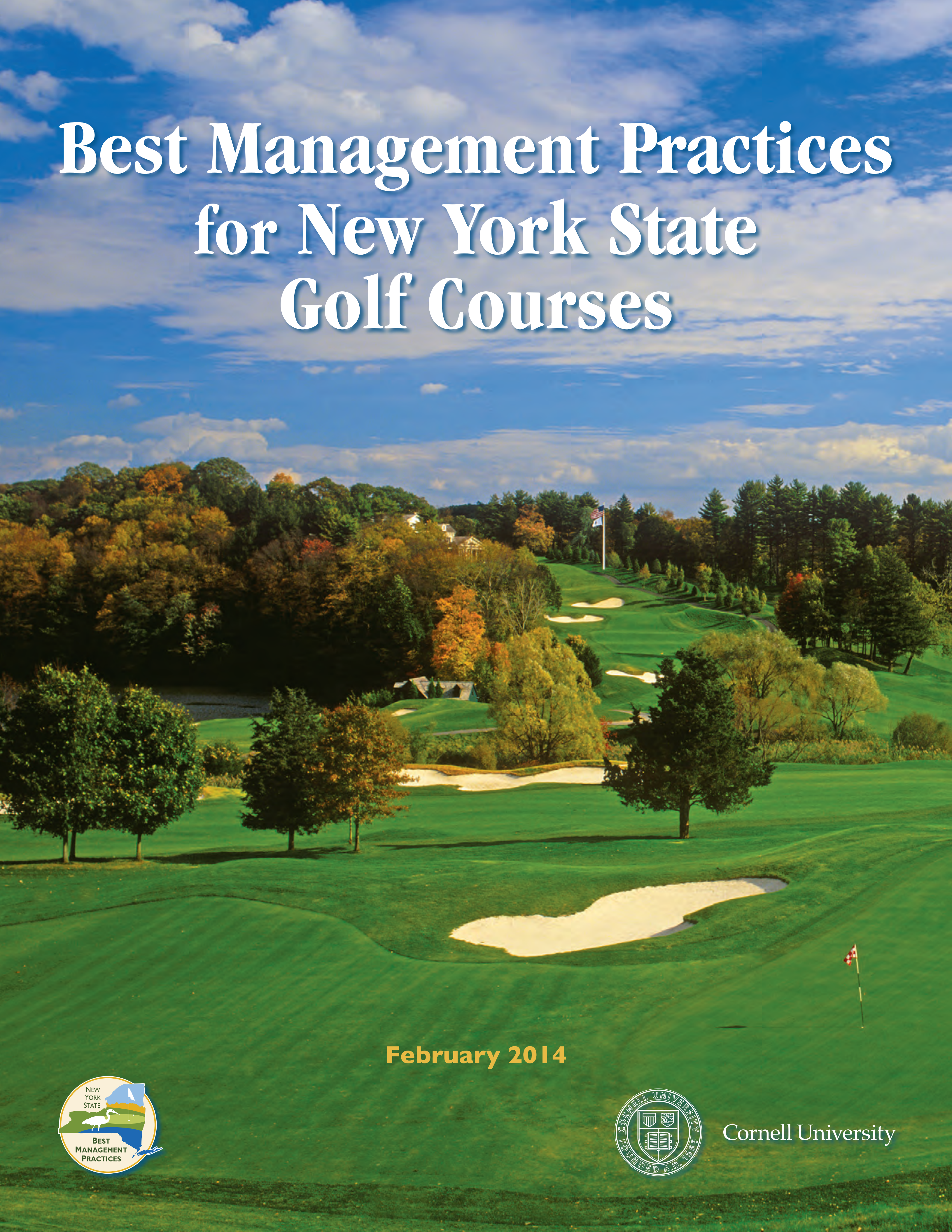
O NYS Golf Course Best Management Practices

Best Management Practices for New York State Golf Courses



February 2014

New York State Best Management Practices

Cornell University

Best Management Practices for New York State Golf Courses

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FOREWORD

The game of golf provides boundless recreational opportunities and health benefits to millions of golfers worldwide. As both a golfer and a golf course designer, I believe that golf courses should exist in harmony with the natural setting. Therefore, respecting the environment is at the core of everything I do.

When I am involved in a golf course project, such as the construction of GlenArbor Golf Club in Bedford Hills, I require that everyone involved share this respect. At my company, we have particularly focused on one of earth's most precious resources – water. Protecting water quality and conserving water are not only a fundamental responsibility for our industry, but also translates into real cost savings for golf course operations. For these reasons, I am proud to endorse the *Best Management Practices for New York State Golf Courses*. The New York State golf course superintendents associations, researchers at Cornell, and the state and national organizations that have provided additional support should be commended for this effort and making this information so readily accessible to anyone who cares about conserving our natural resources.

- *Gary Player, January 2014*

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This project would also not have been possible without the financial support of a number of organizations in New York State. These partners and supporters include members of the following organizations:

Adirondack Golf Course Superintendents Association
Central New York Golf Course Superintendents Association
Finger Lakes Association of Golf Course Superintendents
Golf Course Superintendents Association of America
Environmental Institute for Golf
Hudson Valley Golf Course Superintendents Association
Long Island Golf Course Superintendents Association
Metropolitan Golf Association
Metropolitan Golf Course Superintendents Association
Metropolitan PGA
New York State Turfgrass Association
Northeastern Golf Course Superintendents Association
Turfgrass Environmental Stewardship Fund
Western New York Golf Course Superintendents Association

Last, this project was reviewed in the draft and draft final stages by members of the partner organizations, members of the golf industry, as well as the New York State Department of Environmental Conservation. We thank the reviewers for the time and effort spent to improve the final products of these efforts.

Acronyms

A	acre
AAPFCO	Association of American Plant Food Control Officials
ABW	annual bluegrass weevils
AI	active ingredient
BMP	best management practice
BOD	biological oxygen demand
BPD	backflow prevention devices
CA	calcium
$CaCO_3$	calcium carbonate
CEC	cation exchange capacity
CNMP	Comprehensive Nutrient Management Plan
CO_3	carbonate
CU	coefficient of uniformity
CWA	Clean Water Act
DAP	diammonium phosphate
DCD	dicyandiamide
DI	deep and infrequent irrigation
DU	distribution uniformity
DULQ	distribution uniformity of the lowest quartile
EC	electrical conductivity
ECe	salt tolerance of turfgrass species
ECL	Environmental Conservation Law
ECw	electrical conductivity of water
EIQ	Environmental Impact Quotient
EPA	Environmental Protection Agency
ET	evapotranspiration
FUEIQ	field use EIQ rating
g/L	grams per liter
GCSA	Golf Course Superintendents of America
GIS	geographic information system
GPS	global positioning system
GUS	groundwater ubiquity score
HCO_3	bicarbonate
IBDU	isobutylidene diurea
IPM	integrated pest management
IRPeQ	pesticide risk indicator for Quebec
K	potassium
K_2O	potassium oxide
Kc	crop coefficient
Koc	soil adsorption
lbs/A	pounds per acre

LF	light and frequent irrigation
LR	leaching requirement
MAP	monoammonium phosphate
MCL	maximum contaminant levels
Mg	magnesium
mg/L	milligrams per liter
MOA	Memorandum of Agreement
mPa	millipascal
MSDS	Material Safety Data Sheets
MU	methylene urea
N	nitrogen
Na	sodium
NBPT	n-butylthiophosphoric triamide
NCDC	National Climate Data Center
NFPA	National Fire Protection Association
NH_4	ammonium
NH_3	ammonia
NO_{2-}	nitrite
NO_{3-}	nitrate
NRCC	Northeast Regional Climate Center
NYSDEC	New York State Department of Environmental Conservation
NYS	New York State
NYSDOH	NYS Department of Health
NYSDOT	NYS Department of Transportation
OEHD	Occupational and Environmental Health Department
P	phosphorus
P_2O_5	phosphate
PAWC	plant-available water capacity
Pb	lead
PET	potential evapotranspiration
PIMS	Product Ingredient Manufacturer System
PMEP	Pesticide Management Education Program
PPD	Pesticide Properties Database
PPE	personal protective equipment
ppm	parts per million
PSEP	Pesticide Safety Education Program
RCRA	Resource Conservation Recovery Act
RSC	residual sodium carbonate
S	sulfur
SAR	sodium adsorption ratio
SC	scheduling coefficient
SDS	Safety Data Sheet
SDWA	Safe Drinking Water Act

SEQR	State Environmental Quality Review
SPDES	State Pollutant Discharge Elimination System
SSP	single superphosphate
SWPPP	Stormwater Pollution Prevention Plan
TDS	total dissolved salts
TMDL	Total Maximum Daily Load
TN	total nitrogen
TP	total phosphorus
TSS	total suspended solids
UAN	urea-ammonium nitrate
UF	urea-formaldehyde
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VOC	volatile organic compound
WIN	water insoluble nitrogen
WIN PST	Windows Pesticides Screening Tool
WSN	water soluble nitrogen
Zn	zinc

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1 INTRODUCTION

Golf courses and their supporting industries benefit New York State residents directly and indirectly:

- **Environmental benefits.** Golf courses provide open space, and their well-managed turfgrass protect water and other natural resources.

- **Economic benefits.** The golf industry contributes more than $3 billion and 50,000 jobs annually to the state's economy. Golf fundraisers also contribute approximately $100 million annually to charities across the state, funding countless diverse and worthy causes.

- **Recreational and health benefits**. Golf courses provide excellent recreational and health benefits for golfers of all ages. A Swedish study found golfers who walk when playing live five years longer than non–golfers.

As the stewards of golf courses in NY, superintendents are dedicated to protecting New York's natural resources and embrace the responsibility to maintain these facilities in harmony with the natural environment. The golf industry has led the effort in establishing Best Management Practices (BMPs) for golf courses in New York State. These BMPs will help those in the golf industry work in concert with policymakers and regulators in a shared commitment to water quality protection.

Authors from Cornell University have integrated the latest research on BMPs specifically for New York's climate and environment; however, neighboring New Jersey and Connecticut will benefit as well. The research-based, voluntary BMP guidelines are designed to protect and preserve New York's water resources that enhance open space using current advances in golf turf management.

This effort to provide extensive guidance for environmental stewardship is being conducted in the best traditions of golf, as defined by golf's inherent values: honesty, integrity, and fair play (including upholding the rules when no one is watching). These are core values of golf turf professionals and serve as the basis for this innovative environmental effort.

What are BMPs?

BMPs are methods or techniques found to be the most effective and practical means of achieving an objective, such as preventing water pollution or reducing pesticide usage. Many BMPs reduce stormwater volume, peak flow, and nonpoint source pollution through evapotranspiration, infiltration, detention, filtering, as well as biological and chemical actions. This new guidance provides information for using BMPs to prevent or minimize the effects of golf course management on surface and groundwater to insure and enhance public health and environmental quality. Pollution prevention is easier, less expensive, and more effective than addressing problems "downstream". Essentially, BMPs are a sustainable approach to providing environmental, economic and social benefits to golf and society.

Why are BMPs important to the golf industry?

Golf courses rely on a healthy environment that includes water and wildlife. It is of paramount importance to enhance and protect water quality. A significant body of research exists that indicates successful implementation of BMPs virtually eliminates the golf course risk to water quality. In fact, several studies have shown that implementing BMPs enhances water quality on its journey on and through the golf course property.

Additional incentives for golf courses in New York State to implement BMPs include the following:

- potential for more efficiently allocating resources by identifying management zones
- cost savings associated with applying less fertilizer and pesticide
- improved community relations
- recognition by club members and the community at large as environmental stewards

Through a cooperative approach between the golf industry and friends and neighbors outside the industry, practices have been developed that benefit all parties.

When should you be aware of BMPs?

BMPs provide a science-based approach to protecting water quality from potential risks. Whether managing an existing course, renovating an existing course or constructing a new course, BMPs can be designed, installed and implemented. For example, golf course renovation and design projects can incorporate landscape BMPs such as vegetated swales, properly sited maintenance and storage facilities and efficiently designed irrigation systems. Specifically, during a renovation or grow-in period, BMPs protect water quality while the site is most vulnerable to soil erosion. For existing courses, the day-to-day management decisions on when, how much and how to apply nutrients provides many additional opportunities to apply BMPs that preserves and protects water quality.

How to align golf course management with BMPs

Successful implementation of BMPs begins with understanding a few basic environmental and water quality concepts associated with land management and water (Chapters 2 and 3). Using these concepts, a thorough site-specific understanding of vulnerable areas can focus BMP implementation in every stage of golf course design, construction, renovation, and maintenance (Chapter 4).

BMPs for irrigation (Chapter 5) and nutrient management (Chapter 6) and the role of turf density (Chapter 7), integrated pest management (IPM) and pesticide management (Chapters 8 and 9) will prevent runoff, leaching, and drift. Golf course managers must understand how much water is needed and when to apply it; how to select fertilizers and pesticides; and when, how, and where these compounds should and should not be applied. In addition, IPM principles provide alternatives to applying pesticides, as well as justification for using pesticides when necessary. Finally, maintenance facilities should also be properly managed in order to prevent point source release of chemicals that can reach ground or surface waters (Chapter 10).

2 ENVIRONMENTAL CONCEPTS

Understanding the following environmental concepts provide the basis for understanding the role of BMPs in water quality protection:

- concepts related to climate and microclimates
- concepts related to water, such as the hydrologic cycle and watersheds
- concepts related to soils, such as soil texture and soil moisture
- concepts related to geology, such as karst topography

Water, soils, and geology all play a role in environmental fate and transport mechanisms (such as runoff and leaching) that can contribute to water quality impacts. BMPs act on these fate and transport mechanisms to prevent water quality contamination.

2.1 Climate

Projections of a changing climate suggest that rainfall events will become less frequent, but more intense. As a result, a greater volume of the precipitation is expected to run off instead of infiltrating into the soil and replenishing groundwater. Consequently, the need for supplemental irrigation may increase, and superintendents will need to take greater care in the applying fertilizer and pesticides to reduce the risk of runoff. Structural BMPs are also valuable in managing increased runoff. For more information on available climate data for New York, see the Northeast Regional Climate Center (http://www.nrcc.cornell.edu/).

Golf courses are diverse landscapes with a variety of microclimates that require site-specific management to maintain uniform playing conditions. Microclimates are created by landforms as well as by vegetation and water bodies. In each case, the golf course superintendent must adapt management programs that address nutrient and pest management needs while understanding the effect these microclimates might have on the fate of applied materials.

2.2 Hydrologic Cycle

The hydrologic cycle is the cyclic movement of water in its various phases through the atmosphere, to the Earth, over and through the land, to the ocean, and back to the atmosphere (Figure 2-1). The sun is the powerhouse for the hydrologic cycle, providing the energy for phase changes of water (evaporation and condensation) and for the storage and release of latent heat. Because water is an efficient solvent, all water-soluble elements follow this cycle at least partially. Thus, the hydrologic cycle is the integrating process for the fluxes of water, energy, and the chemical elements throughout the environment.

Water enters the hydrologic system as precipitation, primarily in the form of rainfall or snowfall. It is then delivered to surface waters from runoff or infiltrates into the subsurface. Water can leave the system via stream flow or runoff, evaporation from open bodies of water, or evapotranspiration (evaporation from soil surfaces and transpiration from the soil by plants).

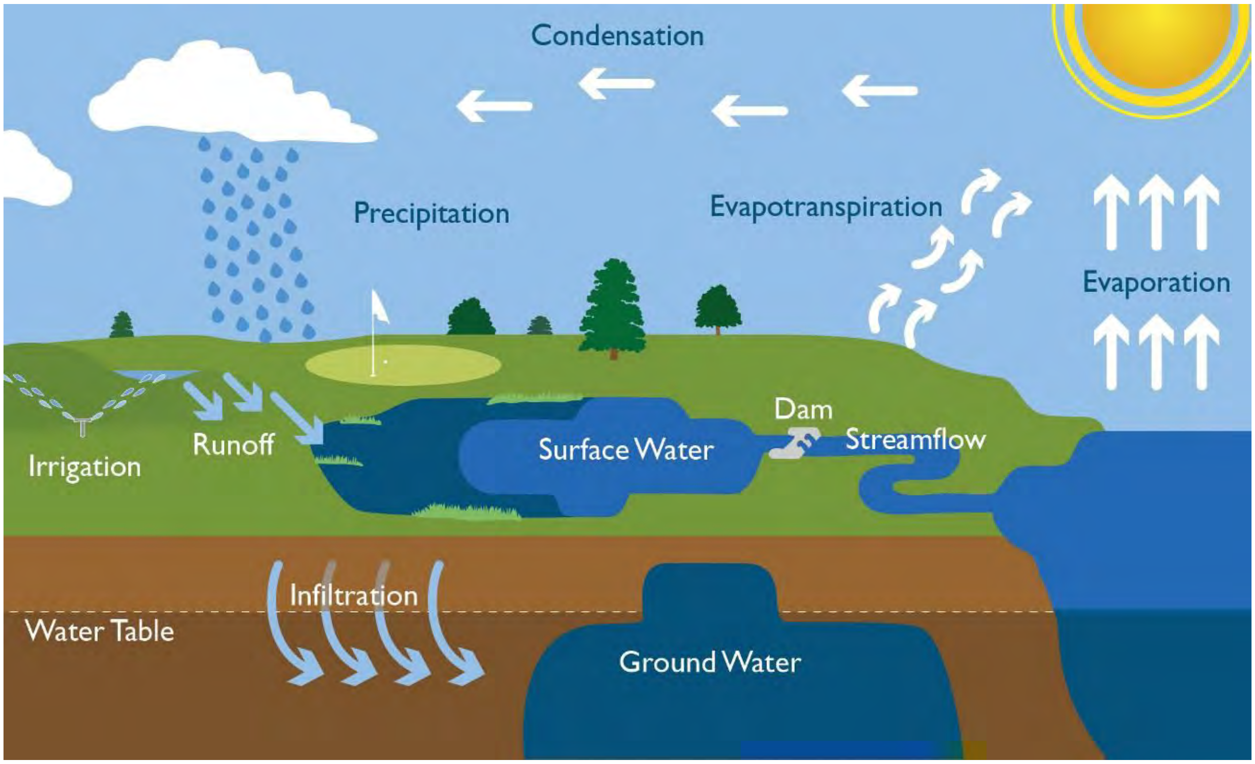


Figure 2-1. The hydrologic cycle.

2.2.1 Groundwater Recharge

Water moves through the surface of the earth, eventually through the soil horizons to natural storage areas below the ground. Depending on subsurface rock formations and overall permeability, the filling of these storage areas or "recharge" can collect water from a few hundred square feet to a few square miles. Groundwater often provides the source of water for perennial stream flow at base flow conditions when there is no precipitation. It is critical to understand the basics of groundwater recharge, both in size and scope, to mitigate potential contamination.

2.2.2 Infiltration and Runoff

The amount of water that infiltrates into the ground from the total run off depends on a number of variables, including the intensity of precipitation or irrigation, soil infiltration capacity, site characteristics, antecedent soil moisture, and season. Water that infiltrates into the soil either is stored within the soil profile or percolates downward toward groundwater, depending on the soil moisture conditions and soil structure. This soil water is then available for evapotranspiration. If the moisture-holding capacity of the soil is exceeded, the excess water percolates downward through the soil profile to groundwater. If the soils are at saturation, any additional precipitation does not infiltrate into the soil and becomes surface runoff instead. It is in this runoff that more soluble compounds applied to turf have the greatest potential to move off site.

Site characteristics including land use, land cover, soils, and topography also influence the amount of infiltration versus amount of runoff. Turf, forests, fields, and other vegetated areas slow down the flow of runoff, filter out sediments, and trap pollutants or break them down biologically. Conversely, hard impermeable surfaces such as buildings, roads, parking areas, and exposed bedrock prevent water from infiltrating into the ground. These hard impermeable surfaces, as well as bare soils, offer little resistance to reduce the velocity of runoff. Similarly, compacted soils and saturated soils retard the infiltration of water and therefore promote runoff. Lastly, steep slopes can increase the rate and amount of runoff.

The amount of runoff versus infiltration at any location also varies seasonally. During the winter, soils in New York are likely to be frozen and impermeable to water. Snowmelt, rain, and low evapotranspiration rates in the spring generate wet soil conditions and downward movement of water to groundwater. The potential for runoff is high because the near-saturated or partially frozen soils have low water infiltration capacities. During the summer, high rates of evaporation and plant water uptake may reduce soil water storage, leaving none to percolate downward. Summer rains only partially recharge the soil profile, and the soil's moisture holding capacity is typically not exceeded. Except for high-intensity thunderstorms, runoff and erosion potentials are generally low during the summer. In the late fall, evapotranspiration rates decrease, and groundwater recharge occurs when the moisture-holding capacity of the soil is exceeded. Runoff and erosion potentials also increase during this period. However, in New York, runoff from turf most often occurs from wet soils and not from high rainfall intensity.

2.3 Watersheds

A watershed is generally defined as an area of land that drains into a body of water, such as a river, lake, estuary, reservoir, sea, or ocean. Thus, all golf courses are in some watershed. A watershed includes the network of rivers, streams, and lakes that convey the water, as well as the land surfaces from which water runs off. Watershed boundaries follow the highest ridgeline around the stream channels and meet at the bottom or lowest point of the land where water flows out of the watershed. The boundary between watersheds is defined as the topographic dividing line from which water flows in two different directions.

Identifying and defining watersheds depends on the scale at which the landscape is examined. A watershed may be small and represent a single tributary within a larger system (such as a subwatershed), or be large and cover thousands of miles and cross numerous state boundaries, such as the Chesapeake Bay watershed. New York State is divided into 17 watersheds (Figure 2-2).

Figure 2-2. Watersheds in New York State.

At a larger scale, the U.S. Geological Survey (USGS) has divided and subdivided the United States into units classified into four levels: regions, subregions, accounting units, and cataloging units. A fifth field of classification (watershed) and sixth field (sub-watershed) are currently under development by USGS. The hydrologic units are arranged or nested within each other, from the smallest (cataloging units) to the largest (regions). Note that watersheds cut across typical regulatory boundaries such as counties and states, which can complicate regulation.

The first level of classification divides the United States into 21 major regions. Regions contain either the drainage area of a major river, such as the Missouri region, or the combined drainage areas of a series of rivers, such as the Texas-Gulf region, which includes a number of rivers draining into the Gulf of Mexico. New York State is situated within the boundaries of three regions: Ohio, Mid-Atlantic, and Great Lakes.

For more information on watersheds, see:

- NY Department of Environmental Conservation (NYSDEC) web site on New York watersheds (http://www.DEC.ny.gov/lands/60135.html)
- USGS watershed classification (http://water.usgs.gov/GIS/huc.html)

USGS Hydrologic Units Example

Cataloging Unit: French River

Accounting Unit: Allegheny

Subregion: Allegheny River Basin

Region: Ohio

- U.S. Environmental Protection Agency (EPA) Surf Your Watershed (http://cfpub.epa.gov/surf/locate/index.cfm)

2.4 Water Conservation

The increasing concentration of the US populations in urban and suburban areas is leading to concentrated demand for water resources. This urbanization has begun to challenge the supply of affordable and plentiful fresh (potable) water for irrigation in New York State. Water suppliers in most of the northeastern US must double the supply capacity to meet demand in the summer, resulting in high infrastructure costs. Therefore, economic, social, environmental, and political pressures dictate that water is used efficiently and conserved on New York's golf courses.

Golf course superintendents can maintain a landscape optimal for play, while conserving water, through effective course design and management. For example, reducing managed turf areas reduces water needs, maximizes rooting in areas that are irrigated, and improves the use of the water applied. In addition, a well designed, properly maintained, and wisely used irrigation system ensures the uniform application of water and minimizes runoff. Many of the BMPs discussed in this manual result in more efficient water usage, such as improving the efficiency of irrigation systems. In addition, superintendents can reduce irrigation requirements by a number of means, such as minimizing maintained areas, maximizing rooting potential, reducing water lost through evapotranspiration, and improving soil water storage where possible on sandy sites.

For general information on water conservation on golf courses, see:

- "Water Conservation on Golf Courses" United States Golf Association (USGA), http://www.usga.org/Content.aspx?id=25918
- "Water Conservation" Golf Course Superintendents Association of America (GCSAA), http://www.gcsaa.org/_common/templates/GcsaaTwoColumnLayout.aspx?id=1783&LangType=1033

For specific water conservation measures for golf courses, see:

- Fertilizing for Water Conservation (Cornell research), published in *Golf Course Management*, http://www2.gcsaa.org/gcm/2000/dec00/pdfs/12fert.pdf

2.5 Soils

Soil is the growing medium for turf on golf courses. Golf course superintendents must understand the behavior and function of water in the soil, as it assists with determining the potential off-site movement of fertilizers and pesticides.

Water can infiltrate into the soil and then can be held in pores or adhere to soil particles. The infiltration and water holding capacity of a soil involves different forms of energy. Three forces determine the water storage capacity of soil:

- gravitational potential, which draws water down and through the soil profile.
- matrix potential, which is defined by the adsorption of water to the soil particle surfaces. Smaller soil particles, like clay or silt, as well as organic matter, have a greater total surface area than a coarser material such as sand.
- osmotic potential, which is the attraction of water to solutes. The plant root system uses osmotic potential to draw water from the soil across the root membrane.

Downward movement of water through large soil pores or when soil is fully saturated is driven by gravity, hence the term gravitational water (Figure 2-3). When the soil is saturated, some of this water will become groundwater recharge or can enter drainage tiles, if present. The amount of water that remains after gravity has exerted its influence is referred to as the "field capacity" of the soil.

The water content of the soil determines whether plants thrive or wilt. Evapotranspiration from the turf surface draws water from the soil. If this process continues unabated and no irrigation or rainfall occurs, the soil will dry to a point known as the wilting point. The difference between soil moisture content at field capacity and the point at which plants wilt due to lack of moisture is referred to as "plant available water". Often little plant-available water is present in the soil when it reaches the wilting point, which is the point at which the soil holds the water with greater energy force than the plant can exert to extract it.

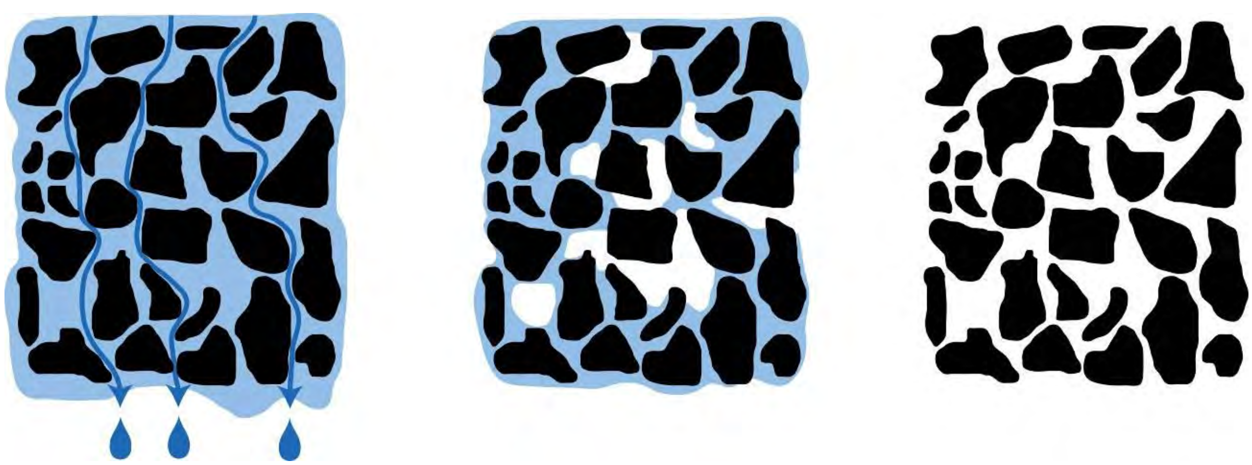


Figure 2-3. Soil water field conditions: saturation (left); field capacity (middle), and wilting point (right).

The amount of plant-available water depends upon the soil structure, texture, and organic matter. The classification of soil structure and textural analysis is shown in the soil texture triangle. (Figure 2-4). Lab analysis can determine the percent distribution of sand, silt, and clay. The amount of plant-available water held by different soils is presented in Figure 2-5. Commercially available moisture meters are able to read soil moisture percentage.

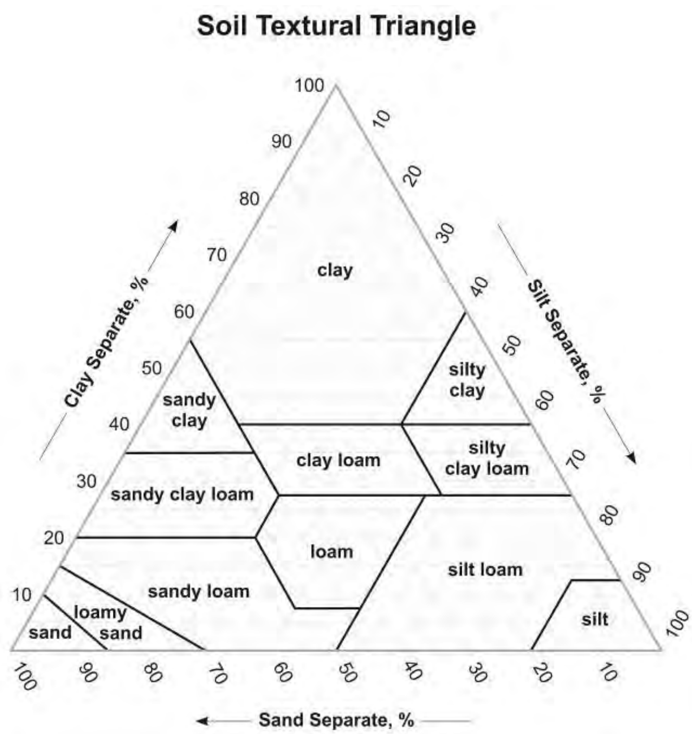


Figure 2-4. Soil textural triangle depicting soil particle distribution for different soils. Soil size definitions are as follows: Clay <0.002mm, Silt = 0.002-0.05 mm, Sand = 0.05 -2.0 mm. Source: USDA.

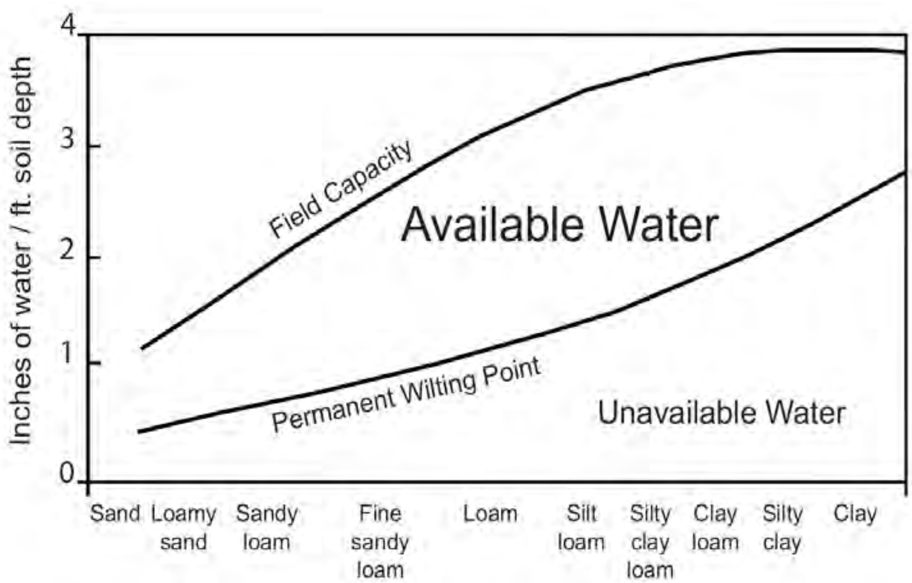


Figure 2-5. Available water by soil type. Source: Ohio Agronomy Guide, 14th edition, Bulletin 472-05.

Adding amendments to sand can dramatically increase the plant-available water capacity (PAWC), as shown in Table 2-1. While peat only slightly increases the PAWC of a 12-inch sand root zone, adding calcine diatomite and a natural zeolite can double or even triple the PAWC of sand.

Table 2-1. Plant-available water holding capacity for sand and sand with amendments

Material	Plant available water holding capacity (% by volume)
Sand	4
Sand/Calcine clay (90:10)	6
Sand/Calcine diatomite (90:10)	8
Sand/Natural zeolite (90:10)	11
Sand/peat (80:20)	5

For more information on soils in New York, see: http://websoilsurvey.nrcs.usda.gov.

2.6 Geology

Golf courses can cover large expanses of land that may vary in geological properties. Understanding these geological properties is critical because these properties can pose risks for ground or surface water contamination.

2.6.1 Surficial Geology

Surficial geology is the study of landforms and the unconsolidated sediments that lie beneath these landforms. The type of surficial geology, along with the type of subsoil and depth to groundwater, can influence the surface water and groundwater interactions that allow contaminants to move from one medium to the other. Soils with hard pans or finer textured horizons in the subsoil may have a greater ability to adsorb contaminants as they leach through the surface horizons. The greatest potential for groundwater contamination occurs where sandy soil overlies porous materials (such as limestone or coarse gravel) with a shallow water table.

For New York State maps of surficial geology, see http://www.nysm.nysed.gov/gis/#surf.

2.6.2 Karst Geology

Karst geology (also called karst topography) is a type of surficial geology associated with carbonate bedrock (limestone, dolomite, or marble) and characterized by sinkholes, depressions in the land surface, caves, and underground drainage systems (Figure 2-6).

In New York State, continental glaciation and local stratigraphic and structural conditions have produced karst features, which may affect the quality and quantity of groundwater in the state. Karst features are created over time by rainwater, which dissolves the carbonate bedrock as it drains into fractures, creating channels and openings in bedrock. These channels and openings to the ground surface provide a direct connection between surface water and groundwater; these enhanced connections are known as "focused" or 'direct' recharge. Direct recharge quickly replenishes the water supply; however, it also leaves the aquifer particularly vulnerable to contamination, especially where the topsoil layer is thin and does not filter out potential contaminants.

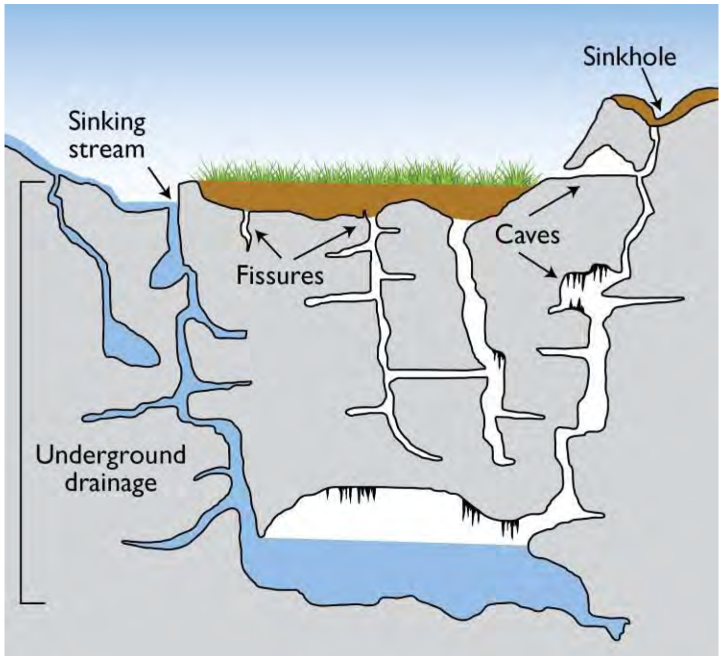


Figure 2-6. Karst geology is characterized by such features as sinkholes, fissures, and caves.

Available bedrock geology maps of NYS identify carbonate bedrock areas that indicate the potential presence of karst features. However, higher resolution maps of the boundaries as well as karst features in these bedrock units would be better suited for site-specific management, but may not be available from other sources.

For more information on karst geology, see:

- Bedrock geology map of NYS: http://www.agiweb.org/environment/karstmap.pdf
- "Living with Karst", American Geological Institute: http://www.agiweb.org/environment/publications/karst.pdf
- Fickies, R.H. and Fallis, E., 1996, Rock Type Map of New York State: New York State Geological Survey, Open file Report 1g1222, scale 1:1,000,000.

2.7 Environmental Fate and Transport Mechanisms

Understanding contaminant fate and transport mechanisms will help superintendents to minimize the risk of off-site movement of nutrients and chemical pesticides applied to golf courses. First, research indicates that using BMPs minimizes the chances for movement of potential water quality contaminants into ground or surface water. When BMPs are not properly implemented, however, water quality is at greater risk. These risks are primarily the result of runoff and leaching, which are themselves environmental fate and transport mechanisms:

- Runoff is the movement of water across the turf and soil surface, typically following a storm event or heavy irrigation.
- Leaching is the downward movement of water through the soil and potentially into groundwater.

Additional fate and transport mechanisms for nutrients and pesticides include drift and spills. Drift occurs when pesticides become airborne as dry particles, liquid spray droplets, or vapor. Spills are the unintended releases of chemicals, such as fertilizers, pesticides, hazardous materials, or petroleum products released during transportation, storage, and routine maintenance and facility operations. These releases can be a point source of contamination.

2.7.1 Runoff

Surface runoff is a water flow along the surface of the ground that occurs when the soil is saturated, compacted, high in clay particles, or has lost soil structure (large pores). When runoff flows along the ground, it can pick up contaminants (including but not limited to pesticides, fertilizers, and petroleum) that then become discharge or nonpoint source pollution. The potential for runoff is greater on steep slopes. Research on golf courses has shown that in areas with minimal slopes, runoff on fairways is less than 5% of rainfall (Easton et al. 2005).

2.7.2 Leaching

Leaching refers to the loss of water-soluble plant nutrients or chemicals from the soil as water moves through the soil profile and into the vadose zone (saturated zone). Solute leaching becomes an environmental concern if it contributes these contaminants to groundwater or to surface waters where contaminated groundwater replenishes surface water bodies. Several variables influence the probability and rate of leaching, such as soil type and structure, vegetation, chemical properties, rate of precipitation, and depth to groundwater. When deciding on the rate and timing of fertilizer and pesticide application, it is critical to assess soil moisture status and potential for high infiltration in order to minimize potential losses. In addition, soil texture is a major influence on nutrient and pesticide leaching. For example, three to four times more nitrates have been shown to leach from a bentgrass sand fairway turf than from a sandy loam or silt loam soil (Petrovic 2004).

For more information on leaching see:

- “Loss of Nitrogen and Pesticides from Turf Via Leaching and Runoff”, http://www.usga.org/course_care/articles/environment/pesticides/Loss-of-Nitrogen-and-Pesticides-from-Turf-via-Leaching-and-Runoff/
- Appendix B, Groundwater Quality of Eastern Long Island, NY Golf Courses

2.7.3 Drift and Volatilization

Pesticides can move from the sites where they are applied into the surrounding environment through drift and volatilization. EPA defines pesticide spray or dust drift as “the physical movement of pesticide droplets or particles through the air at the time of pesticide application or soon thereafter from the target site to any non- or off-target site."

Volatilization occurs when pesticide surface residues change from a solid or liquid to a gas or vapor after a pesticide application. Once airborne, volatile pesticides can come into contact with applicators or move long distances off site. Not all pesticides are volatile, and the higher the vapor pressure of a given chemical, the higher its volatility will be. Appendix C lists all the pesticides registered for use in New York State with the corresponding vapor pressures. Generally, any pesticide with a vapor pressure greater than 1 millipascal (mPa) is deemed to be volatile. For more information on drift and volatilization, see:

- EPA Pesticide Issues: pesticide volatilization http://www.epa.gov/pesticides/about/intheworks/volatilization.htm
- Croplife Foundation, "Minimizing Pesticide Spray Drift" http://croplifefoundation.files.wordpress.com/2012/05/spray_drift.pdf
- Cornell University Pesticide Application, Turf Spraying web page: http://web.entomology.cornell.edu/landers/pestapp/turf.htm

2.7.4 Sedimentation

A primary benefit of turfgrass or any perennial vegetation is the reduction in sediment and particulate movement, or reduced soil erosion. Precipitation and irrigation can carry soil particles (sediment) in runoff and deposit them into surface waters. Too much sediment can cloud the water, reducing the amount of sunlight that reaches aquatic plants and harming aquatic species. In addition, sediments can carry fertilizers, pesticides, and other chemicals that are attached to the soil particles into the water bodies, causing algal blooms and depleted oxygen. Sedimentation is controlled through BMPs that control the volume and flow rate of runoff water, keeping adequate turf density, and reducing soil transport.

2.7.5 Point Sources

The legal definition of "point source" is provided in 6 NYCRR Part 050-1.2(65) as follows:

> The term "point source" means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, or landfill leachate collection system from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture.

On golf courses, point sources of pollution can originate from:

- storage and maintenance facilities
- the unintended release of chemicals, such as pesticides, fertilizers, or fuel, during transportation, storage, or handling

- drainage discharge outlets (for example, the end of a drainage pipe)

Containment measures can easily prevent chemicals from becoming point sources of pollution during storage and handling. To prevent discharges from contaminating surface waters, the discharges must be diverted away from surface water and onto turf areas or other appropriate areas instead.

3 WATER QUALITY MANAGEMENT

Golf course BMPs are designed to minimize the transport of potential water quality contaminants (such as nitrogen and phosphorus) from the golf course into surface waters and groundwater. A decade of public and privately funded research concerning the fate of fertilizers and pesticides applied to turf has concluded that golf courses using BMPs pose little to no risk of contributing to water pollution. Specifically, several studies investigated the movement of nutrients and pesticides through the perennial turfgrass system and found that maintaining a dense, vigorous turf, identifying environmentally sensitive areas, and recognizing potential risks of certain soils and climatic conditions are essential to protecting water quality.

Regulatory compliance is the first step in aligning golf course management with BMPs. New York has some of the nation's strictest state regulations on pesticides and fertilizers. Golf course superintendents must be aware not only of regulations on the purchase, storage, handling, and application of fertilizers and pesticides, but also of the potential water quality contaminants, sources, and impacts associated with these compounds. The next step in successful BMP implementation is to recognize the many management decisions that involve potential contamination of surface waters and groundwater and address course management practices in a systematic fashion. Once course management becomes aligned with regulations and water quality protection BMPs, additional value can be gained by using water quality monitoring as a final step to assess the actual water quality entering and leaving the course.

3.1 Regulatory Framework

Maintaining water quality is a high public priority, to ensure a safe and abundant public drinking water supply as well as to protect fish and wildlife resources that use State waters and wetlands as part of their habitat. A number of federal and state regulations that apply to both drinking water and surface water quality for the protection of aquatic life are relevant to golf course operations, depending upon the proximity to drinking water sources, and surface waters, and depth to groundwater. These include regulations related to stormwater; wetlands; pesticides and pesticide usage; fertilizers; hazardous materials; and water withdrawal.

Maintenance facilities are likely to be subject to a number of local requirements, which may vary by county or town. Local building inspectors should be consulted during planning for new facilities to outline the permitting process and local requirements. Also, consider meeting with a representative from a NYSDEC regional office and the local fire marshal. The NYSDEC requests a State Environmental Quality Review (SEQR) for new construction, which is administered by local governments. NYSDEC comments on SEQR as well as other interested and involved agencies.

3.1.1 Drinking Water

The Safe Drinking Water Act (SDWA), passed in 1974, is the main federal law that ensures the quality of Americans' drinking water. Under the SDWA, EPA sets standards for drinking water quality and oversees the states, localities, and water suppliers who implement those standards.

SDWA authorizes EPA to set national health-based standards for drinking water, known as the National Drinking Water Regulations, to protect against both naturally occurring and manufactured contaminants. These regulations specify maximum contaminant levels (MCLs) for contaminants, which include nitrates, nitrites, and some pesticide constituents. EPA, individual states, and water systems are compelled to work together to ensure that these standards are met. The New York State Department of Health (NYSDOH) established standards for drinking water quality that are more stringent than EPA standards and must be complied with in the state.

For more information, see:

- Surface Drinking Water Act: http://water.epa.gov/lawsregs/rulesregs/sdwa/index.cfm
- National Drinking Water Regulations: http://water.epa.gov/drink/contaminants/index.cfm
- Drinking water contaminants MCLs: http://water.epa.gov/drink/contaminants/index.cfm#List
- NYSDOH drinking water protection program: http://www.health.ny.gov/environmental/water/drinking/

3.1.2 Stormwater

Stormwater is water that originates in some form of precipitation, as either rainfall or snowmelt. Because this water travels along or through the earth's surface, it can collect and carry potential contaminants that could compromise surface waters or groundwater. Therefore, regulations exist that govern the quality of water discharged from runoff sources. NYSDEC has established limits for some chemicals in stormwater, including nitrites, nitrates, and pesticides. NYSDEC has also established a limit for phosphorus levels in stormwater of 0.1 mg per liter.

Individual or general permits for stormwater discharges may be required for activities associated with stormwater discharges, including construction activities. Construction activities disturbing one or more acres of soil must be authorized under the General Permit for Stormwater Discharges from Construction Activities. Permittees are required to develop a Stormwater Pollution Prevention Plan (SWPPP) to prevent discharges of construction-related pollutants to surface waters. The New York State Stormwater Management Design Manual was reissued in 2010 for more information.

The concentration of activities in and around maintenance facilities may increase the levels of chemical residues susceptible to runoff from heavy precipitation. Stormwater collection areas may need to be established to capture runoff in accordance with NYSDEC specifications.

For more information see:

- NYSDEC's "Stormwater" page: www.dec.ny.gov/chemical/8468.html
- NY Stormwater Design Manual: http://www.dec.ny.gov/chemical/29072.html

3.1.3 Surface Water

The goal of all surface water quality protection programs is to ensure that all waters of the State meet water quality standards. The Federal Clean Water Act required states to classify all of the waters of the State according to their best uses and to adopt water quality standards in order to protect those best uses. NYSDEC uses the best uses and standards so established to regulate surface waters, land use associated with tidal and freshwater wetlands, and dams. Specifically, NYSDEC is charged with identifying impaired surface water bodies (i.e., waters not meeting water quality standards), recommending mitigation, and establishing guidelines for enhanced protection through a variety of regulatory programs.

For surface waters in New York not meeting the established State water quality standards, NYSDEC establishes total maximum daily loads (TMDLs) for the pollutant of concern causing the impairment (such as nitrogen, phosphorus, or sediments). NYSDEC has completed TMDLs for many water bodies in New York State, including Long Island Sound, Lake Champlain, waters of the Croton River watershed, and a number of lake watersheds. EPA may also require localities to develop Comprehensive Nutrient Management Plans (CNMPs) for activities in those impaired watersheds. Currently, CNMPs are focused on agricultural land use specifically related to the New York City Watershed Memorandum of Agreement (MOA). Note that state, federal, and local water quality regulations can change—remain informed on local, regional, and national policies and regulations.

For more information, see:

- NYSDEC Division of Water Regulations: http://www.NYSDEC.ny.gov/regs/2485.html
- NYSDEC TMDLs: http://www.NYSDEC.ny.gov/chemical/23835.html
- EPA's National Assessment Database: http://www.epa.gov/waters/305b/

3.1.4 Groundwater

NYSDEC regulates groundwater, including setting groundwater quality and effluent standards. For more information, see NYSDEC Division of Water Regulations: http://www.dec.ny.gov/regs/2485.html.

3.1.5 Freshwater Wetlands

Article 24 of New York Environmental Conservation Law requires permits to conduct activities within a wetland and an adjacent area bordering the wetland. Physical disturbance, as well as application of chemicals (pesticides, herbicides, fungicides, even fertilizer), requires an Article 24 permit if the action is done in a state-regulated wetland or within the regulated adjacent area (typically 100 feet from wetland boundary).

3.1.6 Fertilizers

A growing number of states have enacted regulations that restrict fertilizer sale and application. For example, Minnesota and Wisconsin enacted specific legislation that restricts the application of phosphorus containing fertilizer unless a soil test indicates need. Additionally, Minnesota requires education and certification of applicators to ensure that applicators understand environmental aspects of fertilizer application.

