in six  
sections in 2012)



Old Breakwater North (2011)  
(Short Breakwater)

FIGURE 4-5. MAY 2011 AERIAL VIEW OF ENHANCED AREAS WITH NESTING TERNS

### 4.2 Number of Nests

The first terns were observed at the breakwaters on April 4, 2012. Ten days later (April 14), there were approximately 100 terns present in the harbor. Terns constructed nests and laid the first eggs in late April. The number of tern nests increased rapidly through late April and May ([Figure 4-6](#)).

The annual nest count was conducted on May 18 at the peak of incubation and the start of egg hatching. The number of tern nests on the Buffalo Harbor breakwaters on the peak survey (May 18) was 2,107, a new record high since monitoring began 25 years ago (in 1986). Just over half of these nests (1,166 of 2,107 or 55.3%) were located on the Old Breakwater North ([Table 4-1](#)). The remaining nests were located on the North Breakwater (N=292) and on the Old Breakwater South (N=649) ([Table 4-1](#)).

As in 2011, the number of nests on the Old Breakwater North in 2012 was more than twice the number of nests (N=487) present in 2008 before NYPA enhancements of this breakwater were implemented ([Figure 4-6](#)). The number of nests on the Old Breakwater South in 2012 (N=649) was more than double the number of nests at this site in 2011 (N=289), and more than 13 times greater than the number of nests in 2010 (N=47). In contrast, the number of nests on the North Breakwater was lower in 2012 than in any previous year since 2004 ([Table 4-1](#), [Figure 4-7](#)). The decrease in the number of nests on the North Breakwater was due to mink depredation of tern eggs and chicks in 2012 and in 2011.



FIGURE 4-6. TERNS INCUBATING EGGS ON NORTH BREAKWATER AS RECORDED BY A MOTION-TRIGGERED MONITORING CAMERA

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TABLE 4-1. NUMBER OF TERN NESTS IN BUFFALO HARBOR, 2004-2012

Buffalo Harbor Site	2004	2005	2006	2007	2008	2009	2010	2011	2012
North Breakwater (Donnelly's Breakwall)	796	975	659	747	948	663	906	569 <sup>1</sup>	292 <sup>1</sup>
Nesting Barge (installed in 2009 only)	-	-	-	-	-	224	-	-	-
Old Breakwater North (Short Breakwater)	183	317	450 <sup>2</sup>	419	487	683	882	1,030	1,166
Old Breakwater South (South Breakwater)	49	84	88	71	42	30	47	289	649
Buffalo Harbor Total <sup>3</sup> :	1,028	1,376	1,197	1,237	1,477	1,600	1,835	1,888	2,107

<sup>1</sup> The decrease in nest numbers in 2011 and 2012 was due to mink depredation of tern eggs and chicks

<sup>2</sup> Estimated value

<sup>3</sup> 2009 and 2010 data for sites not monitored by Riveredge provided by NYSDEC

