New York City Department of Environmental Protection
Bureau of Water Supply

Waterfowl Management Program

September 30, 2014

Prepared in accordance with the Final Revised 2007 FAD (Waterfowl Management Program-Section 4.1) of the United States Environmental Protection Filtration Avoidance Determination

A Waterfowl Management Program was developed to evaluate and mitigate pollutant impacts (fecal coliform bacteria) from migratory and resident waterbirds (waterfowl, gulls and cormorants). The purpose of the study reported here, for the period April 1, 2013 to March 31, 2014, is to evaluate further the trends observed in bird numbers and their effect on fecal coliform bacteria levels as a consequence of DEP's Waterfowl Management Program.

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Division of Watershed Water Quality Operations

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INTRODUCTION

The management of waterbird populations at key reservoirs throughout the New York City Water Supply is essential to meet stringent water quality regulations as stated in the Environmental Protection Agency's (USEPA) Surface Water Treatment Rule (SWTR) (USEPA 1989). As a result, DEP developed and implemented a comprehensive Watershed Protection Program to protect its water supply and as a requirement of Filtration Avoidance Determinations received by USEPA and NYSDOH. A component of the Watershed Protection Plan is DEP's Waterfowl Management Program (WMP) which was established to research and manage the relationship between wildlife, particularly waterbirds (geese, gulls, cormorants, swans, ducks, and other duck-like birds) that inhabit the reservoirs and fecal coliform bacteria elevations in the untreated surface water. The Waterfowl Management Program, originally developed for NYC's Kensico Reservoir in 1992, was expanded to include five additional reservoirs for waterbird management under the November 2002 Filtration Avoidance Determination (FAD) (Section 4.1 – Waterfowl Management Program). The 2007 FAD (USEPA 2007) further expanded program to include bird management at Hillview Reservoir in Yonkers, New York. The Final Revised 2007 FAD Report was released in May 2014.

The WMP was designed to study the relationship between seasonal trends in bird populations on the reservoirs as well as trends in fecal coliform concentrations both within the reservoir and at the keypoint water sampling locations. Following several years of waterbird population monitoring, DEP's scientific staff consisting of wildlife biologists and microbiologists identified birds as a significant source of fecal coliform at the Kensico Reservoir (DEP 1993). In response, DEP developed and implemented a Waterfowl Management Program using standard bird management techniques (approved by the United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (USDA) and the New York State Department of Environmental Conservation (NYSDEC) to reduce or eliminate the waterbird populations inhabiting the reservoir system (DEP 2002). DEP has also acquired depredation permits from the United States Fish & Wildlife Service (USFWS) and NYSDEC to implement some management techniques. Since the initial implementation of DEP's bird dispersal and deterrent techniques in 1993 there has been a significant reduction in both bird populations and fecal coliform levels, thus maintaining high quality water in compliance with the SWTR.

Migratory populations of waterbirds utilize NYC reservoirs as temporary staging areas and wintering grounds and therefore can significantly contribute to increases in fecal coliform loadings in the reservoirs during the autumn and winter primarily from direct fecal deposition. These migrant waterbirds generally roost nocturnally and occasionally forage and loaf diurnally on the reservoirs, however, it has been determined that most of the feeding activity occurs away from the reservoir. Fecal samples collected and analyzed for fecal coliform bacteria

concentrations from both Canada Geese (*Branta canadensis*) and Ring-billed Gulls (*Larus delawarensis*) revealed that fecal coliform concentrations are high per gram of feces (Alderisio and DeLuca 1999). Water samples collected near waterbird roosting locations have shown fecal coliform increases concurrent with waterbird populations at several NYC reservoirs in previous DEP reports (DEP 1993 - 2013). Since waterbirds have been associated with elevated fecal coliform bacteria levels found in various reservoirs and lakes (Gould and Fletcher 1978, Hussong et al 1979, Standridge et al 1979, Benton, et al 1983, DEP 1992 and 1993, Levesque et al 1993), a program to discourage waterbird activity was developed for Kensico Reservoir in the autumn of 1993 and is expected to continue indefinitely. The bird dispersal program was expanded in 2004 to allow for "as-needed" waterbird management at five (Rondout, West Branch, Ashokan, Croton Falls, and Cross River). Since that time, the "as-needed" program has been implemented a total of six times with actions at Rondout Reservoir during the winters of 2002/2003, 2003/2004 and 2005/2006, West Branch Reservoir in 2007 and 2010/2011, and at Croton Falls Reservoir during the winter of 2001/2002. To assure DEP's program activities remained in compliance with all federal, state, and local laws including effects on local environmental conditions including endangered species, an Environmental Impact Statement was completed for Kensico in 1996 and another one in the spring of 2004 for the five additional "as-needed" reservoirs. A Final Environmental Impact Statement including a "findings statement" can be found on the DEP website identifying program impacts and required mitigation to meeting implementation standards for the expanded WMP. This report is a requirement of the current Final Revised 2007 FAD.

The purpose of this report is to evaluate further the down-trend observed in waterbird populations and its impact on fecal coliform bacteria concentrations as a consequence of DEP's Waterfowl Management Program for the period April 1, 2013 through March 31, 2014.

METHOD S

Waterfowl Management Program

The Waterfowl Management Program was initiated in 1993 by the City for the Kensico Reservoir in response to elevated coliform bacteria levels contained in the Reservoir. DEP determined the water leaving Kensico reported higher levels of bacteria than the water entering Kensico from source reservoirs and as a result focused on identifying and mitigating local inputs of bacterial pollution. Preliminary waterbird surveys conducted by DEP staff in 1992 demonstrated a seasonality effect with increased numbers of roosting birds and elevated fecal coliform bacteria levels. By December 1993, DEP started a daily bird dispersal program that evolved into a tri-season effort from August through March annually. The program was subsequently expanded to include additional reservoirs.

The 2002 FAD required that the City continue this program for the Kensico Reservoir on a routine basis and expand the program to an "as-needed" basis for five additional reservoirs. Three of these five reservoirs (West Branch, Rondout, and Ashokan) routinely provide Kensico with its source water. The remaining two (Cross River and Croton Falls), while in the Croton System, may also provide Kensico with source water under certain conditions and with permission from the New York State Department of Health. The objective of the program is to minimize the fecal coliform loading to the reservoirs that result from roosting birds during the migratory season. The program includes three activities: avian population monitoring, avian harassment activities (motorboats, airboats, cannons, physical chasing, and pyrotechnics) and avian deterrence (depredation of nests and eggs, bird exclusion wires, and netting at critical intake chambers). All avian harassment techniques and deterrence activities have been approved by USDA and NYSDEC.

The City's 2006 Long-Term Watershed Protection Program expanded the Waterfowl Management Program to an "as-needed" basis to include avian harassment activities for the Hillview Reservoir as well as avian deterrent measures for Hillview and other City reservoirs. The term "as-needed" refers to implementation of avian management measures based on the following criteria:

- fecal coliform bacteria concentrations approaching or exceeding 20 colony-forming units per 100 milliliters at reservoir effluent structures coincident with elevated bird populations;
- current bird populations, including roosting or staging locations relative to water intakes;
- recent weather events;
- operational flow conditions within the reservoir (i.e. elevations and flow patterns and amounts);
- reservoir ice coverage and watershed snow cover; and
- an assessment that active bird management measures would be effective in reducing bird

populations and fecal coliform bacteria levels.

The Final Revised 2007 FAD requirements for the Waterfowl Management Program are outlined in Table 1, below.

Table 1. Final Revised 2007 FAD Activity and Reporting Requirements

Requirements	Due Date
Active Bird Harassment – Kensico Reservoir	Annually , 8/1 to 3/31
Active Bird Harassment – Hillview Reservoir	Year-around
"As-needed" bird harassment – West Branch, Rondout, Ashokan, Croton Falls, and Cross River Reservoirs.	Annually, 8/1 to 4/15
"As-needed" bird deterrent measures – Kensico, West Branch, Rondout, Ashokan, Croton Falls, Cross River, and Hillview Reservoirs.	Year-round
Report Description	**Due Date**
Summary of Waterfowl Management Program activities for all reservoirs, including contract status.	Annually, 9/30

Waterfowl Management Program Contract Status

The current Waterfowl Management Program Contract (WMP-12) is a three year contract for services provided by Henningson, Durham, and Richardson, P.C. (HDR) of Pearl River, New York for the term of September 18, 2011 through September 17, 2014 with a partial year renewal through July 31, 2015.

Waterbird Census

The relationship between elevated waterbird counts and increased levels of fecal coliform bacteria identified from raw water samples is well established. New York City reservoirs, situated in southeastern New York State, lie in the Atlantic Flyway; an important migratory pathway for many groups of birds including waterbirds. The NYC reservoirs may offer important areas of open water used for night roosting, foraging, winter stop-overs, and breeding habitat for some waterbirds species. Since it has been well documented that the primary bacterial contribution to the water supply is from night-roosting and migratory birds defecating in the reservoirs, night census data is presented throughout this report. Defecation rates of waterbirds are typically lower nocturnally than diurnally due to reduced foraging and physical activity, however overnight roosting involves longer periods of time the birds habituate on the

reservoirs (DEP 1993).

Daily waterbird observations were conducted at predawn hours (between 4:30am and 8:00am E.S.T.) and post dusk hours (between 5:00pm to 10:00pm E.S.T.) to determine overnight waterbird roosting populations and to evaluate the success of the hazing activities from the previous day (where applicable) at all reservoirs. Survey times vary seasonally reflecting available daylight hours. For successful data collection, ideal weather and atmospheric conditions were necessary. Precipitation events and fog prohibited data collection and resulted in short gaps of "no data". Reservoir maps with bird zones can be found in Appendix A.

The July 2007 FAD, Section 4.1 specifies the frequency of reservoir surveys and is listed in Table 2. In May 2013 NYSDOH approved DEP's request to reduce bird survey for West Branch, Rondout, Ashokan, Croton Falls, and Cross River Reservoirs. To fulfill the NYSDOH request that DEP continue to monitor populations of birds that are roosting or staging in close proximity to reservoir intakes, DEP performed bird population observations at Rondout, Ashokan, and West Branch Reservoir effluent chambers during routine site visits by Aqueduct Monitoring staff in the form of un-aided (i.e., without binoculars) observations on a weekly basis. Proposed and actual contractor surveys conducted from April 1, 2013 to March 31, 2014 are also listed in Table 2.

Table 2. Frequency of bird observation surveys by reservoir 2013/2014 (as listed under the November 2002 FAD, Section 4.1).

Reservoir	Bird Surveys Scheduled	Proposed/Actual Surveys
Kensico	Pre-dawn to post-dusk daily August 1 to March 31; Pre-dawn and post-dusk weekly April 1 to July 31	264/258[1,2]
West Branch	Pre-dawn, midday, and post-dusk weekly April 2013; changed in May 2013 to biweekly August 1 to April 15 annually	20/20
Rondout	Pre-dawn, midday, and post-dusk weekly April 2013; changed in May 2013 to "as-needed"	4/4
Ashokan	Pre-dawn, midday, and post-dusk weekly April 2013; changed in May 2013 to "as-needed"	4/4
Croton Falls	Pre-dawn, midday, and post-dusk biweekly April 2013; changed in May 2013 to "as-needed"	2/2
Cross River	Pre-dawn, midday, and post-dusk biweekly April 2013; changed in May 2013 to "as-needed"	2/2
Hillview	Pre-dawn, midday, and post-dusk daily all year	365/362[2]

[1]A total of three surveys were cancelled due to holiday observances.
[2] A total of three surveys were cancelled due to severe winter storms on 1/13/14, 2/13/14, and 2/14/14.

Reservoir-wide observational surveys for waterbirds were conducted year-round at Kensico and Hillview Reservoirs (Table 2). On January 17, 2013, DEP requested that the New York State Department of Health (NYSDOH) approve a reduction in in routine waterbird population monitoring since fecal coliform levels, rather than data from routine bird counts, are used as the primary trigger for initiating "as-needed" waterfowl management actions at Rondout, Ashokan, Croton Falls, Cross River and West Branch. DEP's request was approved by NYSDOH on March 13, 2013, and West Branch surveys went from weekly to biweekly from August 1 through April 15 annually and on an "as-needed" basis for the remainder of the year, and surveys went to "as-needed" for Rondout, Ashokan, Croton Falls, and Cross River Reservoirs.

Each survey recorded species evenness (number per species), species richness (species diversity), roosting and foraging locations, flight patterns into and out of the reservoir, bird band/collar identifications, and general behavior during the overnight roosting period. Waterbird data are collected from shoreline locations and/or watercraft (motorboat, Jon boat, or airboat) by a wildlife biologist, ornithologist, or wildlife technician using binoculars and spotting scopes. DEP developed field data sheets to record observation locations with times for each reservoir. Data is entered in an Excel spreadsheet and is checked twice for Quality Assurance/Quality Control.

Each survey data point can consist of a minimum of one or two site visits per datum reported (i.e. night before and morning after the nightly roost), and is dependent on the field conditions (i.e. weather, fog), reservoir physical characteristics (i.e. drought), and time of year (leaf-cover or not). Data collected during reservoir-wide surveys that were incomplete due to inclement weather were not recorded. Only high counts for each category of waterbirds are used for data recording. For example, if there was a count of 20 Canada Geese at a bird observation location and zero for the rest of the reservoir for the night before count and a count of 20 ducks at another location on the morning after survey, a combination of 20 geese and 20 ducks would give a reservoir-wide total of 40 birds. The purpose of using two surveys for data collection is ascertaining species highest concentrations over a specific time period. Some species at certain times of the year are easier to count at night when birds are flying into roost areas (or open water) in the evening whereas other species are easier to count when flying out of the reservoir in the early morning.

Waterbird population zones were delineated at all reservoirs to identify local impacts on water quality and have been described in previous DEP reports for Kensico and West Branch (DEP 1994, 1995, 1997a).

Data reported on fecal coliform bacteria concentrations for both keypoint raw water outflow samples (aqueduct and outflows) and reservoir samples have been reviewed by DEP laboratory and field personnel. The following conditions apply to the water quality data reported:

- Only high concentration duplicate samples are reported (for example if two keypoint samples were collected in a single day, or if more than one sample is collected at different depths at a single limnology sampling location, the highest bacteria count has been used for charting)

- All special investigation samples are reported
- Reanalysis samples are reported
- There were no samples with confluent growth reported

Fecal Coliform Bacteria Data

Water quality data presented in this report were collected by DEP's Watershed and Distribution Water Quality Operations personnel and analyzed and reported by four DEP New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) certified Laboratories in Valhalla, Kingston, Grahamsville, and Queens, New York. Watershed DEP Laboratory personnel utilized the Membrane Filtration Technique for fecal coliform analyses. DEP's Distribution Laboratory personnel utilized the Colilert18 with Quantitray for *E.coli* analyses for samples collected at Hillview Reservoir. Reservoir-wide waterbird survey results are presented with fecal coliform bacteria levels at keypoint (outflow) and reservoir sampling areas.

Precipitation Data

Precipitation data used in this report for the Kensico Reservoir and West Branch Reservoir were collected by DEP's BWS Operations Directorate staff from meteorological stations located at the respective reservoir effluents (reference EKM220, Valhalla for Kensico).

Waterbird Dispersal and Deterrent Techniques

The list of bird dispersal activities conducted since 2002 is presented in Table 3. Waterbird dispersal techniques were employed at Kensico Reservoir from August 1, 2013 through March 31, 2014 using motorboats, airboats, Jon boats, and noisemakers (pyrotechnics include bird bangers, screamers, and CAPA's). Pyrotechnics, physical chasing, propane cannons, and remote-control motorboats were used as deemed necessary on a daily basis year-around at Hillview Reservoir during this reporting period. Dispersal techniques were conducted under a DEP Waterfowl Management Program contract (WMP-12) and by DEP staff. The Kensico program is a permanent bird hazing program conducted between August 1 and March 31 annually and the Hillview program is a daily, year-around program. Beginning at 8:00am and continuing until approximately 1.5 hours past sunset, bird hazing activities were conducted reservoir-wide, targeting all species except those with a federal or NYS endangered or threatened status such as N.Y.S. threatened Pied-billed Grebe (*Podilymbus podiceps*) and Bald Eagle (*Haliaeetus leucocephalus*), and N.Y.S endangered Peregrine Falcon (*Falco peregrinus*).

Airboats were available for bird harassment in 2013/2014 at Kensico, capable of operating over ice and water interfaces with ease. The airboats also have heated cabins which provide longer time periods of bird hazing opportunities (watercraft harassment and pyrotechnic use) during reservoir freezing periods throughout the winter. In addition, a contract has been continued with USDA to conduct lethal management of the resident duck population at Hillview Reservoir. Details of the contract work will be discussed in the Hillview Reservoir section of

this report.

Table 3. Reservoir bird mitigation (April 1, 2013 - March 31, 2014).

Reservoir	Dates of Bird Harassment and Deterrence	Bird Harassment and Deterrence Measures Used
Kensico	August 1, 2013 – March 31, 2014	Bird harassment (motorboats, airboats, Jon boats, and pyrotechnics), shoreline meadow management and fencing, Alewife collections, and maintenance of bird netting for terrestrial bird management (swallows, starlings, pigeons, etc.)
Hillview	April 1, 2013 - March 31, 2014	Bird deterrent overhead wire system, bird harassment (pyrotechnics, propane cannons, physical chasing, remote control motorboats), small mammal management, Alewife (baitfish) collections, maintenance of bird netting for terrestrial bird management (swallows, sparrows, etc.), bird deterrent wires on shaft buildings and on dividing wall railings, swallow and sparrow depredation, and lethal duck management

A number of bird deterrent techniques continue to be maintained throughout the upstate reservoirs while newly installed equipment at Hillview Reservoir continues to improve the success of diverting waterbirds and terrestrial avian species from inhabiting the surface water. Such measures include an overhead bird deterrent wire system and dividing wall bird exclusion wire system at Hillview, bird netting covering effluent building intake openings, and removal of baitfish entering from aqueducts.

The other five reservoirs included in this report are covered under the "as-needed" section for the expanded reservoirs. Detailed descriptions are listed below in Table 3 by reservoir.

In response to entrainment of Alewives (*Alosa pseudoharengus*) and other fish species into the water intake structures at Ashokan Reservoir and their subsequent outflow at Kensico Reservoir, DEP's Waterfowl Management contractor installed a temporary collection boom as deemed necessary around the Catskill Influent structure (CATIC) so that dead fish can be removed. Collection of Alewives is also conducted as-needed at Hillview Reservoir using landing nets from the reservoir dividing wall. Alewives and other bait-sized fish are an attractive food source for avian piscivorous species such as gulls and some species of ducks (Common Merganser (*Mergus merganser*) and when large numbers of fish are flushing into the reservoir, making the birds very difficult to manage.

Waterbird Reproductive Management

Canada Geese and Mute Swan egg and nest depredation techniques were conducted during the spring of 2013 to help reduce fecundity at critical NYC reservoirs (Table 4). Mallard (*Anas platyrhynchos*) nests at Hillview Reservoir were depredated under a USDA federal depredation permit. Other mitigative actions included Canada Geese reproductive maintenance of meadow vegetation (Kensico and Rondout) and shoreline fences (Kensico), where applicable to deter access to the reservoir by flightless birds during the annual molt period. Egg and nest-depredation involved locating all Canada Geese and Mute Swan (*Cygnus olor*) nests within NYC reservoir property, numbering each nest and egg, and puncturing each egg with a probe to break the membranes thereby destroying the embryo. Eggs were then replaced in the nest to allow incubation to continue, but unsuccessfully without development. A small number of goose nests are often destroyed late in the breeding season to encourage the birds to relocate off reservoir property during the annual post-nuptial molt when the birds are rendered flightless for a few weeks.

A total of 52 Canada Geese nests containing 247 eggs were depredated (punctured) at six New York City Reservoirs (Table 4) during the spring of 2013 compared to 51 nests and 253 eggs in the previous year. There was no goose or swan breeding activity recorded at Hillview, however 2 Mallard nests containing 14 eggs were depredated by DEP. All Canada Geese depredation activity was conducted under the terms of Federal Permit (#RG-01040A) from the United States Department of the Interior, United States Fish & Wildlife Service. A NYSDEC permit (#3-14-46) was acquired for Mute Swans egg and nest depredation and a USFWS Permit (MB789947-0) covered Mallard depredation work at Hillview.

DEP did not conduct Canada Geese or Double-crested Cormorant banding in 2013 during this reporting period.

Table 4. 2013 Canada Geese, Mute Swan, and Mallard[2] nest census and egg-depredation.

Reservoir	Number of Surveys	Canada Geese/Mute Swan/[2]Mallard Nests	Canada Geese/Mute Swan/[2]Mallard Eggs Depredated	Canada Geese/Mute Swan/Mallard Depredation Success Rate
Kensico	8	16/0/NA	81/0/NA	96 percent (3 goslings)/NA/NA
West Branch	4	7/0/NA	35/0/NA	100 percent (0 goslings)/NA/NA
Rondout[1]	3	7/0/NA	27/0/NA	75 percent (9 goslings)/NA/NA
Ashokan	3	4/0/NA	17/0/NA	100 percent (0 goslings)/NA/NA
Croton Falls	4	13/2/NA	64/11/NA	100 percent (0 goslings) /NA/NA
Cross River	3	5/0/NA	23/0/NA	82 percent (5 goslings)/NA/NA
Hillview	122	0/0/2	0/0/14	NA/NA/ 70 percent (6 ducklings)

[1] Nest depredation for Canada Geese was restricted due to nesting Bald Eagles.
[2] Mallard nest depredation only conducted at Hillview Reservoir.

RESULTS and DISCUSSION

1. Kensico Reservoir

Kensico Reservoir, a terminal reservoir in the New York City Water Supply System, receives water from Rondout and West Branch Reservoirs via the Delaware Aqueduct and from the Ashokan Reservoir via the Catskill Aqueduct (Figure 44 and 45). Water leaving Kensico is disinfected with chlorine and ultraviolet light (began in October 2012) prior to being delivered via aqueduct to Hillview Reservoir (Figure 46). Kensico Reservoir has been divided into eight Bird Zones to compare bird counts with water quality in samples collected at limnological sampling locations (Figure 46). Waterbird numbers at Kensico Reservoir remained consistently low throughout the reporting period as a result of continued implementation of the Waterfowl Management Program (Figure 1). The geographic configuration of Kensico includes two main open water areas; one in Bird Zone 4 and one in Bird Zone 6 (Figure 46). These open water areas tend to attract concentrations of gulls roosting overnight.

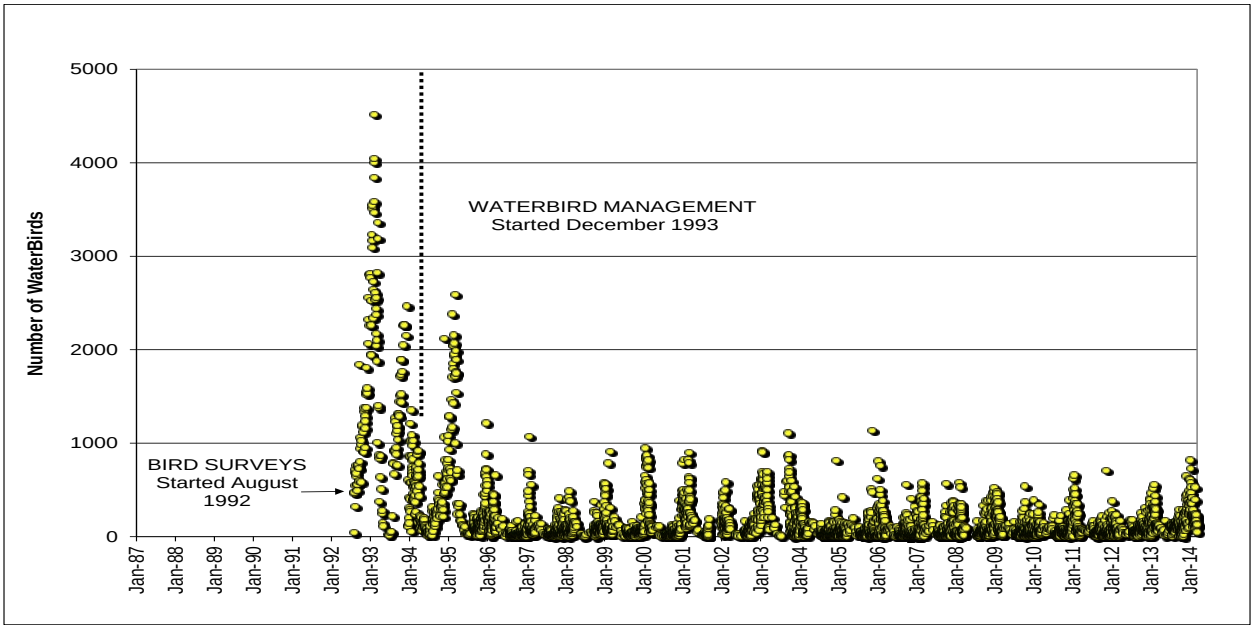

Figure 1. Kensico Reservoir waterbird totals.