In New York, the Dishwater Detergent and Nutrient Runoff Law became effective in January 2012. This law prohibits the use of phosphorus-containing fertilizers with a phosphate (P_2O_5) content greater than 0.67%, unless:

- soil tests show a phosphorus deficiency
- the fertilizer is being used to establish new seeded or sodded turf
- the fertilizer being used is an organic compost
- the fertilizer is derived from litter

The law prohibits application of fertilizer onto impervious surfaces. Fertilizer should not be applied within 20 feet of any surface water, modified to 10 feet if the buffer has vegetative cover. An exception to the buffer requirement exists if the spreader guard, deflector shield or drop spreader is at least three feet from surface water. Finally, the law prohibits the application of fertilizers on lawns and non-agricultural turf between December 1 and April 1.

In addition to state regulations, turf managers should review their county and town ordinances to determine if stricter restrictions apply to phosphorus fertilizer use and application. For example, a few counties have extended the phosphorus-containing fertilizer restriction from November 1 or November 15 to April 1. Currently, local laws enacted to reduce phosphorus include ones adopted in Westchester, Nassau, Suffolk and Chautauqua counties and the Village of Greenwood Lake.

In addition to restrictions on the use of phosphorus-containing fertilizers, CNMPs for those NY counties required to submit plans for impaired waters may restrict the use of nitrogenous fertilizers. Turf managers should consult with the local County Cooperative Extension Office, SWCD Office, or County Water Authority to learn if any restrictions apply.

For more information, see:

- NYSDEC Dishwasher Detergent and Nutrient Runoff Law web page: http://www.dec.ny.gov/chemical/67239.html
- Minnesota legislation: https://www.revisor.mn.gov/statutes/?id=18C
- Westchester County local regulation: http://www.westchestergov.com/pdfs/ENVFACIL_2008LawnFertilizerLaw.pdf
- Nassau County local regulation: http://www.nassaucountyny.gov/agencies/legis/documents/locallaw11-2009.pdf
- Suffolk County local regulation: http://legis.suffolkcountyny.gov/resos2007/i2117-07.htm
- Chautauqua County local regulation: http://www.planningchautauqua.com/?q=watershed/Phosphorus_Law.htm

3.1.7 Pesticide Use Regulations

The New York State Environmental Conservation Law (ECL), Article 33, Part 325, establishes statutory authority to the New York State Department of Environmental Conservation to regulate pesticides and pesticide use. These regulations are covered in detail in Chapter 9, Section 9.1. of this document.

3.1.8 Aquatic Pesticide Applications

The application of any pesticide to water, such as an aquatic herbicide used to control vegetation in golf course ponds, or mosquito or other insect control applied to water, must be covered under a SPDES General Pesticide Permit. For more information, see: http://www.dec.ny.gov/chemical/70489.html.

3.1.9 Maintenance Facilities

Every golf course has a central area for the maintenance and storage of equipment and supplies. These areas can potentially become point sources of pollution because of unintended releases of chemicals such as pesticides, fertilizers, or fuel during storage or handling of these materials. Maintenance and storage facilities are high priority areas to address in protecting water quality. Containment measures in these areas can easily prevent chemicals from becoming point sources of pollution. More information on regulatory considerations related to maintenance facilities and potential hazardous materials is provided in Section 10.1 of this document.

3.2 Potential Water Quality Contaminants

Fertilizers and pesticides maximize productivity and performance in a variety of agricultural and horticultural settings, including golf turf management. In addition to regulations on applying these compounds, their storage and handling is also regulated. Although application practices can affect water quality, the environment is typically at the greatest risk from spills of larger volumes of the concentrated chemicals used to mix fertilizers and pesticides for application. Regardless of how the chemicals are released into the environment, superintendents should understand the fate of these inputs as well as other potential sources of contamination in order to prevent or to mitigate any potential effects on water quality.

3.2.1 Fertilizers

Of the many nutrients applied to golf turf, the primary contaminants of concern in fertilizers are nitrogen and phosphorus. These nutrients can leach into groundwater or be carried in runoff into surface waters after applications. New York's Environmental Conservation Law (ECL) narrative standards state that no nitrogen and phosphorus are allowed in runoff that contribute to algal growth, weeds, or the impairment of the water.

3.2.2 Pesticides

Pesticides may be toxic to aquatic and terrestrial systems. The varying chemical properties of pesticides—for example, their solubility, toxicity, and chemical breakdown rate—determine the potential impact to water quality. Pesticide safety and management is covered in Chapter 9 of this document.

3.2.3 Sediments

EPA defines suspended and bedded sediments as follows:

> "…particulate organic and inorganic matter that suspend in or are carried by the water, and/or accumulate in a loose, unconsolidated form on the bottom of natural water bodies. This includes the frequently used terms of clean sediment, suspended sediment, total suspended solids, bedload, turbidity, or in common terms, dirt, soils, or eroded materials."

Increases in sediment loading can compromise the ecological integrity of aquatic environments, affecting water quality physically, chemically and biologically. In addition, sediments often carry organic matter, nutrients, chemicals (such as pesticides), and other wastes. For example, phosphorus is immobile in most soils and concentrates in the top few inches of the soil, where it is very susceptible to erosion and thus likely to be present in sediment.

3.2.4 Hazardous Materials

Other potentially hazardous materials, such as fuels and paints that are used in everyday operation and maintenance, can contaminate water quality if accidentally released, especially in large quantities. BMPs followed for maintenance operations can prevent contamination from accidental releases.

3.2.5 Waterfowl

The deposits of fecal matter by resident and migrating waterfowl (Canada Geese, mute swans, and others) may contribute to water quality impairment through nutrient enrichment. The overall impact of bird feces on water quality, however, depends on numerous factors, such as the size, depth, and natural chemistry of the water body; avian populations and behavior; and the rate at which other nutrient sources enter the water body (Unckless and Makarewicz 2007). On golf courses, shallow ponds with significant populations of waterfowl are most likely to be affected. In these cases, annual phosphorus loading by waterfowl can be calculated using the days per year that each species spent on any lake or reservoir.

3.3 Potential Water Quality Impacts

If water quality contaminants reach surface waters or groundwater, the potential water quality impacts can include the following:

- drinking water impairment, if nitrogen as either nitrate (NO_3) or nitrite (NO_2) is present at levels above health-based risk values in drinking water
- nutrient enrichment of surface waters
- sedimentation due to eroding soils

- toxicity to aquatic life

3.3.1 Drinking Water Impairment

The presence of nitrogen as either nitrate (NO_3) or nitrite (NO_2) at levels above health-based risk values in drinking water may adversely affect health. MCLs established by EPA are 10 mg/L for nitrate and 1 mg/L for nitrite. Phosphorus contamination of drinking water has not been directly linked to human health problems, although increased levels may affect water taste and odor and, in some cases, enhance the growth of toxic algae. MCLs have been established for some pesticides or pesticide constituents in drinking water, such as glyphosphate.

Although drinking water impairment from golf course management activities is possible, research indicates that this is uncommon. Seventeen studies (36 golf courses) were reviewed by Cohen et al. (1999) and were incorporated into a detailed data review. A total of 16,587 data points from pesticide, metabolite, solvent, and NO_3 analyses of surface water and ground water were reviewed. Approximately 90 organics were analyzed in the surface water database and approximately 115 organics in the ground water database. The results of the analysis indicated that widespread and repeated water quality impacts by golf courses were not observed at the golf course study sites. None of the authors of the individual studies concluded that toxicologically significant impacts were observed, although health advisory levels, MCLs, or maximum allowable concentrations were occasionally exceeded.

3.3.2 Nutrient Enrichment

Nutrient enrichment of surface waters is widespread across the state of New York in large part because of the prevalence of sources of phosphorus and nitrogen, including the following:

- municipal wastewater treatment plant discharges
- urban runoff from impervious surfaces such as parking lots, rooftops and roads
- agricultural activities
- flow from inadequate onsite septic systems
- home lawn and other fertilization practices
- atmospheric deposition

Nutrient enrichment can lead to eutrophication, the process by which a body of water acquires a high concentration of nutrients, which promotes excessive growth of algae (called algal blooms). As the algae die and decompose, oxidation of the organic matter and respiration by the decomposing organisms can deplete dissolved oxygen in the water, in turn causing the death of aquatic organisms such as fish and invertebrates.

Although both phosphorus and nitrogen must be managed to prevent eutrophication, nitrogen is the higher priority for marine environments, while phosphorus is more important in fresh waters. In Long Island Sound, nitrogen fuels the growth of excessive amounts of planktonic algae. In the Sound, the eutrophication process results in hypoxia (very low levels of dissolved oxygen in the water column) each summer, especially in the western half of Long Island Sound. In marine systems, the eutrophication process can also alter the habitat for submerged aquatic vegetation and marine life, reducing the size and diversity of the ecosystem and fisheries. Some algal blooms, often referred to as red or brown tides, can also be toxic to crustaceans, fish, and humans. In freshwaters, phosphorus fuels the growth of excessive amounts of algae that also results in reduced amounts of dissolved oxygen available to freshwater aquatic organisms. Phosphorus levels of 0.035 to 0.10 mg/L have been linked with increased levels of algal growth in rivers, lakes, and estuaries.

In addition to excessive algae growth, nutrient enrichment can contribute to the excessive growth of vascular aquatic plants. Excessive aquatic plant growth can alter the aquatic plant community, deplete oxygen, impact fish communities, restrict recreational use, and cause odors during die off.

For more information, see:

- NYSDEC "Nutrient Loadings and Eutrophication" fact sheet: http:// www.dec.ny.gov /docs/water_pdf/top10nutloading.pdf
- NYSDEC "Aquatic Weeds and Invasive Species" fact sheet: www.dec.ny.gov /docs/water_pdf/top10invasives.pdf
- EPA Nutrient Pollution web page: http://epa.gov/nutrientpollution/

3.3.3 Sedimentation

Sedimentation is the process whereby water that is carrying sediments from eroding soil slows long enough to allow soil particles to settle out. The smaller the particle, the longer it stays in suspension. Larger, heavier particles such as gravel and sand settle out sooner than smaller, lighter particles such as clay (which may stay in suspension for long periods and cause water turbidity). The effects of sedimentation are generally site specific and depend on a number of variables including sediment grain size and type, and hydrological conditions; water quality impacts can include increased turbidity, impairment of aquatic habitats, and filling in of water bodies. In addition, sediments can also affect water quality if they contain other contaminants such as organic matter, nutrients, pesticides, or other chemicals. Sedimentation is only likely to occur on golf courses during construction and major renovations when soils are disturbed.

3.3.4 Toxicity to Aquatic Life

Pesticides applied to golf courses can be harmful to fish and wildlife. Herbicides used to control weeds can be transported to ponds and streams where they can be harmful to aquatic vegetation and algae. Insecticides, including some of the products used for adult mosquito control, also tend to be toxic to fish and aquatic life, and if transported off treated areas by runoff, fish and invertebrates in adjacent waters can be harmed. Fortunately, turf tends to hold water and retard runoff, greatly reducing the pesticide load transported to adjacent water bodies, particularly compared to pesticide treatments on bare ground or agricultural fields. To ensure the protection of aquatic life and compliance with pesticide regulations as described in Section 9.1 of this document, close attention should be paid to all of the instructions listed on the pesticide label. Carefully following label instructions is the best way to insure that a pesticide application will not be harmful to fish and wildlife.

3.4 Water Quality Monitoring

Aligning management programs with established, research-based BMPs is the first step to ensuring water quality protection. Water quality monitoring can confirm the effectiveness of a BMP-based program. Golf course superintendents wanting to develop and implement a water quality monitoring program to document the water quality conditions should first review available baseline water quality data. Baseline data can be assessed to determine the likely origin of contaminants, measure the extent of sedimentation and nutrient inputs, and estimate the potential impacts to surface water and groundwater. Following implementation of BMPs, routine monitoring can be used to measure water quality improvements and identify any areas where corrective actions should be taken.

Water quality monitoring can also demonstrate the presence of water quality issues inherent in water as it enters a golf course property. For example, in Suffolk County extensive laboratory testing for contaminants has shown that groundwater entering the golf course already has extremely high nitrate levels (near or greater than the regulatory limit; see Appendix B) The county also collects surface water samples and shares the test reports with superintendents.

3.4.1 Sources of Existing Information

Several sources of existing surface and groundwater monitoring data may be available, including:

- Soil and Water Conservation Districts – Comprehensive water quality management programs; may be willing to test surface water and assist in installation of groundwater monitoring wells. SWCD listings for NYS are available at: http://www.nys-soilandwater.org/contacts/county_offices.html
- NYSDEC - Conducts a groundwater monitoring program in coordination with USGS. http:// http:// www.dec.ny.gov /docs/water_pdf/top10nutloading.pdf/lands/36117.html
- USGS - Reports results of groundwater monitoring and compares to EPA and NYSDOH standards. The USGS has completed testing and published reports for most of the major watersheds in the state. http://ny.water.usgs.gov/projects/305b/.
- County Water Authorities - Maintain and test community water wells and may have additional test data from other points within the watershed.

3.4.2 Developing a Water Quality Monitoring Program

Developing a water quality monitoring program can include both groundwater monitoring and surface water monitoring. The data from this periodic monitoring can be used to identify issues that may need corrective actions. In addition, water quality monitoring of irrigation sources (particularly water supply wells and storage lakes) provides valuable agronomic information that can inform nutrient and liming programs. A water quality monitoring plan should identify appropriate sampling locations, frequency, and monitoring parameters.

Groundwater monitoring from wells located at the hydrologic entrance and exit from the course may be the best way to evaluate a golf course's impact on water quality. If groundwater monitoring data from these locations are not available from existing sources, monitoring wells can be installed by private companies. Installing groundwater monitoring wells can be relatively expensive, but the expense may be justified in certain cases where the origin of contamination needs to be determined through comparison of water quality entering and exiting the property. To identify the appropriate site for monitoring wells, groundwater flow is required. In some areas of New York, groundwater flow maps have been developed, but may not be available at a fine enough scale for an individual golf course. Experienced environmental engineering firms or USGS can assist in determining suitable monitoring well locations. Testing protocols can be simplified to test only those parameters that are directly influenced by course management, including organic and inorganic levels of nitrogen and phosphorus and a pesticide screen for certain pesticides used on the course. NYSDEC pesticide reports provide the necessary documentation for pesticides used. The USGS also offers contract services to advise on sampling and testing of water samples. SWCD offices can also provide guidance on groundwater testing programs.

Surface water monitoring can include the laboratory testing of a number of different physical and chemical parameters to assess water quality. In addition, the sampling of macrobenthic invertebrates can be used as a relative assessment tool for stream health. Sampling of surface waters can be conducted by golf course staff or volunteer monitoring groups (Figure 3-1).

Figure 3-1. Golf course staff can easily sample surface water. Source: Ken Benoit

A number of references for detailed information on planning a water quality monitoring program on golf courses can be used to plan a site-specific water monitoring program:

- *Environmental Stewardship Guidelines* (Oregon GCSA, 2009) includes a highly detailed chapter on water quality monitoring specific to golf turf. http://www.ogcsa.org/Pages/environmental/ogcsa-guidelines.html
- *Environmental Best Management Practices for Virginia's Golf Courses* (Virginia GCSA, 2012) includes a detailed chapter on water quality monitoring and an example water quality monitoring report appendix. http://www.vgcsa.org/view.asp?id=373&page=68702
- *A Guide to Environmental Stewardship on the Golf Course* (Audubon International, 2002)

BMP Statements

- Assess current surface and groundwater quality.
- Conduct water quality assessment using accepted standards.
- Use an accredited laboratory for water quality assessment.

4 SITE ANALYSIS AND WATER QUALITY PROTECTION

Site analysis is the first and most important step in aligning golf course management with research-based BMPs designed to protect water quality and ecosystem integrity. A site analysis describes site maintenance areas, chemical storage and handling practices, equipment cleaning, and other priority areas on the golf course associated with topography and environmental sensitivity. Following this thorough assessment the feasibility of land use, structural, and management BMPs should be considered to ensure reasonable water quality protection.

The BMPs discussed in this chapter can be incorporated into design for a new course or course renovation. For an existing golf course, the golf course superintendent can undertake a site analysis to identify specific areas of interest to focus the implementation of BMPs. For a new golf course development or a renovation project, the state of New York requires that a licensed golf course designer guide the site analysis process to ensure compliance with relevant regulations. Designers and others involved in golf course development are encouraged to work closely with local community groups and regulatory bodies during planning and siting and throughout the development process. For every site, local environmental issues and conditions must be addressed.

The first step in a site analysis is to develop a better understanding of how a golf course fits into the landscape. The site assessment begins with identifying high priority areas and the current potential for water quality impacts. Note that the high priority areas are more often located where equipment is cleaned and fertilizer and pesticides are stored and handled because these areas have the potential for large volume releases.

4.1 Identifying Priority Areas

Understanding the golf course landscape is the first step in assessing potential water quality issues. Areas to identify first are the environmentally sensitive areas such as wetlands, surface water bodies and shorelines, steep slopes to surface water, and areas with shallow depth to ground water or that are located in a critical groundwater recharge zone (especially true for Long Island, due to its sandy soils). In addition, identify relevant geological characteristics such as karst topography, which leaves groundwater vulnerable to contamination.

On golf courses, point sources of pollution should be identified as priority areas for water quality protection. Specifically, these point sources can originate from storage and maintenance facilities and as the unintended release of chemicals, such as pesticides, fertilizers, or fuel, during transportation, storage, handling or cleaning of mowers and pesticide application equipment. Containment measures can easily prevent chemicals from becoming point sources of pollution, as described in Chapter 10.

The goal of the site assessment process is to identify priority areas, beginning with determining the following:

- the golf course's position relative to its position in the watershed

- drainage basins
- environmentally and ecologically sensitive areas
- management zone boundaries

Watershed drainage basins. Drainage basins on the property should be identified on both topographic maps and routing plans. Identifying drainage basins also helps to determine the approximate area of greens, tees, fairways, and roughs in each drainage basin.

Environmentally sensitive areas. Environmentally sensitive areas are those areas with natural resources susceptible to changes that can alter ecosystem structure or function (such as wetlands), or areas that might be home to an endangered, threatened, rare species, or species of special concern. Information on the presence of endangered species can be obtained from New York's Natural Heritage Program (see http://www.dec.ny.gov/animals/31181.html).

One of the objectives of BMPs is to provide the necessary protection for these environmentally sensitive areas by design and operation of the golf course and maintenance facilities. Superintendents can protect these areas through BMPs, careful selection of pesticides and fertilizers, restrictions on the use of certain materials in sensitive areas (for instance, "no spray" zones), and proper construction. These practices minimize the potential for point and nonpoint source pollutant input to sensitive areas within the management zones at the course.

Management zones. In order to manage a golf course in an environmentally sensitive and responsible manner, establish management zones throughout the course. Management zones are defined as areas that have distinct management practices based on the area's position in the watershed and the drainage basin analysis conducted for the watershed. Management zones work hand-in-hand with BMPs and IPM. Management zones include the following:

Management Zone A: These zones may or may not be part of the playable area AND are considered to be of the highest risk for water quality issues. Therefore, any management of these areas should be focused on minimizing any chemical use, preventing direct discharge into water bodies, and maximizing resident time for water moving along the surface in this zone.

Management Zone B: These zones are part of the playable area and therefore require an increased level of maintenance, but pose significantly less risk than in Zone A. Additionally, when wind speed is greater than 10 mph, a shroud should be used on spray equipment to avoid drift. Therefore, management of these areas should allow for additional chemical use while still minimizing the potential for movement into surface or groundwater.

Management zones should be clearly marked on course maps and the maintenance crew should be familiar with these areas. The use of GPS/GIS systems for precision mapping of these zones and identifying boundary locations can assist the crew in following the management zone guidelines.

4.2 The Broader Golf Course Landscape

Adjacent ecosystems form complex and diverse mosaics on the landscape. Forests, wetlands, bottomland hardwoods, agricultural fields, streams, rivers, and lakes, combine to form biologically diverse and ecologically complex watersheds.

When designing and managing golf courses as ecosystems, do not override or alter natural processes, but rather work to maintain naturally occurring processes. For example, chemical cycling is constantly occurring and it is a key to ecosystem stability. Losses of essential elements are controlled by complex feedback loops involving plants, animals, soil microorganisms, decaying litter, and soils. Natural ecosystems function because of their complexity, which builds stability in these systems.

Chemicals can have an important part impact on the ecosystem. Ecosystems use energy to assimilate chemicals into new biological structures, decompose dead materials, and recycle mineral nutrients. Introduction of chemicals such as pesticides into the system need not upset the natural balance. However, golf courses must be careful not to override the natural cycling processes or to introduce toxic materials where they can harm organisms or ecologically sensitive areas. The best approach is to avoid or minimize problems by using BMPs. These practices may include the sensible use of pesticides, emphasizing localized applications that act quickly and effectively without any appreciable impact on the natural system.

4.3 Water Quality Protection Systems

Using BMPs and management zones, turfgrass management can coexist in harmony with nature. The quantity and quality of water generated within the property boundaries can be protected by appropriate watershed controls and management practices. Because water is the primary movement mechanism for contaminants, protection of water resources also provides protection for sensitive areas and species. Surface water is the focus of watershed protection because recent research on the environmental impact of nutrients and pesticides applied to golf courses has indicated that for the majority of the acreage under turf management, surface runoff is a much greater concern than leaching. While leaching of certain materials does occur at low levels and under specific environmental and climatic conditions, more materials are transported in surface runoff than through leaching (Baris, R.D. et al. 2010). However, certain areas of New York have a history of groundwater contamination problems.

Preventive measures must be in place to keep potential contaminants from entering surface waters. The building blocks of water quality protection include preventive measures (source prevention) or nonstructural practices that minimize or prevent the generation of runoff and the contamination of runoff by pollutants. Structural controls that are part of the design and engineering of the course are capital improvements designed to remove, filter, detain, or reroute potential contaminants carried in surface water. The most effective way to manage surface water is by using a comprehensive systems approach that includes integration of preventive practices and structural controls (Eaker 1994).

This comprehensive systems approach, which should be used throughout the golf course property, should stress optimum site planning and the use of natural drainage systems. Livingston and McCarron (1991) suggest that a stormwater management system might be considered as a “Best Management Practices (BMP) Train” in which the individual BMPs are considered the cars. In most cases, the more BMPs incorporated into the system, the better the performance of the treatment train. The first cars might include BMPs to minimize generation of runoff (for example, irrigation management) and pollutants (such as IPM) and the final car could include a retention pond.

4.3.1 Preventive Strategies

At any golf course, preventive strategies should include combinations of land use controls and source prevention practices. An integrated water quality protection system is based on a tiered concept as follows:

- prevention - prevent problems from occurring
- control - have safeguards in place to control any problems
- detection - consider a monitoring program to detect changes in environmental quality

Preventive measures are categorized as either land use BMPs or source prevention BMPs. Land use BMPs are engineered and incorporated into the course during golf course design and construction. Land use BMPs protect natural resources through primarily mechanical methods, as described in the remainder of this chapter. Source prevention BMPs are implemented during golf course operation to prevent or preclude the possibility of movement of sediment, nutrients, or pesticides from the property or from toxic materials being introduced into ecologically sensitive areas. Source prevention BMPs include the use of management zones as described in Section 4.1 and IPM strategies, as described in the later chapters.

Land use BMPs are incorporated during design for construction activities that affect drainage, surface water, sedimentation and erosion control, and ecologically sensitive areas. Examples of land use control BMPs include

- settling and filtering processes for removing sediment and pollutants that are bound to sediment particles associated with surface runoff
- subsurface drainage, infiltration, and use of land absorption areas (vegetated filter strips) to detain water, allow it to be filtered prior to groundwater recharge
- grassed waterways or outlets
- critical area planting to stabilize highly erodible areas

Other land use BMPs are structural, such as quality basins, infiltration basins, and catch basins that detain water to reduce runoff quantity and nutrient and pesticide discharge.

4.3.1.1 Vegetative Practices

Vegetative Filtration. Common examples of vegetative filters that can be used throughout the golf course are conservation areas or buffers, land absorption areas (vegetated filter strips) and swales (diversions, berms). Vegetative filters act as natural biofilters to reduce storm water flow and pollutant load, and turf areas are effective filters.

Turf uses the natural processes of infiltration, filtration, and biological uptake to reduce flows and pollutant loadings. Vegetated filter strips remove sediment and attached chemicals, organic material, trace metals, and nutrients (nitrogen and phosphorus). Sediment removal rates are generally greater than 70% and nutrient removal is typically greater than 50%.

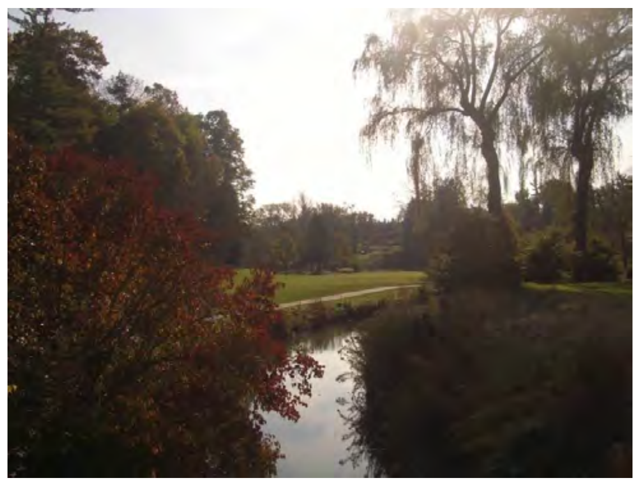
Maintenance of vegetative filters requires management to achieve dense, hearty vegetation. Where changes in vegetative cover must be made, these changes are normally established in low maintenance ground covers. This practice may include the use of native or naturalized plants, including low maintenance turfgrasses. When turf is used as the filtration medium, cultural activities should focus on producing healthy turf with a minimum of maintenance activities.

Turf should be allowed to grow to the highest end of the optimum range for more effective filtration. Fertilizers and pesticides are usually not applied in these areas except sparingly (sometimes during establishment to reduce erosion and runoff problems much faster) or after a risk assessment has determined that application of certain materials will have no impact in adjacent areas. Establishing these buffers reduces erosion and sediment loss decreases. Buffers also protect surface waters by attenuating pollutants in surface runoff.

Soil surface runoff may also be moderated, reducing the impact on receiving water bodies and streams. The greatest benefit is the protection of adjacent ecologically sensitive areas—potential pollutants are simply not introduced, or are introduced on a limited basis compared to more highly maintained turf areas. Figure 4-1 shows several examples of vegetated buffers.

Conservation Areas or Buffers. These are areas where it is critical to establish and maintain perennial vegetative cover to protect resources. The most sensitive portions of watercourses are the areas immediately adjacent to the water. Disturbance within and adjacent to watercourses can degrade water quality by increasing the availability and transport of pollutants. Therefore, retaining vegetated buffers along watercourses is one of the most effective practices used to protect water quality and should be designed to handle the anticipated runoff. If the area is a state or locally designated wetland, a buffer may be required and the width of the buffer specified by the regulating authority.

Critical Area Planting. Planting vegetation on highly erodible or critically eroding areas also protects water quality. The greatest amount of soil erosion and sediment delivery to surface waters occurs when large areas are graded during the construction phase, which requires phased construction to minimize the amount of bare land. Quickly establishing vegetation reduces the movement of materials in runoff, as plants take nutrients in the soil and reduce the amount that can be washed into surface waters or leach into groundwater, as well as trap particulates.



Sodding is an important consideration in these areas since it provides instant ground cover and rooting can occur rapidly for permanent establishment. In certain instances, strip sodding rather than solid sodding can be used if the slopes are not too steep and the strips are wide enough to adequately handle the sediment carried in the runoff. However, sod production systems that use inputs can potentially contribute to water quality issues after installation; pesticides have been found in groundwater monitoring wells on very sandy sites following sodding.

Grassed Swales or Berms or Diversions. Channels constructed across a slope with a supporting ridge on the lower side are another effective control. These channels stabilize a runoff area and reduce sheet and rill erosion by reducing the length of slope. These measures also eliminate vertical channeling and large gullies, which reduces the amount of sediment and related pollutants delivered to the surface waters.

Berms direct water into specific areas to allow vertical filtration rather than allowing surface runoff. Vegetated swales are used to permit filtering and infiltration of storm water. The grasses for these swales should be water tolerant and erosion resistant (rapid germination and establishment to form dense sod). These types of swales are used on gentle slopes where slower velocities enhance the filtering and infiltration processes.

Swales are also effective in routing water to maximize contact time of water and vegetation. An example in which swales are helpful is the routing of water from the underdrains of greens. Filtration can be greatly increased by carefully choosing the route of water from the underdrain. If space is limited, drainage water could be directed to flow along a path that maximizes the distance of contact with vegetation, rather than choosing the shortest route to the lowest elevation. The effectiveness of swales in reducing flows and pollutants is similar to that of filter strips.

Vegetated Filter Strips. Filter strips are manmade or naturally occurring flat areas established at the perimeter of disturbed or impervious areas to intercept runoff as sheet flow and remove particulate matter and contaminants. Either grassed or wooded areas can function as filter strips.

Grassed Waterways. These natural or constructed channels are shaped, graded, and planted to ensure the stable flow of runoff. This practice reduces erosion in a concentrated flow area, such as in a gully or in ephemeral gullies, and reduces sediment and substances delivered to receiving waters. Vegetation may also filter some of the sediment delivered to the waterway; however, filtration is a secondary function of a grassed waterway.

Any chemicals applied to the waterway in treating the adjacent areas may wash directly into the surface waters when runoff occurs shortly after spraying. If standing water is present, applications of fertilizer or pesticides should also be avoided.

Turfgrass used as a Vegetative Filter. One of the most effective BMPs for protection of surface water is use of turf as a vegetative filter in swales and filter strips. Turfgrass areas are extremely effective in reducing soil losses compared to other cropping systems. In a comparison of soil loss from conventional agriculture with soil loss from turf, measured soil loss from tobacco production (4210 lbs/acre) was 842 times higher than from turf areas (5 lbs/acre), even with a slope of 16% on a silt loam soil.

Where polluted runoff from agricultural areas has occurred, establishment of turf buffer strips of only 15 feet have been shown to improve water quality. Studies at Oklahoma State University have shown that turfgrass buffers of 16 ft effectively reduce concentrations of chemicals in runoff. Other studies noted that in cases where water quality has declined due to agricultural practices that lead to loss of nutrients and erosion, grass buffer strips placed between treated fields and surface waters significantly reduce the problem (Cole et al 1997). This result is related to the architecture of the turf canopy, the fibrous turf root system, and the development of a vast macropore soil structural system that encourages infiltration rather than runoff.

Figure 4-1. Grasses filter strips discharging into water filtration basins. ***Source*****: Robert Alonzi.**

Turf density, leaf texture, rooting strength, and canopy height physically restrain soil erosion and sediment loss by dissipating impact energy from rain and irrigation water droplets. These turf features also provide resistance to surface movement of water over turf. Additionally, turfgrasses have an extensive fibrous root system, with 80% of the root mass found in the upper 4 inches of the soil profile. The combination of turf canopy and root mass has a strong soil stabilizing effect.

4.3.1.2 Structural BMPs

Structural BMPs include water quality basins, infiltration basins, and catch basins to regulate or impound runoff. These structures detain and filter water through plant material prior to discharge and can reduce runoff quantity as well as nutrient and pesticide discharge. See Appendix D for renderings of structural BMPs.

Subsurface Drainage. Subsurface drainage directs drainage water and can reduce runoff and leaching. Subsurface drainage is also installed to control a water table or to interrupt subsurface seepage or flow. Where possible, directing this drainage into vegetative areas for biological filtration or infiltration basins helps to control the potential loss of nutrients and pesticides from the golf course, rather than directly draining it into surface water.

Water Quality Basins. These basins are designed to capture the "first flush" runoff and provide water quality treatment primarily through physical settling of sediment-based pollutants. These basins can be constructed by excavation or embankment (or both) to create a ponding area sufficient to handle the required water quality volumes. Planting wetland species in the bottoms of these basins achieves additional quality control through biological filtering and uptake. The discharge system for basins can include a gravel underdrain layer with a small diameter perforated drainage pipe to slow dissipation of runoff over an extended period. Gravel underdrains without an outlet can also provide a measure of infiltration and groundwater recharge where appropriate. Finally, higher intensity storms can be routed through water quality basins for proper flood control and flow attenuation.

Wet Ponds. These ponds are earthen embankments or a combination ridge and channel generally constructed across the slope and minor watercourses to form a sediment trap and water retention basin. Wet ponds are one of the most effective structural BMPs for protecting water quality. Wet ponds at the golf course use a permanent water surface to achieve a high removal rate for sediment, nutrients, and metals. Aquatic plants and biochemical processes within the ponds enhance the removal of nutrients, metals and other pollutants. Secondary benefits include recreation, aesthetics, and wildlife habitat.

Pollutant removal efficiencies of wet ponds vary based on the pollutant of concern and the size of the permanent pool. The highest removal efficiencies are achieved in larger ponds at the golf course, where the ratio of basin volume to the volume of runoff from the average storm is greatest. Wet ponds are also effective in reducing peak discharges, downstream flooding, and stream bank erosion at the golf course.

This feature traps and removes sediment and sediment-attached substances from runoff. Trap control efficiencies for sediment and total phosphorus transported by runoff may exceed 90% in silt loam soils. Dissolved substances, such as nitrates, may be removed from discharge to downstream areas because of the increased infiltration. Where geologic conditions permit, the practice leads to increased loadings of dissolved substances toward groundwater. Water temperatures of surface runoff, released through underground outlets, may increase slightly because of longer exposure to warming surfaces during its impoundment.

Infiltration Controls. Infiltration controls are a general category of structural BMPs that maintain or enhance the ability of water to percolate through the soil profile. Infiltration generally improves water quality by allowing natural physical, chemical, and biological processes to remove pollutants. Pollutant removal in an artificial media or natural soil profile occurs through filtration, absorption, and oxidation by soil microorganisms.

Catch Basins. Catch basins are used primarily as a pretreatment device for the removal of coarse grit, sand, and debris. This pretreatment extends the life and performance of the other BMPs. From the catch basins, runoff is conveyed to the other water quality BMPs.

Wetland and Riparian Zone Protection. Wetlands and riparian areas are often continuums along rivers, streams, and coastal waters and are particularly sensitive to landscape changes and fragmentation. These areas play a critical role in attenuating nonpoint source pollution by intercepting runoff, subsurface flow, and certain groundwater flows and then removing, transforming, and storing pollutants (such as sediment, nitrogen, phosphorus, and certain heavy metals). In addition, they provide aquatic habitat, stream shading, flood attenuation, shoreline stabilization, and groundwater recharge. Wetlands and riparian areas are often highly regulated by the state and local regulatory authorities.

Constructed Wetlands. Constructed aquatic ecosystems features poorly drained soils and rooted emergent hydrophytes, which simulate the role of natural wetlands in water purification. These structures efficiently remove certain pollutants (nitrogen, phosphorus, metals, sediment, and other suspended solids) and can treat wastewater, such as discharges from equipment wash pads. Once these areas are constructed, however, they are considered wetlands and regulated as such.

4.3.2 Effectiveness of BMPs

The effectiveness of pollutant removal by land use BMPs is a function of the following:

- physical, chemical, and biological processes
- the fraction of runoff treated by the BMP
- the nature of the pollutant being removed

Thus, an effective BMP train is one that treats 100% of runoff by physical, chemical, and biological processes. Table 4-1 shows relative removal efficiencies of infiltration basins, vegetated filter strips, grass swales, wet ponds, and storm water wetlands for five variables (total suspended solids, total phosphorus, total nitrogen, pesticides, and chemical oxygen demand). By including as many removal mechanisms as possible, the probability of success for removal of a particular pollutant is increased. These factors should be considered as follows:

1. BMPs that use settling and filtering processes are relatively effective at removing sediment and pollutants that are bound to sediment particles.
2. Turf buffers are very effective filters that allow drainage of water from the course and, at the same time, effective filtering to improve water quality.
3. Turf density, leaf texture, and canopy height are physical factors that restrain soil erosion and sediment loss by dissipating impact energy from rain and irrigation water droplets providing a resistance to surface movement of water over turf.
4. Ponds and infiltration BMPs can achieve 60 to 100% removal efficiencies for sediment.
5. Infiltration BMPs are capable of similar removal efficiencies for sediment, but are subject to clogging if sediment inputs are excessive.
6. Wet ponds and extended-detention ponds with shallow marshes have a moderate to high capability for removing both soluble and particulate pollutants because they use settling and biological uptake and degradation of pesticides.

Table 4-1. Stormwater pollutant removal efficiencies, urban BMP designs (Sources: Schueler 1987 and NYSDEC, 1993)

BMP/Design	TSS*	TP	TN	Zn	Pb	BOD
Extended Detention Pond						
"First flush" runoff volume produced by 1.0 inch storm, detained for 24 hours	75%	50%	35%	55%	55%	40%
Runoff volume produced by 1.0 inch storm detained for 24 hours or more with shallow marsh added in bottom stages	80%	70%	55%	75%	75%	50%
Wet Pond						
Permanent pool equal to 0.5 inch of runoff per watershed acre	55%	35%	25%	25%	45%	25%
Permanent pool equal to 2.5 times the volume of runoff from the mean storm (0.5 inch)	75%	55%	40%	40%	70%	40%
Water Quality Basin						
Infiltration basin which exfiltrates "first flush" of 0.5 inch runoff/ impervious acre	70%	50%	50%	50%	50%	70%
Filter Strip						
25 to 50 foot turf strip	40%	20%	20%	40%	40%	20%
100 foot wooded strip	90%	50%	50%	90%	90%	70%
25 to 50 foot wooded strip	80%	40%	40%	80%	80%	60%
Grassed Swale						
High slopes with check dams	20%	20%	20%	10%	10%	20%
Low gradient	30%	30%	30%	20%	20%	30%
*TSS= Total Suspended Solids; TP=Total Phosphorus; TN= Total Nitrogen; Zn=Zinc; Pb=Lead; BOD=Biological Oxygen Demand						

4.3.3 Maintenance of Structural BMPs

Periodic long-term inspection and maintenance of the structural BMPs are essential to ensure that they function as designed. The superintendent and maintenance crews should be responsible for the inspection and maintenance of the BMPs for the golf course. Best practices for maintenance of these structures are described below.

4.3.3.1 Water Quality Basins

Inspections: Ponds should be inspected on a regular basis to ensure that the structure operates as designed. When possible, inspections should be conducted during wet weather to determine if the pond is meeting the targeted detention times and include checking:

- any evidence of subsidence, erosion, cracking or tree growth on the embankment
- condition of the emergency spillway
- accumulation of sediment around the riser
- adequacy of upstream/downstream channel erosion control measure
- erosion of the pond's bed and banks
- modifications to the pond or its contributing watershed that may influence pond performance

Inspections should be carried out with as-built pond plans in hand (Schueler 1987). Repairs should be made when the need for them is observed.

Mowing. The upper stage, side slopes, embankment, and emergency spillway of an extended detention dry pond must be mowed at least twice a year to discourage woody growth and control weeds. The use of water-tolerant, hardy, and slow-growing native or introduced grasses is recommended.

Debris and Litter Removal. Debris and litter should be removed during regular mowing operations.

Erosion Control. The pond side-slopes, emergency spillway and embankment may periodically suffer from slumping and erosion and require regarding and re-vegetation. However, slumping and erosion should not occur often if the soils are properly compacted during construction.

Sediment Removal. If properly designed, significant quantities of sediment can accumulate in the detention pond. This sediment should be removed periodically in order to preserve the available stormwater management capacity and to prevent the outlet or filter medium from becoming clogged. In addition, accumulated sediment may become unsightly. While more frequent sediment removal may be needed around outlet control structures, the lower stage of a detention pond should be cleaned manually typically every 5 to 10 years.

4.3.3.2 Grassed Swales

Swale maintenance keeps the grass cover dense and vigorous through periodic mowing, occasional spot re-seeding, and weed control. Watering may also be necessary during a drought, particularly in the first few months after establishment. In addition, excessive sediment buildup behind check dams should be removed as necessary.

4.3.3.3 Vegetative Filter Strips

The maintenance required for a filter strip depends on whether or not natural vegetative succession is allowed to proceed. Maintenance tasks and costs are both sharply reduced for "natural" filter strips. However, corrective maintenance is still needed around the edge of the strip to prevent concentrated flows from forming.

Shorter filter strips must be managed as a lawn or short grass meadow and therefore should be mowed at least two or three times a year to suppress weeds and interrupt natural succession. Periodic spot repairs, watering, and fertilization may be required to maintain a dense, vigorous growth. Accumulated sediments deposited near the top of the strip need to be manually removed over time to keep the original grade.

All filter strips should be inspected on an annual basis. Strips should be examined for damage by foot or vehicle traffic, encroachment, gully erosion, density of vegetation, and evidence of concentrated flows through or around the strip. Extra watering, fertilization, and re-seeding is also usually needed in the first few months and years to make sure the strip becomes adequately established (Schueler, 1987).

4.3.3.4 Catch Basins

Catch basins should be cleaned out at least twice a year. Inlet structures usually are cleaned out with a vacuum pump. The resulting slurry of water, sediment, and other contaminants can be transported to a treatment plant or approved landfill for disposal. An alternative disposal method involves carefully siphoning out each chamber without creating a slurry and allowing it to infiltrate over a nearby grass area. The remaining grit and sediment can be removed and trucked to a landfill for final disposal. Maintenance records and clean-out schedules should be kept as part of the maintenance process.

4.3.3.5 Dry Wells

Dry wells rapidly take excess surface water and transport it to the subsoil that recharges groundwater. In areas where groundwater contamination is a problem, such as sandy areas of Long Island, the use of dry wells should be discouraged. Dry wells bypass the biofiltering capacity of the surface turf ecosystem and thus can inadvertently allow nutrients and pesticides to potentially contaminate groundwater. If they are used, the dry wells should be covered when fertilizers and pesticides are applied to prevent direct contamination of the dry wells. Applications of fertilizers and pesticide should also be avoided during wet periods when the dry wells are collecting water to prevent groundwater contamination.

Preventive Maintenance. Maintenance of infiltration facilities ensures their continued effectiveness. Preventive maintenance practices identify areas of erosion in the contributory drainage and stabilize those areas. For example, if suspended solids are not identified and removed, void areas in the stone reservoir of an infiltration trench may become clogged.

Inspections. Logs should be maintained for each BMP structure, recording the rate of de-watering after large storms and the depth of sediment buildup in the well for each observation. Once the performance characteristics of the structure have been verified, the monitoring schedule can be reduced to an annual basis unless the performance data indicate that a more frequent schedule is required.

BMP Statements

- Properly assess maintenance sites and golf course for priority areas related to water quality protection.
- Determine most effective structural or vegetative BMP strategy, if needed.
- Assess effectiveness of implemented BMP strategy.

5 IRRIGATION

Water is a fundamental element for physiological processes in turf such as photosynthesis, transpiration, and cooling, as well as for the diffusion and transport of nutrients. Golf turf quality and performance depend on an adequate supply of water through either precipitation or supplemental irrigation. Too little water induces drought stress and weakens the plant, while too much causes anaerobic conditions that stunt plant growth and promote disease. Excessive water can also lead to runoff or leaching of nutrients and pesticides into groundwater and surface water.

Precise water management is arguably the single most important turf practice for maintaining high quality golf turf. When the amount of water lost from the turf system by evapotranspiration (ET) exceeds amount supplied by rainfall, the turf must be irrigated. Courses should maximize water use efficiency through proper irrigation, as this conserves water and decreases the likelihood of water quality impacts from runoff or leaching. Deliberate use includes using an efficient irrigation system and ensuring the system's proper function, using only the amount of irrigation water needed to maintain healthy turf in playing areas, and incorporating cultural practices that increase the water holding capacity of soil.

5.1 Irrigation Water Supply

5.1.1 Irrigation Water Sources

Irrigation water can come from several sources:

- surface water from ponds, lakes, or stormwater detention ponds
- groundwater from wells
- recycled water sources
- any combined supplemental sources from rainwater and stormwater collection

Regardless of the source, irrigation water must be dependable, reliable, and of sufficient quantity and quality to accommodate turf grow-in needs and ongoing maintenance.

In the northeast, irrigating with recycled water may become more common as the cost of water increases and availability of fresh water decreases, especially in large metropolitan areas. Recycled water is defined as any water that has been treated after human use and is suitable for limited reuse, including irrigation; this water is also referred to by other names such as reclaimed water, wastewater, and effluent water. Using recycled water may also be part of a nutrient reduction strategy to meet TMDLs in impaired watersheds.

For more information on the use of recycled water on golf courses, see:

- Appendix E, *Guidelines for Using Recycled Wastewater for Golf Course Irrigation in the Northeast*
- Environmental Institute for Golf, "Using recycled water on golf courses" http://www.stma.org/sites/stma/files/pdfs/gcsaa_recyledwater_leaflet-1.pdf

5.1.2 Irrigation Water Quality

Water quality used for irrigation turf on golf courses must be suitable for plant growth and pose no threat to public health. Nonpotable water irrigation sources (such as recycled water or storage and detention ponds) should be tested regularly to ensure that the quality is within acceptable limits to protect soil quality and turfgrass performance. In addition, wells along the shore that supply potable water might need to be tested for salt water intrusion. Summarized below is a brief description of water quality parameters of greatest interest for irrigation water (nutrients and salinity issues); additional parameters such as pH and micronutrients may be valuable for detailed evaluations of water quality.

For more information on irrigation water quality, see:

- "Understanding Water Quality and Guidelines to Management" http://gsr.lib.msu.edu/2000s/2000/000914.pdf
- "Irrigation Water Quality Guidelines for Turfgrass Sites" at http://plantscience.psu.edu/research/centers/turf/extension/factsheets/water-quality

5.1.2.1 Nutrients

Irrigation water may contain macronutrients, including phosphorus and nitrogen, as well as other nutrients that should be accounted for in nutrient management programs to avoid over fertilization. Irrigation water, especially reclaimed, recycled, or effluent water, should be tested frequently. Excess nutrients may accumulate to levels that are toxic to plants, potentially influencing aquatic plant growth in rivers, lakes, and estuaries and contribute to a variety of soil- related problems. For example, irrigation water high in sodium and low in calcium and magnesium applied frequently to clay soils can break down soil structure, cause precipitation of organic matter, and reduce permeability. Table 5-1 presents the potential for problems at various nutrient levels in irrigation water. Conversion factors and an example for calculating pounds nutrient per acre-foot of irrigation water are provided in Appendix F.

5.1.2.2 Salinity

Recycled waters usually contain higher amounts of dissolved salts than other irrigation water sources within a specific geographic region (Harivandi 2007). Water quality analyses may report salinity using a number of parameters (Appendix E). Dissolved salts in recycled water tend to reduce the number of cation exchange sites, reducing the nutrient holding capacity of the soil. Deflocculation causes the breakdown of clayey soils and reduces the porosity of the soil. Accumulations of salt in the soil are also phytotoxic.

Table 5-1. Summary of Irrigation Water Quality Guidelines. Source: Duncan, R. R., Carrow, R. N., & Huck, M. T. (2009).

