Appendix L-4
Materials Associated with Review of NYS Office of the Attorney General, Environmental Protection Bureau, *"Toxic Fairways: Risking Groundwater Contamination from Pesticides on Long Island Golf Courses"*

From Toxic to Friendly Fairways on Long Island

A Suffolk County Health Department study conducted in cooperation with the New York State Department of Environmental Conservation and as a condition of the New York State Pesticide Registry indicates that golf courses, long thought of as major groundwater polluters, are in fact more groundwater friendly than homeowners and farms. Much of the skewed reporting of this issue dates back to a report from the New York State Attorney General's Office titled *Toxic Fairways.*

In the Health Dept. survey, 20 wells located on or downgradient from 10 different golf courses were sampled for pesticides. This study included 12 new shallow monitoring wells in areas considered to be "worst case scenarios" immediately adjacent to treated areas on the golf courses. The results show that 17 of the 20 wells monitored had no detectable level of pesticides or metabolites. Two wells at West Sayville and one well in Sands Point did have detections that exceeded the maximum concentration levels (MCL) for certain pesticides.

Interestingly, the levels of nitrate in the groundwater samples were slightly below that of residential land and much lower than the average concentrations on agricultural land. Furthermore, an editorial in the September 3, 1998 News-Review on Long Island promotes the use of open space for golf courses as a result of the groundwater survey.

Excerpted from a news article citing the Suffolk County Health Department study.

Erosion Control Best with Sod

Establishing highly disturbed areas following construction activity poses substantial risk to surface water quality. The movement of sediment may include substantial nutrient loading of water bodies as well as sedimentation from the particulate additions. Effective means of stabilizing these sensitive areas are available from natural and man-made materials.

Researchers at the University of Maryland (including Cornell alumnus Dr. Mark Carroll, Ph.D. '88), investigated the effectiveness of two natural (dry oat straw and turfgrass sod) and four man-made erosion control materials (wood excelsior fiber mats, woven mesh jute fabric, polyester netted coconut fiber, and coconut fiber woven strand). Soil was disturbed on an 8% slope to simulate construction activity. A rainfall simulator was used to establish a condition likely to result in erosion on the plots that were covered with one of the erosion control materials. Rainfall was applied for 30 minutes to establish an antecedent soil moisture, then a 3.8 inch rain was applied for 30 minutes. This storm is likely to occur 1 out of every 5 years.

The sodded plots were the only treatments that extended the time needed to initiate runoff from the site. The other materials had similar runoff initiation times to bare soil. Sod decreased to total amount of runoff by 61% as compared to bare soil. Straw reduced the runoff 25% and jute 16%. All the man-made erosion control materials reduced runoff equally, between 18 and 25%.

There was no significant difference among erosion control materials for sediment loss, except that the open woven coconut strand mat was 9 to 50 times less effective than sod. This was likely due to the mat being first to wet and then pull away from the soil surface, allowing for surface flow under the mat. In addition, with regard to infiltration, the sod was able to maintain a high rate of infiltration longer than the other materials before slowly declining.

The researchers concluded that on moderately sloping hillsides, natural erosion control materials such as sod and straw are equally effective or superior to man-made materials. Of the man-made materials the jute was most effective in reducing the volume of runoff and reduced sedimentation.

From: Krenitsky, E.C., M.J. Carroll, R.L. Hill, and J.M. Krouse. 1998. Runoff and sediment losses from natural and man-made erosion control materials. Crop Science 38:1042-1046.

Scanning the Journals

A review of current journal articles

A Suffolk County Health Department study indicates that golf courses, long thought of as major groundwater polluters, are in fact more groundwater friendly than homeowners and farms.

The researchers concluded that on moderately sloping hillsides, natural erosion control materials such as sod and straw are equally effective or superior to man-made materials.

GCSAA Responds to New York Attorney General's Report, Calls It 'Unsupported by Fact, Inaccurate and Misleading

The Golf Course Superintendents Association of America (GCSAA), responding to a report recently published by the New York State attorney general's office, called the report "unsupported by fact, inaccurate and misleading."

