

**Ground Water Monitoring
Protocol for
Golf at the Bridge: Amended, 2011**

for

Bridgehampton Road Races Corp.

by

N. LaJan Barnes, M.S., P.G.
Project Manager, Hydrogeologist

Stuart Z. Cohen, Ph.D., CGWP
Study Director

Environmental & Turf Services, Inc.
Wheaton, Maryland

10/30/96

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Environmental & Turf Services, Inc.©

STUDY PARTICIPANTS

STUDY SPONSOR: Robert Rubin
Bridgehampton Road Races Corp.
Long Island, New York

TEST SUBSTANCES: Pesticides, fertilizers, and related substances
as noted herein

STUDY DIRECTOR: Dr. Stuart Z. Cohen, CGWP
Environmental & Turf Services, Inc.
Wheaton, Maryland

PROJECT MANAGER: N. LaJan Barnes, P.G.
Environmental & Turf Services, Inc.
Wheaton, Maryland

FIELD COOPERATOR:
(Ground Water Sampling) 1997 - To be approved by SCWA
2011 - Leggette, Brashears & Graham, Inc.
Shelton, Connecticut

FIELD COOPERATOR:
(Well Installation) 1997 - To be determined
2011 - Leggette, Brashears & Graham, Inc.
Shelton, Connecticut

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TERMINATION DATE: None

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Bridgehampton, New York

ANALYTICAL TESTING FACILITY: 1997 - To be approved by SCWA
2011 - Underwriters Laboratories, Inc.
South Bend, Indiana

TECHNICAL REVIEW: Karen A. Randazzo
SCWA, Director of Laboratories

1997

PROTOCOL APPROVAL
SIGNATURE PAGE



Robert M. Rubin
Bridgehampton Road Races Corp., Chairman
Greenwich, Connecticut

7/9/97
Date



Stuart Z. Cohen, Ph.D., CGWP
Study Director
Environmental & Turf Services
Wheaton, Maryland

7/8/97
Date



N. Lajan Barnes, P.G.
Field Study Director
Environmental & Turf Services
Wheaton, Maryland

7/8/97
Date



Michael A. LoGrande
Chairman, CEO
Suffolk County Water Authority
Oakdale, New York

7/9/97
Date

Signature for Protocol as amended by hand
at pages 19, 33 and 34. *MLG*



2011: PROTOCOL APPROVAL
SIGNATURE PAGE

Robert M. Rubin
Bridgehampton Road Races Corp., Chairman
Greenwich, Connecticut

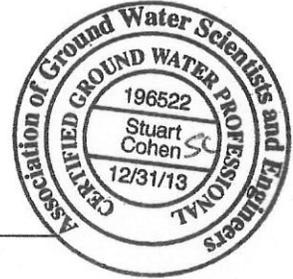
Date

7/15/11

Stuart Z. Cohen, Ph.D., CGWP
Study Director
Environmental & Turf Services
Wheaton, Maryland

Date

6/7/11



N. LaJan Barnes, P.G.
Field Study Director
Environmental & Turf Services
Wheaton, Maryland

Date

6/8/11



Jeffrey W. Szabo, CEO
Suffolk County Water Authority
Oakdale, New York

Date

8/1/11

SCWA Legal Dept.
8/1 2011

Anna Throne-Holst
Town of Southampton, Supervisor
Southampton, New York

Date

6/30/11

EXECUTIVE SUMMARY

This ground water monitoring protocol was originally approved by the Town of Southampton and the Suffolk County Water Authority in 1997. The protocol was implemented successfully, and monitoring continues at the site.

In 2006, Environmental & Turf Services, Inc. (ETS) requested several modifications to the protocol on behalf of the golf course, in accordance with section III(B) of the original protocol as well as amendment #5 (1999). In 2010, the Town Board initiated the necessary action to review these requests. Part of this action was review by two consultants to the Town, Dr. Petrovic and Mr. Cambareri. This protocol reflects modifications that arose from that comprehensive review process.

It is critical to retain all key components of the original protocol - - many/most of which are still in effect - - as well as incorporate the new provisions. Thus the general layout of this revised protocol is to provide the 1997 text first, followed by the 2011 language.

1997

The owners of the Bridgehampton Race Track plan to develop the track site, which is on 516 acres in northern Southampton. One 18-hole golf course will be built along with 20 estate lots. More than 150 acres will remain as non-golf course space.