Water Parameter	Units	Desired Range	Usual Range	Average Domestic	Average Reclaimed
General Water Characteristics					
pH	1-14	6.5-8.4	6.0-8.5	7.7	7.1
Hardness	mg/L	<150	---	---	---
Alkalinity	mg/L	<150	---	---	---
Bicarbonates ($HC0_3$)	mg/L	<120	<610	174	194
Carbonates ($C0_3$)	mg/L	<15	<3	3.0	0
Total Salinity					
ECw	dS/m	0.40-1.20	<3.0	0.8	1.1
TDS	mg/L	256-832	<2000	617	729
Sodium Permeability Hazard					
SARw	meq/L	<6.0	<15	1.9	3.1
RSC	meq/L	<1.25	---	-2.3	-1.88
ECw	dS/m	>0.40	---	---	---
Specific Ion Impact on Root Injury of Foliar Uptake Injury					
Na	mg/L	<70	---	---	---
Cl	mg/L	<70	---	---	---
B	mg/L	<0.50	<2.0	0.17	0.44
Specific Ion Impact on Direct Foliar Injury					
Na	mg/L	<70	---	---	---
Cl	mg/L	<100	---	---	---
$HC0_3$	mg/L	<90	---	---	---
Selected Nutrients/Elements					
N	mg/L	<10	<2.2	---	---
P	mg/L	<0.1	<0.66	---	---
K	mg/L	<20	<2.0	4.0	26
Ca	mg/L	<100	<400	67	64
Mg	mg/L	<40	<60	24	23
SO_4	mg/L	<90	<960	171	196
Fe	mg/L	<1.00	---	0.16	0.20
Mn	mg/L	<0.20	---	0.01	0.03
Cu	mg/L	<0.20	---	0.04	0.03
Zn	mg/L	<1.0	---	.012	0.08
Na	mg/L	<120	<920	70	114
Cl	mg/L	<70	<1062	82	130

Considerations for irrigation water with higher concentrations of salts (total dissolved salts (TDS) > 500) include irrigation duration and frequency, drainage, and turfgrass species selection. Generally, if the amount of water applied to soil (irrigation and precipitation), exceeds ET, salt movement is downward through the soil profile. Conversely, salts move upward in soils if ET exceeds the amount of water in precipitation or irrigation applied to soil. In the latter case, salt drawn to the soil surface gradually accumulates to levels that are toxic to plants (electrical conductivity (EC) > 3 ds/m). This basic process combined with the type of grass grown determines how severe the problem can potentially become and whether it will ultimately affect the playing quality of the turf. Perennial ryegrass and tall fescue are relatively tolerant to salinity compared to annual bluegrass, bentgrass, and Kentucky bluegrass (Table 5-2).

Precipitation levels in New York State are generally great enough to naturally flush soils, thereby controlling salinity levels in soils. If precipitation is not enough to flush soils, leaching fractions can be used to calculate the amount of water needed to flush the soil of salts. The formula for calculating the leaching requirement (LR) is as follows:

$$\text{LR} = \frac{EC_w}{5(EC_e) - EC_w}$$

where:

EC_w = Electrical Conductivity of Water
EC_e = Salt Tolerance of Turfgrass Species

Table 5-2. Relative salt tolerance of turf species in NYS. Source: Harivandi 2011.

Sensitive (<3 dS/m)	Moderately Sensitive (3-6 dS/m)	Moderately Tolerant (6-10 dS/m)	Tolerant (>10 dS/m)
Annual Bluegrass	Annual Ryegrass	Perennial Ryegrass	None in NYS
Colonial Bentgrass	Creeping Bentgrass	Tall Fescue	
Hard Fescue	Slender Creeping, Red, and Chewings Fescues		
Kentucky Bluegrass			

The sodium (Na) concentration and the quantity of other salts in the irrigation water can affect the permeability (the ability of water to infiltrate into the soil and move through the profile) in clay soil. When irrigation water has Na levels > 200 mg L^{-1} , Na may build up over time and affect permeability. Calcium, which is important to soil structure stability, is displaced by sodium, which in turn causes the soil structure to break down, and results in reduced water and oxygen infiltration and percolation. This problem can become a more serious problem on fine-texture clayey soils than sand-based systems (see Table E in Appendix E).

Residual sodium carbonate (RSC) values are used to assess the sodium permeability hazard. RSC is a measure of the influence of bicarbonates and carbonates as compared to the calcium and magnesium concentration. The total salt content of the water (EC) and the sodium adsorption ratio (SAR) must be considered together when determining irrigation water restrictions due to the sodium permeability hazard (Table 5-3). RSC levels below 1.25 meq/L are safe to use for irrigation.

Table 5-3. Irrigation water restrictions related to soil water infiltration. Source Harivandi 2011.

SAR	None	Slight to Moderate	Severe
	EC (mmhos/cm)		
0-3	>0.7	0.7-0.2	<0.2
3-6	>1.2	1.2-0.3	<0.3
6-12	>1.9	1.9-0.5	<0.5
12-20	>2.9	2.9-1.3	<1.3
20-40	>5.0	5.0-2.9	<2.9

5.1.3 Irrigation Water Requirements

Seasonal and bulk water requirement analysis can be conducted to determine water requirements. The seasonal bulk water requirement analysis verifies the suitability of a water source and irrigation system to supply irrigation water under normal conditions. The maximum seasonal bulk water requirement analysis is a worst-case scenario estimate to simulate extended drought conditions, calculated by not allowing for effective rainfall. The National Climate Data Center (NCDC) provides historical climate data as far back as 1895 as well as statistics on precipitation across ten regions in New York. The NCDC uses Palmer Indices, which summarize data for precipitation, evapotranspiration, and runoff, which can be used to calculate the average number of weeks in a statistical year with a water deficit, the average values of the deficits, and the peak evapotranspiration losses assuming no precipitation. For more information, see:

- NCDC data: http://www.ncdc.noaa.gov/
- Calculating water requirements: Chapter 3, "Environmental Best Management Practices for Virginia's Golf Courses" at http://www.vgcsa.org/BMPs.

5.1.4 Water Withdrawal

NYSDEC requires water withdrawal reporting for any system capable of withdrawing more than 100,000 gallons groundwater or surface water per day. In accordance with the recently enacted water quality standard for flow, any withdrawal must also ensure that the existing best use of the waterbody from which the water is taken, such as protection of aquatic life, is not impaired.

For more information on water withdrawal reporting and regulations in New York, see: http://www.dec.ny.gov/lands/55509.html.

5.2 Irrigation System Design and Performance

5.2.1 Design

Irrigation systems should be designed to be efficient, distribute water uniformly, conserve and protect water resources, meet state and local code, and meet site requirements. Site specific characteristics and incorporation of water conservation practices and technologies should be evaluated in the design. The Irrigation Association lists 25 design-oriented BMPs. Figure 5-1 includes several examples of irrigation site-specific designs to conserve water.

Figure 5-1. Irrigation site-specific designs and technologies help to conserve water. ***Source*: Frank Rossi.**

5.2.1.1 Site Considerations

The design and operation of an irrigation system must be tailored to conditions on the course. Planning should account for different soil types, areas of irrigation, and turf species. Soil conditions dictate how much water is needed to complete deep and infrequent cycles to replenish water in the root zone. The areas of irrigation may also vary in their water requirements depending on site characteristics such as aspect to the sun, hill slopes, and degree of shade. For example, wind-exposed areas have greater transpiration losses than sheltered areas and therefore greater water requirements.

5.2.1.2 Infrastructure

Infrastructure design considerations include sprinkler and piping placement, sprinkler coverage and spacing, and communication options and serviceability. An irrigation system must be designed to match peak demand. The capacity to deliver more water in a short interval of time can be increased up to, but not exceeding, the infiltration rates of the soils. Any increase beyond the infiltration rate results in runoff.

The type of system used for irrigation influences the efficiency and effectiveness of water usage. Single head systems irrigate the areas closest to the head more than areas farther out. The difference in distribution uniformity presents a serious problem, as achieving planned water replacement on the outer reaches of the head results in excess water being applied in the middle and increases the risk of runoff. Double-row systems offer an improved efficiency over single-row coverage, although manual watering or other types of supplemental watering may be needed outside the fairway area and into the extended rough. Multi-row sprinkler systems provide the best method to control and conserve water, with the ability to respond to specific moisture requirements of a given fairway area. In addition, newer designs are available with multiple nozzle configurations, back and front, that provide the flexibility to more precisely size the system and improve distribution uniformity.

Advanced irrigation control systems are recommended when possible because they provide precision irrigation control. These systems provide specific schedules for each green, tee, and fairway and allow course managers to make adjustments for differences in microclimates and root zones. Weather stations can be integrated to calculate and automatically program water replacement schedules. Additional features may include rain stop safety switches that either shut down the system in the event of rain or adjust schedules based on the amount of precipitation. Advanced systems can connect soil moisture meters, temperatures gauges, and salinity probes installed on the course.

5.2.2 Performance

Properly working systems are necessary for efficient irrigation. Irrigation audits can be conducted to assess the system function, ensuring that the irrigation system works reliably and cost effectively. The Irrigation Association has published irrigation audit guidelines (http://www.irrigation.org/Resources/Audit_Guidelines.aspx). The following are common measures of system performance used in irrigation audits:

Figure 5-2. Regular irrigation system maintenance helps to conserve water. ***Source:*** **Frank Rossi.**

Coefficient of Uniformity (CU). CU measures system performance by how widely a system varies in distribution. A CU of 100% means that a system is uniform. A CU of 84% or better is considered acceptable for high value products.

Because the CU is calculated with the absolute value of the deviations, the score does not indicate whether the system is over- or under-watering. In addition, the score does not indicate what section of the area tested is not performing.

Distribution Uniformity of the Lowest Quartile (DULQ). The most commonly used calculation to determine uniformity of a sprinkler layout, DULQ is the ratio of the average measurements in the lowest 25% of samples to the overall average of all samples expressed as a percentage. For example, a DULQ of 60% means that the lowest 25% of the samples measured only received 60% of the average water applied. Some resources suggest that a DULQ of 65% or less is poor, 75% is good, and 85% or more is excellent.

Scheduling Coefficient (SC): measures the average water applied to the driest, most critical areas of an area under test and compares to the average. An SC of 100% implies the distribution is uniform. An SC of 120 % indicates that the average was 120% more water applied than the driest area. The SC is often used to adjust run times to ensure that the driest areas receive the required scheduled water replacement. The disadvantage of this method is that all other areas receive 20% too much water, increasing the risk of runoff and leaching.

Figure 5-3. Regular irrigation system auditing ensures uniform application. ***Source:*** **Frank Rossi.**

5.3 Irrigation Management Decisions

Irrigation should be scheduled when soils reach 50% of the plant available water point and the amount of water should replenish the root zone to field capacity. The infiltration rate, effective root zone depth, and estimated ET demand determine irrigation frequency and soak cycle needs. Turfgrass species also affects irrigation frequency, since some turfgrasses more effectively resist drought than others.

5.3.1 Infiltration Rate

Infiltration rates depend on soil texture. Sandy soils have higher porosity and greater infiltration rates than silty or clayey soils. The matrix potential of the finer particle soils increases the time to wet the soil. Figure 5-2 shows the time and area wetted for two different soils: a 15 minute irrigation cycle on a sandy loam penetrates and wets to a depth of 12 inches and a 40 minute cycle wets nearly 36 inches of sandy loam, while clay loam soil requires hours of irrigation to wet the same profile.

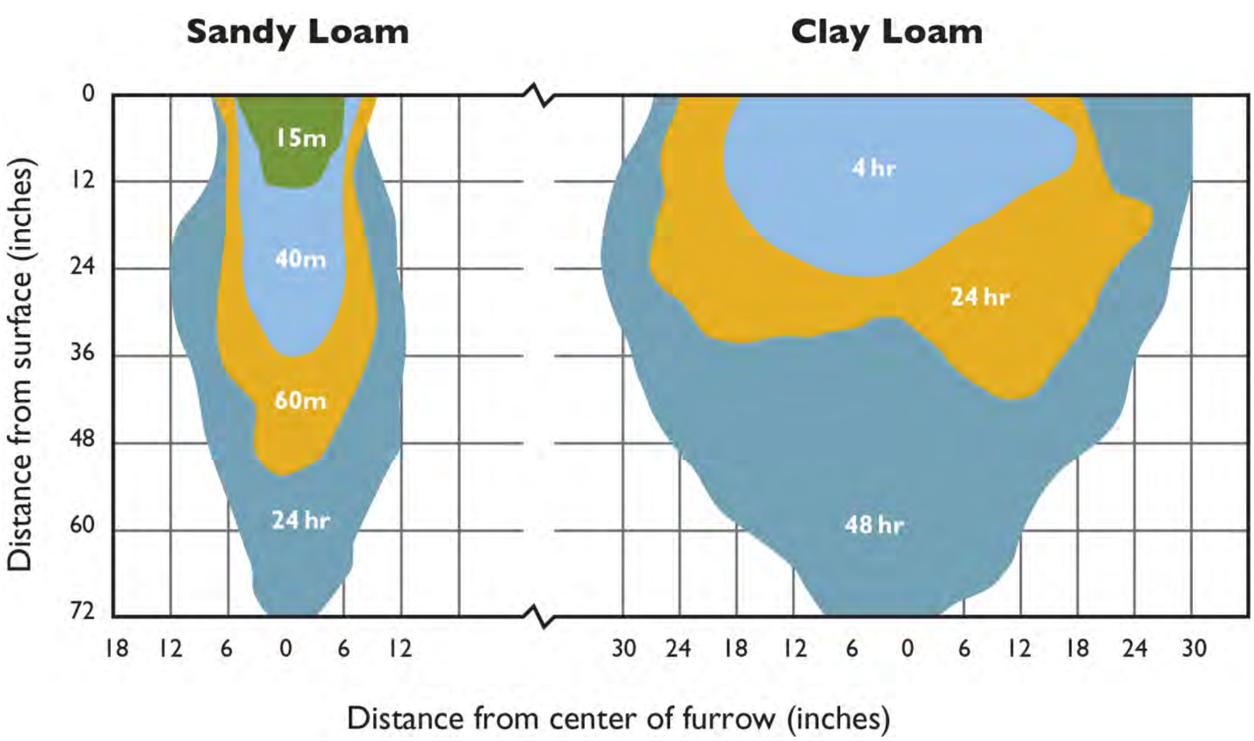


Figure 5-4. Infiltration of two different soil types measured in time and area wetted.

Soils develop unique characteristics called preferential flows that, in some cases, influence or accelerate flow through the profile downward towards groundwater. Examples of preferential flow are as follows:

- Macropores created by larger size particulate, gravel, or wormholes, create channels of preferential flow that direct water downward (Figure 5-3).

- Uneven mixes of soil types can result in veins of sandier soil that are more conductive than finer particle soils.
- Organic matter, organic residues, and subsurface layers of mixed densities may restrict and direct flow in unique patterns or fingers.
- Finger flow in sand, which acts like a large channel, allows water to rapidly flow through the profile along with any soluble compounds (fertilizer and pesticides).
- Hydrophobic soils repel water and thus the water must find another pathway, flowing (by runoff) towards areas that are wettable or into cracks in the soil.

Preferential flow and restrictions can lead to non-uniform moisture distribution in the root zone. Some areas of turf may be drier and other areas may be wetter, even saturated. Superintendents can develop better and uniform soil conditions by managing the soil compaction and organic matter content or thatch, such as by frequent aerification and top-dressing to provide better root-zone profiles. The use of water dispersants may be required to help water move through hydroscopic soil conditions associated with localized dry spot. Wetting agents, and in some cases organic amendments, may be needed to increase water holding capacity of some soils, particularly sandy soils.

Figure 5-5. Preferential flow in soils. *Source:* **Cornell, Soil & Water Lab.**

5.3.2 Root Zone Depth

The depth of the root zone (the depth to which 90% of the root system penetrates) must be determined onsite with a soil probe or spade. The soil type and root zone depth together are used to estimate the soil water-holding reservoir available to the root system.

5.3.3 ET Demand

ET describes the water lost through soil evaporation and plant transpiration and is influenced by the climate conditions on any given day. Hot, windy days with low relative humidity have higher rates of ET than cooler calm days with low relative humidity. At the wilting point, ET has depleted the available water and the plant begins to show stress. Irrigation scheduling needs to periodically refill the soil reservoir to avoid wilting and can be scheduled by calculating the potential evapotranspiration (PET).

5.3.3.1 Calculating PET

The Northeast Regional Climate Center (NRCC) provides estimates of PET based on climate data from every regional airport in New York State. An ET rate of 0.20 is considered high. Conversely, an ET rate of 0.05 is considered moderate. Calculating PET requires a crop coefficient (K_c), which varies by plant species, the leaf area characteristics, and density of the canopy. The K_c typically used for turfgrass management is 0.80. PET estimates should be factored by the crop coefficient to calculate the water replacement to be scheduled.

$$PET \times K_c = \text{Adjusted PET for Turf}$$

$$\text{Precipitation} - \text{Adjusted PET for Turf} = \text{Water Deficit}$$

In 2012, New York State experienced three successive seasons that challenged turf managers with very hot and dry periods. Using NRCC data, the 2012 PET deficit for each week is shown for Syracuse Hancock Airport in Figure 5-3. During the 2012 season, ET exceeded precipitation for 17 weeks, exposing turf to drought stress. The total deficit was 10.18 inches of water. Replacing 80% of the PET deficit would have used 11.9 million gallons of water to irrigate 54 acres, the average number of irrigated acres on an 18-hole golf course in the Northeast (Throssell et al 2009).

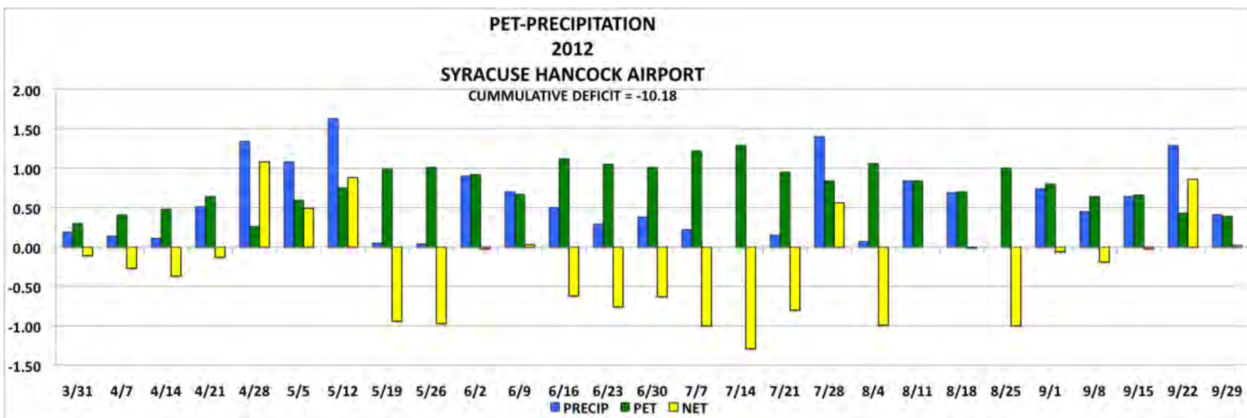


Figure 5-6. Cumulative weekly evapotranspiration deficit (Precipitation –PET) for Syracuse Hancock Airport, New York.

The NRCC provides historical data and ET forecasts at http://www.nrcc.cornell.edu/grass/.

5.3.3.2 Using PET

Information from onsite weather stations or PET data from the NECC can be used at a golf course scale or at a smaller scale to adjust for microclimates and conditions. Meaningful ET occurs from April through October in most cases in NY, so rainfall and ET is useful for this period. A few well-monitored golf courses in NY have demonstrated the importance of factoring in the soil water holding capacity to calculate the amount of irrigation. As shown in Figure 2-6 in Chapter 2, the soil texture determines water supply and frequency of irrigation. For example, a typical 12 inch USGA sand root-zone green will have only about 0.75 inch of plant available water stored. Any daily rain events greater than 0.75 inch need to be reduced to 0.75 inch in the PET calculation (rainfall-ET). Also, to avoid drought stress in turf, irrigation should be at 50% of the PAW, or in the case of the sand green, about 0.20 inch of PET. On very dry days, this value could mean irrigating daily or every couple of days, depending on the weather. At the smaller scale, irrigation should be adjusted in areas with lower PET, such as shady areas. If an on-site weather station is not an option, at the least a rain gauge should be used to collect rainfall due to localized summer storms.

5.3.4 Monitoring Soil Moisture

The NRCS provides a guideline for estimating the soil moisture content of soil by touch (http://nmp.tamu.edu/content/tools/estimatingsoilmoisture.pdf). The turf industry, however, offers tools to more precisely measure soil moisture content. Several handheld and portable instruments can be used to spot check areas (Figure 5-7).

Figure 5-7. Root zone moisture, temperature, and salinity meter (left) and portable moisture meter (right). ***Source*****: John J. Genovesi, Maidstone Club**

Programs are also available to map moisture content using global positioning system (GPS) positioning. Maps can be compared between different times of day, different seasons, and different management routines to compare soil moisture conditions. Irrigation system suppliers now offer in ground moisture meters to provide continuous data input to their controllers to adjust irrigation rates based on soil moisture.

5.3.5 Deep and Infrequent Versus Light and Frequent Irrigation

Several studies have compared deep and infrequent irrigation (DI) to light and frequent (LF) schedules. DI was applied at signs of wilting and the soil was wetted to a depth of 9.5 inches. LF treatments watered daily to replace the ET lost and generally wetted the top 1.5-3.0 inches of soil. Both treatments were syringed as required to cool turf on hot days. The turf treated using DI had increased root and leaf carbohydrates, larger and deeper root masses, reduced thatch, and better overall quality throughout the season ((Fu, J., and Dernoeden, P. H. 2008; Fu, J., and Dernoeden, P. H. 2009a; Fu, J., and Dernoeden, P. H. 2009b). This particular study only considered physiological factors and did not assess the risks of leaching. Soils should not be wetted much below the root zone because this practice increases the risks of pushing nutrient and pesticide residues closer to groundwater.

Other studies have demonstrated that turf pre-conditioned with deficit irrigation for a period of 7 to 14 days withstands periods of drought and has a quicker recovery. Pre-conditioning improves stomatal conductance, transpiration rates, and photosynthetic capacity in subsequent periods of stress. However, letting soils dry completely has a negative effect on plants. Creeping bentgrass, Perennial ryegrass, and tall fescue can be pre-conditioned replacing 60-80% of the water deficit. Kentucky bluegrass has much higher sensitivity to drought stress and should only be watered at 100% of deficit. Cool season turfgrass should not be watered below 40% of deficit. Even though Kentucky bluegrass has the greatest sensitivity to deficits, it has the highest resiliency to recover.

BMP Statements

- Design and maintain irrigation systems to uniformly apply water to the intended area of management.
- Determine accurate supplemental water needs based on appropriate climate and soil data.
- Assess system efficiency through regular audits of application rate and uniformity.

6 NUTRIENT MANAGEMENT

Although nutrients are present in the soil as well as in all forms of turfgrass and other plant material waste, turfgrass management requires the use of fertilizer to meet turf nutrient needs. Understanding the role of plant and soil nutrients as well as applied nutrients is essential to minimizing off-site movement of these compounds that could contaminate surface and groundwater. Because of this potential for off-site contamination, New York State and some local agencies regulate aspects of the use of fertilizers, as discussed in Chapter 3.

6.1 Nutrient Use in Plants

All plants require nutrients to sustain growth and development. Certain essential nutrients are classified as either macro- or micronutrients, based on the amount needed by plants rather than their importance for plant growth. Macronutrients include nitrogen, phosphorus, potassium, calcium, sulfur, and magnesium. Micronutrients include iron, zinc, copper, chlorine, nickel, molybdenum, boron, and manganese (a known issue on higher pH sands in NY).

Micronutrients are required in significantly lower amounts than macronutrients; however, a deficiency or excess of these micronutrients can have a profound influence on plant growth.

Proper nutrient management usually includes the following steps:

1. Determine plant needs (such as light levels, traffic levels, irrigated or not, and expected visual quality).
2. Assess the soil reservoir for availability (soil testing).
3. Determine nutrient needs and select the proper source of nutrient fertilizer (most are combination products).
4. Decide the rate, timing, and frequency of application.

6.2 Soil Testing

Soil testing is the beginning of precise nutrient management programs for all nutrients other nitrogen as it can be used to determine nutrient levels, make fertilizer recommendations, and in some cases diagnose the cause of poor performing turf. Assessing the existing reservoir of available nutrients in the soil can minimize the need for supplemental applications of fertilizer, which saves money while protecting the environment. Soil nutrient analysis aids in determining if nutrient deficiencies exist, as many soils have various levels of nutrient holding capacity, often referred to as cation exchange capacity (CEC). For example, sand-based systems, which have only a limited amount of stored minerals, may demand more mineral additions. Determining supplemental nitrogen needs are typically not based on soil tests as the method of extracting N and the subsequent calibration with plant growth have not been established.

Soil tests are required by the NYS Dishwasher Detergent and Fertilizer Law to confirm a need for phosphorus fertilization prior to its application. Research at Cornell University, however, concluded that no correlation exists between soil test phosphorus levels and runoff until phosphorus levels are 50 fold greater than the sufficiency level. A survey of soil test submissions to the Cornell University Nutrient Analysis Lab found that less than 3% of all submitted samples over a 5 year period had phosphorus values at these levels.

6.2.1 Soil Sampling

General guidelines for soil sampling are as follows:

- Sample when soils are biologically active. Fall sampling is most common and allows time to review results and apply lime and nutrients in advance of spring growth and to develop a season-long plan.
- Do not sample within the two months following heavy fertilizing or liming; sampling around frequent, light applications (spoon feeding) is acceptable.
- Test soils at the same time of year to allow for comparison of results from year to year.
- Because soils exhibit significant spatial variability, take a number of samples, combine, and then subsample. As a rule, a minimum of ten sample locations should be sampled per acre.
- Sample areas with different soils and drainage separately, for instance, sample sand-based greens and tees separately from fairways and roughs.
- Take the sample from the root zone (typically 4-6 inches deep) typically by removing the grass mat from the top of the sample.

6.2.2 Laboratory Analysis

Soil test methods vary in a number of respects:

- the type of chemical extractant used to measure the nutrient that can be released or dissolved into solution
- the ratio of soil to solution
- laboratory methods

Some methods are more suitable for one type of soil than another; therefore different labs use different tests. For example, soil labs at universities in the northeast use the Morgan or Modified Morgan test, which is appropriate for the acidic soils found in this region. Other test methods, such as the Bray-1, the Olsen, and the Mehlich-3 tests, use very different extracting solutions, different soil to solution ratios, and processes and are more appropriate for other types of soils. The Olsen test is specifically designed for calcareous soils (soils that contain calcium carbonate). The Mehlich-3 provides reliable results across a wider spectrum of soil pH. Results vary depending on the test method and even when using the same method, can vary widely from one lab to another due to variations in lab procedures. Consistently use the same laboratory to perform soil test in order to compare results over time.

On sand-based areas of golf courses with low CEC (<6 cmol/kg), soil testing has limited utility. Test results in these areas are often low due to the soil's low nutrient holding capacity. On such sites, test only for pH, CEC, soluble salts, organic matter, phosphorus (to adhere to regulatory requirements); if the pH is above 7.5, also test for calcium and magnesium.

6.2.3 Interpreting Test Results

Soil nutrient analysis provides information on the levels of macronutrients (phosphorus, potassium, calcium, and magnesium) and typical micronutrients (iron, zinc, copper, and boron) present in the soil, as well as the soil pH. In addition to standard pH and nutrient information, additional soil test data, such as CEC, soil organic matter content, and total soluble salts, can be requested and may prove valuable in the management of putting green soils in particular. Soil test results may include N levels, however because nitrogen constantly fluctuates between plant available and unavailable forms, it is unclear whether this information is useful.

Laboratories report results for nutrients as either parts per million (ppm), pounds per acre (lbs/A), or as a predictive index (lbs/A can be converted to ppm by dividing the lbs/A reported by two and ppm can be converted to lbs/A by multiplying by two). Most laboratories report a rating indicating the relative status for each nutrient, such as Very Low, Low, Medium, High, or Very High. Test results provide recommended nutrient (including nitrogen) and lime application levels and frequency of application. Soil test results form the basis for nutrient management planning for selection of nutrient sources, rates of application, and appropriate timing to meet site specific needs for greens, tees, fairways, and roughs.

6.2.4 Supplemental Plant Tissue Analysis

Plant tissue analysis is a useful diagnostic tool when samples are collected over a season in which levels can be correlated with environmental, biological, and fertilizer events. Occasionally sampling provides little information regarding nutrient management when tissue levels are not properly correlated with fertilizer need. Therefore, tissue testing is not considered a reliable means of establishing a nutrient management program on its own. Used in conjunction with soil tests, analyzing plant tissues over time can be used to observe trends that can be correlated to environmental and management factors. Tissue testing may be best used on sand-based areas and when the majority of nutrients are going to be applied in fertigation (the application of nutrients through the irrigation system) or in small amounts (spoon feeding).

6.3 Nutrient Availability and pH

The pH of a soil influences the entire soil chemical environment and fundamentally determines nutrient availability, fertilizer response, and soil biology. In general, a neutral pH is considered adequate for most turfgrass needs; however, slightly more acidic pH can allow for increased levels of metal ions to become soluble and is often favored as a means of increasing the competitiveness of creeping bentgrass and fine fescue over annual bluegrass (Figure 6-1).
Soil pH can be manipulated with a variety of fertilizer sources such as ammonia sources of nitrogen that have a slight acidifying effect as ammonium is processed by microbes. In addition, various types of liming materials such as calcium carbonate or dolomitic (higher Mg) lime supply nutrients can raise the soil the pH. Salts can also raise pH.

Efforts have been made to reduce soil pH with elemental sulfur to address calcareous soil issues with pH in excess of 7.3. Due to the high buffering capacity (the ability of soils where calcium or magnesium is a parent material to resist a pH change) of soils with pH greater than 7.3, the use of elemental sulfur results in little change. This result is especially true for limestone based soils in great lakes region of the state.

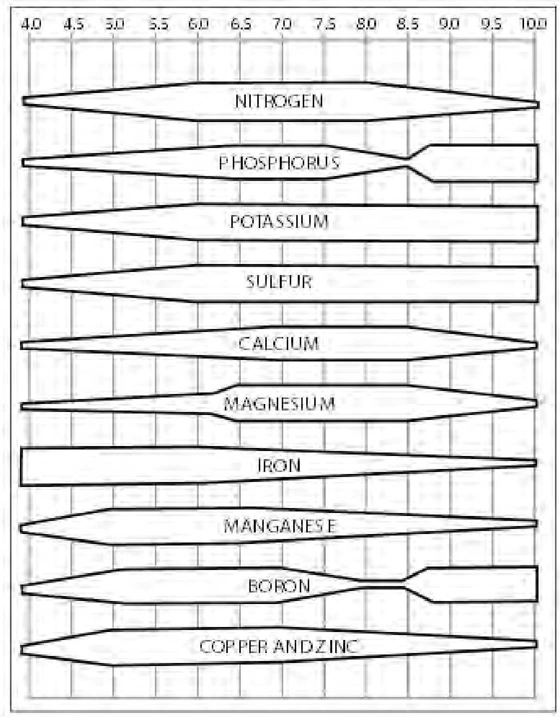


Figure 6-1. Relative soil nutrient availability as influenced by pH. Source: Virginia Turfgrass.

Soil pH profoundly influences phosphorus (P) availability and can influence movement on and through the soil profile. Soil available P or P fertilizer added is either fixed by adsorption to soil particles or retained without precipitating into secondary P minerals. The amount of fixation and retention depends on a wide array of factors, pH being one of the most significant. Precipitation increases as iron or aluminum precipitates at acid pH or as calcium precipitate at alkaline pH. The pH equilibrium between these precipitation extremes is between 6.0 and 7.0.

6.4 Critical Plant Nutrients

Golf course managers must ensure that all supplemental fertilizer is handled and applied to maximize plant response and minimize off-site movement. Nitrogen and phosphorus are the most important macronutrients to manage correctly because they are critical to both plant health and water quality.

6.4.1 Nitrogen

Nitrogen (N) is the most important managed nutrient for both plant growth and health. Insufficient N limits growth and plants' ability to withstand stress. For example, sufficient nitrogen is required for root growth; insufficient amounts may result in a weaker root system and lower reserves. Conversely, excessive N can lead to excessive shoot growth at the expense of root growth and result in a weaker plant structure. Providing sufficient quantities of nitrogen, consistently over time, maintains turf density, quality, and function.

The source, rate, and timing of nitrogen fertilization influence the turfgrass response. For example, soluble N sources provide quick green up but often do not sustain this response for more than a few weeks (depending on rate). These factors also have a significant influence on the fate of nitrogen applied into the environment (Figure 6-2).

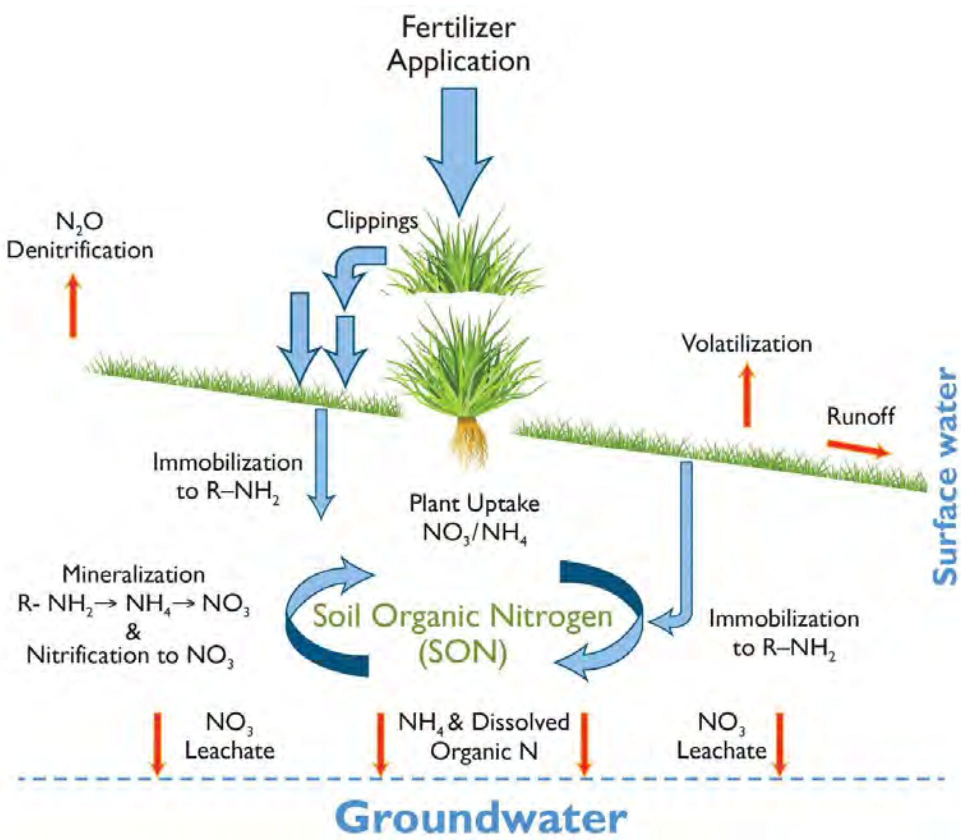


Figure 6-2. Nitrogen cycle.

6.4.2 Nitrogen Fertilizers

Many types of nitrogen fertilizers are available and vary by source, percentage of nutrient, and formulation. The fertilizer industry has standardized labeling to represent the "N" in the "N-P-K" label to represent the percent elemental N regardless of the form, while the P and K represent the percent of phosphate (P_2O_5) and potassium oxide (K_2O), respectively.

It is critical to understand the form of nitrogen supplied in a fertilizer and distinguish which forms have the lowest risk of contaminating groundwater, while still providing a consistent release of nitrogen over time. Additionally, it is critical to understand the environment that the nitrogen fertilizer is being released into to ensure minimal off-site movement.

6.4.2.1 Nitrogen Management Checklist

Using the right product, at the right time, and at measured rates of application maximizes plant use of the fertilizer and minimizes the risk of nutrient leaching or runoff. However, determining these best practices requires an understanding of other important factors.

Soil Issues

- Soil Type: Well-drained soils with coarse textures and high percolation rates have lower water holding capacity, greater infiltration, and higher risks of leaching.
- Organic Matter: Soils with low amounts of organic matter have lower biological capacity to assimilate nitrogen and are more susceptible to leaching.

Plant Issues

- Growth Phase: Newly seeded areas pose higher risks of leaching and runoff than well-established stands of turfgrass. Once established, the increased density of root mass increases nitrogen uptake while reducing the risk of leaching. Turfgrass in early stages of growth (1 to 20 yrs or more, depending on the organic matter starting point) has increasingly greater capacity to store and release nitrogen, reducing fertilizer requirements. The lower the amount of organic matter present in turfgrass, the longer the period of storage will be. As the site matures and the amount of organic matter accumulates (20 to 50 yrs), it poses a higher risk of leaching than younger turf.

Product Characteristics and Application

- Product: The best strategy for use of water soluble fertilizers is light rates of 0.5 lbs n/1000 sq. ft in general; 0.4 lbs n/1000 sq. ft on sand; and no more than 0.7 lbs n/1000 sq. ft on other soils (assuming no heavy rain events) and more frequent applications. This practice more closely matches plant uptake and ensures minimal leaching past the turf root zone. Water insoluble or slow release products, including organics or stabilized products, used properly, have a lower risk of impairing water quality through leaching and runoff. Release rates of combined fertilizer sources and applications can increase or "stack" the amount of available nitrogen. The combined total nitrogen can possibly leach nitrogen even if individual products would not.
- Fertilizer Rate: Excessive applications of any nitrogen-based fertilizer product can create high soil nitrate levels (>1.0 ppm) susceptible to leaching.
- Timing: Application of any nutrient to saturated soil or prior to heavy rainfall can lead to significant off-site movement. Applications made too early in the spring or too late in the fall result in higher soil nitrate levels, posing a greater risk to groundwater quality. Similarly, applications should be reduced during summer decline when plant uptake decreases. Research has not shown an appreciable difference in turf quality using different schedules of application. Applications made every month compared with split schedules of spring and fall, spring only or fall only show reasonable consistency. Light-frequent applications may provide the most consistent quality and limit the susceptibility of losses to leaching and runoff. Low rates of N associated with light-frequent applications may require that applications be made using spray equipment to uniform coverage and response.

6.4.2.2 Nitrogen Fertilizer Use

Water Soluble Sources

Water-soluble nitrogen (WSN), including inorganic N and synthetic organic urea, are released quickly into the soil, which can increase the risk of leaching at high rates. Inorganic sources include ammonium nitrate, ammonium sulfate, potassium nitrate, calcium nitrate, and mono-di-ammonium phosphate. Nitrate (NO_3-N) and ammonium (NH_4-N.) are the principle sources of inorganic nitrogen that plants absorb. Plants generally grow best with a combination of NO_3-N and NH_4-N. NH_4 is best absorbed at a pH around 7.0 and less absorbed at more acidic pH. Conversely, NO_3-N is best absorbed at an acidic pH.

Urea is a common and inexpensive water-soluble form of nitrogen. Urea can burn turf at high rates, but it has a lower burn potential than other inorganics. Losses due to volatilization may also be high when applied as a dry material on days that are hot (>80°F) and humid. Lightly watering in urea solutions (when possible) reduces the amount of volatilization.

Slow Release Sources

Urea is also available coated in sulfur or a polymer for slow release with less volatilization and leaching. In other variations, urea and urea-ammonium nitrate (UAN) are also available with urease inhibitors, n-butylthiophosphoric triamide (NBPT), and nitrification inhibitors, dicyandiamide (DCD). Inhibitors reduce volatility losses and slow the rate of nitrogen release. These coated and stabilized nitrogen fertilizers are effective at reducing the risks of contaminating groundwater and increase the utilization of nitrogen applied.

Other forms of urea include methyleneureas (MU), ureaformaldehyde (UF), triazone, and isobutylidene diurea (IBDU). The MU and UF fertilizers are available in short or long chain C-H or methyl links. Shorter chains have higher salt indexes, increase the burn potential, and release N quicker. The long chain formulations releases over a longer period with lower burn potentials. The products are grouped according to their "fraction". These distinctive fractions have characteristic water solubility and release rates.

The Association of American Plant Food Control Officials (AAPFCO) requires that ureaformaldehyde products be defined to contain at least 35% N-nitrogen, largely as insoluble but slowly available products with a water insoluble nitrogen (WIN) content of at least 60%. A ureaform produced with a 1.3:1 ratio of urea to formaldehyde contains 38% N of which 65-71% is WIN. A methylene urea product with a 1.9:1 ratio contains 39% N of which 36% is WIN. Products are often produced with a mixture of other water-soluble nitrogen sources and a percentage of WIN ureaformaldehyde. Course managers must understand the product being used, the percentage of water solubility, and the release rates in order to use these products effectively.

The UF and MU fertilizers require microbial activity to release their N. A urease enzyme hydrolizes the urea to NH_4 and bacteria nitrify the NH_4 to NO_3. Like the organic fertilizers, little

N is released unless the soil temperature is over 50° F. As the soil warms, and microbial activity increases, more N is released.

IBDU, typically 31% N, does not require microbes because it is slowly hydrolyzed by water. IBDU is available in two grades: a coarse grade that is 90% WIN and a fine grade (greens grade) that is 85% WIN. The finer grade releases quicker and is less likely to be collected during mowing. Acid soils also increase the N release rate.

Liquid "Foliar" Sources

Almost any source of nitrogen can be applied in a liquid form and, depending on how the much water is used when applying, the nutrient can be absorbed foliarly. Foliar products are available using combinations of urea and other inorganic nitrogen compounds. The product is typically sprayed to coat the leaf surface. Plant uptake is generally 10-70% of the fertilizer applied, which can be higher than the amount absorbed by the roots.

6.4.2.3 Release Rates

Research often evaluates different forms of fertilizers, rating each product according to turf quality, color, and clippings as a measure of growth. While these comparisons are important, knowing the portion of the fertilizer's nitrogen content that is "immediately available" and its release rate can help in selecting products and balancing rates with plant requirements. Controlling the amount of available nitrogen also reduces the risk of excess nitrates being leached from the soil.

Biologically active soils may react quickly to release the water insoluble portion of the fertilizer adding more nitrogen that is available to the plant or movement into ground water. A series of studies confirmed that, under active growing conditions, perennial ryegrass, Kentucky bluegrass, tall fescue, and creeping bentgrass assimilate nitrogen, as either nitrate or ammonium, within 48 hours of applications (Bowman et al 1989a). The results suggest that using prudent rates of application, the plant can quickly absorb and use the immediately available nitrogen that has been applied.

6.4.2.4 Organics Versus Synthetics

Several types of fertilizers have been measured for the losses associated with runoff and leaching of phosphorus, nitrate, and ammonium. Research has determined that once turf was established, natural organics lost 3-6% of the nitrogen applied as NO_3-N leachate compared to 8.6-11.1% lost for synthetic organics (Easton and Petrovic 2004). Little difference was found between sulfur-coated urea and the immediately available urea or ammonium phosphate fertilizer. Natural organics, notably dairy and swine composts, increased the percentage losses of phosphorus partially due to more P being applied at the same N amount of the synthetic fertilizer.

6.4.2.5 Water Solubility

Water solubility can potentially increase the risk of leaching. While ammonium cations (NH_4^+) can be held within the soils cation exchange sites, some soils, especially sandy soils, have too little cation exchange capacity to hold ammonium or other cations like potassium or calcium. Nitrates are freely solubilized and mobile in the soil solution. Slow release fertilizers can be used on sites with higher leaching risks to decrease the risks to groundwater. Slow release fertilizers can be applied at a rate of 2-3 lbs N per 1000 sq. ft. per year in split applications. Applications should not be made in late fall (November or later). Since much of the water recharging groundwater occurs during the late fall, winter and early spring, Late fall N applications can result in leaching for two reasons: (1) increased precipitation and groundwater recharge during the period from late fall to early spring and (2) reduced plant uptake of N during winter dormancy.

Timing

Leaching studies conclude that applying fertilizers during clear weather can prevent episodic losses of nitrates to groundwater. The use of quick release, water soluble, immediately available nitrogen sources is an acceptable practice when properly applied. Conversely, over-application or applications that are stacked due to short interval application schedules using some slow-release products can increase the risk of leaching. Precipitation events and excessive irrigation can also drive the nitrates deeper into the soil profile. Testing has shown that applications should be limited so that the water-soluble, immediately available, and released fraction of fertilizer additions does not exceed 0.5 lbs N per 1000 sq. ft., 0.4 on sand, and no more than 0.7 on other soils (assuming no heavy rains in the next several days).

6.4.3 Off-site Movement of Nitrogen Fertilizer

A variety of chemical and environmental factors influences the potential for off-site movement of nitrogen through leaching and runoff.

6.4.3.1 Nitrogen Leaching

All applied N eventually becomes the ammonium or nitrate form of N (or soluble organic N in some cases). Ammonium (NH_4) is rapidly converted in soils to nitrate (NO_3). Ammonium is also tightly held in the clay or organic profile of a soil, typically within the upper 0 to 2-inch layer. Studies typically report only trace amounts of NH_4 in leachate even under high fertilization and irrigation schedules (Bowman et al 1989b; Frank et al 2005).

Excluding the effects of runoff, nitrate (NO_3-N) presents leaching concerns for groundwater quality. Any fertilizer with solubility greater than 30 mg/L (or 30 ppm) can pose a risk for leaching and groundwater contamination. Leaching flow has been measured highest in winter and spring when plant water use is low and little N is taken up by the grass. However, “episodic” leaching events have been observed in the growing months when precipitation (or irrigation) is greater than the amount of water held in soils plus the amount used by plants.

6.4.3.2 Nitrogen Runoff

Runoff losses have been found to be five times greater on the lower slope than the upper slope in a study conducted on a 6-8% slope with sandy loam to loam soils (Easton and Petrovic 2005). The greater losses at the bottom of the slope were associated with higher clay accumulation, lower infiltration rates, wetter soils, and reduced lateral flow. The losses in the lower slopes are indirectly noted by higher saturation levels.

In general, runoff from turf during non-frozen soil conditions is due to saturation excess, not due to infiltration excess. Slope profiles in the topography of a site can lead to accumulated saturation zones that are prone to runoff. Such areas may also have shallow profiles with clay, bedrock, or other compacted soil layers (sometimes seen from construction activities) that creates or restricts lateral flow. The restrictions increase runoff losses in that area. The creation of shallow lateral flow channels tends to carry losses to other areas, including groundwater recharge.

For newly seeded sites, infiltration rates in turfgrass systems increase with age. Infiltration rates increase with increased shoot density through establishment. As infiltration rates increase, runoff decreases. Within a year after seeding, the infiltration rate can increase from 0.1 inch/hr to over 4 inches/hr. The frequency, duration, and intensity of irrigation or precipitation events can be overriding factors in ground saturation and runoff.

6.4.4 Phosphorus

Phosphorus is a critical nutrient for turfgrass growth and development, playing important roles in energy transformations in plant cells and root development. Therefore, P enhances turfgrass establishment and is the most important nutrient in ‘starter fertilizers’. On soils low in P, most of the enhanced establishment is from the N. Phosphorus management is focused on maximizing plant response to supplemental phosphorus, when required as based on soil test results, while minimizing offsite movement.

In the soil, P is generally in complex with other elements and is an insoluble (plant unavailable) nutrient. Phosphorus is slowly made available to plants on an ‘as needed’ basis by chemical reactions in the soil that convert it to either of two anionic forms, dihydrogen phosphate (H_2PO_4)-or hydrogen phosphate (HPO_4^{2-}).