The report, *Toxic Fairways: Risking Groundwater Contamination From Pesticides on Long Island Golf Courses,* is based on a survey of 52 golf courses on Long Island, N.Y. The report claims that the golf courses surveyed are treated with as much as seven times more pesticides per acre than are used to grow food crops. The report implies that the chemicals could pose a risk to local groundwater supplies.

GCSAA President Stephen G. Cadenelli, CGCS, stated, "A number of points from the report are unsupported by fact, inaccurate or misleading. The primary thrust of the report seems to be that simply because these materials are applied on golf courses, they will *de facto* enter groundwater. Yet, no scientific evidence is cited in the report to support this notion. In fact, actual monitoring and sampling studies suggest that there is very little movement of materials applied on courses—even in more vulnerable soils than those found on Long Island."

A major independent study completed on Cape Cod, Mass., and other university studies at Cornell and Pennsylvania State University show that golf course chemicals do not pose a threat to groundwater supplies when properly applied.

"Any suggestion that turf chemicals, when professionally and properly applied, will enter groundwater under golf courses in any amount sufficient to pose risks to humans is without foundation in science," Cadenelli said.

Cadenelli continued, "The report and the news release that preceded it refer to the fact that pesticides are applied to courses for 'merely aesthetic' reasons. Plant protectants are used to control diseases, insects and unwanted plants that cause damage to a very valuable piece of property. Golf course superintendents manage golf courses in an environmentally responsible manner to ensure that there are acceptable conditions for golf and to protect the significant investment that golf courses represent."

Golf courses are businesses: they provide thousands of jobs and millions of dollars in property taxes. The value of land around the golf course is also enhanced, creating a larger volume of tax revenues from homes and businesses located nearby.

Properly maintained turfgrass actually benefits an entire community by preventing erosion, cleansing the air of pollutants, acting as a "heat sink" that cools the atmosphere, maintaining much-needed greenspace in urban settings, providing habitat for thousands of species of birds and wildlife, and filtering pollutants from rain and irrigation water.

More and more golf courses around the country are utilizing effluent (reclaimed wastewater) for their irrigation purposes. The natural filtration properties of turfgrass allow this wastewater to be disposed of on golf courses and be cleansed before it reaches the groundwater supply.

Cadenelli said, "Golf course superintendents were putting the principles of integrated pest management into practice long before 'IPM' became a government buzzword."

Integrated pest management, or IPM, is the utilization of turfgrass management strategies that are economical and have the least possible effect on people, property and the environment. Reduced pesticide usage is an important element of any IPM program.

"Given the expense of chemicals and our own deep concerns about protecting natural resources, why would we use them unnecessarily? Modern emphasis and education is on using pesticides 'curatively,' as a doctor would use a specific medicine to treat a specific problem. Ask those who know—extension agents, pesticide regulators, educators—and they will tell you that golf course superintendents are leading the way in implementing IPM practices," said Cadenelli.

Maria Cinque, turf specialist at the Cornell Cooperative Extension on Long Island, backed up this statement. "We at the Cornell Cooperative Extension have been teaching IPM practices for the last 10 years. Many of those practices are used by golf courses on Long Island," Cinque said. "I believe that the amount of pesticides has definitely been reduced during this period."

Cadenelli noted that superintendents nationwide are using fewer and fewer chemicals more effectively each year.

"It seems ironic that this report is issued at a time when we're using better materials in increasingly small amounts. If there isn't a problem now, I don't see how there could be one in the future," he said.

The report itself stated that "there is no reason to believe that any water now supplied to Long Island exceeds safe drinking water guidelines for any pesticides."

August 25, 2015

Review of "Toxic Fairways: Risking Groundwater Contamination from Pesticides on Long Island Golf Courses"

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I. EXECUTIVE SUMMARY

In 1991, the Environmental Protection Bureau of the Attorney General of New York issued a report on the use of pesticides on Long Island golf courses, their potential for ground water contamination, and their potential for health effects. Some statements were made regarding pesticide use on lawns, as well. This report was revised in 1994 and 1995. Conclusions about pesticide use were based partly on a survey of the golf courses and partly on the work of Cornell researchers regarding agricultural use. Most of the statements about health effects were not supported with references. The authors were highly critical of the US EPA's regulatory program for pesticides. Many people have been citing this report as part of public discussion about a proposed development in Suffolk County, The Hills at Southampton.