Previously, Bridgehampton Road Races Corp. retained Environmental & Turf Services, Inc. to develop a sophisticated, comprehensive turf management plan and ground water risk assessment to ensure that turf chemicals would not impact ground water quality at the site.

The Suffolk County Water Authority (SCWA) has recently begun to recommend that golf course developers and town governments develop a ground water monitoring

contract as part of a deed restriction. A key, but implicit, component of this contract is the requirement for a protocol that describes how the study will be done, how the results will be reported, and what responses will be triggered by detections. Thus the purposes of this protocol are to: 1) meet the requirements of the SCWA guidance; 2) help ensure the study will be conducted in a quality manner; and 3) help ensure the management plan and risk assessment have resulted in a golf course operation that will not impact ground water quality.

One background monitoring well and five downgradient wells will be installed prior to golf course construction. One of the downgradient wells will tap a perched water table on a clay lens. Five years of quarterly sampling will be performed, followed by annual sampling in perpetuity.

A Tier 1 list of pesticides and inorganic chemicals will be analyzed in all sampling rounds. A Tier 2 list will be added if there are detections of the Tier 1 pesticides. In addition, Tier 2 pesticides will be analyzed once per year even if no Tier 1 pesticides are detected. A comprehensive baseline list will be analyzed twice prior to clearing and may be used for subsequent analyses depending on the results of Tier 2 testing. A series of turf chemical use restrictions may be triggered by detections of pesticides and nitrate.

Results will be submitted to the SCWA and the Southampton Department of Land Management. Routine transmittals of results will be supplemented by more comprehensive reports following the baseline testing and annually thereafter.

A Summary of the 2011 Changes

The regular well sampling frequency has been reduced to semi-annual, but certain results can trigger more frequent sampling. There are now seven wells in the regular, semi-annual program, which include four priority wells, two wells that have not demonstrated any influence by the golf course operation, and the perched well.

The seven monitoring wells will be analyzed for total Kjeldahl nitrogen (TKN), nitrate, S150 (semi-volatile) pesticides and field parameters. However, semi-annual monitoring of method S150 pesticides for the two ambient wells will only be triggered if nitrate concentrations are greater than 1 ppm in those wells. If that occurs, they will be sampled in the next sampling event immediately following the > 1ppm detection(s). Every two years, the entire remaining network of 12 monitoring wells will be sampled. Every fourth year will include analyses for a comprehensive list of compounds.

Sampling from the 13 lysimeters located under the biofilters at the 4th, 7th, and 14th greens will be discontinued. Sampling at lysimeter sets F1-3 and F3-3 will continue. New lysimeters will be installed at a depth of 9-12 ft in front of the 4th, 7th, and 14th greens, and they will be incorporated into the program.

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I. INTRODUCTION AND PURPOSE

This protocol was written in 1997, and amended in 1998-1999, 2004, and 2011, as explained below. Following is the structure within each section of this document.

- The text from 1997 is reproduced in its entirety.
- Any amendments added in 1998 (unnumbered), 1999 (amendments 1-9), or 2004 (amendment #10) are either summarized or explicitly stated at the end of the 1997 text. All of these amendments are provided as Appendix A at the end of this document.
- Amendments added in 2011 have their own subsection following the 1997 text; independent amendments for all of the changes were not created as has been done in the past.
- No edits were made to the 1997 text except as stated above. If no dated text (i.e., 2011) is provided, then the default text is the original 1997 protocol.

The outdated tables and figures from the original 1997 Protocol are provided as Appendix B and C, respectively. The original tables and figures that are relevant to the 2011 monitoring are provided in the document as discussed. In addition, any new tables or figures are presented in the document as they are discussed.

1997

The owners of the Bridgehampton Race Track plan to develop the track site, which is on 516 acres in northern Southampton. One 18-hole golf course will be built along with 20 estate lots. More than 150 acres will remain as non-golf course space.

A prime concern of the Bridgehampton Road Races Corp. is the protection of ground water quality. Therefore Environmental & Turf Services, Inc. was retained to develop a sophisticated, comprehensive turf management plan and ground water risk assessment (O'Connor, 1995; Barnes, et al., 1995) to ensure that turf chemicals would not impact ground water quality at the site.