Prior to implementing a formal bird harassment program, DEP began collecting bird census data in August of 1992. Bird counts reached several thousand during the migratory/wintering period (Figure 1) with high bird roosting counts recorded at the water intake coves at Kensico. Figure 1 shows a dramatic decline in bird counts from several thousand in 1993 to a few hundred during the same migratory period in recent years with bird harassment techniques employed. Fecal coliform bacteria show a dramatic decline simultaneous with the commencement of the bird harassment efforts in December 1993, and this observation (or effect) continues through the present day (Figure 2).

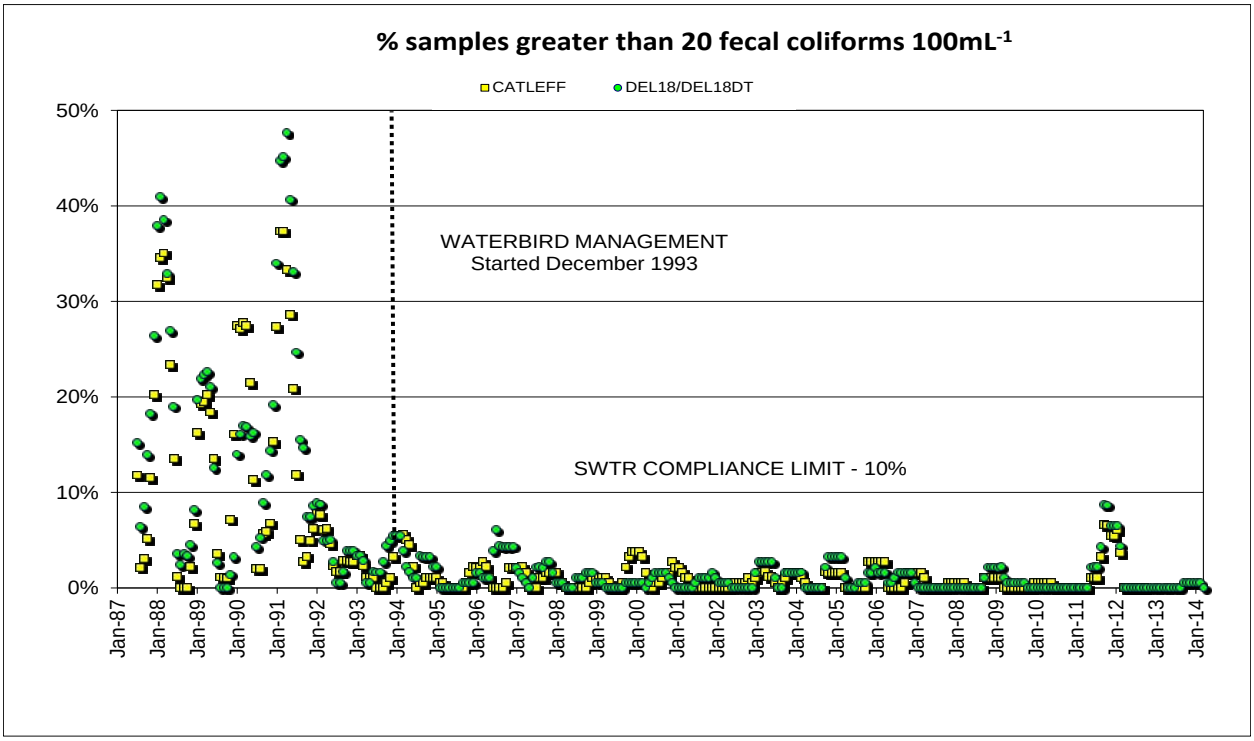

Figure 2. Kensico Reservoir Surface Water Treatment Rule compliance (fecal coliforms 100mL^{-1} at DEL18/DEL18DT and CATLEFF).

The WMP continued to maintain a high level of success from April 1, 2013 through March 31, 2014 managing waterbirds at Kensico Reservoir. Resident and migratory waterbird populations were kept at low levels (Figure 1); a result of implementing bird dispersal activities (Figure 3).

Figure 3. DEP contractor discharging pyrotechnics for bird dispersal activities at Kensico Reservoir.

Figures 4 and 5 compare the regulatory source water samples collected from Delaware Shaft 18 (DEL18DT) with respect to fecal coliform bacteria and reservoir bird counts for the 2011/2012 and 2012/2013 seasons.

In 2013 a coliform-restricted assessment based on compliance of the SWTR for Kensico Reservoir determined that the basin status was 'non-restricted', as was the case in 2012 (DEP 2014). From April 1, 2013 through March 31, 2014 the percentage of source water sample results at DEL18DT above 20 fecal coliforms $100mL^{-1}$ over the previous 6 months was 0 percent from April 2013 to August 2013, 0.5% from September 2013 through February 2014 and back to 0 percent in March 2014. During the current reporting period there were 5 double digit fecal coliform counts ranging from 10 to 34 fecal coliforms $100mL^{-1}$ that were likely associated with precipitation events of more than one inch recorded in the previous three days (Table 4). Only one fecal coliform bacteria sample (34 fecal coliform $100mL^{-1}$ recorded on September 13, 2013 exceeded the SWTR limit of 20. More than 1 inch of rain was recorded at the Westchester County Airport sampling station (EKM220) during the three days prior and probably associated with the bacterial elevation. There were no waterbirds observed in Bird Zone 2 cove, closest to the DEL18DT sampling site and 115 Gull Spp. and 6 ducks recorded in Bird Zone 4 on September 13, 2013. For comparison, overnight bird counts recorded from September 13, 2014 through October 13, 2013 in Bird Zone 4 averaged 106 gulls and no associated fecal coliform bacteria elevation. The month of October is often associated with an increase in migratory flights of gulls to Kensico and surrounding areas. For comparison purposes, there were no samples collected from DEL18DT that exceeded 20 fecal coliform $100mL^{-1}$ in the 2012/2013 reporting period (Figures 5 and 6).

Table 5. Double-digit (>=10) fecal coliform $100mL^{-1}$ results, precipitation events, and bird counts at Kensico Reservoir keypoint water sampling location (DEL18DT).

Date	**DEL18DT fecal coliform $100mL^{-1}$** (Bold indicates more than 20 fecal coliform $100mL^{-1}$)	**Precipitation within 3 days of elevated fecal coliform >=10 fecal coliform 100 mL^{-1} (inches rounded to the nearest 100^{th})[1]**	**Bird Counts on or before sample date**	
			Reservoir-wide totals	**Bird Zones 2, 3, and 4 totals (closest to the DEL18DT Effluent)**
5/26/2013	12	2.16	69 on 5/22/13	29 on 5/22/13
5/29/13	10	0.39	12	5
7/2/13	10	1.45	23 on 6/26/13	16 on 6/26/13
9/13/13	**34**	1.26	149	121
11/28/13	10	3.70	142	15

[1] Precipitation data reported from Kensico Reservoir (sampling site reference EKM220), Valhalla, New York

Reservoir-wide waterbird counts remained relatively low but slightly higher when compared to counts conducted during the same time period in 2012/2013. In 2013/2014 (April 1, 2013 to March 31, 2014) overnight waterbird counts averaged about 172 birds per survey night and spiked at 822 (271 geese, 70 gulls, and 481 ducks) on January 27, 2014 compared to an average of 113 birds/night in 2012/2013 (Figures 6 and 7).

In Bird Zone 2, closest to Delaware Shaft 18 (DEL18DT), waterbirds were observed 44 times in 2013/2014 of which 36 of those observations occurred during the bird harassment period and were largely attributed to extensive ice cover and flocks of ducks arriving overnight past the normal hours of operation for bird dispersal activities. All birds in the water intake cove (Bird Zone 2) observed during the pre-dawn period are immediately dispersed using motorboat hazing actions. A high count of 190 ducks was observed in Bird Zone 2 on January 27, 2013 but was not associated with a fecal coliform bacteria elevation (Figure 8). Waterbird surveys in Bird Zone 3, adjacent to the Bird Zone 2 cove revealed only 7 occasions when birds were present out of 258 survey days. A high count of 9 ducks was recorded on April 3, 2013 and 9 Canada Geese was recorded on January 13, 2014 (Figure 9). Bird counts spiked at 278 ducks recorded on January 29, 2014 in Bird Zone 4 whereas the high count of gulls reached 268 on October 13, 2014 (Figure 10). Waterbirds remained at '0' for overnight counts from February 7, 2014 to March 10, 2014 mostly in response to extensive reservoir icing.

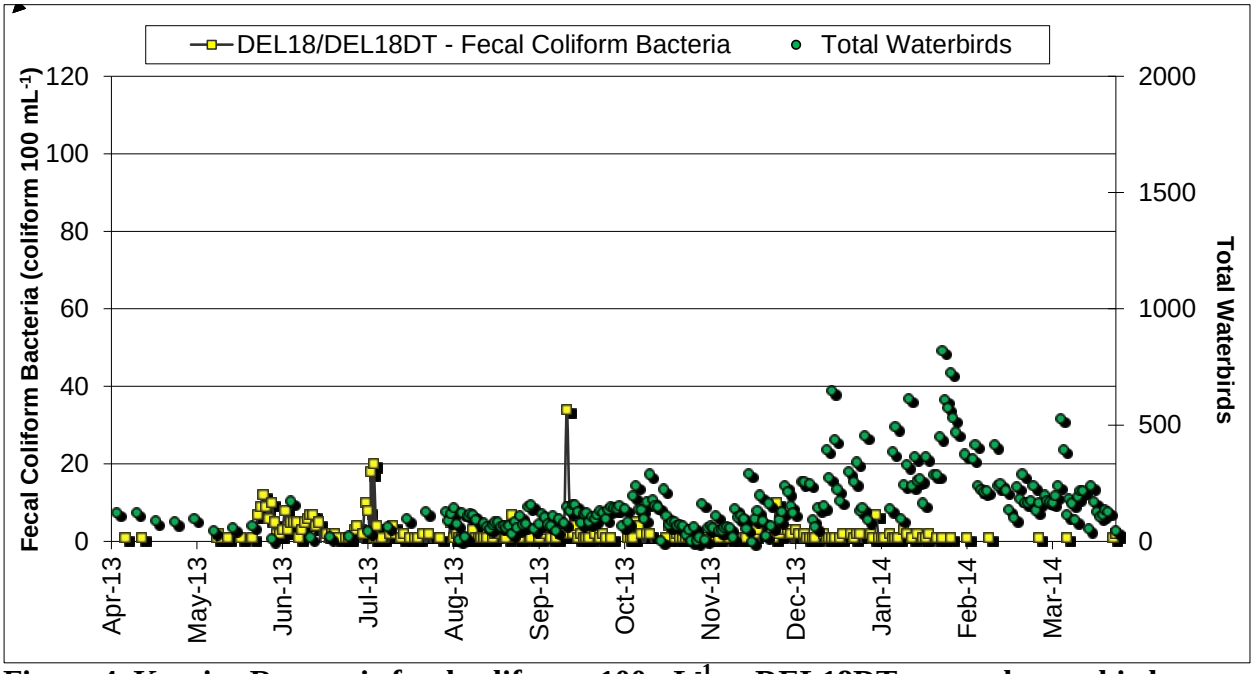

Figure 4. Kensico Reservoir fecal coliforms 100mL^{-1} at DEL18DT vs. total waterbirds (4/1/2013 to 3/31/2014).

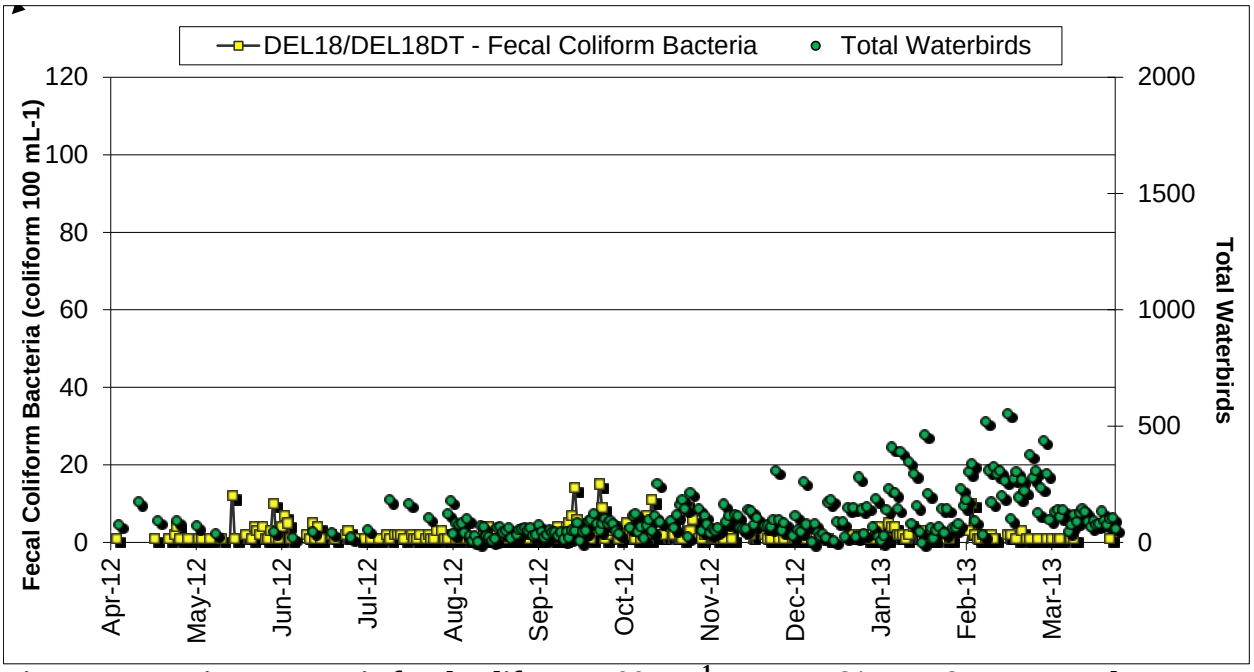

Figure 5. Kensico Reservoir fecal coliforms 100mL^{-1} at DEL18/DEL18DT vs. total waterbirds (4/1/2012 to 3/31/2013).

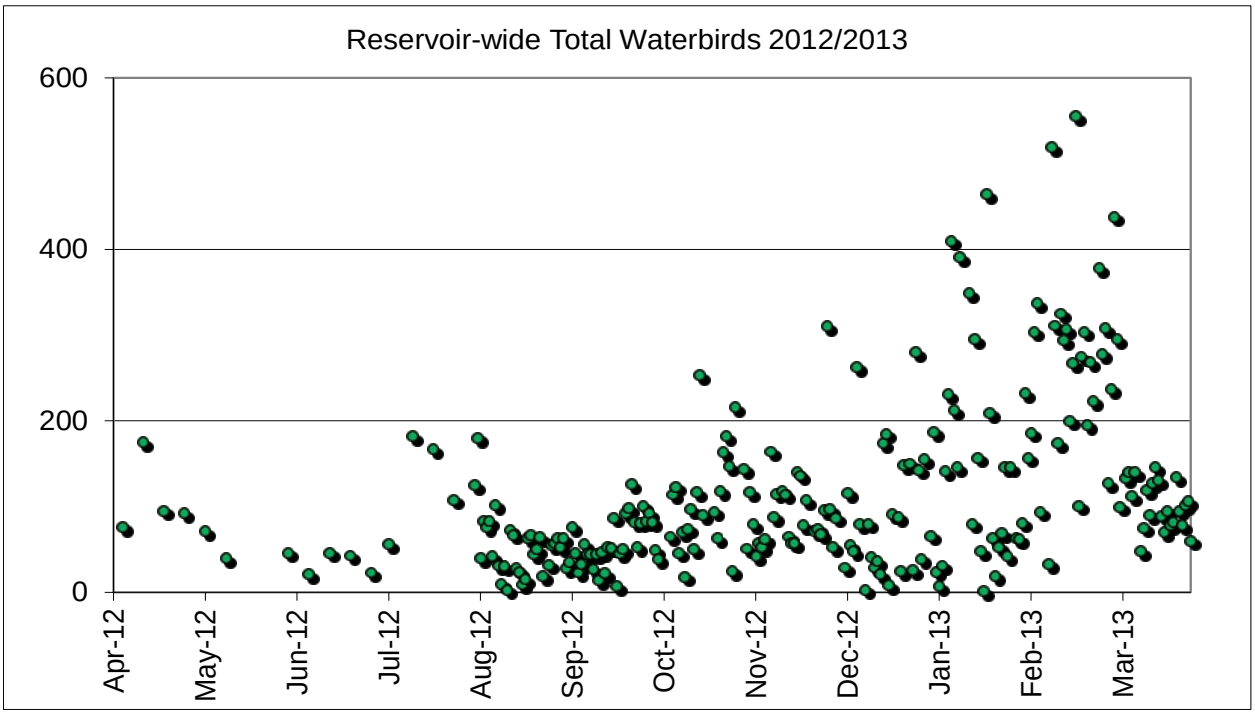

Figure 6. Kensico Reservoir total annual waterbirds (4/1/2012 to 3/31/2013).

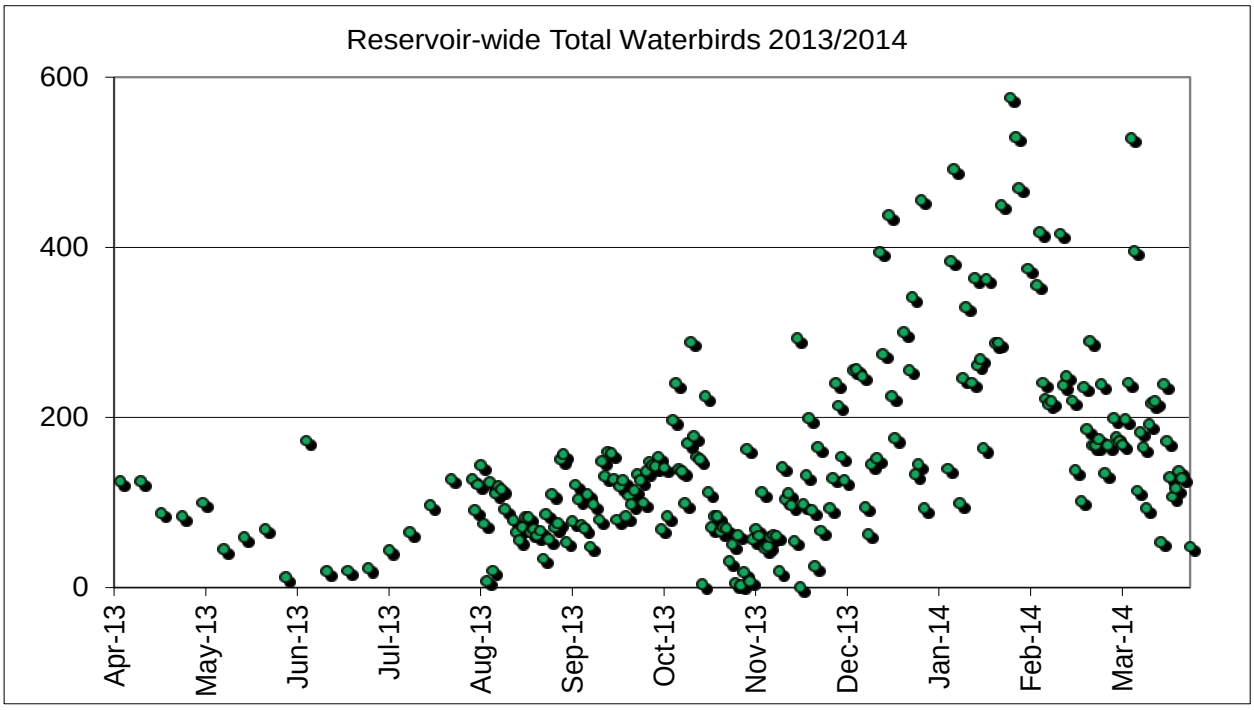

Figure 7. Kensico Reservoir total annual waterbirds (4/1/2013 to 3/31/2014).

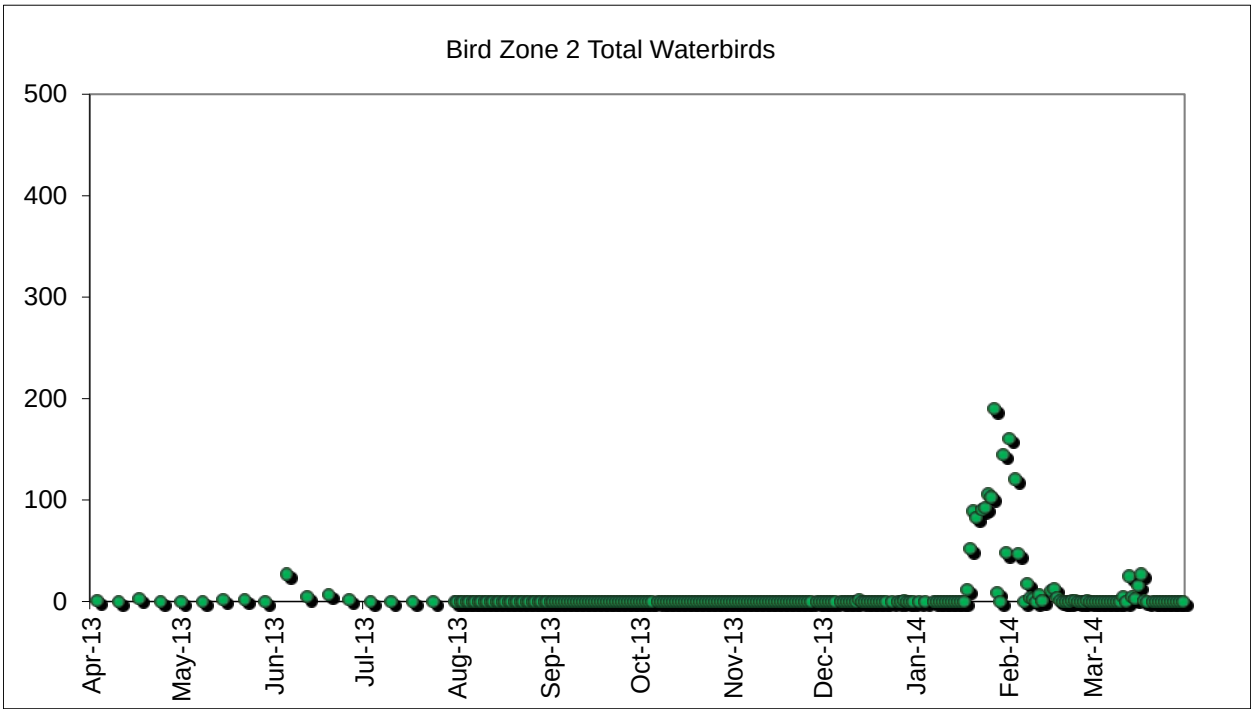

Figure 8. Kensico Reservoir Bird Zone 2 waterbirds (4/1/2013 to 3/31/2014).

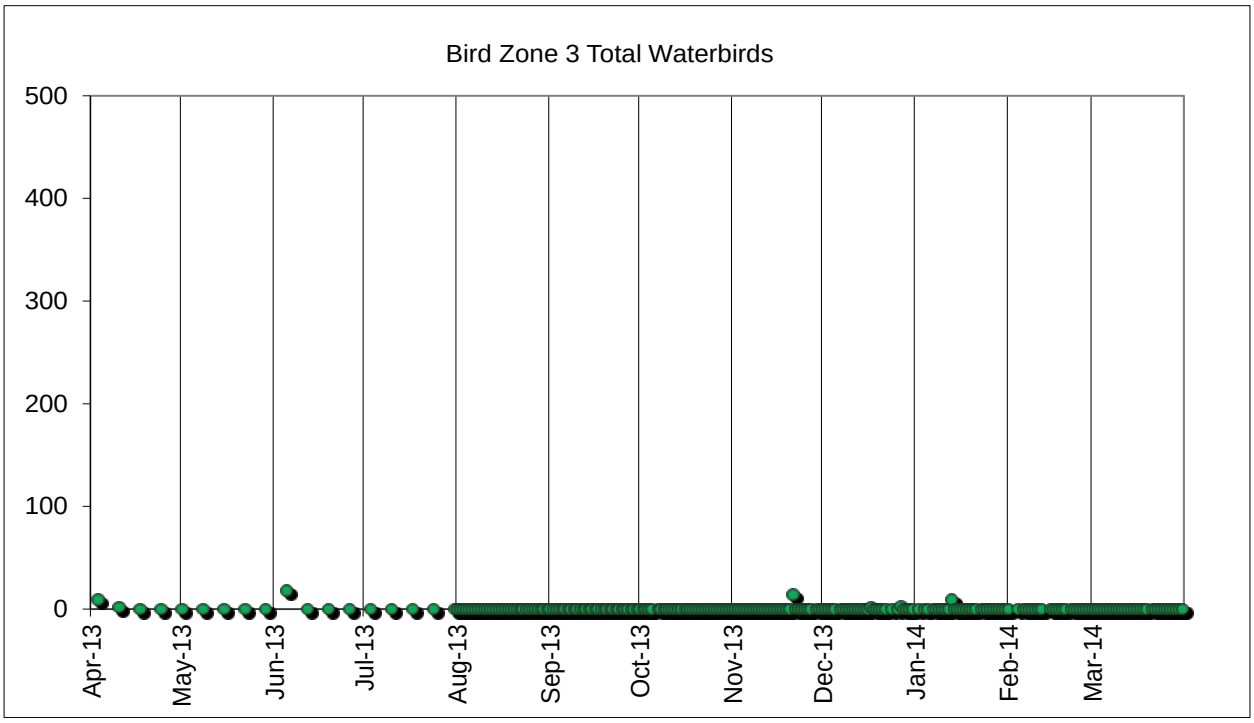

Figure 9. Kensico Reservoir Bird Zone 3 waterbirds (4/1/2013 to 3/31/2014).