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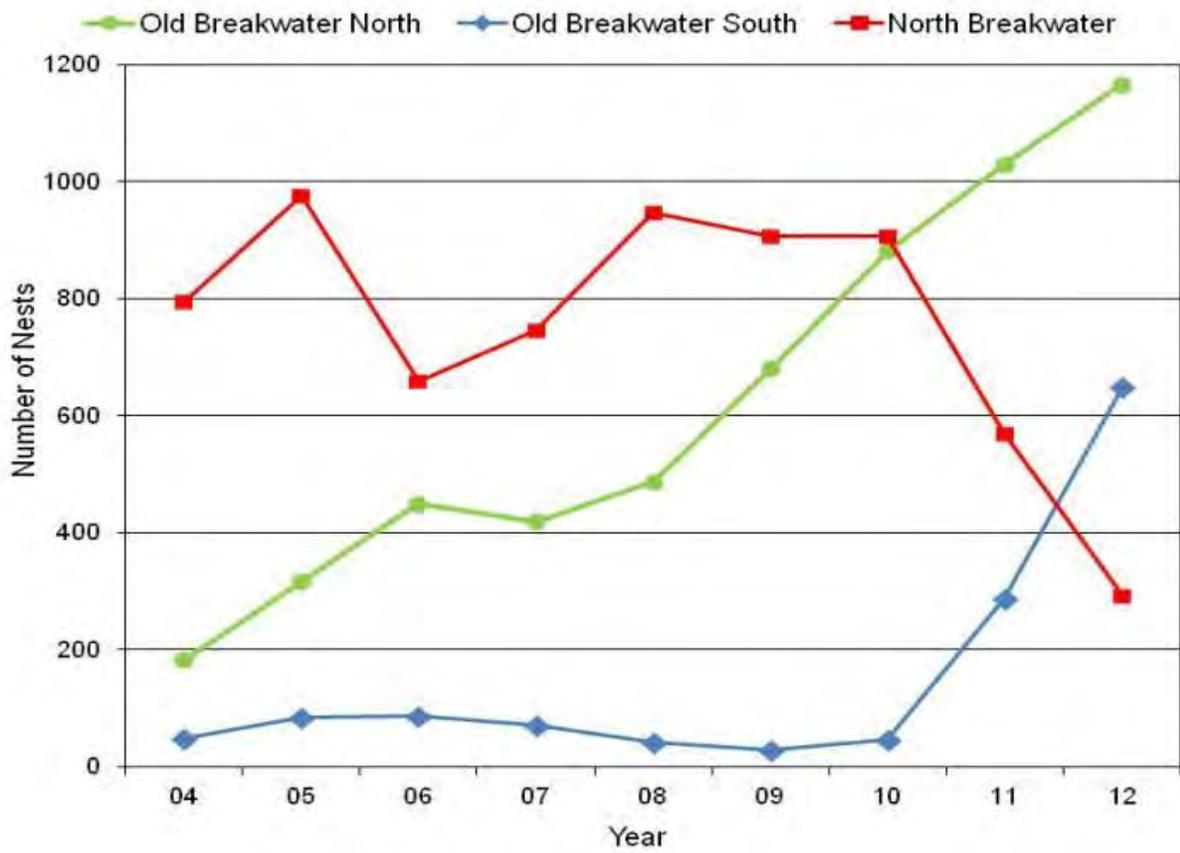


FIGURE 4-7. NUMBER OF TERN NESTS ON BUFFALO HARBOR BREAKWATERS

### 4.3 Productivity

Productivity and factors that could potentially affect productivity were monitored through nest surveys (Figure 4-8), chick banding, and predator monitoring using cameras and traps. The peak period of tern hatching occurred in late May and early June, similar to 2010 and 2011. Hatching was delayed on the North Breakwater, and, as in 2011, the behavior of terns on this breakwater suggested disturbance by a mammalian predator.

By May 23, the first wave of tern chicks were old enough to band. Chick banding was performed because it facilitates accurate chick counts, measurements of chick survivorship, and the determination of breeding productivity. The first major banding effort was conducted on May 23 with 711 chicks banded. Hatching progressed rapidly, and on May 30, another 1,818 tern chicks were banded. On June 6 and 7, only 412 chicks were banded, suggesting that the first wave of hatching was slowing down. After June 7, banding operations were suspended while the first wave of chicks was growing old enough to learn to fly. Through June 7, a total of 2,941 tern chicks were banded. In contrast, over five days during the first week of June 2011, 1,313 tern chicks were banded. In 2011 and 2012, almost all chicks were banded on the Old Breakwaters North and South.

On the North Breakwater, only 27 tern chicks were banded. However, over 125 tern chicks were found dead and many eggs were abandoned. During the same period in 2011, 592 tern chicks were found dead on the North Breakwater, as well as hundreds of unhatched abandoned eggs (from a much greater number of nests). In 2011 and 2012, virtually all of the dead chicks were 3 days old or less when they died. These chicks were likely killed directly by mink depredation or indirectly by the abandonment of nests at night by adult terns, leaving eggs and chicks exposed to weather and low temperatures. Terns may live to be more than 20 years old and adults generally sacrifice their eggs or chicks before they take the risk of being killed themselves on the nest at night.

