New York City Department of Environmental Protection
Bureau of Water Supply

Waterfowl Management Program

September 30, 2013

Prepared in accordance with the Final 2007 (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, 2012 to March 31, 2013, 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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Bureau of Water Supply
Division of Watershed Water Quality Operations

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The author, Mr. Christopher A. Nadareski, is DEP's Section Chief of Wildlife Studies and Contract Project Manager. He is responsible for the Waterfowl Management Program oversight including data management, field data collection, and contract administration.

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 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) was also expanded to included bird management at Hillview Reservoir in Yonkers, New York. The new FAD (draft 2013) Mid-term report is expected to be approved and released in 2013.

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 (NYS-DEC) 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 NYS-DEC 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 - 2012). 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 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, 2012 through March 31, 2013.

METHODS

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. 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 serve Kensico with its source water. The remaining two (Cross River and Croton Falls), while in the Croton System, may serve Kensico with source water under special circumstances. 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 NYS-DEC.

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:

- Current bird populations, including roosting or staging locations relative to water intakes;
- Fecal coliform bacteria concentrations approaching or exceeding 20 fecal coliform per $100mL^{-1}$ water samples collected at reservoir effluent structures coincident with elevated bird populations;
- 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
- Determination that active bird management measures would be effective in reducing bird populations and fecal coliform bacteria levels.

The 2007 FAD (Table 1) requires that DEP continue implementation of its Waterfowl Management Program in accordance with Section 2.3.1 of the City's 2006 Long-Term Watershed Protection Program and the milestones therein with the following clarification:

- DEP will perform avian population monitoring in accordance with the frequencies specified in the City's 2001 Watershed Protection Program Summary, Assessment and Long-term Plan.

Table 1. Final 2007 FAD requirements.

Requirements	Due Date
Active Bird Harassment – Kensico Reservoir	8/1 to 3/31; Annually
"As needed" Bird Harassment – West Branch, Rondout, Ashokan, Cross River, Croton Falls, and Hillview Reservoirs	8/1 to 4/15; Annually
Avian Deterrent Measures – Kensico, West Branch, Rondout, Ashokan, Cross River, Croton Falls, Hillview Reservoirs and other City reservoirs as needed	Year-round; Annually
Submit annual summary of Waterfowl Management Program activities including contract status, and implementation and analysis of all program elements (including special studies)	7/31; Annually (Approved change to 9/30 annually under mid-term revisions to Final Draft 2007 FAD)

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.

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, 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. Otherwise precipitation events and fog prohibited data collection resulted in short gaps of "no data". Reservoir maps with bird zones can be found in Appendix A.

The July 2007 FAD, Section 6.4.1 specifies the frequency of reservoir surveys and is listed in Table 2. Proposed and actual surveys conducted from April 1, 2012 to March 31, 2013 are also listed in Table 2.

Table 2. Frequency of bird observation surveys by reservoir 2012/2013 (as listed under the November 2002 FAD, Section 6.4.1 and USEPA Administrative Order on Consent governing the covering of Hillview Reservoir (Docket No. SDWA-02-2010-8027 Catskill Delaware System).

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 all year; Increased to daily "as needed"	52/52
Rondout	Pre-dawn, Midday, and Post-dusk Weekly all year; Increased to daily "as needed"	52/52
Ashokan	Pre-dawn, Midday, and Post-dusk Weekly all year; Increased to daily "as needed"	52/52
Croton Falls	Pre-dawn, Midday, and Post-dusk Bi-weekly all year; Increased to daily "as needed"	26/26
Cross River	Pre-dawn, Midday, and Post-dusk Bi-weekly all year; Increased to daily "as needed"	26/29[3]
Hillview	Pre-dawn, Midday, and Post-dusk Daily all year	365/362[2]

[1] A total of three surveys were cancelled due to holidays.
[2] Three additional surveys were cancelled due to inclement weather (Hurricane 'Sandy' on October 29 – 30, 2012 and Winter Storm 'Nemo' on February 9, 2013).
[3] Three additional waterbird surveys were conducted in 2012 for pump test operations.

Reservoir-wide observational surveys for waterbirds were conducted year-round at all six reservoirs listed (Table 2). Each survey recorded species evenness (number per species), species richness (species diversity), roosting and foraging locations, bird band/collar identifications, and general behavior during the overnight roosting period. Waterbird data are collected from shoreline locations and/or watercraft (motorboat, Jonboat, 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 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. Distribution DEP 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 and EWM218, Carmel for West Branch).

Waterbird Dispersal 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, 2012 through March 31, 2013 using motorboats, Biondo Airboats, Jonboats, 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 2012/2013 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 was initiated 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.

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) to remove the dead fish that collected at the boom. Collection of Alewives is also conducted as needed at Hillview Reservoir. Alewives are an attractive food source for avian piscivorous species such as gulls and some species of ducks and when large numbers of fish are flushing into the reservoir, making the birds very difficult to manage.

Table 3. Reservoir bird mitigation (April 1, 2012 - March 31, 2013).

Reservoir	Dates of Bird Harassment/Deterrence/Depredation	Bird Harassment/Deterrence/Depredation Measures Used
Kensico	August 1, 2012 – March 31, 2013	Bird harassment (motorboats, airboats, Jonboats, pyrotechnics, and Bird distress tapes), waterbird egg and nest depredation, shoreline meadow management and fencing, Alewife collections, and bird netting for terrestrial bird management (swallows, starlings, pigeons, etc.)
West Branch*	April 1, 2012 – May 31, 2012	Waterbird egg and nest depredation
Rondout*	April 1, 2012 – May 31, 2012	Waterbird egg and nest depredation
Ashokan*	April 1, 2012 – May 31, 2012	Waterbird egg and nest depredation
Croton Falls*	April 1, 2012 – May 31, 2012	Waterbird egg and nest depredation
Cross River*	April 1, 2012 – May 31, 2012	Waterbird egg and nest depredation
Hillview	April 1, 2012 - March 31, 2013	Bird deterrent overhead wire system, bird harassment (pyrotechnics, propane cannons, physical chasing, remote control motorboats), small mammal management, Alewife (baitfish) collections, bird netting for terrestrial bird management (swallows, sparrows, etc.), bird deterrent wires on shaft buildings, nest and egg depredation for ducks, swallows and sparrows, and lethal duck management

*Indicates reservoir whereby mitigation only occurs "as needed" under the Final 2007 FAD, Section 6.4.1.

Waterbird Reproductive Management

Canada Geese and Mute Swan egg and nest depredation techniques were conducted during the spring of 2012 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. 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.

Table 4. 2012 Canada Geese, Mute Swan, and Mallard[2] nest census and egg-depredation.

Reservoir	Number of Surveys	Canada Geese/Mute Swan/Mallard Nests	Canada Geese/Mute Swan/Mallard Eggs Depredated	Canada Geese/Mute Swan/Mallard Depredation Success Rate
Kensico	7	16/1/0	65/9/0	93 percent (5 goslings)/100 percent (0 cygnets)/NA
West Branch	4	8/0/0	34/0/0	94 percent (2 goslings)/NA/NA
Rondout[1]	1	3/0/0	21/0/0	75 percent (7 goslings)/NA/NA
Ashokan	2	3/0/0	16/0/0	52 percent (15 goslings)/NA/NA
Croton Falls	4	12/0/0	70/0/0	92 percent (6 goslings) /NA/NA
Cross River	3	9/0/0	47/0/0	98percent 1 gosling)/NA/NA
Hillview[2]	91	0/0/2	0/0/14	NA/NA/100 percent

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

A total of 51 Canada Geese nests containing 253 eggs were depredated (punctured) at six New York City Reservoirs (Table 4) during the spring of 2012 compared to 65 nests and 278 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 NYS-DEC permit (#3-12-58) 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 2012 during this reporting period.

RESULTS and DISCUSSION

1. Kensico Reservoir

Kensico Reservoir receives water from Rondout and West Branch Reservoirs via the Delaware Aqueduct and from the Ashokan Reservoir via the Catskill Aqueduct. Water leaving Kensico is disinfected with chlorine and ultraviolet light (began in October 2012) prior to being delivered via aqueduct to Hillview Reservoir. Kensico Reservoir has been divided into eight Bird Zones to compare bird counts with water samples collected at limnological sampling locations. 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 39). These open water areas tend to attract concentrations of gulls roosting overnight.

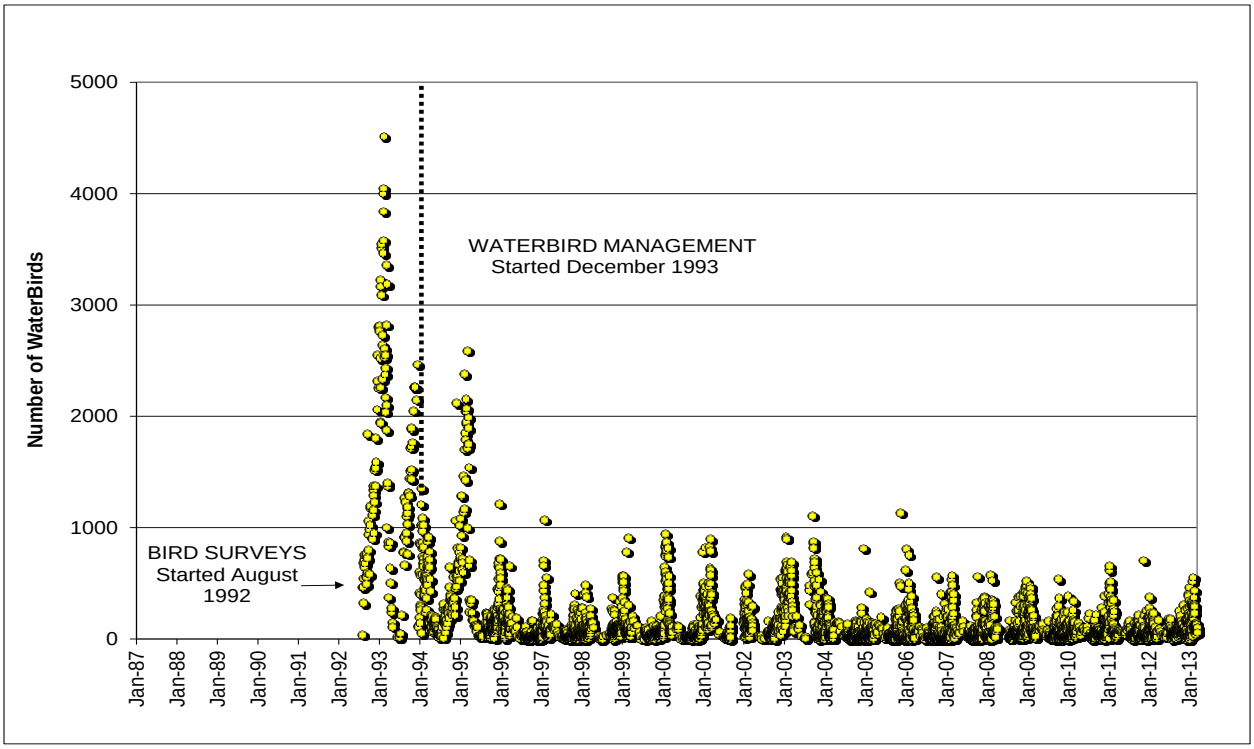

Figure 1. Kensico Reservoir waterbird totals.

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 in 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

inception of the bird harassment efforts, and this observation (or effect) continues through the present day (Figure 2).

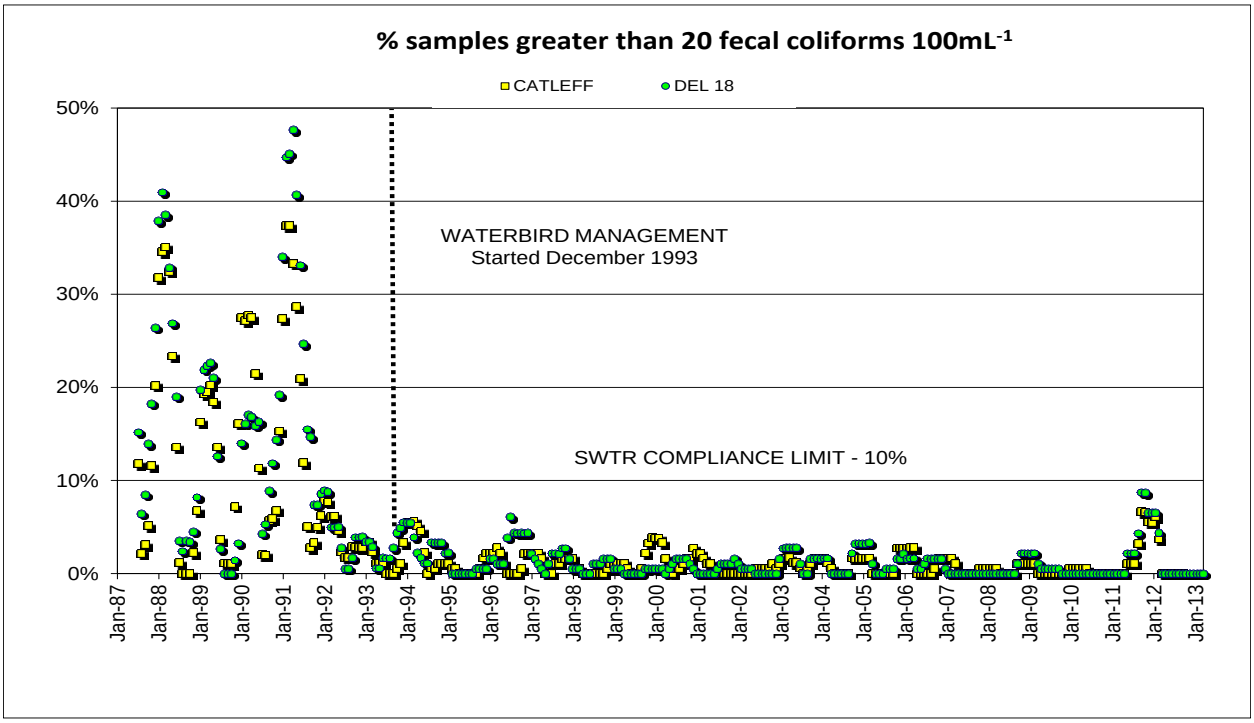

Figure 2. Kensico Reservoir Surface Water Treatment Rule compliance (fecal coliforms 100mL^{-1} at DEL18/DEL18DT and CATLEFF).

The WMP continued to maintain a high level of success from April 1, 2012 through March 31, 2013 managing waterbirds on select NYC reservoirs. Resident and migratory waterbird populations were kept at low levels (Figure 1). Figures 3 through 5 compare the regulatory source water samples collected from Delaware Shaft 18 (DEL18/DEL18DT) and the Catskill Lower Effluent Chamber (CATLEFF) with respect to fecal coliform bacteria and reservoir bird counts for 2011/2012 and 2012/2013 seasons. On August 20, 2012 DEP officially changed the sampling location from the DEL18 forebay site to the DEL18 downtake and changed the name for raw water compliance samples from 'DEL18' to 'DEL18DT'. From April 1, 2012 through March 31, 2013 the maximum monthly percentage of source water sample results above 20 fecal coliforms 100mL^{-1} remained at 0 percent for DEL18/DEL18DT (Figure 2). The CATLEFF effluent also remained at 0 percent from April 1, 2012 through September 13, 2012. After September 13, 2012 the CATLEFF system was taken off-line (Figure 2) and no subsequent fecal coliform bacteria data for this sampling location is reported in this document. For comparison purposes, there were 16 samples collected from DEL18 that exceeded 20 fecal coliform 100mL^{-1} and 12 samples from CATLEFF in the 2011/2012 reporting period primarily attributed to two important precipitation events; Tropical Storms 'Irene' and 'Lee' (Figures 4 and

6). During the current reporting period there were 6 double digit fecal coliform counts ranging from 10 to 15 fecal coliforms 100mL^{-1} that were likely associated with precipitation events of more than one inch recorded in the previous three days (Table 5).

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

Date	DEL18/DEL18DT Fecal coliform 100mL^{-1}	CATLEFF Fecal coliform 100mL^{-1}	Precipitation within 3 days of elevated fecal coliform >=10 fecal coliform 100 mL^{-1} (inches rounded to the nearest tenth)[1]	Bird Counts on or before sample date	
				Reservoir-wide totals	Bird Zones 2, 3, and 4 totals (closest to the DEL18/DEL18DT and CATLEFF Effluents)
5/30/2012	10	-	0.44	46	12
09/9/12	14	-	2.31	44	42
09/18/12	15	Off Line	1.82	7	5
10/07/2012	11	Off Line	0.12	114	65
10/19/2012	10	Off Line	1.43	41[2]	35
01/31/13	10	Off Line	1.30	63	32

[1.] Precipitation data reported from Kensico Reservoir (sampling site reference EKM220), Valhalla, New York
[2.] Bird Zone 1 not included in survey totals due to limited reservoir access and heavy fog conditions.

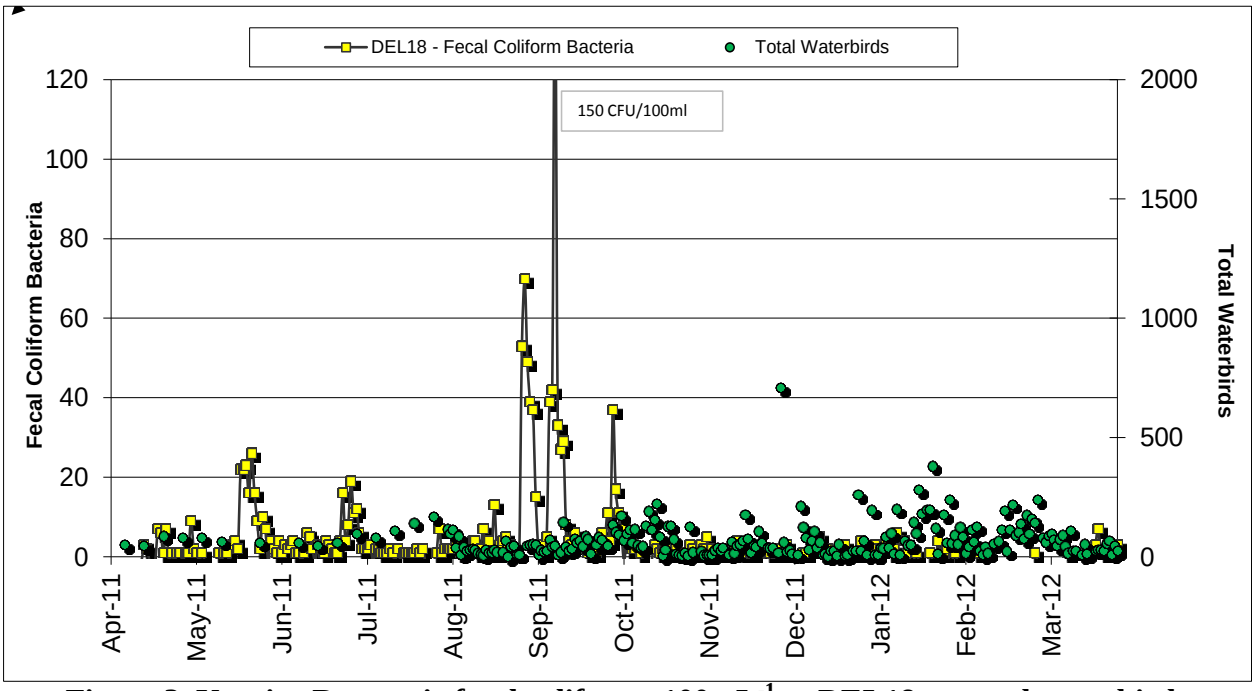

Figure 3. Kensico Reservoir fecal coliforms 100mL^{-1} at DEL18 vs. total waterbirds (4/1/2011 to 3/31/2012).