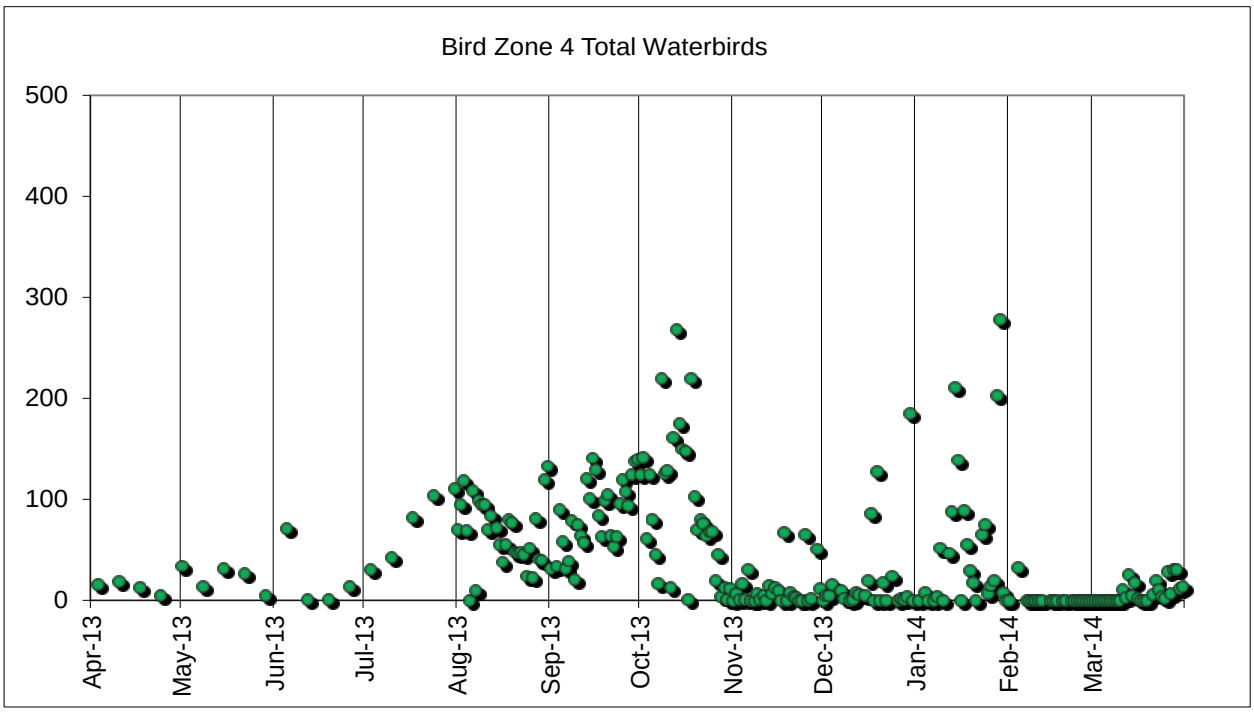

Figure 10. Kensico Reservoir Bird Zone 4 waterbirds (4/1/2013 to 3/31/2014).

The incidence of specific groups of waterbird groups continues to follow trends for annual migration and over-wintering patterns. Waterbird roosting locations during the winter period are generally determined by extent of ice-cover. During 2013/2014 gull counts declined by mid-January 2014 largely due to the extent of ice cover at Kensico when compared to the same time period in 2012/2013 when there was little ice cover recorded. The DEP contractor used two Biondo Airboats for bird dispersal activities during the ice-cover period as the craft are designed to operate on ice or water interfaces (Figure 11). The gulls continued to attempt to roost up to mid-January 2014 when the extent of ice cover eliminated much of the open water. Kensico was approximately 99% covered by ice by March 1, 2014. Duck counts increased from a daily average of 115 per overnight count in 2012/2013 (8/1/ to 3/31) to 172 per overnight count in 2013/2014 which may reflect the lack of open water due to the extent of ice cover at other local and regional water bodies, smaller in size. Similarly, Canada Geese numbers increased from a daily overnight count of 12 in 2012/2013 compared to 24 in 2013/2014 and most likely represents the complete freezing of other local and regional water bodies (Figures 12-13).

Figure 11. Biondo Airboat in operation for bird dispersal activities at Kensico Reservoir.

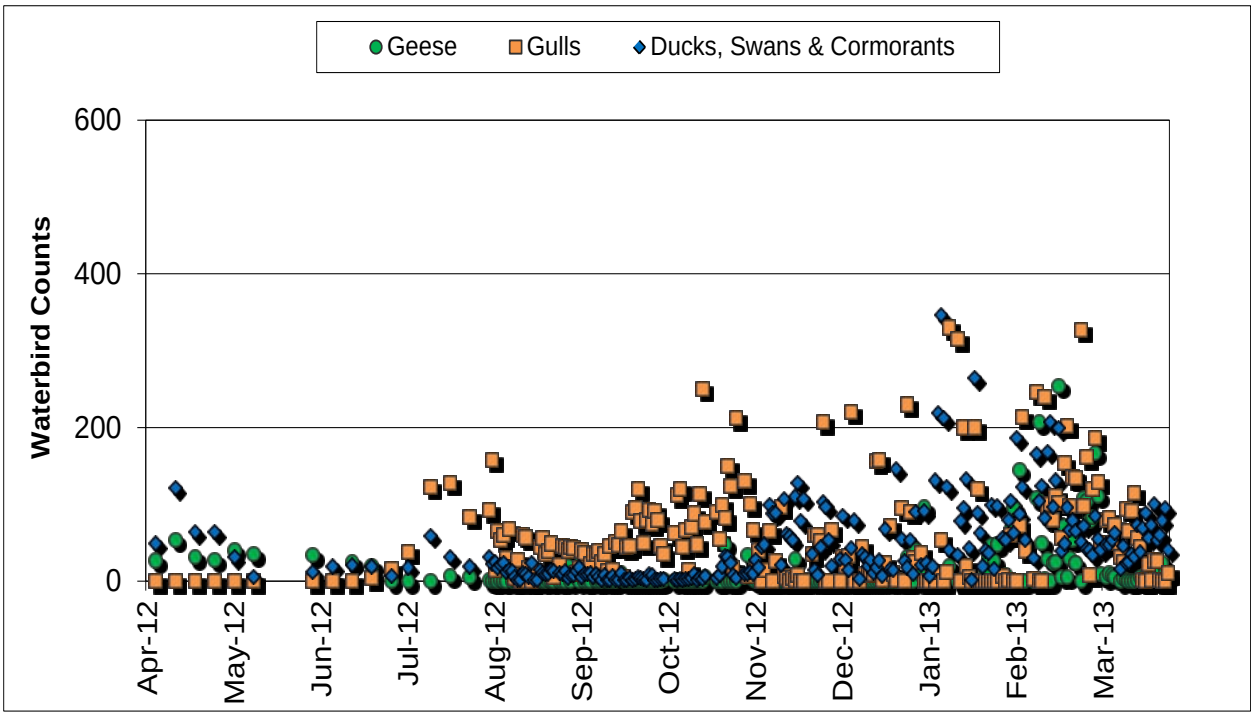

Figure 12. Kensico Reservoir total waterbird groups (4/1/2012 to 3/31/2013).

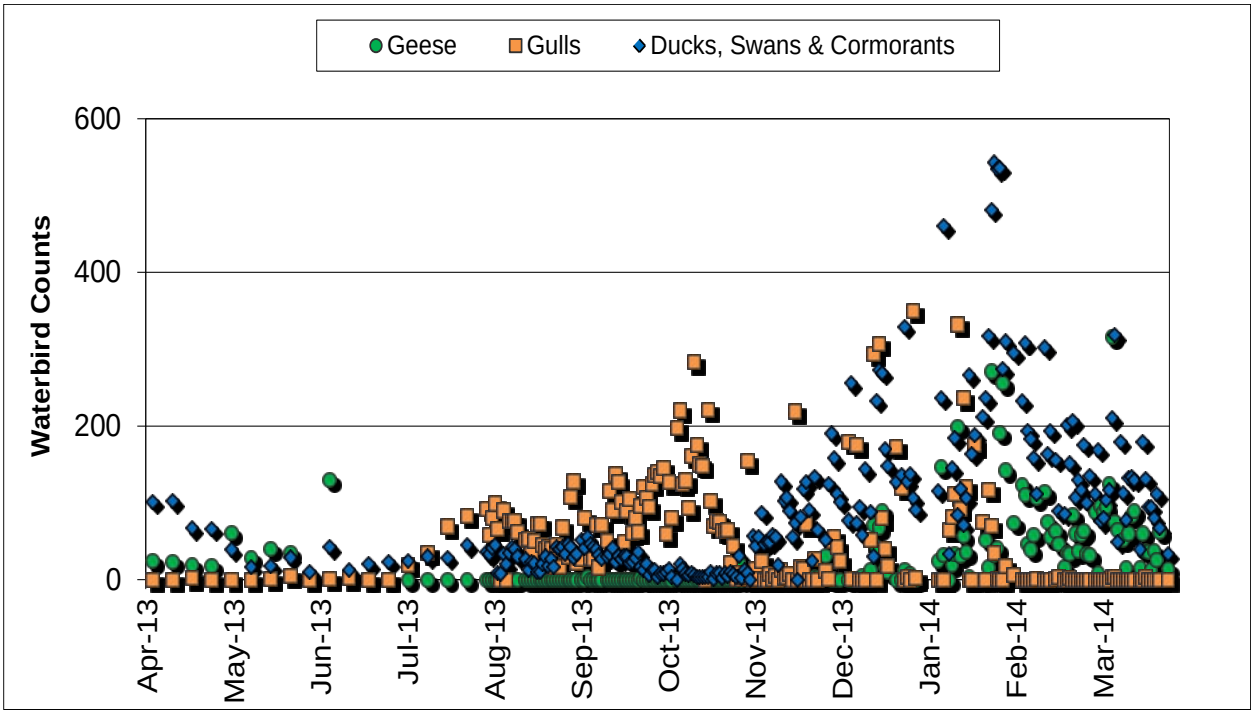

Figure 13. Kensico Reservoir total waterbird by groups (4/1/2013 to 3/31/2014).

The Westchester County Airport, located immediately east of the Rye Lake area (Bird Zone 6 in Figure 39) continued to manage birds for air-traffic safety. As part of the airport's Wildlife Hazard Management Plan (Airport Depredation Orders – Resident Canada Goose nest and egg depredation order, 50 CFR 12.50 and Control order for resident Canada Geese at airports and military airfields 50 CFR 12.49), Westchester County has contracted with USDA to remove all Canada Geese within a seven-mile radius around the airport property which includes all of the Kensico Reservoir. During this reporting period, DEP allowed USDA officials under contract with the Westchester County Airport access to NYC-owned property to determine if there were geese present during the annual goose molt period in the spring of 2013. Results of the USDA survey indicated that geese were present on the Kensico Reservoir property and a follow-up action occurred on June 25, 2013 when 5 Canada Geese were live-trapped and removed from the reservoir property.

DEP's bird management activities have to conform to preventing dispersal of waterbirds into the flight paths of arriving and departing aircraft at Westchester County Airport as the airport lies adjacent to the eastern shoreline of Kensico Reservoir (Figure 14). Bird dispersal crews are instructed to abstain from discharging pyrotechnics with approaching aircraft to avoid potential airstrikes with birds and pilot confusion with the use of aerial low-grade explosives. DEP maintains routine communication with airport officials including its contractor with any changes in bird management activities conducted at the reservoir.

It is suspected that the increased spatial separation between birds and the water intake at Delaware Shaft 18 at Kensico is an important factor that helps reduce the threat for an increase in fecal coliform bacteria. As a result, bird harassment activities were heavily concentrated in the vicinity Delaware Shaft 18 and the lower main basin of Kensico (Bird Zones 2, 3, and 4; Figure 46). Overall, waterbird numbers continue to be sufficiently managed at Kensico to maintain compliance with the federal Surface Water Treatment Rule for fecal coliform bacteria levels.

Alewives (and including other baitfish) transported through upstate aqueducts to Kensico were present during the autumn/winter period of 2013/2014. When present, the dead and dying alewives typically attract foraging gulls and diving ducks. DEP and its contractor continued to monitor fish concentrations and collected dead/dying baitfish as they entered Kensico Reservoir. The volume of fish observed, collected, and disposed of at Kensico CATIC (influent) in 2013/2014 was 41 pounds compared to 800.8 pounds collected in 2012/2013 and 115.8 pounds collected in 2011/2012. The lower volume of fish observed in 2013/2014 reduced the amount of bird dispersal efforts necessary at the CATIC.

In the spring of 2013 a total of 16 Canada Geese nests were identified along the reservoir shoreline and on islands. Among the nests, 81 eggs were depredated (punctured) and replaced back to the nest to allow the nesting geese to continue to incubate (Table 4). The average number of eggs per nest was 5.3 compared to 4.4 in the previous year (DEP 2013). A total of 3 goslings were observed rendering the egg depredation success at 96 percent in 2013 compared to

the 93 percent success rate in 2012. Adult breeding geese or failed breeders generally disperse from the reservoir prior to the post-breeding season molt which begins in June (annually) however if goslings are hatched some of the adults tend to remain at the reservoir during the molt or flightless period which can last three to four weeks. Canada Geese that do remain at Kensico during the molt period are subject to removal through depredation by the Westchester County Airport. No Mute Swan nests were observed at Kensico in 2013.

The ongoing implementation of the WMP has allowed DEP to maintain compliance with the SWTR standard for fecal coliform bacteria throughout 2013/2014 and dating back to 1993.

2. West Branch Reservoir

The 2007 FAD lists West Branch Reservoir as one of five reservoirs covered under the "as-needed" criteria for Waterfowl Management. Since the implementation of the WMP program, only two "as-needed" actions have been implemented at West Branch. West Branch Reservoir is divided into four bird survey zones associated with reservoir water quality sampling locations (Figure 47).

Waterbird population surveys were conducted during the month of April 2013 and from August 1, 2013 through March 31, 2014 on a biweekly frequency for this reporting period as per NYSDOH's March 13, 2013 approval to reduce the routine waterbird population monitoring from weekly surveys to biweekly surveys from August 1 through April 15 annually and on an "as-needed" basis for the remainder of the year (Table 2). Additional daytime (un-aided eye) bird observations were conducted by DEP Aqueduct Monitoring staff during routine site visits. A total of 31 additional bird observations were conducted during this reporting period. The dates, times and count ranges for birds observed at the West Branch Effluent (Shaft 10) are listed in Table 6 unless counts were zero or no data were collected due to environmental conditions or field errors. A total of 22 out of 31 observations were reported as "0" or no birds present. During this reporting period, DEP was not required to initiate an "as-needed" bird dispersal action due to elevated fecal coliform bacteria and waterbird counts. In the event a bird dispersal action is required, DEP would implement a program using contractor personnel to eliminate the presence of waterbirds as a water quality threat.

Table 6. West Branch Reservoir daytime bird observations at Delaware Effluent (Shaft 10).

Date	Time of Observation	Bird Count Range
July 18, 2013	1150	1 - 50
August 1, 2013	0958	1 - 50
August 8, 2013	0932	1 - 50
August 22, 2013	1159	1 - 50
September 19, 2013	0918	1 - 50
September 26, 2013	0940	1 - 50
October 3, 2013	0909	1 - 50
December 19, 2013	1027	1 - 50
December 26, 2013	0935	1 - 50

Migratory and wintering waterbird populations at West Branch were surveyed biweekly to record annual trends which aids in identifying sources of elevated fecal coliform bacteria levels. In 2013/2014, gulls were only recorded on 2 of the 20 surveys conducted with counts of '2' on 8/16/13 and '1' on 11/22/13. This compares to a gull count spike of 334 on October 2, 2012 in the previous reporting period (DEP 2012). The reduction in bird surveys in 2013/2014 from the previous year may not capture temporary or short-term migratory population increases.

Reservoir-wide total birds reached 1,830 on December 6, 2013 compared to 3,245 waterbirds recorded on December 4, 2012, in the previous year (Figures 15 and 16). Duck counts, mostly Common Mergansers, generally increase annually from mid-March to late April which encompasses the northward springtime migration and again from late-September through the end of December 2013 which includes the southward migrational movements. With the onset of ice-cover in late December 2013 total bird counts dropped from 807 recorded on December 20, 2013 to 2 on January 17, 2014.

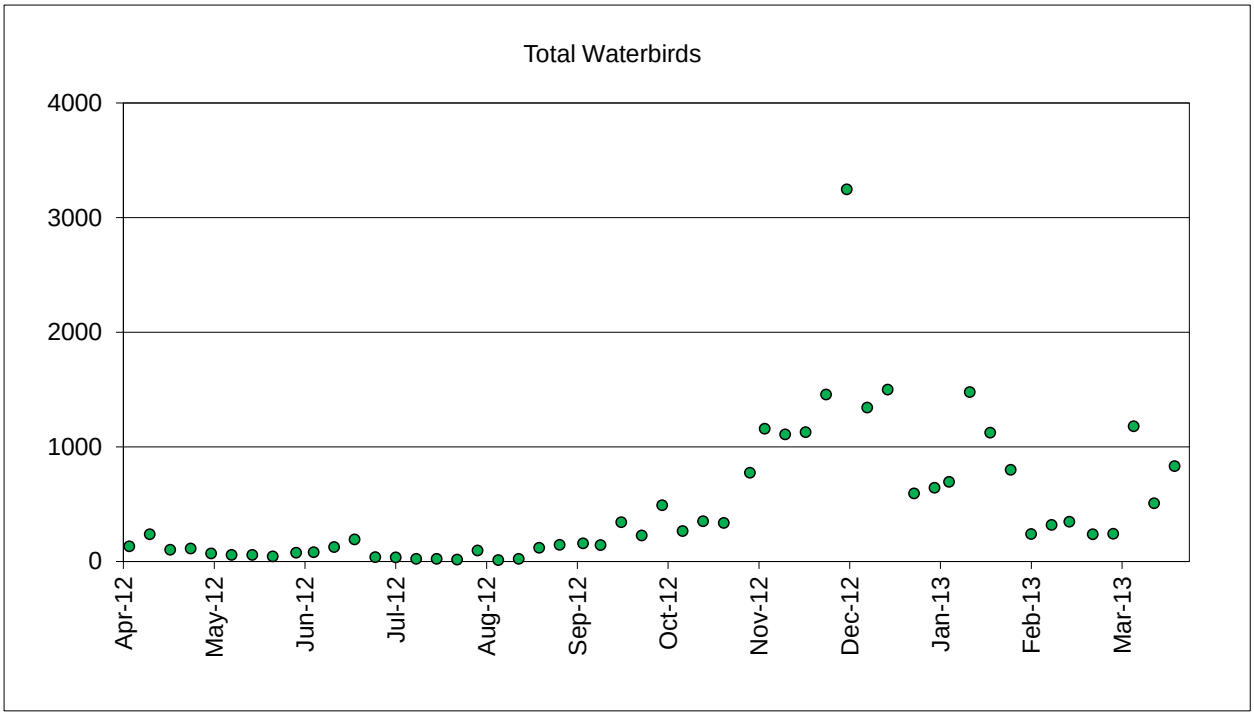

Figure 14. West Branch Reservoir total waterbirds (4/1/2012 to 3/31/2013).

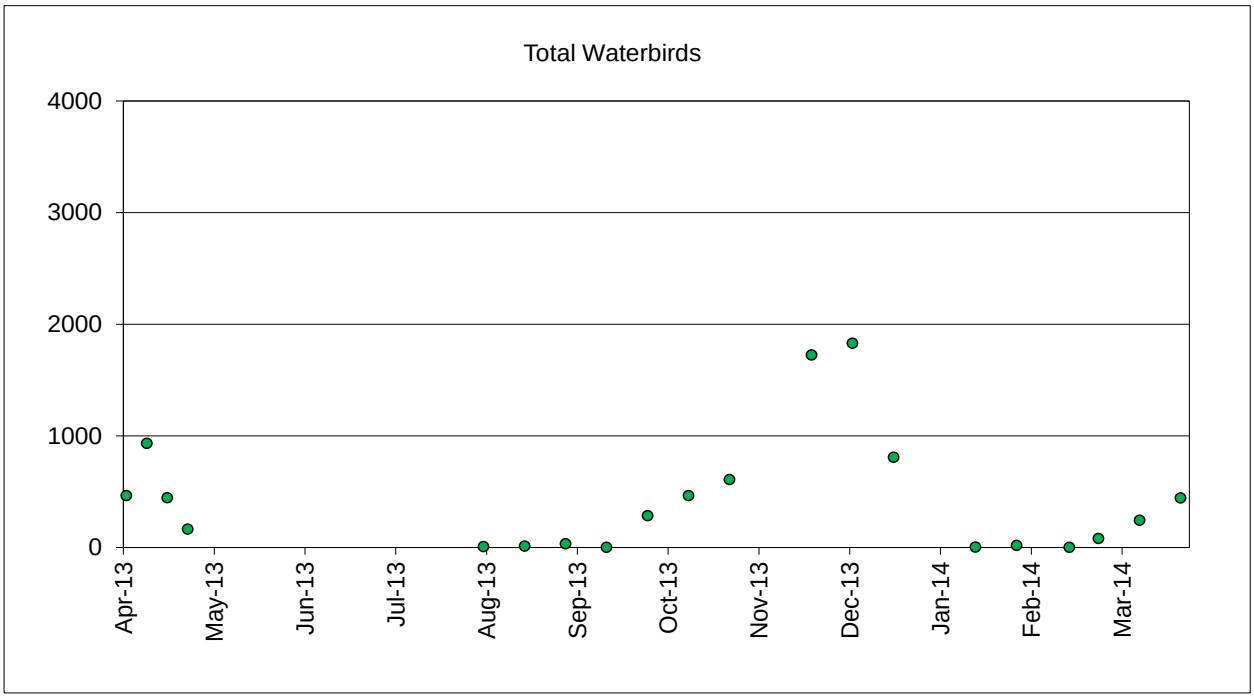

Figure 15. West Branch Reservoir total waterbirds (4/1/2013 to 3/31/2014).

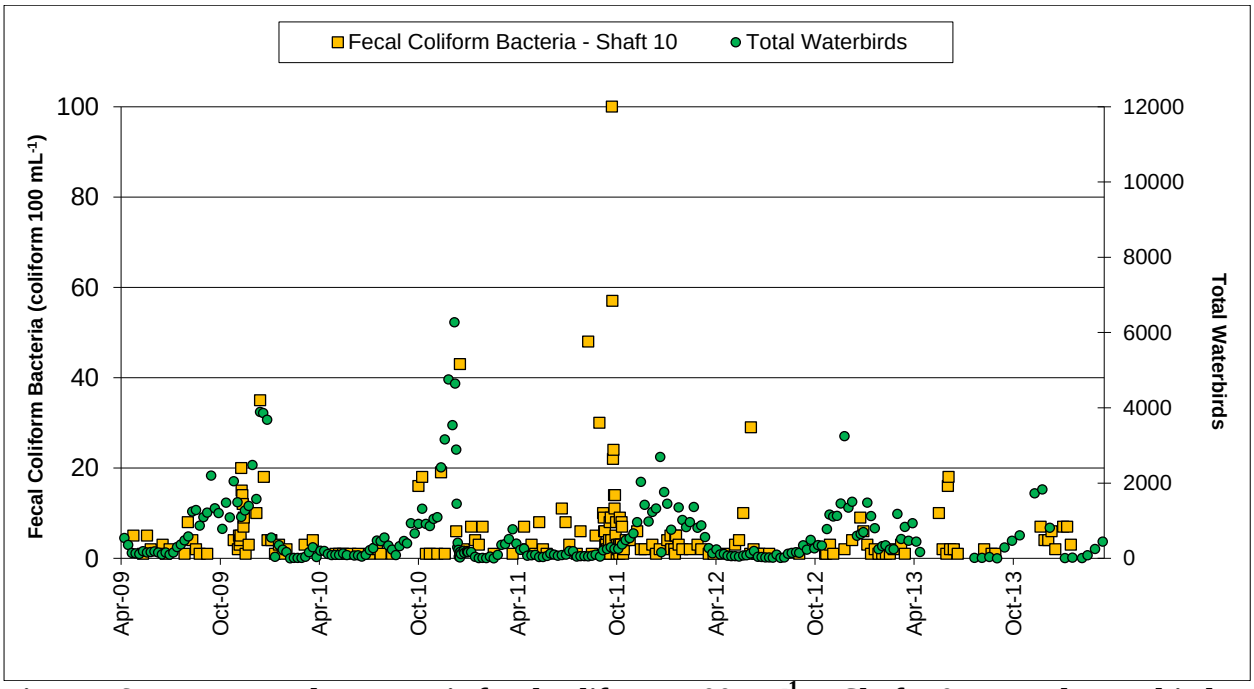

Figure 16. West Branch Reservoir fecal coliforms 100mL^{-1} at Shaft 10 vs. total waterbirds (4/1/2009 to 3/31/2014).