The Suffolk County Water Authority (SCWA) has issued some draft guidance in response to queries it receives from towns regarding golf course development. The SCWA recommends that developers and town governments develop a ground water monitoring contract as part of a deed restriction. A key component of this contract is the requirement for a protocol that describes how the study will be done, how the results will be reported, and what responses will be triggered by detections. Thus the purposes of this protocol are to: 1) meet the requirements of the SCWA guidance; 2) help ensure the study will be conducted in a quality manner; and 3) help ensure the management plan and risk assessment have resulted in a golf course operation that will not impact ground water quality.

2011

In July, 1998, the Town hired two consultants, Mr. Cambareri and Dr. Petrovic, to review the approved, 1997 protocol. ETS issued nine protocol amendments that were written in response to the consultants' recommendations, from late 1998 through early 1999. A tenth amendment regarding new pesticide analytes was issued in 2004. Five additional wells required by the New York Attorney General's office were also installed in 2000, but without a protocol amendment. The first (unnumbered) amendment (2/25/98) was written to record the locations of four monitoring wells and the background well BW-1. In addition, Tables 1-5 were revised in 2000 due to protocol amendment #3, and again in 2004 (amendment #10) due to an update of the pesticide use list.

In 2006, ETS requested several modifications to the protocol on behalf of the golf course, in accordance with section III(B) of the original protocol as well as amendment #5 (1999). In May, 2010, the Town Board voted to retain Dr. A.M. Petrovic and Mr. T. Cambareri to conduct a comprehensive review of nine years of monitoring program results (2001-2009) ("Technical Review of Test Results and Implementation of the Ground Water Monitoring Protocol for The Bridge Golf Course"). The review process concluded early in 2011, and the consultants issued their final report in April (Petrovic and Cambareri, 2011); however, it was not approved for final distribution until May.

This revised version of the protocol incorporates the 1998, 1999, and 2004 amendments, as well as the recent recommendations of Petrovic and Cambareri (2011). All of the monitoring recommendations will be implemented via this monitoring protocol. However, three of the recommendations are not related to this protocol; rather, they are directly relevant to golf course operations, as follows. Golf course operations and habitat management, among other topics, are addressed in the “Natural Resource Management Plan for The Bridge Golf Course” (NRMP; ETS, 2000), as well as the Integrated Golf Course Management Plan[®] and Water Quality Risk Assessment (IGCMP and risk assessment; ETS, 1997). A summary of the three amendments to the NRMP and the IGCMP are described below. These amendments were submitted for approval in April, 2011 to the Town only, since they NRMP was a Town requirement and its function is not directly relevant to the mission of the SCWA.

Amendment 1: Fertilizer Nitrogen Restriction. Changes have been made to the language in the Executive Summary and the end of section IV(D) of the NRMP, and the beginning of section V(B)(2) of the IGCMP. The new annual limit for applied fertilizer nitrogen (N) is 3,000 lb N/yr.

Amendment 2: Selection and Evaluation of New Pesticides. Changes have been made to the language, as appropriate, to sections V(B)(1-3) and V(C)(3) of the NRMP, section V(G)(1) of the IGCMP. This topic is also relevant to the Town Planning Board approval conditions 15(I), (J), and (X) (4/15/99). The golf course will report to the Town on the potential risks and efficacy of several relatively new biorational fungicides, including but not limited to boscalid (Emerald[®]), the mineral oil Civitas[®], and BioTrek[®]. A water quality monitoring protocol amendment may also be needed in the highly unlikely event that one of these new biorational control agents triggers potential concerns that require it to be added to the list of monitoring analytes. However, at this time, none of these products are included in the monitoring program.

Amendment 3: Soil Moisture Sensors and Drip Irrigation. Changes have been made to the language in section VII(B)(1) of the NRMP and in section V(I)(1) of the IGCMP.

The use of drip irrigation in bunker surrounds will be expanded as practical. Once it was discovered by the reviewers that moisture sensors had been installed voluntarily at a several of the greens, they recommended that time domain reflectometry soil moisture probes should be installed in all 18 non-practice greens, and in tees and fairways, as practical.

II. SITE CONDITIONS

1997

Much of the discussion in this section has been adopted from work done by ETS during the permitting process (DEIS, 1995 and Barnes, et al., 1995).