By mid-June, all tern nests on the North Breakwater had been abandoned, and few adult terns were present. Only the very earliest hatching tern chicks successfully fledged from this site in 2012, and overall average productivity of the 292 tern nests recorded in the May 18 survey

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was calculated at only 0.1 chicks fledged per nest ([Table 4-2](#)). No tern chicks fledged from this site in 2011 ([Table 4-3](#)). In 2012, a mink was consistently recorded on a motion-triggered monitoring camera during mid-June. In an effort to control the effects of mink depredation on terns, NYSDEC issued a nuisance mink trapping permit. One mink was removed from the North Breakwater on July 25. Mink depredation on the North Breakwater caused most terns to abandon nesting at this site in 2012 and in 2011.

Conversely, early breeding terns on the Old Breakwater North and the Old Breakwater South had excellent chick survivorship. Overall average productivity of monitored nests ranged from 1.6 chicks fledged per nest on the Old Breakwater South to 1.9 chicks fledged per nest on the Old Breakwater North (north end). Across the three enhanced areas of the Old Breakwaters North and South, average productivity was 1.8 chicks fledged per nest ([Table 4-2](#)). This is comparable to the highest productivity ever recorded on the Buffalo Harbor breakwaters in 2011, which was 1.9 chicks fledged per nest ([Table 4-3](#)) ([Riveredge Associates, 2012](#)).

Throughout the breeding season, 4,269 tern chicks were banded on the Buffalo Harbor breakwaters. Of the 4,269 tern chicks banded, 794 did not survive to fledging and were recovered in the colony. These data suggest that the survivorship in 2012 of banded chicks was 81.5%, which is higher than the 76.4% overall survivorship of 2,883 tern chicks banded in 2011 in Buffalo Harbor. These data also suggest that 3,475 tern chicks survived to fledging, which notably is 58% more than fledged in 2011.

In 2011 and 2012, terns continued to breed in Buffalo Harbor later in the summer than ever before. In mid-August there were chicks incapable of flight on the Old Breakwater South, by far the latest recorded date for tern chicks in Buffalo Harbor in 25 years of monitoring.



FIGURE 4-8. MONITORING TERN NESTS ON BUFFALO HARBOR BREAKWATERS

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TABLE 4-2. TERN PRODUCTIVITY ON BUFFALO HARBOR BREAKWATERS 2012

Breakwater	Sections Monitored	Chicks Fledged	Nests	Productivity (chicks fledged per nest)
North Breakwater	1-5	27	292 <sup>1</sup>	0.1
Old Breakwater South	3-6	516	315	1.6
Old Breakwater North (north end)	R1-R4	412	222	1.9
Old Breakwater North (south end cell)	C1, C2, C5, C6	593	323	1.8
Old Breakwater North and South Combined	All Sections	1521	860	1.8

<sup>1</sup> Includes some nests outside the containment frame, all of which failed.

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TABLE 4-3. TERN PRODUCTIVITY ON BUFFALO HARBOR BREAKWATERS 2004-2012

Buffalo Harbor Site <sup>1</sup>	2004	2005	2006	2007	2008	2009	2010	2011	2012
North Breakwater <sup>2, 3, 4</sup>	0.5	0.9	0.9	0.9	0.8	-	0.0	<b>0.0</b>	<b>0.1</b>
Old Breakwater North <sup>2, 3, 5</sup>	0.3	0.5	-	1.4	1.0	<b>1.4</b>	<b>1.6</b>	<b>1.9</b>	<b>1.8</b>
Old Breakwater South <sup>3, 6</sup>	-	0.0	0.5	0.0	0.0	0.0	0.0	<b>1.8</b>	<b>1.6</b>

**Values in bold are post-enhancement by the Common Tern HIP.**

Footnotes:

<sup>1</sup> Data for sites not monitored by Riveredge. Data provided by NYSDEC.

<sup>2</sup> Cells with dashes mean that site was not monitored in detail that year.

<sup>3</sup> Averages include fenced and graveled areas or nesting boxes on breakwaters where installed from 2004 to 2008.

<sup>4</sup> North Breakwater was partially fenced and graveled using five gallon buckets from 2004 to 2008, and again in 2009 and 2010; the south end was fully enhanced and operated by the HIP beginning in 2011.