There were no fecal coliform bacteria counts above 20 fecal coliforms $100mL^{-1}$ recorded at the Delaware Shaft 10 (DEL10) from April 1, 2013 through March 31, 2014 compared to one recorded in the previous reporting period (Figure 16).

DEP conducted reproductive control on Canada Geese from April 1 through May 31, 2013 to reduce productivity at West Branch Reservoir. In 2013, seven nests and 35 eggs were depredated which was down slightly from the previous year at 8 nests and 34 eggs (Table 4). The egg-depredation was deemed 100 percent successful as no goslings were observed following the nesting period. There were no Mute Swans or Double-crested Cormorants observed nesting at West Branch in 2013 and therefore not subject to depredation actions.

3. Rondout Reservoir

Rondout Reservoir is a terminal or source water reservoir to both Kensico and West Branch. Located west of the Hudson River, Rondout is part of the Delaware System of reservoirs. The 2007 FAD lists Rondout as one of five reservoirs covered under the "as-needed" criteria for Waterfowl Management. Since the implementation of the WMP, only three "as-needed" actions have been implemented at Rondout. The Rondout Reservoir is divided into nine bird sampling geographic zones associated with reservoir water quality sampling locations (Figure 48).

Waterbird population surveys were only conducted during the month of April 2013 for this reporting period as per NYSDOH's March 13, 2013 approval to reduce the routine waterbird population monitoring from weekly surveys to an "as-needed" option. During this reporting period DEP was required to initiate an "as-needed" bird dispersal action due to elevated fecal coliform bacteria and waterbird counts. In the event a bird dispersal action is required, DEP would implement a program using contractor personnel to eliminate a water quality threat.

During this reporting period, there were no reservoir effluent samples above 20 fecal coliforms 100mL^{-1} from the Rondout Effluent compared to seven in the previous reporting period (Figure 17).

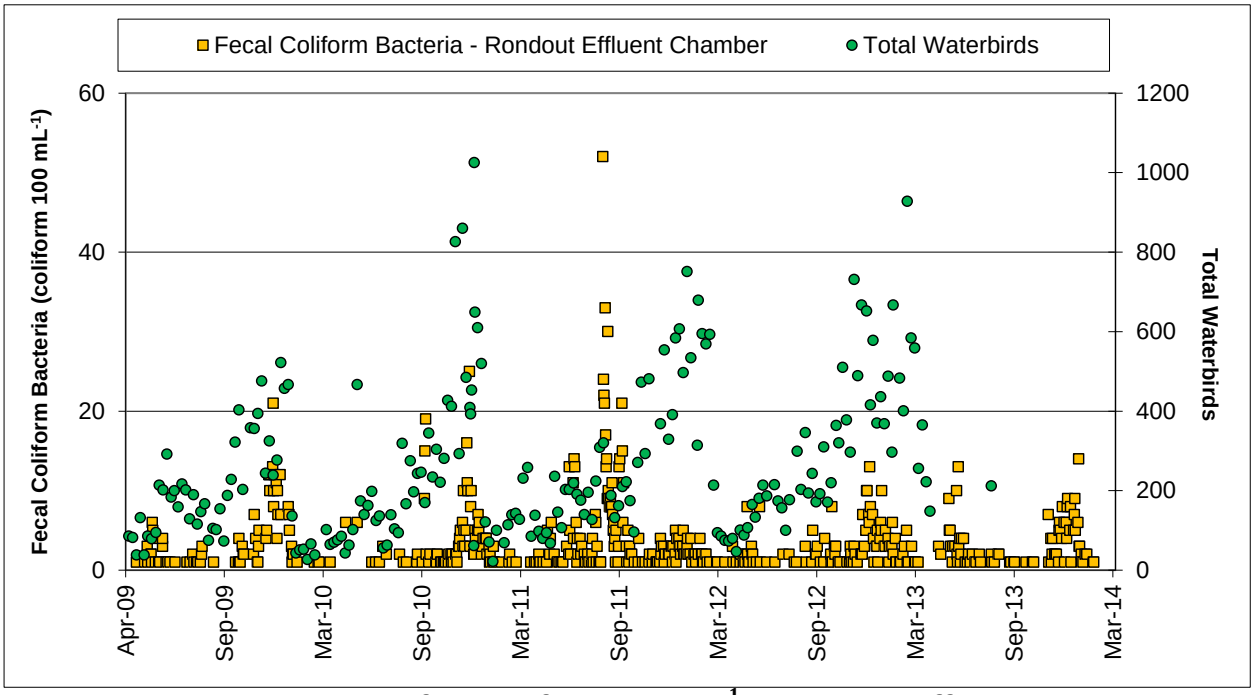

Figure 17. Rondout Reservoir fecal coliforms 100mL^{-1} at Rondout Effluent vs. total waterbirds (4/1/2009 to 4/30/2014). Waterbird surveys discontinued on 4/30/2013.

Additional daytime (un-aided eye) bird observations were conducted by DEP Aqueduct Monitoring staff during routine site visits. A total of 46 additional bird observations were conducted during this reporting period. The dates, times and count ranges for birds observed at the Rondout Effluent Chamber are listed in Table 7 unless counts were zero or no data were collected due to environmental conditions or field errors. A total of 27 out of 46 observations were reported as "0" or no birds present.

Table 7. Rondout Reservoir daytime bird observations at Rondout Effluent.

Date	Time of Observation	Bird Count Range and Actual Bird Counts
5/20/2013	1100	1 – 50
5/28/2013	0824	1 - 50
6/17/2013	0900	2
6/24/2013	0910	1 – 50
7/8/2013	1029	1 – 50
7/22/2013	1007	1 – 50
7/29/2013	0818	1 – 50
8/5/2013	1005	1 – 50
8/12/2013	0941	2
8/26/2013	0906	2
9/3/2013	0826	3
9/30/2013	0947	9
11/4/2013	0831	1 – 50
12/2/2013	0922	1
12/16/2013	0853	1
12/23/2013	1056	1 - 50
1/6/2014	1019	2
1/13/2014	1007	1 - 50

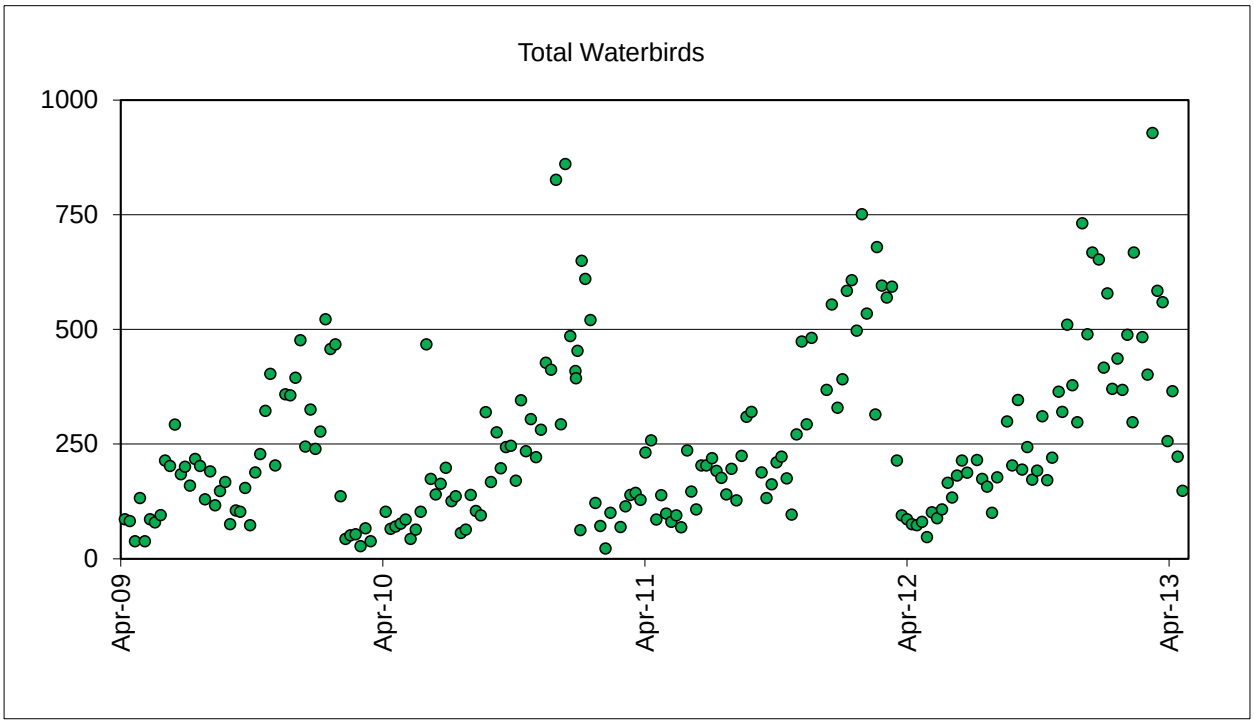

Figure 18. Rondout Reservoir total waterbirds (4/1/2009 to 4/30/2013).

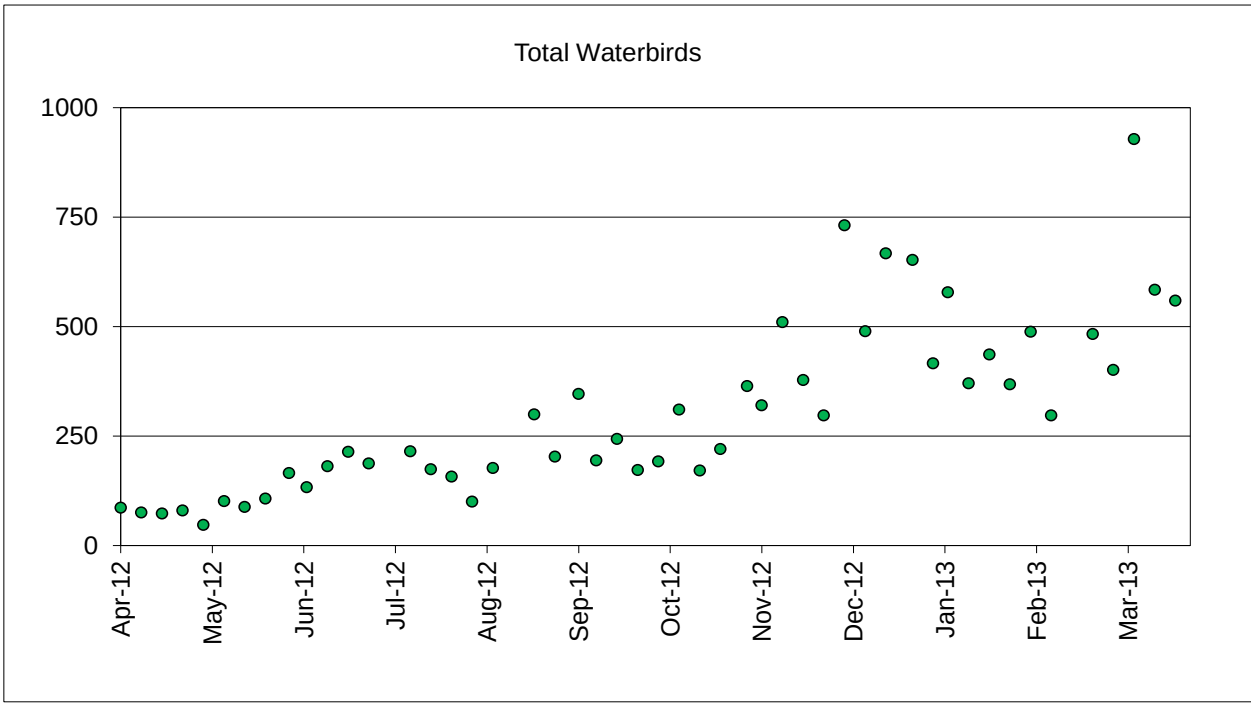

Figure 19. Rondout Reservoir total waterbirds (4/1/2012 to 3/31/2013).

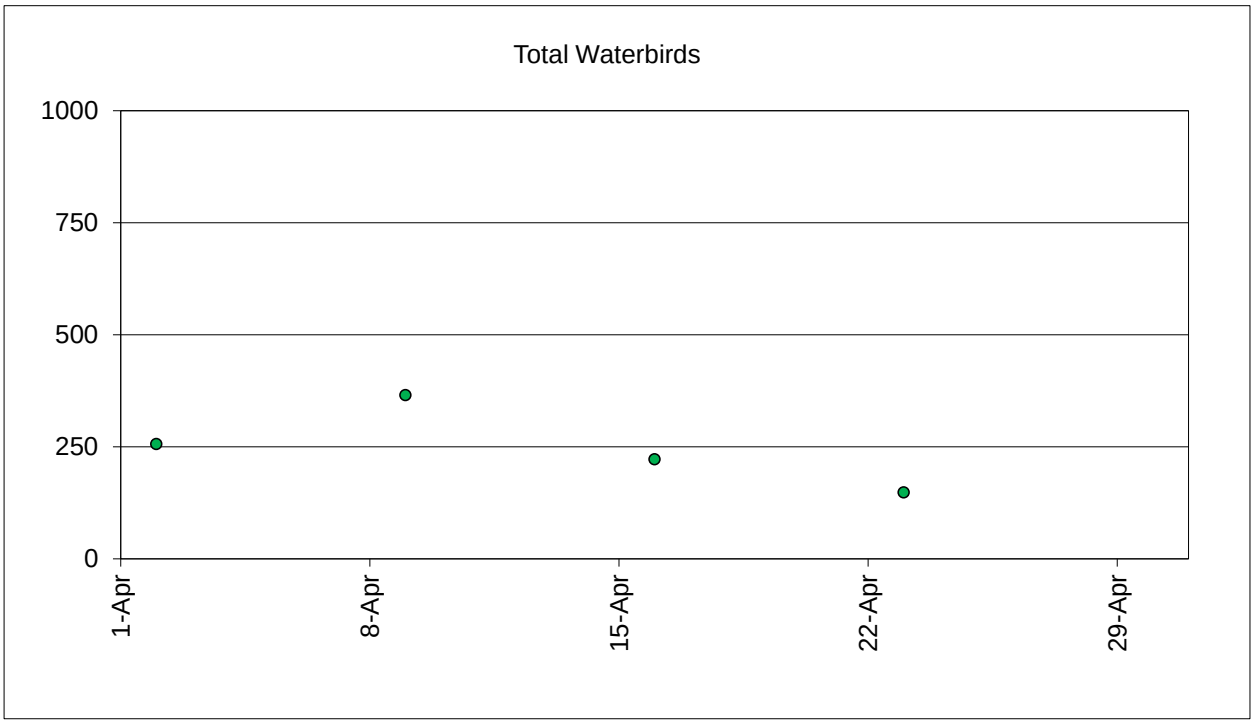

Figure 20. Rondout Reservoir total waterbirds (4/1/2013 to 4/30/2013).

DEP conducted routine monitoring and maintained full compliance with a protection plan for Bald Eagles (*Haliaeetus leucocephalus*) as required by the NYSDEC and United States Fish and Wildlife Service in preparation for any "as-needed" bird harassment activity as stated in the Findings Statement of the Environmental Impact Statement (N.Y.S. Environmental Conservation Law, Art. 8 (§8101 et seq.)) on file.

DEP also conducted reproductive control on Canada Geese at Rondout in 2013. Due to the close proximity of some Canada Geese nests to active Bald Eagle nests DEP abstained from some goose egg and nest depredation work to maintain compliance with the New York State Endangered Species Protection Laws and USFWS Bald and Golden Eagle Protection Act (Figure 22). Seven nests with 27 eggs were depredated in the spring of 2013 (Table 4). A total of 9 goslings were documented compared to 7 goslings observed in 2012. There were no Mute Swan nests identified at Rondout in 2013.

Figure 21. Adult Bald Eagle in roost adjacent to Canada Goose nesting locations at Rondout Reservoir.

4. Ashokan Reservoir

The 2007 FAD lists Ashokan Reservoir as one of five reservoirs covered under the "as-needed" criteria for Waterfowl Management. Since the implementation of the WMP, no "as-needed" actions have been necessary at Ashokan. Ashokan Reservoir is divided into two main basins each with a water intake chamber located at the Dividing Weir (Figure 49). There are six waterbird sampling geographic zones, three within each basin and associated with reservoir water quality sampling locations (Figure 49).

Waterbird population surveys were only conducted during the month of April 2013 for this reporting period as per NYSDOH's March 13, 2013 approval to reduce routine waterbird population monitoring from weekly surveys to an "as-needed" option. Additional daytime (un-aided eye) bird observations were conducted by DEP Aqueduct Monitoring staff during routine site visits. A total of 34 additional bird observations were conducted at the Ashokan East Basin Effluent and 37 were conducted at the Ashokan West Basin Effluent during this reporting period. The dates, times and count ranges for birds observed at the Ashokan East Basin Effluent are listed in Table 8 and those for the Ashokan West Basin Effluent are listed in Table 9 unless counts were zero or no data were collected due to environmental conditions or field errors. A total of 28 out of 34 observations were reported as "0" or no birds present at the East Basin Effluent and no birds were observed on 30 out of 37 observations a the West Basin Effluent.

Table 8. Ashokan Reservoir daytime bird observations at Ashokan East Effluent.

Date of Observation at Ashokan East Basin	Time of Observation	Bird Count Range and Actual Bird Counts
5/29/2013	1036	15 - 20
7/26/2013	0954	1 – 50
7/30/2013	1001	1 – 50
8/21/2013	1355	1
9/24/2013	1010	1 – 50
11/26/2013	1025	1 – 50

Table 9. Ashokan Reservoir daytime bird observations at Ashokan West Effluent.

Date of Observation at Ashokan East Basin	Time of Observation	Bird Count Range and Actual Bird Counts
7/9/2013	1024	3
7/26/2013	952	1 – 50
7/30/2013	959	8
8/27/2013	1003	1 – 50
9/24/2013	1012	1 – 50
12/17/2013	1058	12
3/25/2014	1013	2

Since the inception of the WMP Expanded Program at Ashokan Reservoir in March 2002, DEP has not been required to initiate an "as-needed" bird dispersal action due to elevated fecal coliform bacteria and waterbird counts. In the event a bird dispersal action is required, DEP would implement a program using contractor personnel to eliminate a water quality threat.

Waterbird numbers were recorded on four dates during April 2013 (Figures 22-24). Total birds ranged from 227 on April 26, 2013 to 652 on April 12, 2013. Ashokan East Basin counts comprised more than 96% of the total birds observed on the reservoir on all four surveys (Figure 25).

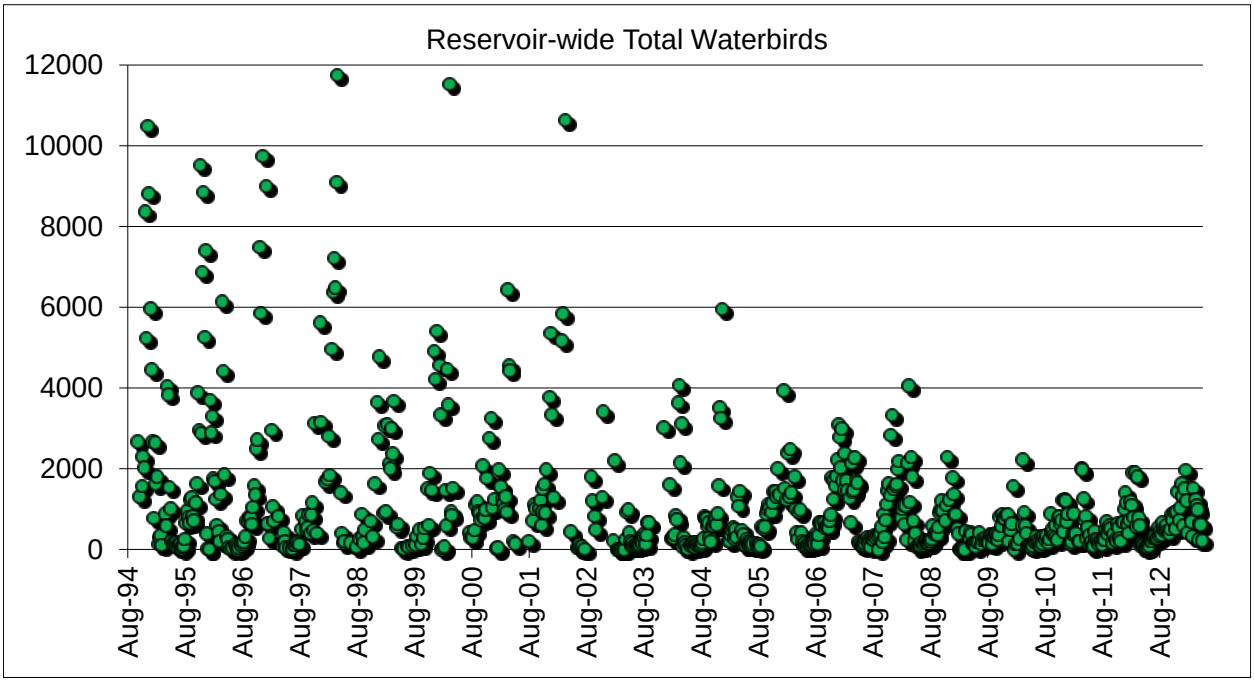

Figure 22. Ashokan Reservoir total waterbirds (August 1994 to May 2013).

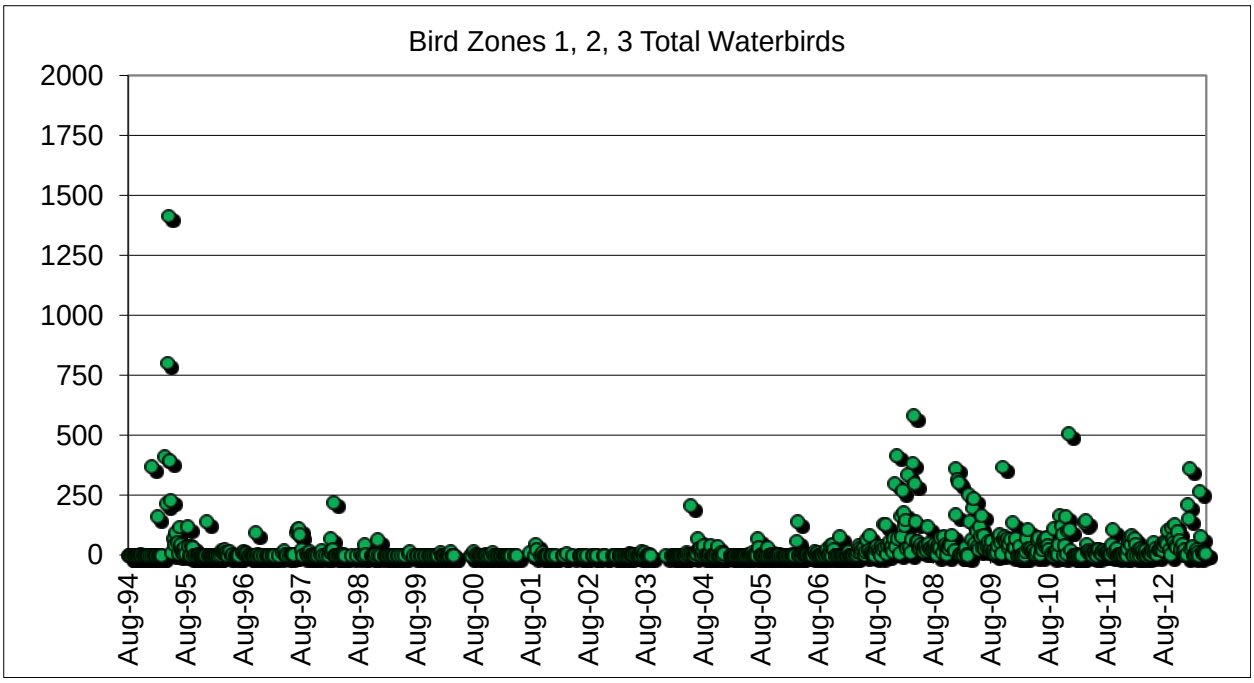

Figure 23. Ashokan Reservoir West Basin total waterbirds in Bird Zones 1, 2, and 3 (August 1994 to May 2013).