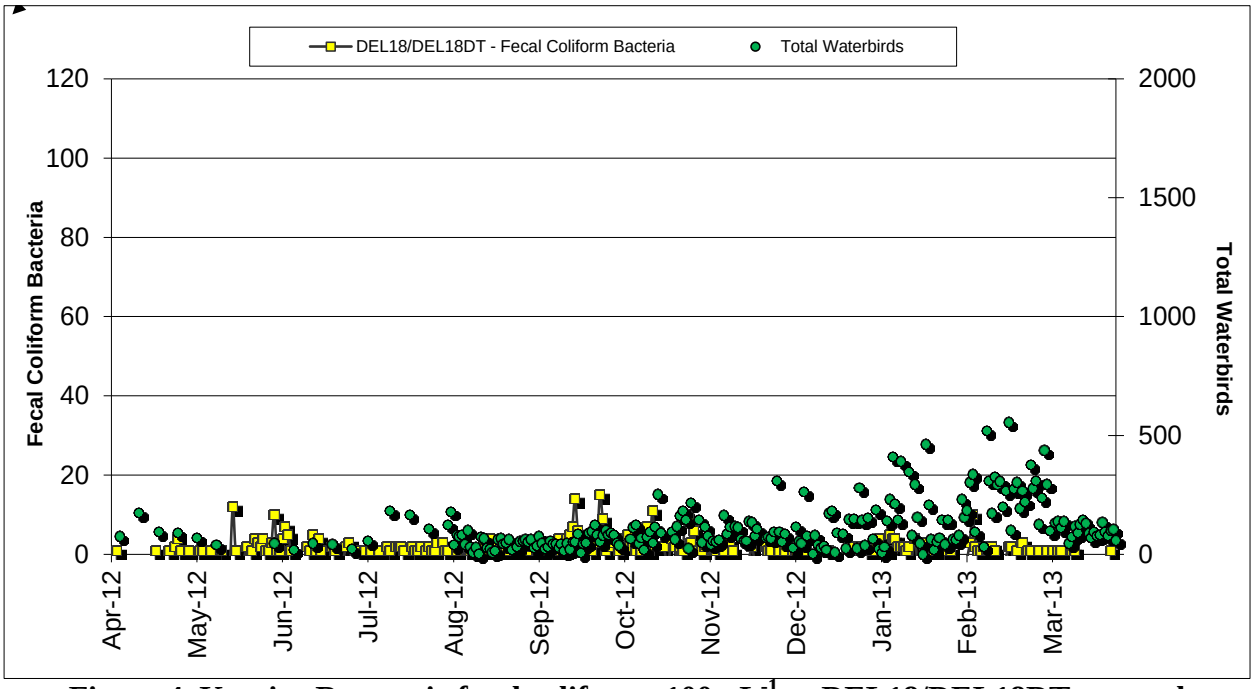

Figure 4. Kensico Reservoir fecal coliforms 100mL^{-1} at DEL18/DEL18DT vs. total waterbirds (4/1/2012 to 3/31/2013).

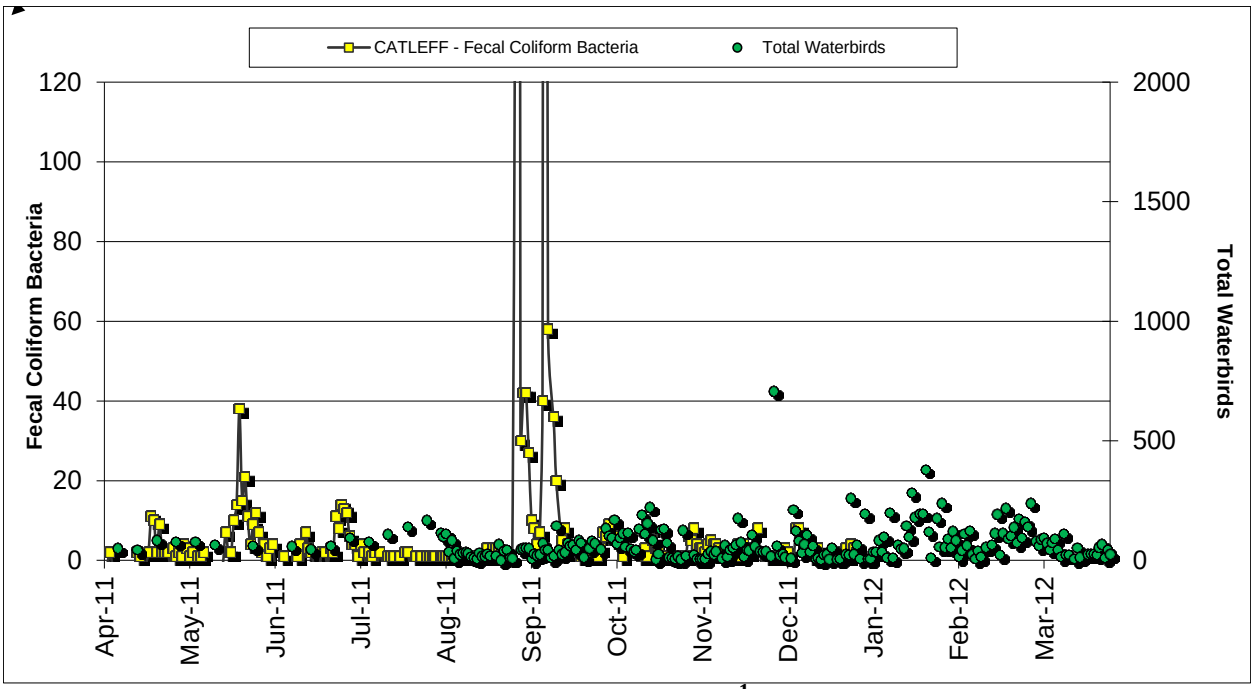

Figure 5. Kensico Reservoir fecal coliforms 100mL^{-1} at CATLEFF vs. total waterbirds (4/1/2011 to 3/31/2012).

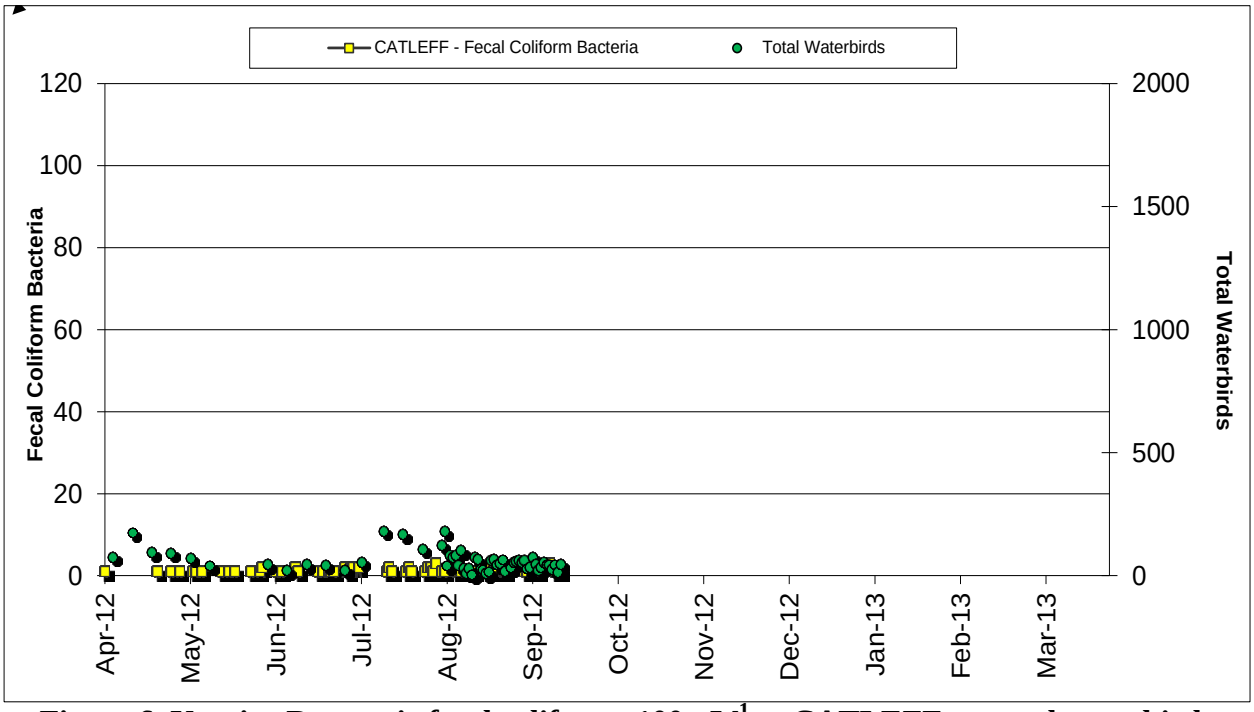

Figure 6. Kensico Reservoir fecal coliforms 100mL^{-1} at CATLEFF vs. total waterbirds (4/1/2012 to 9/13/2012).

Reservoir-wide waterbird counts remained relatively low throughout the reporting period (April 1, 2012 to March 31, 2013) averaging about 113 birds per survey night and spiking at 555 (254 geese, 102 gulls, and 199 ducks) on February 20, 2013 compared to an average of 69 birds/night in 2011/2012 (Figures 7 and 8). Due to Hurricane Sandy which affected southeastern New York on October 29 and 30 there was no waterbird data collected and no bird harassment measures conducted. In Bird Zone 2, closest to Delaware Shaft 18 (DEL18/DEL18DT), waterbirds were observed 23 times in 2012/2013. Ten of those observations occurred during the month of February (2013) and were largely attributed to flocks of ducks arriving overnight past the normal hours of operation for bird harassment. A high count of 90 ducks was observed in Bird Zone 2 on February 12, 2013.

In Bird Zone 3, closest to the Catskill Effluent (CATLEFF), birds were observed on nine surveys, five of which were recorded during the active harassment period. The high count of birds for Zone 3 was 29 Canada Geese on November 18, 2012 (Figure 10) after CATLEFF was off-line. There was only one observation of birds over 200 in Bird Zone 4, closest to DEL18 and CATLEFF, compared to two occurrences over 200 in 2011/2012 (Figure 11). The high count of 250 birds (all gulls) in Zone 4 occurred on October 16, 2012, also after CATLEFF was offline, and was probably a result of rain and fog creating low visibility conditions restricting boat harassment activities during the evening of October 15, 2012.

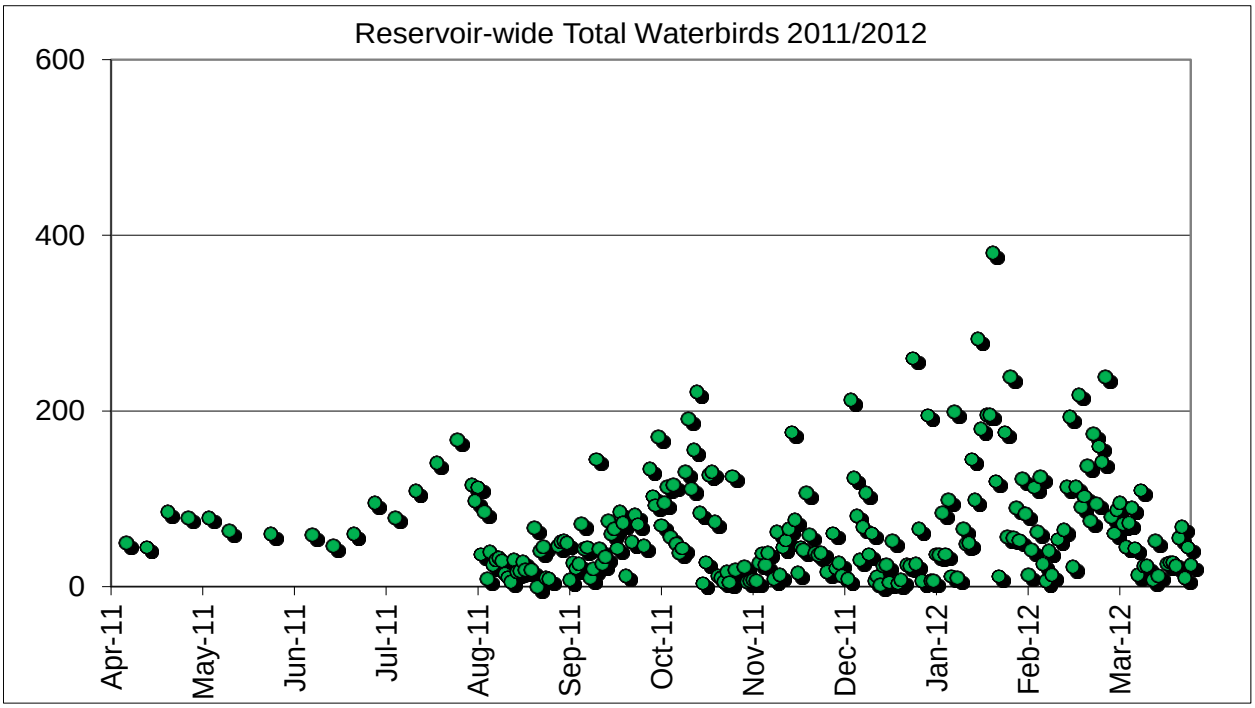

Figure 7. Kensico Reservoir total annual waterbirds (4/1/2011 to 3/31/2012).

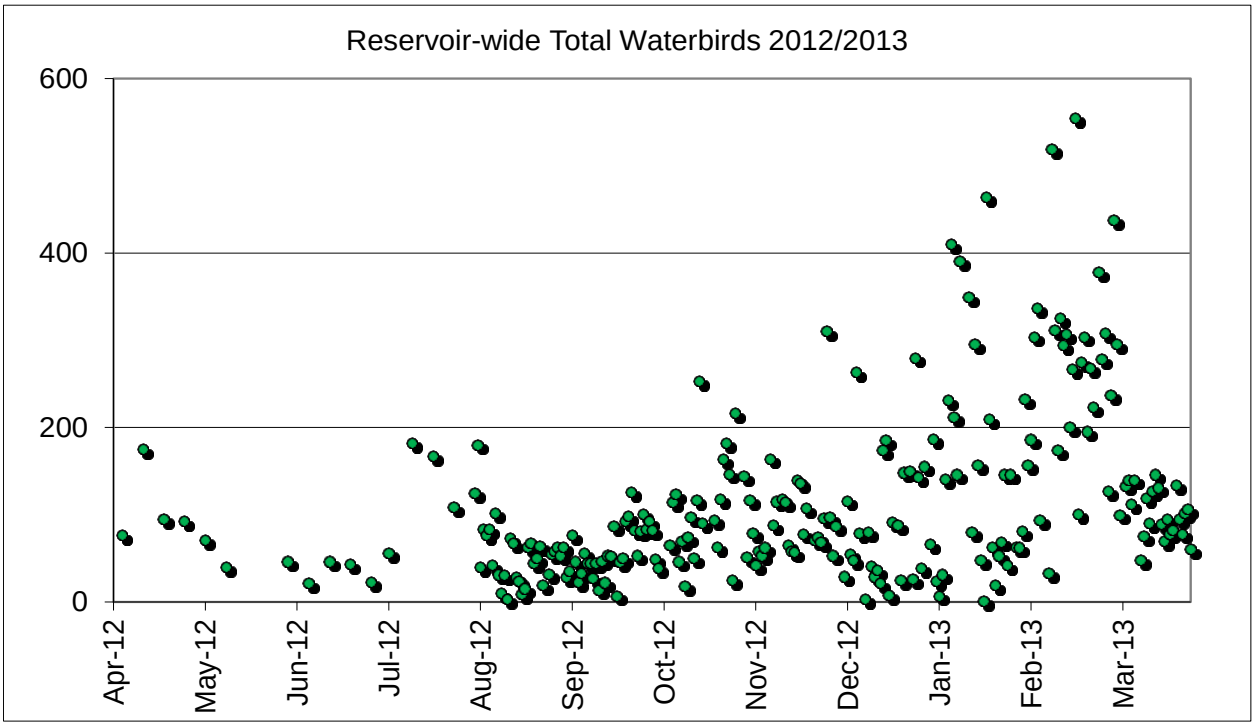

Figure 8. Kensico Reservoir total annual waterbirds (4/1/2012 to 3/31/2013).

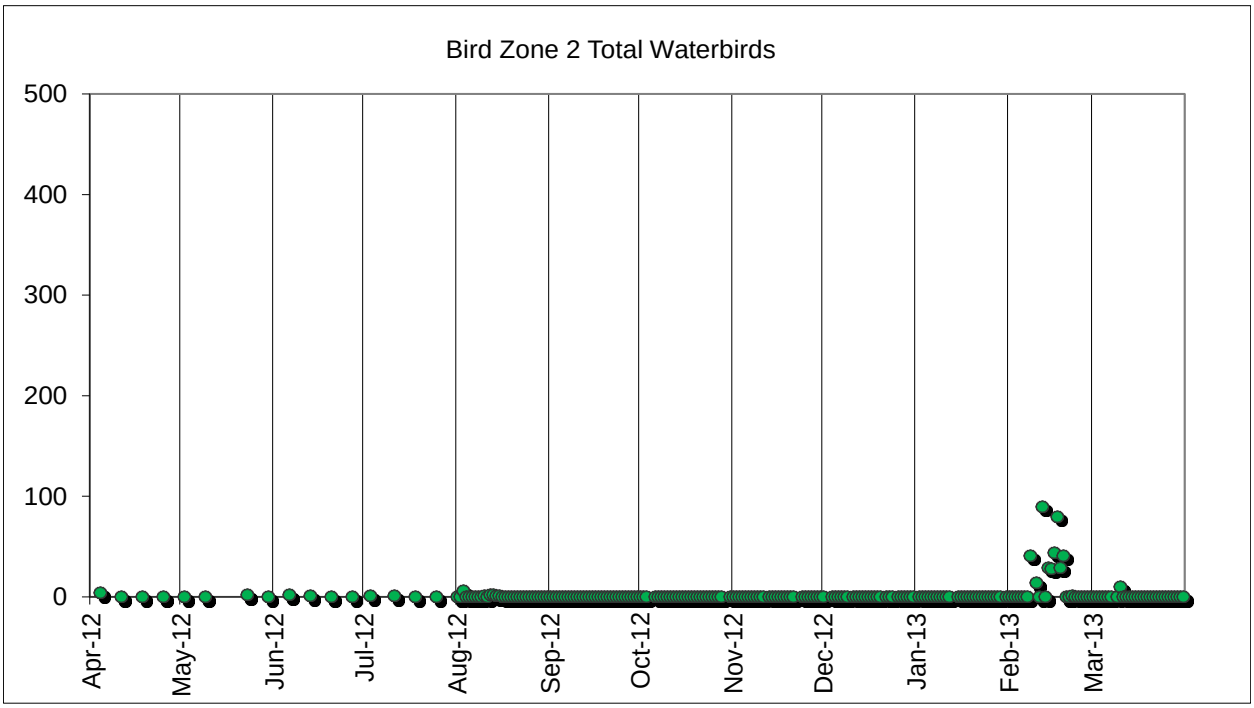

Figure 9. Kensico Reservoir Bird Zone 2 waterbirds (4/1/2012 to 3/31/2013).

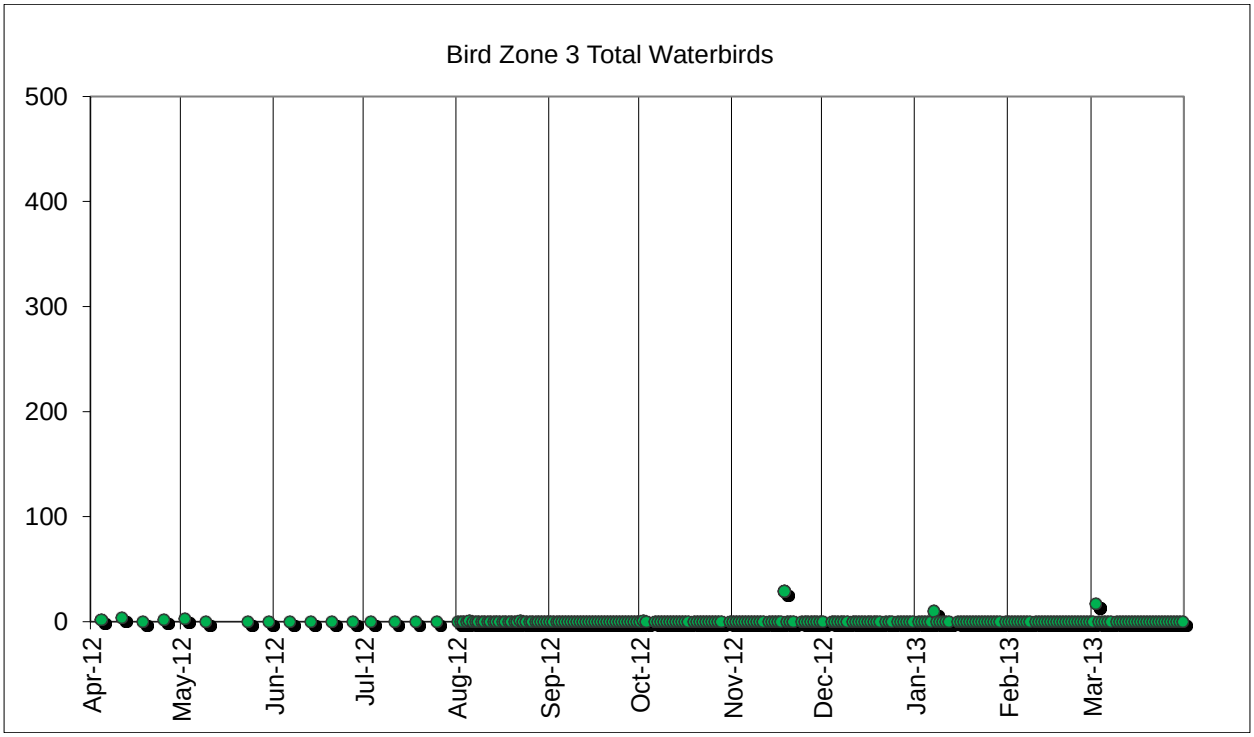

Figure 10. Kensico Reservoir Bird Zone 3 waterbirds (4/1/2012 to 3/31/2013).