<sup>5</sup> Old Breakwater North was partially fenced and graveled using five gallon buckets in 2007, 2008, 2009, and 2010; the end cell was fully enhanced and operated by the HIP beginning in 2009; the crest section was fully enhanced and operated by the HIP beginning in 2011.

<sup>6</sup> Old Breakwater South end cell was partially fenced and graveled using five gallon buckets in 2007 and 2008; fully enhanced and operated by the HIP beginning in 2009.

## 5.0 DISCUSSION

The habitat enhancements of the Common Tern HIP were very successful at attracting large numbers of nesting terns to the high quality nesting substrate provided on the Buffalo Harbor breakwaters. The number of tern nests on these sites in 2012 was a new record high, the highest number ever recorded in 25 years of Buffalo Harbor tern nesting monitoring ([Figure 5.1](#)).

Averaged across all sections of the enhanced nesting areas monitored on the Old Breakwater South and the Old Breakwater North, tern productivity ranged from 1.6 to 1.9 chicks fledged per nest. The North Breakwater, however, only produced 0.1 chicks fledged per nest. Photographic evidence from 2012 and trapping from 2011 and 2012 indicates that mink are largely responsible for this poor productivity.

Old Breakwater North continues to be the most productive of the Buffalo Harbor breakwaters. Although tern nesting productivity was good at this site in 2007 and 2008 when partially graveled, it has increased substantially in recent years. Since implementation of the NYPA Common Tern HIP in 2009, both the number of tern nests and the average productivity of these nests have increased dramatically. The newly enhanced habitat of the elevated crest section on the north end of the breakwater did very well in its first year of 2011 with productivity higher than ever previously recorded. In 2012, the productivity at this site was even higher, at 1.9 chicks fledged per nest.

In recent years, weather has played a strong part in the number of chicks fledged per nest on the Buffalo Harbor breakwaters ([Riveredge Associates, 2010, 2011, 2012](#)). In 2010, the only tern chicks that fledged in all of Buffalo Harbor came from nests on the enhanced areas of the NYPA HIP ([Riveredge Associates, 2011](#)). In early 2012, nesting gravel was displaced by strong winter storms. The restoration of this gravel in late March and early April, before terns started nesting, was successful at maintaining high average productivity of terns nesting on the HIP enhancements. In both 2012 and 2011, the containment frames and pea gravel of the NYPA HIP have provided excellent habitat for tern nesting and overall average productivity has exceeded that recorded in previous years.

## Common Tern HIP: 2012 Buffalo Harbor Monitoring

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In 2012 and 2011, camera and trapping evidence identified mink as the predator that is lowering tern breeding success on some enhanced areas of the HIP. The removal of mink contributed to the success of terns nesting at this site, and efforts to further reduce mink depredation on terns could increase productivity rates even further, especially on the North Breakwater. Mink depredation on terns on the North Breakwater has lowered the number of terns attempting to nest there and resulted in much larger numbers of terns nesting on the Old Breakwater South than in previous years.

For the past several years, the annual average productivity values of improved sites on the Buffalo Harbor breakwaters are much greater (1.8 in 2012) than the annual average productivity of 0.3 to 0.4 chicks fledged per nest recorded at most Niagara Frontier tern nesting sites from 1986 to 2003, when most sites did not have added nesting gravel ([Harper and Adams, 2005](#)).

The primary goal of the Common Tern HIP is to provide long-term stable substrate that can be used by terns for many years with little maintenance. The containment frames constructed in spring 2009 and fall 2010 showed no damage from winter storms in 2010, 2011, and 2012. The gravel in the containment frames was only slightly displaced by winter storms in 2011, but major displacement occurred prior the 2012 nesting season. Nonetheless, the gravel remaining in spring 2012 was redistributed without replenishment or the use of heavy machinery, and a sufficient minimum depth of gravel was available for the 2012 breeding season.

In total, the Common Tern HIP created over 10,000 square feet of improved tern nesting habitat on the Buffalo Harbor breakwaters. Monitoring of tern nesting on these improved nesting areas started in 2011 and will continue for five years through 2015 ([Kleinschmidt Associates and Riveredge Associates, 2012b](#)). After these five years of nest monitoring, the structures of the HIP will be monitored annually for maintenance and repair ([Kleinschmidt Associates and Riveredge Associates, 2012a](#)).