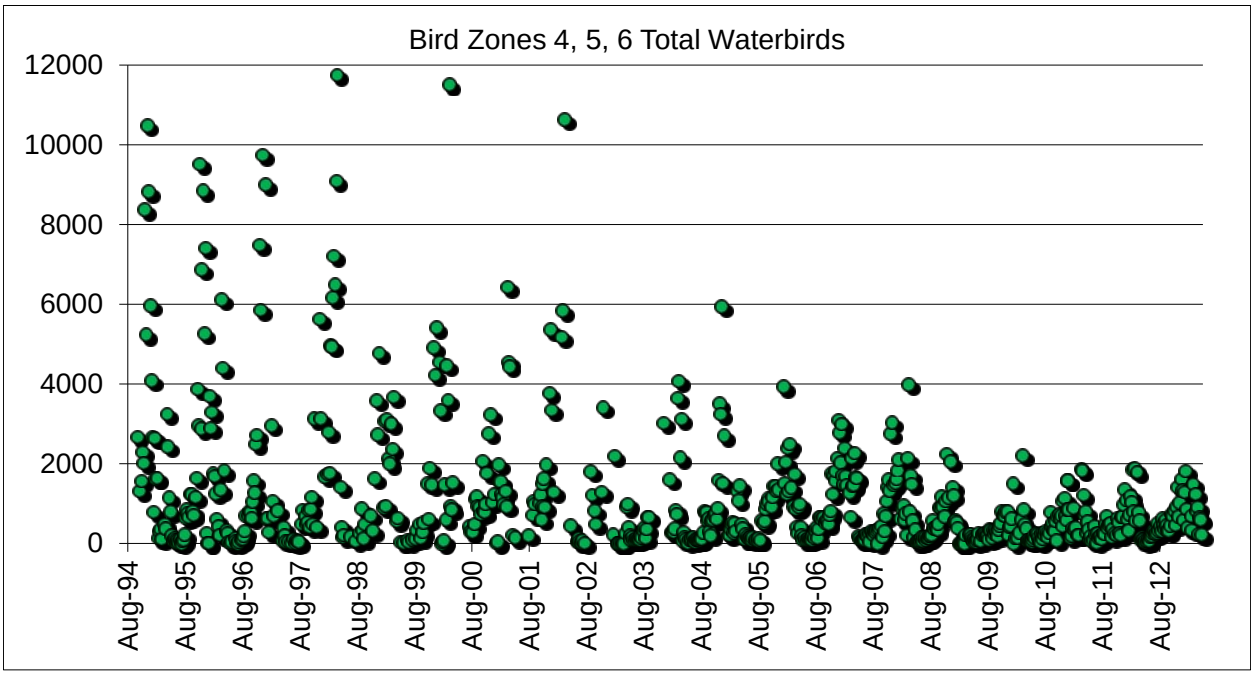

Figure 24. Ashokan Reservoir East Basin total waterbirds in Bird Zones 4, 5, and 6 (August 1994 to May 2013).

There was only one fecal coliform sample collected at the water intake sampling location at Ashokan (EARCM) that exceeded 20 fecal coliforms 100mL^{-1} on March 1, 2014 (Figure 25). There were no corresponding bird counts to report for March 2014.

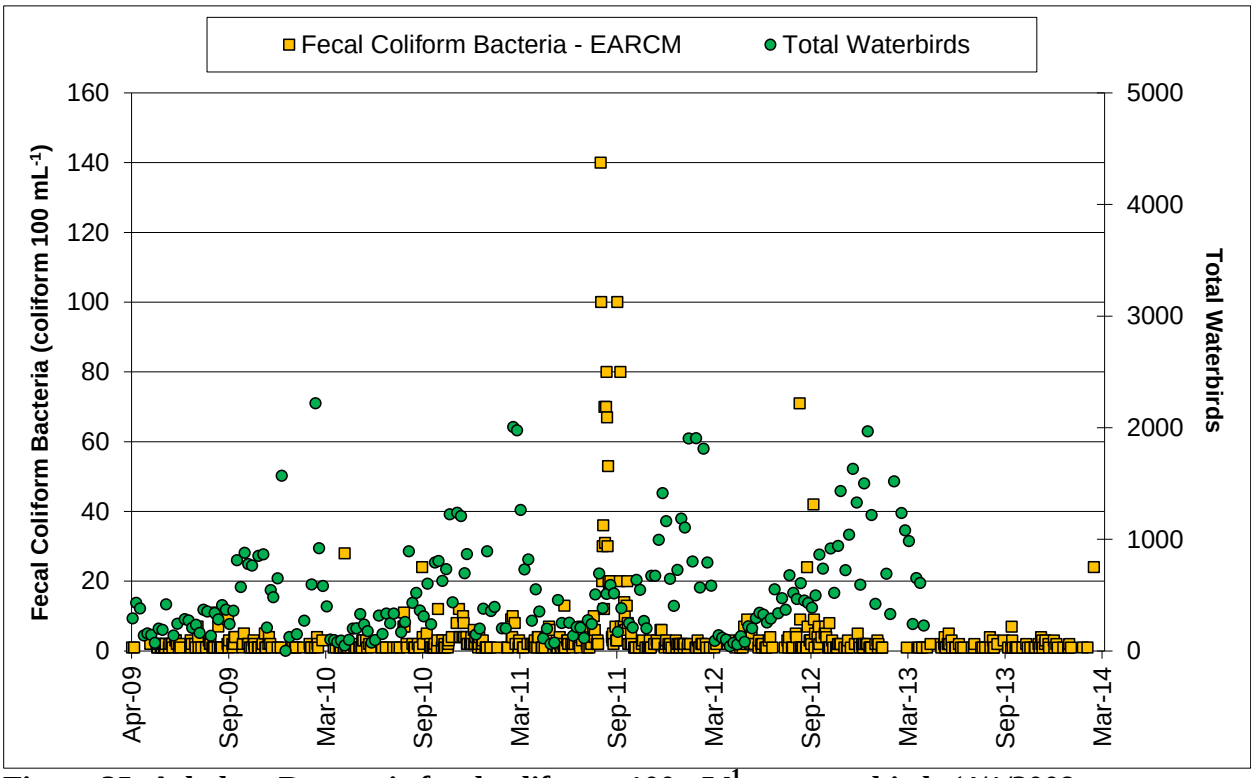

Figure 25. Ashokan Reservoir fecal coliforms 100mL^{-1} vs. waterbirds (4/1/2009 to 3/31/2014). Waterbird surveys were discontinued as of 4/30/2013.

DEP conducted reproductive control on Canada Geese from April 1 through May 31, 2013 to reduce productivity at Ashokan. In 2013, four Canada Geese nests were identified and 17 eggs addled compared to three nests and 16 eggs 2012 (Table 4). The egg-depredation success rate at the Ashokan Reservoir in 2013 was 100 percent compared to a 52 percent success in 2012. No goslings were observed in late spring 2013 compared to 15 observed in spring 2012. There were no Mute Swans found nesting in 2013 similar to 2012.

5. Croton Falls Reservoir

The 2007 FAD lists Croton Falls Reservoir as one of five reservoirs covered under the "as-needed" criteria for waterfowl management. Croton Falls Reservoir is divided into five bird sampling geographic zones associated with reservoir water quality sampling locations (Figure 50).

Waterbird population surveys were only conducted during the month of April 2013 for this reporting period as per NYSDOH's March 13, 2013 approval to reduce routine waterbird population monitoring from biweekly surveys to an "as-needed" option. As-needed actions are based on fecal coliform bacteria levels at the effluent, operational changes in water delivery and waterbird population counts. In the event a bird dispersal action is required, DEP would implement a program using contractor personnel to eliminate a water quality threat.

Waterbird counts were only conducted on April 5 and April 19, 2013 remained consistent with April bird counts from the previous year (Figures 26 and 27). Total birds recorded on April 5, 2013 was 613 (17 Canada Geese, 300 Gull spp., and 296 ducks) and on April 19, 2013 was 290 (35 Canada Geese, 18 Gull spp., and 237 ducks). Gull counts generally decline by mid-April as most continue in the springtime northward migration.

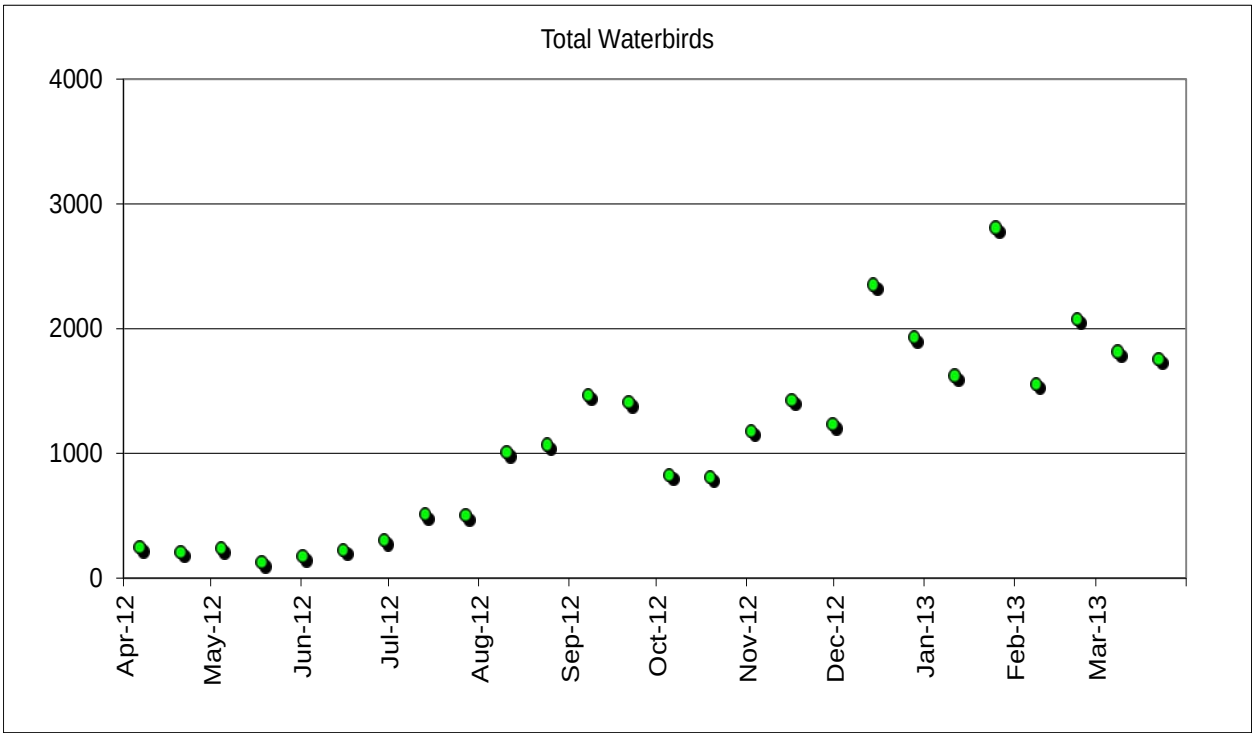

Figure 26. Croton Falls Reservoir total waterbirds (4/1/2012 to 3/31/2013).

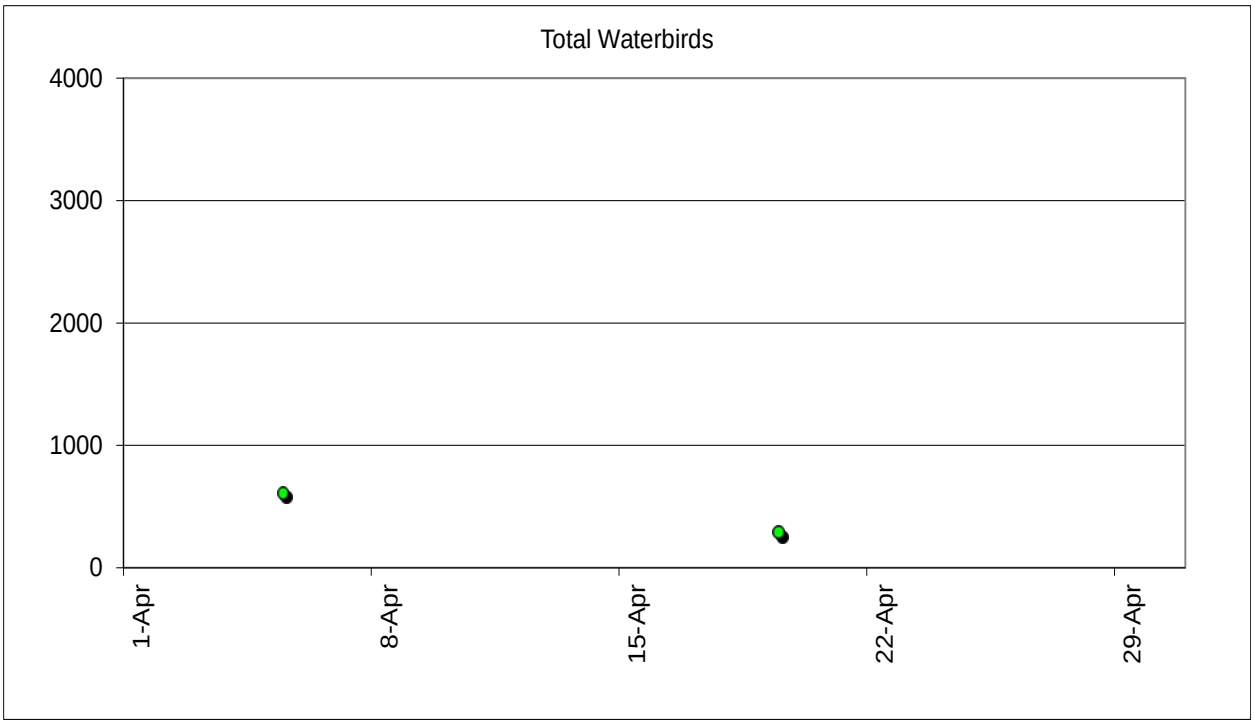

Figure 27. Croton Falls Reservoir total waterbirds (4/1/2013 to 4/30/2013).

There were a total of four fecal coliform bacteria samples measured at the Croton Falls release in 2013/2014 above 20 fecal coliforms $100mL^{-1}$ compared to six recorded in 2012/2013 (Figure 28). In past years, fecal coliform levels became elevated during the onset of waterbird autumn migration movements and winter roosts at Croton Falls however the highest recorded elevation of fecal coliform at 140 fecal coliforms $100mL^{-1}$ on June 13, 2012 bird counts were relatively low with no gulls present. The activation of the "as-needed" waterbird dispersal program was unnecessary during this reporting period.

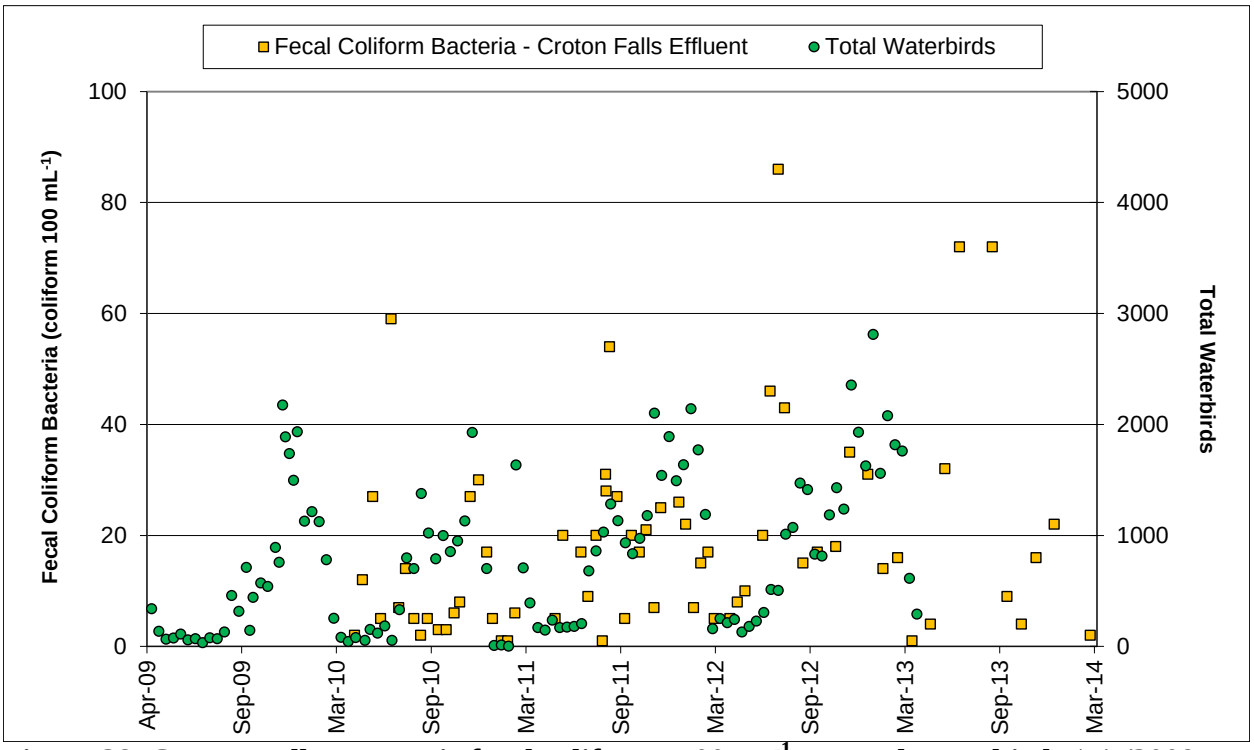

Figure 28. Croton Falls Reservoir fecal coliforms 100mL^{-1} vs. total waterbirds (4/1/2009 to 3/31/2014). Waterbird surveys were discontinued as of 4/30/2013.

DEP conducted reproductive control on Canada Geese from April 1 through May 31, 2013 to reduce productivity at Croton Falls (Table 4). In 2013, 13 Canada Geese nests were identified and 64 eggs were depredated compared to 12 nests and 70 eggs in 2012 (Table 4). The Canada Goose egg-depredation success rate at Croton Falls for 2013 was 100 percent with no goslings that hatched. There were 2 Mute Swan nest depredated with a total of 11 eggs found in 2013.

6. Cross River Reservoir

The 2007 FAD lists Cross River Reservoir as one of five reservoirs covered under the "as-needed" criteria for Waterfowl Management. Cross River Reservoir is divided into three bird sampling geographic zones associated with reservoir water quality sampling locations (Figure 51). Waterbird population surveys were only conducted during the month of April 2013 for this reporting period as per NYSDOH's March 13, 2013 approval to reduce routine waterbird population monitoring from biweekly surveys to an "as-needed" option. Since the inception of the WMP Expanded Program at Cross River in March 2002, DEP has not been required to initiate an "as-needed" bird dispersal action due to elevated fecal coliform bacteria and waterbird counts. In the event a bird dispersal action is required, DEP would implement a program using contractor personnel to eliminate a water quality threat.

Waterbirds counts were only conducted on two days in April 2013 and remained consistent with surveys conducted in the previous year (Figures 29 and 30). Fecal coliform bacteria concentrations are reported for April 1, 2013 through March 31, 2014 (Figure 31). FCB levels in water samples at Cross River Reservoir exceeded the 20 fecal coliforms $100mL^{-1}$ level only one time compared to four times in the previous reporting period (Figure 32). The bacterial elevations recorded at the Cross River Effluent Chamber during the month of April 2013 do not appear to be coincidental with population surges of waterbirds.

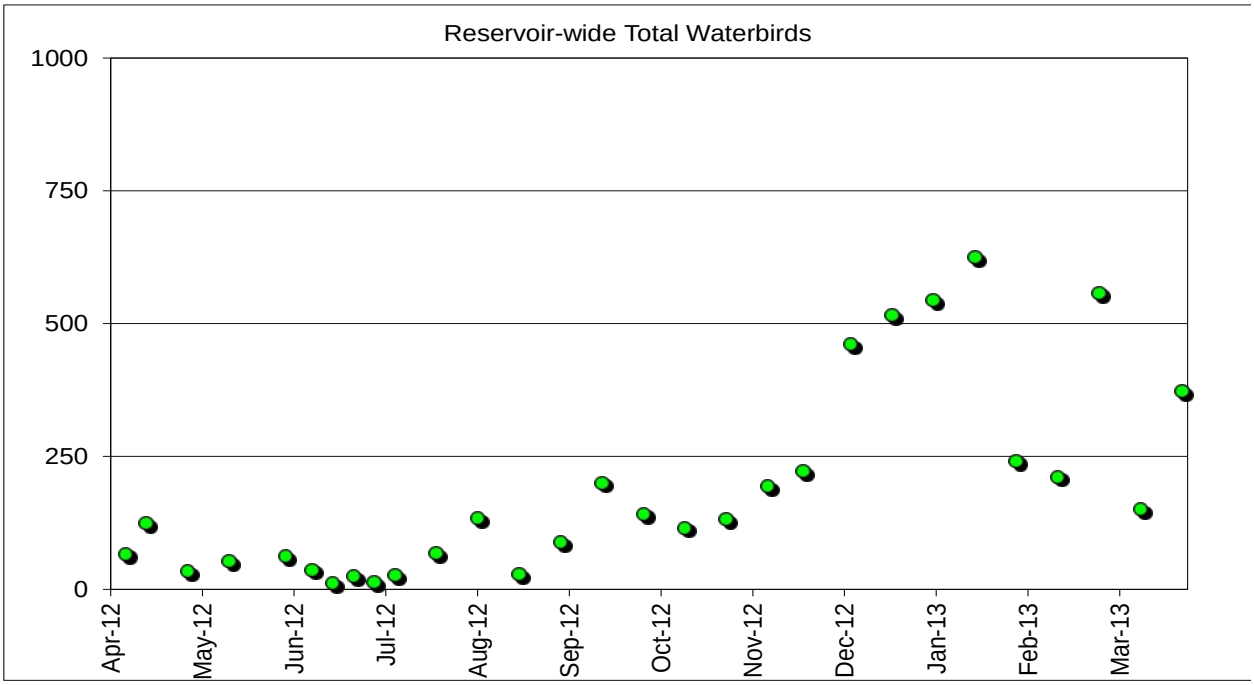

Figure 29. Cross River Reservoir total waterbirds (4/1/2012 to 3/31/2013).

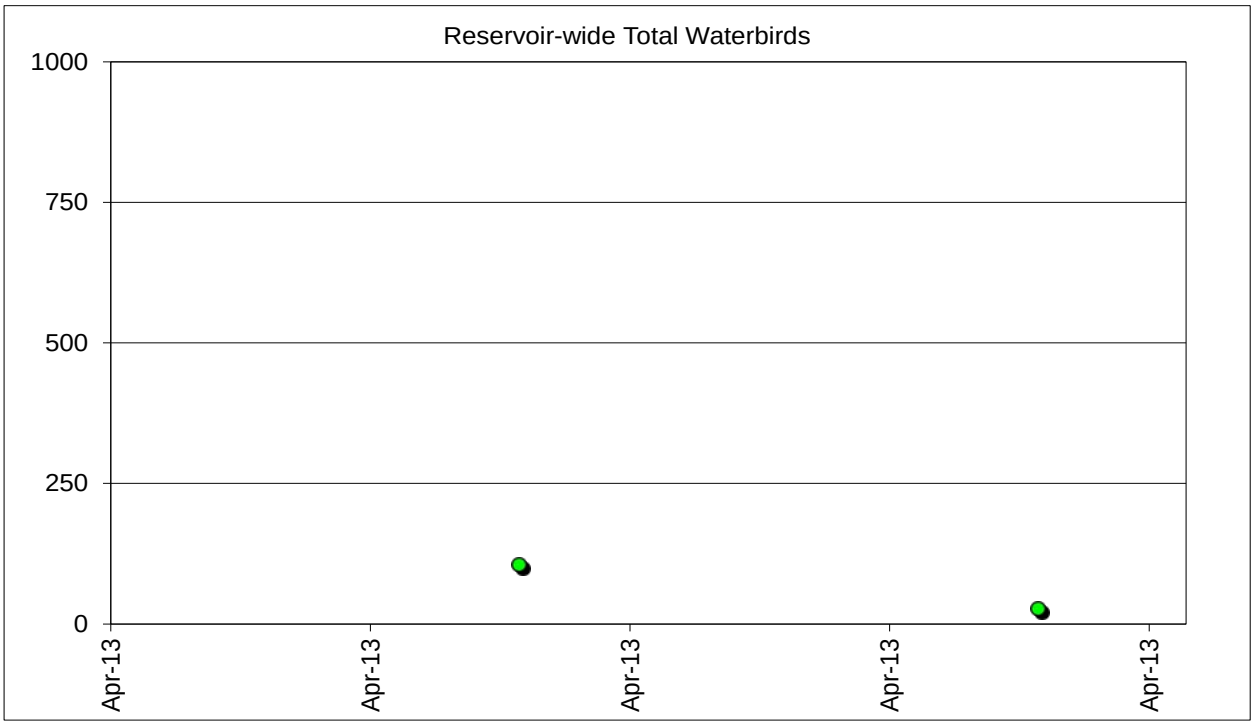

Figure 30. Cross River total waterbirds (4/1/2013 to 4/30/2013).