The site presently consists of cleared and heavily vegetated areas. The cleared area presently includes a race track. Topographic elevations range between approximately 60 ft and 280 ft at the northern and southern portions of the property, respectively. The dominant vegetation type in the heavily vegetated area is Oak-Mixed Heath Forest and consists primarily of scarlet, white, and black oak canopy with an understory of huckleberry and low bush blueberry. The cleared/disturbed area consists of quaking aspen, large toothed aspen and a variety of grasses including orchard grass, crabgrass, fescue grass, and foxtail grass. There are no streams or wetlands located on the site.

2011

The Bridgehampton Race Track was developed into a high-end, 18-hole golf course originally called Golf at the Bridge; it is now called The Bridge. The general topography was not altered except where needed for optimum playing conditions. The site is still heavily wooded in and around the golf course in out-of-play areas. In addition, natural vegetation was enhanced in the out-of-play areas as designated in the Natural Resource Management Plan (ETS et al., 2000). Two drainage ponds were constructed to receive surface water runoff. One of the ponds is located on the northwest side of the golf course near hole 15 and the other is located near hole 8 on the northeastern portion of the property. No streams nor wetlands were constructed on the property, and none existed before development.

1997

A. Geology

The geology at the site is typical of the complex glacial outwash sequence throughout the South Fork (Koppelman, et al., 1992). The glacial outwash sequence is characterized by sand, gravel and clay lenses. These sand, gravel, and clay sequences result in high permeabilities and perched water tables.

B. Hydrogeology

1997

Ground water under the site is within the hydrogeological Zone V and flows to the north-northeast toward Noyack Bay and Sag Harbor as shown on the contour maps prepared by Suffolk County DHS. Fresh ground water beneath the site occurs in the Upper Glacial and Magothy Aquifers which have a combined thickness of approximately 700 ft (LBG, 1995).

Depth to ground water was encountered at an elevation of 12 ft above sea level (118 ft bg) at a boring location (TB-3) at the northeastern portion of the property. Another boring, northwest of TB-3, encountered a clay layer at a depth of 20 to 60 ft above sea level (40 to 80 ft bg) that supported a perched ground water table. This clay layer is discontinuous on the property.

2011

Ten years of water table contour plots indicate that the direction of flow is to the north and northeast, as stated above. The ground water divide is in the vicinity of well BW-1, which separates that well from the golf course and all of the downgradient monitoring wells. This is one of the reasons that BW-1 will no longer be used as the background well for the sampling program (Section III(B) Sampling Schedule below).

A perched aquifer was also found in the vicinity of hole 8. Well PW-1 taps that relatively shallow ground water source at approximately 35 ft below the surface. This well currently produces sufficient water for the monitoring program.

III. STUDY DESIGN

A. Monitoring Well Installation

1. Locations

1997

Six monitoring wells will be installed around the perimeter of the golf course. A professional engineer or geologist will certify in writing to the SCWA that all wells were installed according to this protocol and in compliance with New York State regulations. In addition, a scientist/engineer from the SCWA will observe well installation to ensure protocol compliance.

There will be one upgradient well and four downgradient wells that will be completed in the water table aquifer. An additional well will also be installed to intercept a perched water table at the northeastern portion of the property. The upgradient well will be installed in the southeast portion of the property as a background well and the remaining five wells will be installed downgradient to intercept ground water flow from the golf course (Figure 1).

The downgradient wells will be located at the eastern, western, and northern perimeters of the golf course. All wells will be located in topographic lows (as much is feasible) in out-of-play areas of the golf course (see Figure 1a). Exact locations of the wells will be determined in the field by the field geologist/hydrogeologist.

2011

The original Figure 1 (Map of Suggested Well Locations) is no longer relevant to the monitoring program. Thus it has been replaced with Figure 1a, which shows the current well and lysimeter locations (both current and proposed new lysimeter locations). The 1997 Figure 1 is provided in Appendix C for reference.