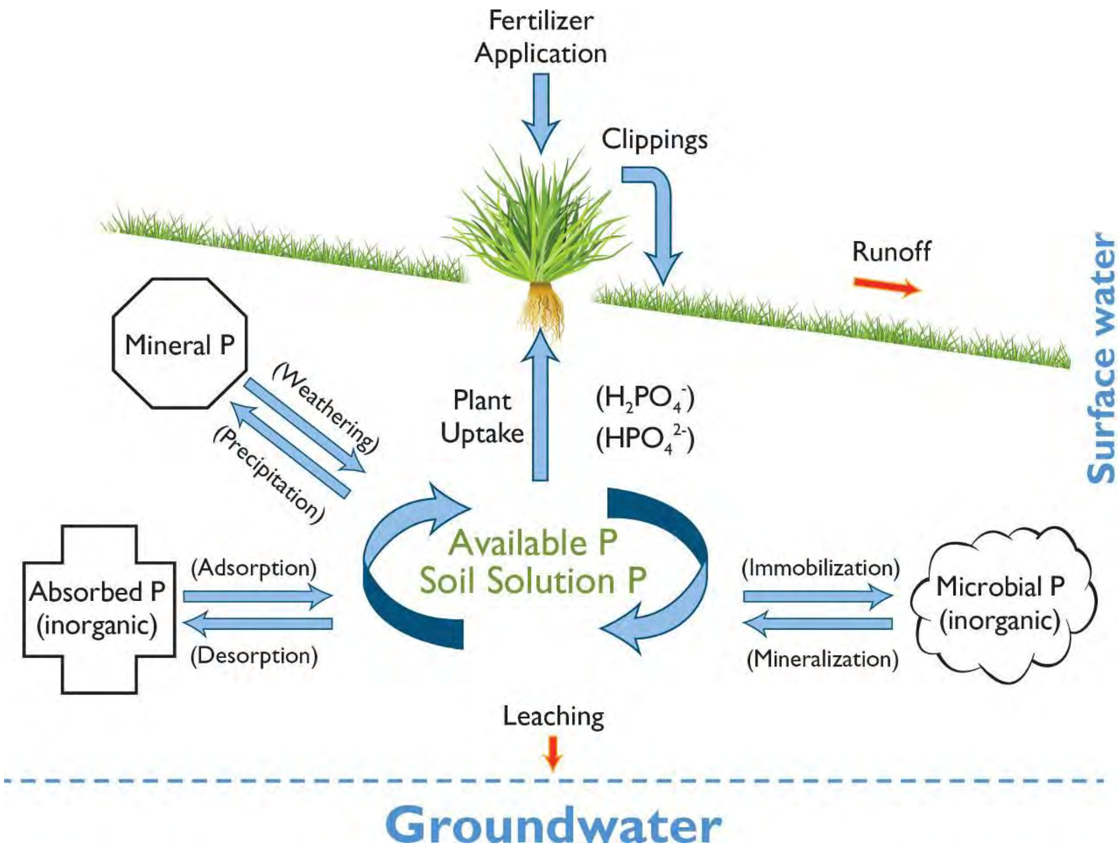


Figure 6-3. Phosphorus cycle.

A soil is considered to have a phosphorus deficiency if it is at or below the medium sufficiency level. Research has often found that turfgrass shows signs of distress at P levels of 5 to 11 ppm (Mehlich III), a range considered Low or Very Low. The medium sufficiency ratings for each test method are shown in Table 6-1.

Table 6-1. Medium sufficiency levels by test method. Source: http://nmsp.cals.cornell.edu/software/Morganequiv7.xls

Test Method / Extractant	Medium Sufficiency	
	ppm	lbs/acre
Mehlich-3	26-54	52-108
Bray P1	15-30	30-60
Olsen	12-28	24-56
Morgan (for agronomic crops)	10-20	20-40
Modified Morgan/Cornell (for turf)	< 2	1-4

Testing labs provide recommendations for the amount of phosphorus fertilizer needed to correct the deficiency. Recommendations are made separately for fertilizing established turfgrass or for pre-plant fertilization to establish a new stand of turf with either seeded or sodded turfgrass (Table 6-2).

Table 6-2. Phosphorus fertilizer recommendations for turfgrass (Petrovic 2012).

Established Turfgrass	Current Recommendations		P_2O_5 Recommended lbs/acre
	Morgan lbs/acre	Mehlich-3 lbs/acre	
Low	< 1	< 3	80
Medium	≥ 1	≥ 3	40
High	> 4	> 12	0
Newly Seeded or Sodded Turfgrass	< 1	< 3	140
	≥ 1	≥ 3	100
	≥ 4	≥ 12	60
	≥ 8	≥ 24	40

6.4.5 Phosphorus Fertilizers

Phosphorus fertilizers are processed from rock phosphate mined from apatite mineral deposits around the world. The processing increases the availability of reactive and water-soluble P content. Many products formulations are available. The P content of any fertilizer is listed in the N-P-K ratio on the label as the percent P_2O_5.

Water solubility is a measure of the fertilizer's ability to dissolve into the soil solution. Some of the water-insoluble fraction of the fertilizer P can be extracted by citric acid. The remaining P is citric insoluble and remains in the soil until soil processes mineralize the insoluble P. The water soluble fraction and the citric acid soluble fraction comprise the total plant available P. The formulas to convert these factors are based on the molecular weight:

$$\%P = \%\ P_2O_5 \times 0.43$$

$$\%\ P_2O_5 = \%P \times 2.29$$

Using a higher solubility fertilizer, while perhaps best for the plant, increases the risk of leaching or runoff contamination. Phosphorus fertilizers are listed in Table 6-3 with the corresponding fraction of Total Plant Available P (water soluble and citric soluble fractions).

Table 6-3. Phosphate fertilizers (Tisdale, 1993; Turgeon, 1985)

Fertilizer	%N	% P_2O_5	%P	% Total P Available	Cold Water Solubility (g/L)	Salt Index
Rock Phosphate	---	27-41	12-18	14-65	---	---
Single Superphosphate	---	16-22	7-9.5	97-100	20	0.4
Triple Superphosphate	---	44-52	17-23	97-100	40	0.2
Monoammonium phosphate (MAP)	11-13	48-55	21-24	100	230	2.7
Diammonium phosphate (DAP)	18-21	46-53	20-23	100	430	1.7
Ammonium polyphosphate	10-15	34-37	15-16	100	---	---
Urea ammonium phosphate	28	27	12	100	---	---
Nitric phosphates	14-28	14-28	6-10	80-100	---	---
Potassium phosphates	---	41-51	17-22	100	---	---
Sewer Sludge	4	6	0	0	---	---

6.4.5.1 Phosphorus Management Checklist

Soil Issues

- Phosphorus fixation increases with increasing clay content in the soil. The larger amount of surface area associated with clayey soils and the Al-Fe minerals in the lattice help adsorb more P than other soils. In calcareous soils, the adsoption is associated with calcium carbonate ($CaCO_3$).
- Larger fertilizer additions are required to maintain a level of plant available P in finer soils compared to that in coarser, sandy soils. The risk of leaching P is highest in sandy soils.
- The rate of biological activity, and therefore P mineralization, increases with increasing temperatures. Fertilizer applications should only be applied to active soils when soil temperatures are above 50°F.
- Liming acid soils increases the P solubility in acid soils, but over-liming can reduce P solubility. Sorption also occurs to calcium cations (Ca^{2+}) but only at pHs up to 6.5. At higher pH values, Ca-P precipitates form.
- Incorporating P into the soil when possible increases adsorption and reduces the amount of plant available P. Broadcasting P fertilizer on the surface leaves the fertilizer susceptible to runoff.

Plant Issues

- Returning clippings to the turf is a practical method of returning organic P back to the soil. Clippings may account for 0.10 to 0.35 lbs P per 1000 sq ft. If clippings are removed, the loss of P depletes available P for plant uptake.

Other Sources Issues

- Foliar applications at light rates may increase plant uptake. Unabsorbed foliar P, however, remains at risk for episodic losses due to runoff caused by heavy precipitation or excessive irrigation. A light irrigation after P fertilizer application has been shown to reduce P runoff.
- Phosphanate fungicides are chemically different from phosphanate fertilizers in that the fungicide provides a phosphite ion ($H_2PO_3^-$) having one less oxygen atom. Potassium phosphite, also labeled as mono and di-potassium salts of phosphorus acid, Aliette, and Chipco Signature are the most common examples of a phosphanate fungicides. No evidence suggests that the phosphite ion is used in the plants metabolism. Regardless, the amount of P supplied in any fungicide application is negligible.

6.4.5.2 Phosphorus Fertilizer Use

Rock Phosphate

Rock phosphate can be used as a P fertilizer on soils with a pH of 6 or less. It is not soluble in water. The mineralization of P is a slow process, typically over a period of years depending on soil properties. If used, it should be finely ground and incorporated into the soil. If a soil test indicates a severe deficiency, others sources may be best for the short term. However, rock phosphate could be used as a long term source.

Single and Triple Superphosphates

Single superphosphate (SSP) has 16 to 22% P_2O_5 (7 to 9.5%P). The fertilizer is 90% water soluble and is all plant available P. SSP also contains 12% sulfur (S).

Triple superphosphate has 44 to 52% P_2O_5 (17 to 23%P). The fertilizer has a very high water soluble fraction. It is only available in granular form.

Ammonium Phosphates

Studies suggest that there is increased plant uptake of the P in ammonium phosphate fertilizers due to the presence of ammonium (NH_4^+). Monoammonium phosphate (MAP) and diammonium phosphate (DAP) are water-soluble. MAP and DAP are granular products (Tisdale 1993).

Monoammonium, diammoniam, and ammonium polyphosphate are typically used for foliar P applications.

Biosolids

Another source of P comes from the use of biosolids as an organic fertilizer. Milorganite is a popular example containing 6% nitrogen and 4 % P_2O_5. Release of the N and P fractions is by microbial mineralization.

Other P Sources

Phosphorus may be an integral by-product of other soil amendments, natural organic fertilizers, and bio-stimulants. The most notable additions come from the use of composts as soil amendments or nitrogen sources and the use of recycled water.

- Manure & Composts: Fertilizers that are produced as by-products of the livestock or poultry industry can be classified as composts or manure. Phosphorus in these products exceeds the 0.67% limit stated in the Dishwater Detergent and Nutrient Runoff law, but have been exempted. Manure and composts are often used to improve soil structure or as sources of nitrogen fertilization. Applying dairy composts incorporated into the top 6 inches of soil at rates of 600 to 1,200 lbs per 1,000 sq ft introduces 5 to 10 lbs P per 1,000 sq ft. Dairy compost, at approximately the same rates, introduces 4 to 8 lbs P per 1,000 sq ft. The use of compost as a soil amendment has been shown to greatly increase the stratification of P in the upper soil profile and the risks of runoff contamination.
- Recycled Water: Recycled water used for irrigation has been reported to contain a range of 3 to 10 mg/L of inorganic PO_4-P and 10 to 15 mg/L of NO_3-N and NH_4-N each. The nutrients can be used for plant growth.

6.4.6 Off-site Movement of Phosphorus Fertilizer

Similar to nitrogen fertilization, a variety of chemical and environmental factors influence the potential for off-site movement of phosphorus. The primary means of off-site movement is by runoff due to phosphorus content at or near the soil surface. Improper handling of organic waste, notably clippings, can also be a significant source of phosphorus movement off-site, and thus clippings should not be placed in or near storm water treatment structures or wetlands. Finally, phosphorus leaching can occur, but only under very specific soil and chemical situations.

6.4.6.1 Phosphorus Runoff

Turfgrass, like other untilled systems, accumulates higher concentrations of soil P in the upper soil profile (0 to 2 inches) compared to lower depths. Frequent P fertilization, especially at higher rates, substantially increases the soil P levels in this upper profile. Consequently, P in fertilizer can be lost in runoff, as much as 20% of P fertilizer. Runoff can also wash away soil sediment and plant debris with mineral P and organic P. The runoff risks are very high during turfgrass establishment due to limited plant utilization and more runoff present than in established turf.

6.4.6.2 Phosphorus Leaching

In its rare anionic form, phosphorus can leach and is a concern for water quality issues. P leaching potential is best managed by applying P based on soil test results. When phosphorus is complexed with other elements in the soil, however, it has a low leaching potential unless it has been over applied for many seasons. Sandy soils, on the other hand, often have a low potential to fix (tie up) P and therefore are more likely to have a P leaching problem.

6.5 Fertilizer Applications

Proper application of fertilizers is possible only with accurately calibrated sprayers or spreaders. Incorrectly calibrated equipment can easily apply too little or too much fertilizer, resulting in damaged turf, excess cost, and contamination of the environment. Therefore, sprayers and spreaders should be calibrated at first use and after every fourth application. The time it takes to calibrate application equipment is returned many fold in improved results. An excellent resource for spreader care and calibration can be found on the Penn State Plant Science website (http://plantscience.psu.edu/research/centers/turf/extension/factsheets/calibrating-spreader). Spreaders should also be thoroughly cleaned after use due to the high salt content that corrodes metal parts. However, the wash water will likely contain N or P and should be disposed of properly (see Chapter 10).

6.5.1 Granular Fertilizer Application

Fertilizer is applied to turf in both granular and liquid forms. When applied in a granular form, it is distributed with a drop, rotary, or pendulum-type spreader. The drop, or gravity-type, spreader has a series of openings at the bottom of the hopper through which the fertilizer drops a few inches to the ground directly beneath. The rate of application can be changed by adjusting the size of the openings. Drop spreaders distribute fertilizer precisely and uniformly.

Drop spreaders are usually two feet wide, but wider models are available. Drop spreaders are normally preferred for the application of fine or very light particles such as ground limestone or granular pesticides that must stick to the foliage. Too much overlapping or misses between application swaths can result in streaking because of uneven nitrogen distribution.

Rotary spreaders are also called centrifugal, broadcast, or cyclone spreaders. Most have a plate, called an impeller, which is attached beneath the hopper and spins as the spreader wheels turn. When fertilizer drops through the adjustable openings at the bottom of the hopper, it falls onto the rotating impeller and is thrown away from the spreader in a semicircular pattern. Rotary spreaders broadcast granular materials over a wider area and faster than the drop type. The spreading width normally ranges from 6 feet for small spreaders to 60 feet for very large ones. Streaking is less likely with rotaries because the swaths are overlapped and the edge of the distribution pattern is not as sharp as that produced by a drop spreader. Rotary spreaders do not provide as accurate and uniform an application as drop spreaders, but the distribution can be satisfactory if the proper overlap is used. Spreading mixed materials of different sizes is a problem because larger, heavier granules are thrown farther than smaller, lighter particles and ground limestone often drifts when applied with a rotary spreader. The speed at which the spreader is pushed or driven has a major impact on application rate.

Pendulum-type spreaders have a spout that moves from side to side. They are pulled by a tractor or turf vehicle, have a large hopper capacity, and can throw dry materials a great distance when the spout moves rapidly.

6.5.2 Liquid Fertilizer Application

Liquid fertilizer applications allow for lower rates and more precise applications than granular application. Liquid application is usually less expensive than granular applications, though the initial cost of the sprayer equipment is high compared to the cost of a spreader. If not expecting foliar uptake of nutrients, a minimum two gallon spray volume of the fertilizer-water mixture is applied per 1,000 ft^2 to ensure that fertilizer washes into the root zone.

Fertigation is the application of nutrients through the irrigation system. Minute amounts of fertilizer are regularly metered into the irrigation lines and distributed along with the irrigation water through the sprinkler heads. For fertigation, the irrigation system must be capable of distributing water uniformly. The advantages of fertigation include a more efficient plant use of nutrients, a steadier growth rate, and a savings on labor costs. Fertigation is not widely used yet on NYS golf courses, but could significantly improve nutrient application efficiency and water quality protection. So far, it has been most widely used during grow in to aid establishment, or for applying about half of the total yearly amount of N.

BMP Statements

- Recognize all organic waste generated on golf course contains nutrients that are potential contaminants.
- Determine accurate supplemental nutrient needs based on soil chemical and physical analysis. On sand based areas, consider foliar testing as a diagnostic tool.
- Supplement soil with appropriate rate and source of nutrients to maintain optimum availability and minimum off-site movement.
- Assess application efficiency through regular equipment calibration.

7 CULTURAL PRACTICES

Cultural practices support turfgrass density and therefore play an important role in preserving and protecting water quality. This chapter provides specific recommendations for ensuring that the turf is properly adapted and has adequate infiltration, yet sufficient water and chemical holding properties to minimize effects on water quality.

7.1 Turfgrass Selection

The increased availability of improved turfgrass species and varieties provides an excellent opportunity to select the most well adapted turf to site conditions (Figure 7-1 and 7-2). Well adapted species require reduced amounts of inputs of supplemental fertilizer and pesticides, and if selected for drought tolerance, requires less water to survive and maintain playability.

Figure 7-1. It is critical to keep abreast of the latest developments in turfgrass breeding when selecting the best species and varieties. ***Source*****: Frank Rossi.**

Figure 7-2. Attending field days offers great opportunities to interact with turfgrass scientists on the latest in turfgrass species and variety developments. ***Source*****: Frank Rossi.**

7.1.1 Climate

Highly specific and often less than ideal microclimate conditions challenge many superintendents. A common microclimate is a putting surface location with light deficits and restricted air movement. In these situations, limited options exist for proper turf selection, as these climates simply cannot sustain any turf without significant inputs. Typically, in northern climates, these adverse site conditions lead to increases in weedy species such as annual bluegrass.

7.1.2 Choosing the Right Grass

The perennial nature of golf turf implies that when you do establish or renovate a new turf area it is critical to choose a well-adapted species and variety. Of course putting surfaces are unique growing environments, but larger areas such as fairways could have grasses adapted to reduced nutrient levels, and traffic tolerance potentially reducing the nutrient loading. This is an important BMP for nutrient management. Additionally, natural areas that serve as Landscape BMP's also require careful attention to finding a well-adapted species. Certain grasses adapted to low inputs, reduced mowing, even submersion tolerance could be part of the selection criteria. Ultimately, it is vital to start out with a well-adapted species that will thrive, meet the functional and visual quality expectations, and be sustained using BMPs.

7.1.3 Annual Bluegrass Invasion

Over time, annual bluegrass becomes the dominant species in turf. This invasiveness is a result of the highly adaptive and prolific reproductive capacity of annual bluegrass that favors its competitive ability over other cool season turfgrass. Therefore, regular surface disruption when desirable turf is not actively growing selects for the invasive annual bluegrass.

Eventually, every course faces the choice to renovate or manage, invariably when there is catastrophic failure. Renovation eradicates and then manages to exclude annual bluegrass, hopefully with proper site modifications to allow perennial species to thrive. Conversely, others choose simply to manage the annual bluegrass type that has colonized the location. This is a "pay me now or pay me later" situation where management is less disruptive, but the inputs required to sustain adequate turf are costly.

Research shows that annual bluegrass requires significantly more inputs to provide acceptable quality golf turf, especially on putting greens, than more perennial species such as bentgrass or fescues.

Figure 7-3. Annual bluegrass invasion into existing bentgrass putting green. Over time, the continued surface disruption and shift in maintenance will lead to increasing populations of this invasive species. *Source*: Frank Rossi.

Figure 7-4. Annual bluegrass is very susceptible to winter damage, especially from ice accumulation. Note the live bentgrass amongst the dead annual bluegrass. As the turf thins, the potential for off-site movement of inputs increases. *Source*: Frank Rossi.

7.1.3.1 Annual Bluegrass and Water Quality

For water quality protection, the answer seems obvious that the less annual bluegrass being managed, the fewer inputs required, and the lower the risk to water quality. While this solution may not be as practical on putting surfaces, the putting surfaces comprise less than 10% of the managed turf. It is fairway, rough, and tee areas where annual bluegrass challenge water quality preservation with large tracts of land being treated to sustain a weedy species.

Why do courses not simply renovate to more perennial creeping bentgrass species? Because renovation is disruptive and preventing annual bluegrass re-invasion is difficult. The re-invasion often occurs because of managers' reluctance to alter site conditions, but also because restricted play in cold periods (when bentgrass is damaged) allows annual bluegrass to thrive. As a result, mixed stands of annual bluegrass with perennial grasses such as bentgrass, fescue, ryegrass, and Kentucky bluegrass must be managed. The recommended BMP is to favor the competitive ability of the perennial species in management practices in hopes that the annual bluegrass will adapt and tolerate the management. The better adapted the perennial turf is to the site and management, the better it competes with the annual bluegrass.

7.2 Turfgrass Establishment

At times, effective golf turf management requires renovating an existing stand or establishing new turf. Renovation can be ideal for including the genetically improved turfgrasses, which are well-suited to modern golf turf management. Also, the latest genetic material often requires significantly fewer inputs, further reducing the need for fertilizer, pesticides, and water.

Establishing new turfgrass areas or renovating existing stands can create significant risk to water quality. During establishment, soil is exposed prior to seeding or sodding to ensure effective contact for water transfer from the soil to the plants. Therefore, practices should be implemented that reduce establishment time to full turfgrass cover and protect the soil from being transported in rain events during establishment. These practices can include sodding heavily sloped areas or mulching new seedlings.

Minimizing the amount of fertilizer and chemicals used during the establishment phase is critical, as the establishing turf does not provide the needed uptake to prevent runoff and leaching. For example, a Cornell University study found that using fungicide-treated seed instead of a granular fungicide at establishment significantly reduces the risk of leaching.

Newly establishing areas, especially from seed with soil exposed, should be irrigated carefully. Light, frequent amounts of water to keep the seedbed moist will encourage germination and seedling development. Once the turf density reaches 60 to 70%, cover irrigation can be reduced to more normal levels, as turf will begin to root and extract water and nutrients from the soil.

Figure 7-5. The use of sod can limit the species and varieties used, but significantly reduces the risks associated with new establishment. ***Source*: Frank Rossi.**

7.3 Turfgrass Density and Runoff

Turfgrass runoff research consistently concludes that maintaining high shoot density turf is the most effective means of reducing runoff volume. The tortuous path travelled by rainfall or irrigation water increases as the number of shoots per unit area increases. In addition to the reduced runoff, the fibrous root system of turf has been shown to increase infiltration. The longer the water deposited on the turf surface is delayed from runoff, the more likely that proper infiltration will occur. The combination of reduced runoff volume and increased infiltration is a primary aspect of water quality protection, thus maintaining a dense turf is vital. In addition, denser turf also provides a better playing surface.

7.3.1 Mowing

A turf is defined as low growing vegetation maintained under regular mowing and traffic. Conversely, areas not regularly mowed are not considered turf. Mowing is a significant selection tool and one that, when done properly, has a profound influence on turf density.

7.3.1.1 Mowing Height

Mowing practices require decisions regarding type of mower, height, frequency, and clipping management. Individually and collectively these practices, when performed properly, maximize turf density.

Height of cut is often determined by the function of the site, with additional emphasis on visual quality. A close cut turf is often viewed as more aesthetically pleasing. However, lower heights of cut, especially at turf heights below 1.5 inches, require more maintenance to maintain turf density.

Mowing height significantly affects rooting depth because the lower the turf is mowed, the shorter the root system, and therefore the greater concentration of surface rooting. Additionally, the lower height of cut requires more frequent mowing as leaf extension accelerates when turf is cut lower and tissue must be removed more frequently.

Ultimately, every turfgrass species has an ideal mowing height range and a mowing range that the species can tolerate. Maintaining turf within the ideal range maximizes density. As long as mowing heights remain within the tolerance range, however, adequate density is possible when other maintenance factors such as water and nutrients are provided in the optimal range.

Figure 7-6. Proper mowing adjustment, especially reel mowers, ensures maximum turf performance while minimizing stress that leads to reductions in turf density. ***Source*****: Frank Rossi.**

7.3.1.2 Mowing Frequency

The turf growth rate and height of cut dictate mowing frequency. As mentioned previously, the lower the cut, the more frequently mowing is required. In general, increasing mowing frequency increases turf density.

Little evidence supports the accepted rule that no more than 30% of the leaf tissue should be removed in a single mow. Instead, significant evidence indicates that some turf species such as tall and fine fescue and perennial ryegrass can have between 50 and 75% of the tissue removed before any turf thinning occurs. Ultimately increasing mowing frequency positively effects turf density, but will increase the energy consumption of the maintenance program.

7.3.1.3 Mower Selection

Mower selection is based on the expected height of cut. Mowing heights at or below 1.5 inches are typically best achieved with a reel-type mower. Reel mowers allow for rapid clipping of turfgrass tissue at practical operating speeds with minimal turf damage (when properly adjusted). Mowing heights above 1.5 inches are best achieved with rotary impact mowers, also when blades are sharpened and properly balanced.

Any mistake in mower set up from blade sharpness to bedknife alignment can lead to increased stress from wounding and reduction in turf density. Therefore, the mower must be properly adjusted and set up to minimize leaf shredding and wounding for pathogens. Reel and rotary mower blades are shown in Figures 7-7 and 7-8.

Figure 7-7. Reel mowers are ideal for golf turf mowed under 1" height of cut. ***Source*****: Frank Rossi.**

Figure 7-8. Rotary mowers are best used for height of cuts above 1". Blades should be sharpened after every 10 hours of use. ***Source*****: Frank Rossi.**

7.3.1.4 Clipping Management

Clipping management is the decision to let the clippings fall back to the turf canopy or remove them in a bucket or bag. From a water quality perspective, grass clipping are a nutrient rich resource and should be viewed as fertilizer and handled and applied with similar precaution. Accumulated clippings distributed over a relatively small area can significantly increase nitrate leaching. Some courses will remove clippings from fairways. Distributing these clippings to driving ranges, clubhouse lawns or simply stockpiled as organic waste. Excessive clippings aggregation has been shown to increase soil nitrate levels from less than 2.5 mg N kg-1 to a range of 15-30 mg N kg-1 across the 3-12 inch profile in areas that received four times the amount of normal clippings return. (Bigelow et al. 2005).

Removal of clippings should only be performed if the function of the site dictates removal (such as ball roll on a putting surface). If clippings are left on the site, they must not be allowed to discharge into adjacent water bodies or to clump on the surface and shade the turf (Figure 7-9and 7-10).

Several research experiments have investigated the effect of long-term clipping management on turf fertilization. In general, clipping removal mines the soil for nutrients and takes them to another location. Thus leaving the clippings on the site as the turf ages assists in sustaining the nutrient content of the soil and reduces the reliance on supplemental fertilizer.

In summary, a properly mowed turf maintains a high shoot density that limits surface water movement. A properly mowed turf sustains an adequate underground biomass to retain additional water and nutrients that infiltrate. Finally, when managing clippings consider them a nutritional resource and leave them on site if possible. Use care in removing or discharging in order to preserve water quality (for instance, do not put clippings in or near storm water treatment structures or wetlands).

Figure 7-9. Clipping removal is only recommended on surfaces where they disrupt the function of the sites, such as putting surfaces. ***Source*****: Frank Rossi.**

Figure 7-10. Clippings left on turf after mowing can lead to shading of the turf below and heat stress from microbial activity generated in the piles. ***Source*****: Frank Rossi.**

7.4 Organic Matter

Turf is a perennial plant system that increases biomass as a result of growth and management. Biomass accumulates at the surface from the development and deposition of plant parts such as leaves, stems, and roots. Aboveground plant parts such as leaves and stems are often removed and regrown as a result of frequent mowing. Underground plant parts such as stems (rhizomes) and roots cycle as living, dead, and decomposing organic matter.

The accumulation of organic matter in the top 3 to 6 inches of a turf system provides nutrient and water holding as well as cushioning and insulation. When organic matter accumulates at a rate greater than it degrades, however, it can restrict infiltration of water and gas exchange between the atmosphere and the soil air space in pores.

Excessive organic matter at the surface can become hydrophobic and increase runoff from the turf surface, which may also reduce the effectiveness of fertilizer and pesticides. Furthermore, excessive surface organic matter can promote surface rooting that interferes with the turf's use of water and mineral nutrients, which leads to increased potential for off-site movement of chemicals applied to turf. Figures 7-11 through 7-13 illustrate the problems resulting from the accumulation of surface organic matter.

Figure 7-11. Excessive surface organic matter can lead to anaerobic conditions that encourage diseases such as black layer. *Source*: Frank Rossi.

Figure 7-12. Soil layering leads to impeded drainage, increasing surface moisture that can lead to runoff. *Source*: Frank Rossi.

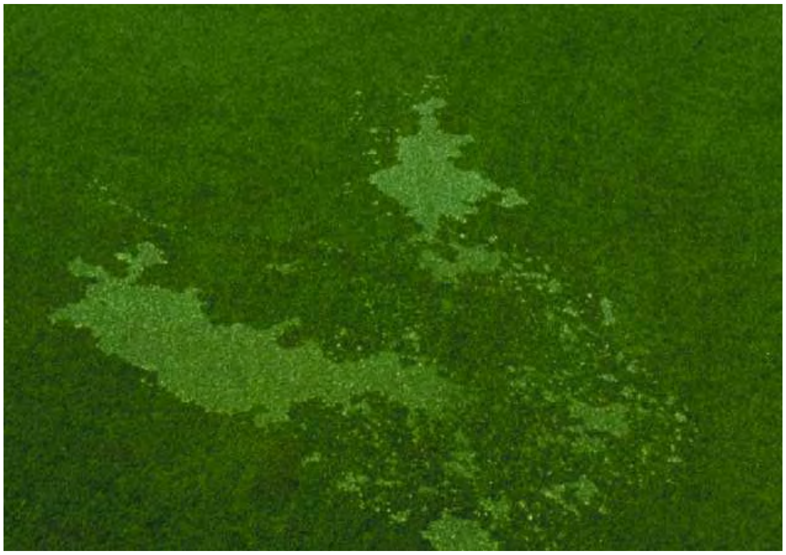


Figure 7-13. Surface organic matter accumulation results in hydrophobic conditions that can lead to increased runoff. The use of wetting agents can mitigate such problems. ***Source*****: Frank Rossi.**

7.4.1 Factors That Increase Organic Matter

Many factors influence the accumulation of organic matter including turfgrass species, fertilization, and soil physical and chemical properties. Some turf species such as the fine leaf fescues produce significant amounts of highly lignified tissue that degrades slowly. Other species such as perennial ryegrass produce very little lignified tissue and therefore do not accumulate much surface organic matter. Grasses with high amounts of stem tissue, like rhizomes and stolons, often accumulate greater amounts of organic matter.

Figure 7-14. Wet surfaces lead to reduction in golf turf performance, such as plugged balls. This also increases the risk of runoff when soil surface is persistently wet. ***Source*****: Frank Rossi.**

7.4.1.1 Grass Type

Creeping bentgrass and annual bluegrass are considered intermediate in their development of organic matter. They accumulate organic matter, but often that matter is not highly lignified tissue and, under warm moist soil conditions, it degrades. Still, these grasses accumulate organic matter at the surface at a rate greater than microorganisms can degrade and thus the accumulation requires dilution or mechanical removal.

7.4.1.2 Fertilization

Increase in biomass is a normal aspect of plant growth. Supplemental fertilization for functional and aesthetic purposes produces more biomass and more organic matter when compared to an unfertilized turf. The rate of decomposition also increases with supplemental fertilization, up to a point. Therefore applying enough fertilizer to meet the visual and functional requirements of the turf, but not in excess of these requirements, is critical. Excess fertilization increases biomass production that leads to excess surface organic matter production, reduced infiltration, and increased runoff.

Organic matter is a food source for macro- and microorganisms. The soil food web requires an adequate amount of organic matter and microbial activity to function properly. Degradation of organic matter is maximized in a well-aerated, moist soil with temperatures greater than 65°F. For every ten degree Celsius increase in soil temperature, microbial activity increases tenfold; this principle is referred to as the "Q10".

7.4.1.3 Soil Management

Poorly drained soils with high bulk density and predominance of fine particles that restrict soil gas exchange reduce microbial activity. These dense, cool soils also restrict rooting to the surface, which further exacerbates the surface organic matter problem. Maintaining a permeable soil surface sustains adequate microbial activity, good deep root development, and proper infiltration. Taken together, these practices lead to a turf surface less likely to create runoff and more able to retain chemicals applied to turf top prevent leaching.

Understating soil physical properties and amending the soil to minimize the potential for compaction is the key to proper soil management. Soil modification is best performed at establishment. Additionally, hollow-tine cultivation by removing existing soil and organic matter and adding coarse textured material such as sand or compost can be effective over time. Hollow-tine cultivation that removes 0.5 inch soil cores to a 4 inch depth has been shown to influence less than 5% of the turf surface during normal operation. Equipment modifications can be made to increase that percentage to as much as 20%, however, this is a tedious and long-term process.

Additional forms of cultivation such as solid tine, needle tine, or water injection cultivation that make a hole but do not remove soil can also increase soil infiltration. The benefits of these practices are short-lived and consequently must be repeated routinely to maintain a permeable surface. Due to golf traffic, soils prone to compaction will continue to become compacted and limit infiltration without soil modification.

Figures 7-15 through 7-22 illustrate soil management techniques.

Figure 7-15. Slice holes made from a putting surface spiking operation used to maximize infiltration and gas exchange. *Source*: Frank Rossi.

Figure 7-16. Core cultivation shown from a distance (top) and up close (bottom) is an ideal method for alleviating compaction, removing organic matter, and amending problem soils, which should increase infiltration and reduce the risk of runoff. ***Source*****: Frank Rossi.**

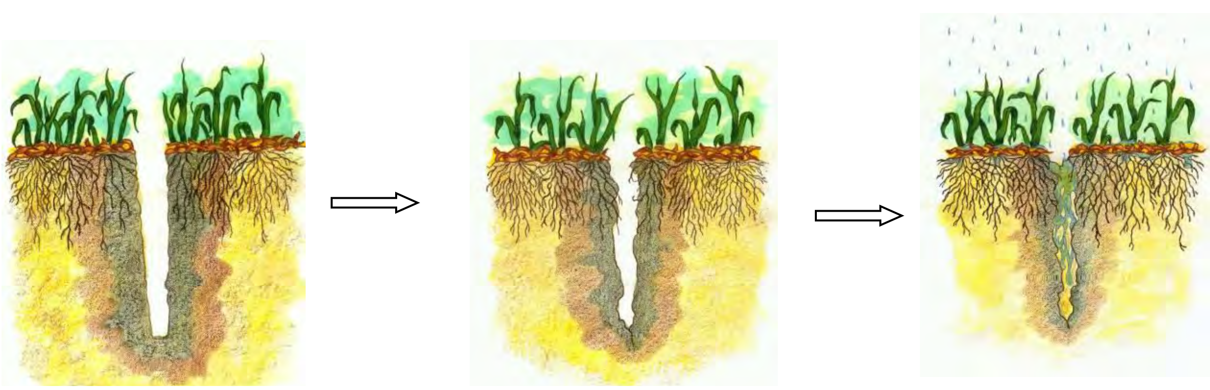


Figure 7-17. Schematic representation of core hole over time. Note hole edges are different colors depicting change in bulk density around the core. Over time the core edges collapse as water and roots begin to infiltrate the core.

Figure 7-18. Deep slicing can aid with remediating large areas of soil in need of increased infiltration and gas exchange. ***Source*****: Frank Rossi.**

Figure 7-19. Spiking attachments aid with increasing infiltration and can affect significant amounts of surface areas. ***Source*****: Frank Rossi.**

Figure 7-20. Less invasive cultivation methods such as water injection significantly increases infiltration and gas exchange. ***Source*****: Frank Rossi.**

Figure 7-21. Water injection cultivation is the 'gold standard' for increasing infiltration and improved gas exchange with minimal surface disruption. ***Source*****: Frank Rossi.**

Figure 7-22. Hollow tine cultivation is an ideal method for amending soils. ***Source*****: Frank Rossi.**

7.4.1.4 Soil Modification With Topdressing

Managing surface organic matter is best accomplished by prevention through proper fertilization and soil management. Many common golf turf grasses, however, under routine maintenance and adequate prevention still produce organic matter that requires some level of management. The most effective means of managing surface organic matter is through regular applications of sand or soil via topdressing. A light (0.1 to 0.2 inches) application of material applied and integrated into the surface of the turf dilutes the organic matter and creates a physical matrix that functions as a soil.

Topdressing is often performed in conjunction with some form of cultivation that either removes a core or makes a hole. The cultivation can not only provide minor removal of the surface material but also create space for topdressing to serve the purpose of dilution and creation of a pseudo-soil matrix.

Recent research suggests that under normal golf turf management, creeping bentgrass putting surfaces require between 18 and 22 cubic feet of sand per 1000 square feet per year to properly dilute surface organic matter. This application requires topdressing as frequently as every 5 days without any cultivation, to as many as 14 to 21 days with more routine cultivation. Ultimately, the goal of proper dilution is to ensure the adequate infiltration while preserving sufficient retention of the turf system to prevent leaching. Figures 7-23 through 7-26 illustrate soil modification with topdressing.

Figure 7-23. Although large scale sand topdressing operations can be costly, they aid in reducing runoff from soils with organic matter accumulation and heavy compaction. ***Source*****: Frank Rossi.**

Figure 7-24. Sand topdressing helps provide high performance playing surfaces that also reduce the risk of runoff by increasing infiltration, reducing compaction, and diluting organic matter. *Source*: Frank Rossi.

Figure 7-25. Sand-based greens offer the best options for maximizing performance and minimizing water quality issues. *Source*: Frank Rossi.

Figure 7-26. Proper topdressing material selection and storage are vital for maintaining a permeable turf surface. ***Source*: Frank Rossi.**

7.5 Summary

BMPs for golf course turf to preserve and protect water quality using cultural practices must be designed to sustain high turf shoot density. A dense turf reduces runoff and the negative effect of off-site movement of water and pollutants. This density maintenance must be a primary concern for golf courses.

A dense turf, however, accumulates surface organic matter that can restrict infiltration and lead to increased runoff. Maintaining the permeability of the turf surface is as important as maintaining turf density. Strategies for preventing excessive organic matter accumulation are important, but the management through dilution and cultivation of the soil is key. This practice can include modification to improve the root zone, balance adequate infiltration as means of reducing runoff, and adequate retention to prevent leaching.

BMP Statements

- Use and manage turfgrass species and varieties adapted to macro and micro climatic conditions of your location.
- Maintain turf with high shoot density to minimize runoff and maximize infiltration.
- Manage the surface accumulation of organic matter to maintain a permeable system that minimizes runoff and maximizes subsurface retention.

8 INTEGRATED PEST MANAGEMENT

Integrated pest management (IPM) concepts were originally developed in the 1960s by entomologists who examined pest management, especially the use of pesticides, as it relates to both economic value and environmental impact in agriculture. Since then, the definition and practice of IPM has grown to include all types of pests (insects, weeds, pathogens and diseases, and vertebrates) and settings beyond agriculture such as parks, golf courses, homes, and office buildings (Bajwa and Kogan 2002; Hoffmann and Gangloff-Kaufmann 2004). The turf industry has embraced IPM and virtually all modern textbooks and courses on turfgrass management include IPM. IPM for turf can be defined as follows:

> IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks and maintains turfgrass quality.

The concepts and principles of IPM should continually be reviewed and refocused with the goal of protecting water quality and soil on any property. Key tenets of IPM include pest prevention as a first line of defense and basing pest management decisions on:

- knowledge of pest biology and life cycle
- action thresholds—derived scientifically and through experience
- monitoring of pests
- monitoring of turfgrass health
- monitoring of weather conditions and forecasts

IPM is a useful framework for addressing course needs, while prioritizing initiatives and tasks. Using IPM requires careful attention to detail, which usually results in improved course quality, often using fewer inputs. By following the latest research, managers can have high quality playing surfaces with minimal impact on the environment.
Research at Bethpage State Park has shown that IPM can result in 33 to 96% less environmental impact without reducing course quality, and does not cost more than conventional management (Rossi and Grant 2009). IPM is flexible and superintendents can usually balance course quality and environmental goals.

For more information:

- New York State's IPM Program: http://www.nysipm.cornell.edu/default.asp
- *Reducing Chemical Use on Golf Course Turf: Redefining IPM*: www.hort.cornell.edu/turf/pubs/manual.html
- *Cornell Guide for Commercial Turfgrass Management*: ipmguidelines.org/turfgrass/
- Bethpage State Park research: http://www.nysipm.cornell.edu/publications/long_term/files/long_term.pdf

8.1 Seven Steps of IPM

Although IPM permeates all aspects of course management and planning, it can be thought of in seven steps. The steps are sequential, but in practice all are ongoing and overlapping:

Step 1 – Planning
Step 2 – Identification and Monitoring
Step 3 – Course Management
Step 4 – Evaluation & Analysis
Step 5 – Intervention
Step 6 – Record Keeping
Step 7 - Communication

8.1.1 Planning

Many environmental stresses that result in higher pest incidence and severity can be avoided through careful course design and planning, however, most superintendents are faced with managing an existing course. Pest problems and inputs can still be minimized through course modifications and preventive cultural practices.

Knowledge of past pest occurrence, locations ("hot spots"), and management practices are essential as past problems are likely to recur or continue without intervention. The winter months are a valuable time for reviewing pest issues from the previous season, by asking questions such as:

- Can environmental conditions be modified to reduce pest pressure? For example, can trees be removed around a putting green to increase airflow and reduce disease incidence and severity?
- Can traffic be routed to reduce stress? For example, can cart or walking paths be moved to diffuse walk-off areas on a putting green?
- Were monitoring procedures adequate to detect pests early? For example, should pitfall traps be installed to monitor for early season annual bluegrass weevil migration?
- Can pest-resistant grass cultivars be overseeded on any area of the course? For example, a cultivar such as Memorial, a dollar spot resistant cultivar of bentgrass, can be used to overseed putting greens.
- Are cultural practices adequate for minimizing pest problems? For example, would more frequent topdressing decrease anthracnose pressure?
- Have suppliers of new or hard to find products or equipment been identified in order to be prepared to react quickly to a pest outbreak? For example, where can entomopathogenic nematodes for grub control be obtained if needed and desired?

Part of planning is also being aware of new pests. Educational meetings, trade journals, blogs, listserves, and contact with other superintendents and local cooperative extension personnel are usually the best avenues for being alerted. Once a threat is identified, a superintendent should plan how to prevent, monitor, and manage the new pest.

8.1.2 Identification and Monitoring

Figure 8-1. Pink and gray snow mold. *Source*: Jennifer Grant.

Every course should have a plan for formal pest monitoring or "scouting" of all areas. For example, the frequency should be daily on putting greens, at least weekly on tees and fairways and bi-weekly on. Whenever possible, the pest pressure should be quantified with measurements such as:

- number of insects per unit area
- disease patch sizes
- percent area affected

Qualitative descriptors such as "high", "low", or "very bad" are subjective and difficult to calibrate and track change over time. Photographs also provide excellent documentation and can be used for identification and training.

Once detected, pests must be properly identified and documented, including mapping on an area map and recording the date of the outbreak. This information can be used to build a database for reference in future seasons. Superintendents and staff should continually hone and improve skills by attending training seminars and field days, obtaining reference materials, and providing peer-peer training on problems occurring on the course. Golf course personnel should also know where to send photos or samples when additional expertise is warranted for identification or confirmation.

Figure 8-2. Soap flushes are a useful monitoring technique. The soap irritates many insects and causes them move out of the thatch and lower plant parts to the tips of grassblades for easier detection and counting. This technique is especially useful for monitor.

Figure 8-3. Soil cores removed with cup cutters can be searched quickly and easily for the presence of white grubs. The grubs can also be identified for species and life stage. *Source*: Curt Petzoldt.

Recommended diagnostic laboratory locations include:

- Cornell Cooperative Extension County office (diagnostic labs available in limited locations), http://www.cce.cornell.edu/learnAbout/Pages/Local_Offices.aspx
- Cornell University Insect Diagnostic Laboratory, http://entomology.cornell.edu//extension/idl/index.cfm
- Cornell University Plant Disease Diagnostic Clinic, http://plantclinic.cornell.edu/
- Rutgers University Plant Diagnostic Laboratory, http://njaes.rutgers.edu/plantdiagnosticlab/default.asp

8.1.3 Course Management

Almost every aspect of golf course management affects the likelihood and severity of pest problems. Although practices required for playability sometimes supersede the optimal IPM choice, manipulating cultural practices should be a key part of an IPM approach. For example, low mowing heights used to obtain high ball roll distances on putting greens can be modified by mowing and rolling greens on alternate days to lessen turf stress while still providing the same ball roll. Similarly, frequent topdressing buries the crown, effectively giving the plant a higher height of cut, while still providing good ball roll. Ultimately stress-reducing practices such as these decrease the incidence of disease and reduce weeds, which in turn reduces reliance on chemical pesticides.

8.1.4 Evaluation and Analysis

IPM is a knowledge-intensive decision-making system, requiring evaluation of incoming information, such as:

- scouting results

- weather forecasts
- golf course calendar events
- previous pest history and course hot spots
- past pest management success (for example, timing and efficacy of cultural practices, biological controls, and pesticides)
- new information from university research and the experience of peers

By constantly integrating these sources of information, the superintendent can best decide if a pest threat exists, and when, whether, and how it can be avoided or controlled. For some pests, action thresholds will trigger an intervention reaction (Step 5) in season. For others, cultural management strategies may be intensified.

8.1.5 Intervention

Intervention is the action taken when pest levels reach the threshold known to cause unacceptable damage or turf loss. In some cases, these thresholds have been determined scientifically, while in other instances these thresholds are based on site-specific experience. To avoid unacceptable damage or loss, the IPM method relies on an integrated approach using multiple cultural, mechanical, and biological management methods. Using the IPM approach, chemical control is reserved as a last option used only when other methods are insufficient for maintaining acceptable turfgrass quality and playability.

When chemical control is warranted, evaluation and analysis (Step 4) often allows for early intervention, which may result in the use of lower toxicity treatments and spot treatment rather than whole area treatments. An IPM practitioner considers all approaches and selects the least disruptive, but effective, option.

8.1.6 Record Keeping

Documentation is key to connecting the elements of an IPM program and increasing its value. In order to be effective, IPM record keeping should exceed legal requirements (see Table 8-1, Figure 8-4).

Table 8-1. IPM Record Keeping

Record-keeping Category	Record Details
Scouting Records	Pest occurrence, location and severity
	Improvements or increases in pest issues in response to management tactics
Cultural Management Logs	Frequency, timing, location
	Equipment settings, rates (e.g. amount of sand used for topdressing)
	Operator
Weather Conditions	Current
	Forecasted

Record-keeping Category	Record Details
Pesticide Application Records	All legal requirements such as date, location, product, area treated, and applicator
	Reason(s) for application
	Results
Water Requirements	Monitor soil moisture

Ways to simplify documentation and integration of IPM methods with other aspects of course management include the following:

- Integrate scouting records with mandatory pesticide application records.
- Encourage all staff to report pest sightings and have a convenient method for tracking and sharing this information.
- Use electronic records rather than hand-written records.
- Encourage staff use of tablets and phones for sending data and photos to a central location.
- Use Cornell's TracGolf software program (http://www.nysipm.cornell.edu/trac/about/about_golf.asp)
- Emphasize scouting records and other IPM information as part of staff training, meetings, and daily communications.

Figure 8-4. Photographs are useful for documenting pest occurrence and damage, and can be compared against past and future photos. ***Source*****: Jennifer Grant.**

8.1.7 Communication

Good communication within the maintenance team is an essential aspect of IPM. Regardless of who monitors pest issues, all staff should be aware of pest problems and management activities and should be encouraged to report observed and potential problems. Furthermore, IPM training should be provided to as many staff as possible.

Communication to golfers, members, administrators, and neighbors is also important. Communicating with these stakeholders lessens the chance of surprises and conflicts and increases recognition of the superintendent and staff as trained professionals that care about protecting the environment. Explaining the IPM approach in personal communications, promotional literature, club newsletters, blogs, and websites helps to advance these goals.

8.2 Management Options

An IPM manager uses a mix of preventive and reactive strategies to manage pest problems. Course management decisions and cultural practices are ongoing, while reactive measures are decided and implemented in season. Selecting from a number of management options according to incoming information instead of the calendar is a hallmark of an IPM manager.

8.2.1 Diversification

Diversification of management options is key, using a variety of cultural, biological, physical, and possibly chemical strategies. The case against sole reliance on chemical approaches is obvious because it promotes resistance, and frequent use may subject applicators, golfers and the environment to unnecessary risks. Similarly, reliance on any other single-tactic approaches is also not recommended, because if it fails, damage or turf loss is likely which can also negatively affect water quality. IPM's diversification of tactics allows for multiple layers of protection, and therefore better insurance against pests.

8.2.2 Role of Cultural Management

Turfgrass is a perennial plant system in which cultural practices, especially irrigation, mowing, topdressing, aeration, and venting, greatly affect both short and long term plant health. Healthy plants and soil can better withstand pest pressure. Weak turf can be outcompeted by weeds that take advantage of bare ground or thin turf. Pathogens in particular can take advantage of weak, stressed, or otherwise unhealthy plants and cause disease. Unhealthy plants are also less able to fend off, compensate for, mask, or recover from insect damage. Below are examples of how an IPM approach can be used to for a specific weed, disease, and insect pest issue.