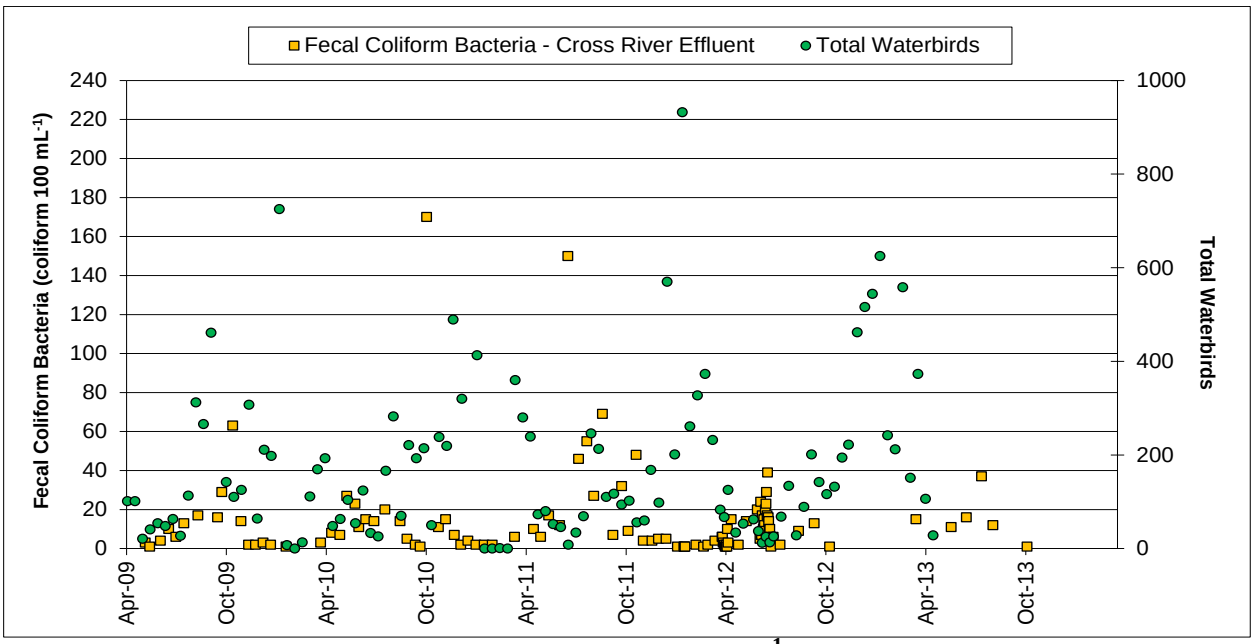

Figure 31. Cross River Reservoir fecal coliforms 100mL^{-1} vs. total waterbirds (4/1/2009 to 3/31/2014). Waterbird surveys were discontinued as of 4/30/2013.

The Cross River Pump Station was not utilized during this reporting period, and activation of the “as-needed” waterbird dispersal program was unnecessary.

DEP conducted reproductive control on Canada Geese from April 1 through May 31, 2013 to reduce productivity at Cross River. In 2013, 5 nests were identified and 23 eggs addled compared to 9 nests and 47 eggs in 2012 (Table 4). The Canada Goose egg-depredation success rate for Cross River in 2013 was 82 percent with 5 goslings reported. There were no Mute Swans observed nesting in 2013.

7. Hillview Reservoir

The City's Long-Term Watershed Protection Program (July 2007 FAD) expanded the Waterfowl Management Program to include Hillview Reservoir on an "as-needed" basis similar to the 2002 FAD expansion for five additional reservoirs listed above. DEP initiated an in-depth program for waterbird management starting in 1993 followed by program enhancements with the 2007 FAD and again in 2011 under the Hillview Administrative Order. The Hillview Reservoir is divided into two bird sampling geographic zones associated with the reservoirs two distinct basins and water quality sampling stations (Figures 52 and 53). Waterbird population survey frequencies have varied through the years but generally have been conducted at a minimum on a weekly basis and in recent years on a daily basis. Bird deterrent and dispersal activities have also been employed since 1993 with a high level of success reducing and in most cases eliminating the presence of roosting waterbirds; particularly geese, cormorants, ducks, and gulls.

Prior to 1993, DEP Operations staff infrequently employed a variety of noisemakers to eliminate birds roosting diurnally and nocturnally at Hillview. During the summer of 1993, DEP's Wildlife Studies Section initiated a formal bird management program to monitor birds throughout the year and develop a bird deterrence/dispersal program. Pyrotechnics and propane operated cannons were initially used to chase the birds off the water and on reservoir shaft buildings. In July 1994, a bird deterrent wire system was partially installed which formed an aerial grid above the surface water to prevent birds such as swans, cormorants, geese, gulls and ducks from landing and defecating in the water (Figure 32). The wire grid, which was mostly completed by the spring of 1995, consisted of a combination of high-test monofilament, Kevlar wire, and twine. The grid was strung along the shoreline fences spanning a distance of nearly 1,200 feet. From 1994 to 2006, this wire grid system was maintained by DEP staff until a contract was let in 2006 to install an upgraded version of the wire deterrent system using Kevlar-coating wire strung on 15' stanchions with reel tensioning devices at the base.

Figure 32. Hillview Reservoir overhead bird deterrent wires.

DEP and its contractor continue to use pyrotechnics, propane cannons, remote-control motorboats, and employ physical chasing techniques to supplement the wire system to actively keep birds off the reservoir. In the winter of 2008, DEP installed remote-operated propane cannons along the reservoir's dividing wall to keep gulls and other birds from roosting on the dividing wall railings. The cannons were supplemented by installation of Daddi-Long-Legs (bird deterrent wires) placed on the tops of the 15' stanchions to prevent birds from roosting. The program enhancements were funded in association with an USEPA Administrative Order. In 2013 DEP installed a new bird deterrent wire system along the reservoir's ½ mile long dividing wall railing to keep gulls and other species from landing and roosting (Figure 33 photo of wires on railing). The newly installed railing wires have been largely successful in preventing gulls from attempting to land on the reservoir dividing wall and can be attributed to the reduced gull activity recorded during this reporting period.

Figure 33. Hillview Reservoir bird deterrent wire system on dividing wall railing.

A USEPA Administrative Order on Consent governing the covering of Hillview Reservoir (Docket No. SDWA-02-2010-8027 Catskill Delaware System) was signed on May 24, 2010. Under this order and beginning on August 1, 2011 DEP began implementing an enhanced wildlife management program at Hillview to further protect the water supply. New best management practices included increased bird census conducted on daily from pre-dawn to post-dusk hours and harassment from 5:00am until port-dusk hours; mammal population monitoring

and removal; alewife (baitfish) monitoring and removal, animal sanitation inspections (facility and grounds inspections and clean-up of animal feces); swallow spp. and sparrow management; and continued monthly reporting on wildlife management activities at Hillview Reservoir.

Overnight waterbird counts have been conducted since 1993 and daytime counts were initiated in the summer of 2004 with less frequent data collected from 1993 through 2004 (Figures 34 and 35). During the period from summer 2004 through early 2007 the overhead bird deterrent wire system was in disrepair and in preparation for replacement. Prior to bird wire mitigation in 1994, gulls comprised more than 70 percent of the night-roosting species on the reservoir. In 2013/2014 night-roosting guilds of birds comprised the following breakdown: Canada Geese 2 percent, Gull Spp. 1 percent, and ducks 97 percent. Except for a low number of diving ducks (Ruddy Ducks, *Oxyura jamaicensis*) all waterbirds observed and reported on both nocturnal and diurnal surveys were dispersed from the reservoir using pyrotechnics, cannons, and physical chasing from 5:00am until post-dusk times. Physical chasing of birds occurs from the time of personnel arrival starting as early as 5:00am. DEP and its contractor crews were largely successful in dispersing the gulls, geese, cormorants, and some ducks once observed.

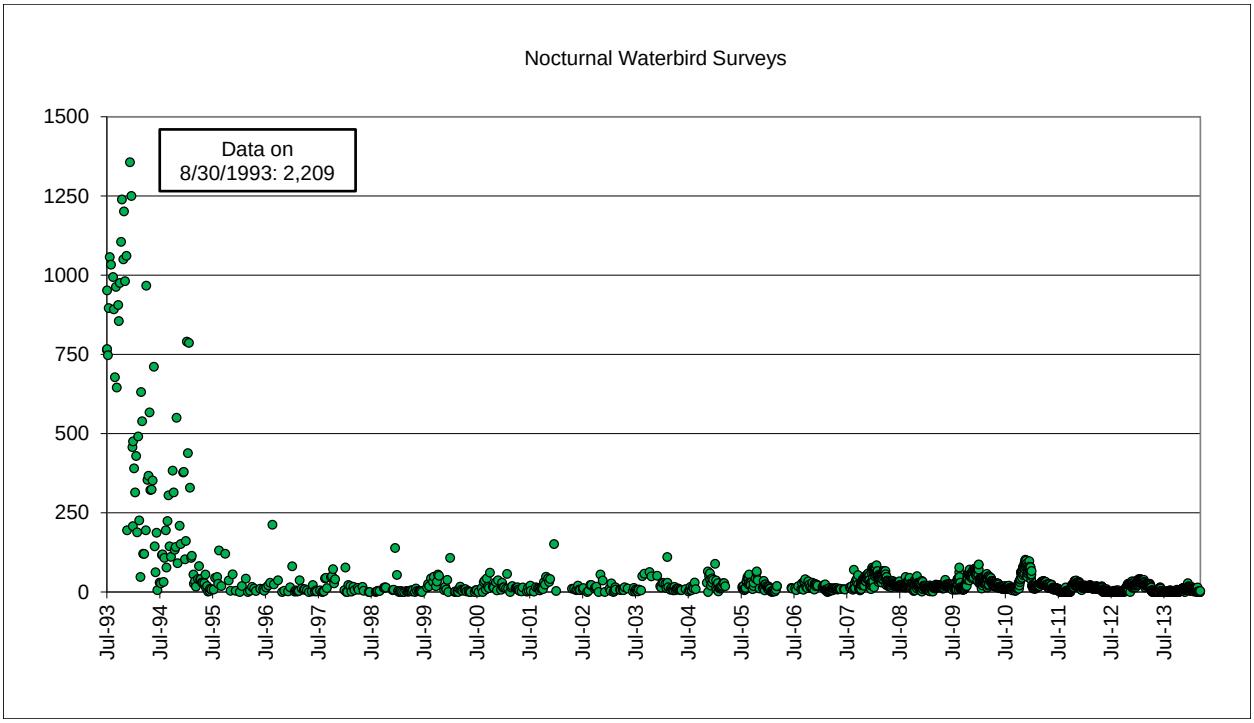

Figure 34. Hillview Reservoir total waterbirds nocturnal counts (1993 to 2014).

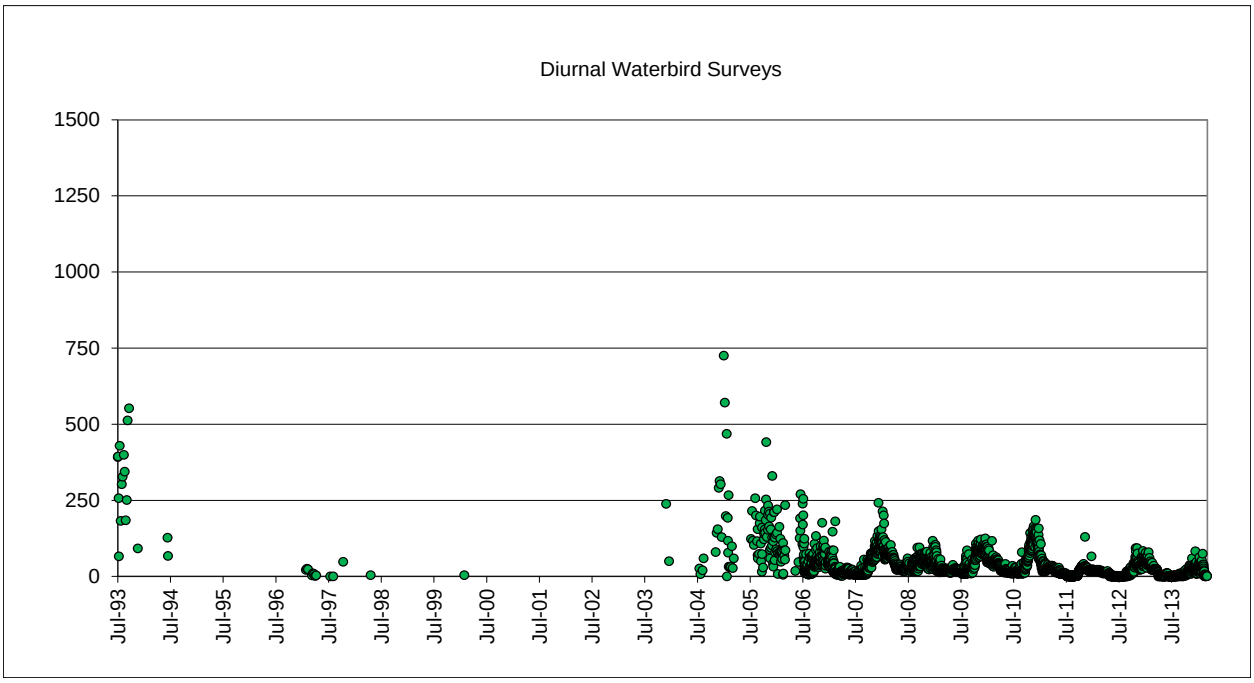

Figure 35. Hillview Reservoir total waterbirds diurnal counts (1993 to 2014).

The diving ducks (Ruddy Ducks and Bufflehead (*Bucephala albeola*)) continue to remain unaffected by a variety of bird deterrent and dispersal measures employed by DEP to date. As a result, DEP utilized contract services with United States Department of Agriculture, Wildlife Services for lethal removal of ducks during this reporting period. The lethal duck removal program was initiated in April 2011 and is conducted on an as-needed basis. A total of 31 Ruddy Ducks and 1 Bufflehead duck were lethally removed by sharpshooters during this reporting period. An additional Mallard duck was live trapped and removed and one Ruddy Duck and one Herring Gull were found dead along the shoreline and subsequently disposed of in 2013/2014.

Overnight and daytime waterbird counts on both basins remained very low and were almost exclusively from a relatively small resident duck population during the autumn and winter. A total of 357 out of a possible 365 overnight surveys conducted were deemed successful. Small numbers of gulls were observed during the overnight period on fourteen of 357 surveys compared to 7 in 2012/2013. On two of the fourteen gull nights', only two gulls were observed roosting in the reservoir and during the remaining twelve nights the gull counts were one. There was one observation of Canada Geese recorded during the overnight observation on January 4, 2014 following a day of no bird hazing activity and probably due to a major winter storm on January 3, 2014 when bird dispersal operations were suspended. Overnight waterbird counts peaked at twenty-four on April 13 and April 16, 2013 compared to a high of 41 in the previous report (DEP 2013).

The behavior patterns of the waterbirds utilizing Hillview Reservoir are different from the other upstate reservoirs reported in the document as Hillview is situated in a highly urbanized area and surrounded by large populations of breeding gulls throughout the NYC metropolitan area. This partially explains why gull activity is a year-around challenge at Hillview. Since the installation of the bird deterrent wire system in 1994, small numbers of gulls and two species of ducks remain the target of active harassment activity.

Water quality results for Hillview are presented in this report as 'number of positive *E. coli'* for each month of the reporting period at four water quality sampling locations (Figures 36-39). *E. coli* (grab samples) levels remained relatively unchanged entering Hillview at water quality sampling locations Site 1 and 2 when compared with samples leaving the reservoir at sampling Site 3 and 58. On two occasions, one each during July and August 2013, there were two positive *E. coli* samples and one positive *E. coli* sample reported respectively at sampling Site 3. The positive *E. coli* detections occurred following a brief period of Ruddy Duck activity during spring migration however it is not consistent with other times of the year when duck counts were higher and there were no positive *E. coli* detections. There is however an annual increase in swallow and swift activity following the breeding season when adults and hatch-year birds are attracted to the reservoir for foraging from properties adjacent to Hillview.

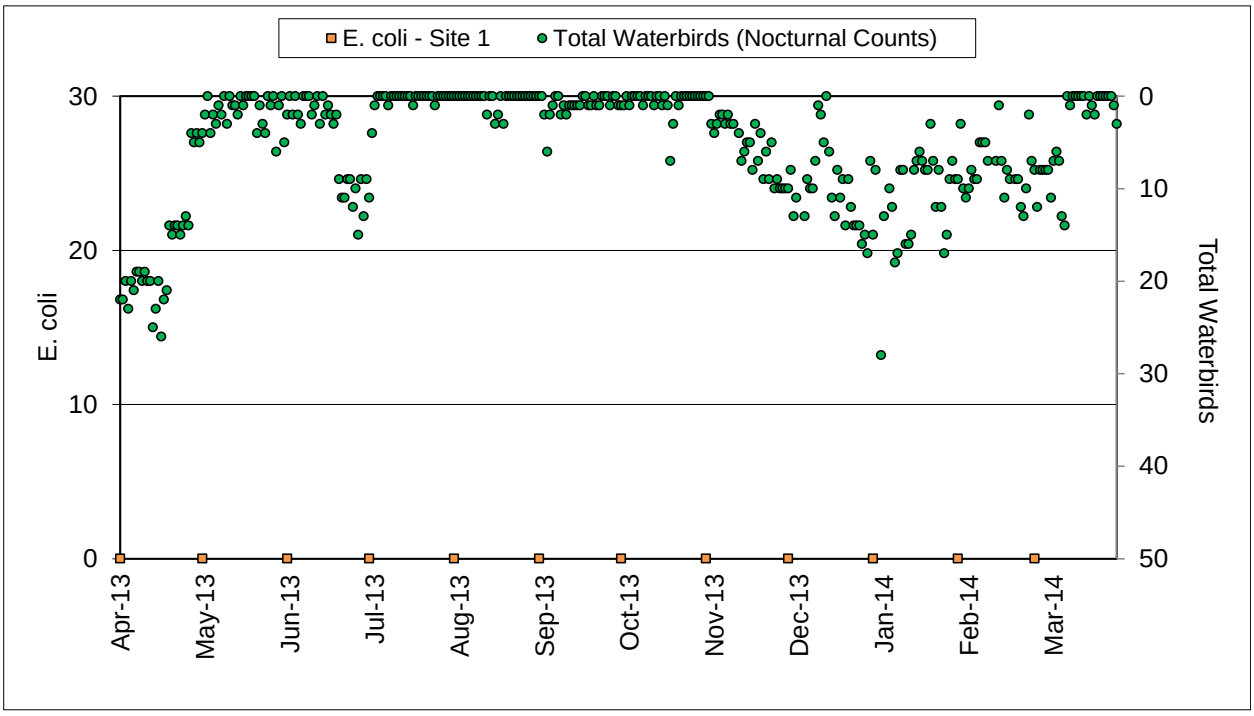

Figure 36. Hillview Reservoir number of positive *E. coli* (grab sample) at water Sampling Site 1 versus total waterbirds (4/1/2013 to 3/31/2014).

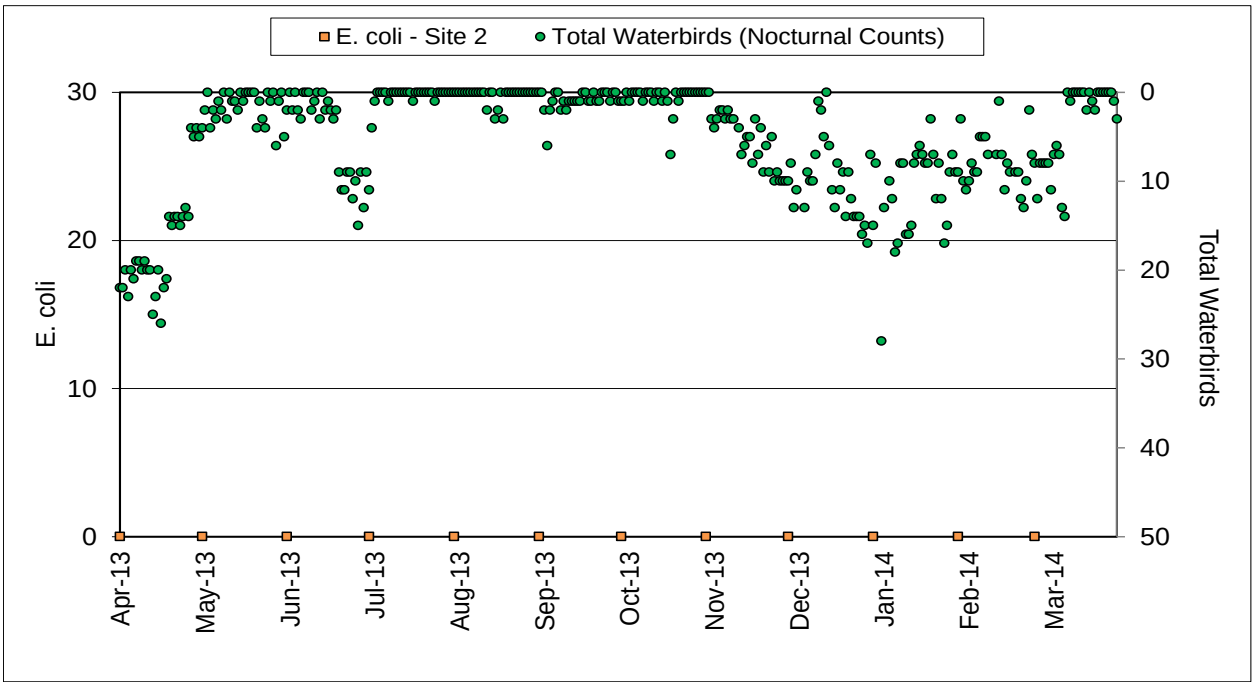

Figure 37. Hillview Reservoir number of positive *E. coli* (grab sample) at water Sampling Site 2 (4/1/2013 to 3/31/2014).

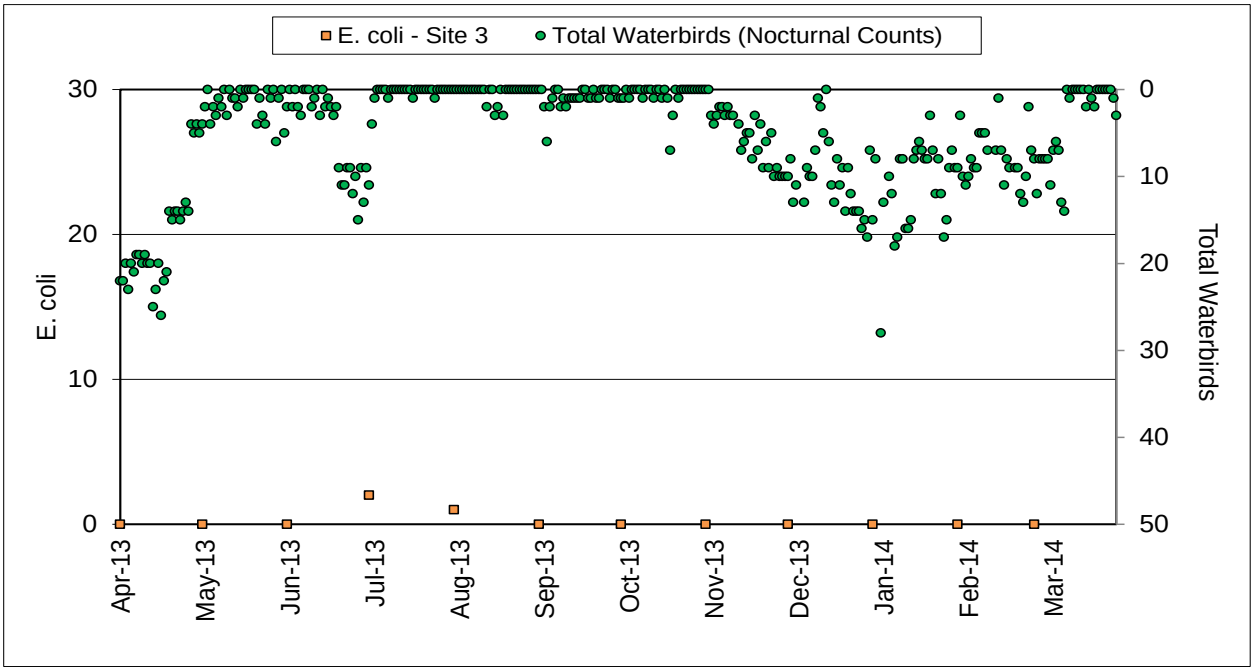

Figure 38. Hillview Reservoir number of positive *E. coli* (grab sample) at water Sampling Site 3 (4/1/2013 to 3/31/2014).