Since the initial Common Tern HIP enhancement in 2009, the majority of tern chicks fledged from the Buffalo Harbor breakwaters did so from nests on the gravel provided by the Common Tern HIP. These birds will migrate to Central and South America during the winter

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and return to the Buffalo Harbor breakwaters in future years to breed. The Common Tern HIP will provide critically needed high quality nesting habitat for these birds and assist with the recovery of this state-listed threatened species.

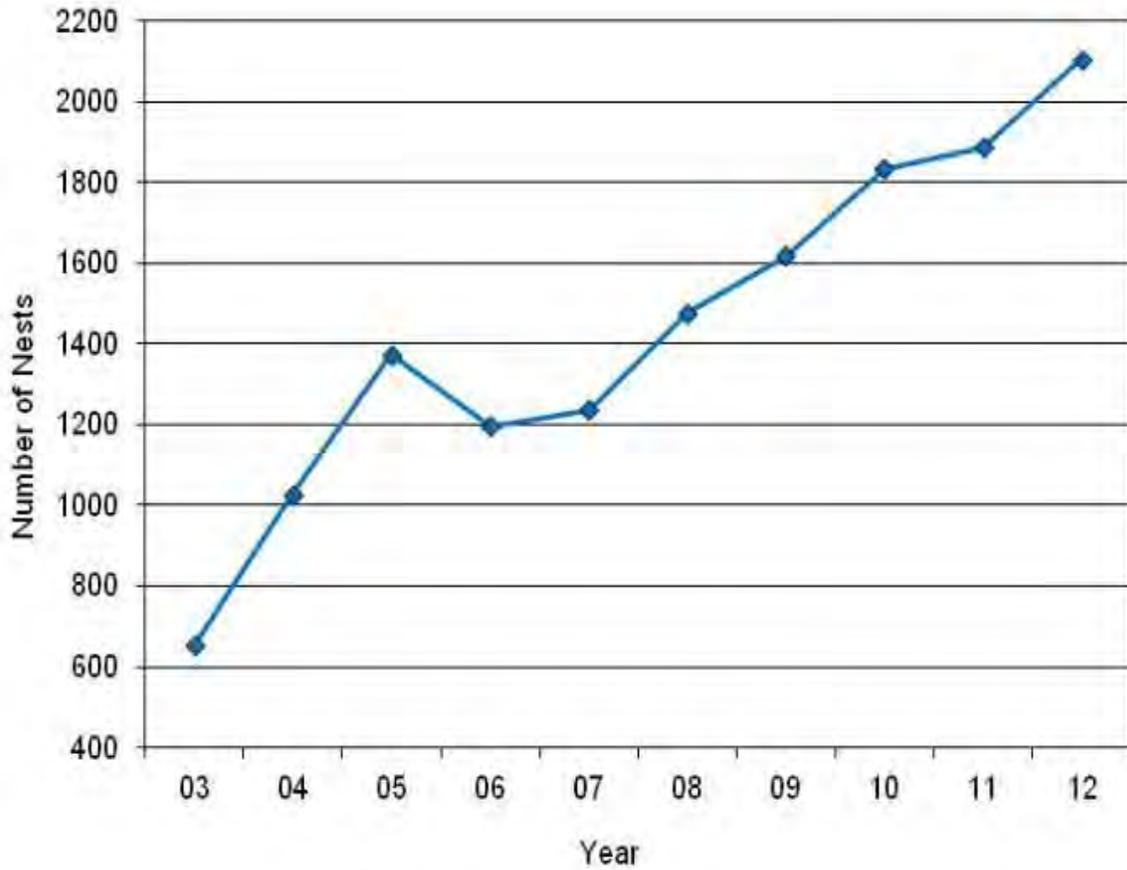


FIGURE 5-1. NUMBER OF TERN NESTS ON BUFFALO HARBOR BREAKWATERS OVER LAST TEN YEARS (2003-2012)

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