Figure 8-5. ***Poa annua*****.** ***Source*****: Jennifer Grant.**

8.2.2.1 Weed Example

One of the most effective prevention strategies in weed management is to use the appropriate turf varieties for the specific site conditions and intended use on the golf course. For example, a recent development in some golf courses is the use of tall fescue/blue blends in the rough because heat and drought in the summers create challenges for turf management (Figure 8-6). Another

Figure 8-6. Tall fescue/bluegrass blend in a rough. Source: Bob Mugass, University of Minnesota.

concept is to use weed suppressive fine fescues in the roughs, such as Intrigue II and Columbra II that produce allelochemical from their roots. These compounds inhibit the growth of weeds while maintaining a healthy stand of fine fescues. New turf varieties have been developed that provide improved drought tolerance, disease resistance, and have a greater ability to handle foot and cart traffic. In the near future, salt tolerance will be added to the growing list of improved turf varieties as restrictions on high quality water use become an increasing concern for golf courses. Using these improved turf varieties can effectively minimize weed infestation in greens and fairways with low turf density or bare areas.

Another effective prevention strategy is to use high quality turf seed that is free of weed seeds. Many suppliers provide a guarantee that states the percentage of weed-free content. The same strategy is useful in determining sod installations for the course as most suppliers guarantee a percentage cover of weed-free sod. The general rule is to purchase high quality seed that is greater than 99% weed free and sod that is 100% weed free, including annual bluegrass.

While prevention is a critical component in weed management, post-emergence control is a necessary part of routine turf management. Many chemical methods for post-emergence control provide rapid, inexpensive eradication of grass and broadleaf weeds. The nonchemical control options include use of thermal weeding technologies, such as propane weed torches, steam wands, and infrared heating devices. These thermal devices can remove patches of weeds or sections of turf for a renovation project. A study conducted at the Royal Quebec Golf Course showed control of *Poa annua* in bentgrass fairways treated with flame weeding using a tractor fitted with burners. The bentgrass was able to recuperate, while *P. annua* declined after one month (see GCSA Management article http://www2.gcsaa.org/gcm/1997/oct97/10poawar.html for more information). Thermal weeding can give stoloniferous or rhizomatous turfgrasses a competitive edge over weeds that grow as bunchgrasses.

Figure 8-7. Hand weeding is sometimes the most effective and environmentally friendly method of weed management. This photo shows invasive species in the rough. *Source*: Jennifer Grant.

Dollar spot, caused by the pathogen *Sclerotinia homoeocarpa*, is a common golf course disease in New York State (Figure 8-8). Besides using chemical controls, managers can plan to lessen disease incidence and severity with the following activities:

Figure 8-8. Dollar spot. *Source*: Jennifer Grant.

- Plant resistant cultivars of creeping bentgrass such as Memorial and Declaration.
- Minimize moisture stress and leaf wetness.
- Remove morning dew as early as possible.
- Roll putting greens three or more times per week.
- Apply biological organisms known to suppress dollar spot such as *Bacillus licheniformis*, *Bacillus subtilis*, and *Pseudomonas aureofaciens.*
- Use horticultural oils (Civitas), labeled for the intended use both for treated area and pest, instead of or in conjunction with traditional fungicides.

8.2.2.2 Insect Example

Annual bluegrass weevils (ABW) are pests of golf courses in many parts of New York (Figure 8-9) . The only cultural practice known to successfully minimize their damage is to reduce the amount of annual bluegrass in infested areas. In mixed stands of annual bluegrass and creeping bentgrass, as is commonly found on putting greens, practices that favor bentgrass can be promoted. In other areas, it may be acceptable to convert the grass to alternate species such as ryegrass or Kentucky bluegrass. It may also be possible to protect areas by creating a barrier strip of an alternate grass species that deters the spring migration of ABW adults traveling from their overwintering sites to playing surfaces.

Figure 8-9. Annual bluegrass weevils. ***Source*****: Jennifer Grant.**

Vacuuming has been used to monitor ABW adults in turf, but may also work as a physical and mechanical control practice if done frequently, especially during the spring migration (Figure 8-10). Biological control methods have been largely unsuccessful in scientific research, but the use of entomopathogenic nematodes may still hold promise.

Beyond the techniques listed, IPM for ABW has relied mainly on careful monitoring of the insect as well as phenological indicators and degree days to target insecticide applications. Pitfall traps, soap flushes, and vacuum sampling detect when and where the adults are moving from their overwintering spots. An insecticide targeting adults is typically timed for the peak migration time. Subsequently, these sampling techniques, along with saline floats that monitor larval development, are used to time the application of an insecticide targeted at 3rd to 5th instar larvae.

Figure 8-10. Vacuuming to determine annual bluegrass weevil adult presence, location, and movement. ***Source*****: Jennifer Grant.**

8.2.3 Use of Softer and Alternative Pesticides

IPM encourages the use of pesticides as a "last resort" when other methods of pest control prove to be inadequate. However, when pesticides are deemed necessary, an effective product least likely to harm human health or the environment should be selected. Other management options include using an alternative product, such as biological controls or reduced risk pesticides.

8.2.3.1 Biological Controls

Biological control uses other living organisms to suppress or eliminate pests. Several organisms are known to have some efficacy against turfgrass pests and have been marketed as pest control products. These biological controls may act to suppress pest populations alone or work synergistically with other natural, cultural, physical, or chemical management methods. Examples of biological controls that are commercially available in New York State are provided in Table 8-2.

Table 8-2. Biological controls

Beneficial Bacteria	**Action**
Bacillus licheniformis	Labeled for dollar spot management
Bacillus subtilis	Labeled for management of brown patch, dollar spot, powdery mildew, rust and anthracnose
Pseudomonas aureofaciens (strain TX-1)	Labeled for management of anthracnose, dollar spot, pink snow mold and pythium
Bacillus thuringiensis	Labeled for management of caterpillars in turf. A strain that affects white grubs is known, but not currently commercially available.
Paenibacillus popilliae and *Paenibacillus lentimorbus*	Cause "milky spore disease" and are labeled for management of Japanese beetle grubs in turf. Other strains cause milky spores in other species of grubs, but are not commercially available.
Entomopathogenic Nematodes	**Action**
Heterorhabditis bacteriophora and *Steinernema glaseri*	Effective against white grubs
Steinernema carpocapsae	Effective against cutworms and possibly annual bluegrass weevils

8.2.3.2 Reduced Risk Pesticides

The EPA defines conventional "Reduced Risk" pesticides as having one or more of the following advantages over existing products:

- low impact on human health
- low toxicity to non-target organisms (birds, fish, and plants)
- low potential for groundwater contamination
- lower use rates
- compatibility with IPM

A number of reduced risk pesticides can be used on turfgrass in NYS (Table 8-3). Biological pesticides, which also have many of these desirable characteristics, are classified separately by the EPA.

Table 8-3. Reduced risk pesticides

Category	Reduced Risk Pesticide
Fungicides	Azoxystrobin
	Boscalid
	Fludioxonil
	Trifloxystrobin
Herbicides	Bispyribac-sodium
	Carfentrazone-ethyl
	Mesotrione
	Penoxsulam
Insecticides	Chlorantraniliprole
	Spinosad

8.3 Pesticide Selection Criteria

When chemical control is needed, several important criteria can be used to select the right pesticide:

- must be registered for use in New York State
- must be properly transported, handled, and stored
- should be effective in treating the pest problem
- the frequency of pesticides usage considered with respect to the possibility of chemical resistance
- costs should be considered
- environmental risk and potential for water quality impacts must be evaluated

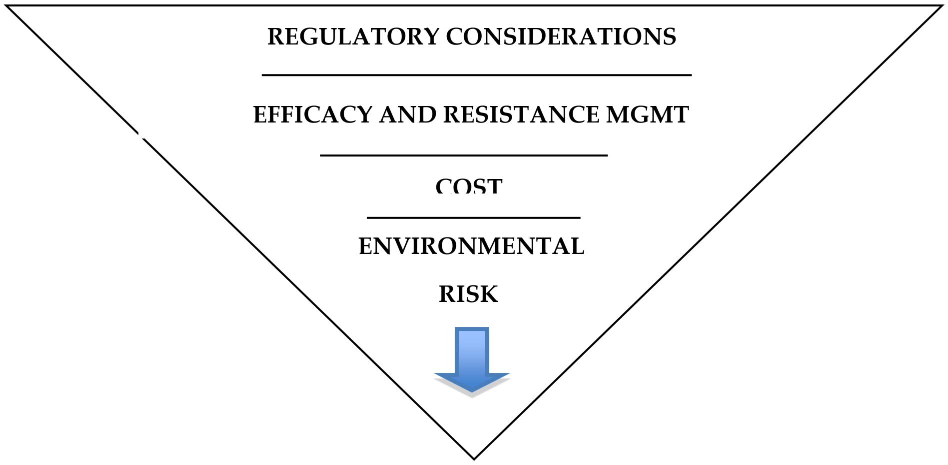


Figure 8-11: Pesticide selection criteria.

8.3.1 Efficacy and Resistance Management

Among the pesticides registered for use in New York, selection should be based on the effectiveness of the product to prevent or treat pest problems. Products that are more effective can often be used at lower rates and fewer applications. The *Cornell Guide for Commercial Turfgrass Management* published annually by Cornell University lists recommendations for the most effective treatments of pest problems. In addition to these guidelines, manufacturers and trade journals often present research reviewing different products tested. The University of Kentucky provides a special service to the industry by reviewing all research on fungicides and grading the effectiveness of fungicides annually.

If chemical control is required, rotating chemical classes of pesticides used is recommended to manage the potential of resistance to any specific mode of action. Avoiding resistance makes each chemical used more effective, reducing rates and frequencies of applications. Every pesticide label should identify its resistance class.

For more information, see:

- *Cornell Guide for Commercial Turfgrass Management*: ipmguidelines.org/turfgrass/
- University of KY fungicides report: www.ca.uky.edu/agc/pubs/ppa/ppa1/ppa1.pdf
- Fungicide Resistance Action Committee: www.frac.info
- Herbicide Resistance Action Committee: www.hracglobal.com/
- Insecticide Resistance Action Committee: www.irac-online.org/
- EPA Pesticide Resistance Labeling: www.epa.gov/PR_Notices/pr2001-5.pdf
- International Survey of Herbicide Resistance Weeds: www.weedscience.com/summary/home.aspx

8.3.2 Costs

Pesticides are marketed in a variety of forms and packaging. Product selection should not be based on the price per container, as application rates and intervals vary and more effective products with a lower environmental risk can cost less per day of treatment. The real costs of products can be compared using simple tools. Table 8-4 shows an example that compares very effective bio-based controls to conventional pesticides for the treatment of dollar spot.

Table 8-4. Cost comparisons of alternative chemical control of dollar spot

Control	App Rate (oz or fl oz per 1000 ft²)	Cost per 1000 ft²	Acres Treated	Spray Interval	Cost per Day	FRAC Class	EIQ Quotient	Field Use EIQ
Traditional Program								
Daconil	4	$1.94	3	14	$18.09	MS	37.42	336
Banner Maxx	2	3.30	3	14	$30.77	3	31.63	25
Program 4								
Emerald	0.13	$2.36	3	28	$11.00	7	26.64	7
Civitas	16	$3.59	3	28	$16.77	Bio-based	0.00	0

8.3.3 Environmental Risks

The use of pesticides presents certain risks in terms of toxicity to human or other nontarget organisms including soil microbes, insects, birds, animals, and aquatic species. Pesticides can migrate off the target site through the environmental transport process of runoff, leaching, or drift. Understanding both the site and pesticide characteristics and their relationship is the basis for assessing a pesticide’s site-specific vulnerability to environmental transport.

8.3.3.1 Pesticide Toxicity

Pesticides may pose varying degrees of risk to humans denoted by the EPA as acute toxicity levels for oral ingestion, dermal sensitivity, inhalation, and eye irritation. Signal words on labels characterize pesticide into four toxicity-based categories to invoke special attention when handling or applying the pesticide (Table 8-5).

Table 8-5. Signal words by toxicity ratings

Toxicity	Signal Word
Category I	DANGER
Category II	WARNING
Category III	CAUTION
Category IV	None required

Pesticide labels also stipulate proper personal protective equipment (PPE) to be worn when handling or applying pesticides. In addition, instructions on the label specify proper procedures in case of accidents or emergencies to prevent exposure. Not as much is known about chronic toxicity due to prolonged exposure to a pesticide as is known about acute toxicity. Some pesticides are known to accumulate over time, although the risks of such accumulation have not been fully identified.

The Pesticide Action Network has compiled a pesticide database that identifies pesticides with known or suspected toxicity. Appendix C provides human health and aquatic toxicity risk ratings for pesticides registered for use in New York State.

For more information:

- PAN Pesticide Database: http://www.pesticideinfo.org
- Pesticide Properties Database (PPDB), pesticide physicochemical, toxicological, ecotoxicological and other related data: http://agrochemicals.iupac.org

8.3.3.2 Pesticide Characteristics

The fate of a pesticide applied to turf is determined by the soil characteristics, environmental conditions, and the chemical properties of the pesticide. These factors can be used to help recognize conditions and select pesticides that can help minimize the risk of ground and surface water contamination through leaching, runoff, or drift.

Information for pesticides approved for use in New York State are summarized in Appendix C and includes the following information: rate ranges, Field Use EIQ ranges, Chemical Class, Aquatic Toxicity, Solubility, Soil Adsorption (Koc), half life, GUS values, and WIN PST ratings for sand greens. The tables provide reference tools to select pesticides based on their environmental fate and toxicity. A summary of chemical and physical property threshold values indicating the potential for groundwater contamination is provided in Table 8-6.

Table 8-6. Threshold values indicating potential for groundwater contamination by pesticides.

Chemical or Physical Property	Threshold Value
Water solubility	Greater than 30 ppm
Henry's Law Constant	Less than lO^{-2} atm to m^{-3} mol
Kd	less than 5, usually less than 1 or 2
Koc	less than 300 to 500
Hydrolysis half-life	more than 25 weeks
Photolysis half-life	more than 1 week
Field dissipation half-life	more than three weeks

8.3.3.3 Soil

Soil texture is based on the proportion of sand, silt, and clay. Soils with larger particle sizes have higher aeration (macropore) porosity and greater risk of leaching. Soil surveys classify soil type and texture into four hydrologic groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation for a long period. The NRCS Soil Survey defines four hydrologic soil groups that vary with respect to leaching and runoff potential (Table 8-7).

Table 8-7. Leaching and runoff potential by soil group

Runoff Potential

Leaching Potential

Soil Group	Description
A	Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
B	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well-drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
C	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
D	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a clay pan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

.4 Pesticide Persistence

Once applied, pesticides break down in the environment through a number of processes: exposure to light (photodegradation), chemical reactions in the soil, and the action of soil microbes or other organisms (biodegradation). Environmental conditions such as temperature, moisture, and pH also affect the rate of pesticide degradation. The rate of degradation is expressed in terms of half-life, which is the number of days required for half the concentration of a pesticide to breakdown. Persistent pesticides, those with a half-life greater than 21 days, pose a threat to water quality.

8.3.3.5 Solubility

Pesticide chemical properties include a measure of the chemicals cold water solubility, often expressed as grams per liter (g/L), milligrams per liter (mg/L), or parts per million (ppm). A pesticide with a solubility of less than 30 ppm (mg/L) is considered to have a low potential risk to ground and surface water contamination.

8.3.3.6 Soil Adsorption (Koc)

Once in the soil, pesticides vary in how tightly they are adsorbed to soil particles. Chemical mobility in soil is determined by the ratio of the pesticide's solid and aqueous phases, K_D, in the soil. In a solid phase, the pesticide can bind to soil particles and organic matter. In the aqueous phase, the pesticide dissolves in water. The K_D factor varies by soil type. Soil scientists normalize the values, calculating a new coefficient, Koc that accounts for soil organic matter content. The higher the Koc value the greater the bond between the soil and the pesticide. Pesticides with a Koc less than 300-500 are considered a risk to ground water quality, as they tend to dissolve and move with water. The Koc is not well correlated in high clay soils. In these cases, K_D is used to evaluate soil mobility.

8.3.3.7 Groundwater Ubiquity Score

The Groundwater Ubiquity Score (GUS) was developed to model persistence and soil adsorption factors to provide a method to determine the relative risk of leaching. The model was validated by comparing actual leaching data with predicted risks. Pesticides with GUS values greater than 2.8 have high risk of leaching. Pesticides with GUS values below 1.8 are considered to have a low risk of leaching. GUS values for pesticides approved for use in New York have been charted to identify the "leachers" from the "non-leachers" (Tables 8-7, 8-8, and 8-9). These GUS values assess risk based on the chemical properties and do not account for soil conditions. Soils with high infiltration rates or sites with excessive slope may be more prone to leaching and runoff. Nonetheless, GUS values provide a tool to help turf managers select chemicals with the lowest GUS value.

8.3.3.8 Volatility

Some pesticides volatilize readily. Volatility is influenced by environmental conditions, such as temperature, relative humidity, and air movement. High temperatures and low humidity increase evaporation rate. The level of a pesticide's volatility may be indicated on the label.

8.3.4 Pesticide Evaluation Tools

Models have been developed that combine multiple characteristics and give relative weighting or ranking of the potential risk of specific pesticides. These are briefly discussed below. For further information on pesticide evaluation tools, see:

- Cornell EIQ calculator: http://www.nysipm.cornell.edu/EIQCalc/input.php
- WIN-PST: http://go.usa.gov/Kok

- IRPeQ: http://www.mddep.gouv.qc.ca/pesticides/indicateur-en.htm

8.3.4.1 Environmental Impact Quotient

The Environmental Impact Quotient (EIQ) was developed to rate the risk of pesticides to human health and non-target organisms. The EIQ value is derived from mathematically weighting all the risk factors into a quotient. The EIQ is multiplied by the rate of application and percent active ingredient to calculate the Field Use EIQ Rating (FUEIQ):

$$FUEIQ = EIQ \times Rate\ (lbs/acre) \times \%AI$$

The FUEIQ provides a measure of the weighted risk or toxicity of a pesticide expressed as a value per acre. Multiplying the FUEIQ by the number of acres treated provides a risk/toxicity rating for the treated area. Summarizing all applications in this manner provides a summation of risks/toxicity for the entire property over a period. Cornell provides an online EIQ calculator to compare FUEIQ results (http://www.nysipm.cornell.edu/EIQCalc/input.php). A FUEIQ under 25 is desirable. Any value over 100 poses high risks to applicators and the environment. The *Cornell Guide for Commercial Turfgrass Management* lists the range of FUEIQs for the rate range on each pesticide registered for use in New York. The Cornell publication *Reducing Chemical Use on Golf Course Turf: Redefining IPM* describes the methodology to evaluate pesticide environmental toxicity using EIQ.

8.3.4.2 Windows Pesticide Screening Tool

Windows Pesticides Screening Tool (WIN-PST) is an environmental risk screening tool developed by USDA-NRCS for pesticides. This tool uses site-specific information to evaluate the potential of pesticides to move with water and eroded soil/organic matter and affect non-targeted organisms.

The risk of pesticide contamination of either surface water or groundwater is mostly affected by the properties of the pesticide, the properties of the soil, and the amount of rainfall after application. Unlike the EIQ and GUS, WIN- PST can be tailored to site-specific soil conditions and management practices. The method uses standard soil properties provided by the NRCS data base or can be adjusted to site-specific soil factors that affect the movement of pesticides, such the depth of the root zone and the organic matter content. The environmental risk can also be evaluated based on anticipated weather (rainfall).

The following example illustrates how WIN PST can be used for golf course conditions such as a sand green. For this example, the soil is sand at a typical greens depth of 12 inches and the average organic content for the 12 inch profile is 1%, by weight. The pesticides were applied to the turf foliage under two rainfall conditions: low potential for rainfall and a high potential for rainfall. Appendix G contains the WIN PST risk screening for pesticide leaching for most pesticides registered in NYS for use on golf courses. Under the low rainfall potential scenario, most of the pesticides evaluated had a low or very low risk (four had a high/extra high) to humans (long term exposure as a drinking water source) and only one pesticide has a high or extra high risk to fish, even when applied to this very high leaching-groundwater contamination soil like sand. When applied under a high potential rainfall scenario, however, 15 pesticides had a high/extra high risk to humans, and 20 had high/extra high risk to fish.

Based on these result, one of the BMPs for this example is to only apply pesticides when the potential for rainfall is low. On sites where greens drainage is discharged near streams or near drinking water wells, extreme care needs to be taken if a pesticide application is needed during a period with a high potential for rain. Appendix G can be used to select pesticides that have a low risk even under these conditions.

8.3.4.3 Pesticide Risk Indicator for Quebec

Quebec's Ministry of Sustainable Development, Environment, Wildlife and Parks developed the Pesticide Risk Indicator for Quebec (IRPeQ), a diagnostic and decision-making tool designed for the optimal management of pesticides. This tool has both a health component and an environmental component.

BMP Statements

- Conduct a thorough assessment of pest pressure.
- Establish appropriate pest thresholds for managed turf areas.
- Identify and correct growing environments that exacerbate pest pressure.
- Implement sanitation, exclusion, and cultural practices to minimize pest pressure.
- Determine least toxic pest control programs including preventive approaches.
- Assess control program effectiveness using established monitoring practices.
- Recognize environmental fate of pesticides and select pesticides using a selection strategy that includes an evaluation of pesticide characteristics and potential for nontarget effects.

9 PESTICIDE STORAGE, HANDLING AND APPLICATION

Pesticides are an integral component of progressive IPM programs and are tools used to increase or maintain the economic value of properties being managed. The purchase, storage, handling, and use of pesticides are regulated by a number of state and federal agencies because of concerns these compounds pose for human health and the environment.

Recent survey information collected and published by the Environmental Institute for Golf's Environmental Profile Project indicates the level of safeguards currently enacted in the golf course management industry (Lyman et al. 2012). The survey indicated that 98% of average 18-hole golf facilities stored pesticides on the property, with no significant difference in the percentage of golf facilities storing pesticides based on the number of holes, facility type (private or public), or maintenance budget. The most common characteristics of pesticide storage areas include:

- locked or restricted access (94%)
- signs indicating pesticide storage (85%)
- emergency shower or eyewash station nearby (74%)
- impervious floor (68%)
- spill kits (67%)
- floors capable of containing liquid spills (63%)
- passive venting (58%)
- separate/dedicated building (54%)
- impervious shelving (51%)
- powered venting (50%)
- explosion-proof fixtures (30%)

The study also surveyed pesticide handling facilities. The most common characteristics of pesticide handling stations for average 18-hole golf facilities include:

- spill kit located near mix/load area (60%)
- anti-siphoning device on water line (56%)
- emergency water shut-off valve (45%)
- impervious floor (45%)
- recycling of pesticide containers (36%)
- tank-filling capacity greater than 50 gallons per minute (36%)
- floors capable of containing liquid spills (35%)
- overhead protection from weather (29%)
- pesticide rinsate collection (27%)
- stand-alone pesticide mixing tank (15%)

Golf course monitoring programs conducted in New York and several other states indicate little to no risk of water contamination of pesticides applied to golf turf (Appendix B). The application of pesticides is often made with low concentrations of active ingredients, often between 1 to 5% solutions. Simple attention to proper application procedures, especially avoiding direct discharges into water bodies or near wellheads, should typically suffice.

The storage and handling of pesticides on golf courses presents the greatest risk to water quality contamination because of the potential for an unintended release of a large volume of pesticides. Therefore the greatest attention to BMPs should be directed at storage and handling. Properly selecting, storing, handling, and applying pesticides minimizes their potential to reach surface water or groundwater through runoff, leaching, or drift.

For more information on the general use and management of pesticides, see:

- Pesticide Safety Education Program (PSEP), Cornell University Pesticide Management Education Program (PMEP): psep.cce.cornell.edu
- Pesticide Product Ingredient Manufacturer System (PIMS): pims.psur.cornell.edu/
- Cornell University, College of Agriculture and Life Sciences, Occupational & Environmental Health Pesticide Program Overview: oeh.cals.cornell.edu/pestmain.html

9.1 Pesticide Use Regulations

The New York State Environmental Conservation Law (ECL), Article 33, Part 325, establishes statutory authority to the New York State Department of Environmental Conservation to regulate pesticides and pesticide use.

9.1.1 Business Registration

All businesses must register for permits to with the NYSDEC to commercially apply pesticides.

9.1.2 Certified Applicators and Technicians

The law requires commercial applicators and technicians applying pesticides to golf course turf to be certified in categories 3A (ornamentals, shade trees, and turf) or 3B (turf only). Commercial applicators must meet requirements in continuing education credits. Special supervisory restrictions apply to technicians and apprentices.

9.1.3 Labels

When chemical controls are to be used, only pesticides labeled for use in New York State are permitted. In addition to a listing by NYSDEC of registered pesticides, Cornell's pesticide Product Ingredient Manufacturer System (PIMS) lists all registered pesticides searchable by EPA registration number, common name, or active ingredient.

9.1.4 Pesticide Reporting Law

Applicators are required to file an annual report by February 1 each year summarizing their pesticide applications from the previous calendar year. These applicator reports are compiled each year in a summary report on sales and use around the state. The DEC is also monitoring water quality reports to assess pesticide levels in high-risk watersheds, aquifers, and wells across the state.

9.1.5 Neighbor Notification

The ECL was amended to include the Neighbor Notification Law requiring a 48-hour notice to adjoining property owners prior to pesticide application. However, the requirement is only effective for counties that adopt the requirements into local ordinances; golf courses and sod farms are specifically exempted. Registered businesses should check with county officials or regional NYSDEC offices to see if specific local requirements apply.

9.1.6 Pesticide Storage

The pesticide label is the law and all pesticides should be stored according to instructions on their labels. In addition to the label, Part 326.11 of the New York Codes, Rules and Regulations (NYCRR)(http://www.dec.ny.gov/regs/4423.html) states "No person shall store any restricted pesticide or empty containers thereof in such a manner as may be injurious to human, plant or animal life or to property or which unreasonably interferes with the comfortable enjoyment of life and property throughout such areas of the State as shall be affected thereby." Pesticide storage areas should be designed and managed in a manner that prevents or minimizes the risk of injury, harm to the environment or any impact on the use or value of property. The following suggestions are offered for consideration:

- Storage facilities should be structurally separate from "residential, office and general work areas; livestock quarters, food, feed or seed storage and water supply sources". Storage should be in separate buildings and situated to be at least 50 ft away from residential or farm property. Fencing is currently not stipulated but could be considered as an added precaution.
- To the extent practical, pesticides should be stored more than 500 feet from wetlands and waterbodies.
- Storage areas should have a raised berm on all sides and an impervious surface for containment.
- Facilities should be equipped with "spill containment material" and fire extinguishers. Suggested spill containment material includes absorbent spill containment pads, sweeping compound, brushes or brooms, a dust pan, shovel and a disposal container or bag.
- Protective equipment should be available near but not within the storage area.
- The storage facility should be locked and properly posted with warnings.
- Annual updates should be provided to the local fire department and include a "Fire and Spill Response Plan". Additional precautions might include provisions of the National Fire Protection Association (NFPA) codes.
- Chemicals should be segregated by function (fungicide, insecticide, and herbicide) and hazard level. All flammable and "incompatible" materials should be stored separately.
- Mixing areas should be similarly bermed with impervious surfaces.
- Indoor mixing areas should be properly vented.

- Bulk containers, construed to be equal to or greater than 55 gallons, should be locked and drains should be used to collect any spills into a containment area. The spill containment system should have a capacity equal to or greater than 25% of the volume of pesticides stored.
- A water supply and wash station are required at or adjacent to the facility for emergencies.
- A suitable first aid kit for pesticide poisoning should be nearby.
- Forced air vent systems capable of exchanging the air volume 3 to 4 times per hour should be considered along with temperature control for keeping temperatures under 95°F and above freezing.
- Local fire departments should be made aware of the pesticides and fertilizers stored to prepare in event of a fire at the storage facility.

Very old or inadequate storage areas may or may not be out of compliance, but consider planning for improvements to implement these recommendations over time. For more information, see also NYSDEC guidelines for pesticide storage at http://www.dec.ny.gov/regs/4423.htm.

9.1.7 Pesticide Transport

Off-property transport of pesticides must comply with New York State Department of Transportation (NYSDOT) regulations. Regulations require that the driver be trained for hazardous material transport. Drivers are required to carry the pesticide label and SDS sheet, have sufficient knowledge to handle any spills, and communicate with emergency responders in case of spills. Pesticides transported off the property or stored in a sprayer tank must be labeled with basic pesticide information as required under the Environmental Conservation Law.

9.1.8 Mixing and Loading

Mixing, loading, and washing areas should be well ventilated and should take place in contained areas that are bermed, have impervious surfaces, and roofed to prevent rainfall spreading pesticide residue. Precautions should be in place to effectively respond to emergencies, such as the availability of proper PPE, spill response kits, and emergency wash stations.

NYSDEC regulations require the use of Backflow Prevention Devices (BPD) when public water is used with pesticide application equipment. Use caution and read the labels carefully to ensure that pesticides mixed together are compatible. Water used for mixing should be tested for pH to ensure that tank mixes do not expire prematurely due to alkaline hydrolysis.

The State of Michigan currently has some of the most comprehensive regulations addressing the construction of mixing and loading areas. This information is also part of the MI Environmental Stewardship Program that includes a useful module developed by Michigan State University designed to help golf courses determine need, size and capacity of mixing loading areas (see www.mitesp.org/assets/Modules/05PestMixLoad2009.pdf).

9.1.9 Pesticide Waste and Rinse Water Disposal

Pesticide containers must be cleaned and disposed of or recycled properly. Procedures typically include triple rinsing nonflammable containers and either returning cleaned empty containers to the vendor or properly sealing and disposing of them in a sanitary landfill. Rinsate may be re-applied to turfgrass consistent with instructions on the label. Unused pesticides must be disposed of in accordance with state regulations, such as by returning to the supplier or disposing at an approved hazardous waste facility.

9.1.10 Aquatic Pesticide Applications

The application of any pesticide to water, such as an aquatic herbicide used to control vegetation in golf course ponds, or mosquito or other insect control applied to water, must be covered under a SPDES General Pesticide Permit.

For more information on pesticide usage, see:

- NY Pesticide Business Registration: www.dec.ny.gov/permits/209.html
- Pesticides Registered in NY: www.dec.ny.gov/chemical/27354.html
- NY State Pesticide PIMS: pims.psur.cornell.edu/
- NY Pesticide Reporting Law: www.dec.ny.gov/chemical/27506.html
- NYSDEC Pesticide Storage Guidelines: http://www.dec.ny.gov/regulations/8871.html
- NYSDEC Policies on Backflow Prevention Devices: www.dec.ny.gov/regulations/23471.html
- NYSDEC Waste Transporter Permit Program: www.dec.ny.gov/chemical/8483.html
- Regulated Hazardous Wastes in NY: http://www.dec.ny.gov/chemical/8486.html
- New York State Solid Waste Management http://www.dec.ny.gov/chemical/8498.html
- Michigan State University mixing and loading pad module, including checklists: www.mitesp.org/assets/Modules/05PestMixLoad2009.pdf
- SPDES General Pesticide Permits: http://www.dec.ny.gov/chemical/70489.html.
- Clean Sweep NY: www.cleansweepny.org

9.2 Pesticide Application Strategies

In addition to selecting an appropriate pesticide based on the strategies discussed in Chapter 8, a number of factors should be considered when applying pesticides to avoid water quality impacts (Table 9-1). For example, a number of site-specific considerations for the use of pesticides should be evaluated using the results from the site analysis to identify areas where the risks of pesticides reaching surface or groundwater are greater (such as steep slopes, shallow water tables, and areas with frequently wet soils). In addition, pesticides should be applied accurately and with care to avoid conditions that can increase the chances of runoff, leaching, or drift (Figure 9-1).

Table 9-1. Factors contributing to greater risk for groundwater and surface water contamination. Source: USGA 1995

Chemical	Soil	Site	Management
High solubility	Porous soil (sand)	Shallow water table	Incomplete planning
Low soil adsorption	Low organic matter	Sloping land	Misapplication
Long half-life (persistent)		Near surface water	Poor timing
Low volatility		Frequently wet soils	Over-irrigation

Figure 9-1. Typical fairway pesticide application using foam and dye for accuracy. ***Source*: Robert Alonzi.**

9.2.1 Preventing Runoff and Leaching

Pesticides can be transported into water by several means:

- surface runoff following precipitation events or irrigation
- leaching through the soil horizon to reach groundwater

- adsorbtion on eroded soil that reaches surface water
- flowing directly to groundwater through sinkholes and permeable rock

The use of vegetated buffers may be the single most important strategy mitigating the impact of runoff as these buffers can "capture" pesticides and prevent them from reaching waterways. In addition, the timing and location of applications should be thoroughly evaluated. Preventing runoff and leaching of pesticides is heavily influenced by weather and irrigation scheduling. Pesticide applications followed by heavy rain or irrigation can cause the pesticides to leach into groundwater. This leaching can occur even for nonpersistent pesticides (those with a short half-life). Pesticide applications on saturated soils following heavy rain or irrigation can also lead to surface runoff. In addition, avoid applying pesticides in sensitive areas.

9.2.2 Preventing Drift

Drift can potentially cause water quality impacts, damage to susceptible nontarget crops, and a lower than intended rate to the turfgrass, thus reducing the effectiveness of the pesticide. Two types of drift occur: airborne (spray) drift and vapor drift. Spray drift is influenced by many interrelated factors including droplet size, nozzle type and size, sprayer design, weather conditions, and the operator. The amount of vapor drift depends upon a pesticide's volatility and atmospheric conditions such as humidity and temperature. Volatile turfgrass pesticides should be avoided. In some cases, the pesticide label may indicate low volatility. Low volatility, however, does not mean that a chemical will not volatilize under conducive conditions, such as high temperatures or low relative humidity. For more information, see Appendix H, Preventing Drift.

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- Ensure full compliance with existing pesticide regulations, including applicator and technician certification and following all label directions.
- Adapt or implement as many NYSDEC pesticide storage guidelines as possible.
- Assess site and weather conditions thoroughly before applying pesticides.

10 MAINTENANCE FACILITIES

Every golf course has a central area for the maintenance and storage of equipment and supplies. These areas can potentially become point sources of pollution because of unintended releases of chemicals such as pesticides, fertilizers, or fuel during storage or handling of these materials. Maintenance and storage facilities are high priority areas to address in protecting water quality. Containment measures in these areas can easily prevent chemicals from becoming point sources of pollution.

10.1 Regulatory Considerations

While federal and state regulations or guidelines may apply to maintenance facilities, these areas are more likely to be subject to a number of local requirements, which may vary by county or town. Local building inspectors should be consulted during planning for new facilities to outline the permitting process and local requirements. Also, consider meeting with a representative from a NYSDEC regional office and the local fire marshal. The NYSDEC requests a State Environmental Quality Review (SEQR) for new construction, which is administered by local governments. NYSDEC comments on SEQR as well as other interested and involved agencies.

10.1.1 Pesticide and Fertilizer Storage

Pesticides are labeled with legal requirements for proper storage and disposal requirements. New York State (NYS) has published guidelines for the storage of pesticides as discussed in Chapter 9. These guidelines are also relevant for fertilizer storage, as the potential water quality impacts from spills of fertilizer are the same, particularly for large containers (greater than 55 gallons) of liquid fertilizers. Fertigation often has large tanks for the liquid fertilizer and the storage/containment structure can be large (often part of the irrigation pump house).

10.1.2 Fuel and Fuel Oil Storage

NYS has regulations for above and below ground storage of fuel and fuel oil in Part 613 of the ECL. Every facility manager should review this regulation carefully. The regulations require daily inspection logs be kept and annual inspections. Counties and towns may also have their own fuel storage regulations.

10.1.3 Other Materials Storage

Use caution when storing other hazardous material including lubricants, cleaners, flammable paints, and other volatile organic compounds (VOCs). Incompatible and flammable materials should be stored separately in approved storage cabinets.

10.1.4 Mixing and Loading

NYS guidelines recommend mixing and loading areas to be contained and bermed, with impervious surfaces. These areas should also be well ventilated. Precautions should be in place to effectively respond to emergencies such as the availability of proper PPE, spill response kits, and emergency wash stations. New York State also requires the use of backflow prevention devices (BPDs) to protect potable water supplies, unless an air gap is maintained between water sources and container.

10.1.5 Washing

Currently no federal, state, or county regulations exist for the design and operation of wash stations. However, NYS guidelines recommend wash areas to be contained and bermed, with impervious surfaces.

Wastewater or rinse water can be reapplied to turf areas by certified pesticide applicators. Discharge of wastewater from wash stations with low concentrations of pesticides and fertilizers onto the ground does not require any special permits. However, USEPA and the NYSDEC do not permit wastewater to be discharged into a stormwater runoff system or any groundwater recharge area without special permits.

10.1.6 Stormwater

The concentration of activities in and around the facility may increase the levels of chemical residues that would be susceptible to runoff from heavy precipitation. Stormwater collection areas may need to be established to capture runoff in accordance with NYSDEC specifications. Discharges may require a SPDES general permit and compliance testing. In addition to chemical contamination limits (CCLs) for nitrites, nitrates, and pesticides, the NYSDEC also has a limit for phosphorus levels in stormwater of 0.1 mg P per liter.

10.1.7 Waste Management

Golf courses may generate a number of different types of wastes. Examples of wastes that may be generated at a golf facility include, but are not limited to, the following:

- parts wash solvents
- waste gasoline
- cleaning materials
- paints
- waste oil
- lead-acid batteries
- aerosol cans
- spent fluorescent bulbs
- unusable pesticides and inner bag liners
- unusable herbicides and inner bag liners
- antifreeze

A waste is a hazardous waste if it exhibits a specific characteristic (ignitability, corrosivity, reactivity, toxicity) or if it is included in any of the four specifically listed categories of hazardous waste. Many waste fluorescent lamps are hazardous wastes due to their mercury content. Other examples of lamps that, when spent, are commonly classified as hazardous waste include: high-intensity discharge (HID), neon, mercury vapor, high pressure sodium, and metal halide lamps. In New York State, the hazardous waste regulations are found in 6 NYCRR Parts 370 through 374-3 and 376.

USEPA issued the Universal Waste Rule in 1995 to streamline compliance with hazardous waste regulations. This rule is designed to reduce the amount of hazardous waste in the municipal solid waste stream, to encourage the recycling and proper disposal of some common hazardous wastes and to reduce the regulatory burden on generators. Universal wastes include such items as hazardous batteries, hazardous mercury-containing thermostats, certain pesticides, and hazardous lamps. Although handlers of universal wastes must meet less stringent standards for storing, transporting, and collecting wastes, the wastes must comply with full hazardous waste requirements for final recycling, treatment, or disposal. Therefore, every golf club is responsible (and liable) for the safe handling of the product and proper waste disposal by a reputable waste removal service. These services should be certified and bonded for transporting your waste to similarly accredited processing centers.

For more information, see:

- NYSDEC State Environmental Quality Review: http://www.dec.ny.gov/permits/357.html
- NYSDEC regulations on handling and storing petroleum: http://www.dec.ny.gov/regs/4433.html
- NY policies on backflow prevention devices: www.dec.ny.gov/regulations/23471.html
- NY Stormwater Design Manual: http://www.dec.ny.gov/chemical/29072.html
- Regulated Hazardous Wastes in New York: http://www.dec.ny.gov/chemical/8486
- New York State Solid Waste Management: http://www.dec.ny.gov/chemical/8498.html
- NYSDEC: Hazardous Waste Management: www.dec.ny.gov/chemical/8486.html
- Lead Acid Batteries: www.dec.ny.gov/chemical/86024.html
- NYSDEC Waste Transporter Permit Program: www.dec.ny.gov/chemical/8483.html

10.2 Maintenance Facilities Design and Operation

A site analysis can identify and assess risk for ground or surface water contamination. The first step is to determine the environmentally sensitive areas, potential release points, and containment strategies currently employed. This analysis should address aspects of storage and handling of chemicals.

10.2.1 Storage

The goal of an ideal storage facility is the safe siting and storage of potential contaminants that ensures a high level of water quality protection (Figure 10-1). NYSDOH does not allow chemical storage or mixing and loading facilities within 100 feet of a potable well. Other requirements include local zoning for the siting of maintenance facility and operations, which vary by town and county. Requirements often include a minimum distance (set-back) from wetlands, surface wells and property lines. The Freshwater Wetlands Act (http://www.dec.ny.gov/lands/4937.html) requires a 100 ft buffer around wetlands. Some townships have even broader requirements.

Figure 10-1. Chemical storage building organization. Source: Robert Alonzi.

Modular or independent containment units can be installed in many sizes. The units are typically self-contained, fireproof and secure and can be temperature controlled with ventilation. Options include fire suppression, eye washes, and safety showers.

Figure 10-2. Modular containment units can be installed in many sizes. Source: Robert Alonzi.

Floor drains should include a sump and a chemical pump to move the chemicals discharged to a waste tank as in Figure 10-1. The material can be reclaimed, diluted to label concentrations, and applied to turf areas or collected for disposal using certified hazmat haulers.

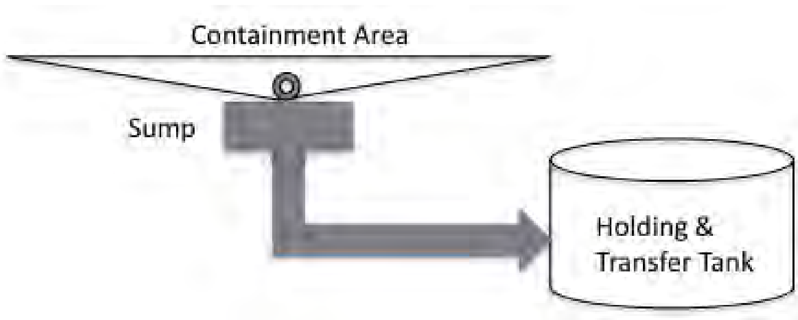

Figure 10-3. Containment area with sump and transfer to holding tank.

Updating chemical storage areas does not necessarily require a new building. Many changes can be easily attained:

- impervious flooring
- flooring sloped to a drain
- curbing to contain at least 25% of the volume of liquid chemicals and fertilizers stored
- ventilation to exhaust any fumes in the event of a spill
- PPE for workers and emergency wash stations

10.2.2 Mixing and Loading

As with the storage areas, the handling area (mixing and loading) of pesticides and fertilizers should be contained to minimize release of concentrated or diluted pesticides and fertilizers. These compounds should be mixed and loaded on a covered impervious surface properly sized and sloped to capture the maximum potential spill. Backflow preventers should be installed on fresh water supplies used for filling. The station could also be upgraded to pre-mix pesticide/fertilizer loads in a controlled environment then transferred to the sprayer. See Figures 10-4 through 10-6 for proper mixing and loading practices.

Figure 10-4. Loading fill spray tank from premix. *Source*: Robert Alonzi.

Figure 10-5. Recovery lines and trans pump in the equipment mixing and loading area.
***Source*: Robert Alonzi.**

Figure 10-6. Mixing and loading recovery tanks. *Source*: Robert Alonzi.

10.2.3 Wastewater Handling

The release of organic waste associated with equipment cleaning needs the same level of protection afforded liquid and granular nutrients and pesticides. When debris is removed from equipment, it should not be released into open surface waters or in a location near well heads or shallow groundwater. Figure 10-7 shows a well designed wash area.

Figure 10-7. Equipment wash area. ***Source*****: Old Oaks County Club.**

Often effective equipment cleaning areas can be maintained as mixing and loading areas with impervious flooring and drains that allow for some separation of organic solids and liquids (Figure 10-7). When using the simple wash-pad and collection area be sure to direct any uncontained liquid to be dispersed along the land, preferably along a designed bio-filtration system. Closed system cleaning stations are available that separate clippings/solids and treat the wash water. The recycled water is reused as wash water. The EPA suggests the stages of treatment, as shown in Figure 10-8. Another approach to wastewater treatment uses microbes to break down chemical compounds (Figure 10-9). Both types of systems may require additional purification steps to remove odors and harmful bacteria. These systems must be carefully sized to process the peak water volume anticipated for contaminant levels expected. The equipment varies in costs but increases with structural requirements and permits.

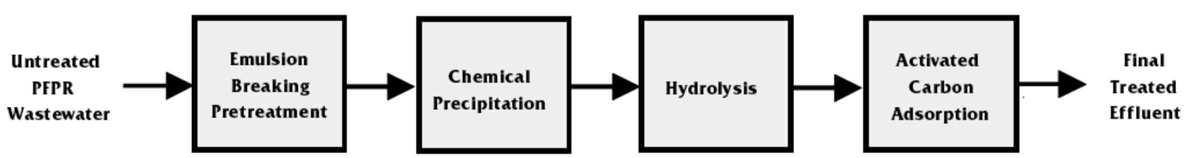

Figure 10-8. Stages of treating wastewater, as shown for an activated carbon adsorption system (EPA, P2 Guide).

Figure 10-9. Microbial system for treating wastewater. ***Source*****: Robert Alonzi.**

10.2.4 Integrated Chemical Management

New construction designs should consider integrating storage, mixing, and washing operations in an integrated chemical management system. Buildings and infrastructure are designed to account for the traffic and usage. The resulting design should provide a much better envelope of the operations compared to separately constructed areas. Integrated designs often include fuel storage and filling stations within the same containment areas.

10.2.5 Organic Matter Management

Nutrient BMPs recommend that clipping be widely redistributed to turf. Research has shown that nitrate levels in leachate increased to as much as 30 mg/L in areas that received four times the normal clippings return. Some clubs elect to collect clippings from fairways and then dump these clippings as yard waste. The accumulation of clippings and other yard wastes such a leaves, tree limbs, and other plant debris can be a substantial source of contamination to surface water and groundwater if placed close to water courses.

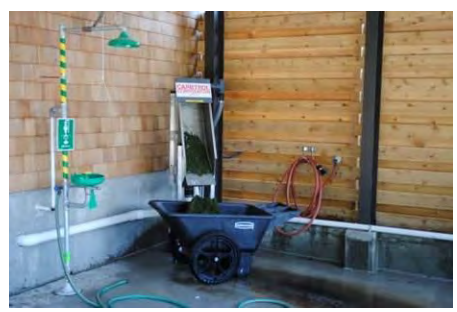

Figure 10-10. Clippings removal unit. ***Source*****: John J. Genovesi, CGCS, Maidstone Club.**

Clippings should be screened and collected when cleaning equipment in the maintenance area (Figure 10-13). They should not be allowed into the stream of wastewater. The inherent concentration of organic nitrogen and phosphorus, along with any pesticide residues, can contaminate the wastewater or reduce the effectiveness of wastewater treatment equipment. Ideally, clippings should be blown off using compressed air and then collected

(Figure 10-11). If water is being used, sumps should screen and convey clippings and other solids prior to wastewater disposal or treatment.

Figure 10-11. Prior to washing equipment, removing clippings while over grass (top) or a pad (bottom) with an air hose or prewash reduces the amount of organic debris in the wash water. Source: Robert Alonzi.

Figure 10-12. Typical equipment wash area with drain. ***Source*****: Robert Alonzi.**

Figure 10-13. A Retrofitted RGF system separates solids in the wash water. *Source*: Robert Alonzi.

Figure 10-14. A retrofitted RGF system solid separation pad. ***Source*****: Robert Alonzi.**

Many clubs have contracted with local composting companies to haul their organic waste. Material is generally accumulated in dumpsters and then frequently removed.

10.2.6 Lubricants, Greases, Paints, and Solvents

Lubricants, greases, paints and solvents should be stored appropriately, typically in fireproof enclosures, separately from pesticides and fertilizers. Special cleaning stations are commercially available that contain and recycle solvents and degreasers.

In addition to any handling precautions specified on the product label or MSDS sheet, added steps should be taken to prevent and contain any spills. Spills should be cleaned up using approved dry absorbants. Contaminated material should be stored in containers specially marked as hazardous waste and disposed of using licensed waste haulers and hazmat processors.

10.3 Emergency Planning

Planning and preparations should be made for potential emergencies. Local emergency personnel such as local fire departments should be consulted and notified of the locations of pesticides and fertilizers storage as well as regularly updated lists of chemicals stored. Storage areas should be properly placarded. Training and orientation should also be conducted with employees to review those plans and preparations.