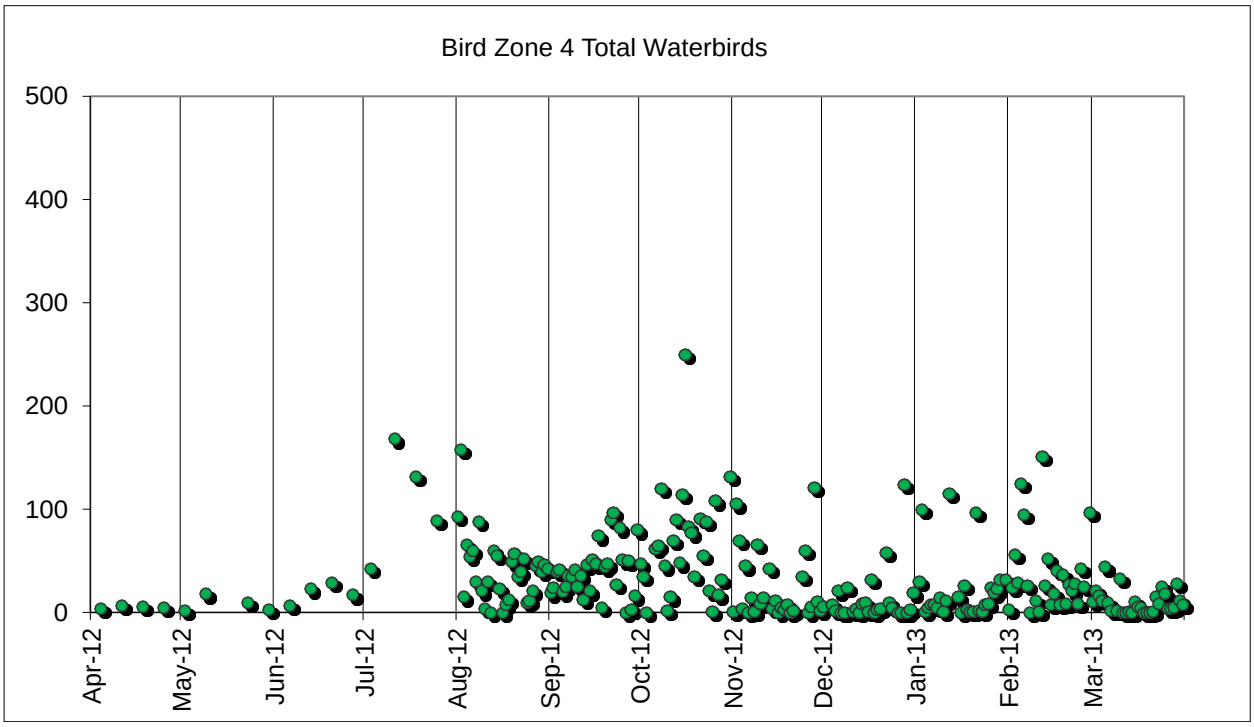

Figure 11. Kensico Reservoir Bird Zone 4 waterbirds (4/1/2012 to 3/31/2013).

The incidence of specific groups of waterbird groups continues to follow trends for annual migration and over-wintering patterns. Waterbird group roosting locations are generally determined by extent of ice-cover. During 2012/2013 gull numbers persisted throughout the winter as there was little to no ice cover. Duck counts appeared to be lower and Canada Geese remained low (Figures 12-13).

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 three-mile radius around the airport property which includes all of the Kensico Reservoir. During this reporting period, DEP allowed USDA and 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 2012. Results of the USDA goose survey did not identify any geese present from the Kensico Reservoir property and therefore no action was recommended for this reporting period.

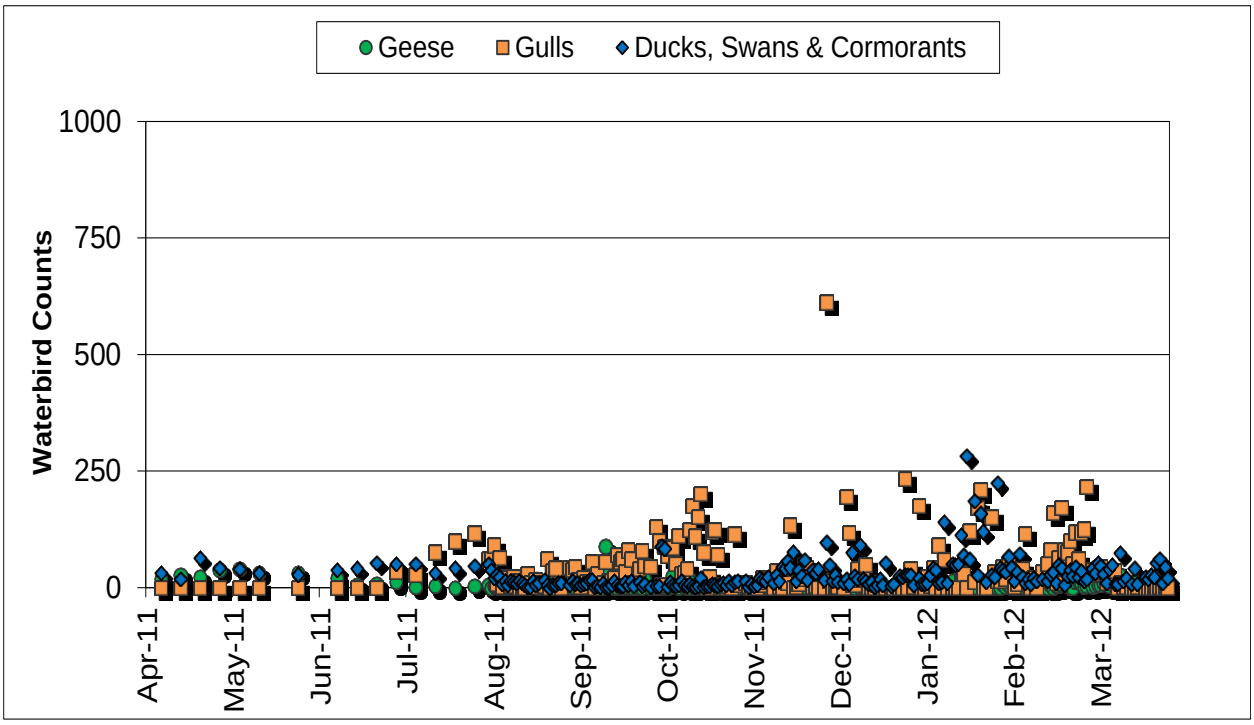

Figure 12. Kensico Reservoir total waterbird groups (4/1/2011 to 3/31/2012).

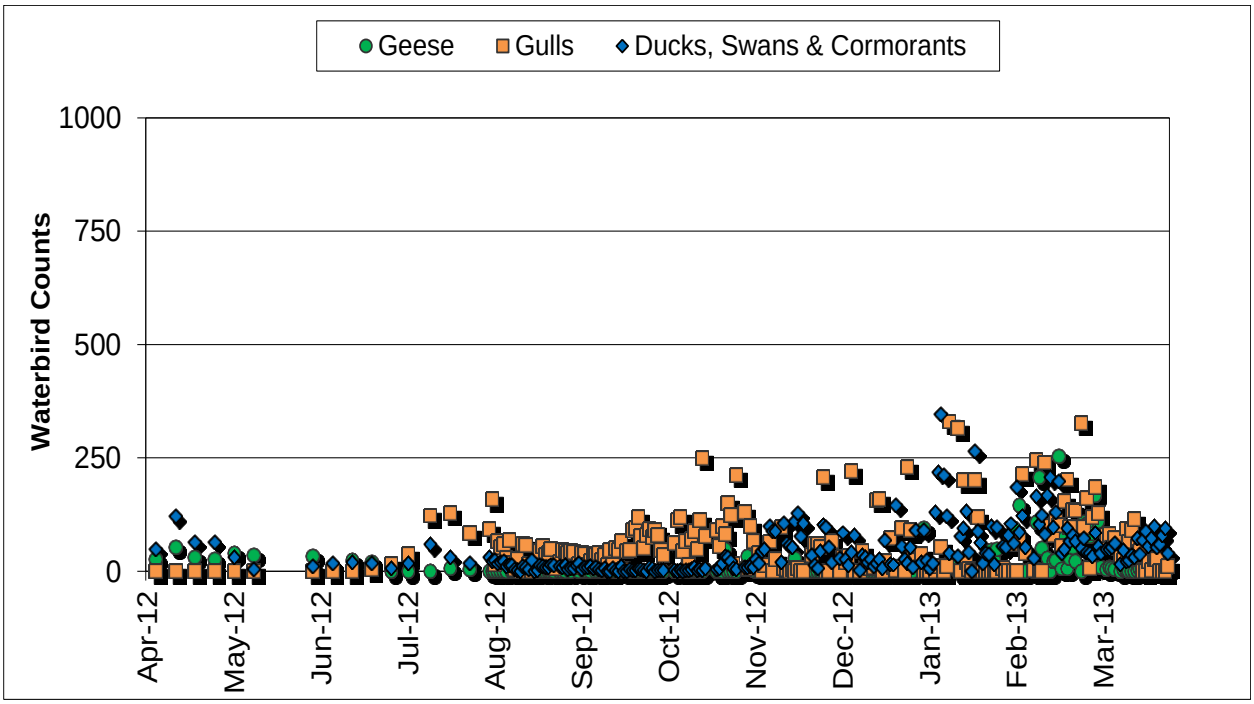

Figure 13. Kensico Reservoir total waterbird by groups (4/1/2012 to 3/31/2013).

It is suspected that the increased spatial separation between birds and the water intakes continued to reduce the threat for an increase in fecal coliform bacteria near Delaware Shaft 18 and the Catskill Lower Effluent Chamber. As a result, bird harassment activities were concentrated in the vicinity Delaware Shaft 18 and the Catskill Lower Effluent Chamber before it was taken off-line. Overall, waterbird numbers continue to be lower throughout Kensico; a direct result of the ongoing bird harassment work.

Alewives (baitfish) transported through upstate aqueducts to Kensico were present during the autumn/winter period of 2012/2013. When present, the dead and dying alewives typically attract foraging gulls and ducks. DEP and its contractor will continue to monitor fish concentrations and collect dead/dying baitfish as they enter Kensico Reservoir. The volume of fish observed, collected, and disposed of at Kensico CATIC (influent) in 2012/2013 was 800.8 pounds compared to 115.8 pounds collected in 2011/2012 and no fish collected in 2010/2011.

In the spring of 2012 a total of 16 Canada Geese nests were identified along the reservoir shoreline and on islands. Among the nests, 65 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 4.4 compared to 5.6 in the previous year (DEP 2012). A total of 5 goslings were observed rendering the egg depredation success at 93 percent in 2012 compared to the 98 percent success rate in 2011. 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. One Mute Swan nest with nine eggs was depredated in 2012.

The ongoing implementation of the WMP has assisted DEP in remaining compliant with the SWTR standard for fecal coliform bacteria throughout 2012/2013 (Figures 4 and 6) 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 40). Migratory and wintering waterbird populations at West Branch were sampled weekly to record annual trends which aids in identifying sources of elevated fecal coliform bacteria levels. In 2012/2013, gulls were only recorded on 9 of the 52 surveys conducted and 8 of 9 observations were counts of 6 birds or less. A high count of 334 gulls was recorded on October 2, 2012. This compares to a gull count spike of 160 on July 19, 2011 in the previous reporting period (DEP 2012). Reservoir-wide total birds reached 3,245 on December 4, 2012 compared to 2,027 recorded on November 22, 2011, in the previous year (Figures 14 and 15).

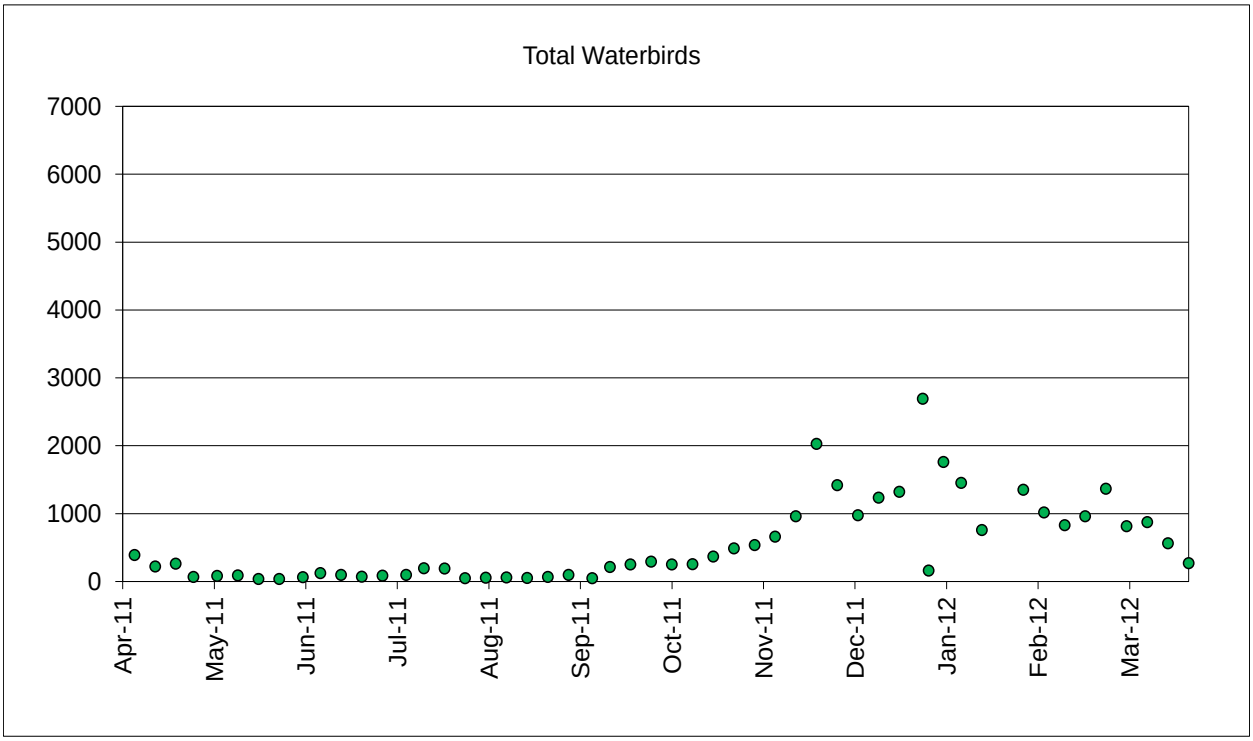

Figure 14. West Branch Reservoir total waterbirds (4/1/2011 to 3/31/2012).

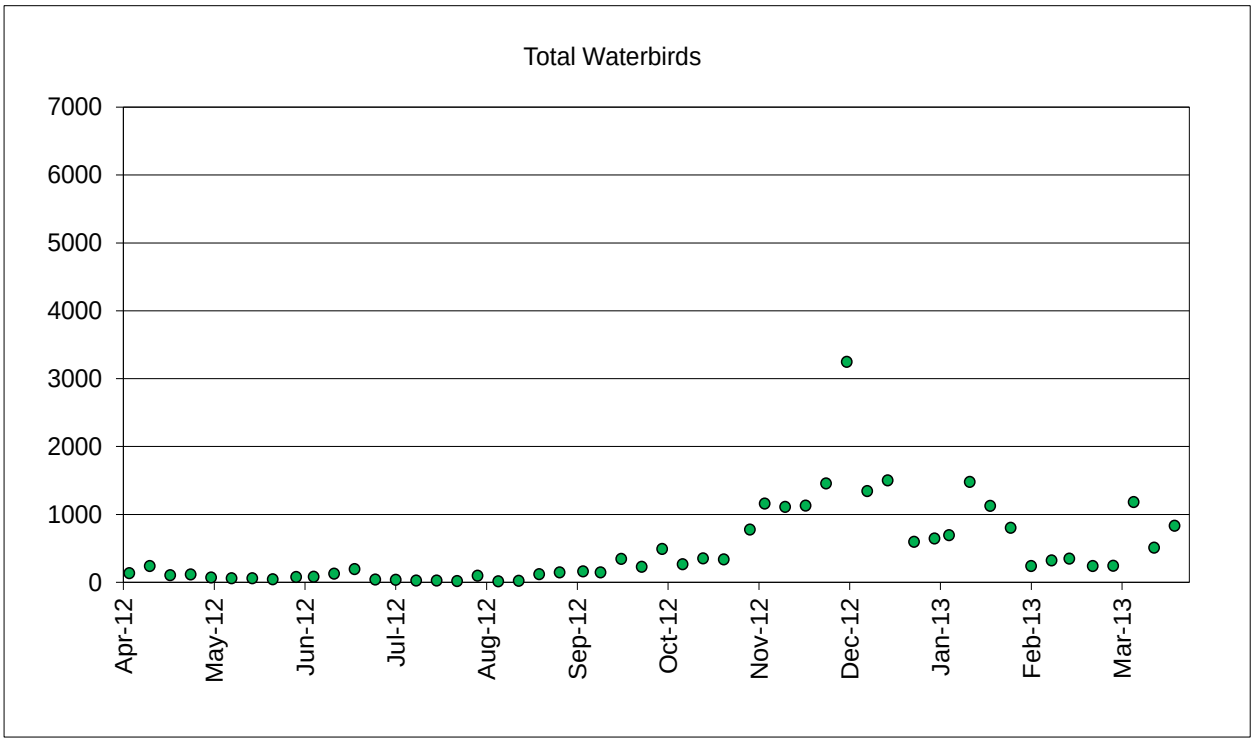

Figure 15. West Branch Reservoir total waterbirds (4/1/2012 to 3/31/2013).

Of the season high of 3,245 birds, 3,238 were ducks, mostly Common Mergansers (*Mergus merganser*). Mild winter conditions throughout the northeast may have affected some of the winter gull roost locations in 2012/2013, providing more open freshwater options other than West Branch. Ice cover on the reservoir reached 100 percent coverage by February 5, 2013 and diminished by March 19, 2013.

There was one fecal coliform count above 20 fecal coliforms $100mL^{-1}$ recorded at the Delaware Shaft 10 (DEL10) water intake on June 13, 2012 (29 fecal coliforms $100mL^{-1}$) (Figure 16) compared to six recorded in the previous reporting period. The one elevated fecal coliform datum was associated with 0.75 inches of precipitation recorded from June 11 – 13, 2013 and a bird count of 126 on June 12, 2013. There was no important waterbird population increases associated with the aforementioned elevated bacteria count (Figure 16).

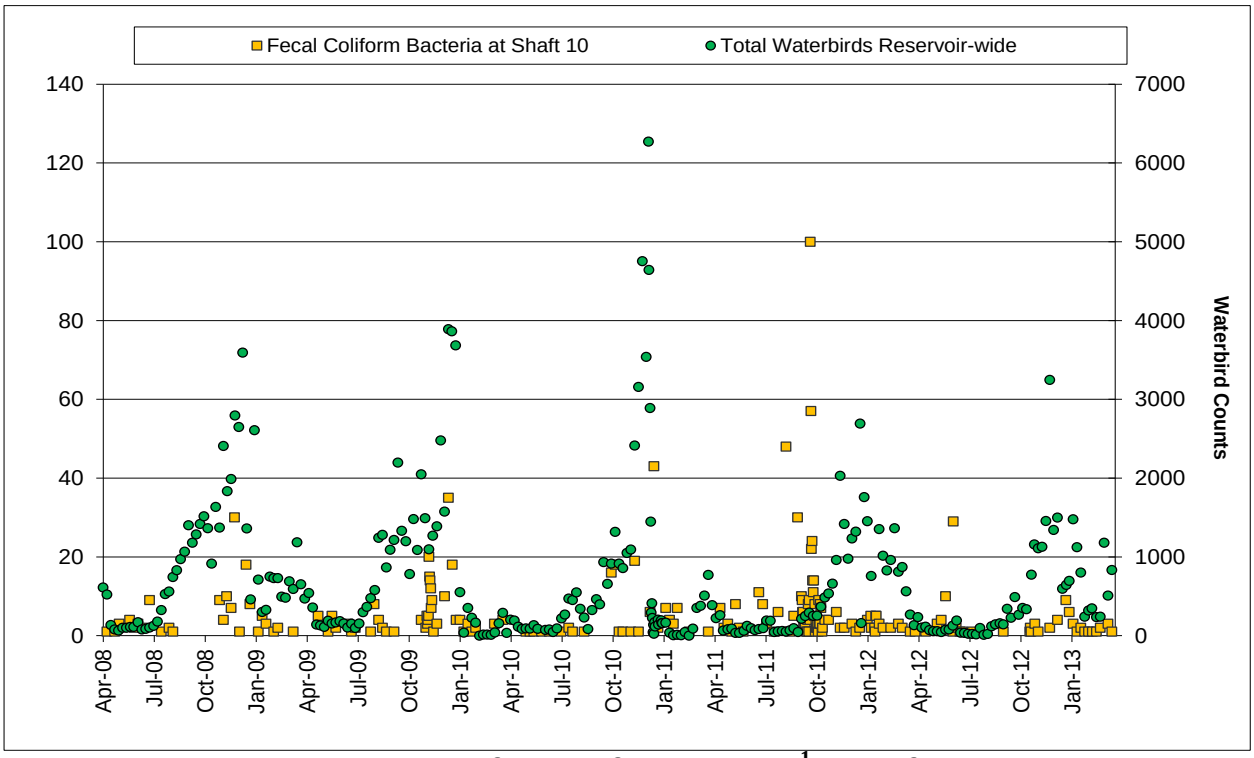

Figure 16. West Branch Reservoir fecal coliforms 100mL^{-1} at Shaft 10 vs. total waterbirds (4/1/2008 to 3/31/2013).