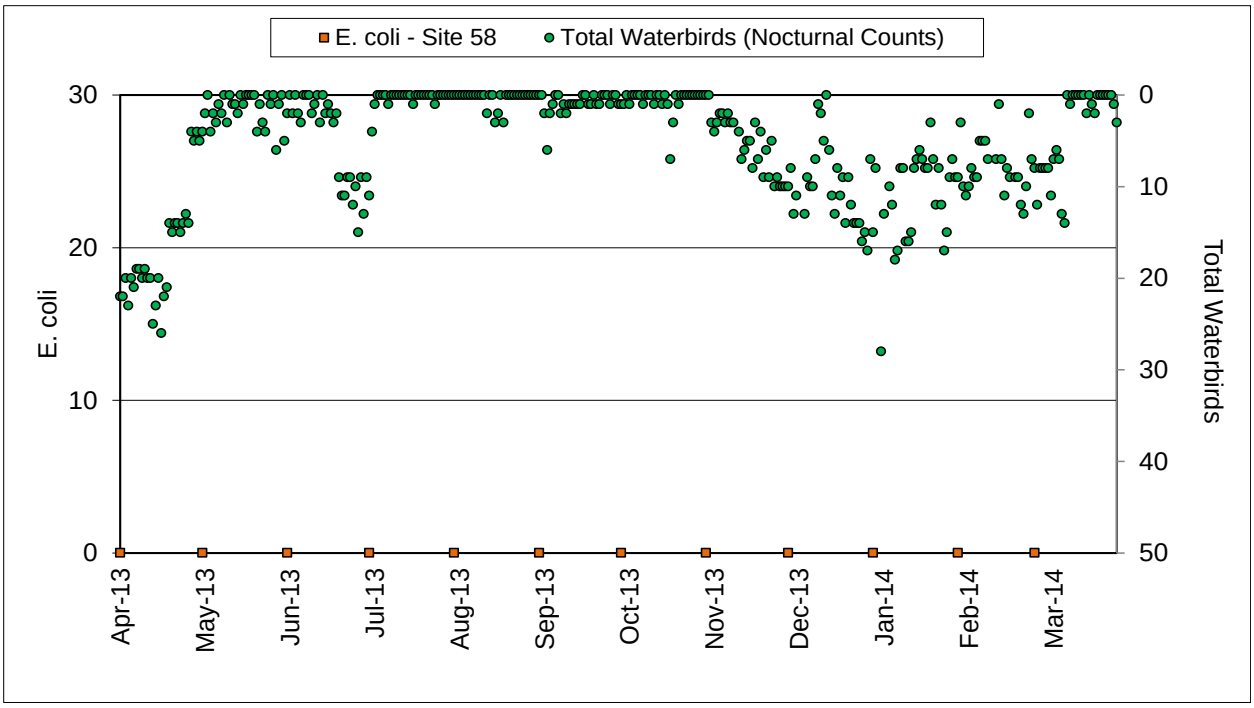

Figure 39. Hillview Reservoir number of positive *E. coli* (grab sample) at water Sampling Site 58 (4/1/2013 to 3/31/2014).

Additional actions employed by DEP working in conjunction with assistance of NYSDEC and USDA Wildlife Services included implementing the following mitigative activities:

- Winter 2008 – Present: Use of remote control propane cannons for bird harassment along the reservoir dividing wall.
- September 2008 and February 2009 – Present: Use of remote control motor boat for harassment.
- December 2008 – Present: Use of canoes, kayaks, and electric motored Jon-boats for harassment.
- September 2009 – Present: Deployment of gill nets and use of electric motored Jon-boats to attempt to capture ducks.
- April 2010 – Experimental lethal shooting employed by the USDA Wildlife Services.
- April 2010 - Nighttime spotlighting using electric motored Jon-boats for capturing ducks.
- July 2010 – Present: Bird netting installed on reservoir shaft buildings intake openings to preclude roosting and breeding swallow spp.
- January 2011 – Present: Submission of a monthly report on wildlife management activities to NYSDOH and USEPA.
- June 2011 – Present: USDA Wildlife Services Contract implemented to remove all resident ducks or other waterfowl that are unsuccessfully harassed or removed by other

non-lethal means as-needed.

- August 2011 – Present: Under the Administrative Order and enhanced wildlife management program was implemented and includes the following:
    - Increased weekly survey shifts from 10 per week to 14 per week to allow daily, dawn to dusk coverage.
    - Daily sanitation surveys – observations and removal of animal fecal matter on the reservoir shaft buildings on the reservoir dividing wall.
    - Weekly small mammal trapping inside the reservoir perimeter fence and on the dividing wall.
    - Removal of Barn and Cliff Swallow nests (Figure 40) on the reservoir shaft buildings and Osprey nests along the dividing wall bird wire stanchions. Nest removal activity approved by USFWS following the birds' breeding season in autumn of 2011 and 2012.
    - Collection and disposal of alewives (baitfish) from the Uptake 1 facility (water received from Kensico Reservoir). Removal of alewives facilitates the elimination of waterbird foraging activity and roosting at the reservoir.
- May 2012 – Present: Expanded access for USDA Wildlife Services Contract sharpshooters to discharge firearms from reservoir dividing wall to improve duck depredation efficiency.
- January 2013 - Present: Received USFWS depredation permit for swallows and Mallard nest/egg/young removal during the breeding season.
- 2013 - Completed installation of avian deterrent wire system on reservoir dividing wall railing.
- 2013 – Present: Expanded access for USDA Wildlife Services Contract sharpshooters to discharge firearms from Jon boats to improve duck depredation efficiency.

Figure 40. Cliff Swallow nests constructed of mud along cornice of shaft buildings.

Mammal Trapping

DEP initiated a year-around mammal trapping program in August 2011 and currently employs trapping efforts for raccoons and other mammals each week of the year. Traps were generally set around the Downtake 1 and Uptake 1 perimeter catwalks and along the dividing wall close to the shaft buildings. A variety of commercial and supermarket-type trapping baits have been used with variable success. Traps have been outfitted with catchment plates to avoid release of fecal material from trapped animals into the reservoir. All traps are secured with wires to the railing system to prevent trap roll-overs. To date, raccoons have been the most frequently trapped species. Other mammals trapped and subsequently depredated under New York State Department of Environmental Conservation approval include striped skunk (*Mephitis mephitis*), Virginia opossum (*Didelphis virginiana*), mice (*Peromyscus* Spp.), meadow vole (*Microtus pennsylvanicus*), and northern short-tailed shrew (*Blarina brevicauda*).

In 2013/2014 a total of 2,431 traps were set; an increase of 35% from the 2012/2013 reporting period (Table 10 and 11). Seven raccoons (*Procyon lotor*) were successfully removed compared to only two in the previous report.

Table 10. Mammal trapping summary April 2013 through March 2014.

Month/Year	Number of Live-traps Set	Trapping Success
April 2013	156	2 Raccoons
May 2013	144	No success
June 2013	84	No success
July 2013	252	2 Meadow Voles, 1 *Peromyscus* Spp.
August 2013	296	4 Raccoons, 1 Meadow Vole, 3 *Peromyscus* Spp., and 1 Short-tailed Shrew
September 2013	288	2 Peromyscus and 1 Meadow Vole
October 2013	360	No success
November 2013	192	No success
December 2013	192	No success
January 2014	192	No success
February 2014	132	No success
March 2014	143	1 Raccoon

The success of the trapping program is displayed in Table 10 and Figure 41. A total of 49 mammals from 6 species have been live-trapped inside the reservoir perimeter fence. All trapped specimens were euthanized and subsequently composted at the DEP Animal Compost Facility located in Ulster County. A total of 3,298 mammal trapping nights have been set since August 2011. A single mammal trapping night consists of one trap baited for one night.

Table 11. Trapping success summary for Hillview Reservoir (August 2011 to April 2014)

Species Trapped	2011 (August 1 to December 31)	2012	2013	2014 (January 1 to April 30)	Trapping totals by species
Raccoon	12	5	6	1	**24**
Striped Skunk	0	1	0	0	**1**
Opossum	0	0	0	1	**1**
Mice (*Peromyscus* Spp.)	7	0	11	0	**18**
Meadow Vole	0	0	4	0	**4**
Short-tailed Shrew	0	0	1	0	**1**
Annual Trapping totals	**19**	**6**	**22**	**2**	**49**

The number of raccoons successfully trapped has declined at Hillview since the inception of the enhanced wildlife management strategy back in 2011. Year-around mammal trapping may be a contributing factor for a decline of the raccoon population on the Hillview property. DEP also completed a capital project improvement which included the elimination of potential denning locations for raccoons through the removal of trees and patches of unmaintained vegetation around the reservoir dike perimeter. This habitat modification could also be contributing to the apparent decline in the population of raccoons.

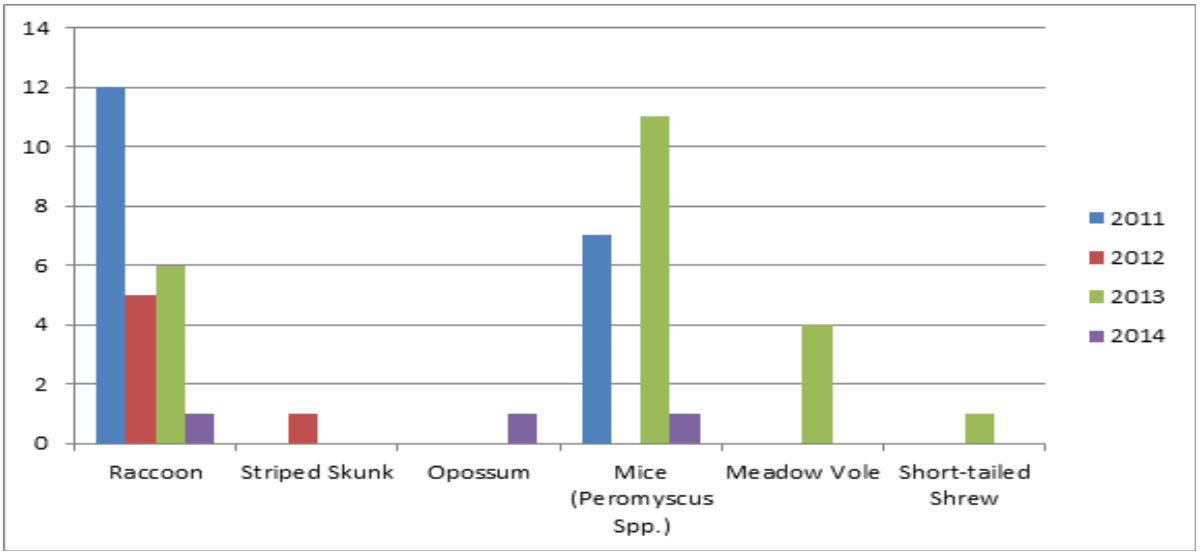

Figure 41. Comparison of species trapped at Hillview Reservoir (August 2011 to April 2014).

As part of the current DEP ongoing wildlife management initiatives, nighttime remote sensing cameras have been used to document the presence or absence of wildlife on the reservoir dividing wall and catwalks surrounding the shaft buildings at Hillview. Figure 42 represents the occurrence of nighttime remote camera photographs of animals versus the trapping success. The number of camera hits of wildlife appear to peak during the spring may coincide with raccoon breeding cycles and young present. Raccoons are known to breed during the later winter period and have a 63 day gestation period which would suggest birthing in April and May. Raccoon home range can be 2 to 4 miles and extend to further distances during the autumn whereby the occurrence increase in the autumn may be attributed to these movements. The low camera detection and trapping success rate during the winter may be attributed to a lack in insect-type food that attracts them to the reservoir dividing wall. The low detection rate of raccoons during the summer may be a result of alternate available feeding locations including berries and seeds found in the surrounding habitat.

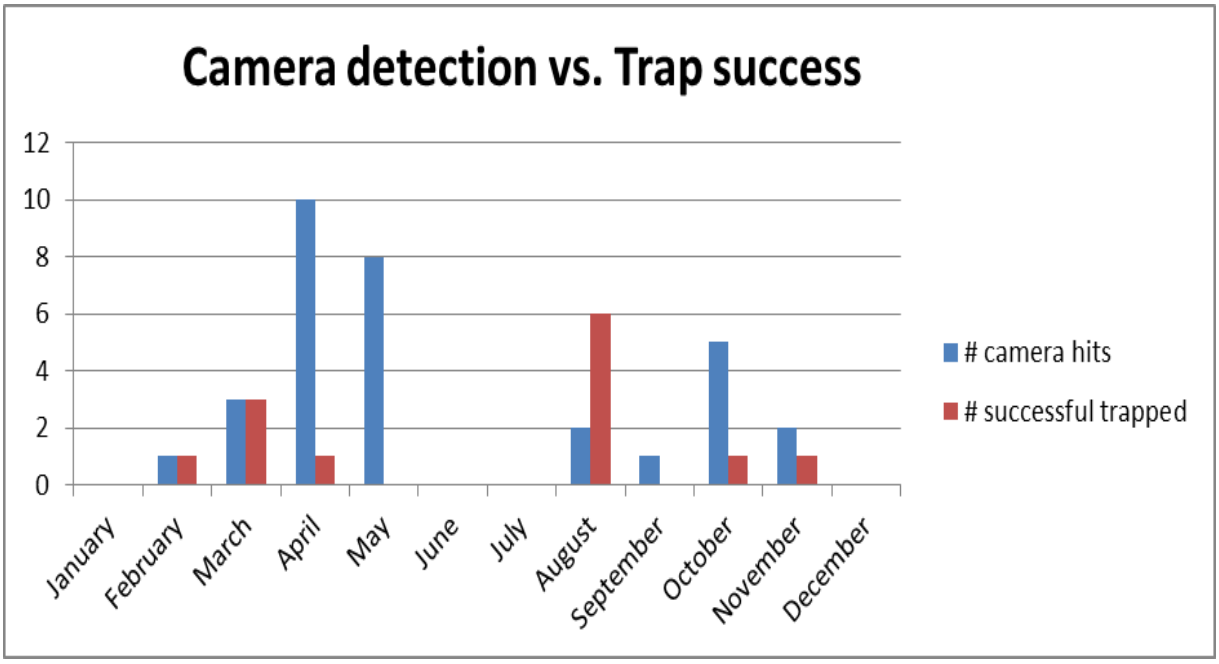

Figure 42. Occurrences of remote nighttime photography of animals recorded on the reservoir catwalk and dividing wall versus trapping success (August 2011 to April 2014).

During the 2013/2014 waterbird nesting season there were no reported nesting attempts by Canada Geese or Mute Swans however two Mallard nests were identified and subsequently depredated under permit. A total of 9 Mallard eggs were depredated in July. One of two nests produced a total of 6 ducklings that were promptly live-captured and delivered to a wildlife rehabilitator for captive release and subsequent released at locations distant from Hillview Reservoir. A total of 9 Mallard eggs were depredated in July. The Mallard egg depredation success rate was 70% for 2013/2014.

CONCLUSION

DEP's Waterfowl Management Program is a key component to the City's continuance of Filtration Avoidance as outlined under the 2007 Filtration Avoidance Determination. The program has helped DEP maximize options for delivering high quality water into distribution. The Waterfowl Management Program has been in continuous operation since 1993 and continues to effectively reduce waterbird populations and reduce fecal coliform bacteria levels which have assisted DEP in maintaining compliance with the Environmental Protection Agency's Surface Water Treatment Rule as part of the Safe Drinking Water Act (42 U.S.C. §300f et seq.) regulations.

The reduced waterbird and related fecal coliform bacteria counts at Kensico Reservoir and Hillview Reservoir can be attributed directly to the variety of bird dispersal and deterrence techniques. When dispersal tools (motorboats, airboats, propane cannons, and pyrotechnics) are used in a variety of combinations they result in the most effective means to bird reduction over large open areas of drinking water. To date, it remains inconclusive what the tolerable number of waterbirds is at NYC reservoirs before water quality is compromised; therefore, the objective of the Waterfowl Management Program will be to continue with the an active harassment program during the bird migratory seasons for Kensico and year-around at Hillview Reservoirs and on an "as-needed" basis for reservoirs that are a direct source to Kensico.

The establishment of bird-free zones (spatial distributions) around the water intake structure at Kensico Reservoir, whether program-initiated through harassment or by the natural process of the birds selecting roosting locations, continues to be a key influence on lower fecal coliform bacteria levels. The spatial distributions of the birds in relation to the flow dynamics of the reservoir appear to have the greatest influence in the transport of bacteria to the water intakes. It is evident that when DEP properly manages its waterbird populations, bird-related fecal coliform bacteria concentrations have remained low.

Bird deterrence measures which include waterbird reproductive management, bird deterrent netting, overhead bird deterrent wires, shoreline fencing, and meadow management continued to reduce local breeding opportunities around water intake structures and eliminate fecundity during this reporting period. DEP will continue to consider options as deemed necessary for Canada Geese and Mute Swan management to reduce local breeding populations by means of "take" under federal and state depredation permits. The "take" option was utilized by the USDA as part of the Westchester County Airport depredation order to remove local Canada Geese during this reporting period. The removal of locally breeding Canada Geese helps break the strong nest-site fidelity these birds exhibit particularly with a species that may survive more than 20 years as a breeder.

At Hillview Reservoir, DEP continued to employ the use of pyrotechnics, physical chasing, remote-operated propane cannons, remote-control motorboats, Daddi-Long-Legs, bird

deterrent wires and netting to prevent ducks, gulls and other non-waterbird species from landing on the reservoir dividing wall, and including additional lethal control measures to manage ducks, geese, swallows and sparrows. Remote-operated propane cannons have improved bird deterrence during times of inclement weather when DEP and contractor staffs are not permitted on the reservoir dividing wall and pyrotechnics are rendered ineffective from the reservoir shoreline. As a part of the Administrative Order, DEP has initiated small mammal trapping inside the reservoir perimeter fence and on the reservoir dividing wall. In 2013/2014 a total of 2,431 traps were set; an increase of 35% from the 2012/2013 reporting period. Seven raccoons (*Procyon lotor*) were successfully removed compared to only two in the previous report. Under the current program, DEP is allowed under federal and state law to remove the swallow nests outside the active breeding period and did conduct such activity during this reporting period. A total of 86 Swallow nests were removed from the reservoir shaft buildings from April through July 2013. DEP has received a federal depredation permit for 2013 to remove active swallow nests during the nesting period at Hillview Reservoir if deemed necessary.

Waterbird populations continue to demonstrate seasonal elevations primarily during the autumn and winter periods in all reservoirs listed in this report. Climate alterations can affect behaviors and migratory activity changes of "local" or resident birds such as Canada Geese. Gull populations are migratory and utilize the New York City Reservoir system as a migratory stop-over or wintering area until local conditions (i.e. ice and snow cover) become too intolerable. Ice cover on the reservoirs and snow cover in the associated watershed or daily flight range for food often determine whether they will continue in migration or utilize the reservoirs.

DEP continues to remain in compliance with SWTR regulations, with low seasonal elevations of fecal coliform bacteria recorded annually from late autumn through early winter. Monitoring the effects that bird dispersal measures have on each reservoir has been achieved through over two decades of routine water quality monitoring, population surveys and identifying bacteria origins as-needed. Avian population survey results have provided inferences about the potential effects of avian fecal matter based on the spatial and temporal aspects of the birds and have also assisted DEP in evaluating the effectiveness of the dispersal measures. DEP will continue with the implementation of the Waterfowl Management Program as part of its Filtration Avoidance Program to protect water quality by managing waterbird populations.

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Appendix A. Reservoir maps with bird zone designations and water sampling locations

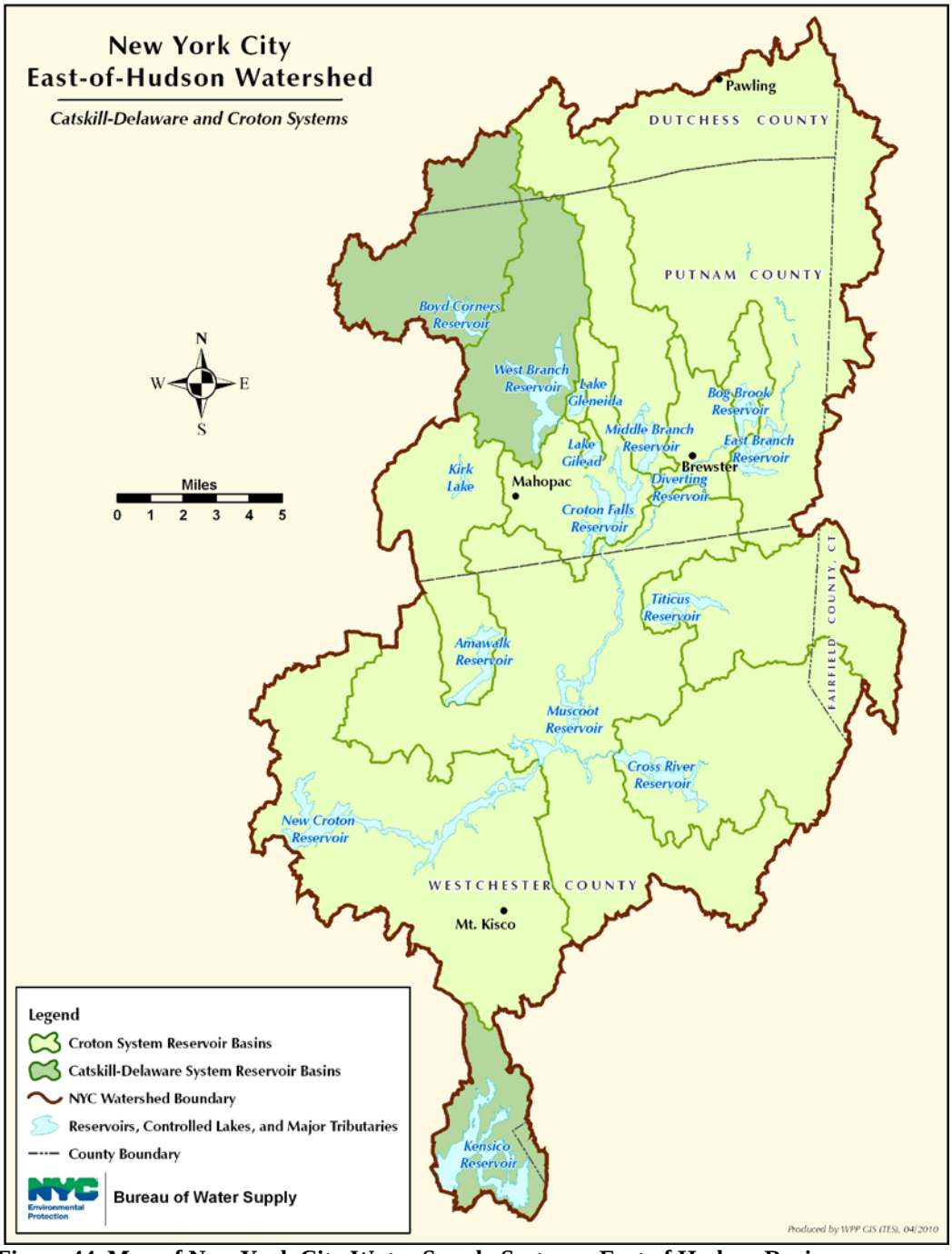

Figure 44. Map of New York City Water Supply System – East of Hudson Region.

Figure 45. Map of New York City Water Supply – West of Hudson Region.

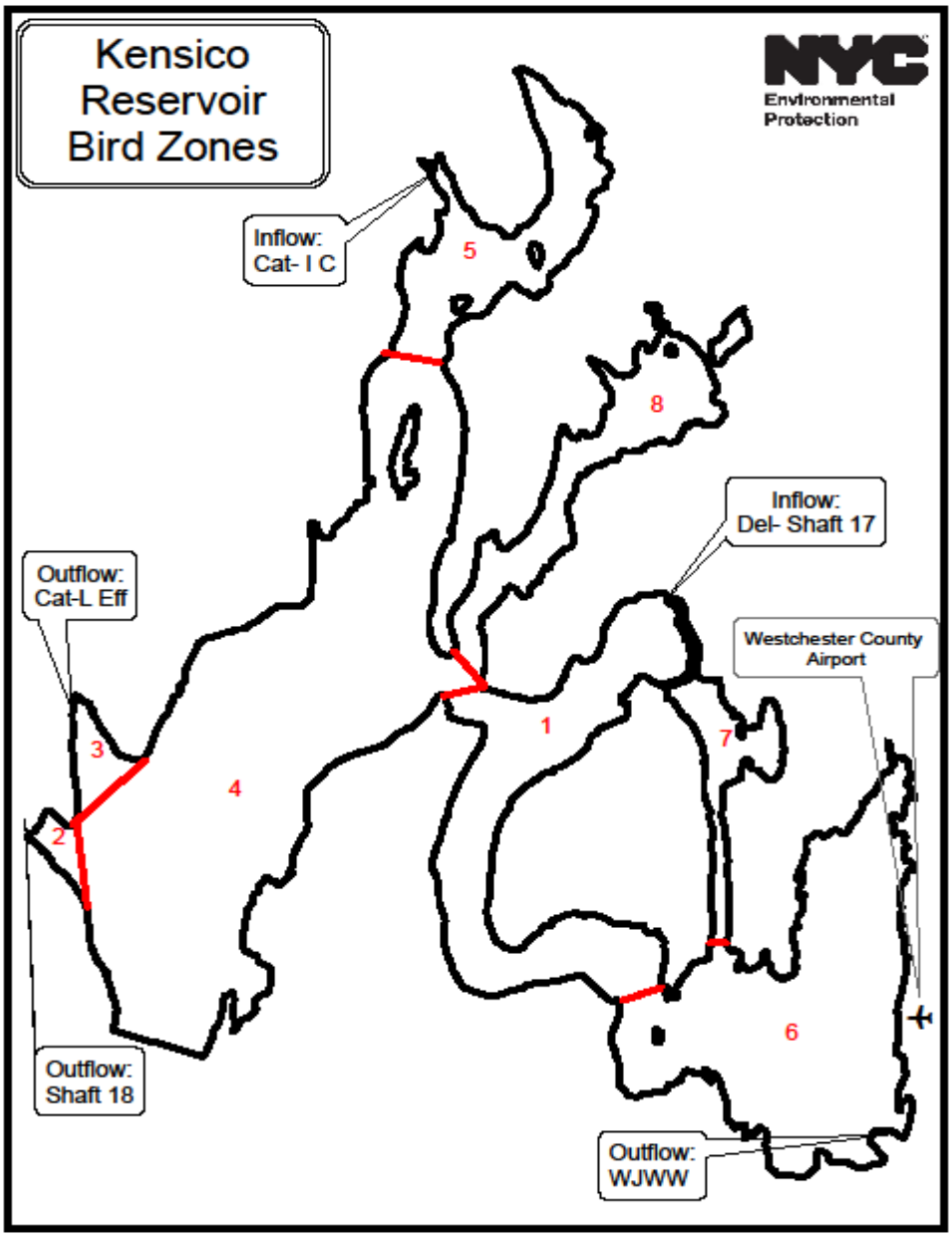

Figure 46. Map of Kensico Reservoir bird zones.