Figure 1a. Locations of Installed Wells and Lysimeters (2011)

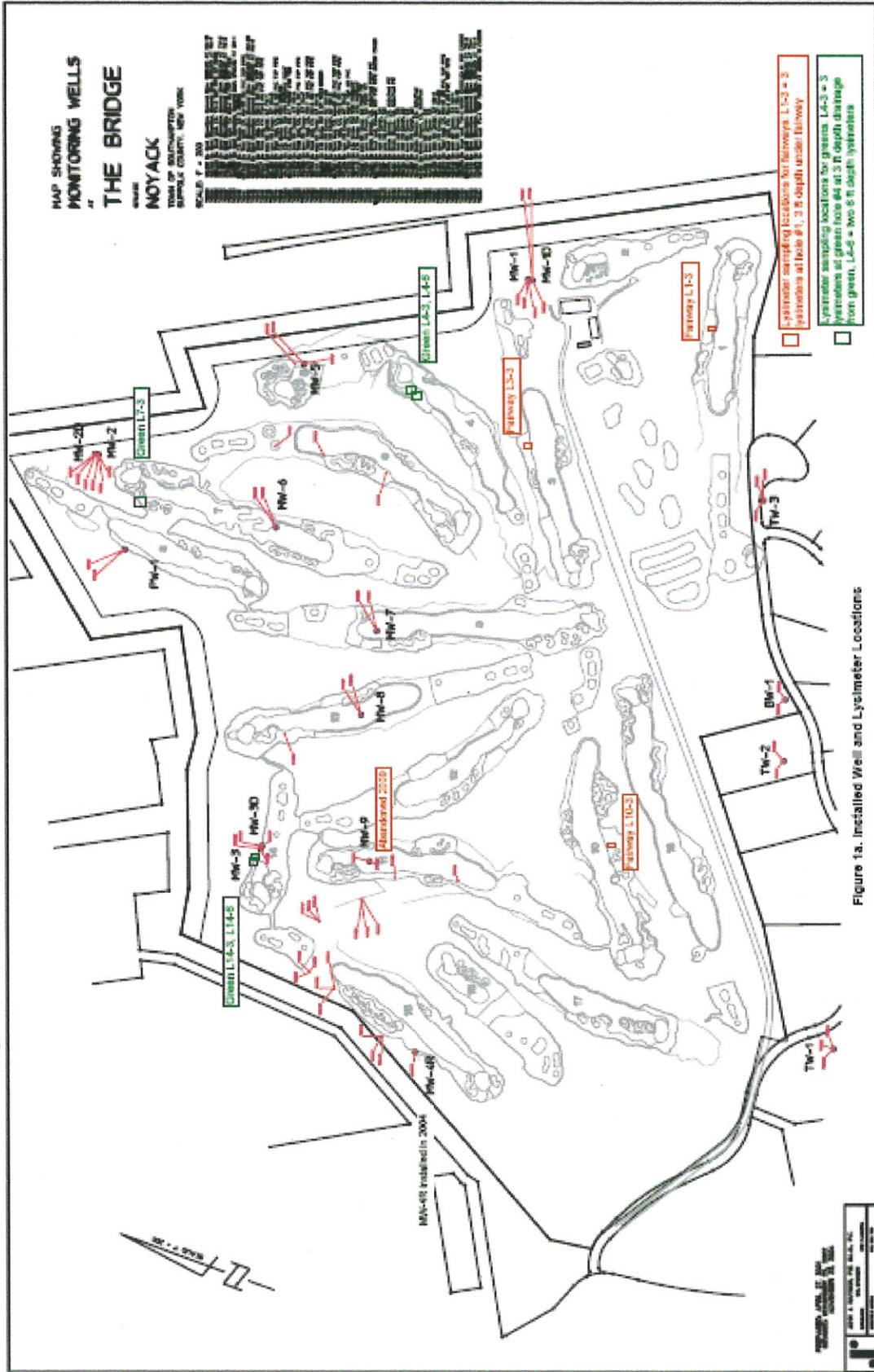


Figure 1a. Installed Well and Lysimeter Locations

Fourteen monitoring wells were installed in 1998 and 2000. MW-4 was replaced by MW-4R in 2004 (ETS, 2005), and MW-9 was abandoned in 2009 (ETS, 2010). The current well locations are indicated in Figure 1a (above).

1997

2. Depth of Wells

All wells will be drilled to encounter the water table in the sand and gravel aquifer with the exception of the perched water table well noted above. Exact depths cannot be determined at this time. It must be a field decision when the water table is encountered. However, depth to water is expected to be in the range of 90 to 120 ft. Wells will extend 5 to 13 ft into the aquifer depending on water table fluctuations.