DEP conducted reproductive control on Canada Geese from April 1 through May 31, 2012 to reduce productivity at West Branch Reservoir. In 2012, eight nests and 34 eggs were depredated which was down from the previous year at 12 nests and 45 eggs (Table 4). The egg-depredation was deemed 94 percent successful as there were two goslings documented following the reproductive period. There were no Mute Swans nesting at West Branch in 2012. The Double-crested Cormorant nesting colony was located high in an inaccessible shoreline tree 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 41).

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.

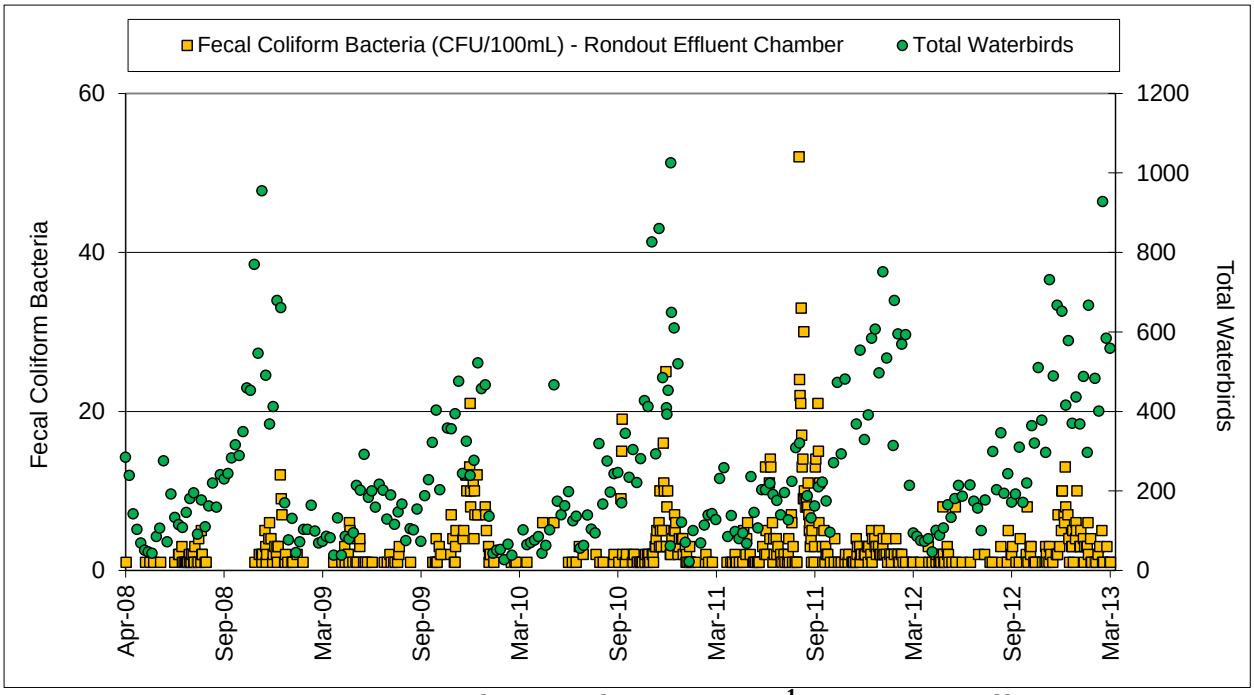

Figure 17. Rondout Reservoir fecal coliforms 100mL^{-1} at Rondout Effluent vs. total waterbirds (4/1/2008 to 3/31/2013).

Canada Geese population counts reached 210 on October 9, 2012 and a seasonal high of 292 on December 18, 2012. One-hundred and thirty geese were observed on June 26, 2012, probably a result of onset of the post-nuptial molt with birds moving to the reservoir environment. A high count of 420 gulls was recorded on March 12, 2013 of which 250 were observed in Bird Zone 1 (Figure 41) in close proximity to the Rondout Effluent Chamber. Duck numbers remained mostly constant throughout the year peaking at 532 on December 4, 2012.

Each year seasonal elevations of waterbirds (mostly gulls and ducks) are recorded at Rondout (Figure 18). Reservoir ice-cover reached 90 percent on February 4, 2013, late in the season which provided continued opportunity for gull roosting throughout most of the winter period.

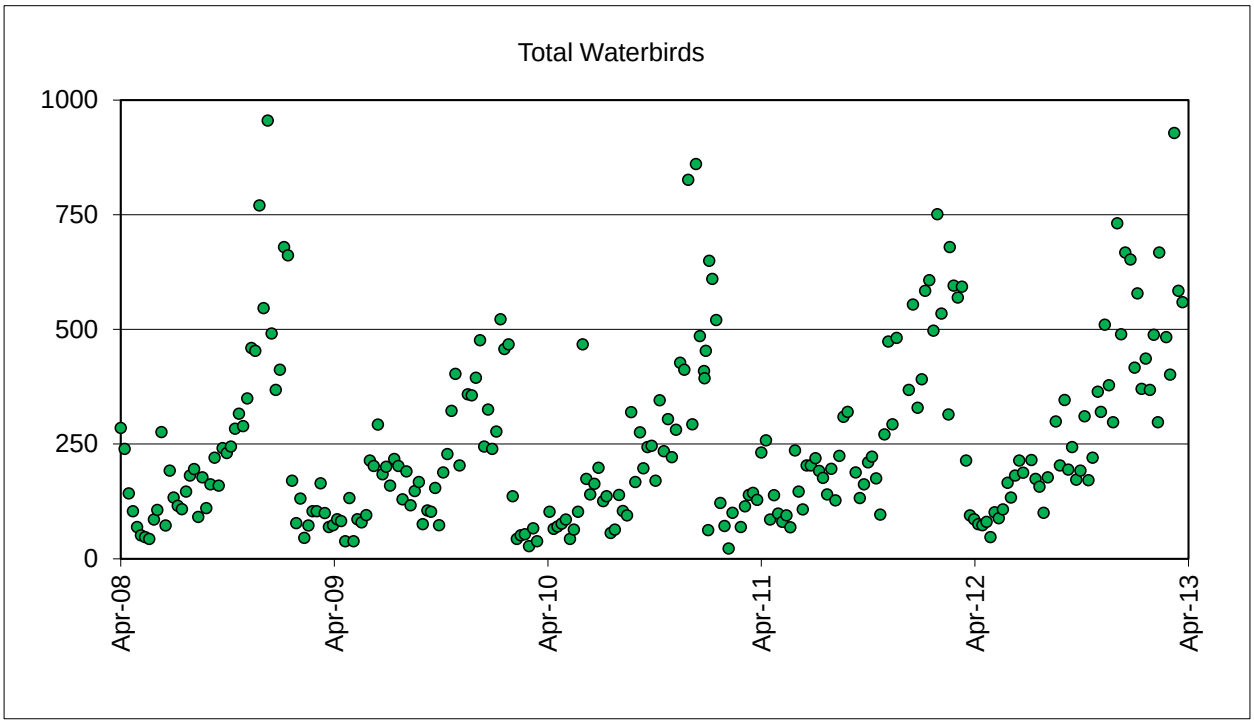

Figure 18. Rondout Reservoir total waterbirds (4/1/2008 to 3/31/2013).

DEP has monitored the spatial distribution of the gull populations at Rondout particularly during the December through January period. In previous years, gulls typically roost at Bird Zone 1; zone closest to the Rondout Effluent Chamber. There does not, however, appear to be a foraging attraction by the birds nor is it due to ice cover restrictions on other parts of the reservoir forcing the birds to roost at the Zone 1 location this time of year. No additional surveys were necessary during this reporting period as there were only three occurrences of gulls roosting in Bird Zone 1 during the winter period. In addition, it was not necessary for DEP to activate the bird harassment program in the 2012/2013 reporting period. The seasonal increase in waterbird populations was similar to the previous year (Figures 19 and 20).

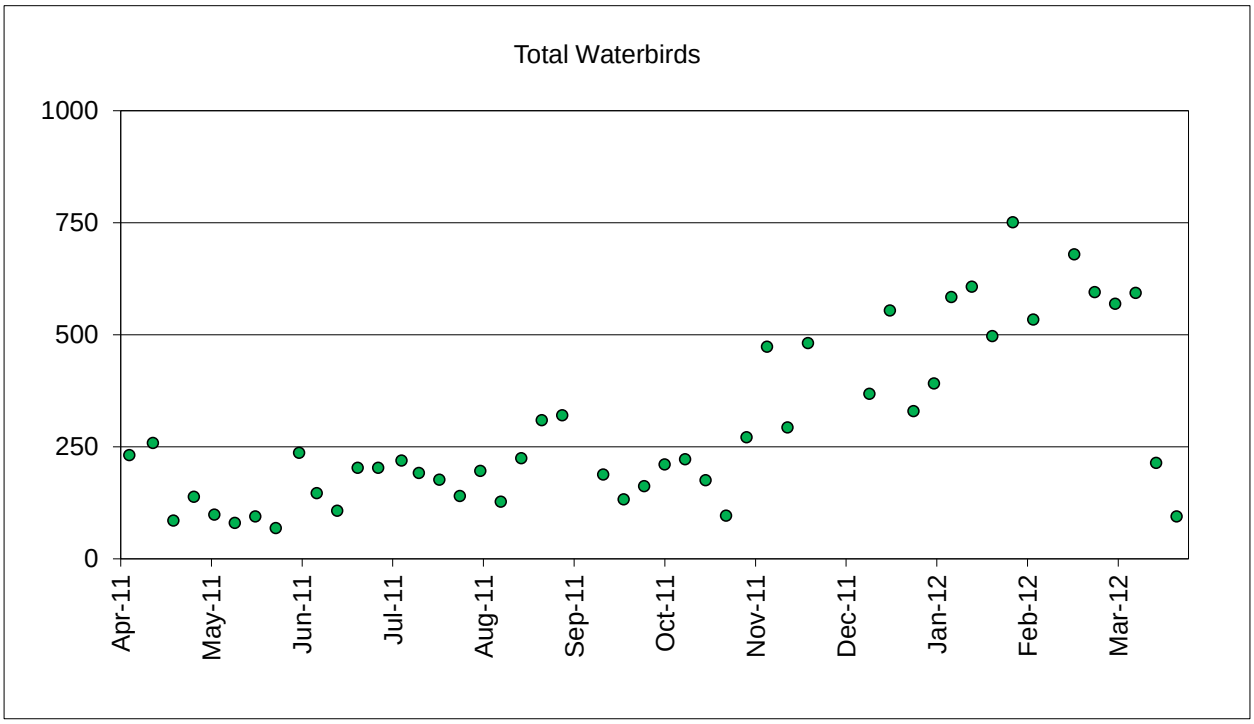

Figure 19. Rondout Reservoir total waterbirds (4/1/2011 to 3/31/2012).

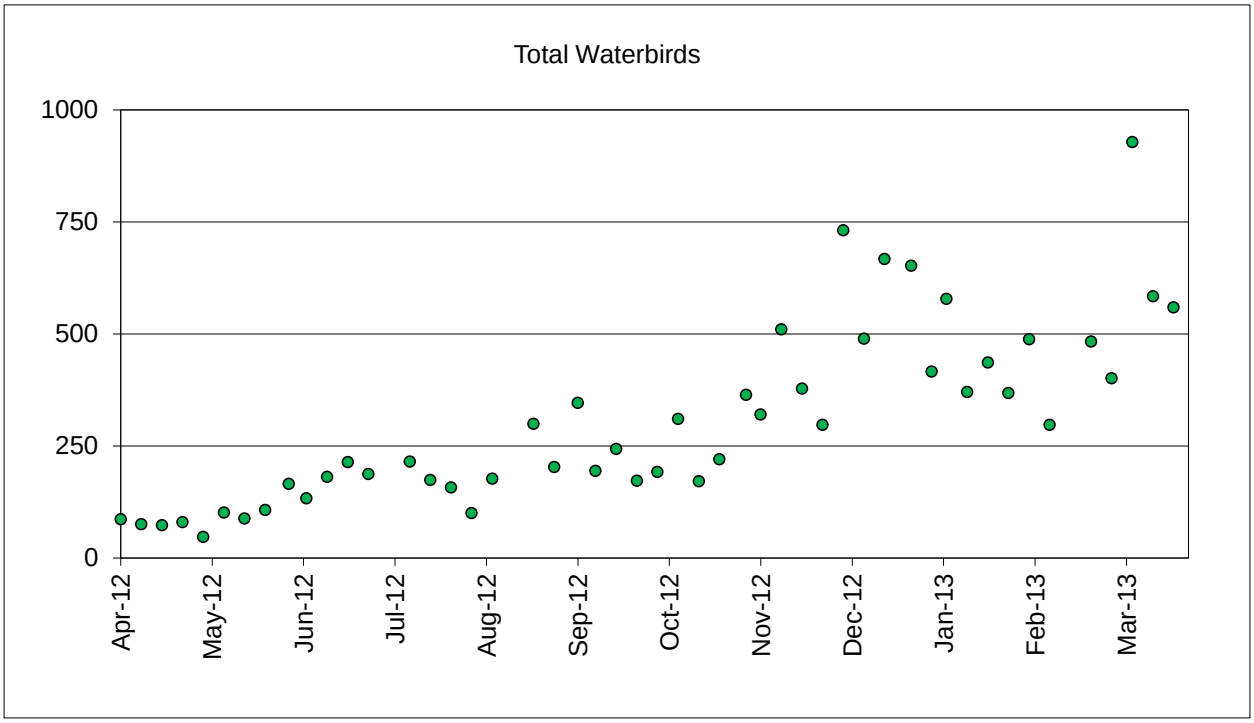

Figure 20. Rondout Reservoir total waterbirds (4/1/2012 to 3/31/2013).

DEP also conducted routine monitoring and maintained full compliance with a protection plan for Bald Eagles (*Haliaeetus leucocephalus*) as required by the NYS-DEC 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 conducted reproductive control on Canada Geese at Rondout in 2012. Due to the close proximity of some Canada Geese nests to established 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. Three nests with 21 eggs were depredated in the spring of 2012. A total of 7 goslings were documented compared to 16 goslings observed in 2011 (Table 4). There were no Mute Swan nests identified at Rondout in 2012.

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 32). There are six waterbird sampling geographic zones, three within each basin and associated with reservoir water quality sampling locations (Figure 42). Overall, bird numbers (particularly gulls) continue to decrease in abundance during the migration and over-wintering period at Ashokan over the past years (Figure 21). The East Basin (Bird Zones 4, 5, and 6) relative to the West Basin (Bird Zones 1, 2, and 3) of Ashokan continues to be the primary waterbird roosting area. Total waterbird counts continue to be much lower in recent years when compared to counts in the 1990's and early 2000's preceding the following the closure of two Ulster County landfills (Town of Ulster and Town of New Paltz) which attracted gull foraging activity from the late summer through the winter (Figures 22 and 23).

Gull counts spiked at a count of 1,068 on November 21, 2012 compared to a high count of 1,436 on February 10, 2012. Reservoir ice-cover reached 100 percent by February 8, 2013 and receded by March 22, 2013 compared to only five percent ice-cover recorded during the 2011/2012 reporting period. Canada Geese numbers rose to a high count of 271 on August 17, 2012 compared to 218 on August 5, 2011. Ashokan West Basin generally has very low bird counts annually compared to the East Basin (Figures 22 and 23). Geese and gull counts decreased to 0 by mid-February probably as a result of reservoir ice-cover reaching 100 percent in early February 2013.

Duck species, present year-around, reached a peak of 1,295 on March 1, 2013 compared to a high count of 295 recorded on December 2, 2012 in the previous report (DEP 2012).

Three fecal coliform samples collected at the water intake sampling location at Ashokan (EARCM) exceeded 20 fecal coliforms $100mL^{-1}$ during September and October of 2012 (Figure 24). Bird counts remained elevated during the autumn and winter and rose to a high of 1,966 on January 11, 2013 of which 688 were gulls and 1,258 were ducks along with 20 Canada Geese. There does not appear to be an association with elevated bird counts and fecal coliforms levels above the 20 fecal coliforms $100mL^{-1}$.

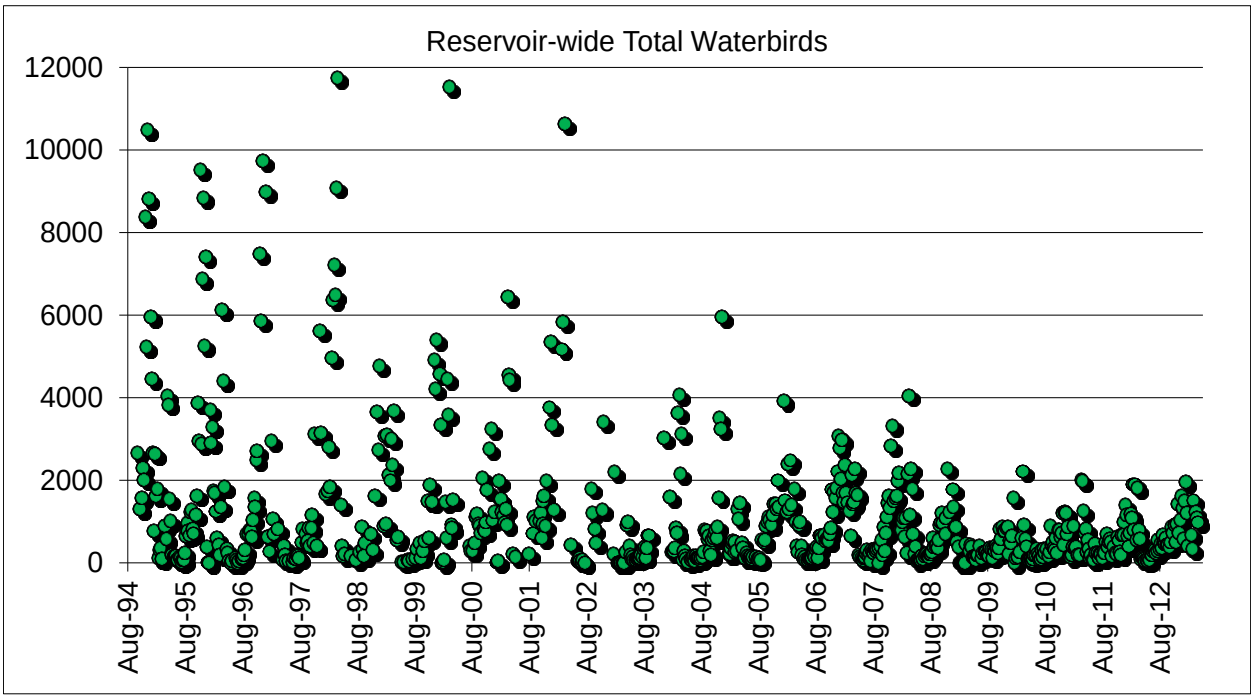

Figure 21. Ashokan Reservoir total waterbirds (1994 to 2013).