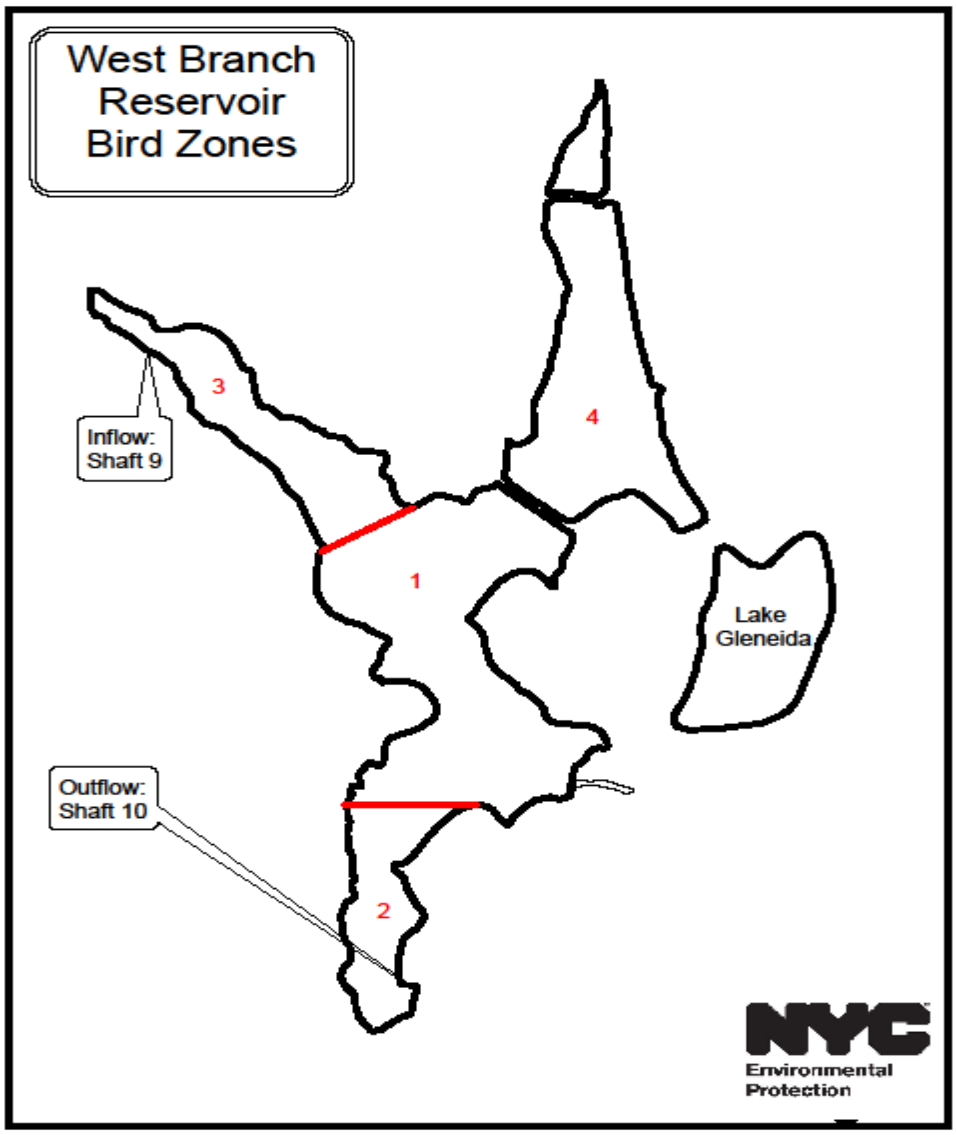

Figure 47. Map of West Branch Reservoir bird zones.

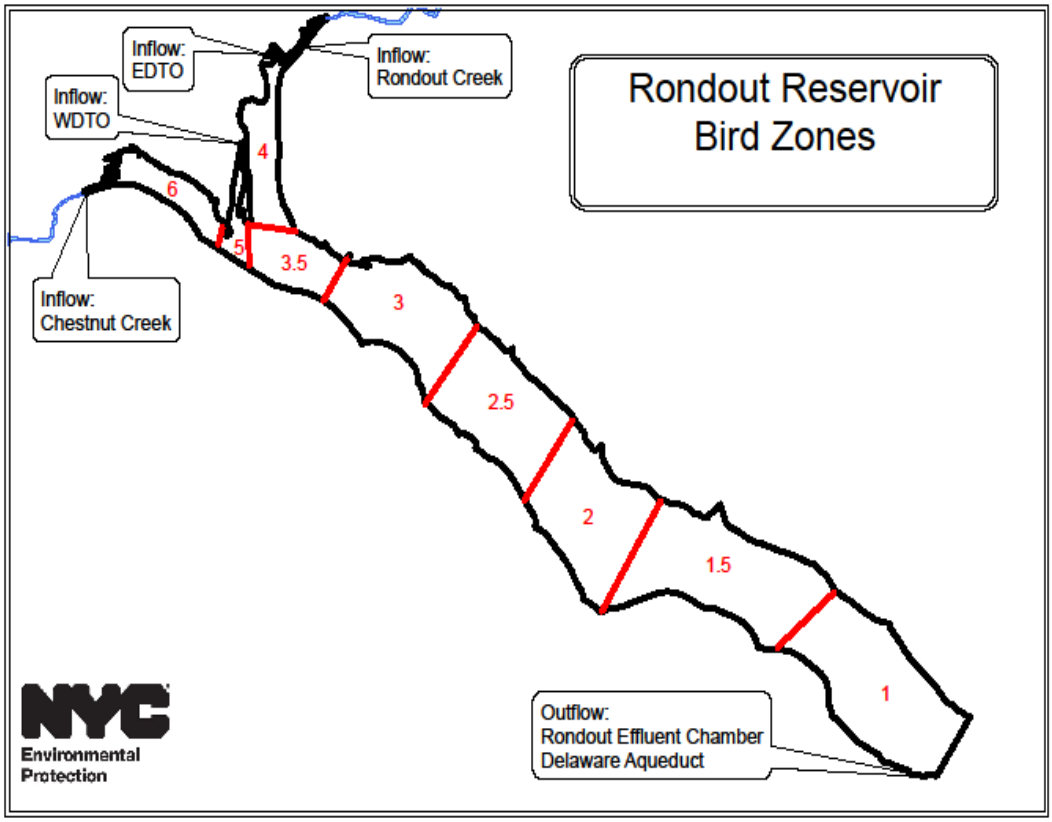

Figure 48. Map of Rondout Reservoir bird zones.

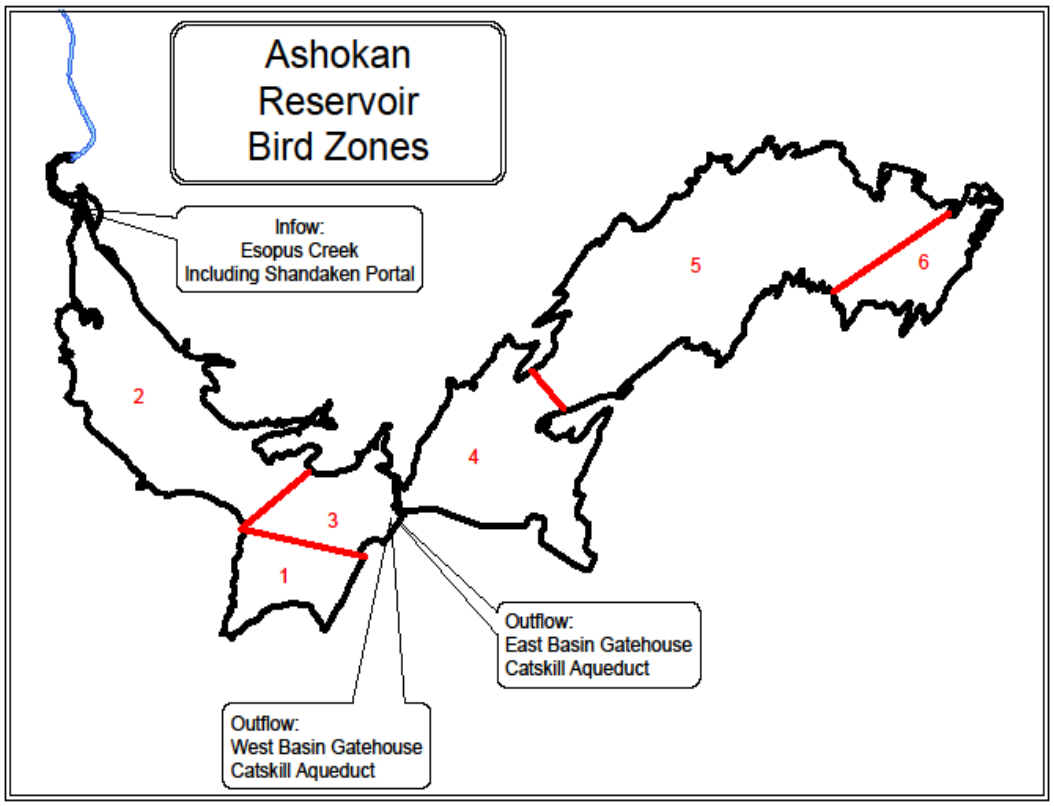

Figure 49. Map of Ashokan Reservoir bird zones.

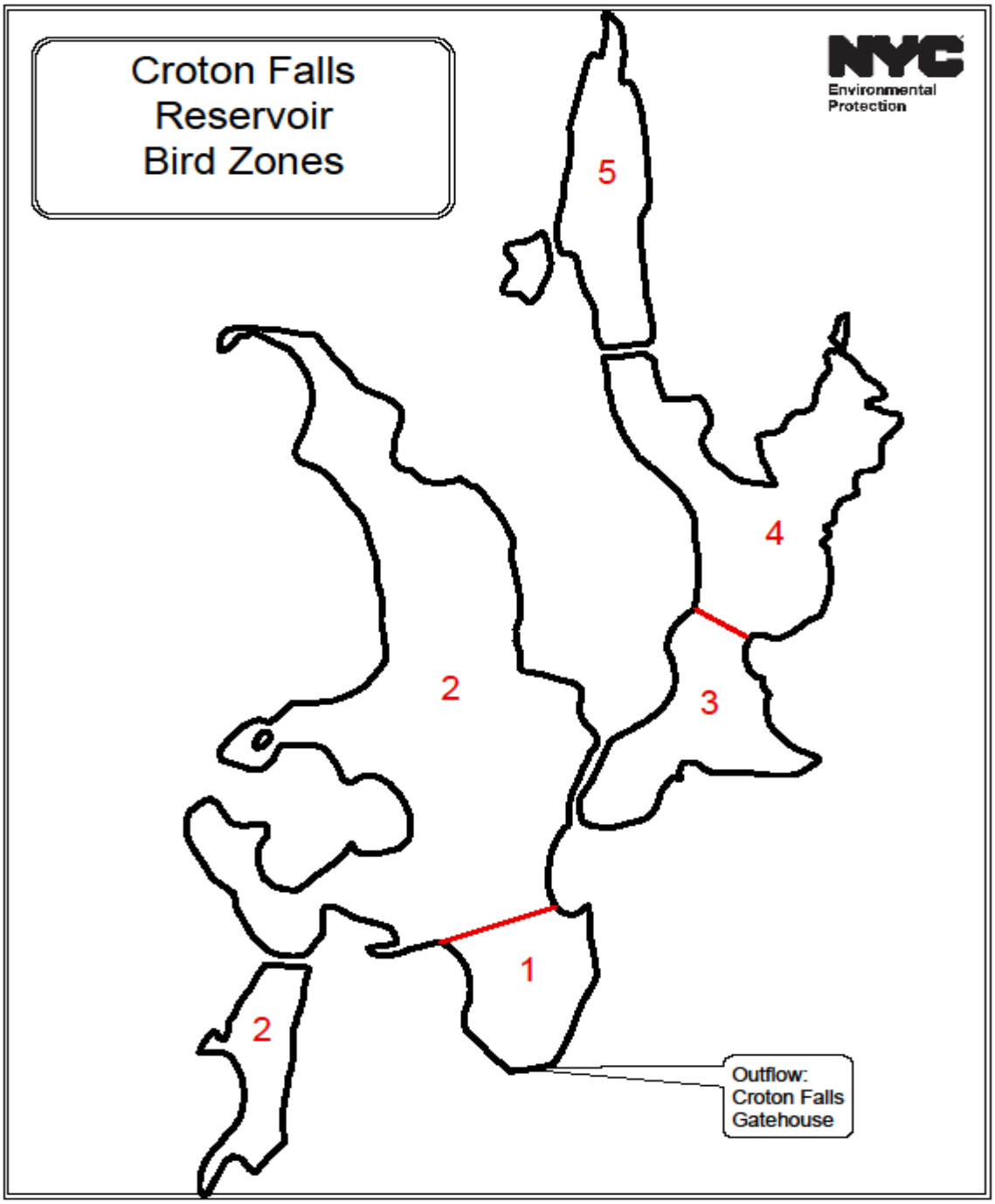

Figure 50. Map of Croton Falls Reservoir bird zones.

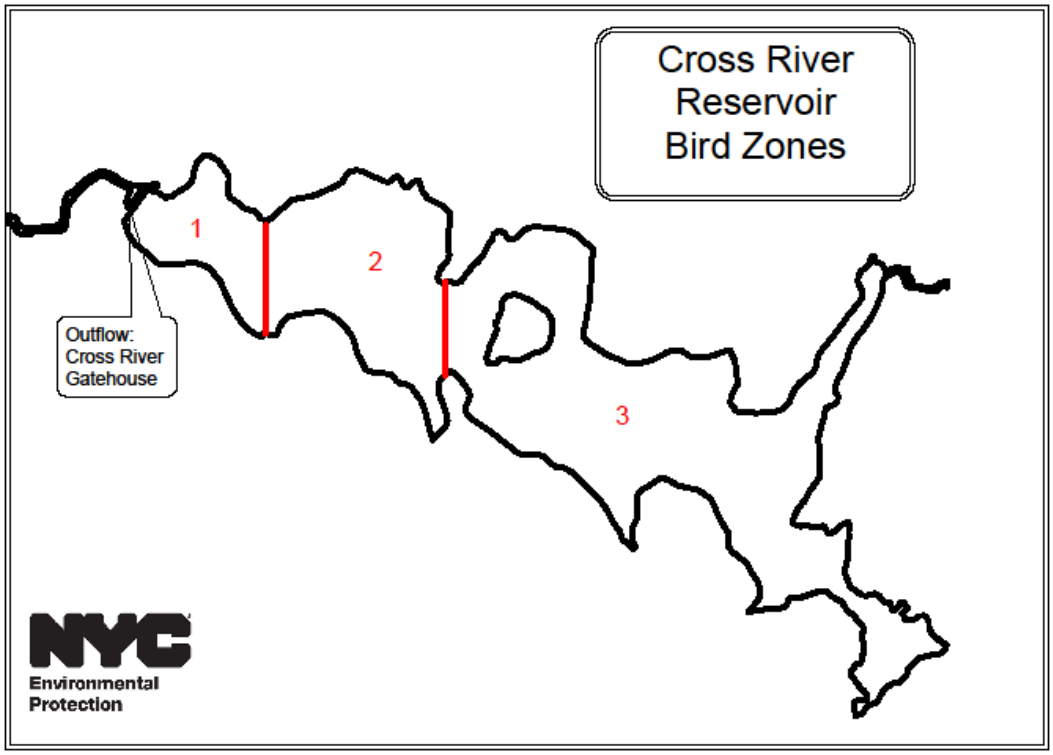

Figure 51. Map of Cross River Reservoir bird zones.

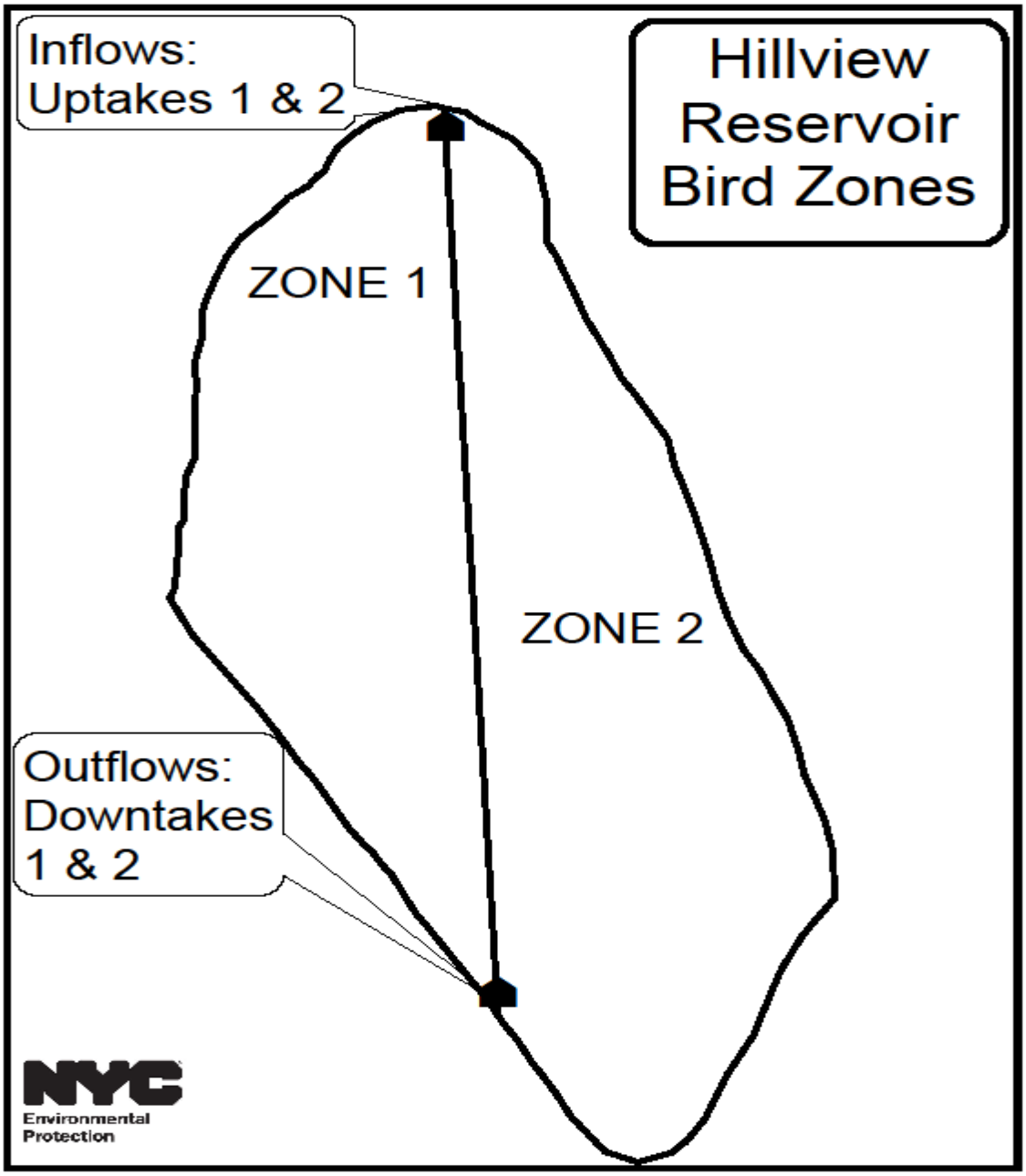

Figure 52. Map of Hillview Reservoir bird zones.

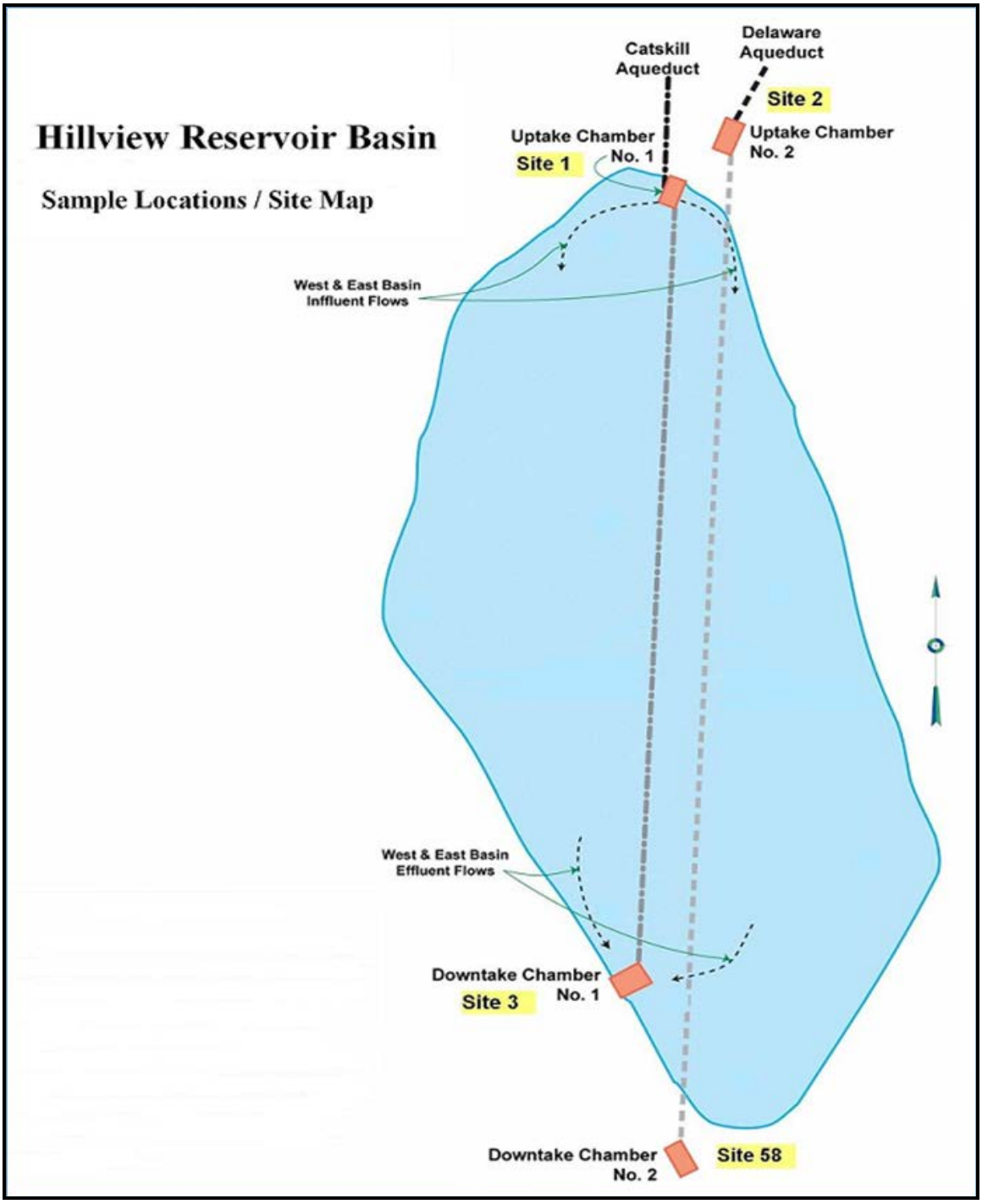

Figure 53. Map of Hillview Reservoir water sampling locations.