The authors concluded that Long Island golf course managers use pesticides at rates four to seven times the number of pounds per acre used in agriculture, and home owners use between three and six times the number of pounds per acre used in agriculture. They also made many allegations regarding the deficient review of pesticides on the market and their health effects.

Golf Course Pesticide Use. It was difficult to critically examine the quantitative analysis done by the Cornell group of the broad agricultural use categories. This is because they did not provide the underlying data. A quantitative analysis of pesticide use on 90 crops I did in collaboration with the US EPA and the National Center for Food & Agricultural Policy concluded the following (Cohen, 1995): *"Golf courses are in the middle range of pesticide use when one considers total acreage, and do not reach the top 10 percent when one considers actual treated acreage. Golf courses appear to account for about 1 percent of agricultural pesticide use in the United States."*

Further, the AG's office apparently made arithmetic errors. I obtained an application rate comparison of 3.7-4.9 times for the golf to agricultural use rate ratio using their information (rounded to four to five times), not four to seven times.

Home Lawn Pesticide Use. The support for the three to six times the ag use rate statement (see above) was a highly biased article published in Time magazine. It was written by a reporter who provided no references nor offered any data to support his claim. It is unconscionable that the State Attorney General's scientific staff would rely on this source for such a conclusion.

Pesticide Regulation by the US EPA. The pesticide regulatory program at the USDA - - prior to the creation of the EPA in 1970 - - was weak. But it became much stronger with the passage of the Federal Insecticide, Fungicide, and Rodenticide Act in 1972. Then a series of rigorous, comprehensive data

requirements were promulgated ca. 1982-1984 (Title 40 of the Code of Federal Regulations, Part 158) that required pesticide registrants to conduct 75-100-plus studies in the areas of toxicology, environmental fate, ecological effects, product chemistry, worker exposure, turf transferrable residues, and crop residues for each pesticide. Also, a systematic and comprehensive program to evaluate the "inert" ingredients was begun in 1986. Finally, since 1996, the risk-based standard for most turf pesticides has been "a reasonable certainty of no harm" to children and others. Apparently, the report's authors chose not to balance their criticisms with this information.

Ground Water Contamination by Pesticides. The title of the report and several of its statements tend to give the reader significant concerns about ground water contamination by golf course pesticides. Yet studies by the SCDHS (2002) and us (Baris et al., 2010) indicate groundwater contamination by pesticides applied to golf courses is not a significant problem.

Health Effects. The report contains many comments regarding adverse health effects caused by pesticides. References are not provided to support the statements. For example, the report states in the Introduction, *". . . some [pesticides] have been linked to birth defects."* We are not aware of birth defects caused by pesticide applications, particularly applications made within the last 30 years.

II. DETAILED COMMENTS

A. Publication Version

This report was originally published in July, 1991. It was revised in February 1994 and December 1995. These comments focus on the 1995 version. The authors were from the Environmental Protection Bureau of the Office of the Attorney General (AG) of New York State.

B. A Comparison of Agricultural and Turf Pesticide Use

Subsection 1 below lists some key statements in the AG's report. Subsection 2 describes a pesticide use analysis I published in 1995. Subsections 3 and 4 evaluate the report statements.

1. Key Statements in the Report Regarding Use (The locations of the statements in the report are listed following each quote.)

The report makes the following statements regarding pesticide use. They are based, in part, on the results of a 1990 survey of 1989 pesticide use at 52 Long Island golf courses, plus a section of a handbook coauthored by a Cornell researcher.

- *". . . three to six times as much pesticides are used per acre on home lawns than to grow the food we eat.(1) As shown later in this report, golf courses on Long Island use almost four to seven times the average amount of pesticides used in agriculture, on a pound per acre basis."* (Introduction section)
- *". . . many golf course managers apply huge amounts of pesticides following a pre-determined "recipe" of repeated applications, rather than customized treatments addressing actual problems."* (Introduction section) This is not true. Turf professionals managing golf courses apply lower amounts of pesticides on a very specific schedule. The schedules are based on scientific monitoring of regional and local weather conditions, pest development (larval, instar and adult stages of insect development),

pathogen identification, pesticide resistance, and Integrated Pest Management Programs.)