New York State responds to reports of petroleum and other hazardous material releases through the Spill Response Program maintained by the NYSDEC. Spill response staff throughout the State investigate such spill reports and take action based on the type of material spilled, the potential environmental damage, and safety risks to the public. Releases to the environment should be reported to the NYSDEC Spills Management Hotline at 1-800-457-

7362. See http://www.dec.ny.gov/chemical/8428.html for more information on reporting of spills.

10.3.1 Safety Data Sheets (SDS)

The Hazard Communication Standard (HCS) (29 CFR 1910.1200(g)), revised in 2012, requires that the chemical manufacturer, distributor, or importer provide Safety Data Sheets (SDSs) (formerly MSDSs or Material Safety Data Sheets) for each hazardous chemical to downstream users to communicate information on these hazards. The information contained in the SDS is largely the same as the MSDS, except now the SDSs are required to be presented in a consistent user-friendly, 16-section format. More information on SDS can be found at: https://www.osha.gov/Publications/OSHA3514.html.

10.3.2 First Aid

Adequate provisions should be provided to immediately treat any person exposed to chemical exposure including eye wash stations and showers. First aid kits should be maintained to treat skin contact, ingestion, or inhalation.

Cornell's Occupational and Environmental Health Department (OEHD) at the Cornell College of Agricultural Sciences have guidelines that can be used a template for spill management:

- Evacuate personnel from the immediate area of the spill.
- Control the spill. Do not endanger yourself. To the extent possible, shut off the source and block the flow.
- Call 911 if:
  - anyone is injured
  - the spill is too large for a local clean up
  - the spill migrates off-site
  - the spill threatens the health and safety of anyone
- Identify the spilled material(s).
- Barricade the area and notify others in surrounding areas not to enter the spill area.
- Wait for help to arrive.

Spill kits (Appendix I) can be used for incidental releases and the following procedures followed:

- Consult the appropriate SDS and label (for pesticides).
- Wear the appropriate PPE.
- Contain the spill. Prevent spread or escape from the area by using sorbents.
- Clean up the spill. Never hose down an area until the cleanup is completed.

To clean up pesticides:

- Recover as much product as possible in a reusable form. Store and use as intended. Recover the rest of the product as a waste product by using an adsorbent or sweeping compound.

- When all recoverable material is secured, clean contaminated surface residues using triple-rinse technique; for instance, a spill of liquid on the floor requires that the area be damp-mopped three times.

To clean up all other chemicals:
- Small liquid spills can be cleaned up with a commercially available absorbent. Avoid using paper towels; they increase the surface area and the rate of evaporation, increasing the fire hazard.
- For acid or base spills, use a sorbent that will neutralize the liquids (trisodium phosphate, sodium bicarbonate, or other commercially available products).
- Use a dustpan and brush to sweep up the absorbed spill. Wash the contaminated area with soap and water.

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- Assess potential point source pollution risk.
- Manage organic and inorganic waste to minimize potential point source pollution.
- Ensure compliance with regulatory requirements designed to prevent point source pollution.

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APPENDICES

Appendix A: Glossary

Aquifer – An underground source of water made up of porous rock, like sand, shell or limestone.

Available Water – The difference between soil moisture content at field capacity and the point at which plants wilt due to lack of moisture little water remains available to the plant.

Biological control – The use of living organisms to reduce populations of other living organisms-namely pests.

Environmental Impact Quotient (EIQ) – A method for quantifying the effect of pesticides on the environment, people, water and wildlife.

Eutrophication – The enrichment of bodies of fresh water by inorganic plant nutrients (e.g. nitrate, phosphate). It may occur naturally but can also be the result of human activity (cultural eutrophication from fertilizer runoff and sewage discharge) and is particularly evident in slow-moving rivers, shallow lakes, and impoundments.

Evaporation – The process by which water changes from a liquid into a gas.

Evapotranspiration - The sum of evaporation and plant transpiration from the Earth's land surface to atmosphere.

Flow – The movement of water from one place to another.

Groundwater Recharge – The hydrologic process by which water enters into groundwater.

Hypoxia - Very low levels of dissolved oxygen in the water column

Infiltration – The process by which water is absorbed into the ground.

Leaching - The downward movement of a chemical or nutrient (e.g. pesticide or nitrogen from fertilizer) through the soil and potentially into groundwater.

Nonpoint Source – Nonpoint source pollution is caused by water moving over and through the ground picking up and carrying away natural and human-made pollutants and finally depositing them into lakes, rivers, wetlands, coastal waters and ground waters.

Nutrients – Elements as nitrogen and phosphorus compounds necessary for plant growth and survival. Elevated levels can cause unwanted growth of algae, and can result in the lowering of the amount of oxygen in the water when the algae die and decay.

Runoff – the movement of water across the turf and soil surface, typically following a storm event or heavy irrigation

Sedimentation – The deposition of loose particles of sand, clay, silt, and other substances that settle at the bottom of a body of water. Sediment can come from the erosion of soil or from the decomposition of plants and animals.

Pesticide Drift – The U.S. Environmental Protection Agency defines spray or dust draft as "the physical movement of pesticide droplets or particles through the air at the time of pesticide application or soon thereafter from the target site to any non- or off-target site".

Pesticide Resistance – The decreased susceptibility of a pest population to a pesticide that was previously effective at controlling the pest.

Pesticide Volatilization – the chemical process whereby pesticide surface residues change from a solid or liquid to a gas or vapor after application. Once airborne, volatile pesticides may drift off site. Pesticide volatility varies, and not all pesticides volatilize.

Point Source- A point source is a source of pollution from originating from a single identifiable source. However, this does not legally include agricultural storm water discharges and return flows from irrigated agriculture, including turf.

S*tormwater* - Water that originates in some form of precipitation as either rainfall or snowmelt.

Transpiration – Loss of water through the leaves of plants.

Watershed – An area of land that drains into a body of water (e.g. river, lake, reservoir, etc.) and includes the network of rivers, streams and lakes that convey the water, as well as the land surfaces from which water runs off.

Water Table – Marks the very top of the ground water layer, and is the border between the unsaturated and saturated zone.

Appendix B: Groundwater quality of eastern long island, ny, golf courses

In New York, groundwater quality has been tested on 27 golf courses in Suffolk County by the Suffolk County government. From 1999 to 2010, up to 42 wells were sampled for a total of 366 sampling events. The samples were tested for a wide range of compounds from nutrients like nitrate and ammonia; metals like arsenic, cooper and cadmium; and 54 organic compounds, including pesticides and metabolites. These sample tests resulted in over 20,000 individual results. These test results are provided on the next page and as a download from the NY BMP web site.

Nitrate was found to be a common contaminate of groundwater in some areas, although 57% did not have a detectable level of nitrate. Twenty nine percent had nitrate concentrations of less than 5 mg/L, 10 % had concentration from 5 to 10 mg/l and only 4 % were greater than 10 mg/L, the drinking water standard. The Nitrogen Challenge with Suffolk County golf courses and the Peconic Estuary Program has set a target goal of groundwater of no greater than 2 mg nitrate/L. Sixty eight percent of the samples tested were below this goal level.

The most commonly detected golf course pesticide was metalaxyl. Fourteen percent of the samples tested had detectable levels of metalaxyl, with concentration ranging from 0.1 to 2.74 ppb (ug/L). An old no longer used herbicide dacthal (the acid metabolite) was detected in 9% of the samples, at concentration as high as 272 ppb. Imidacloprid was detected in 6% of the samples in concentrations no greater than 10 ppb. Several other pesticides (PCNB, propiconazole and iprodione) were occasionally detected at very low concentrations (<1 ppb).

The results of this testing would suggest than golf courses are having at most a minor impact on the groundwater quality of eastern Long Island.

Appendix D: Conversion Tables

Hectare =	107,639.10	sq ft
Acre =	43,560.00	sq ft
Hectare =	2.47	acres
kilogram =	2.20	lbs
inch =	2.54	cm
cm=	0.39	in
gallon H_2O =	8.35	lbs
gallon H2O =	3.79	kg
gallon =	0.13	cu ft
gallon =	3.79	L
cu ft =	7.48	gal
cu ft =	1,728.00	cu in

Appendix E: Guidelines for Using Recycled Wastewater for Golf Course Irrigation in the Northeast

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Introduction

The availability of fresh water for irrigation in many parts of the United States is becoming critically limited. This is especially true for irrigation of non-food and fiber productions sites including parks, commercial and residential lawns, athletic fields, golf courses, cemeteries, sod farms and other landscape plantings. This is true even for the northeastern US where many people perceive an abundance of fresh water. In order to meet demand, major metropolitan water suppliers in the northeastern US are required to double the supply capacity of their systems for the three summer months that are dominated by landscape irrigation demands.

As urban and suburban sprawl continues, the demand for freshwater resources also increases. Water conservation and/or the use of alternative water sources, such as waste water for landscape irrigation can help address the growing demand for fresh water. Most large-scale waste water irrigation comes from sewage treatment plant effluent. The southwestern US has successfully used treated sewage effluent and gray water for irrigation for many years.

The benefits of using waste water as an irrigation source include: conservation of freshwater that would be used for irrigation, supply of small amount of nutrients to enhance plant growth every time the site is watered, and a reduction of pollutant (phosphorus and nitrogen) discharge in to surface water.

The potential hazards from waste water irrigation involve salt injury to plants, long term effects on soil health (reducing in drainage and increase in runoff/erosion), other soluble compounds in the water and human pathogens in the waste water. Proper water treatment has all but eliminated the human pathogen issue. Long-term use of waste water irrigation of turfgrass sites in the desert southwest, a low rainfall area, has shown to increase salts levels in the soil which could harm plant growth and impede drainage by destroying the structure of soils with clay. However, in areas with 30 to 60 inches of rainfall per year, will waste water irrigation harm plant growth and soil health?

In the Northeast, waste water use for irrigation has been very limited. For example,, in New York State only two golf course complexes out of 850 golf courses use waste water for irrigation. One golf course (45 holes) in Lake Placid, NY, gets all its irrigation water from the Village of Lake Placid and the Village of Lake Placid has reduced its phosphorus loading into Lake Champlain by 25 percent. At the Turning Stone Casino Resort, four of the five courses use recycled waste water, which is generated by on-site use, exclusively for irrigation. To date, neither the Lake Placid golf courses nor the Turning Stone Casino golf courses have reported any observable turf damage from the use of recycled waste water.

Water as an Essential Resource

Potable water reserves comprise only 2-5% of the total global water supply. Ground water makes up only 1.7% of that total. Ground water supplies only 30% of the water resources used for human and industrial purposes, the remaining 70% comes from surface water sources.

The demand for fresh water for human consumption and uses continues to increase. Interest in conserving fresh water and finding alternative water sources to be used for agriculture and landscape management has become important societal concerns/issues.

What is Waste Water?

Waste water is water that has been reclaimed from municipal waste water or sewage treatment plants. Waste water is also referred to as recycled water, reclaimed water, effluent water and gray water. Recycled water can beneficially be used for agricultural or landscape purposes and for recharging ground water supplies.

Before being recycled or discharged into streams or lakes, the waste water goes through a primary, secondary or tertiary treatment process. The primary treatment process removes the sediments and is not recommended for use. The secondary treatment uses a process of biological oxidation and disinfection. The resulting effluent can be used to irrigate non-food crops, and possibly for industrial cooling processes, wetland and wildlife habitat, stream augmentation and ground water recharge of aquifers not supplying potable water. Tertiary treatment involves chemical coagulation, filtration and disinfection. This water can be used for golf course and landscape irrigation, food crop irrigation and other uses.

Using recycled waste water for golf course irrigation can decrease the diversion of freshwater from sensitive ecosystems, decrease the discharge of waste water to sensitive water bodies, may be used to enhance wetlands and riparian habitats and prevent or reduce pollution.

Why golf courses?

Golf courses serve important environmental, recreational and economical roles in our communities as sites for recreation, wildlife sanctuaries and comprise land that can help to filter recycled water.

The typical Northeast 18-hole golf course uses between 15-30 million gallons of water per year. The Northeast is currently fortunate to have access to water to meet this demand under most non-drought conditions. Other parts of the country with low rainfall have had to switch to alternative water sources for irrigation so enough freshwater would be available for human consumption.

Use of Recycled Waste Water for Golf Course Irrigation

Golf course managers in the Northeast are largely unfamiliar about using recycled waste water for irrigation. Many questions have slowed the adoption of this practice including:

1. Will the waste water be harmful to the turf?
2. Will I have a consistent water supply when I need it for irrigation?
3. Would extra equipment or retrofitting the current irrigation system be necessary?
4. How would the public or clients react to the use of this water on the golf course?
5. Is it necessary and easy to get approval to use waste water for irrigation?
6. How must management be changed when using waste water?
7. What are the costs or savings associated with using waste water?

Potential benefits of irrigating with waste water include the opportunity to conserve a precious natural resource, to provide a site that would serve as a biofilter (thus reducing the amount of effluent water reaching streams and lakes), to use a water source that contains some nutrients (which would reduce the need for some additional fertilization) and to find a less expensive water source than potable water.

New York Golf Course Experiences with Recycled Waste Water for Irrigation

We are using the experiences of three New York golf courses to provide insight on using waste water for irrigation: Lake Placid Resort Golf Course, Turning Stone Casino and Resort, and Indian Island Golf Course.

Lake Placid Resort Golf Course

The Lake Placid Resort Golf Course is a rather large operation with 45 holes of resort golf turf. For the last 7 years, 12 - 20 million gallons of recycled waste water have supplied all their irrigation needs. The Lake Placid Resort Golf Course had the opportunity to be part of a New York State Energy Research Development grant associated with the Lake Champlain Basin program with the objective of helping to reduce the amount of phosphorus reaching the lake. The grant funded the testing of the river water and ground water as well as some startup costs at the treatment plant and the golf course.

The close supply of recycled water, within a mile of the golf course, aided a quick start up. The water was tested weekly and a close working relationship with treatment plant manager was established. Joe De Forest, assistant golf course superintendent, stated that access to this waste water allowed the golf course to irrigate the fairways which previously were not irrigated. He found that the turf was healthier and better able to handle periods of stress. The regular fertilizer program could be reduced slightly and there was a dramatic increase in the turf quality which led to increased revenue from more play.

With the ability to irrigate areas not previously irrigated, such as the fairways and by keeping the turf growing during the summer period, there was a slight increase in disease, insect and weed pressure and expense to manage these changes. More labor was needed to handle the extra mowing and pest management which was an expected outcome when increasing the amount of irrigated land.

When irrigating with waste water, Deforest suggests:

1) Developing a good relationship with the treatment plant personnel so they can keep you informed of plant operations that might affect your water supply.

2) Having the water tested on a routine basis, monthly as a minimum and weekly if the water has a high salt content.

3) Keeping or developing an alternate water supply in case there is an interruption of water supply from the treatment plant.

The overall environmental impact to the community included a 25% reduction of phosphorus loading into the Lake Champlain Basin from the Village of Lake Placid Sewage Treatment Plant. On average the golf course used 20 million gallons of waste water per year and served as a bio-filter thus reducing the amount of waste water directly discharged into the Chubb River.

Turning Stone Casino and Resort

Turning Stone Casino and Resort had the unique opportunity to build their golf courses knowing that waste water would be the main source for irrigation. This is a very large complex with three 18-hole and two 9-hole golf courses. Four of the five courses use waste water exclusively for irrigation. The golf course managers anticipated certain benefits of using waste water including the ability to conserve a natural resource by using recycled waste water, have a constant reliable supply of water that contained some needed nutrients and have a relatively inexpensive source of water. However the managers had some concerns which focused on water quality issues for growing turf including: 1) the pH of the waste water, 2) whether there would be a slight odor, any pathogens or trace organics, and 3) the heavy metal and salinity content.

The Oneida County Waste Water Treatment Facility is a two stage aerobic processes in which the water passes through a series of filters and screens, then a chlorine contact, next through a tertiary filter, chlorinated and finally discharged. Water is tested four times a day for non-turf related water quality parameters before it leaves the plant.

Turning Stone has two of their 18-hole courses and one 9-hole par three course certified in the Audubon International Sanctuary Program. This certification program requires water quality analysis be made twice a year for total phosphorus, pH, total calcium carbonate (CaC03), total metals, total kjeldhal nitrogen as nitrogen, chloride, nitrate nitrogen, sulfate, alkalinity as CaC03 and total dissolved salts. The results indicated the water was suitable for irrigation with minor modification.

Daily 1.1 million gallons of waste water is pumped to the golf course regardless of demand and held in a holding pond. The unused water or extra water moves through an overflow system which drains into a stream that has many opportunities for the water to be filtered before it exits the golf course and finally reaches Oneida Lake.

The golf course director, Andy Knappenburger and the course manager Frank Albino have been quite pleased with the quality of the turf and playability. They advise regular water testing so informed management decisions can be made throughout the growing season.

Indian Island Golf Course on Riverhead, Long Island

In this situation, the Waste Water Treatment Plant in Riverhead discussed with the Suffolk County Parks Committee the possibility of using effluent water from the plant to irrigate the golf course which was right next to the plant. The goal was to conserve their fresh water supply and hopefully reduce the effluent discharged into the Peconic Estuary. The golf course agreed to consider using the waste water for irritation if the Health Department verified a lack of public safety concerns and if trial applications demonstrated the recycled water was suitable for growing turf.

The golf course built a practice green, tee and fairway as a test model to see how the use of this recycled water would affect the turf. They replicated the grasses and management regime used elsewhere on the golf course and began testing the soil and water. The results from the demonstration site showed no impact from using recycled waste water.

However, in order to meet the daily quality and quantity requirement of 350,000 gallons of high quality water for the golf course, the existing water treatment system at the plant would need to be upgraded. The original cost of the system upgrade was estimated in 2004 to be almost two million dollars. Current estimates now come close to three million dollars so the project is on hold until supplemental funding is procured to launch this project.

When considering recycled water for irrigation, plan ahead and use the following steps:

- Determine what town, county and state permits and approvals are necessary when considering using recycled waste water for irrigation.

- The ideal situation would be to have the recycled water source fairly close to the golf course. If this is not possible the costs to set up a deliver system can be extremely costly.

- Visit the water treatment plant, learn about their water treatment process, ask for an analysis of the water and begin to develop a relationship with the plant manager.
- Your course may need some additional equipment to be able to utilize the new water source efficiently. A booster pump and electricity may be needed for the additional pump capacity.
- Where will the extra recycled water be stored? Are there lakes or ponds on the golf course that could serve as holding areas? These ponds may have an odor problem.
- Be prepared to devote more time to management. More time will be necessary to monitor soil nutrient levels and water quality. With the increase in acreage irrigated there will be more mowing and possibly more pest pressure to deal with. Depending on water quality more time will be necessary to monitor drainage.
- If weeds and algae build up in the irrigation pond a herbicide treatment may be necessary to reduce aquatic weed growth. Be sure the herbicide treatment will not harm golf course grasses or have any restrictions for use as an irrigation source.
- Be sure your membership is aware that recycled water is being used.
- Take steps to be sure the irrigation water does not reach adjacent properties or potable water sources by runoff off or overspray into wetlands or water courses.
- Make sure it will not be used for drinking.

Evaluating Recycled Waste Water for Growing Turf

Begin with a water sample

Be sure to use a certified water testing laboratory. Each water testing laboratory has specific guidelines for sampling water and submitting samples for testing so be sure to follow their instructions. Generally, the water should be sampled from the irrigation head after it has run for a few minutes so that stagnant water can be flushed from the line. Do not sample directly from the pond or well. Laboratories usually require about 12-16 oz for a sample. If the laboratory does not supply a sampling bottle, place the sample in a clean plastic bottle after it has been rinsed with the same water to be tested. Avoid using bottles containing carbonated beverages, sports drinks or food. Be sure to label the sample and keep notes regarding the location of where the sample was taken. See appendix for a list of a few labs that test waste water for irrigation.

Which parameters should you test?

When assessing irrigation water quality the following components should be evaluated: the salt content, which is expressed as electric conductivity (ECw) or total dissolved salts (TDS), the sodium (Na) hazard expressed as the sodium adsorption ratio (SARw), the levels of carbonate, bicarbonate, residual sodium carbonate (RSC), calcium, magnesium, boron, chlorine, and pH. Table A lists the common units used to report water test results.

Table B. Water Components and Units

Quality Factor	Preferred Units
Water – degree of acidity/alkalinity	Ph
Total Salinity – impact on plant growth from higher total salts	
Electrical conductivity (EC)	dS/m, mmhos/cm
Total dissolved salts (TDS)	mg L^{-1}
Carbonates and Bicarbonates	mg L^{-1}, ppm, meq L^{-1}
Sodium Permeability Hazard – impact on soil structure	
Sodium adsorption ratio (SAR)	meq L^{-1}
Adjusted SAR (adj SAR)	meq L^{-1}
Residual sodium carbonate (RSC)	meq L^{-1}
Ion Toxicity – impact on root and foliar contact	
Na – sodium	meq L^{-1}, mg L^{-1}
Cl – chloride	mg/L
B – boron	mg/L
Nutrients	mg L^{-1}, meq L^{-1}

Note: 1 milligram per liter (mg L^{-1}) equals 1 part per million (ppm). Another unit is miliequivalent per liter (meq L^{-1}).

Additional water quality factors impacting irrigation water include the presence of solid particles which can be organic (organic matter) or inorganic in nature (sand, silt, clay). These particles can clog irrigation heads and nozzles, cause wear and tear on equipment and plug soil pores causing a reduction in drainage. A filtering system should be added to the golf course irrigation system to prevent this. Weed seeds, algae and chemical materials can also be found in recycled water.

Water testing labs may use different units when reporting results. Table B provides conversion factors to convert mg L^{-1} to meq L^{-1}. For a more comprehensive listing of conversion factors, see Table K at the end of this document.

Table C. Conversion Factors

Component	To convert mg L^{-1} to meq L^{-1}, multiply by	To convert meq L^{-1} to mg L^{-1}, multiply by
Sodium (Na^+)	0.043	23
Calcium (Ca^{++})	0.050	20
Magnesium (Mg^{++})	0.083	12
Bicarbonate (HCO_3^-)	0.016	61
Carbonate (CO_3^{--})	0.033	30
Chloride (Cl^-)	0.029	35

For example, if your water test report states the calcium level was 1.6 meq L^{-1} and you wanted to know the level in mg L^{-1}, take 1.6 x 20 = 32 mg $L^{-1}$of calcium.

Soluble Salts

Salts found in the soil originate from mineral weathering to form soil, from fertilizers or irrigation water. All irrigation water will contain some soluble salts and traces of other materials. Soluble salts include sodium chloride, calcium chloride or magnesium sulfate and at high concentrations can inhibit growth. Insoluble salts, which do not inhibit growth but can clog soil pores, include limestone, calcium carbonate and gypsum (magnesium sulfate).

Some salts are nutrients and are beneficial to turf but many can be toxic at high concentrations. Salt is the most common problem with recycled water.

Caution must be used if the waste water being used to establish turf or renovate turf is high in soluble salts and if rainfall is limited. Young plants are more sensitive to salt injury than well established mature plants.

High levels of salt in the soil inhibit water uptake by the roots causing reduced growth, discoloration, wilting, leaf curling and eventually desiccation or leaf firing. High salt levels

in the soil influence water infiltration into and percolation through the soil resulting in poor drainage.

The salt content of the waste water will depend on the water source. High levels of salt can accumulate if the irrigation water is high in salts, if there is limited rainfall and if capillary rise of water brings salts to the soil surface due to evapotranspiration. Soils with high levels of salt are called saline soils.

The salinity of the water is reported in several ways, as electric conductivity (ECw) and stated as milimhos per centimeter (mmhos cm^{-1}), micromhos per centimeter (umhos cm^{-1}), decisiemens per meter (dSm^{-1}) or siemens per meter (Sm^{-1}) or as total dissolved salts (TDS) in units of milligrams per liter (mg L^{-1}) or parts per million (ppm). Most sewage effluent contains 200-3000 mg L^{-1} TDS or 0.30 – 4.7 dSm^{-1}. (Feigin et al.1991). Table C lists the total salinity hazard based on electric conductivity (ECw) and total dissolved salts (TDS).

Table D. Total Salinity Hazard Classification Guidelines for Variable Quality Irrigation Water based on Electric Conductivity (ECw) and Total Dissolved Salts (TDS) (Adapted from Carrow and Duncan, 1998)

Salinity Hazard Class	ECw (dSm^{-1})	TDS (mg L^{-1})	Management Requirements
Low	<0.75	<500	no detrimental effects expected
Medium	0.75 – 1.50	500 - 1,000	moderate leaching* to prevent salt accumulation
High	1.5 – 3.00	1,000 – 2,000	turf species/cultivar selection, good irrigation, leaching*, drainage
Very High	>3.00	>2,000	most salt-tolerant cultivars, excellent drainage, frequent leaching*, intensive management

** It has not been determined that leaching is required in higher rainfall areas like the Northeastern US.*

Turfgrasses tolerance to salt

Turfgrasses differ in the tolerance to salt (see Table D). Cultivars within a species can also vary in their salt tolerance. Acceptable levels for turf irrigation water ranges from 200-800 mg L^{-1}. Soluble salt levels greater than 2000 mg L^{-1} may injure turf.

Table E. Turfgrasses Tolerance to Total Salinity (Adapted from Harivandi and Beard, 1998)

Sensitive	Moderately Tolerant	Tolerant	Very Tolerant
0-3 dSm^{-1}	**3.1-6 dSm^{-1}**	**6.1-10 dSm^{-1}**	**>10 dSm^{-1}**
Annual bluegrass	Annual ryegrass	Perennial ryegrass	Bermudagrass
Colonial bentgrass	Creeping bentgrass	Tall fescue	Seashore Paspalum
Kentucky bluegrass	Fine-leaf fescues		
Rough bluegrass			
Most zoysia spp.			

In the Northeast, the annual rainfall ranges between 30" and 60". We do not expect the accumulation of high levels of salt with this amount of rainfall. However, under serious periods of drought and when the irrigation water has high soluble salts, management strategies may be employed to reduce the salt concentration.

In situations where the salt concentration is medium (500-1000 mg L^{-1}), leaching with fresh water may be necessary to prevent salt accumulation. The volume of water applied should be increased by 12.5% for each 640 mg L^{-1} rise in TDS in the irrigation water. Additional management strategies must be used when trying to manage sites with very high concentrations of salt, >2000 mg L^{-1}. Along with frequent leaching with good quality water, salt tolerant species should be used, and a routine aeration program should be established, comprised of frequent shallow core aeration and deep tine cultivation (8-12" once or twice a year) to help maintain excellent drainage (Duncan, Carrow and Huck 2000). Leaching could lead to ground water quality problems, so do it as little as possible!

Sodium Permeability Hazard

The sodium (Na) concentration and the quantity of other salts in the irrigation water can affect soil permeability, which is the ability of water to infiltrate into the soil and move through the profile. When irrigation water has sodium levels > 200 mg L^{-1} sodium (Na) may build up over time and will affect permeability. Calcium which is important to soil structure stability is displaced by sodium which causes the soil structure to break down resulting in reduced water and oxygen infiltration and percolation. This problem can become a more serious problem on fine-texture clayey soils, than sand-based systems. (See Table E).

To assess the potential of the problem you need to know the following:

1) **sodium adsorption ratio** (SARw) which incorporates the influence of sodium, calcium and magnesium concentrations. SAR values >6 meq L^{-1} contain sodium (Na) high enough to cause structural deterioration of some soils.

2) **bicarbonate and carbonate levels.** The bicarbonate ion can combine with calcium and or magnesium and precipitate out as calcium carbonate and magnesium carbonate. This increases the Sodium Adsorption Ratio because it lowers the amount of dissolved calcium concentration.

Also, high levels of bicarbonate in the water can raise the pH to undesirable level.

3) **type of clay in the soil**. Expanding clays like montmorillonite and illite are more susceptible to structural breakdown than other clays that do not crack when drying.

Table F. Sodium Permeability Hazard (Adapted from Harivandi and Beard, 1998: Carrow and Duncan, 1998)

Irrigation Water Components	Degree of Problem		
SARw or adj SARw			
(sodium adsorption ratio by clay type (mg L^{-1})			
	Low	Moderate	High
Clay type unknown	<10	10 – 18	>18
Clays that shrink and swell*	<6*-8**	6*-16**	>9*->16**
Clays do not crack on drying *** or swell on wetting	<16	16 – 24	>24
Sands with ECw >1.5 dSm^{-1}	<10	10 – 18	>18
Sands with ECw <1.5 dSm^{-1}	<6	6 -9	>9
RSC (residual sodium carbonate)	<1.25	1.25 – 2.50	>2.50

** Montmorillonite clays (2:1); ** Illite clays (2:1); *** Kaolinite (1:1). Other 1:1 types are Fe/Al oxides and allophones.*

Another fact to keep in mind is that sodium (Na) is absorbed by plant roots and transported to the leaves, where it can accumulate and can cause plant injury.

The Residual Sodium Carbonate (RSC) is also used to assess the sodium permeability hazard and includes the influence of bicarbonates and carbonates as compared to the calcium and magnesium concentration. To determine the residual sodium carbonate (RSC) the levels of bicarbonate and carbonate are added and the combined calcium and magnesium levels are subtracted and reported as meq L^{-1}. RSC = (CO3 + HCO3) – (Ca + Mg), in meq L^{-}. If the RSC is >1.25 meq L^{-1} and the SARw is >6 meq L^{-1}, water acidification may be necessary.

The total salt content of the water (ECw) and the sodium adsorption ratio (SARw) must be considered together when determining the sodium permeability hazard. The high soluble salt concentration inhibits or counteracts the dispersing influence sodium. The electric conductivity and the sodium adsorption ratio of the waste water can be used to assess the potential for irrigation problems (Table F).

Table G. Assessing Soil Permeability* and Potential Irrigation Problem using Electric Conductivity (ECw) and Sodium Adsorption Ratio (SAR) together (Adapted from Harivandi 1998)

	Degree of Restriction on Use		
Soil water infiltration	**None**	**Slight to Moderate**	**Severe**
if SARw = 0-3 & ECw=	>.7	0.7 – 0.2	<0.2
if SARw = 3–6 & ECw =	>1.2	1.2 – 0.3	<0.3
if SARw = 6-12 & ECw =	>1.9	1.9 – 0.5	<0.5
if SARw =12-20 & ECw =	>2.9	2.9 – 1.3	<1.3
if SARw =20-40 & ECw =	>5.0	5 – 2.9	<2.9

** Soil permeability is the ability of water to infiltrate into the soil and percolate/drain. Gas exchange is also reduced by low soil permeability.*

Ion Toxicities

Ions that can cause some toxicity problems include sodium (Na^+), chloride (Cl^-), boron (B^+), bicarbonate (HCO_3^-), and pH (H^+ or OH^-). (See Table G). Germinating seeds and young seedlings are especially sensitive to high levels of these ions. Use Table G to assess the risk factor in terms of toxicity to roots or leaves.

Table H. Specific Toxic Ion Reference Points (Adapted from Harivandi and Beard, 1998: Carrow and Duncan, 1998)

Specific Toxic Ions		Risk		
		Low	Moderate	High
Sodium Content				
toxicity to roots	SARw	<3	3 -9	>9
	mg L^{-1}	<70	70 – 210	>210
toxicity to leaves	meq L^{-1}	<3	>3	
	mg L^{-1}	<70	>70	
Chloride Content				
toxicity to roots	meq L^{-1}	<2	2 – 10	>10
	mg L^{-1}	<70	70 – 355	>355
toxicity to leaves	meq L^{-1}	<3	>3	
	mg L^{-1}	<100	>100	
Residual Chlorine (Cl_2)	mg L^{-1}	<1	1 – 5	>5
Boron				
toxicity on roots	mg L^{-1}	<0.7	0.7 – 3.0	>3
Bicarbonate	meq L^{-1}	<1.5	1.5 – 8.5	>8.5
	mg L^{-1}	<90	90 – 500	>500

Nutrient Levels

Recycled water contains a number of different nutrients that can have an impact on the golf course fertility program and can have an environmental effect. Routine testing is necessary so in season adjustments can be made to reduce supplemental fertilization when sufficient nutrients are supplied by the recycled waste water. Table H offers some general guidelines for interpreting the nutrient content of the recycled waste water.

Table I. Nutrient Guidelines in Irrigation Water (mg L-1) (Adapted from Duncan, Carrow and Huck, 2000)

Nutrient	Low	Normal	High	Very High
	mg L^{-1}			
P	<0.01	0.1 – 0.4	0.4 – 0.8	>0.8
PO_4^-	<0.3	0.3 – 1.21	1.21 – 2.42	>2.42
P_2O_5	<0.23	0.23 – 0.92	0.92 – 1.83	>1.83
K	<5	5 – 20	20 – 30	>30
K_2O	<6	6 – 24	24 – 36	>36
Ca	<20	20 – 60	60 – 80	>80
Mg	<10	10 -25	25 -35	>35
N	<1.1	1.1 – 11.3	11.3 – 22.6	>22.6
NO_3^-	<5	5 – 50	50 – 100	>100
S	<10	10 – 30	30 – 60	>60
SO_4^-	<30	30 – 90	90 -180	>180

By calculating the ratios of specific nutrients you may be able to detect a possible nutrient deficiency. Concerns should be verified by a plant tissue analysis before making major fertilizer program changes.

Table J. Nutrient Ratios in Irrigation Water and Potential Deficiencies* (Adapted from Duncan, Carrow and Huck. 2000)

Ca: Mg	<3:1	Ca deficiency
	>8.1	Mg deficiency
Ca:K	<10.1	Ca deficiency
	>30:1	K deficiency
Mg:K	<2:1	Mg deficiency

>10.1	K deficiency

** Irrigation water with nutrient concentrations outside these ranges can be used; the fertility program may be adjusted to avoid deficiencies*

Example Waste Water Report

The reference tables provided can be used to assess the suitability of the waste water for turf irrigation. The following is a sample water test report.

CAYUGA LABORATORIES

Green Valley Golf Club — File Number: 736548

Pleasantville, NJ — Date Received:

Sample Location:

Sample Description:

pH	8.43	
Hardness	304.36	mg L^{-1}
Hardness	17.80	grains/gal
Conductivity	1.61	dSm^{-1}
Sodium Adsorption Ratio	5.23	
Adjusted SAR	9.62	
pHc	7.56	
Residual Sodium Carbonate	-2.10	

		mg L^{-1}	meq/L	lbs/ac in
Calcium	(Ca)	57.95	2.89	13.14
Magnesium	(Mg)	38.66	3.18	8.77

Potassium	(K)	16.05	0.41	3.64
Sodium	Na)	209.66	9.12	47.55
Iron	(Fe)	< 0.30		
Total Alkalinity	$CaCO_3$)	198.36		44.99
Carbonate	(CO_3)	21.90	0.73	4.97
Bicarbonate	(HCO_3)	197.53	3.24	44.80
Hydroxide	(OH)	0.00		
Chloride	(Cl)	319.99	9.02	72.57
Sulfur as	(SO_4)	76.52	1.59	17.36
Salt Concentration	(TDS)	1033.60		234.42
Boron	(B)	0.18		0.04

Use the following steps to determine the suitability of the water represented in the above water sample report (Modified from Carrow).

1. Check **Electric Conductivity (ECw)** and **total dissolved salts (TDS)** for their impact on turfgrass.

   Check the values listed in the sample report for conductivity 1.61 mmhos/cm* and the TDS level of 1033.60 mg L^{-1} with Table C. Both values are considered high.

   *** 1 mmhos cm^{-1} = 1dSm^{-1}**

   High total salinity values in conjunction with low sodium Na^+ and bicarbonate HCO_3^- levels would indicate the potential to create a saline soil condition. Do not use this water if possible or other management practices may be needed such as aeration and leaching.

2. Check sodium (Na) level.

   Use Table G to evaluate the sodium (Na) level which is 209.66 mg L^{-1}**. Although this is a moderate level, Na levels >200** mg L^{-1} **can build up over time.**

3. It may be worthwhile to note the Sodium Adsorption Ratio (SARw) at this time especially if the soils are more fine-textured. These soils are more susceptible to structure deterioration when the salt concentration is high.

   According to Table G. the SARw level of 5.23 meq L^{-1} is under the level of concern for plant roots.

4. The permeability hazard can be determined by evaluating the electric conductivity (ECw) in conjunction with the sodium adsorption ratio (SAR) levels. Knowledge of the clay type will be useful. These values will determine the level of aerification, amendments and leaching that may be needed.

   Use Table F to see that with ECw at 1.61 (mmhos/cm which = dSm^{-1}) and a SARw of 5.23 there would be no restriction in permeability with this water.

5. Now check for bicarbonates and carbonates in the water. If concentrations are greater than 120 mg L^{-1} and 15 mg L^{-1}, respectively, you will have to take an additional step.

   The report states the bicarbonate and carbonate levels at 197.53 + 21.90 = 219.43 mg L^{-1} **Both levels are higher than the cautionary levels.**

6. Check the Adjusted Sodium Adsorption Ration (adj SAR) and the Residual Sodium Content (RSC) to verify the degree of impact that these ions will have on Ca and Mg activity. A SARw level >6 meq L^{-1} and a RSC level >1.25 mg L-1 may indicate that acid treatment plus lime or gypsum applications are needed.

   The SARw level of 5.23 meq L^{-1} and the RSC level of -2.10 are under the level for concern as shown in Table D.

7. Use Table H to check sulfur (S) and or sulfate (SO^4) levels in the water. If S >60 mg L^{-1} or SO4 > 180 mg L^{-1}, you may need to use lime as an amendment. The high sulfates (sulfur) in the water will combine with lime to form gypsum. Removing the excess sulfur and sulfates will help minimize anaerobic problems and black layer formation when regular aeration and leaching are used in management protocols.

   Sulfur reported as sulfate is 76.52 mg L^{-1}**. Table H indicates this level is in the normal range and below the level of concern which is 180** mg L^{-1}**.**

8. Check actual Chloride (Cl) and Boron (B) levels for their specific ion toxicity potential. These ions normally will affect susceptible turf cultivars but continued accumulation can eventually

influence even tolerant species. Plants tolerant to high total salinity also are generally tolerant to high levels of these specific ions.

The value for Cl it is 319.99 mg L^{-1} and for B it is 0.18 mg L^{-1}. Both levels are considered moderate according to Table G.

9. Check levels of actual nutrients and make appropriate adjustments in your fertility program to account for nutrient additions or any induced deficiencies. Check the report levels for the following nutrients and compare with Table H. Calcium at 57.95 ppm is in the normal range, magnesium at 38.66 ppm is considered very high and potassium 16.05 ppm is in the normal range.

10. Calculate Ca:Mg, Ca:K and Mg:K ratios and adjust the fertility program accordingly.

The ratio of Ca: Mg is 1.5:1, for Ca:K it is 3.5:1 and for Mg:K 2.4:1. According to Table I, these ratios indicate there could be calcium and magnesium deficiencies. At this point, you could look for symptoms of calcium and magnesium deficiencies and have a tissue test done to confirm this possibility.

In summary, this water poses some concerns if used because of its high electric conductivity, moderate sodium level and high bicarbonates and possible calcium and magnesium deficiencies.

How much nutrients are supplied by waste water irrigation?

Another useful management step is to determine the amount of nutrients supplied with the irrigation water so that the total amount of supplemental fertilization can be reduced accordingly. Table J lists the amount of nutrients supplied per inch of irrigation water per 1000 sq. ft.

Table K. Nutrients Supplied by Waste Water Irrigation per 1000 sq ft per Inch of Irrigation at a concentration of 1 mg L-1

Nutrient or Element	**Concentration** mg L^{-1}	**Lb of nutrients/ 1000 sq ft/ Inch of irrigation**
N	1	.005
NO_3^-	1	.001
P	1	.012
PO_4^-	1	.004
P_2O_5	1	.005
K	1	.006

K_2O	1	.005
Ca^{++}	1	.005
Mg^{++}	1	.005
S	1	.005
SO_4^{-2}	1	.002

The below sample water test results will be used to demonstrate how to calculate the nutrients provided given the analysis of this particular irrigation water.

Sample

Waste Water Results from Sun Mountain Golf Course

Parameter		
Ammonium	NH_4	12.07 mg L^{-1}
Nitrate Nitrogen	NO_3	3.17 mg L^{-1}
Phosphorus	P	.32 mg L^{-1}
Potassium	K	8.62 mg L^{-1}
Calcium	Ca	85.69 mg L^{-1}
Magnesium	Mg	15.17 mg L^{-1}
Sulfur	S	.33 mg L^{-1}
Sodium*	Na	21.36 mg L^{-1}
Chloride*	Cl	230.85 mg/kg
Electric Conductivity *	EC	.82 dS/m

During the 2005 growing season, Sun Mountain Golf Course irrigated with 20" of the above waste water. The manager wanted to determine if an adjustment in their fertilizer program would be necessary after applying 20" of this particular water.

To calculate the amount of nutrients supplied by waste water irrigation follow the steps below.

1. **Add the ammonium (**NH_4**) and nitrate nitrogen (**NO_3**) amount to come up with total nitrogen.**

   12.07 + 3.17 = 15.24 mg L^{-1} total nitrogen.

   From Table J note that each mg L^{-1} of nitrogen contributes .005 lb of nutrients with each inch of irrigation. Multiply 15.24 by .005 which = .077 mg L^{-1} of nitrogen per inch of water. Multiply this by 20 (the amount of total irrigation) to come up with **1.5 lb of nitrogen** which was supplied per 1000 sq ft last year with the waste water irrigation.

2. **Phosphorus (P) fertilizer recommendations are reported in the oxide form P_2O_5.**

   To calculate the P_2O_5 when you have the P value multiply the P value by 2.29.

   Take the P value of 0.32 multiple it by 2.29 to come up with 0.73 mg L^{-1} of P_2O_5. Then multiply this by .005 (the pounds of nutrients supplied with each inch of irrigation) which totals .004 mg L^{-1} and then multiply by 20 (the total inches of irrigation) to see that **0.07lb of P_2O_5** was supplied per 1000 sq ft last year with the waste water irrigation.

3. **Potassium (K) fertilizer is reported as K20 so you will have to make this calculation first.**

   To calculate the K_20 when you have the K value multiply K by 1.2.

   8.62 mg L^{-1} of potassium multiplied by 1.2 equals 10.3 mg L^{-1} of K_20. Multiply this by .005 (the pounds of nutrients supplied with each inch of irrigation) to get .05 mg L^{-1} then multiply this by 20 (the total inches of irrigation) to see that **1.0 lb of K_20** was supplied per 1000 sq ft last year with the waste water irrigation.

* Other reported parameters:

  According to Table G, the sodium level of 21.36 mg L^{-1} is very low and is not of concern, but the chloride level of 230.85 mg/kg is in the moderate risk category. Table C indicates salinity as reported as electric conductivity is in the medium range.

With 20" of irrigation water applied in 2005 the turf was receiving a total of 1.5 lb of nitrogen, 0.07 lb of P_2O_5 and 1.0 lb of K_20. The golf turf manager should take this nutrient contribution into consideration and adjust the fertilization program accordingly.

Summary

This initial survey of the potential for using waste water to irrigate golf course shows great promise. Managers found that the benefits of using the recycled waste water out weighed the costs. Especially when the waste water source was close to the golf courses, waste water offered less expensive water for irrigation.

It was acknowledged that extra management would be necessary to monitor the water and soil nutrient content through routine testing so timely adjustments could be made throughout the growing season. Managers found that having access to waste water would increase the areas irrigated and offered more play. Extra mowing and pest management may be necessary.

The community would reap environmental benefits by having more water from the treatment plants diverted to the golf course where the soil would serve as a bio-filter and reduce the amount of phosphorus and nitrogen reaching streams and lakes.

These guidelines provide the necessary information on what testing should be done on waste water and how to interpret the results to use waste water safely.

Golf course managers and community members are encouraged to learn all they can about their local water sources. The references listed at the end of this publication contain in-depth information which should be thoroughly reviewed by all interested parties.

References

1. Carrow, R.N. and R.R. Duncan. 1998. Salt affected turfgrass sites: Assessment and Management. Ann Arbor Press, Chelsea, MI. 185p.

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3. Feigin, A.L. and J. Shalhevet.1991. Irrigation with treated sewage effluent. Management for environmental protection. Springer-Verlag. Berlin

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5. Harivandi, M.A. Evaluating Recycled Waters for Golf Course Irrigation. USGA Green Section Record. November/December 2004.

6. Harivandi, M.A., and J. B. Beard. 1998. How to Interpret a Water Test Report. Golf Course Mgmt. 66(6):49-55

7. Huck, M., R.N. Carrow and R.R. Duncan. Effluent Water: Nightmare or Dream Come True? USGA Green Section Record. March/April 2000.

8. Stowell, L. 1999. Pointers on reclaimed water contract negotiations – Pace Pointers (June). Web page (www.pace.ptricom)

Examples of Water Testing Labs that do complete waste water analysis:

Brookside Farms Laboratories, Inc., 308 South Main St., New Knoxville, OH 45871
419-753-2448. www.blinc.com

CLC Labs, 325 Venture Dr., Westerville, OH 43081. 614-888-1663

A & L Great Lakes Lab, Inc. , 3505 Conestoga Drive 209, Fort Wayne, IN 46808
260-483-4759. www.algreatlakes.com

MDS Harris -Agronomic Services, 624 Peach St., Lincoln, NE 68502
402-476-2811. http://ag.mdsharris.com

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Will Maxwell, superintendent, Indian Point Golf Course.

Table L. Conversion factors

	To convert mg L^{-1} to meq/L, multiply by:	To convert meq/L to mg L^{-1}, multiply by
Sodium Na^{+}	0.043	23.0
Calcium Ca^{++}	0.050	20.0
Magnesium Mg^{++}	0.083	12.2
Chloride Cl	0.029	35.4
Potassium K^{+}	0.026	39.0
Sulfate SO_4^{--}	0.021	48.0
Carbonate HCO_3	0.016	61.0

Note: 1 mg L^{-1} = 1 ppm

For example, to convert 220 mg L^{-1} Na^{+} to meq L^{-1}: (220 mg L^{-1}) x (0.043) = 9.46 meq L^{-1} Na^{+}

	Convert ECw	Multiply by:
Electrical Conductivity of Water	mSm^{-1} to dSm^{-1}	0.01
	dSm^{-1} to mSm^{-1}	100

$mScm^{-1}$ to mSm^{-1}	100
mSm^{-1} to ppm	6.4
dSm^{-1} to ppm	640
$mScm^{-1}$ to ppm	640
ppm to dSm^{-1}	0.0016

Other Conversion Factors:

1 mmhos cm^{-1} = 1 dSm^{-1} = 1,000 umhos cm^{-1} = 0.1 Sm^{-1}

1 umhos cm^{-1} =0.001 dSm^{-1} = 0.001 mmhos cm^{-1}

1 ppm = 1 mg L^{-1} (solution) = 1 mg kg^{-1} (soil)

1% concentration = 10,000 ppm

1 $mmolc^{-1}$ = 1meq L^{-1}

1 ECw (dSm^{-1}) = 640 ppm (TDS = Total Dissolved Salts)

TDS (ppm) = ECw x 640; TDS (lb./ac.ft.) ≈ TDS (ppm x 2.72)

ppm = grains per gallon x 17.2

(grains/gallon is still used by domestic effluent water purveyors to report hardness)

Sum of cations and anions (meq L^{-1}) ≈ EC (dSm^{-1}) x 10

Appendix F: Conversion Factors And Example For Calculating Pounds Nutrient Per Acre-Foot Of Irrigation Water

(Duncan, R. R., Carrow, R. N., & Huck, M. T. (2009). *Turfgrass and landscape irrigation water quality: Assessment and management*. Boca Raton: CRC Press.)

11.3 ppm N = 0.71 Ib. N per 1,000 sq. ft.
50 ppm $N0_3^-$ = 0.71 Ib. N per 1,000 sq. ft.
0.4 ppm P = 0.057 lb. P_20_5 per 1,000 sq. ft.
1.21 ppm $P0_4^-$ = 0.057 lb. P_20_5 per 1,000 sq. ft.
0.92 ppm P_20_5 = 0.057 lb. P_20_5 per 1,000 sq. ft.
20 ppm K = 1.5 lb. K_2O per 1,000 sq. ft.
24 ppm K_2O = 1.5 lb. K_2O per 1,000 sq. ft.
60 ppm Ca = 3.75 lb. Ca per 1,000 sq. ft
25 ppm Mg = 1.56 lb. Mg per 1,000 sq. ft.
30 ppm S = 1.87 lb. S per 1,000 sq. ft.
90 ppm $S0_4^-$ = 1.87 lb. S per 1,000 sq. ft.