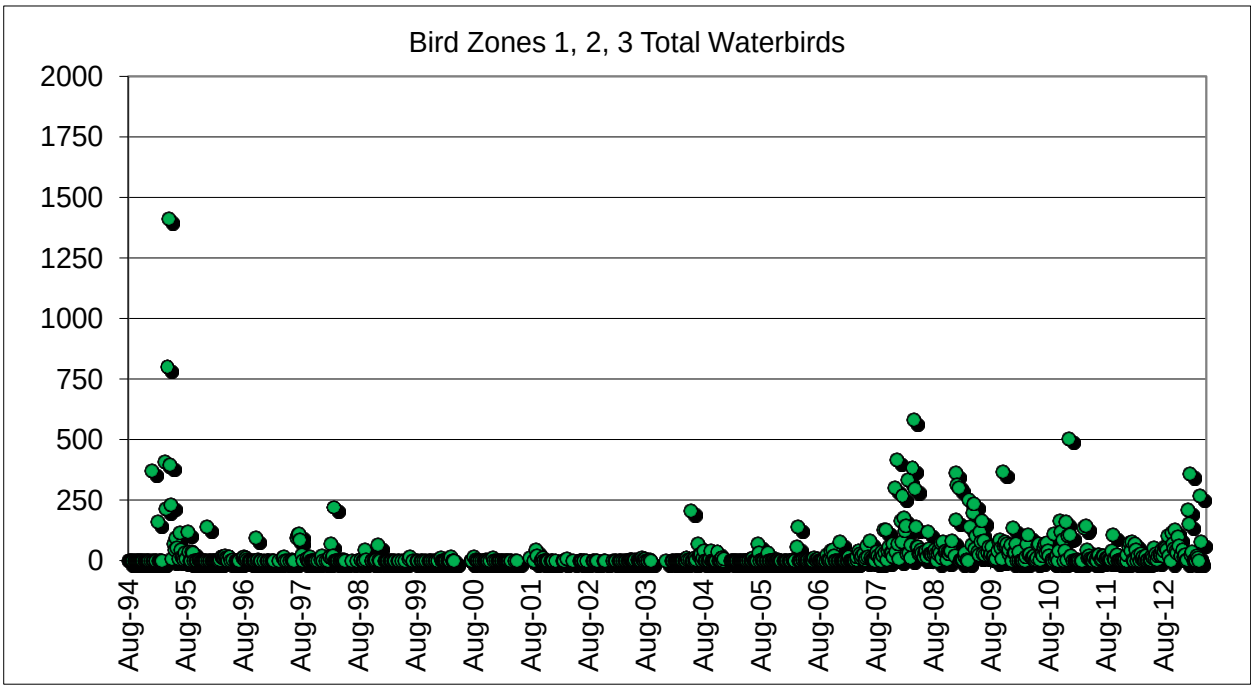

Figure 22. Ashokan Reservoir West Basin total waterbirds in Bird Zones 1, 2, and 3 (1994 to 2013).

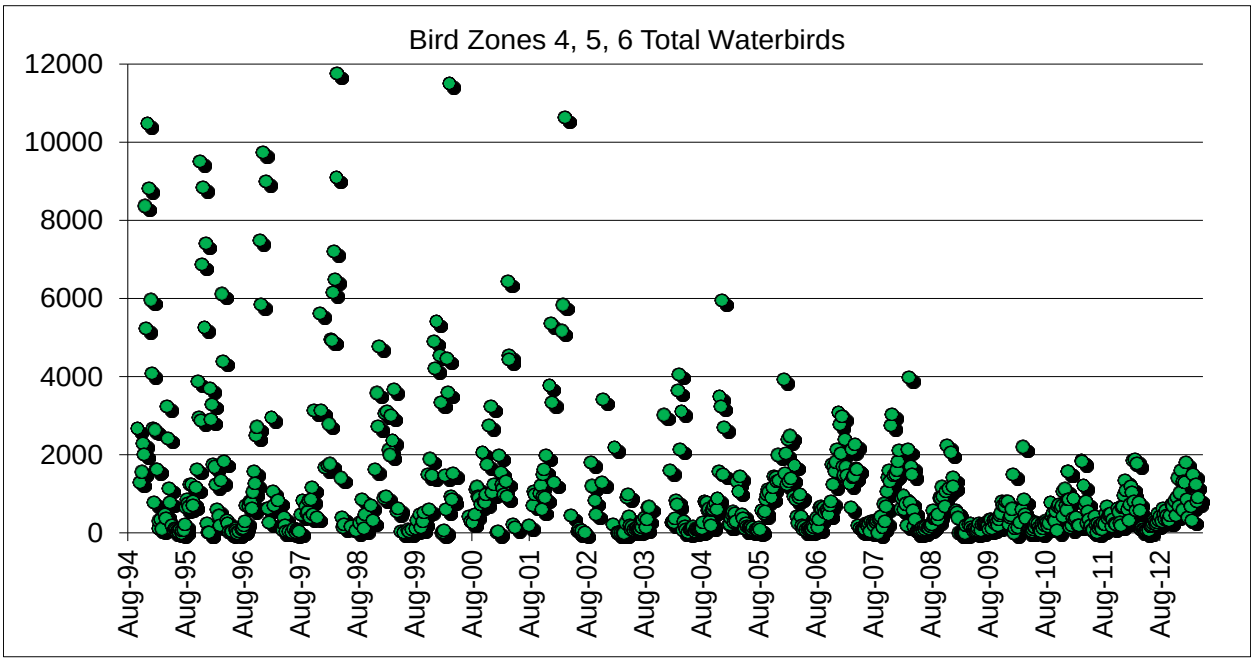

Figure 23. Ashokan Reservoir East Basin total waterbirds in Bird Zones 4, 5, and 6 (1994 to 2013).

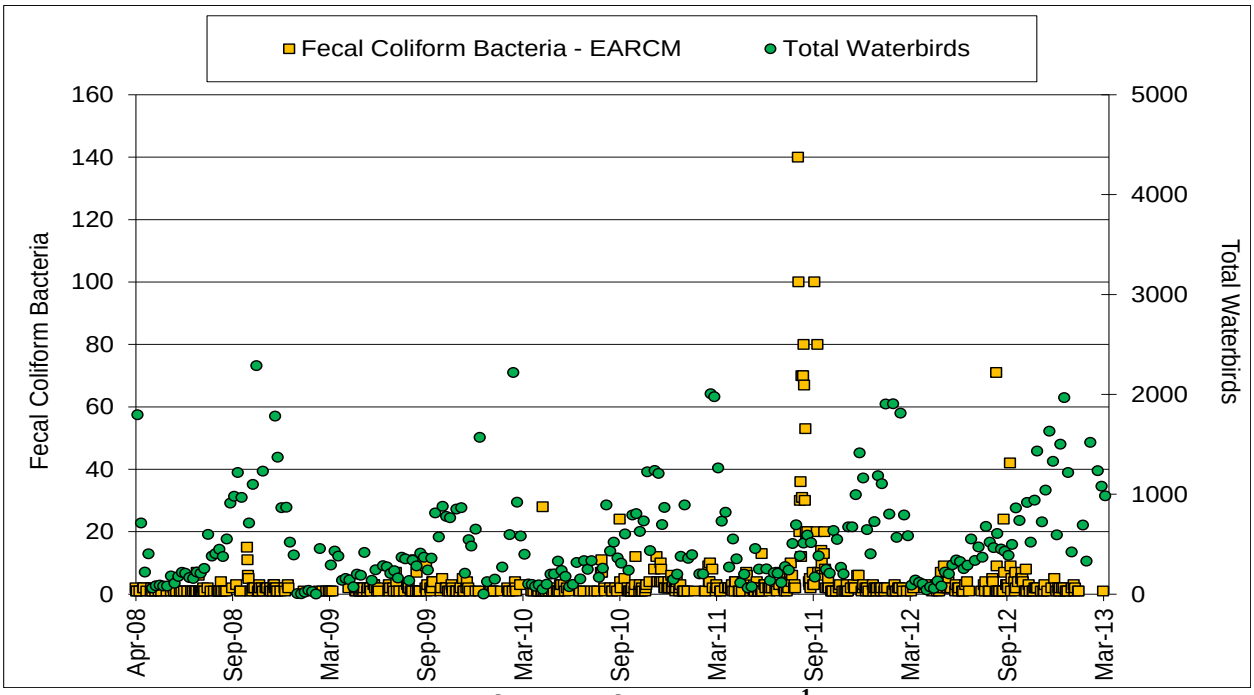

Figure 24. Ashokan Reservoir fecal coliforms 100mL^{-1} vs. waterbirds (4/1/2008 to 3/31/2013).

DEP conducted reproductive control on Canada Geese from April 1 through May 31, 2012 to reduce productivity at Ashokan. In 2012, three Canada Geese nests were identified and 16 eggs addled compared to three nests and four eggs 2011 (Table 4). The egg-depredation success rate at the Ashokan Reservoir in 2012 was 52 percent compared to a 21 percent success in 2011. A total of 15 goslings were observed in late spring 2012 compared to 15 observed in spring 2011. DEP identified that some of the successful broods of geese were known to have hatched in wetlands off DEP property. There were no Mute Swans found nesting in 2012 similar to 2011.

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 43). Similar to the previous year, gulls and waterfowl (ducks) continue to represent the primary bird groups counted throughout Croton Falls Reservoir from mid-July 2012 through the spring of 2013.

Geese were present throughout the year reaching a high count of 83 on August 10, 2012. Waterbird species (mostly Common Mergansers (*Mergus merganser*) and Mallards (*Anas platyrhynchos*)) were present throughout the year; increasing in numbers starting in mid-July and spiking at 1,633 on December 14, 2012 and again on January 25, 2013 to a high of 1,777 (Figures 25 and 26). Gulls were first observed in late June 2012 and peaked at 1,643 on February 22, 2013. Total reservoir-wide bird high counts exceeded 2,000 on December 14, 2012, January 25, 2013, and on February 22, 2013 compared to two times in the previous reporting period (Figures 25 and 26).

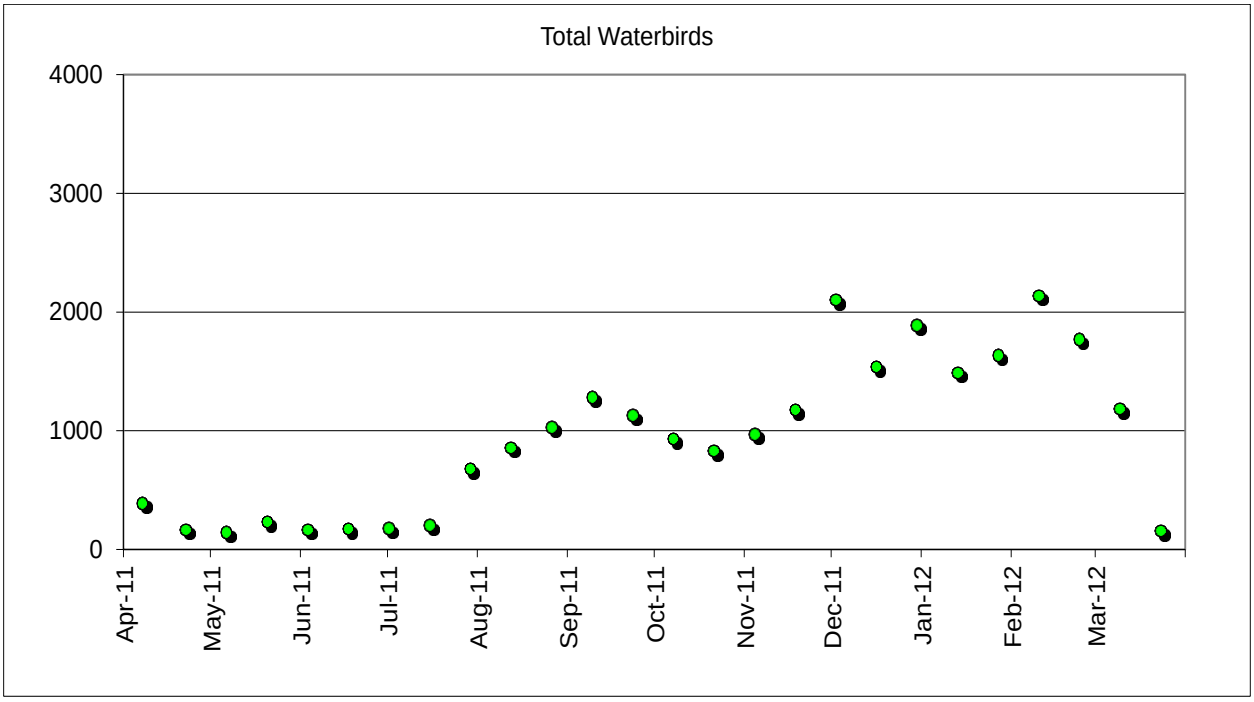

Figure 25. Croton Falls Reservoir total waterbirds (4/1/2011 to 3/31/2012).

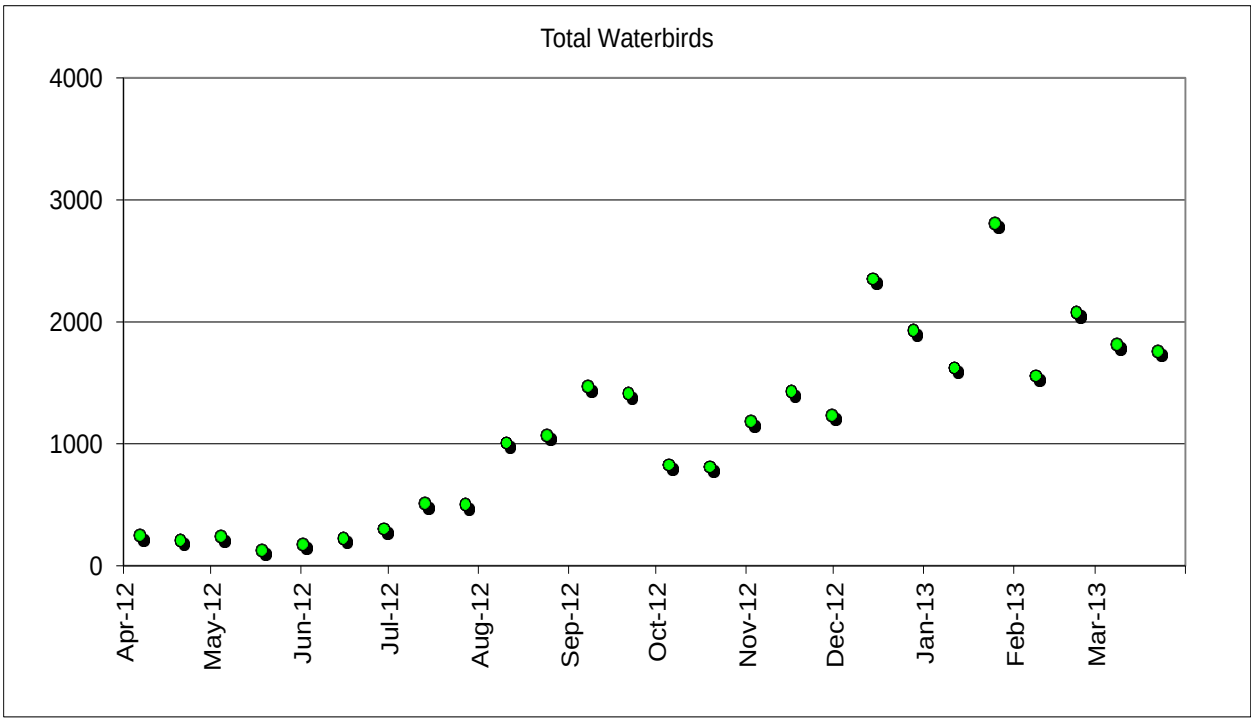

Figure 26. Croton Falls Reservoir total waterbirds (4/1/2012 to 3/31/2013).

There were a total of six fecal coliform bacteria samples measured at the Croton Falls release in 2011/2012 above 20 fecal coliforms $100mL^{-1}$. 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.

DEP conducted reproductive control on Canada Geese from April 1 through May 31, 2012 to reduce productivity at Croton Falls (Table 4). In 2012, twelve Canada Geese nests were identified and 70 eggs were depredated compared to 12 nests and 55 eggs in 2011 (Table 4). The egg-depredation success rate at Croton Falls for 2012 was 92 percent with six goslings that hatched. There were no Mute Swans found nesting in 2012 similar to 2011.

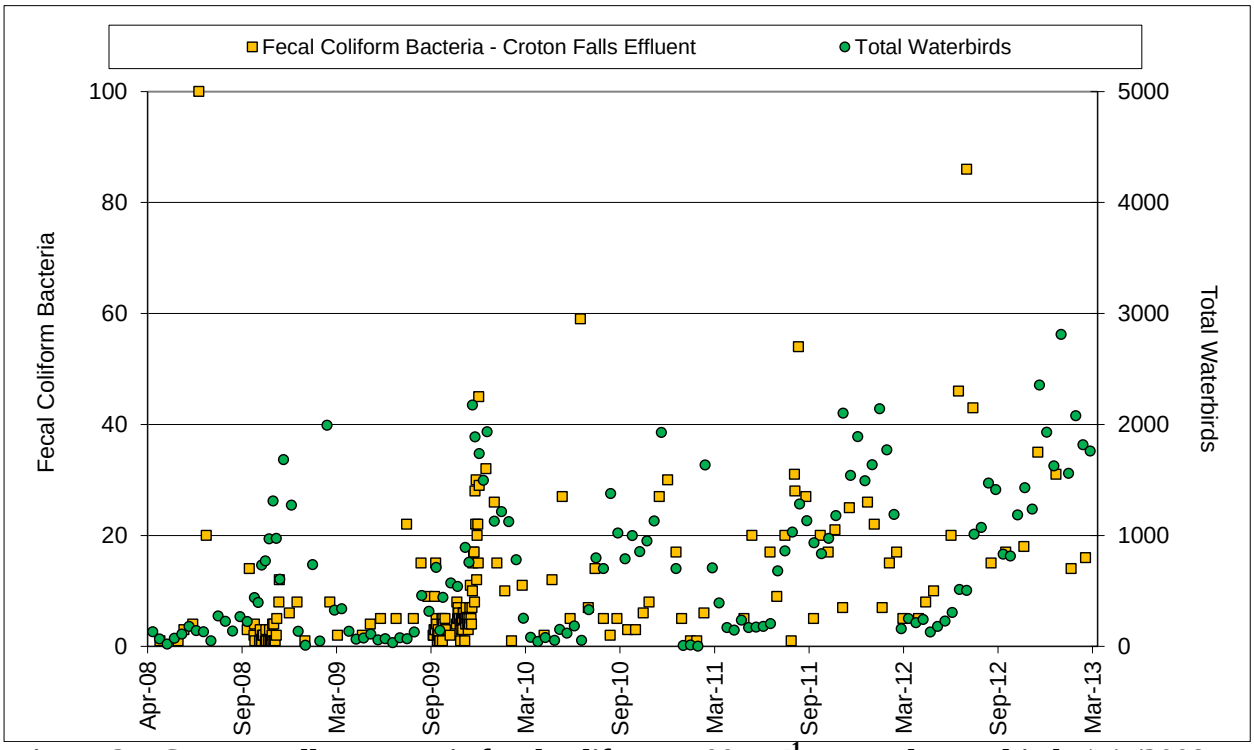

Figure 27. Croton Falls Reservoir fecal coliforms 100mL^{-1} vs. total waterbirds (4/1/2008 to 3/31/2013).

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 44). Bird numbers at Cross River were similar with those reported in previous years peaking at 625 recorded on January 18, 2013 compared to a high of 932 recorded in January 20, 2012 (Figures 28 and 29). Waterbirds continued to roost on the reservoir throughout the entire winter similar to the previous reporting period. Canada Geese numbers reached a high count of 165 on September 14, 2012 probably related to the onset of fall migration. The duck population rose from mid-September 2012 through the end of March 2013. Gulls were only observed on one survey at Cross River with a high count of 5 recorded on September 28, 2012 compared to a high of 20 observed on April 1, 2011 (DEP 2012). The reservoir reached a maximum ice cover of approximately 99 percent on February 14, 2013.

Fecal coliform bacteria concentrations identified in water samples at Cross River Reservoir exceeded the 20 fecal coliforms $100mL^{-1}$ level four times compared to seven times in the previous reporting period (Figure 30). The bacterial elevations recorded at the Cross River Effluent Chamber do not appear to be coincidental with population surges of waterbirds although biweekly sampling may not capture daily or temporary migratory increases. The Cross River Pump Station was not utilized during this reporting period, and activation of the "as needed" waterbird dispersal program was unnecessary.

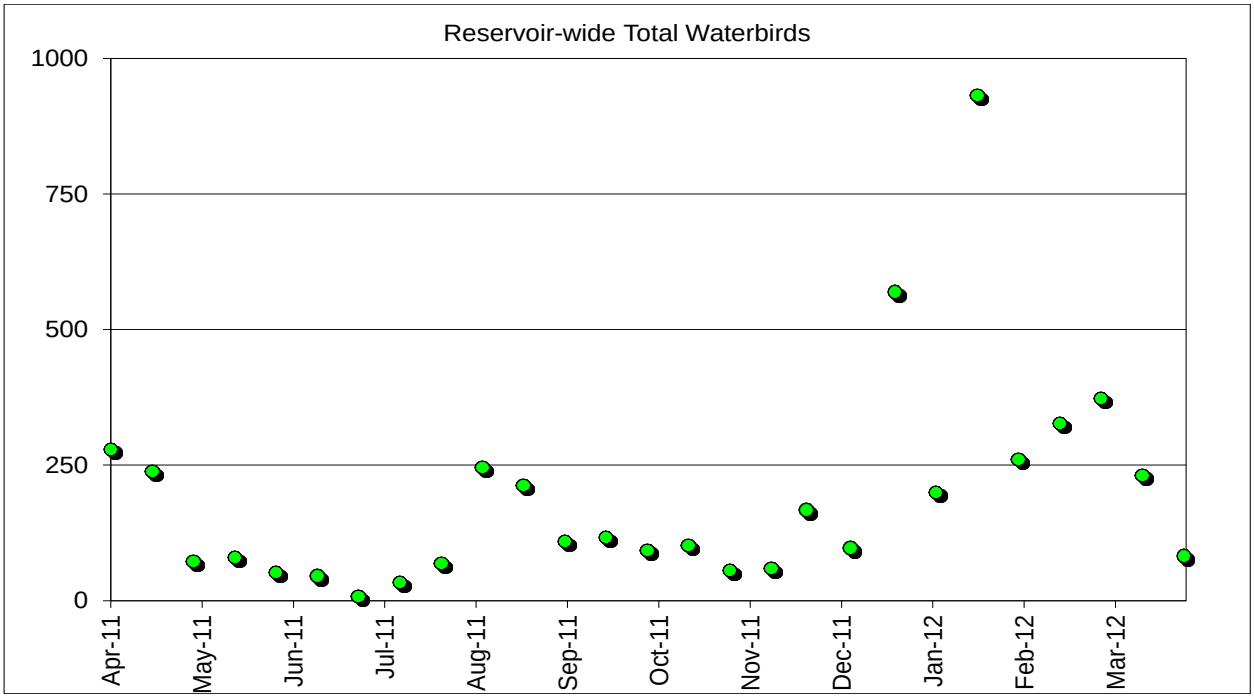

Figure 28. Cross River Reservoir total waterbirds (4/1/2011 to 3/31/2012).