3. Well Construction

1997

A hollow-stem auger technique will be used to drill through the sand and gravel. The wells will be constructed with 4-inch nominal inside-diameter PVC either schedule 40 or 80 whichever is most appropriate to obtain the desired sampling results for both the riser and the screen. Each well screen will have a slot size that will be consistent with the sand pack size (either 0.010 or 0.020). The screen type (slotted or wire wrapped) will be determined based on the sand pack used. The diameter of the boreholes will be 8-10 in.

The length of the well screens will be determined by the range of ground water table fluctuation as seen on that part of the Island. Installation of the well screens will be based on that information. Ideally well screens will most likely extend 2 to 5 ft above the top of the water table. Well screens of 10-15 ft length are recommended.

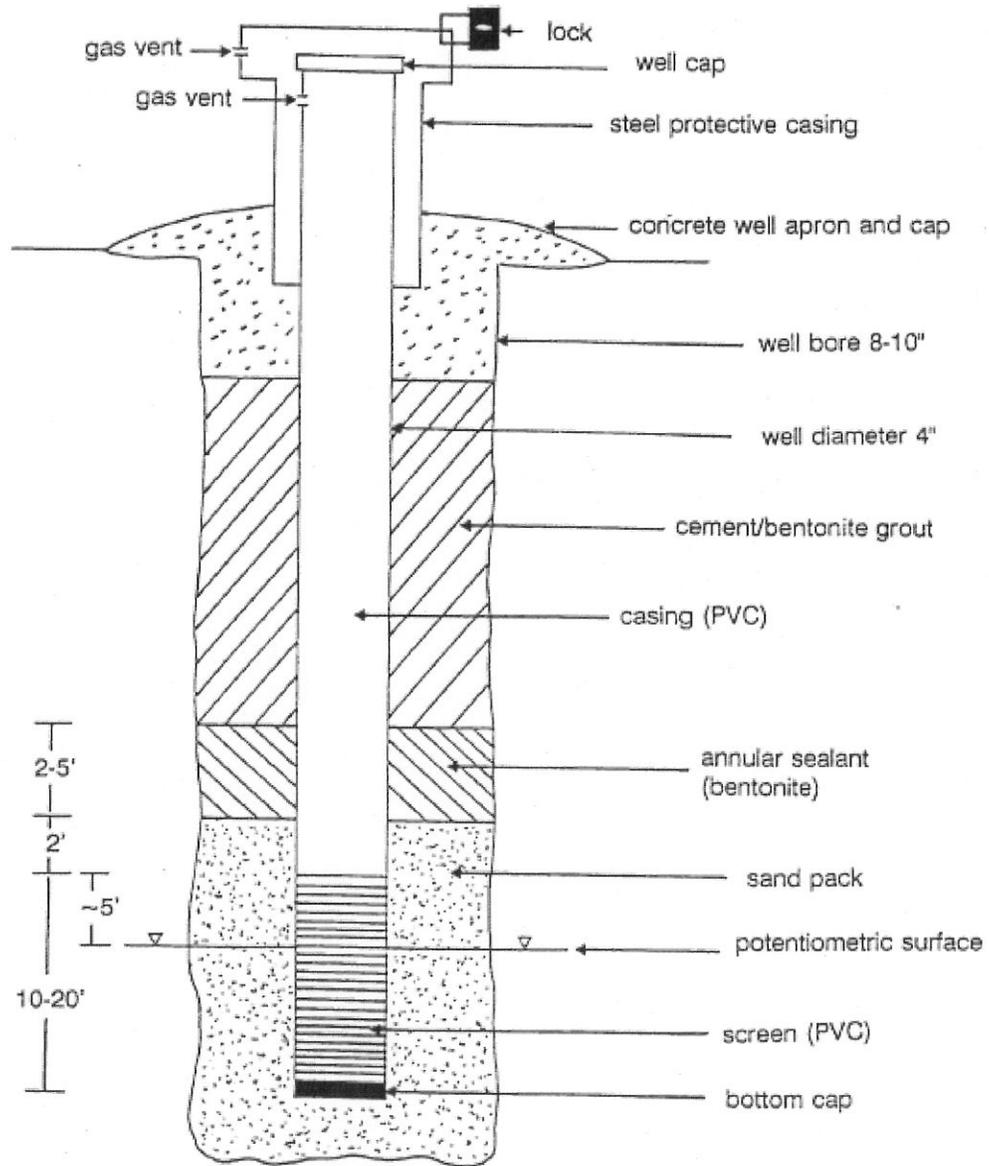
The sand pack material chosen will be appropriate for the screen type selected and be placed in the annular space between the borehole wall and the screen to allow sufficient flow from the aquifer into the well. The sand pack will be placed from the bottom of the borehole to approximately 2 ft above the screen. Bentonite will be placed above the sand as a seal followed by a bentonite cement grout to approximately 1-2 ft below the ground surface. The bentonite seal will be left to set up for at least one hour after in place before pouring the grout and cement into the hole. This will ensure a good seal. If well risers extend above the surface, the last 1-2 ft will be filled with cement only and will be sloped downward away from the well at the surface. A stainless steel locking casing protector will be installed in the top 1-2 ft of cement and extend above the PVC riser to protect the well from vandalism and heavy equipment. If the wells are completed flush with ground surface, then the PVC riser will be cut below ground surface and the stainless steel locking protective casing will be installed in the cement to ground surface. Each well will have a bottom plug, a PVC cap, and the riser will have a vent hole. Figure 2 shows a typical monitor well diagram.