- *"If these 50,000 pounds were applied evenly across the total area of the 52 golf courses, it would amount to an average of seven pounds of pesticides per acre annually. By comparison, a national average of 1.5 pounds of pesticides per acre are applied in agriculture annually.[(3)] The actual rate of golf course pesticide use may be much higher than seven pounds per acre, since the playing surfaces that are treated make up only a portion of the golf courses' total acreage. A comparison of pesticide usage in agriculture and golf course maintenance which is based on the acreage actually treated with pesticides is even more alarming. Based on responses to our survey, pesticides were applied to only about 50 percent of the total acreage of Long Island golf courses. By contrast, pesticides are applied to about 62 percent of all agricultural land. Using these figures, the average golf course application rate increases to 18 pounds of pesticides per treated acre per year, about seven times the agricultural rate of 2.7 pounds per treated acre per year.[(4)] Thus, between four and seven times as much pesticides are used on Long Island golf courses than are applied on food crops."* (Summary of Survey Results section).
- *"By comparison, when homeowners follow the directions for various annual do-it-yourself lawn care programs, they may apply from 3.2 to 9.8 pounds of pesticide per acre annually. Thus, homeowners may apply up to 3.6 times as much pesticides as is typically used in agriculture."* (Summary of Survey Results section).

Footnotes Cited in the State Attorney General's Report

1. Time Magazine, June 3, 1991

3. D. Pimentel et al., "Environmental and Economic Impacts of Reducing U.S. Agricultural Pesticide Use," Handbook of Pest Management in Agriculture, 2nd edition, edited by David Pimentel, CRC Press, Boca Raton, Florida, 1991, page 679 [sic].

4. D. Pimentel et al., op cit.

There is some truth to most of these statements. Unfortunately, the statements are misleading, individually and collectively. An analysis follows.

2. A Detailed Published Analysis of Pesticide Use

These statements by the AG and his staff became widely circulated and highly publicized once the 1991 version of the report was issued. Therefore I conducted a detailed analysis of the issue with the collaboration of staff from the Economic Analysis Branch of the US EPA's Office of Pesticide Programs, and Leonard Gianessi of the National Center for Food and Agricultural Policy (Cohen, 1995). Basically, I obtained pesticide use and crop acreage data from these sources for fungicides (75 crops), insecticides (88 crops) and herbicides (90 crops).

The table below summarizes the results for 13 of the 90 crops evaluated, including golf course turf and homeowner turf. The pesticide use rankings for golf course turf were 31st of 90, 47th of 88, and 38th of 75 for application rates (pounds of active ingredient per acre) of herbicides, insecticides, and fungicides, respectively. Homeowner turf ranked lower than golf course turf in all three categories.

The following paragraph summarized the key findings of the analysis (p. 104 in Cohen, 1995).

> *"Now the question can be answered: Do golf courses use greater amounts of pesticides than agriculture on a per-acre basis? It should be apparent the answer is "definitely sometimes." Golf courses are in the middle range of pesticide use when one considers total acreage, and do not reach the top 10 percent when one considers actual treated acreage. Golf courses appear to account for about 1 percent of agricultural pesticide use in the United States."*