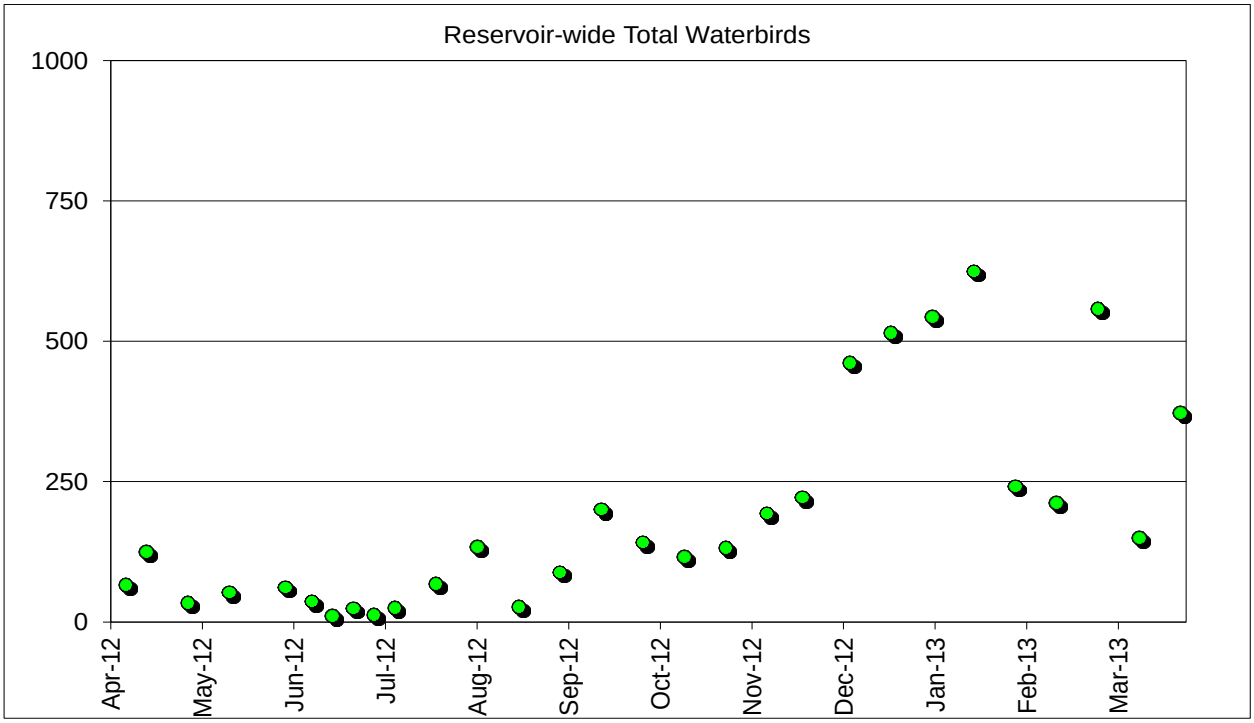

Figure 29. Cross River total waterbirds (4/1/2012 to 3/31/2013).

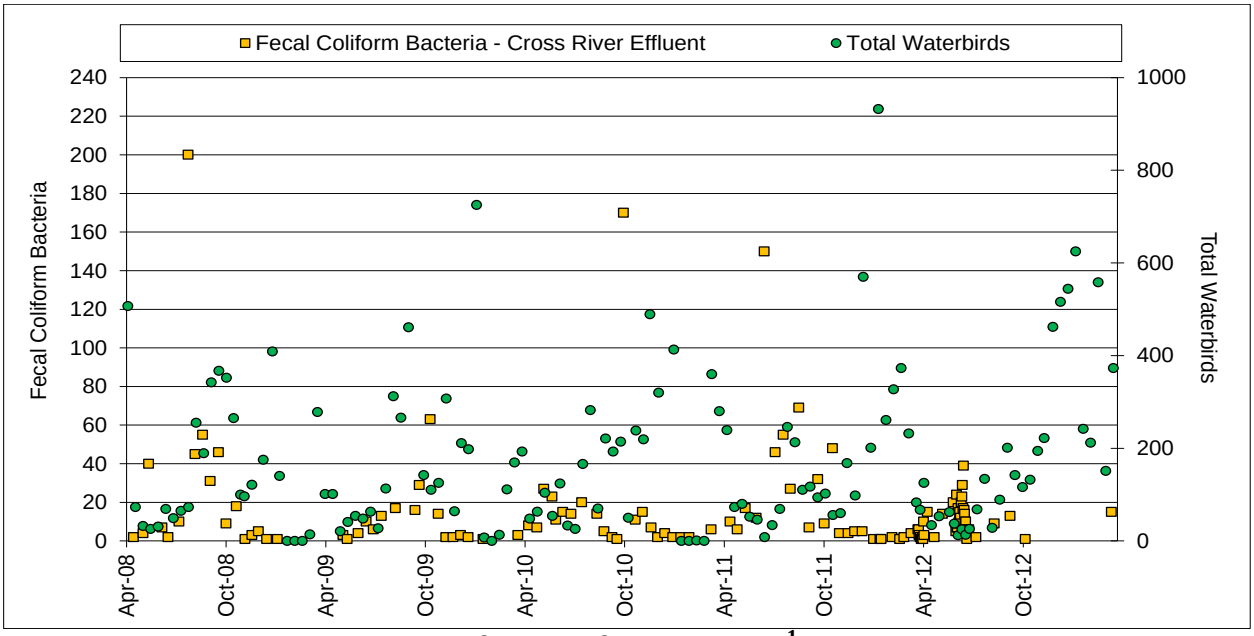

Figure 30. Cross River Reservoir fecal coliforms 100mL^{-1} vs. total waterbirds (4/1/2008 to 3/31/2013).

DEP conducted reproductive control on Canada Geese from April 1 through May 31, 2012 to reduce productivity at Cross River. In 2012, nine nests were identified and 47 eggs addled compared to 12 nests and 32 eggs in 2011 (Table 4). The egg-depredation success rate for Cross River in 2012 was 98 percent with 1 gosling reported. There were no Mute Swans observed nesting in 2012.

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 45 and 46). 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 harassment 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/harassment 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. 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. 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.

An 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 whereas routine daytime counts were initiated in the summer of 2004 with less frequent data collected from 1993 through 2004 (Figures 31 and 32). 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. This compares to 0.3 percent for gulls down from 1.0 percent in 2011/2012, 0.5 percent for geese up from 0.1 percent in 2011/2012 and 99.2 percent for ducks up from 98.8 percent in this reporting period. Except for a low number of diving ducks (Ruddy Ducks, *Oxyura jamaicensis*) all waterbirds observed and reported on both nocturnal and diurnal surveys were harassed off 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 contractor crews were largely successful in dispersing the gulls and geese once observed. The diving ducks (Ruddy Ducks and Bufflehead (*Bucephala albeola*)) have generally remained unaffected by a variety of bird deterrent and harassment measures employed by DEP to date. As a result, DEP utilized contract services with USDA for lethal removal of ducks during this reporting period. The lethal duck removal program was initiated in April 2011 and was conducted on an as needed basis. A total of 43 ducks and 3 Canada Geese were lethally removed by sharpshooters during this reporting period, up from 14 total birds in 2011/2012.

Overnight and daytime waterbird counts on both basins remained very low and were almost exclusively from a relatively small resident duck population. Of the 362 overnight surveys conducted there were only seven instances of small numbers of gulls observed during the overnight period compared to 14 in 2011/2012. For three of the seven gull nights' only one gull was observed roosting and the high overnight count of 5 gulls was recorded on November 17, 2012. There were five observations of Canada Geese recorded during the overnight observation in mid-May 2012. All Canada Geese were lethally removed under the USDA contract on May 25, 2012 (Figure 32). Overnight waterbird counts peaked at 41 on January 30, 2013 compared to a high of 36 in the previous report (DEP 2012). Water quality results for Hillview are presented as number of positive *E. coli* for each month of the reporting period at four water quality sampling locations (Figures 33-36). *E.coli* (grab samples) levels remained 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. There were no positive *E.coli* detections recorded from grab samples at Sampling Sites 1, 2, 3, and 58.

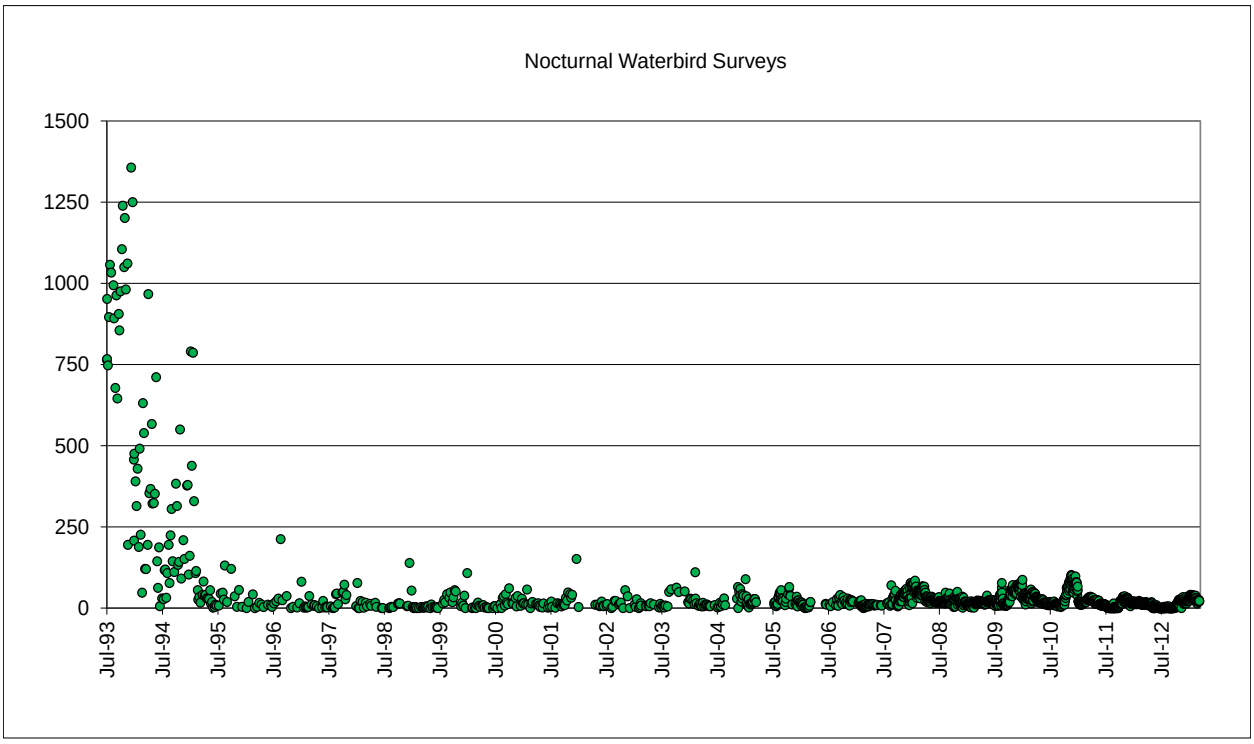

Figure 31. Hillview Reservoir total waterbirds nocturnal counts (1993 to 2013).

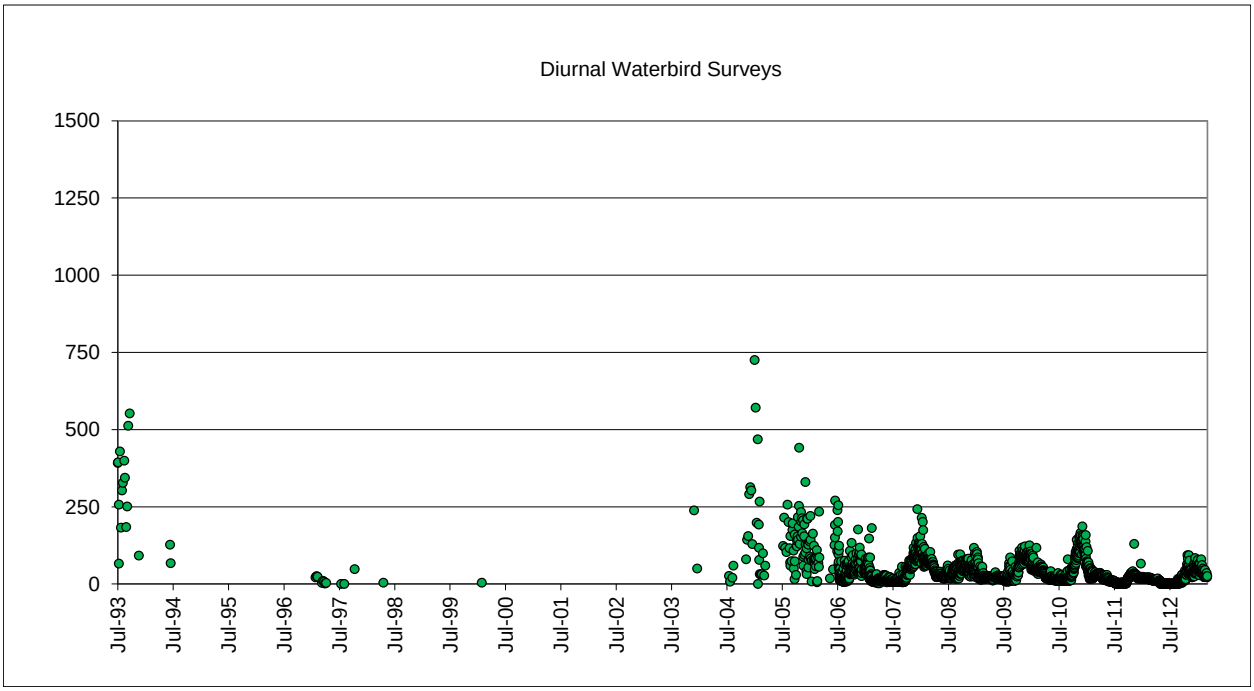

Figure 32. Hillview Reservoir total waterbirds diurnal counts (1993 to 2013).

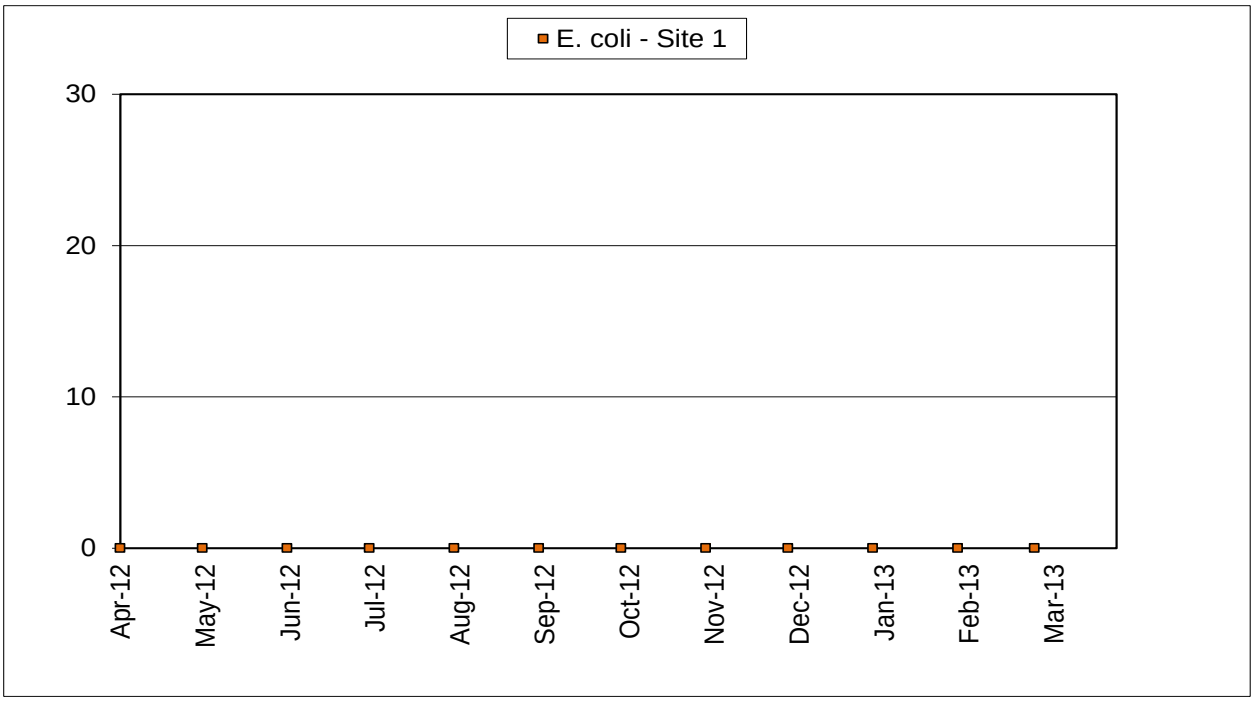

Figure 33. Hillview Reservoir number of positive *E. coli* (grab sample) at water Sampling Site 1 versus total waterbirds (4/1/2012 to 3/31/2013).

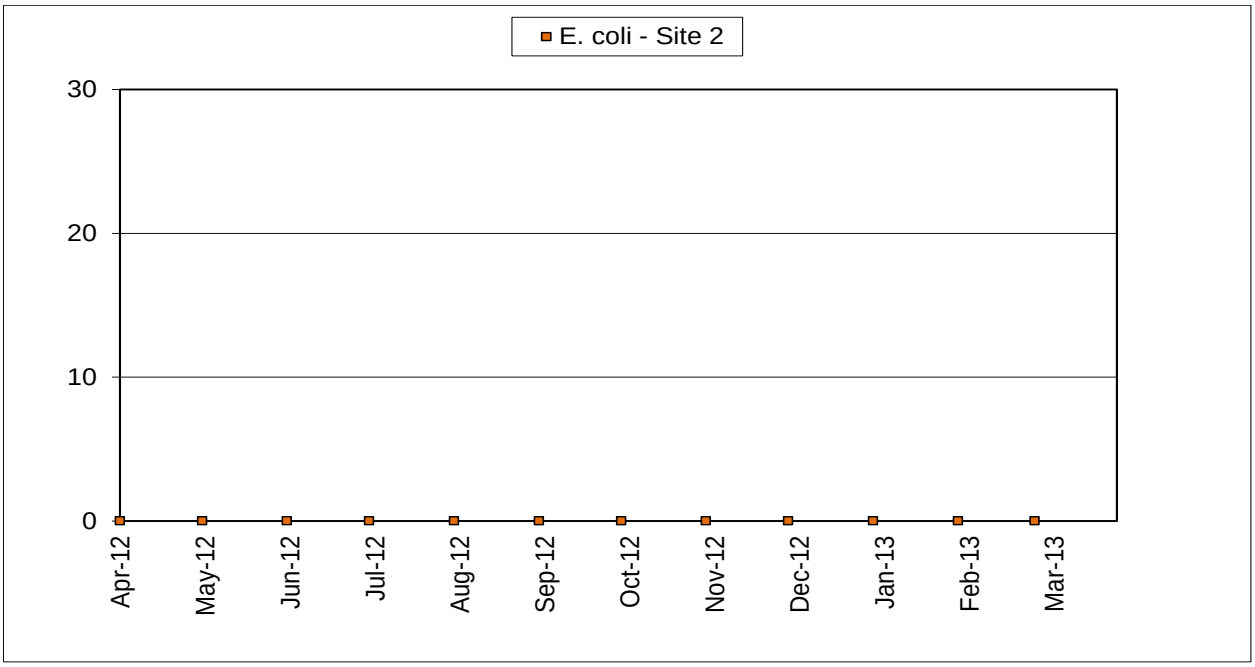

Figure 34. Hillview Reservoir number of positive *E. coli* (grab sample) at water Sampling Site 2 (4/1/2012 to 3/31/2013).