The grout and cement will be allowed to set up prior to well development (at least one hour). Well development will be conducted long enough to remove silt and fines from the well bore by pumping. The wells will be allowed to stabilize after development for approximately one week so accurate water level measurements can be taken. Both wells will be surveyed by a licensed surveyor at ground surface and at the top of the casing. The top of the casing will be marked by a notch at the time of the survey so that water level measurement can be measured in the same place for each sampling event.

All boreholes will be logged by a geologist/hydrogeologist. An "as built" well log diagram will be prepared for each of the wells. The diagram will contain the following information:

Figure 2. Recommended Well Construction Specifications

(This is the original 1997 figure)



Designed after RCRA TEGD (RCRA, 1986)

- Date/time of construction
- Well location
- Borehole diameter
- Well depth and description of lithologies encountered
- Casing material/diameter
- Screen material, slot size, and length
- Sand pack (depths from ___ to ___)
- Bentonite seal (depths from ___ to ___)
- Cement/grout (depths from ___ to ___)
- Ground surface elevation
- Elevation of measuring point at the top of the well casing
- Depth to static water.

2011

Wells were constructed as noted above in 1998 and 2000. In addition, replacement well MW-4R was installed in 2004 and well MW-9 was abandoned in 2009. Leggette, Brashears & Graham, Inc. (LBG), Shelton, CT, supervised the installation of all of the wells (ETS, 2001) and in accordance with this Protocol.

2011

4. Lysimeter Construction

Originally, the owners of The Bridge had decided, voluntarily, to install 22 suction lysimeters throughout the golf course as an early warning device for turf chemical leachate. When the Town's reviewers learned of this in 1999, they decided to make their installation, sampling, and reporting of results mandatory. Thus protocol amendment #9 [1999], "Lysimeter Sampling," was developed and approved.

Twenty-two lysimeters were installed in 2000 as a result of protocol amendment #9 (see Figure 1a above). Eighteen of the lysimeters were installed at 3 ft depths at six golf hole locations: three fairways (holes 1, 3, and 10) and three greens (holes 4, 7, and 14). Two lysimeters each were installed at two of the greens locations at the 6 ft depth (holes 4 and 14). The leachate water from the lysimeters at the corresponding depths at one location is combined to provide one set of samples for that particular depth and location (e.g., one set of samples at the 3 ft depth and one set of samples for the 6 ft depth at L4-3 and L4-6). Thus samples have been collected to date from eight lysimeter sets. The details for the lysimeter installation were provided in the Comprehensive Baseline report (ETS, 2001).

In 2010 (9/7/10), ETS recommended deleting lysimeter sampling from the program following a comprehensive review of nine years of monitoring data. The Town's consultants proposed the following alternative, which was accepted. Lysimeter sets at fairway hole 1 (F1-3) and hole 3 (F3-3) will continue to be sampled in the new monitoring program. Sampling from the 13 lysimeters located under the biofilters at the 4th, 7th, and 14th greens will be discontinued. New lysimeters will be installed at an angle at a depth of 9 ft to 12 ft in the front of three greens at holes 4, 7, and 14.