Pesticide Use for Various Crops on a Per-Acre Basis*

Crop/Site	Acres	lb a.i./A (rank)		
		Herbicides (90 crops ranked)	Insecticides (88 crops ranked)	Fungicides (75 crops ranked)
Onions	151,676	6.32 (1)	1.41 (48)	6.56 (22)
Citrus	878,300	6.21 (2)	25.86 (4)	6.16 (26)
Sweet Corn	761,045	2.79 (13)	1.81 (42)	1.45 (49)
Pears	72,226	1.57 (39)	77.68 (1)	13.42 (11)
Cotton	11,120,700	2.65 (18)	1.79 (43)	0.19 (59)
Tomatoes	411,361	1.64 (36)	1.82 (41)	21.20 (4)
Feed Corm	78,156,196	2.73 (16)	0.34 (66)	~0
Grapes	764,137	1.42 (44)	6.51 (12)	61.92 (1)
Apples	502,792	1.10 (57)	31.36 (3)	13.64 (8)
Peaches	186,388	1.38 (47)	15.15 (8)	40.11 (2)
Tobacco	784,770	1.52 (41)	4.41 (16)	0.47 (56)
Homeowner turf	20,900,000	1.20 (52)	0.30 (66)	0.03 (66)
Golf course turf	1,400,600	1.79 (31)	1.50 (47)	3.21 (38)

* The number 1 crop in each category is highlighted.

3. Managed Turf Areas

The AG's report states that pesticides were applied to half of the golf course acreage (third bullet in B(1) above). The basis for this conclusion was not disclosed. We note, instead, that a more realistic conclusion is that 67% of golf course acreage receives pesticide applications. This is based on the fact that the average 18-hole golf course is 150 acres (A), of which 100 A are maintained turfgrass[*] (GCSAA, 2007). The 150 A statistic agrees almost perfectly with our calculation using the data in Table 1 of the NY Attorney General's report, an average of 147 A per golf course that responded to the survey. (Note: this table includes data for 18, 9, and 27+ hole golf courses, but the typical number is 18.)

This information is used in subsection 4(b) below to critically evaluate the AG's conclusions.

[*] It should be noted that three private courses in the area all manage less than 100A of turf - - Sebonack, The Bridge, and The Hills.

4. Critical Evaluation of the AG's Conclusion Regarding Pesticide Use

a. Home Lawns. The basis for the statement regarding pesticide use on home lawns (1(a) above) is an article published in Time magazine, written by a reporter who provided no data in support. Most people, particularly most scientists, would not consider this to be an authoritative source.

Nor is it an objective source. ***There was no attempt to disguise the author's pronounced negative bias.*** For example, the first sentence states:

> *"Lawn is the curse of suburban man, his bizarre fetish, the great green god he sprays to."*

Two paragraphs later, the Time reporter states:

> *"Do-it-yourselfers don't read warning labels or take precautions to protect themselves, and they use up to six times as much pesticide per acre as farmers do."*

It is unconscionable that the State Attorney General's scientific staff would rely on this source for such a conclusion.

In contrast, my analysis (Cohen, 1995) relied on objective, authoritative data sources.

b. Golf Courses. We recalculated the average pounds of pesticide applied per golf course acre per year. Our number is 6.6 lb/A (50,035 lb/7543 A), compared with the AG's number, 7 lb/A. We assume the report authors rounded off the 6.6 to 7, which is acceptable.

However, we obtain a significantly different result for pounds of pesticide applied per treated acre, regardless of whether we use our value for treated acres (67%) or the AG's value (50%), as follows:

- using 57% - - (6.6 lb/a)/0.67 = 9.9 lb/treated A, or
- using 50% - - (6.6 lb/A)/0.50 = 13.2 lb/treated A.

Neither 9.9 lb/A nor 13.2 lb/A is close to the 18 lb/A stated in the AG's report (in the "Summary of Survey Results" section). When we divide these two numbers by the generic agricultural-treated-acre (2.67 lb/A, rounded to 2.7 by the AG), we obtained a comparative use range of 3.7-4.9 times. This can be rounded off to four to five times, but it is definitely not seven times, as the AG report claims, and which has been quoted extensively.

There is further uncertainty regarding the basis for the statement that golf course pesticide applications are four to seven times greater relative to cropland agriculture. That uncertainty is in the denominator, i.e., the pesticide application rate in agriculture. The rates quoted in subsection B(1) above are 1.5 lb/A as a national average of pesticides applied to cropland, and 2.7 lb/A of pesticides applied to treated cropland. ***Thus the AG's own data and assumptions do not support its 7-fold use-rate conclusion.***

Unfortunately, the references cited do not provide the bases for their numbers. The AG report cited Pimentel et al. 1991 for both numbers. That paper lists a single source for all of the numbers in the key table relevant to the AG report - - Pimentel and Levitan (1986). The latter reference contains an almost identical table with 63 data entries. The authors cite their data sources as, "Sources: available from the authors."