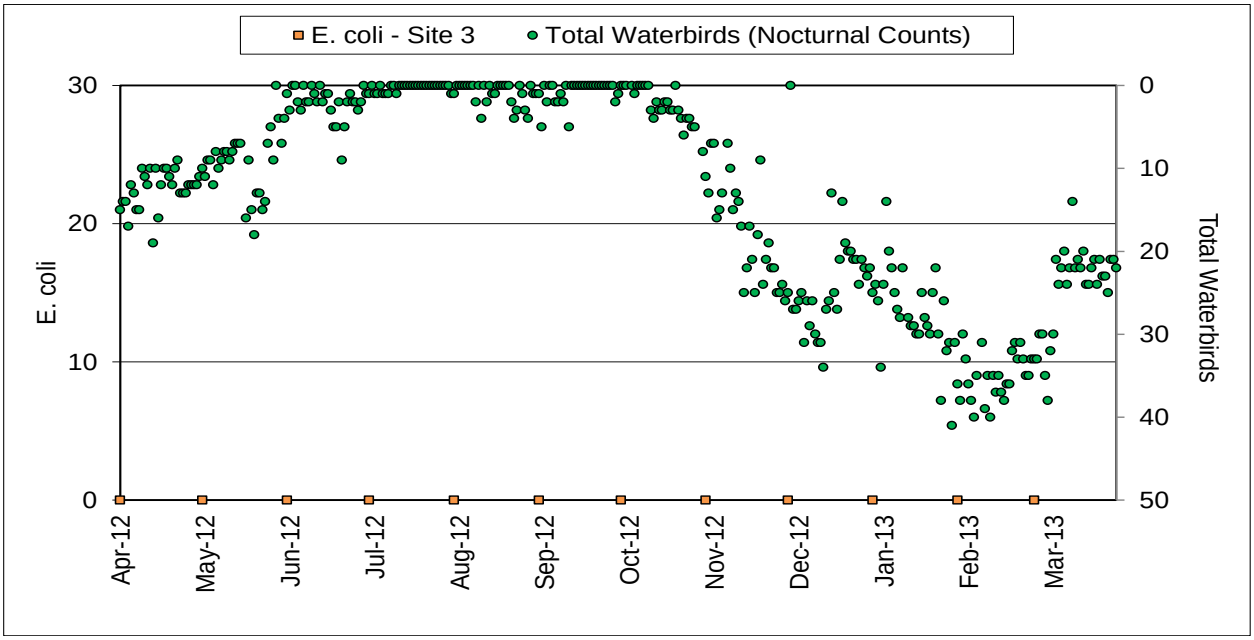

Figure 35. Hillview Reservoir number of positive *E. coli* (grab sample) at water Sampling Site 3 (4/1/2012 to 3/31/2013).

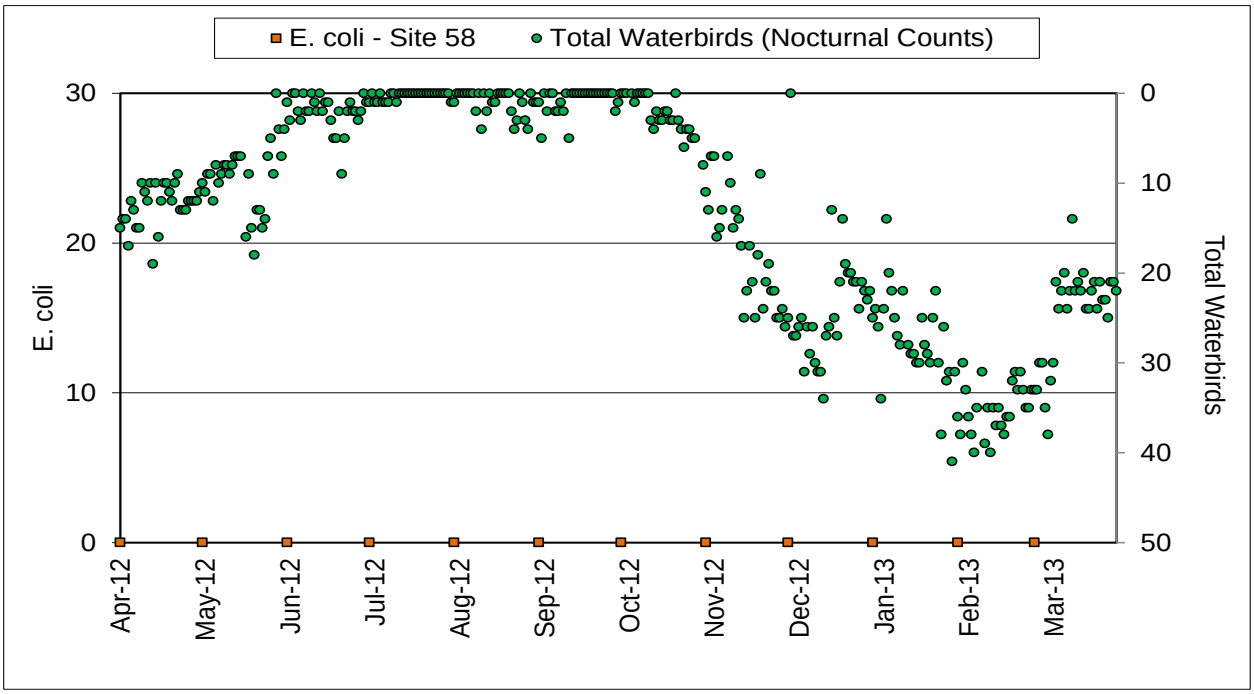

Figure 36. Hillview Reservoir number of positive *E. coli* (grab sample) at water Sampling Site 58 (4/1/2012 to 3/31/2013).

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.

Additional actions employed by DEP working in conjunction with assistance of NYS-DEC 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 and Osprey nests on the reservoir shaft buildings and along the dividing wall bird wire stanchions outside the established nesting seasons. 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.

DEP will continue to assess the feasibility of waterbird trapping efforts using the nighttime spotlighting technique as well as gill net deployment in the late summer when the ducks undergo a molt and are temporarily rendered flightless. If live-trapping efforts are successful the small flock of Ruddy Ducks will be relocated to a northern New York location that has been predetermined by the NYS-DEC. Daily monitoring and bird harassment activities will continue under a DEP contract to supplement the new bird wire grid system which was completed in late 2007.

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, Hillview Reservoir, and other reservoirs that have undergone "as needed" action 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 water intake structures at reservoirs that are sources to Kensico (i.e., West Branch, Rondout, and Ashokan Reservoirs), 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 deemed unnecessary by the USDA as part of the Westchester County Airport depredation order to remove local Canada Geese during this reporting period.

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 2012/2013 a total of 1,170 traps were set and only two raccoons (*Procyon lotor*) and one striped skunk (*Mephitis mephitis*) were trapped and removed from the reservoir property. 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 13 Cliff Swallow nests were removed from the reservoir shaft buildings from October 2012 through February 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

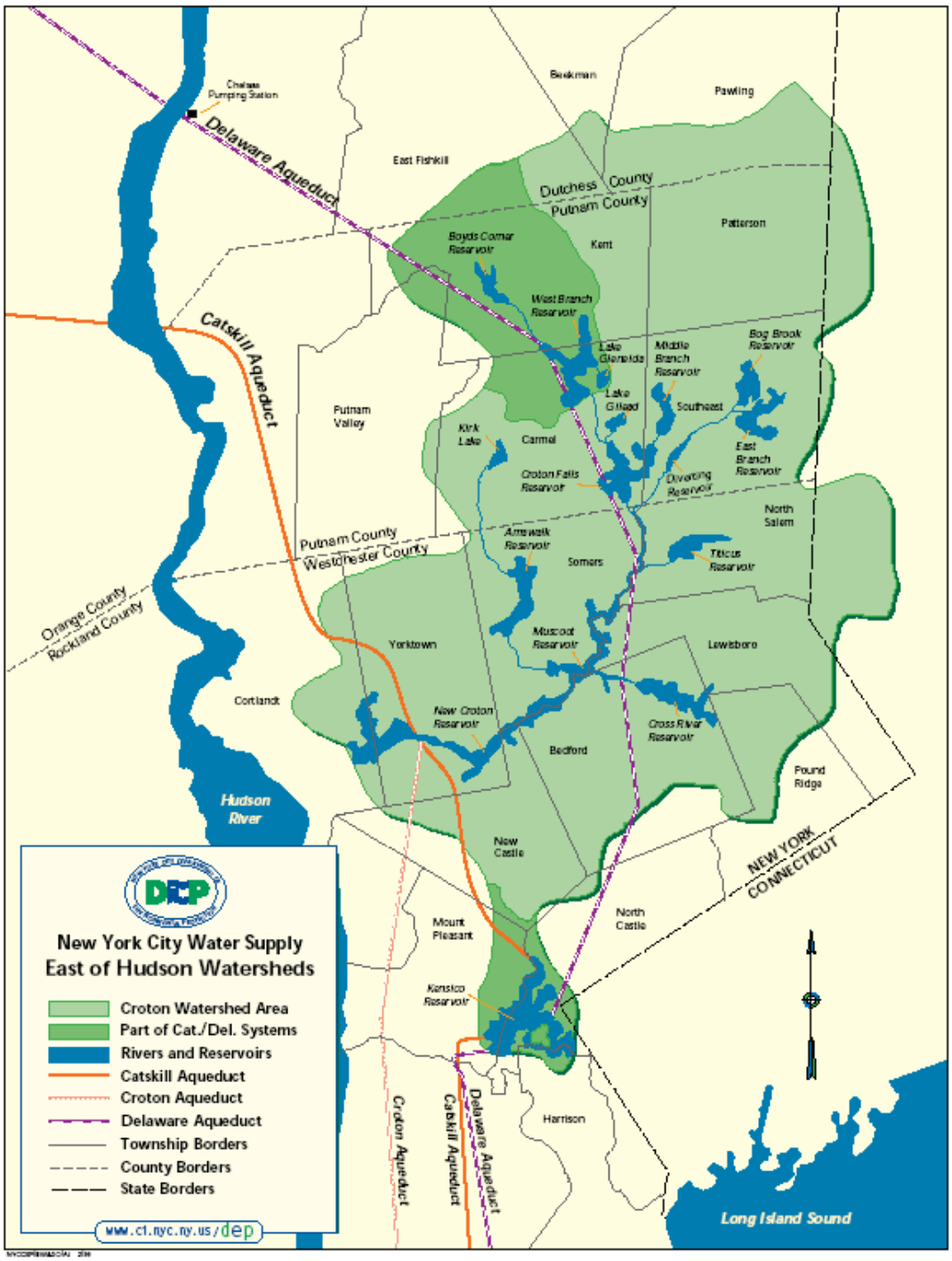

Figure 37. Map of New York City Water Supply System – East of Hudson Region.

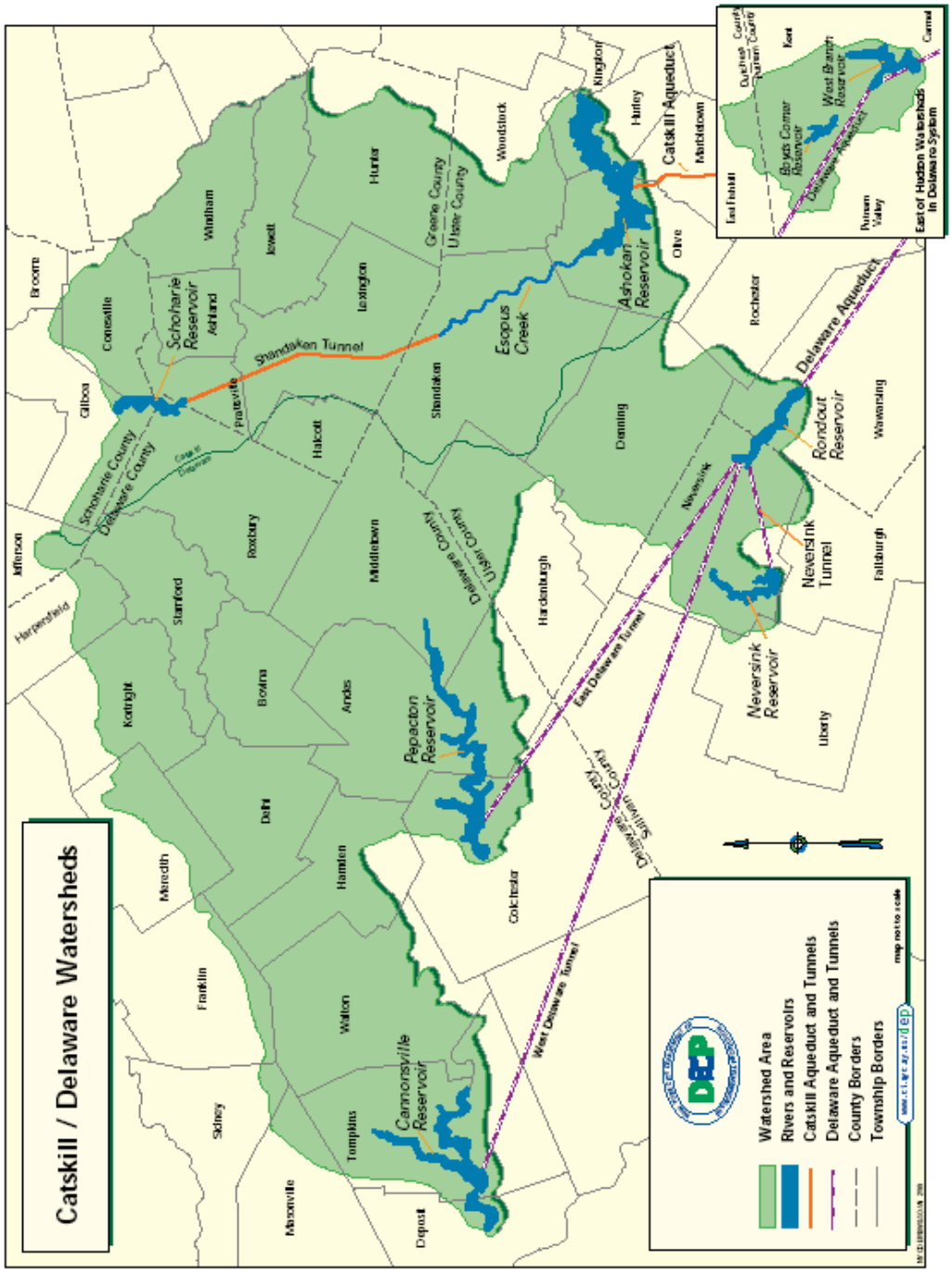

Figure 38. Map of New York City Water Supply – West of Hudson Region.

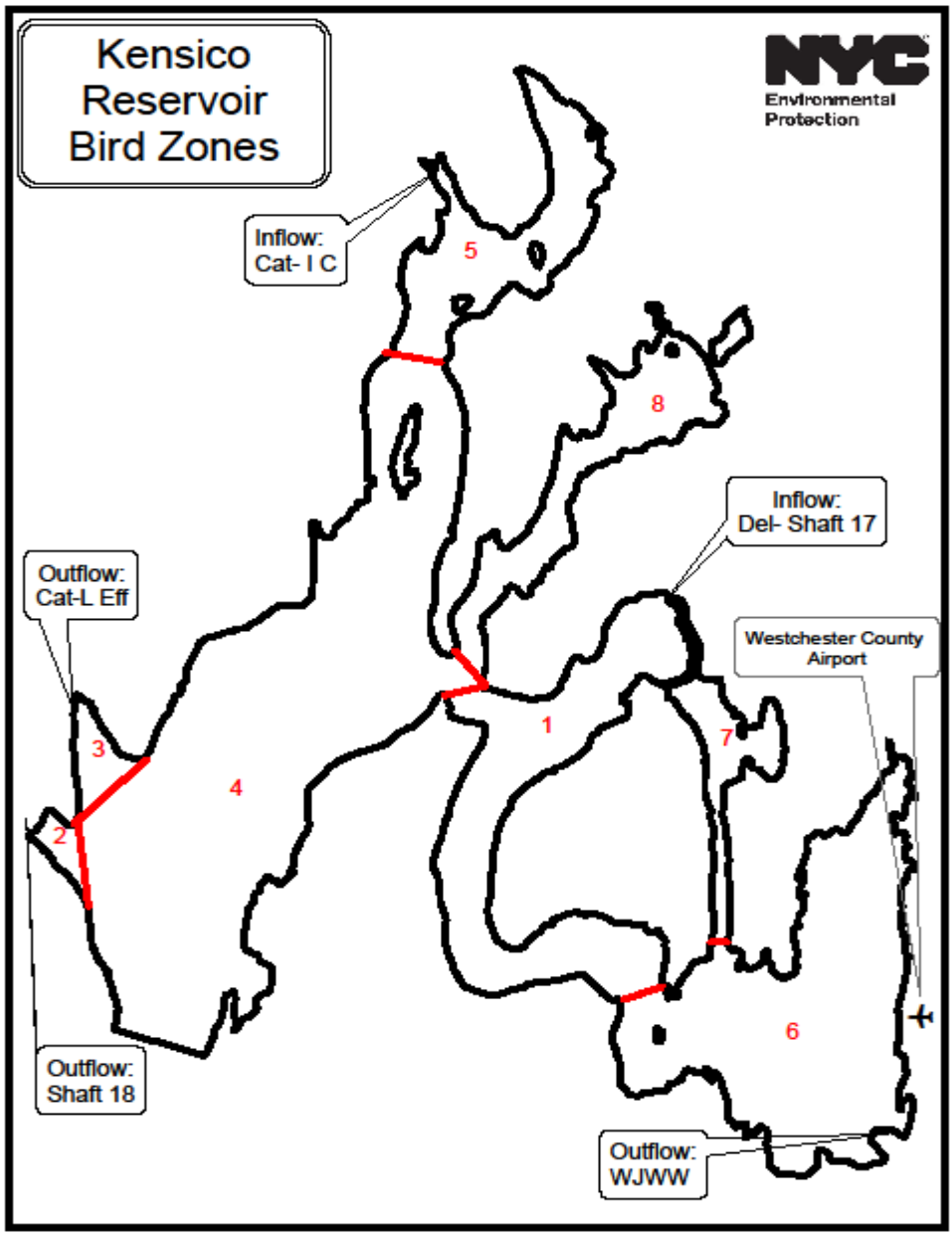

Figure 39. Map of Kensico Reservoir bird zones.

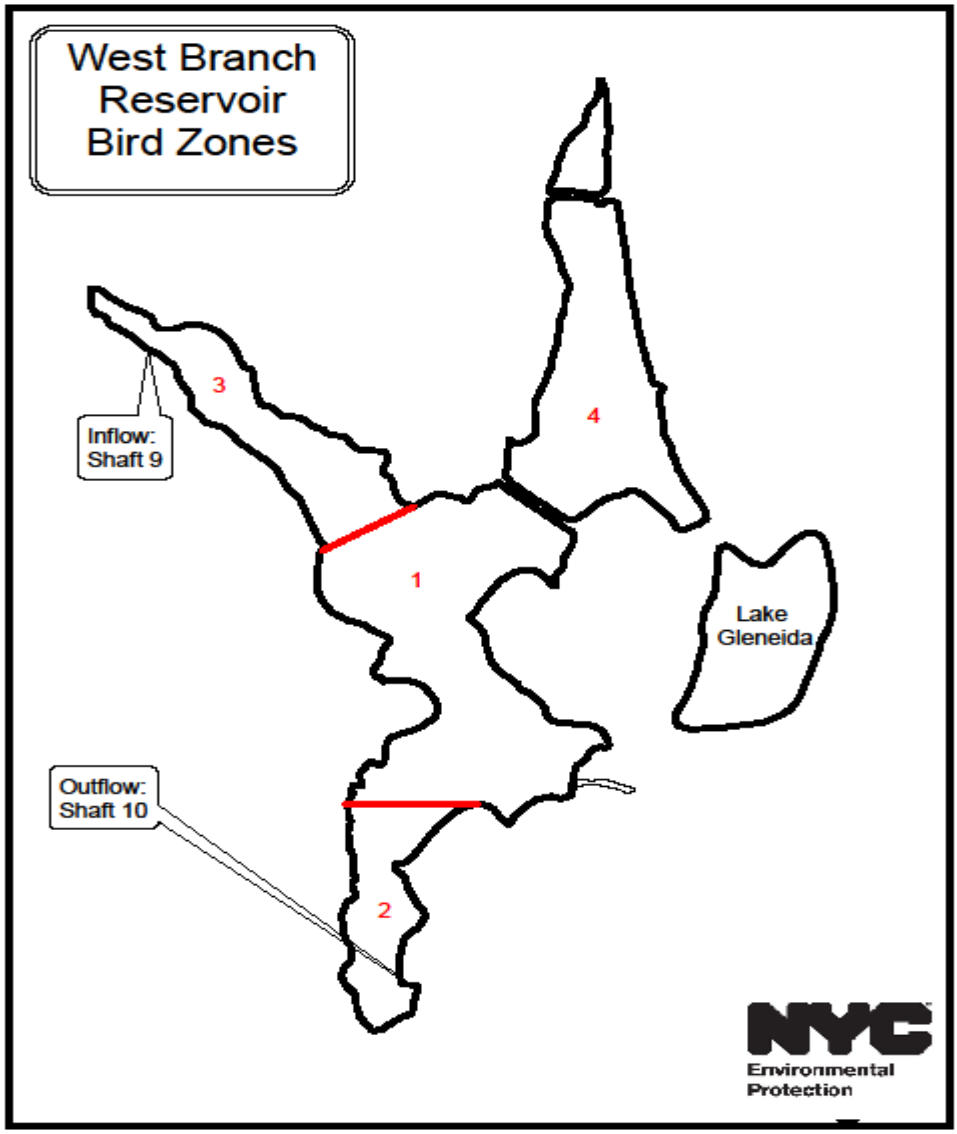

Figure 40. Map of West Branch Reservoir bird zones.