B. Sampling Schedule

1997

Monitoring will begin no less than one week after the wells have been developed, to allow the aquifer around the well bore to stabilize. Two baseline sampling rounds will be taken prior to golf course clearing. Thereafter the wells will be sampled quarterly for the first five years. Annual sampling will be conducted in perpetuity.

Table 1. Sampling Schedule for the First Five Years

<u>Year</u>	<u>Sampling Events</u>
0	2 (Baseline events prior to clearing)
1	4
2	4
3	4
4	4
<u>5</u>	<u>4</u>
Total	5 22

The sampling schedule will trigger a response (see section VI below), if "problems" are detected (as defined below).

For pesticides, "problems" are defined as trace detections in downgradient well locations. For nitrate-nitrogen, "problems" are defined as confirmed concentrations exceeding 5 ppm. (See Section VI.)

2011

This section had been amended in 1999 and is further amended now, in 2011. Basically, the 1999 amendment (#5) modified the switch from quarterly to annual sampling after five years such that it could only happen following a comprehensive technical review and consultation between all three signatory parties -- the Study Director (currently S. Cohen, ETS), the SCWA, and the Town.

This process was heavily delayed. It finally occurred after almost 10 years of sampling. The sampling frequency is now changed from quarterly to semi-annual, but certain results can trigger the program back into the quarterly regime, as described in section VI (Response Triggers).

1. Wells

Quarterly monitoring in the 13 wells (originally 14) is reduced to semi-annual monitoring in seven wells, and less frequent sampling in the other wells. The semi-annual wells include two ambient wells (MW-1D and MW-3D), one miscellaneous well (PW-1; perched ground water), and four turf response (TR) wells (MW-2S, -2D, -3S, and -5). There are three ambient wells, which are not influenced by golf course management; however, only two of them will be included in the semi-annual monitoring. (The third ambient well is MW-6.) These seven wells will be sampled in June and September of each year for the next five years for field parameters, nutrients, and pesticides as described in section D below. The revised sampling schedule below (Table 1a) replaces Table 1 above and also provides the well type designation as determined by the Town's consultants.

Table 1a. Well Categories and Sampling Schedule (2011)

Well	Category	Semi-Annual	2-Year
BW-1	Dropped from monitoring program	NS	NS
PW-1	Miscellaneous	YES	YES
MW-1S	Miscellaneous	NO	YES
MW-1D	Ambient	YES	YES
MW-2S	Turf Response	YES	YES
MW2D	Turf Response	YES	YES
MW-3S	Turf Response	YES	YES
MW-3D	Ambient	YES	YES
MW-4/4R	Turf	NO	YES
MW-5	Turf Response	YES	YES
MW-6	Ambient	NO	YES
MW-7	Turf	NO	YES
MW-8	Turf	NO	YES
MW-9	Abandoned	NA	NA

NS = not sampled, NA = not applicable

2. Lysimeters

Quarterly monitoring from the original eight sets of lysimeters is reduced to semi-annual monitoring at five lysimeter locations. Samples will be collected from two of the original eight sets of lysimeters located at fairways 1 and 3. In addition, three new lysimeters will be installed in the front end of the green at holes 4, 7, and 14. (It is uncertain if more than one new lysimeter will be installed at each of the greens; however, at least one 9 to 12 ft lysimeter will be installed at each green.) Samples will no longer be collected from the lysimeters located under the fairway of hole 10 or from the lysimeters located under the biofilters at the greens of holes 4, 7, and 14.

C. Water Table Depth

1997

Depth to water will be measured at the wells at each sampling event. The wells will need to be uncapped and allowed to stabilize to ambient air pressure prior to taking water level measurements due to their depth. This will help establish water table contours for the site (a ground water flow net) when combined with data from the irrigation well(s).

A clay layer was encountered at 39 ft below grade in a well boring at the northeastern portion of the property. This clay layer is discontinuous and produces a perched water table. One well will be completed in this clay layer to monitor ground water at this level.

2011

Depth to water will be recorded at all 13 monitoring wells and the DOH test wells during each monitoring event (i.e., a snapshot in time); however, production of ground water flow maps will be reduced from quarterly to annually, in accordance with Petrovic and Camberari (2011). Long term hydrographs will be presented for all semi-annual sampled wells in the annual reports.