Thus AG's office apparently made some sort of arithmetic error in calculating the golf:ag ratios, and the fundamental basis for the denominator - - ag application rates - - was not provided.

C. The US EPA's Regulatory Program

Listed below are key statements from the report that are critical of the US EPA, followed by my responses.

1. Data Review

"The U. S. Environmental Protection Agency (EPA), which regulates pesticides, is currently reviewing the data on the health and environmental effects of some pesticides to decide whether these products should be continued to be used. In the meantime, thousands of pesticides still under review are freely marketed--unless the EPA decides to restrict or eliminate their use. So far, only one of the 34 most commonly used pesticides for turf and lawn care has completed this review." (Introduction section)

The statement that the EPA was reviewing the data of *"some pesticides"* was misleading, at best. The truth is that the EPA comprehensively reviewed the data regarding <u>all</u> pesticides in a process that began ca. 1978 and ended in the early 2000s. A followup comprehensive re-review process is ongoing, as part of the continual data review cycle. The data that are reviewed have been developed pursuant to Title 40, Code of Federal Regulations, Part 158, which requires 75-100 plus studies in all relevant scientific disciplines (toxicology, product chemistry, etc.)

The statement, *"In the meantime, thousands of pesticides still under review are freely marketed . . ."* is also misleading. First, although there are thousands of formulated products, there are only hundreds of pesticide active ingredients. Second, by the time of the report - - 1995 - - most pesticides had undergone a comprehensive data/risk review as part of the initial application submission review and/or the Reregistration Eligibility Decision (RED) and/or the registration standards processes. Regarding the number one of 34, I don't know the correct number as of 1995, but I guess it had exceeded 10.

2. Decisions Based on Risk-Benefit Analysis

"The federal pesticide law, known as the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) which gives the EPA authority over pesticides, requires the EPA only to decide that the pesticide poses "no unreasonable *risk" (emphasis added) to public health or the environment, based on its perceived economic, social and environmental costs and benefits. Before the EPA may register a pesticide and allow it onto the market, the agency must first determine that the risks are worth the benefits."* (Introduction section)

This was correct in 1995. But it became incorrect in 1996 with the passage of the Food Quality Protection Act (FQPA). The passage of the FQPA that year had the net effect of ensuring that ***registration decisions for pesticides with food uses are to be held to a higher standard, i.e., "a reasonable certainty of no harm"***, with a focus on children; an evaluation of aggregate risks from aggregate exposures (residues in food + drinking water + post-application contact with treated surfaces [e.g., turf]); and an additional safety factor for pre-natal and post-natal exposures. For example, since 2,4-D has food uses, as well as turf uses, EPA must consider potential risks to children without regard to benefits. [NOTE: risk-benefit balancing is still allowed for ecological effects, unless threatened or endangered (T/E) species are involved. The EPA is extremely conservative in its pesticide risk assessments for T/E species.]

3. Regulation of Ground Water Contamination by Pesticides

"Despite this sobering lesson, government has yet to address groundwater contamination by pesticides before *it happens. Instead, pesticide contamination has been responded to--after the fact--with band-aid measures that only address the immediate problem, not its source."* (Recommendations section)

This was incorrect in 1991, 1994, and 1995, when all three versions of the report were issued. During 1979-1986, I collaborated with others at the US EPA to develop an aggressive pesticides-in-ground-water monitoring, modeling, and regulatory program (Enfield et al., 1982; Cohen et al., 1984; Cohen et al., 1986). We identified pesticides with ground water contamination potential, imposed monitoring requirements, and provided the scientific support needed by our regulatory colleagues to impose pre-registration and post-registration regulatory requirements. We banned two pesticides, helped prevent another from entering the market place, and imposed many legally-enforceable product label statements.

Subsequent monitoring studies indicate that ground water contamination by pesticides applied to golf courses is not a significant issue (Baris et al., 2010; SCDHS, 2002).