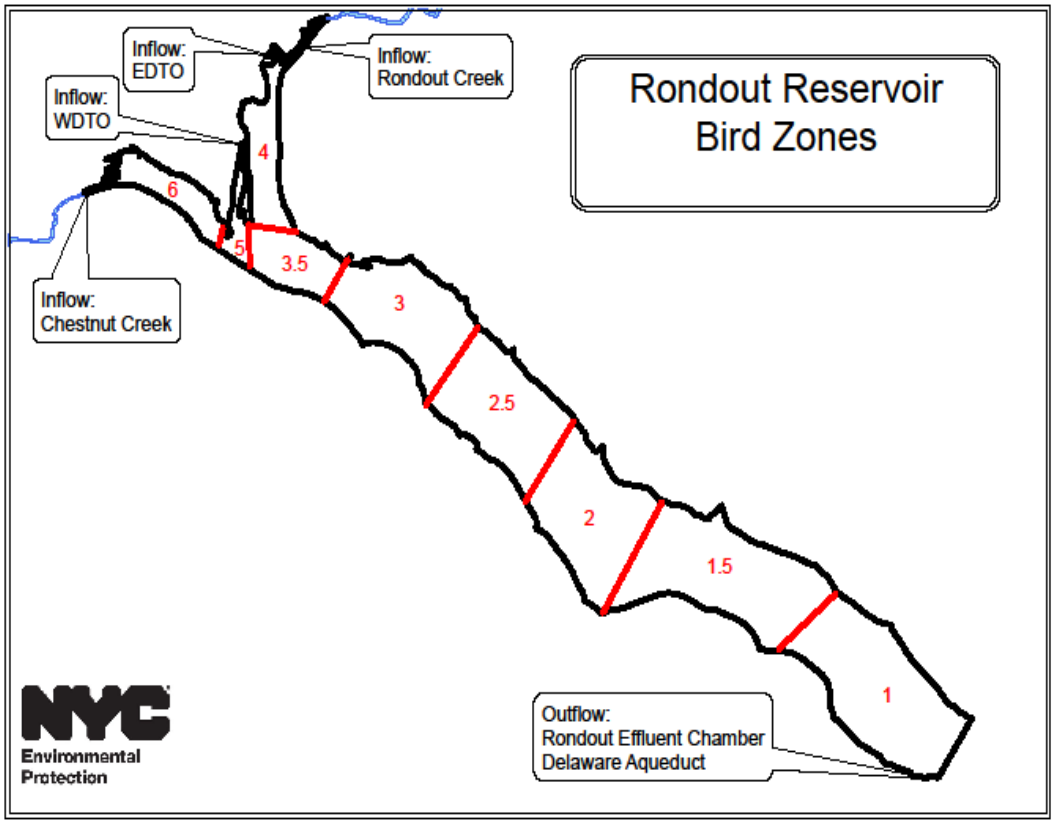

Figure 41. Map of Rondout Reservoir bird zones.

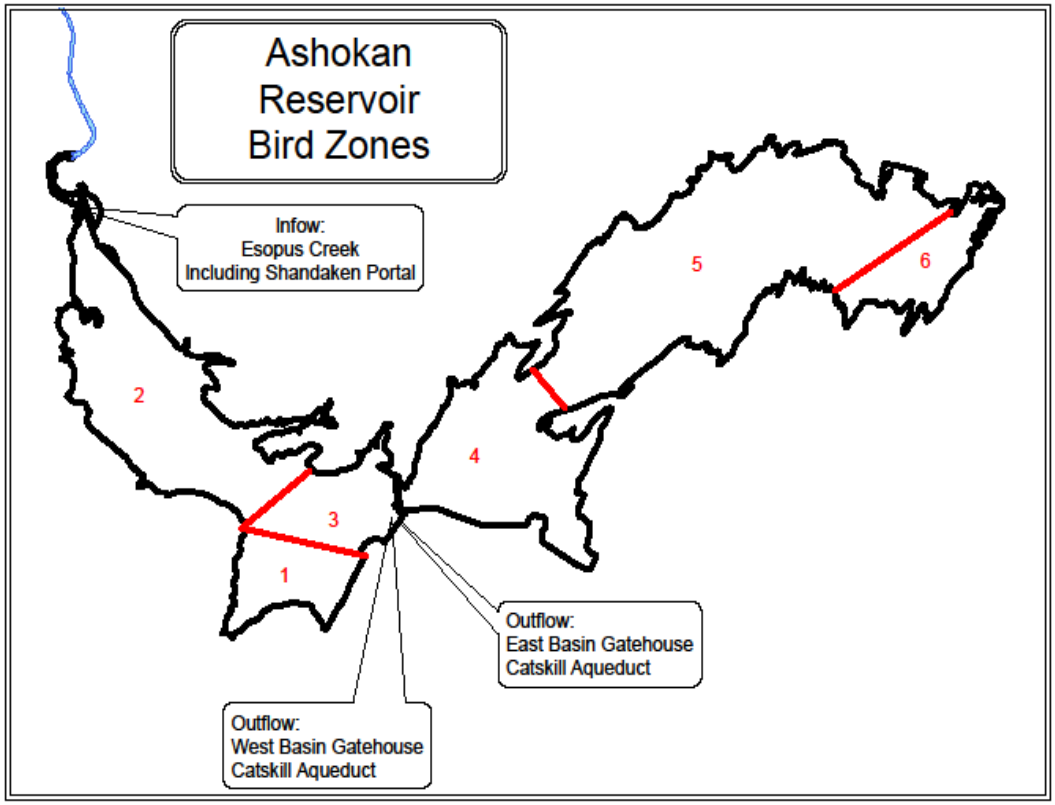

Figure 42. Map of Ashokan Reservoir bird zones.

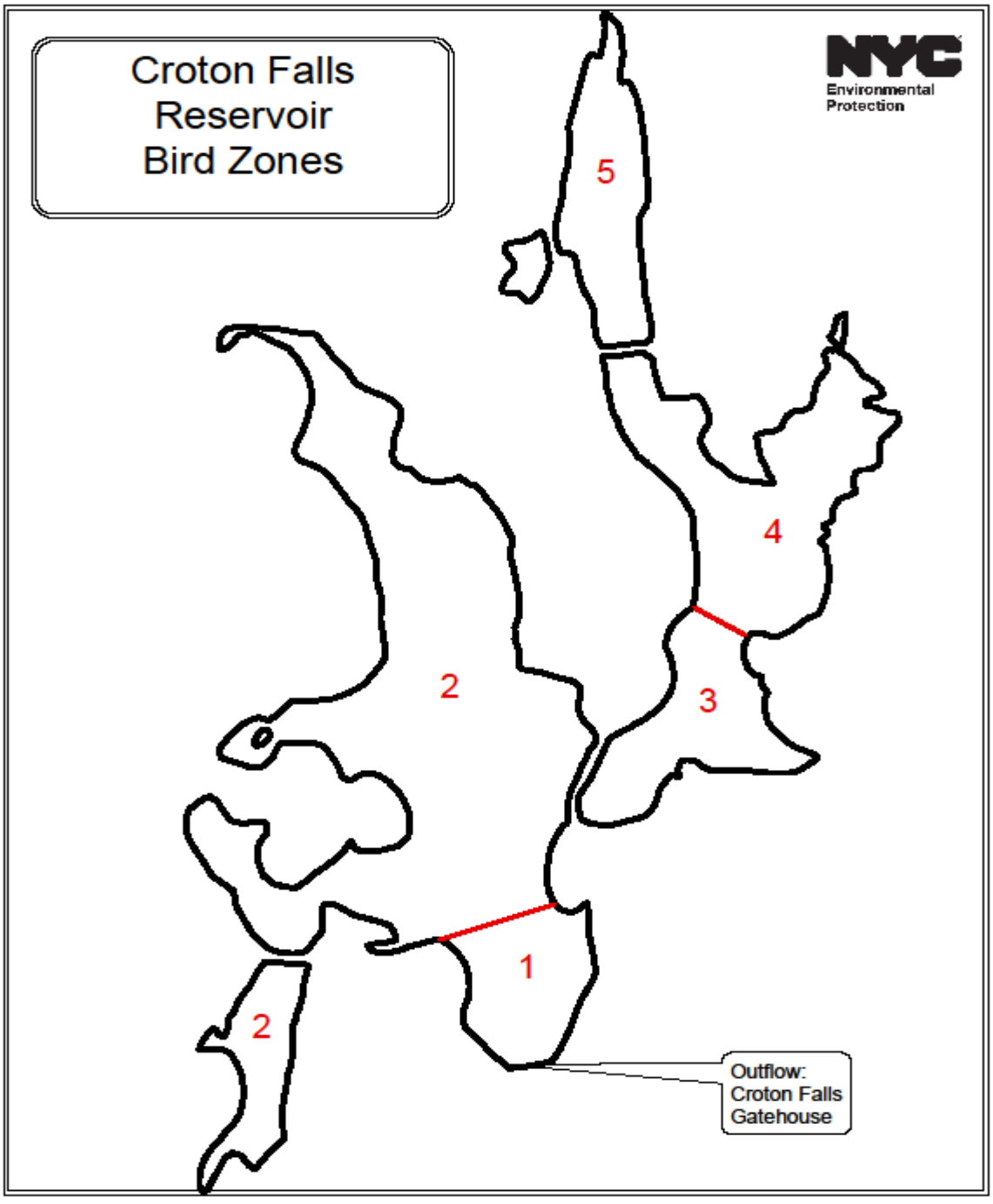

Figure 43. Map of Croton Falls Reservoir bird zones.

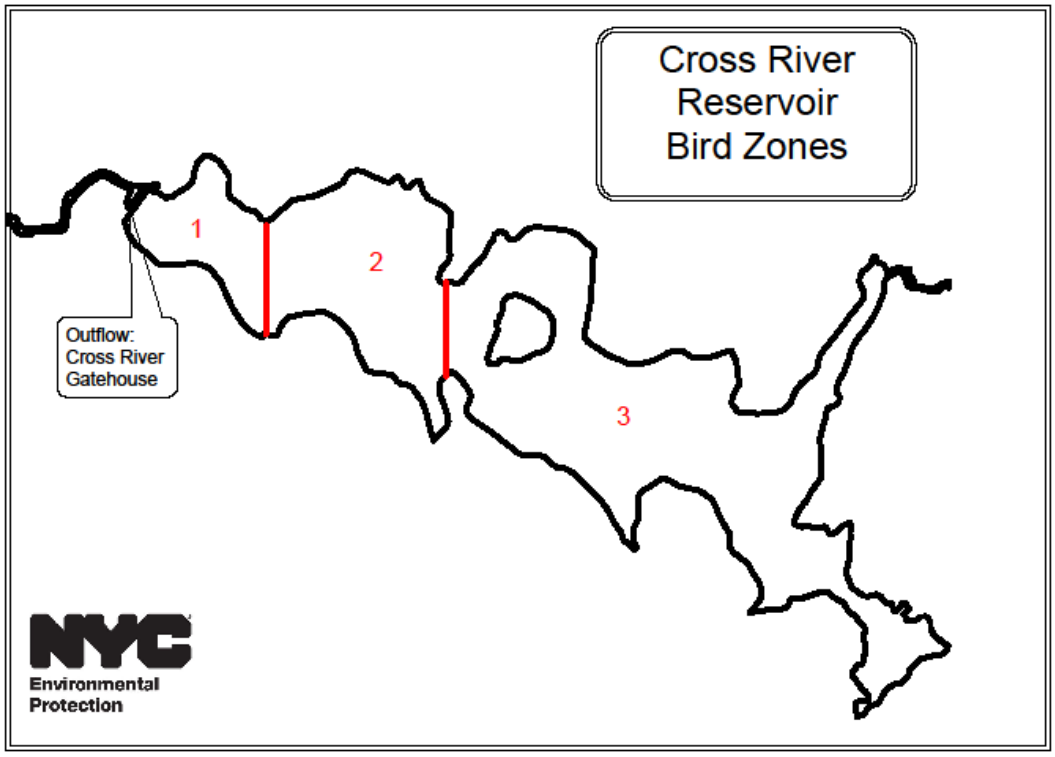

Figure 44. Map of Cross River Reservoir bird zones.

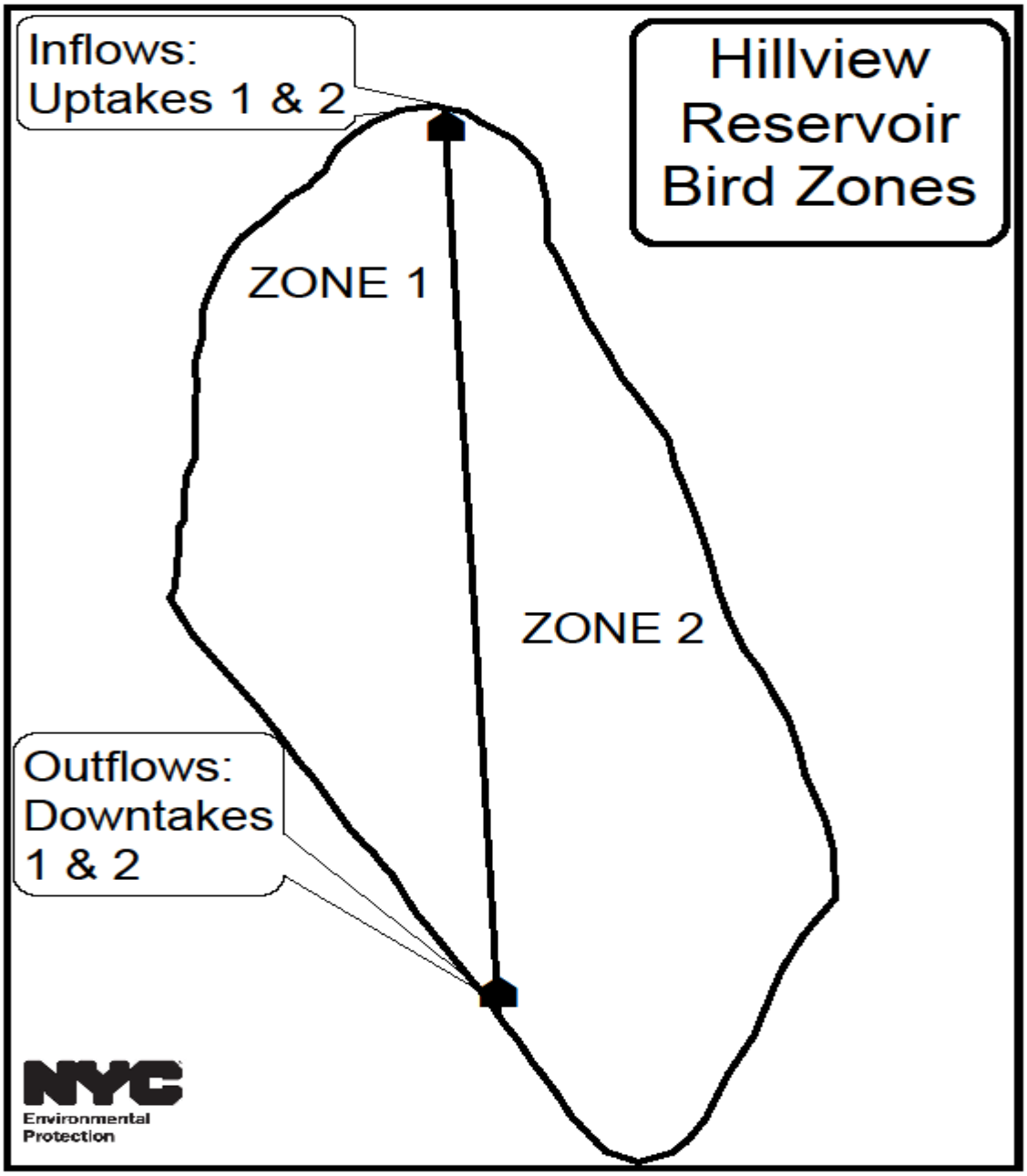

Figure 45. Map of Hillview Reservoir bird zones.

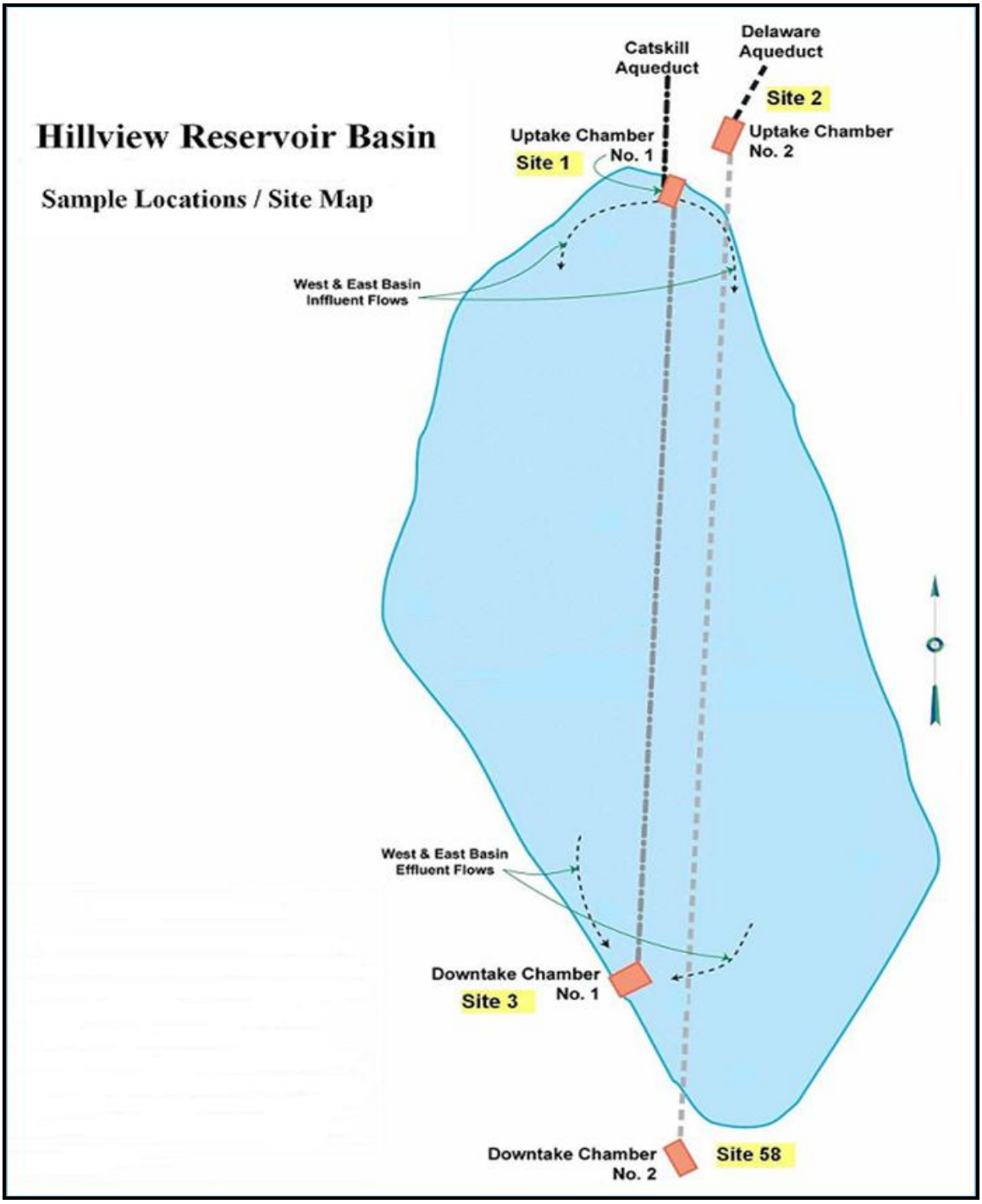

Figure 46. Map of Hillview Reservoir water sampling locations.