1 acre = 43,560 sq. ft.

Example: Irrigation water has 15 mg/L $N0_3^-$

15 mg/L	= (15)(0.226 mg/L N)
	= 3.39 mg/L as N
lb N per acre-foot of water	= (mg/L of N)(2.72)
	=(3.39 mg/L of N)(2.72)
	=9.22 lb N per acre-foot water

Or, 9.22/43.56 = 0.21 lb N per 1000 sq. ft. per 12 in. irrigation water

Appendix G: WIN PST Example

WIN PST can be used for golf course conditions such as a sand green. In this example, the soil is sand at a typical greens depth of 12 inches and the average organic content for the 12 inch profile is 1%, by weight. The pesticides were applied to the turf foliage under two rainfall conditions: low potential for rainfall and a high potential for rainfall. Appendix G contains the WIN PST risk screening for pesticide leaching for most pesticides registered in NYS for use on golf courses. Under the low rainfall potential scenario, most of the pesticides evaluated had a low or very low risk (four had a high/extra high) to humans (long term exposure as a drinking water source) and only one pesticide has a high or extra high risk to fish, even when applied to this very high leaching-groundwater contamination soil like sand. When applied under a high potential rainfall scenario, however, 15 pesticides had a high/extra high risk to humans, and 20 had high/extra high risk to fish.

Based on these result, one of the BMPs for this example is to only apply pesticides when the potential for rainfall is low. On sites where greens drainage is discharged near streams or near drinking water wells, extreme care needs to be taken if a pesticide application is needed during a period with a high potential for rain. Appendix G can be used to select pesticides that have a low risk even under these conditions.

Appendix H: Preventing Drift

Drift can potentially cause not only water quality impacts, but also damage to susceptible off-target crops, and a lower than intended rate to the turfgrass, thus reducing the effectiveness of the pesticide. There are two types of drift, airborne (spray) drift and vapor drift.

Spray Drift

Spray Drift is influenced by many inter-related factors including droplet size, nozzle type and size, sprayer design, weather conditions and the operator.

Droplet Size

Lower spray volumes can result in smaller droplets that enhance leaf coverage although there is a limit to droplet size due to drift. Droplets under 150 microns generally pose the greatest hazard; droplets less than 50 microns have insufficient momentum for impaction as they remain suspended in the air indefinitely or until they evaporate. Research in England concluded that a 100 micron droplet takes 11 seconds approximately to fall ten feet in still air; when a similar size droplet is released into a 5mph wind drifts about 75 feet before hitting the ground. The higher the operating pressure, the smaller the droplet. Conversely, low pressure produces large droplets that may bounce off the target. Certain spray surfactants can change the droplet spectrum, reducing the number of driftable droplets.

Nozzle Type and Size

Correct nozzle selection is one of the most important, yet inexpensive, aspects of pesticide application. A nozzle's droplet size spectrum determines deposition and drift. Conventional flat fan nozzles fitted to a turfgrass sprayer produces droplets in the range of 10 – 450 microns. (Note: 25,000 microns = 1 inch.) Drift is a concern with droplets less than 100 microns. Increasing the Volume Median Diameter (VMD) reduces drift, but droplets that are too bounce off the leaves to the ground.

Sprayer Design

Shields are better at targeting the spray into the grass, reducing drift and increasing deposition. They vary from the simple to the complex. Shielded sprayers allow managers to apply pesticides in variable weather conditions.

Weather Conditions

Wind speed and direction, relative humidity, temperature and atmospheric stability affects drift. Applying the correct product to the correct target at the correct time with the correct equipment is the key to good spraying.

Operator

Correct sprayer calibration ensures that all the nozzles are discharging the correct amount of liquid at the correct distance and angle to the target and at the correct forward speed.

Vapor Drift

The amount of vapor drift depends upon a pesticide's volatility and atmospheric conditions such as humidity, temperature. Turfgrass pesticides with known volatility should be avoided. In some cases, the pesticide label may indicate low volatility. However, low volatility does not mean that a chemical will not volatilize under conducive conditions, such as high temperatures or low relative humidity.

Best Practices for Spraying

Before spraying:

1. Train the operator to use the sprayer correctly.
2. Plan the spraying operation; consider the use of spray instruction cards as a good management tool.
3. Read and follow the pesticide label.
4. Select the correct nozzle for the target. Adjust the size and position of the nozzles to achieve correct distribution within the grass canopy,
5. Consider the use of sprayer nozzles which direct the spray to the target.
6. Consider spray additives to reduce drift.
7. Improve spraying logistics to ensure adequate time to spray within 'ideal' conditions.
8. Only spray when weather conditions are ideal; avoid spraying on days when conditions are favorable for atmospheric inversion or wind drift.
9. Calibrate the sprayer with water to ensure that everything is working correctly.

During spraying:

1. Stay alert: ensure the spray is not allowed to drift on to non-target areas and watch for changes in wind speed and direction.
2. Keep spray pressure as low as possible and ensure an accurate gauge is used.
3. Maintain a constant speed and pressure. If an automatic regulator is fitted, remember, small increases in speed result in large increases in pressure.
4. Avoid spraying near sensitive crops or watercourses; use a buffer zone.

Appendix I: Spill kits

Spill kits should contain:

- Gloves (nitrile, at least; foil barrier laminate better)
- Tyvek® coverall
- Goggles
- Temporary storage container for spill
- Sorbent pads and/or socks
- Loose absorbent (SlikWik®, vermiculite)
- Sweeping compound
- Warning sign or caution tape
- Chalk (for marking spill area on floor)
- Dust pan or small shovel (plastic preferable)
- Small broom
- Permanent marker (for marking spill container after clean-up)
- Recommended materials and suppliers are provided by Cornell's Occupation & Environmental Health Department at http://oeh.cals.cornell.edu/Spill_Kit_Contents.html

Forms of Sorbents

- Booms: cylindrical shape; vary in length and width; used to control and contain spills
- Socks or mini booms: cylindrical shape; vary in length and width; used in facility spill response or maintenance; contain spills or leaks (placed around equipment)
- Pillows: rectangular in shape; used for medium size spills; can be used for leaks and drips
- Pad and rolls: flat sorbent sheets of various lengths can be used to line shelves, catch leaks under machinery and clean up spills
- Loose sorbents: sorbent media that is not contained in any type of pillow or mesh; typically used on small spills

Sorbent Categories

- Universal sorbents: designed to absorb any liquid; they will absorb aggressive liquids such as acids and bases as well as non-aggressive liquids and solvents, such as cleaners, water-based fluids, gasoline and alcohol; made of polypropylene or expanded silicate materials.
- Petroleum sorbents ("oil-only sorbents"): designed for absorption of oil and/or petroleum-based liquids; these sorbents are hydrophobic (will not absorb water or water-based liquids); can be used in maintenance applications for hydraulic and engine oil cleanup; made of polypropylene or treated cellulose.
- Maintenance sorbents: absorb non-aggressive liquids commonly found in manufacturing and maintenance operations (coolants, lubricants, oils, cut-ting fluids);

will pick up water-based as well as oil-based fluids; made of recycled materials, such as cotton, wool, cellulose or corn cob; can also be made of polypropylene or any combination of the materials listed.

Sorbent capacity: the amount of weight the sorbent will absorb in relation to itself (e.g., absorbs 12 times its weight) or the liquid capacity of the sorbent (e.g., absorbs 8 gallons). Because all liquids don't weigh the same per gallon, the weight capacity of the sorbent actually varies from liquid to liquid. A more accurate way to assess the sorbent capacity is by its liquid capacity.

Hampshire Country Club Planned Residential Development
Village of Mamaroneck,
Westchester County, New York
Final Environmental Impact Statement

P

Natural Resources Conservation Service Hydric Soil Report

Hydric Soils

This table lists the map unit components that are rated as hydric soils in the survey area. This list can help in planning land uses; however, onsite investigation is recommended to determine the hydric soils on a specific site (National Research Council, 1995; Hurt and others, 2002).

The three essential characteristics of wetlands are hydrophytic vegetation, hydric soils, and wetland hydrology (Cowardin and others, 1979; U.S. Army Corps of Engineers, 1987; National Research Council, 1995; Tiner, 1985). Criteria for all of the characteristics must be met for areas to be identified as wetlands. Undrained hydric soils that have natural vegetation should support a dominant population of ecological wetland plant species. Hydric soils that have been converted to other uses should be capable of being restored to wetlands.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). These soils, under natural conditions, are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

Hydric soils are identified by examining and describing the soil to a depth of about 20 inches. This depth may be greater if determination of an appropriate indicator so requires. It is always recommended that soils be excavated and described to the depth necessary for an understanding of the redoximorphic processes. Then, using the completed soil descriptions, soil scientists can compare the soil features required by each indicator and specify which indicators have been matched with the conditions observed in the soil. The soil can be identified as a hydric soil if at least one of the approved indicators is present.

Map units that are dominantly made up of hydric soils may have small areas, or inclusions, of nonhydric soils in the higher positions on the landform, and map units dominantly made up of nonhydric soils may have inclusions of hydric soils in the lower positions on the landform.

The criteria for hydric soils are represented by codes in the table (for example, 2). Definitions for the codes are as follows:

1. All Histels except for Folistels, and Histosols except for Folists.
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that:
   A. Based on the range of characteristics for the soil series, will at least in part meet one or more Field Indicators of Hydric Soils in the United States, or
   B. Show evidence that the soil meets the definition of a hydric soil;
3. Soils that are frequently ponded for long or very long duration during the growing season.
   A. Based on the range of characteristics for the soil series, will at least in part meet one or more Field Indicators of Hydric Soils in the United States, or
   B. Show evidence that the soil meets the definition of a hydric soil;
4. Map unit components that are frequently flooded for long duration or very long duration during the growing season that:
   A. Based on the range of characteristics for the soil series, will at least in part meet one or more Field Indicators of Hydric Soils in the United States, or
   B. Show evidence that the soil meets the definition of a hydric soil;

Hydric Condition: Food Security Act information regarding the ability to grow a commodity crop without removing woody vegetation or manipulating hydrology.

References:
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Report—Hydric Soils

Hydric Soils–Westchester County, New York				
Map symbol and map unit name	**Component**	**Percent of map unit**	**Landform**	**Hydric criteria**
CrC—Charlton-Chatfield complex, 0 to 15 percent slopes, very rocky				
	Leicester, very stony	5	Depressions, drainageways	2
CsD—Chatfield-Charlton complex, 15 to 35 percent slopes, very rocky				
	Leicester, very stony	6	Depressions, ground moraines, drainageways, hills	2
CtC—Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes				
	Leicester, extremely stony	1	Depressions, ground moraines, drainageways, hills	2
Uc—Udorthents, wet substratum				
	Fredon	2	Depressions	2
	Ipswich	2	Tidal marshes	1, 3
	Raynham	2	—	2
UlC—Urban land-Charlton-Chatfield complex, rolling, very rocky				
	Sun	2	Depressions	2, 3
	Palms	1	Marshes, swamps	1, 3

Data Source Information

Soil Survey Area: Westchester County, New York
Survey Area Data: Version 13, Oct 8, 2017

Soil Data Access (SDA) Hydric Soils List

An SDA-populated select list is used to pick a state and SSA which enables creation of a "Hydric Soils Report" based upon those selections. The data is not static; it hits Soil Data Access Live. To reset the table hit F5 on the keyboard. Once a survey is selected and table appears, if a new survey is selected it will append to the table at the bottom. For more information about the table,

New York

selected stateId = NY

Westchester County, New York

selected SSA areasymbol = NY119

State_Sym	Area_Symbol	Area_Name	mukey	Mapunit_SYM	Mapunit_Name	Comp_Name_phase	muacres	Comp_RV_Pct	majcompflag	Comp_Acres	Comp_Landform	microfeature	Hydric_Rating	hydric_criteria
NY	NY119	Westchester County, New York	309693	Ce	Catden muck, 0 to 2 percent slopes	Catden	3054	80	Yes	2443.2	depressions	null	Yes	1, 3
NY	NY119	Westchester County, New York	309693	Ce	Catden muck, 0 to 2 percent slopes	Timakwa	3054	5	No	152.7	swamps	null	Yes	1, 3
NY	NY119	Westchester County, New York	309693	Ce	Catden muck, 0 to 2 percent slopes	Natchaug	3054	5	No	152.7	depressions	null	Yes	1, 3
NY	NY119	Westchester County, New York	309693	Ce	Catden muck, 0 to 2 percent slopes	Canandaigua	3054	5	No	152.7	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309693	Ce	Catden muck, 0 to 2 percent slopes	Alden	3054	5	No	152.7	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309694	ChB	Charlton fine sandy loam, 3 to 8 percent slopes	Leicester	7863	1	No	78.6	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309698	ClB	Charlton fine sandy loam, 3 to 8 percent slopes, very stony	Leicester, very stony	689	2	No	13.8	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309699	ClC	Charlton fine sandy loam, 8 to 15 percent slopes, very stony	Leicester, very stony	1256	2	No	25.1	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309703	CrC	Charlton-Chatfield complex, 0 to 15 percent slopes, very rocky	Leicester, very stony	42635	5	No	2131.8	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309704	CsD	Chatfield-Charlton complex, 15 to 35 percent slopes, very rocky	Leicester, very stony	25384	6	No	1523.0	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309705	CtC	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	Leicester, extremely stony	9186	1	No	91.9	depressions	null	Yes	2
NY	NY119	Westchester	309706	CuD	Chatfield-	Leicester, extremely	10901	4	No	436.0	depressions	null	Yes	2

		County, New York			Hollis-Rock outcrop complex, 15 to 35 percent slopes	stony								
NY	NY119	Westchester County, New York	309707	Ff	Fluvaquents-Udifluvents complex, frequently flooded	Fluvaquents	4410	50	Yes	2205.0	flood plains	null	Yes	2, 3, 4
NY	NY119	Westchester County, New York	309707	Ff	Fluvaquents-Udifluvents complex, frequently flooded	Sun	4410	3	No	132.3	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309707	Ff	Fluvaquents-Udifluvents complex, frequently flooded	Leicester	4410	2	No	88.2	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309707	Ff	Fluvaquents-Udifluvents complex, frequently flooded	Ridgebury	4410	2	No	88.2	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309707	Ff	Fluvaquents-Udifluvents complex, frequently flooded	Carlisle	4410	1	No	44.1	marshes, swamps	null	Yes	1, 3
NY	NY119	Westchester County, New York	309707	Ff	Fluvaquents-Udifluvents complex, frequently flooded	Palms	4410	1	No	44.1	marshes, swamps	null	Yes	1, 3
NY	NY119	Westchester County, New York	309708	Fr	Fredon silt loam	Fredon, poorly drained	514	50	Yes	257.0	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309708	Fr	Fredon silt loam	Leicester	514	3	No	15.4	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309708	Fr	Fredon silt loam	Fluvaquents	514	2	No	10.3	flood plains	null	Yes	2, 4
NY	NY119	Westchester County, New York	309708	Fr	Fredon silt loam	Palms	514	1	No	5.1	marshes, swamps	null	Yes	1, 3
NY	NY119	Westchester County, New York	309712	HrF	Hollis-Rock outcrop complex, 35 to 60 percent slopes	Leicester, very stony	6160	4	No	246.4	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309713	Ip	Ipswich mucky peat, 0 to 2 percent slopes, very frequently flooded	Ipswich	221	90	Yes	198.9	tidal marshes	null	Yes	1
NY	NY119	Westchester	309713	Ip	Ipswich mucky	Westbrook	221	5	No	11.1	tidal marshes	null	Yes	1

		County, New York			peat, 0 to 2 percent slopes, very frequently flooded									
NY	NY119	Westchester County, New York	309713	Ip	Ipswich mucky peat, 0 to 2 percent slopes, very frequently flooded	Pawcatuck	221	5	No	11.1	tidal marshes	null	Yes	1
NY	NY119	Westchester County, New York	309716	LcA	Leicester loam, 0 to 3 percent slopes, stony	Leicester, poorly drained	1484	50	Yes	742.0	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309716	LcA	Leicester loam, 0 to 3 percent slopes, stony	Sun	1484	7	No	103.9	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309716	LcA	Leicester loam, 0 to 3 percent slopes, stony	Leicester, very stony	1484	3	No	44.5	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309717	LcB	Leicester loam, 3 to 8 percent slopes, stony	Leicester, poorly drained	3580	35	Yes	1253.0	hills, ridges, till plains	null	Yes	2
NY	NY119	Westchester County, New York	309717	LcB	Leicester loam, 3 to 8 percent slopes, stony	Sun	3580	7	No	250.6	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309718	LeB	Leicester loam, 2 to 8 percent slopes, very stony	Leicester, poorly drained	1912	25	Yes	478.0	hills, ridges, till plains	null	Yes	2
NY	NY119	Westchester County, New York	309718	LeB	Leicester loam, 2 to 8 percent slopes, very stony	Sun	1912	10	No	191.2	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309719	Pa	Natchaug muck, 0 to 2 percent slopes	Natchaug	2034	80	Yes	1627.2	depressions	null	Yes	1, 3
NY	NY119	Westchester County, New York	309719	Pa	Natchaug muck, 0 to 2 percent slopes	Catden	2034	8	No	162.7	depressions	null	Yes	1, 3
NY	NY119	Westchester County, New York	309719	Pa	Natchaug muck, 0 to 2 percent slopes	Limerick	2034	5	No	101.7	flood plains	null	Yes	2
NY	NY119	Westchester County, New York	309719	Pa	Natchaug muck, 0 to 2 percent slopes	Sun	2034	4	No	81.4	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309719	Pa	Natchaug muck, 0 to 2 percent slopes	Halsey	2034	3	No	61.0	terraces	null	Yes	2
NY	NY119	Westchester County, New York	309720	Pc	Natchaug and Catden mucks, ponded, 0 to 2 percent slopes	Natchaug	337	45	Yes	151.7	depressions	null	Yes	1, 3
NY	NY119	Westchester County, New York	309720	Pc	Natchaug and Catden mucks, ponded, 0 to 2 percent slopes	Catden	337	40	Yes	134.8	depressions	null	Yes	1, 3
NY	NY119	Westchester County, New York	309720	Pc	Natchaug and Catden mucks,	Fredon	337	5	No	16.9	depressions	null	Yes	2

					ponded, 0 to 2 percent slopes								
NY	NY119	Westchester County, New York	309720	Pc	Natchaug and Catden mucks, ponded, 0 to 2 percent slopes	Sun	337	5	No	16.9	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309720	Pc	Natchaug and Catden mucks, ponded, 0 to 2 percent slopes	Fluvaquents	337	3	No	10.1	flood plains	null	Yes	2, 3, 4
NY	NY119	Westchester County, New York	309721	PnB	Paxton fine sandy loam, 3 to 8 percent slopes	Ridgebury	15192	6	No	911.5	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309722	PnC	Paxton fine sandy loam, 8 to 15 percent slopes	Ridgebury	13496	2	No	269.9	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309723	PnD	Paxton fine sandy loam, 15 to 25 percent slopes	Ridgebury	4898	1	No	49.0	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309724	PoB	Paxton fine sandy loam, 0 to 8 percent slopes, very stony	Ridgebury, very stony	164	4	No	6.6	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309725	PoC	Paxton fine sandy loam, 8 to 15 percent slopes, very stony	Ridgebury, very stony	570	2	No	11.4	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309726	PoD	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	Ridgebury, very stony	670	1	No	6.7	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309727	Pt	Pits, gravel	Fredon	475	2	No	9.5	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309728	Pv	Pits, quarry	Sun	217	3	No	6.5	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309729	Pw	Pompton silt loam, loamy substratum	Fluvaquents	569	2	No	11.4	flood plains	null	Yes	2, 4
NY	NY119	Westchester County, New York	309729	Pw	Pompton silt loam, loamy substratum	Fredon	569	2	No	11.4	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309730	Ra	Raynham silt loam	Raynham	431	85	Yes	366.4	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309730	Ra	Raynham silt loam	Sun	431	4	No	17.2	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309730	Ra	Raynham silt loam	Unnamed soils, occasionally flooded	431	2	No	8.6	null	null	Yes	2, 4
NY	NY119	Westchester County,	309731	RdA	Ridgebury loam, 0 to 3 percent	Ridgebury, poorly drained	1616	50	Yes	808.0	depressions	null	Yes	2

		New York			slopes									
NY	NY119	Westchester County, New York	309731	RdA	Ridgebury loam, 0 to 3 percent slopes	Sun	1616	5	No	80.8	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309731	RdA	Ridgebury loam, 0 to 3 percent slopes	Leicester	1616	3	No	48.5	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309731	RdA	Ridgebury loam, 0 to 3 percent slopes	Ridgebury, very stony	1616	2	No	32.3	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309732	RdB	Ridgebury loam, 3 to 8 percent slopes	Ridgebury, poorly drained	3385	35	Yes	1184.8	drumlinoid ridges, hills, till plains	null	Yes	2
NY	NY119	Westchester County, New York	309732	RdB	Ridgebury loam, 3 to 8 percent slopes	Sun	3385	5	No	169.3	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309733	RgB	Ridgebury loam, 2 to 8 percent slopes, very stony	Ridgebury, poorly drained	913	35	Yes	319.6	drumlinoid ridges, hills, till plains	null	Yes	2
NY	NY119	Westchester County, New York	309733	RgB	Ridgebury loam, 2 to 8 percent slopes, very stony	Sun	913	5	No	45.7	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309743	Sh	Sun loam	Sun	3323	85	Yes	2824.6	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309743	Sh	Sun loam	Ridgebury	3323	5	No	166.2	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309743	Sh	Sun loam	Leicester	3323	5	No	166.2	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309743	Sh	Sun loam	Palms	3323	3	No	99.7	marshes, swamps	null	Yes	1, 3
NY	NY119	Westchester County, New York	309743	Sh	Sun loam	Sun, stony	3323	2	No	66.5	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309744	Sm	Sun loam, extremely stony	Sun	964	85	Yes	819.4	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309744	Sm	Sun loam, extremely stony	Leicester	964	5	No	48.2	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309744	Sm	Sun loam, extremely stony	Ridgebury	964	5	No	48.2	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309744	Sm	Sun loam, extremely stony	Palms	964	3	No	28.9	marshes, swamps	null	Yes	1, 3
NY	NY119	Westchester County, New York	309744	Sm	Sun loam, extremely stony	Sun, non-stony	964	2	No	19.3	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309670	SuA	Sutton loam, 0 to 3 percent slopes	Leicester	394	5	No	19.7	depressions	null	Yes	2

NY	NY119	Westchester County, New York	309672	Ub	Udorthents, smoothed	Sun	6928	2	No	138.6	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309673	Uc	Udorthents, wet substratum	Fredon	3920	2	No	78.4	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309673	Uc	Udorthents, wet substratum	Ipswich	3920	2	No	78.4	tidal marshes	null	Yes	1, 3
NY	NY119	Westchester County, New York	309673	Uc	Udorthents, wet substratum	Raynham	3920	2	No	78.4	null	null	Yes	2
NY	NY119	Westchester County, New York	309676	UhB	Urban land-Charlton complex, 2 to 8 percent slopes	Sun	2744	3	No	82.3	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309677	UhC	Urban land-Charlton complex, 8 to 15 percent slopes	Sun	1485	3	No	44.6	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309678	UhD	Urban land-Charlton complex, 15 to 25 percent slopes	Sun	612	3	No	18.4	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309679	UlC	Urban land-Charlton-Chatfield complex, rolling, very rocky	Sun	11596	2	No	231.9	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309679	UlC	Urban land-Charlton-Chatfield complex, rolling, very rocky	Palms	11596	1	No	116.0	marshes, swamps	null	Yes	1, 3
NY	NY119	Westchester County, New York	309680	UlD	Urban land-Charlton-Chatfield complex, hilly, very rocky	Sun	2242	1	No	22.4	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309681	UmC	Urban land-Chatfield-Rock outcrop complex, rolling	Sun	849	1	No	8.5	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309682	UpB	Urban land-Paxton complex, 3 to 8 percent slopes	Ridgebury	8081	5	No	404.1	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309683	UpC	Urban land-Paxton complex, 8 to 15 percent slopes	Ridgebury	3441	5	No	172.1	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309684	UpD	Urban land-Paxton complex, 15 to 25 percent slopes	Ridgebury	695	5	No	34.8	depressions	null	Yes	2

NY	NY119	Westchester County, New York	309685	UrB	Urban land-Ridgebury complex, 1 to 8 percent slopes	Ridgebury, poorly drained	571	10	Yes	57.1	drumlinoid ridges, hills, till plains	null	Yes	2
NY	NY119	Westchester County, New York	309685	UrB	Urban land-Ridgebury complex, 1 to 8 percent slopes	Sun	571	5	No	28.6	depressions	null	Yes	2, 3
NY	NY119	Westchester County, New York	309686	UvB	Urban land-Riverhead complex, 2 to 8 percent slopes	Fluvaquents	1103	1	No	11.0	flood plains	null	Yes	2, 4
NY	NY119	Westchester County, New York	309687	UvC	Urban land-Riverhead complex, 8 to 15 percent slopes	Fluvaquents	293	1	No	2.9	flood plains	null	Yes	2, 4
NY	NY119	Westchester County, New York	309688	UwB	Urban land-Woodbridge complex, 3 to 8 percent slopes	Ridgebury	3198	10	No	319.8	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309690	WdA	Woodbridge loam, 0 to 3 percent slopes	Ridgebury	934	7	No	65.4	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309691	WdB	Woodbridge loam, 3 to 8 percent slopes	Ridgebury	8003	7	No	560.2	depressions	null	Yes	2
NY	NY119	Westchester County, New York	309692	WdC	Woodbridge loam, 8 to 15 percent slopes	Ridgebury	1610	7	No	112.7	depressions	null	Yes	2

Report Metadata: Back to top

- **Area_Symbol:** A symbol that uniquely identifies a single occurrence of a particular type of area (e.g. Dane Co., Wisconsin is WI025).
- **Area_Name:** The name given to the specified geographic area.
- **mukey:** A non-connotative string of characters used to uniquely identify a record in the Mapunit table.
- **Mapunit_SYM:** The symbol used to uniquely identify the soil mapunit in the soil survey.
- **Mapunit_Name:** Correlated name of the mapunit (recommended name or field name for surveys in progress).
- **Comp_Name_phase:** Component name - Name assigned to a component based on its range of properties. Local Phase - Phase criterion to be used at a local level, in conjunction with "component name" to help identify a soil component.
- **muacres:** The number of acres of a particular mapunit.
- **Comp_RV_Pct:** The percentage of the component of the mapunit.
- **majcompflag:** Indicates whether or not a component is a major component in the mapunit.
- **Comp_Acres:** The number of acres of a particular component in a mapunit. ((muacres*comppct_r)/100)
- **Comp_Landform:** A word or group of words used to name a feature on the earth's surface, expressed in the plural form. Column Physical
- **Hydric_Rating:** A yes/no field that indicates whether or not a map unit component is classified as a "hydric soil". If rated as hydric, the specific criteria met are listed in the Component Hydric Criteria table.
- **Hydric_criteria:** Criterion code for the soil characteristic(s) and/or feature(s) that cause the map unit component to be classified as a "hydric soil." These codes are the paragraph numbers in the hydric soil criteria publication.

Criteria:

1. All Histels except Folistels and Histosols except Folists; or
2. Map unit components in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, or Andic, Cumulic, Pachic, or Vitrandic subgroups that:
   a. Based on the range of characteristics for the soil series, will at least in part meet one or more Field Indicators of Hydric Soils in the United States, or
   b. Show evidence that the soil meets the definition of a hydric soil;
3. Map unit components that are frequently ponded for long duration or very long duration during the growing season that:
   a. Based on the range of characteristics for the soil series, will at least in part meet one or more Field Indicators of Hydric Soils in the United States, or
   b. Show evidence that the soil meets the definition of a hydric soil; or
4. Map unit components that are frequently flooded for long duration or very long duration during the growing season that:
   a. Based on the range of characteristics for the soil series, will at least in part meet one or more Field Indicators of Hydric Soils in the United States, or

b. Show evidence that the soils meet the definition of a hydric soil.

Q Requests for Jurisdictional Determination and Responses, NYSDEC and USACE

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Permits, Region 3
21 South Putt Corners Road, New Paltz, NY 12561-1620
P: (845) 256-3054 I F: (845) 255-4659
www.dec.ny.gov

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

February 15, 2019

Mr. David Kennedy, VHB
100 Motor Parkway, Suite 135
Hauppauge, NY 11788-5120

Re: Hampshire Country Club, 1025 Cove Road
Village of Mamaroneck, Westchester County
CH#: 7840
Article 25 Tidal Wetlands Jurisdictional Determination

Dear Mr. Kennedy:

The New York State Department of Environmental Conservation (DEC) has reviewed your request for a jurisdictional determination for a permit pursuant to Article 25, of the Environmental Conservation Law (ECL), Tidal Wetlands that was submitted on behalf of the Hampshire Country Club, and received by this office on September 10, 2018. Additional information was received on January 3, 2019, January 11, 2019, February 3, 2019 and February 14, 2019. The project involves the consists of constructing 105 single-family units on 94.5-acres, comprising 44 single-family residences and 61 semi-detached carriage residences, reducing the existing golf course from 18-holes to 9-holes, and preserving 36 acres for open space. Delancey Cove contains DEC-regulated tidal wetlands, mapped as littoral zone and intertidal marsh. The adjacent area can extend as much as 300 feet from the tidal wetland boundary. The extent can be constricted by several factors:

- The seaward edge of the closest lawfully and presently existing (i.e. as of August 20, 1977), functional and substantial fabricated structure generally parallel to the wetland boundary and 100 feet of greater in length;
- The elevation contour of 10 feet above mean sea level, as shown on the most recent United States geological survey topographical map prior to the effective date of the regulations (August 20, 1977); and
- The crest of a bluff or cliff, where the 10-foot contour crosses the bluff or cliff.

The Department has determined that the presence of a riprapped gabion wall, Hommocks Road, Cove Road and Eagle Knolls Road represents "presently existing (as of August 20, 1977), functional and substantial fabricated structures," pursuant to the tidal wetland regulations §661.4(b)(ii), and therefore limits the adjacent area on the property. Therefore, the 10-foot contour line is the landward extent of the regulated adjacent area on this property as shown on the survey (attached), received by this office on February 14, 2019.

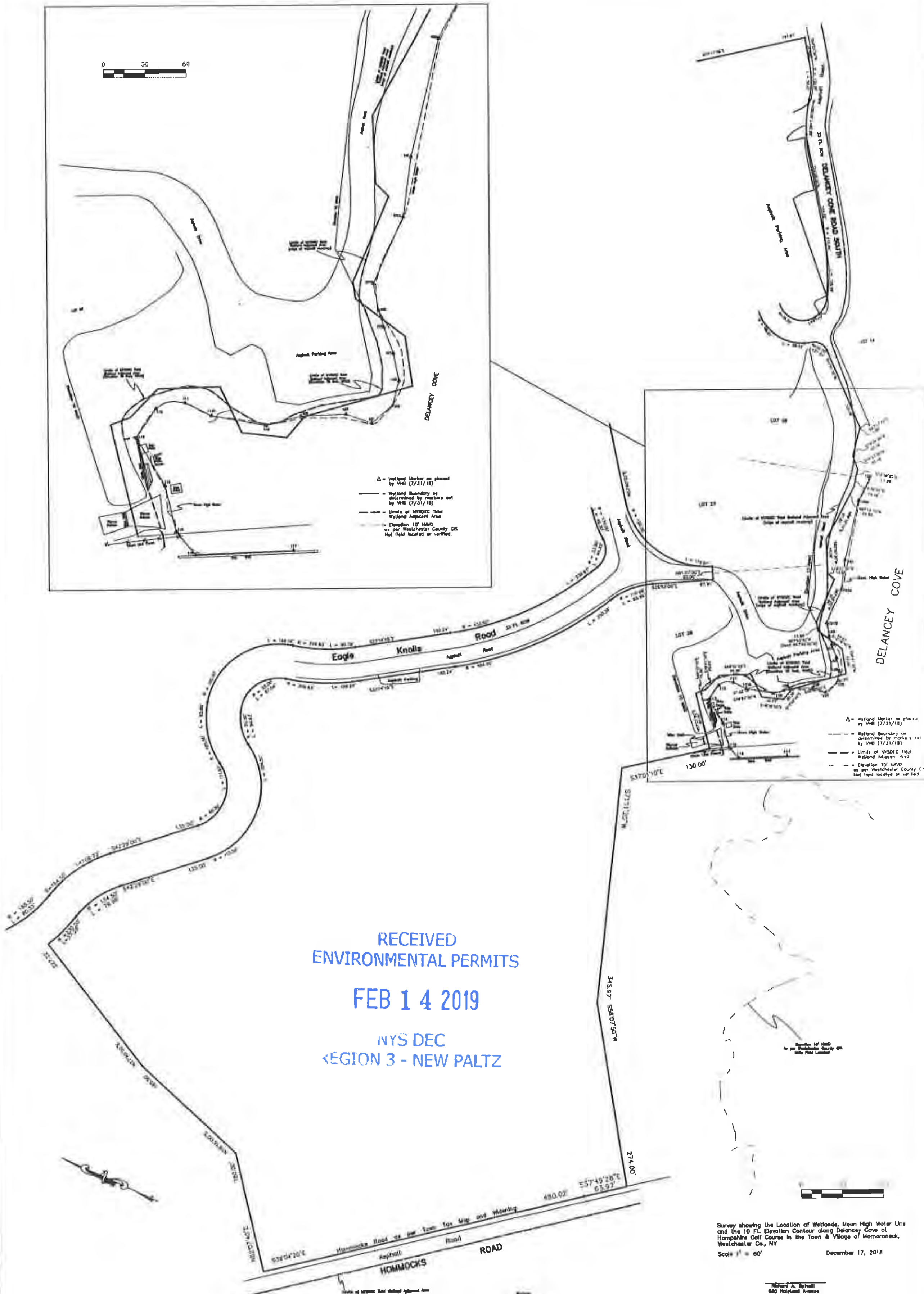
If there are any questions, please feel free to contact me at 845-256-3050 or by email at sarah.pawliczak@dec.ny.gov.

Respectfully,

Sarah Pawliczak
Division of Environmental Permits

Encl: Survey from VHB

cc: Angela Schimizzi, NYSDEC Division of Marine Resources
Village of Mamaroneck Planning Department
Mamaroneck Harbor and Coastal Zone Management Commission



Survey showing the Location of Wetlands, Mean High Water Line and the 10 Ft. Elevation Contour along Delancey Cove at Hampshire Golf Course in the Town & Village of Mamaroneck, Westchester Co., NY

Scale 1" = 60'

December 17, 2018

Notes:

1. Elevations are in the NAVD 1988 System.
2. Mean sea level is 3.4 Ft. (NAVD)
3. Tidal wetland boundary as delineated by VHB on July 31, 2018

Richard A. Spinelli
660 Halstead Avenue
Mamaroneck, NY
(914) 381-2387
N.Y.S. Lic. Land Surveyor
No. 49240

September 4, 2018

Ref: 28677.03

VIA CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. John Petronella
Region 3 Permit Administrator
New York State Department of Environmental Conservation
21 South Putt Corners Road
New Paltz, New York 12561

Re: Request for Tidal Wetlands Boundary Verification and Jurisdictional Determination
Hampshire Country Club
1025 Cove Road
Republic Airport
Village of Mamaroneck
Westchester County, New York

Dear Mr. Petronella:

VHB Engineering, Surveying, Landscape Architecture and Geology, P.C. (VHB) is serving as environmental consultant to Hampshire Country Club LLC. (HCC), which is requesting a tidal wetland boundary verification and jurisdictional determination (JD) from the New York State Department of Environmental Conservation (NYSDEC) for the 106.2-acre property located at 1025 Cove Road, in the Village of Mamaroneck, Westchester County, New York (hereinafter, the "Subject Property," see Appendix A, Figures 1 and 2).

The Subject Property is currently developed with recreational membership club facilities, including an 18-hole golf course, clubhouse, swimming pool, tennis courts, maintenance facilities, and other support uses. Two roads (Cove Road and Eagle Knolls Road) run east-west through the southern portion of the Subject Property. Additionally, the Subject Property abuts the tidal waters of Delancey Cove (a tributary to Long Island Sound), which is regulated as IM (Intertidal Marsh) and LZ (littoral zone) tidal wetlands by the NYSDEC (see Appendix A, Figure 3).

HCC is proposing to construct a Planned Residential Development (PRD) consisting of 105 residential

100 Motor Parkway
Suite 135
Hauppauge, New York 11788
P 631.787.3400
F 631.234.3437

units and 36 acres of common open space on portions of the Subject Property. VHB prepared a Draft Environmental Impact Statement for the PRD, which was accepted on December 13, 2017 by the Village of Mamaroneck Planning Board, which is serving as lead agency. In response to comments received regarding the DEIS, VHB is currently preparing responses to be included in the Final Environmental Impact Statement (FEIS) for the PRD. Several public comments included requests for clarification of the NYSDEC's tidal wetland jurisdiction at the Subject Property. In addition, a comment letter from NYSDEC Region 3 Division of Environmental Permits representative Sarah Pawliczak, dated February 14, 2018 (see Appendix B), include a preliminary statement regarding the extent of the NYSDEC's tidal wetland jurisdiction at the subject property:

> "*Hammocks Road, Cove Road, and Eagle Knolls Road can be considered a substantial fabricated structure limiting ·the tidal wetland adjacent area. But the area which is southeast of Eagle Knolls Road and within 300 feet of the regulated wetland, in Delancey Cove, is regulated adjacent area*."

VHB delineated the tidal wetland boundary of Delancey Cove to the south of the Subject Property on July 31, 2018 (Wetland Delineation Survey included as Appendix C). Based on field observations, in addition to the roads referenced by Ms. Pawliczak, it appears that other substantial fabricated structures, as defined in 6 NYCRR 661.4(b)(ii), occur at or just landward of the delineated wetland boundary. Specifically, a stone seawall, timber bulkhead, rip-rap gabions, concrete retaining wall and concrete tide gate structures occur along the Delancey Cove shoreline, to the south and west of Cove Road and to the southwest of Eagle Knolls Road (representative photographs included as Appendix D). Based on preliminary review, it appears that these structures may further limit the extent of the regulated tidal wetland adjacent area at the Subject Property. Accordingly, on behalf of HCC, we are respectfully requesting verification of the delineated tidal wetland boundary and a formal determination of the NYSDEC's tidal wetland jurisdiction at the Subject Property.

To assist in the processing of this request, attached please find two copies of the following:

Appendix A	Site Figures 1 through 3
Appendix B	NYSDEC correspondence, dated February 14, 2018
Appendix C	Wetland Delineation Survey
Appendix D	Photograph Location Map and representative photographs

Thank you for your cooperation in this matter. Please feel free to contact me at your earliest convenience at 631.787.3400 or at dkennedy@vhb.com to arrange for a field inspection of the Subject Property, or if you require any additional information to process this request.

Sincerely,

VHB Engineering, Surveying, Landscape Architecture and Geology, P.C.

David Kennedy
Project Scientist

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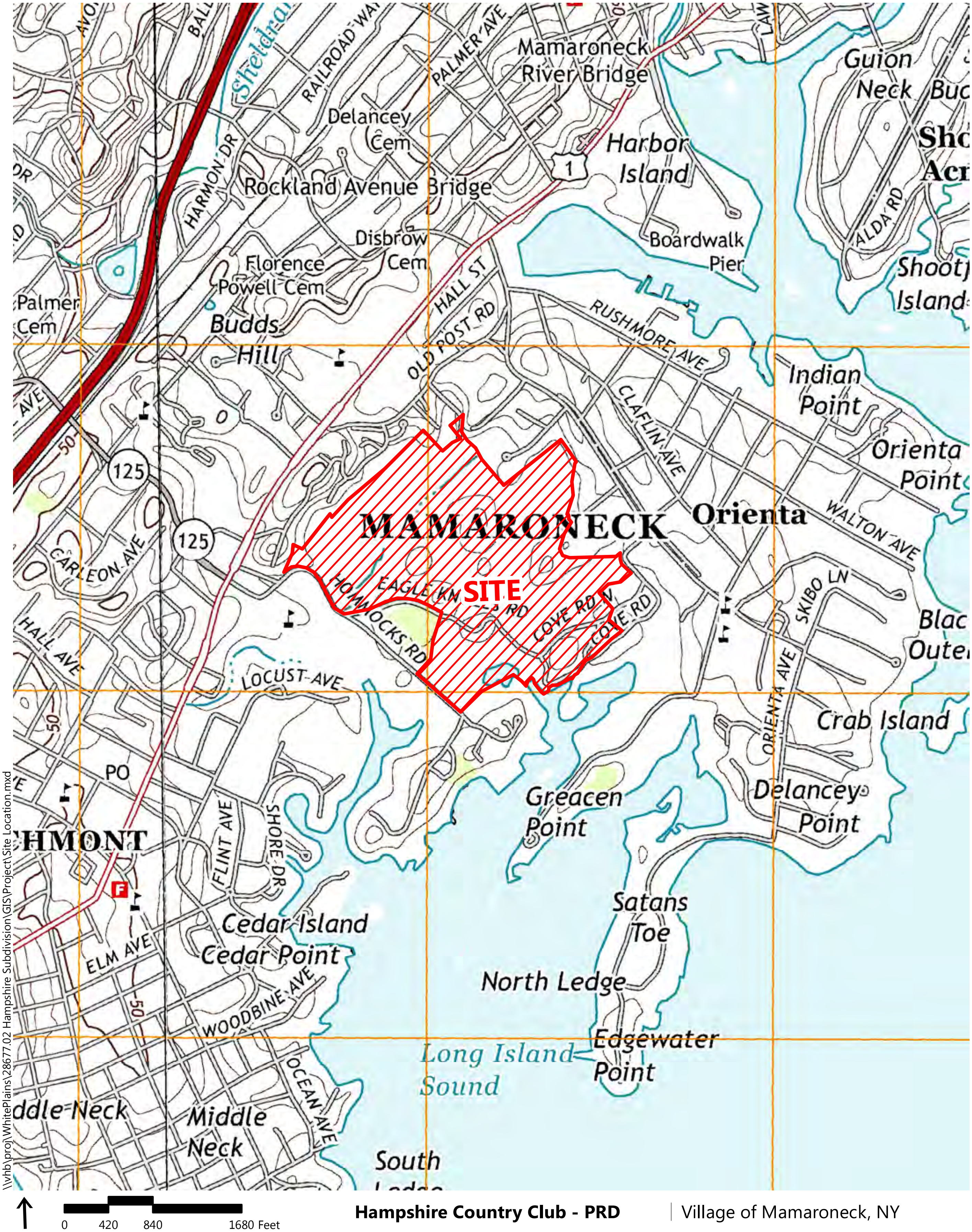
Appendix A

Figure 1



\\vhb\proj\WhitePlains\28677.02 Hampshire Subdivision\GIS\Project\Site Location.mxd

Hampshire Country Club - PRD | Village of Mamaroneck, NY

Regional Location Map

Source: USGS Mamaroneck, NY

Figure 2

Source: ESRI GIS

0 170 340 680 Feet

Hampshire Country Club - PRD | Village of Mamaroneck, NY

Site Aerial Photograph

vhb | **Figure 3**

\\NYWPDATA\projects\28677.02 Hampshire Subdivision\GIS\Project\Wetlands Chapter Maps\Wetlands - Freshwater and Tidal.mxd

0 175 350 700 Feet

Hampshire Country Club - PRD | Village of Mamaroneck, NY

NYSDEC Tidal Wetlands

NYSDEC Wetland Map

Source: U.S. Fish and Wildlife Service

Appendix B

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Permits, Region 3
21 South Putt Corners Road, New Paltz, NY 12561-1620
P: (845) 256-3054 I F: (845) 255-4659
www.dec.ny.gov

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

41

February 14, 2018

Ms. Betty-Ann Sherer
Land Use Coordinator
Village of Mamaroneck Planning Department
169 Mt. Pleasant Avenue
Mamaroneck, NY 10543

RE: Hampshire Country Club Planned Residential Development
Village of Mamaroneck, Westchester County
Comments on Draft Environmental Impact Statement
CH#: 7242

Dear Ms. Sherer:

Department of Environmental Conservation (DEC) staff have reviewed the Draft Environmental Impact Statement (DEIS) for Hampshire Country Club Planned Residential Development. The project consists of constructing 105 single-family units on 94.5-acres, comprising 44 single-family residences and 61 semi-detached carriage residences, reducing the existing golf course from 18-holes to 9-holes, and preserving 36 acres for open space.

DEC PERMITS AND JURISDICTION

The following comments are offered, with reference to articles of the Environmental Conservation Law.

Article 25, Tidal Wetlands

DEC regulates tidal wetlands and the adjacent area, the upland surrounding the wetlands. The extent of the tidal wetland adjacent area can be constricted by several factors:

- The seaward edge of the closest lawfully and presently existing (i.e. as of August 20, 1977), functional and substantial fabricated structure generally parallel to the wetland boundary and 100 feet of greater in length;
- The elevation contour of 10 feet above mean sea level, as shown on the most recent United States geological survey topographical map prior to the effective date of the regulations (August 20, 1977); and
- The crest of a bluff or cliff, where the 10-foot contour crosses the bluff or cliff.

Hommocks Road, Cove Road, and Eagle Knolls Road can be considered a substantial fabricated structure limiting the tidal wetland adjacent area. But the area which is southeast of Eagle Knolls Road and within 300 feet of the regulated wetland, in Delancey Cove, is regulated adjacent area.

The Grading and Utility Plan, Exhibit 3F-1, shows a "proposed 4' x 10' channel improvement" within 170 feet of the wetland with no apparent barrier. This appears to be modification of an existing structure and a regulated activity.

The tidal wetlands regulations include as a regulated activity any "new discharge of any pollutant requiring a SPDES permit." This includes new discharges under the SPDES General Permit for Stormwater Discharges from Construction Activity - GP-0-15-002. As this will proposal will include new impervious surfaces and it appears that there will be an increase in discharge, it appears that a tidal wetland permit for new discharge of stormwater is required.

However, Exhibit 2-14a shows plantings within the DEC-regulated tidal wetland adjacent area. Establishing plantings in the tidal wetlands adjacent area, is categorized as a "use not requiring a permit" pursuant to the regulations §661.5(9). Please note that DEC recommends the use of native species suitable for the area of proposed planting. The introduction of any plant listed in 6 NYCRR Part 575, Prohibited and Regulated Invasive Species, is prohibited.

Please note that the pond may be under the regulation of the Army Corps of Engineers and if excavation is required to establish wetland plantings, a Corps permit pursuant to Section 404 of the Clean Water Act may be required. If so, a Section 401 Water Quality Certification would be required from DEC.

Article 11, Title 5, Endangered and Threatened Species
Section 3.K.1.b. does not mention the SEQR Lead Agency coordination letter, CH# 5963, from DEC to the Village of Mamaroneck Planning Board, regarding State-listed threatened and endangered species. The letter notes that this project is in close proximity to occurrences of breeding marsh birds, king rail (*Rallus elegans*) and least bittern (*Ixobrychus exilis*). However, DEC has determined that this project will have no impact on these species and no further reviewing is necessary at this time.

Article 19, Air Resources
Section 3.S, Air Quality, states that some buildings "may require emergency generators, boilers, or other fuel burning sources" and that applications would be submitted for the "appropriate NYSDEC air permits under the Division of Air Resources (DAR)." Please note that applications for Air Registrations should be submitted to the NYSDEC Division of Air Resources. If the emissions exceed the registration thresholds and an Air State Facility Permit is required, the application must be submitted to the Regional Permit Administrator, not directly to DAR. Application for Air Resource permits must be made simultaneously with Tidal Wetlands application, if applicable. Please contact the Air Resource staff with questions on regulation at (845) 256-3185.