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Water Quality Monitoring Programs: Summary of Golf at The Bridge and Sebonack Golf Club Programs, Southampton, NY

Ground and surface water monitoring programs have been required at to golf courses in Southampton, Golf at The Bridge (The Bridge) as per Planning Board Conditions Approval dated April 15, 1999 and Sebonack Golf Club (Sebonack). Each of these golf facilities were constructed on lands that had prior uses, which have influenced (ambient) water quality. Each golf facility's water quality monitoring program necessitated the installation of groundwater monitoring wells to evaluate groundwater elevation, seasonal changes, horizontal flow direction, and background water quality. Lysimeters were also installed to provide shallow soil-water interfaced sample locations.

The water quality monitoring programs mimic NYSDEC Part 360 Solid Waste Regulations for monitoring programs that typify municipal landfill closure programs (well installation procedures, baseline analytes, sample collection-chain of custody, lab certifications, etc.). The frequency of sample collection and analyses is quarterly. Based upon evaluations of the analytical results by the Town's consultants, recommendations can be offered to change the monitoring program including reduction in the frequency of sample collection and list of analytes for analyses. Each program requires the superintendent to provide quarterly reports of:

- All chemical inputs applied (pesticides and nutrients)
- Precipitation and irrigation records
- IPM scouting and threshold records
- Changes to the course that impacted the area of managed turf (tee expansions, planting of native fields)
- Cultural practices (aeration, topdressing, verti-cutting, seeding, etc.) that was performed
- Summary of turf management strategies or other mechanism to support input decision making

It is noteworthy that in each case, The Bridge and Sebonack the water quality results showed no significant impact to ground or surface waters and the Town's consulting professionals recommended a reduction in monitoring water quality from quarterly to semi-annually. It is important that the green designs of The Bridge and Sebonack are markedly different. Sebonack has installed heavy (landfill quality) HPDE liners beneath the green drainage layer with a closed pipe collection system that discharges the greens generated "leachate" to a (HPDE) lined pond. The Sebonack green's irrigation and precipitation do recharged water to the aquifer.

A review of the 2013 Bridge Annual Groundwater Monitoring Report (the 2014 report has not been released), reported that none of the over 100 pesticides tested and reported were detected above the detection limit in any groundwater samples except for trace amounts of Chlorothalonil, Flutolanil, Myclobutanil, Pendimethalin, Propiconazole a & b and PCNB, which were a trace levels: 0.1-0.3 ug/L (ppb). The threshold for these compounds is 0.5 ppb, and when the threshold is reached it triggers a response, beginning with re-sampling of the well as required under the groundwater monitoring program protocols.

During 2013, seven turf groundwater monitoring wells had nitrates averaging 1.14 mg/L (ppm) and the highest concentration of nitrate found on the golf course wells was 1.8 mg/L. Nitrate

levels over five years (2005-2009) average for all of the turf groundwater sampling wells was 1.48 mg/L (ppm).

The depth to water recorded at the monitoring wells varies at The Bridge site from approximately 107 feet to 204 feet below ground surface.

The depth to water recorded at the monitoring wells varies at the Sebonack Golf Club from approximately 5 feet to 65 feet below ground surface.

These regions are comprised of a Pleistocene glacial deposit associated with the Ronkonkoma terminal moraine. The moraine is comprised of till, poorly-sorted mixture of clay, sand, gravel and boulders. The till deposits have an estimated average horizontal conductivity of 130 ft/d or less (**McCymonds and Franke, 1972**). Outwash, a well-sorted, moderately to highly permeable deposit, lies between and south of the moraines and consists of fine very coarse quartz-rose, sand and pebbles to boulder-sized gravel. The horizontal hydraulic conductivity of outwash deposits is to be at least 270 ft/d (**McClymonds and Franke, 1972**). The moraine also contains reworked and outwash interlayered within it and is underlain by the Magothy aquifer.

The September 15, 2014 review letter prepared by A. Martin Petrovic, the consultant reviewing the Sebonack water quality monitoring results for Southampton Town, states in the summary,

> "No pesticides applied in the past 12 months were observed in any groundwater monitoring wee, indicating that pesticides being applied to the Sebonack golf course are apparently not leaching into the groundwater of this site.
>
> Two of the six groundwater monitoring wells had total nitrogen (nitrate) levels above the response threshold. It is concluded in the 2012 review of six years on monitoring results that it is likely that the previous land use of this site is still affecting water quality in 2013. Golf course fertilization is limited and is not likely affecting water quality.
>
> Two lysimeter locations (1 & 3) at the 15 foot depth, along with 3 and 9 foot depth lysimeters at location 1, had nitrate concentration above the response threshold of 5 mg/L and 4 of 15 sample locations were above the 10 mg/L drinking water standard."

Lysimeters are used as an "early warning method" to protect the groundwater from nitrogen contamination from fertilization as well as help interpret the results form groundwater monitoring wells (**Petrovic 2014**).

According to a July 16, 2014 letter report, Petrovic reviewed the analytical results of water samples collected from Sebonack's two ponds. One pond is an irrigation water supply reservoir and the second is a collection point for drainage generated from the lined greens. Results from this second pond indicate what compounds could have potentially leached from chemical inputs applied to the greens. Nitrate level in the greens drainage pond was below the detection limit of 0.1 mg/L, indicating little nitrogen leached from greens.

The irrigation pond had a nitrate level of 0.6 mg/L far below the resampling threshold of 4 mg/L.

Total Kjeldahl nitrogen (TKN) is the sum of organic forms of nitrogen and ammonia. This can be used to measure nitrogen generated by organic sources including sewage and manures. At Sebonack, both ponds had TKN concentrations <1.2 mg/L, which Petrovic suggested were sourced by the organic soil amendments and organic fertilizer, each abundantly used by the course.

One pesticide, Myclobutanil (a fungicide), applied in the past 12 months was detected at 0.3 ug/L in the irrigation pond, below the resampling threshold. Three pesticides were detected in the greens drainage pond: Myclobutanil at 7.5 mg/L (the resampling threshold for this parmeter is 5 mg/L), Boscalid (a fungicide) at 0.6 ug/L, and Propiconazole-b at 0.2mg/L. None of the pesticide concentrations in either pond exceeded the NYS Surface Water Standard for MCLs.

Petrovic further states,

> "Based on the overall good groundwater quality as it relates to fertilizer and pesticide use, the applications of fertilizer and pesticides should continue as was done in the past."

and concludes:

> "Based on the water quality monitoring results, the operation of the Sebonack golf course is not adversely impacting groundwater quality."

Similarly, Golf at The Bridge has consistently been operated in a manner consistent with best management practices and conditions set forth by the Southampton Town Planning Board (**Petrovic**). In 2012, the Bridge applied only 1,767 pounds of nitrogen, which was 59% of the maximum allowed annual amount of 3,000 pounds. The turf quality did not suffer from the reduction in nitrogen. In 2013, fertilizer applications using a formulation of 47-0-0 were applied to tees, greens and fairways at a low rate of 0.1 lb. N/1000 sf, as recommended by the turf management plan. Fertilizer applied form June to September 2013 totaled 1,142 pounds of nitrogen, with an annual total of 1,839 pounds of nitrogen applied (61% of the maximum allowed amount of 3,000 pounds nitrogen per year). In Suffolk County, New York, fertilizer cannot be applied after October 31 or before April 1, and nitrogen levels in groundwater samples remained below the target goal of 2.0 mg/L.

Based on the historical water quality test results, it was recommended in 2011 that the Bridge adjust its water quality monitoring program to a semi-annual reporting period and is no longer required to provide reports on a quarterly basis. Long-term trends evaluated form 2000-2011 indicate that a peak of nitrogen levels reported from monitoring well water samples was reached in 2008. Since 2008, the nitrogen levels fell to a stable value of about 1.5 mg/L and nitrogen levels in the ambient wells (background) was consistently <0.2 mg/L. The information supports the conclusion that fertilization at The Bridge golf course has had minimal impact on the quality of groundwater at the Bridge (**Cohen & Barnes, 2013**).