Article 15, Title 15, Water Withdrawal
According to the section H, Water Supply, the facility has two existing wells which provide irrigation water for the golf course. No information is provided on the capacity of these wells. If the total pump capacity of the wells exceeds 100,000 gallons per day, then a Water Withdrawal permit is required pursuant to Article 15, Title 15 of the Environmental Conservation Law. Please provide the pump capacity of the existing wells. Please note that this regulated is based on the physical capacity of the existing pumps, not on the amount of water actually being withdrawn nor the calculated safe yield. Please note that if these wells have sufficient capacity, submission of an application for permit should be made as soon as possible and can be independent of any applications needed for this development.

State Pollutant Discharge Elimination System (SPDES) Stormwater – Construction
DEIS Section 2.E.1.k. does not mention the need for a SPDES General Permit for Stormwater Discharges from Construction Activity.

DEIS Section 3.F.1.c. only notes the need to prepare and submit a SWPPP to the Village of Mamaroneck. However, as stated in Table 1.1, the project requires a SPDES permit from DEC. The project sponsor must submit a Notice of Intent to the DEC along with the MS4 Acceptance Form and the SWPPP.

If there are any questions, please feel free to contact me at 845-256-3050 or by email at sarah.pawliczak@dec.ny.gov.

Sincerely,

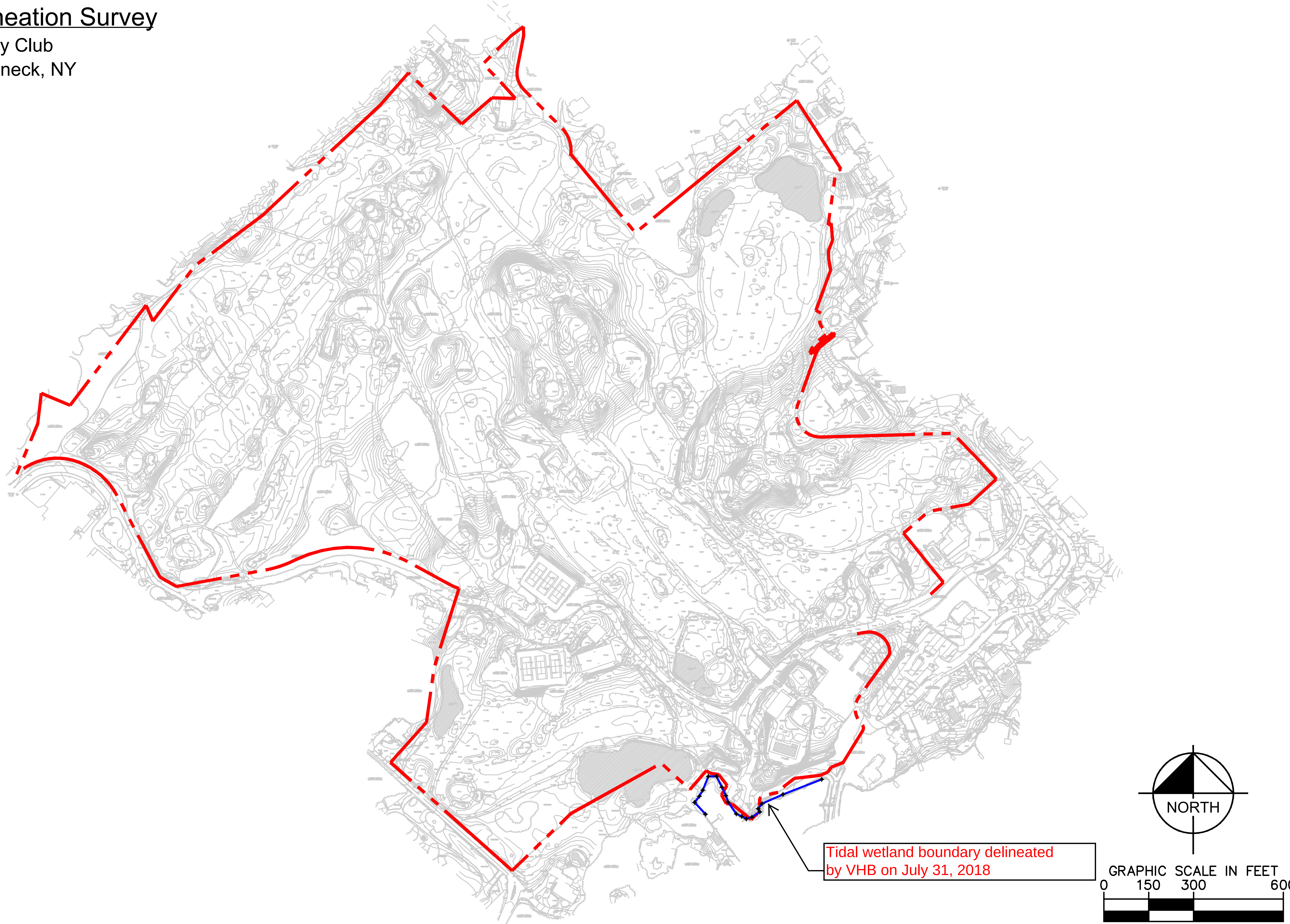
Sarah Pawliczak
Division of Environmental Permits

cc: Heather Gierloff, NYSDEC Division of Marine Resources
Katherine Pijanowski, USACE

Appendix C

Wetland Delineation Survey

Hampshire Country Club
Village of Mamaroneck, NY



Appendix D

Source: Google Earth, 2017

Hampshire Country Club - PRD | Village of Mamaroneck, NY

1 → Photograph Location

Photograph Location Map

Photograph No. 1: View of stone seawall (as indicated by the arrow) along the Delancey Cove shoreline (July 31, 2018).

Photograph No. 2: View of concrete retaining wall and tide gate structures along the Delancey Cove shoreline (July 31, 2018).

Photograph No. 3: View of concrete retaining wall along the Delancey Cove shoreline (July 31, 2018).

Photograph No. 4: View of rip-rap gabions along the Delancey Cove shoreline (July 31, 2018).

Photograph No. 5: View of rip-rap gabions landward of the shoreline area (July 31, 2018).

Photograph No. 6: View of timber bulkhead located landward of the shoreline area (July 31, 2018).

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September 4, 2018

Ref: 28677.03

VIA CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. Ronald Pinzon
Chief, Eastern Permits Section
United States Army Corps of Engineers
New York District
Regulatory Branch
Jacob K. Javits Federal Building
26 Federal Plaza, Room 1937
New York, New York 10278-0090

Re: Request for Approved Jurisdictional Determination
Hampshire Country Club
1025 Cove Road
Village of Mamaroneck
Westchester County, New York

Dear Mr. Pinzon:

VHB Engineering, Surveying, Landscape Architecture and Geology, P.C. (VHB) is serving as environmental consultant to Hampshire Country Club LLC. (HCC), which is requesting an Approved Jurisdictional Determination (JD) for 106.2-acre property located at 1025 Cove Road in the Village of Mamaroneck, Westchester County, New York (hereinafter, the "Subject Property").

The Subject Property is currently developed with recreational membership club facilities, including an 18-hole golf course, clubhouse, swimming pool, tennis courts, maintenance facilities, and other support uses. Additionally, the Subject Property abuts the tidal waters of Delancey Cove (which is a tributary to Long Island Sound) and contains several ponds, drainage ditches and subgrade drainage pipes associated with the golf course drainage systems. These features were created or altered historically for drainage and irrigation and to serve as water hazards for the golf course, which has been operational since 1944. Two of the golf course drainage systems (Golf Course Drainage Systems 1 and 3) discharge to Delancey Cove

Engineers | Scientists | Planners | Designers

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Hauppauge, New York 11788
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via a series of culverts and tide gates. The third drainage system (Golf Course Drainage System 2) is self-contained and comprised of two isolated ponds (Ponds 5 and 6) that do not discharge to Delancey Cove. In addition, the Subject Property also contains an isolated emergent marsh (Wetland A). Based on the information and supporting documentation presented in the enclosed wetland delineation report, Wetland A and Ponds 5 and 6 appear to be isolated, artificially-created or altered features, with no apparent hydrological connection or other significant nexus to wetlands, streams, surface waters, drainage networks or other waters of the United States. Accordingly, on behalf of HCC, we are hereby requesting an Approved JD for the surface waters and wetlands at the Subject Property, including Wetland A, Pond 5 and Pond 6.

To assist in the processing of this request, the enclosed wetland delineation report for the Subject Property has been prepared in accordance with the United States Army Corps of Engineers (USACE) guidance document entitled "*Checklist of Information Included with Requests for Jurisdictional Determinations*." The wetland delineation report includes details regarding historical site usage, a government agency map review, and descriptions of the vegetation, soils and hydrology of the surface waters and wetlands that comprise the three golf course drainage systems. In addition, the report includes a justification for a proposed non-jurisdiction determination for Wetland A, Pond 5 and Pond 6.

For your records, contact information for the project sponsor/property owner are provided below:

Mr. Daniel Pfeffer, Managing Director
c/o Hampshire Country Club, LLC
1025 Cove Road
Mamaroneck, New York 10543
(914) 698-4610

Additionally, a letter from the property owner authorizing the USACE to inspect the Subject Property in association with this Approved JD request is included as Appendix F of the wetland delineation report.

Thank you for your cooperation in this matter. Please feel free to contact me at your earliest convenience at 631.787.3400 or at dkennedy@vhb.com to arrange for a field inspection of the subject property, or if you require any additional information to process this request.

Sincerely,

VHB Engineering, Surveying, Landscape Architecture and Geology, P.C.

David Kennedy
Project Scientist
\\vhb\proj\WhitePlains\28677.03\ProjRecords\FinalDocs\USACE JD Request\USACE Cover letter_20180904_FINAL.docx

Wetland Delineation Report

Hampshire Country Club

1025 Cove Road
Village of Mamaroneck,
Westchester County, New York

PREPARED FOR

Mr. Daniel Pfeffer, Managing Director
c/o Hampshire Country Club, LLC
1025 Cove Road
Mamaroneck, New York 10543

PREPARED BY

VHB Engineering, Surveying and Landscape Architecture and Geology, P.C.
100 Motor Parkway, Suite 135
Hauppauge, New York 11788

September 4, 2018

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Appendix C - NRCS Soil Report

Appendix D - Wetland Delineation Data Forms

Appendix E - Representative Photographs

Appendix F - Property Owner Authorization Letter

1.0

Introduction

This wetland delineation report has been prepared by VHB Engineering, Surveying Landscape Architecture and Geology, P.C. (VHB), for the 106.2-acre property located at 1025 Cove Road in the Village of Mamaroneck, Westchester County, New York (hereinafter, the “Subject Property,” see Appendix A, Figures 1 and 2). The Subject Property is currently developed with recreational membership club facilities, including an 18-hole golf course, clubhouse, swimming pool, tennis courts, maintenance facilities, and other support uses. The Village/Town of Mamaroneck municipal boundary line passes through the Subject Property, creating a 98.9-acre portion in the Village of Mamaroneck and a smaller 7.3-acre portion within Town of Mamaroneck. The Subject Property is owned by Hampshire Country Club, LLC (HCC).

The Subject Property, which has a topographic elevation ranging from 0 to 23±-feet above mean sea level (see Appendix A, Figure 3), abuts the tidal waters of Delancey Cove (which is a tributary to Long Island Sound) to the south and contains several ponds, drainage ditches and subgrade drainage pipes associated with three golf course drainage systems (Golf Course Drainage Systems 1, 2 and 3), as well as an emergent marsh (Wetland A) (see Appendix A Figure 4). These features were created or altered historically for drainage and irrigation and to serve as water hazards for the golf course, which has been operational since 1944. Two of the golf course drainage systems (Golf Course Drainage Systems 1 and 3) discharge to Delancey Cove via a series of culverts and tide gates, while the third drainage system (Golf Course Drainage System 2) is self-contained. A summary of the three golf course drainage systems and Wetland A is provided on Table 1.

Table 1 – Wetland System Summary

Feature	Components	Discharge Point	Area (acres)
Golf Course Drainage System 1	Ponds 13 & 16, drainage ditches and sub-grade pipes	Delancey Cove	1.07
Golf Course Drainage System 2	Ponds 5 & 6, sub-grade drainage pipes	None	0.81
Golf Course Drainage System 3	Ponds 10, 11 & 18, drainage ditches and sub-grade pipes	Delancey Cove	2.28
Wetland A	Emergent Wetland	None	0.39

A wetland delineation of the Subject Property was originally performed by Nelson, Pope and Voorhis, LLC (NP&V) in 2010 and updated in 2012. The wetland boundaries were verified by VHB on July 24 and 31, 2018 (see surface water and wetlands survey in Appendix B), and updated upland and wetland data plot information was collected. To summarize these activities, this report has been prepared pursuant to the United States Army Corps of Engineers (USACE) guidance document entitled *Checklist of Information Included with Requests for Jurisdictional Determinations*.[1] The report includes a government agency map review, descriptions of the vegetation, soils and hydrology data collected in the field, and appended supporting information. Also included in this report is a justification for a proposed waters of the United States non-jurisdictional determination for Golf Course Drainage System 2 and Wetland A.

[1] United States Army corps of Engineers. 2014. *Checklist of Information Included with Requests for Jurisdictional Determinations. Available online at:* http://www.nan.usace.army.mil/Portals/37/docs/regulatory/Formdoc/JD%20Checklist.pdf Accessed August 7, 2018.

2.0

Map Review and Field Data

Map Review

According to the United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) maps, there are four wetlands at the Subject Property, as shown on Figure 5 (see Appendix A) and summarized on Table 2.

Table 2 – NWI Summary

Site Feature	Cowardin Class Code	Description
Pond 10	PUBHh	Palustrine, Unconsolidated Bottom, Permanently Flooded, Diked/Impounded
Pond 13	PUBHx	Palustrine, Unconsolidated Bottom, Permanently Flooded, Excavated
Wetland A	PEM1C	Palustrine, Emergent, Persistent, Seasonally Flooded
Ditch/Culvert	R4SBC	Riverine, Intermittent, Streambed, Seasonally Flooded

As shown on Figure 6 (see Appendix A), there are no New York State Department of Environmental Conservation (NYSDEC) freshwater wetlands located at or adjacent to the subject Property. Delancey Cove, located adjacent to the south of the Subject Property, is regulated as a tidal wetland by the NYSDEC.

Review of the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey map data (see Appendix A, Figure7) indicates that five distinct soil units at the Subject Property. Two of the soil units are classified as hydric soils on the NRCS Hydric Soils List, as summarized on Table 3. A copy of the NRCS Soil Report is included as Appendix C.

Table 3 – NRCS Soil Summary

Map Unit Symbol	Map Unit Name	Acres/Percent	Hydric Rating
CrC	Charlton-Chatfield complex, rolling, very rocky	7.7/7.2	No
CtC	Chatfield-Hollis-Rock outcrop, complex, rolling	24.1/22.5	No
Uc	Udorthents, wet substratum	62.658.4	Yes
Uf	Urban Land	0.0/0.0	No
UIC	Urban land-Charlton-Chatfield complex, rolling, very rocky	11.9/11.1	Yes
W	Water	0.9/0.8	-

Field Observations and Data

As observed in the field, the vegetated upland areas of the Subject Property are comprised primarily of maintained/landscaped fairways, roughs and greens of the golf course. These habitats are representative of the Mowed Lawn and Mowed Lawn with Trees communities as described in the New York Natural Heritage Program (NYNHP) publication "*Ecological Communities of New York State*"[2] (ECNYS). The golf course ponds, emergent wetlands and drainage ditches are representative of the ECNYS Farm Pond/Artificial Pond, Common Reed Marsh and Ditch/Artificial Intermittent Stream communities.

Vegetation, soils and hydrology data were collected for wetland and upland data plots at Golf Course Drainage Systems 1, 2 and 3 and Wetland A, in accordance with the procedures set forth in the 1987 USACE Wetland Delineation Manual[3] and the 2012 USACE Regional Supplement for the Northcentral and Northeast Region.[4] The locations of the data plots are shown on Figure 4 (see Appendix A). USACE Northcentral and Northeast Region wetland delineation data forms were completed for each data plot (see Appendix D) and representative site photographs were taken (see Appendix E). A summary of observed conditions at Golf Course Drainage Systems 1, 2 and 3 and Wetland A is provided below.

▼

[2]Edinger, G.J., D.J. Evans, S. Gebauer, T.G. Howard, D.M. Hunt, and A.M. Olivero (editors). 2014. *Ecological Communities of New York State.* Second Edition. A revised and expanded edition of Carol Reschke's Ecological Communities of New York State. New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY.

[3] Environmental Laboratory. 1987. "Corps of Engineers Wetlands Delineation Manual," Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

[4] United States Army Corps of Engineers Engineer Research and Development Center. 2012. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0).

Golf Course Drainage System 1

Golf Course Drainage System 1 is comprised of Ponds 13 and 16, with associated drainage ditches and sub-surface drainage pipes. Two overflow outlets with gate valves located at the south side of Pond 13 are connected to culverts that travel offsite beneath Hommocks Road and the athletic fields situated to the west of the road to a subsurface vault that in turn discharges to Delancey Cove. Based on site observations, Pond 13 appears to be tidally influenced.

The wetland boundaries of the ponds and surficial drainage ditches of the drainage system are well-defined by topographic gradients that occur along the adjacent turf and rock-lined banks. The ponds and drainage ditches are generally sparsely vegetated, with wetland vegetation limited to scattered shoreline areas where broadleaf cattail (*Typha latifolia*) occurs. Wetland soils consist of loamy and sandy clays characterized by hydric soil indicator F3 (Depleted Matrix). Primary and secondary hydrology indicators along the wetland boundary include A2 (High Water Table), A3 (Saturation) and D2 (Geomorphic Position).

Golf Course Drainage System 2

Golf Course Drainage System 2 is comprised of Pond 5 (0.18 acre) and Pond 6 (0.63), with sub-surface drainage pipes. The two ponds are isolated from the other golf course drainage systems, have no outlets, and do not discharge to Delancey Cove. According to the golf course manager, Pond 5 receives stormwater runoff from the immediate surrounding area, and Pond 6 was constructed in the 1990s for irrigation of the golf course. Water sources for Pond 6 include an irrigation well located adjacent to the pond and stormwater from the neighboring residential development.

The wetland boundaries of the two ponds are well-defined by topographic gradients along the adjacent golf course fairways and greens. Observed wetland vegetation includes duckweed (*Lemna* sp.) on the pond surfaces, as well as narrow-leaved cattail (*Typha angustifolia*), (*Cyperus flavescens*), (*Persicaria amphibia*) and sensitive fern (*Onoclea sensibilis*) along the pond margins. Wetland soils consist of loamy and sandy clays with gravel components that are characterized by hydric soil indicator F3 (Depleted Matrix). Primary and secondary hydrology indicators along the wetland boundary include A2 (High Water Table), A3 (Saturation), B3 (Aquatic Fauna) and D2 (Geomorphic Position).

Golf Course Drainage System 3

Golf Course Drainage System 3 is comprised of Ponds 10, 11 and 18, and associated drainage ditches and sub-surface drainage pipes. Three tide gates at the south side of Pond 10 connect to subgrade culverts that discharge to Delancey Cove, located a short distance to the south. Based on site observations, Pond 10 appears to be tidally influenced.

The wetland boundaries of the ponds and surficial drainage ditches of the drainage system are well-defined by topographic gradients that occur along the adjacent turf and rock-lined banks. The ponds and drainage ditches are generally sparsely vegetated, with the exception of the eastern portion of Pond 10, which is characterized by an emergent marsh with a dense growth of common reed (*Phragmites australis*). Wetland soils consist of loamy and sandy clays characterized by hydric soil indicator F3 (Depleted Matrix), as well as hydric soil indicator A2 (Histic Epipedon. Primary and secondary hydrology indicators along the wetland boundary include A2 (High Water Table), A3 (Saturation), C9 (Saturation Visible on Aerial Imagery, D1 (Stunted or Stressed Plants) and D2 (Geomorphic Position).

Wetland A

Wetland A (0.39 acre) is an isolated depressional feature that occurs along the northwestern boundary of the Subject Property and extends onto the neighboring residential properties. The wetland has no outlets and is situated within a shallow topographic low that receives surficial runoff from the immediate surrounding area, including the offsite residential properties that adjoin the wetland. Based on review of historical aerial imagery (Nationwide Environmental Title Research, available online at https://www.historicaerials.com/), it appears that Wetland A was constructed *circa* 1974.

The wetland is dominated by a dense growth of common reed (*Phragmites australis*). Other wetland indicator species include spotted jewelweed (*Impatiens capensis*), false water pepper (*Polygonum hydropiperoides*) and willows (*Salix* spp.) Subsurface conditions are characterized by organic (hemic) soils over a confining clay layer, as characterized by wetland soil indicator A2 (Histic Epipedon). Primary hydrology indicators along the wetland boundary include A2 (High Water Table) and A3 (Saturation).

3.0

Proposed Non-Jurisdictional Determination Justification

In Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers (the "SWANCC Decision," 2001), and Rapanos v. the United States (the "Rapanos Decision," 2006), the United States Supreme Court ruled that the USACE's jurisdiction over "waters of the United States" under Section 404 of the Clean Water Act (CWA) does not extend to isolated wetlands. Further, the Supreme Court ruled that waters or wetlands that do not have a "significant nexus" to a traditional navigable waterway (TNW) are isolated waters that should not be considered waters of the United States for the purposes of the CWA. Pursuant to the Rapanos Decision, a significant nexus exists when a wetland or waterbody, either by itself or in combination with other similar sites, significantly affects the physical, biological, and chemical integrity of a downstream navigable waterway. Significant nexus is further defined as "*having a significant effect on the chemical, physical or biological integrity of an interstate water, its tributaries or adjacent wetlands*."[5]

Based on the information presented in Sections 1.0 and 2.0 of this report, Golf Course Drainage Systems 1 and 3 both discharge to, and therefore are hydrologically connected with, Delancey Cove, which is a TNW. As such, it appears that Golf Course Drainage Systems 1 and 3 may be regulated "waters of the United States" under Section 404 of the Clean Water Act (CWA).

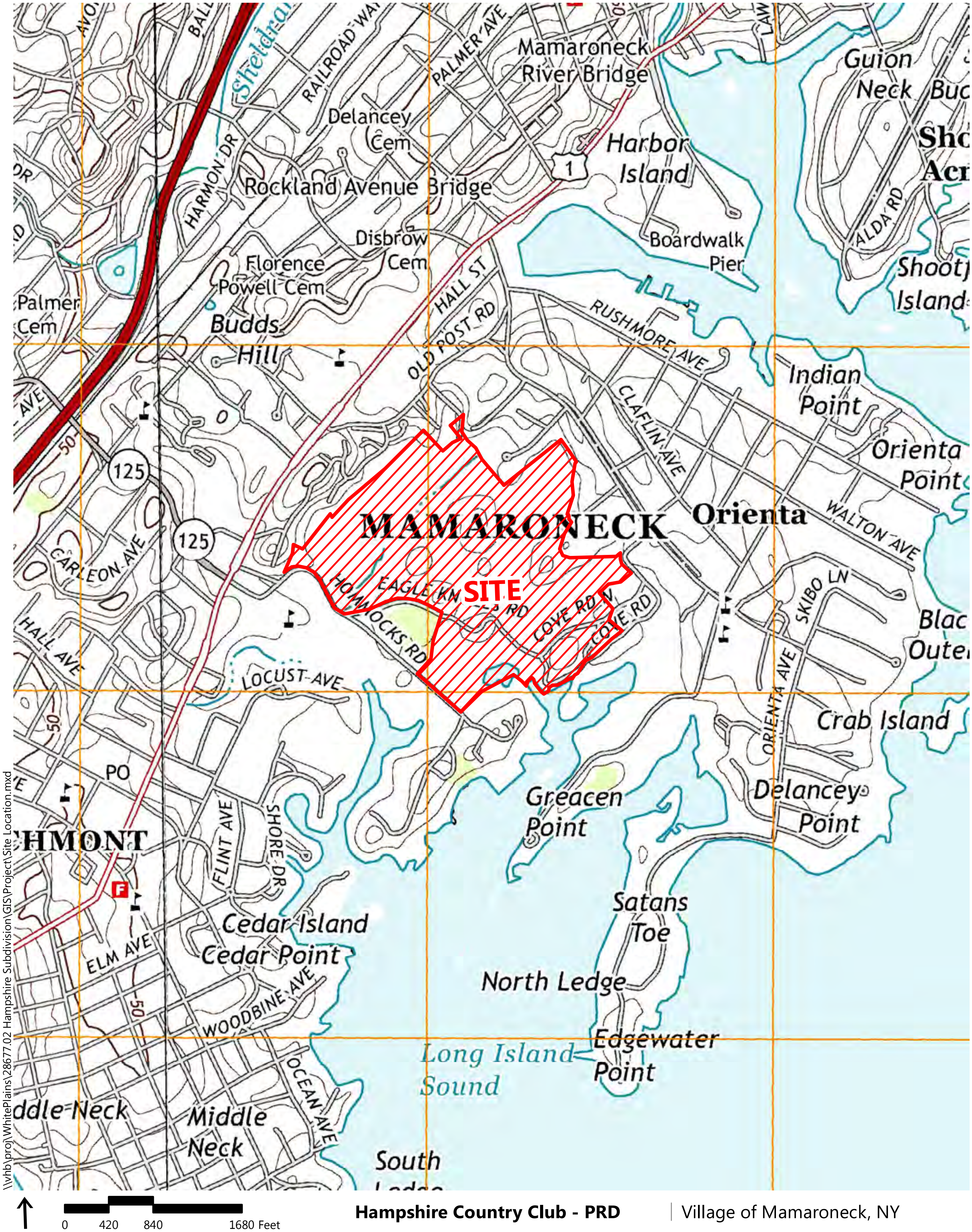
[5] United States Environmental Protection Agency and United States Army Corps of Engineers. 2008. Clean Water Act Jurisdiction Following U.S. Supreme Court's Decision in Rapanos v. United States & Carabell v. United States.

In contrast, Wetland A and the two ponds that comprise Golf Course Drainage System 2 (Ponds 5 and 6) are depressional features that were constructed or altered historically for drainage and irrigation purposes, and to serve as golf course water hazards. Wetland A and Ponds 5 and 6 do not have outlets and do not discharge to Delancey Cove. Moreover, no surficial connections or other significant nexus between these three features and Golf Course Drainage Systems 1 and 3 were observed in the field. Accordingly, based on the legal precedents of the SWANCC and Rapanos Decisions regarding isolated wetlands, it appears that Pond 5, Pond 6 and Wetland A are isolated and therefore not subject to USACE jurisdiction as waters of the United States under Section 404 of the CWA.

\\vhb\proj\WhitePlains\28677.03\ProjRecords\FinalDocs\USACE JD Request\Hampshire CC_Wetland Delineation Report_20180904_FINAL.docx

Appendix A

Figure 1



Hampshire Country Club - PRD | Village of Mamaroneck, NY

Regional Location Map

Source: USGS Mamaroneck, NY

Figure 2

Source: ESRI GIS

0 170 340 680 Feet

Hampshire Country Club - PRD | Village of Mamaroneck, NY

Site Aerial Photograph

0 175 350 700 Feet

Hampshire Country Club - PRD | Village of Mamaroneck, NY

USGS Topographic Map

Source: U.S. Geological Survey

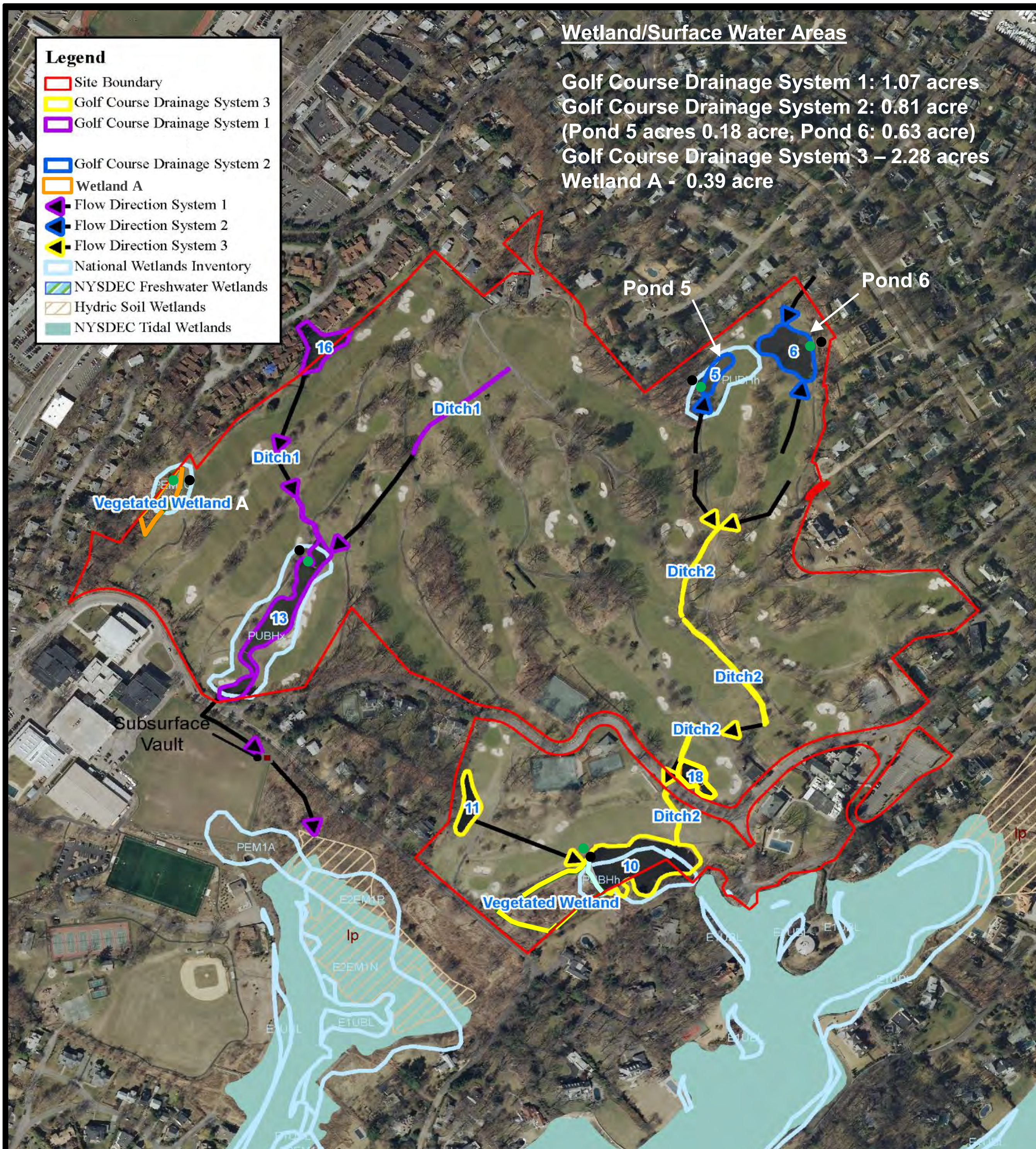


FIGURE 4 – DRAINAGE SYSTEM AND WETLAND MAP*

Hampshire Country Club, 1025 Cove Road, Village of Mamaroneck, Westchester County, New York

● Wetland Data Plot

● Upland Data Plot

N

vhb

*Based on wetland delineation conducted by Nelson, Pope and Voorhis, LLC in 2012 and verified by VHB on July 24 and 31, 2018.

Figure 5

\\NYWPDATA\projects\28677.02 Hampshire Subdivision\GIS\Project\Wetlands Chapter Maps\NWI.mxd

Hampshire Country Club - PRD | Village of Mamaroneck, NY

National Wetlands Inventory Map

Source: U.S. Fish and Wildlife Service

Figure 6

\\NYWPDATA\projects\28677.02 Hampshire Subdivision\GIS\Project\Wetlands Chapter Maps\Wetlands - Freshwater and Tidal.mxd

Hampshire Country Club - PRD | Village of Mamaroneck, NY

NYSDEC Freshwater Wetlands

NYSDEC Tidal Wetlands

NYSDEC Wetland Map

Source: U.S. Fish and Wildlife Service

Figure 7

Map Scale: 1:7,270 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 100, 200, 400, 600

Feet: 0, 350, 700, 1400, 2100

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

Hampshire Country Club - PRD | Town of Harrison, New York

USDA NRCS Soils Map

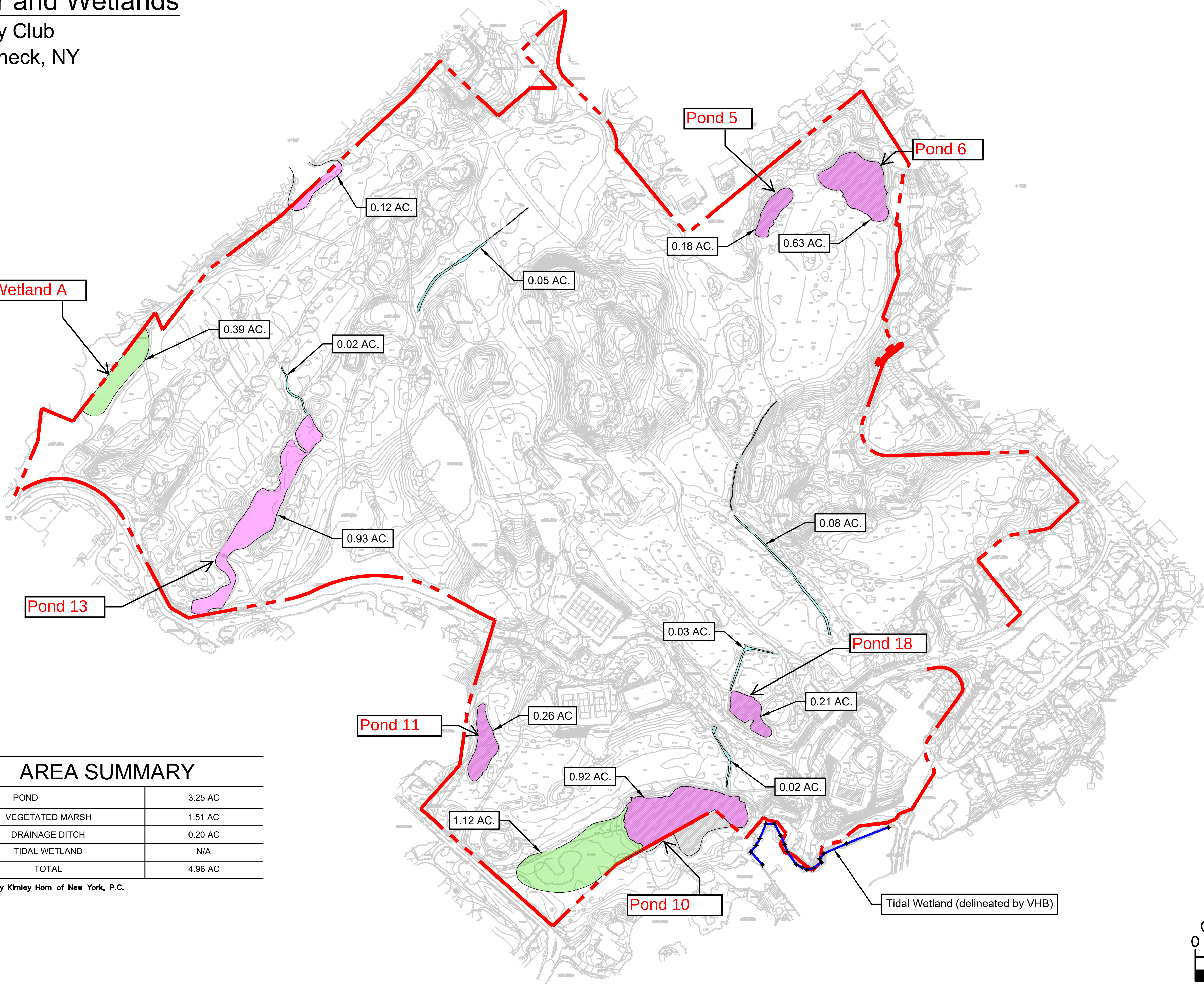
Source: USDA Natural Resources Conservation Services

Appendix B

Surface Water and Wetlands

Hampshire Country Club

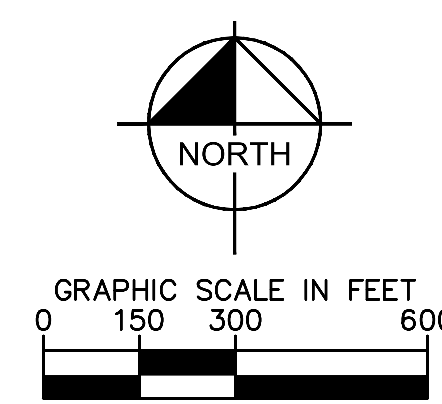
Village of Mamaroneck, NY



AREA SUMMARY

POND	3.25 AC
VEGETATED MARSH	1.51 AC
DRAINAGE DITCH	0.20 AC
TIDAL WETLAND	N/A
TOTAL	4.96 AC

*Prepared by Kimley Horn of New York, P.C.



Appendix C

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Westchester County, New York

Hampshire Country Club

February 25, 2016

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:7,270 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 100, 200, 400, 600

Feet: 0, 350, 700, 1400, 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Westchester County, New York
Survey Area Data: Version 11, Sep 25, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 21, 2014—Aug 27, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Westchester County, New York (NY119)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CrC	Charlton-Chatfield complex, rolling, very rocky	7.7	7.2%
CtC	Chatfield-Hollis-Rock outcrop complex, rolling	24.1	22.5%
Uc	Udorthents, wet substratum	62.6	58.4%
Uf	Urban land	0.0	0.0%
UlC	Urban land-Charlton-Chatfield complex, rolling, very rocky	11.9	11.1%
W	Water	0.9	0.8%
Totals for Area of Interest		**107.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Westchester County, New York

CrC—Charlton-Chatfield complex, rolling, very rocky

Map Unit Setting

National map unit symbol: bd8f
Elevation: 100 to 1,000 feet
Mean annual precipitation: 46 to 50 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 115 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Charlton and similar soils: 50 percent
Chatfield and similar soils: 30 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton

Setting

Landform: Ridges, hills, till plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Acid loamy till derived mainly from schist, gneiss, or granite

Typical profile

H1 - 0 to 8 inches: loam
H2 - 8 to 24 inches: sandy loam
H3 - 24 to 60 inches: sandy loam

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B

Description of Chatfield

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex

Across-slope shape: Convex
Parent material: Loamy till derived mainly from granite, gneiss, or schist

Typical profile

H1 - 0 to 7 inches: loam
H2 - 7 to 24 inches: flaggy silt loam
H3 - 24 to 28 inches: unweathered bedrock

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to high (0.01 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B

Minor Components

Hollis

Percent of map unit: 5 percent

Rock outcrop

Percent of map unit: 5 percent

Sutton

Percent of map unit: 4 percent

Sun

Percent of map unit: 2 percent
Landform: Depressions

Leicester

Percent of map unit: 2 percent

Palms

Percent of map unit: 1 percent
Landform: Marshes, swamps

Carlisle

Percent of map unit: 1 percent
Landform: Marshes, swamps

CtC—Chatfield-Hollis-Rock outcrop complex, rolling

Map Unit Setting

National map unit symbol: bd8h
Elevation: 100 to 1,000 feet
Mean annual precipitation: 46 to 50 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 115 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Hollis and similar soils: 30 percent
Chatfield and similar soils: 30 percent
Rock outcrop: 20 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chatfield

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till derived mainly from granite, gneiss, or schist

Typical profile

H1 - 0 to 7 inches: loam
H2 - 7 to 24 inches: flaggy silt loam
H3 - 24 to 28 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to high (0.01 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B

Description of Hollis

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: A thin mantle of loamy till derived mainly from schist, granite, and gneiss

Typical profile

H1 - 0 to 1 inches: fine sandy loam
H2 - 1 to 16 inches: fine sandy loam
H3 - 16 to 20 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D

Description of Rock Outcrop

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Capacity of the most limiting layer to transmit water (Ksat): Low to very high (0.01 to 19.98 in/hr)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s

Minor Components

Charlton

Percent of map unit: 8 percent

Sutton

Percent of map unit: 5 percent

Leicester

Percent of map unit: 2 percent

Sun

Percent of map unit: 2 percent
Landform: Depressions

Unnamed soils, very shallow

Percent of map unit: 2 percent

Palms

Percent of map unit: 1 percent
Landform: Marshes, swamps

Uc—Udorthents, wet substratum

Map Unit Setting

National map unit symbol: bd7g
Elevation: 50 to 2,400 feet
Mean annual precipitation: 46 to 50 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 115 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, wet substratum, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Wet Substratum

Typical profile

H1 - 0 to 4 inches: gravelly loam
H2 - 4 to 72 inches: very gravelly loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 5.95 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Low (about 4.6 inches)

Minor Components

Udorthents

Percent of map unit: 5 percent

Urban land

Percent of map unit: 5 percent

Fredon

Percent of map unit: 2 percent
Landform: Depressions

Paxton

Percent of map unit: 2 percent

Ipswich

Percent of map unit: 2 percent
Landform: Tidal marshes

Raynham

Percent of map unit: 2 percent

Hinckley

Percent of map unit: 2 percent

Uf—Urban land

Map Unit Setting

National map unit symbol: bd7j
Elevation: 50 to 2,400 feet
Mean annual precipitation: 46 to 50 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 115 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Udorthents

Percent of map unit: 5 percent

Riverhead

Percent of map unit: 2 percent

Udorthents, wet substratum

Percent of map unit: 2 percent

Unadilla

Percent of map unit: 2 percent

Chatfield

Percent of map unit: 2 percent

Sutton

Percent of map unit: 2 percent

UIC—Urban land-Charlton-Chatfield complex, rolling, very rocky

Map Unit Setting

National map unit symbol: bd7n
Elevation: 100 to 1,000 feet
Mean annual precipitation: 46 to 50 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 115 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 40 percent
Charlton and similar soils: 20 percent
Chatfield and similar soils: 15 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton

Setting

Landform: Ridges, hills, till plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Acid loamy till derived mainly from schist, gneiss, or granite

Typical profile

H1 - 0 to 8 inches: loam
H2 - 8 to 24 inches: sandy loam
H3 - 24 to 60 inches: sandy loam

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.5 inches)

Description of Chatfield

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex

Parent material: Loamy till derived mainly from granite, gneiss, or schist

Typical profile

H1 - 0 to 7 inches: loam
H2 - 7 to 24 inches: flaggy silt loam
H3 - 24 to 28 inches: unweathered bedrock

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to high (0.01 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: Low (about 3.2 inches)

Minor Components

Leicester

Percent of map unit: 5 percent
Landform: Depressions

Sutton

Percent of map unit: 5 percent

Udorthents

Percent of map unit: 5 percent

Rock outcrop

Percent of map unit: 5 percent

Hollis

Percent of map unit: 2 percent

Sun

Percent of map unit: 2 percent
Landform: Depressions

Palms

Percent of map unit: 1 percent
Landform: Marshes, swamps

W—Water

Map Unit Setting

National map unit symbol: bd7z
Mean annual precipitation: 46 to 50 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 115 to 215 days

Farmland classification: Not prime farmland

Map Unit Composition

Water: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

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Dwellings With Basements—Westchester County, New York
(Hampshire)

Map Scale: 1:7,270 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 100, 200, 400, 600

Feet: 0, 350, 700, 1400, 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Lines

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Points

Very limited

Somewhat limited

Not limited

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Westchester County, New York
Survey Area Data: Version 11, Sep 25, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 21, 2014—Aug 27, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Dwellings With Basements

Dwellings With Basements— Summary by Map Unit — Westchester County, New York (NY119)						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
CrC	Charlton-Chatfield complex, rolling, very rocky	Somewhat limited	Charlton (50%)	Slope (0.04)	7.7	7.2%
CtC	Chatfield-Hollis-Rock outcrop complex, rolling	Very limited	Chatfield (30%)	Depth to hard bedrock (1.00)	24.1	22.5%
				Slope (0.04)		
			Hollis (30%)	Depth to hard bedrock (1.00)		
				Slope (0.04)		
Uc	Udorthents, wet substratum	Very limited	Udorthents, wet substratum (80%)	Depth to saturated zone (1.00)	62.6	58.4%
				Depth to hard bedrock (0.42)		
Uf	Urban land	Not rated	Urban land (85%)		0.0	0.0%
			Unadilla (2%)			
			Chatfield (2%)			
			Sutton (2%)			
			Riverhead (2%)			
UlC	Urban land-Charlton-Chatfield complex, rolling, very rocky	Not rated	Urban land (40%)		11.9	11.1%
			Leicester (5%)			
			Sutton (5%)			
			Udorthents (5%)			
			Rock outcrop (5%)			
			Hollis (2%)			
			Sun (2%)			
			Palms (1%)			
W	Water	Not rated	Water (100%)		0.9	0.8%
Totals for Area of Interest					**107.2**	**100.0%**

Dwellings With Basements— Summary by Rating Value		
Rating	Acres in AOI	Percent of AOI
Very limited	86.7	80.9%
Somewhat limited	7.7	7.2%

Dwellings With Basements— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Null or Not Rated	12.8	12.0%
Totals for Area of Interest	**107.2**	**100.0%**

Description

Dwellings are single-family houses of three stories or less. For dwellings with basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of about 7 feet.

The ratings for dwellings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility. Compressibility is inferred from the Unified classification of the soil. The properties that affect the ease and amount of excavation include depth to a water table, ponding, flooding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix D

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hampshire Country Club City/County: Mamaroneck/Westchester Sampling Date: 7/24/18

Applicant/Owner: Hampshire Recreation, LLC State: NY Sampling Point: Wetland A-W1

Investigator(s): David Kennedy Section, Township, Range: Village of Mamaroneck

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): concave

Slope (%): <5 Lat: 40° 56' 12.30" N Long: 73° 44' 39.26" W Datum: WGS 84

Soil Map Unit Name: Udorthents, wet substratum (Uc) NWI classification: PEM1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No ___ Hydric Soil Present? Yes X No ___ Wetland Hydrology Present? Yes X No ___	**Is the Sampled Area within a Wetland?** Yes X No ___ If yes, optional Wetland Site ID: Wetland A

Remarks: (Explain alternative procedures here or in a separate report.)

Golf course irrigation pond constructed *circa* 1974. Hydrologic inputs to the artificial pond are from an adjacent groundwater well and stormwater discharge from the neighboring residential development.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes X No ___ Depth (inches): 4

Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 1

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Wetland A-W1

Tree Stratum (Plot size: 30 feet)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix baylonica	20	yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
= Total Cover	20		

Sapling/Shrub Stratum (Plot size: 15 feet)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
= Total Cover			

Herb Stratum (Plot size: 5 feet)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Phragmites australis	90	yes	FACW
2. Polygonum hydopiperoides	10	no	OBL
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
= Total Cover	100		

Woody Vine Stratum (Plot size: 30 feet)

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
= Total Cover			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	____	x 1 = ____
FACW species	____	x 2 = ____
FAC species	____	x 3 = ____
FACU species	____	x 4 = ____
UPL species	____	x 5 = ____
Column Totals:	____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes X No ____

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Wetland A-W1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-8	2.5YR 3/2	98	10YR 4/6	2	C	PL	hemic (mucky peat)	
8-19	5Y 2.5/1	100					hemic (mucky peat)	
19-24	5Y 3/1	100					clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- X Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: clay

Depth (inches): 19

Hydric Soil Present? **Yes** X **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hampshire Country Club City/County: Mamaroneck/Westchester Sampling Date: 7/24/18

Applicant/Owner: Hampshire Recreation, LLC State: NY Sampling Point: Wetland A -U1

Investigator(s): David Kennedy Section, Township, Range: Village of Mamaroneck

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): flat

Slope (%): 0 Lat: 40° 56' 12.53" N Long: 73° 44' 38.89" W Datum: WGS 84

Soil Map Unit Name: Udorthents, wet substratum(Uc) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?		X
Hydric Soil Present?	X	
Wetland Hydrology Present?		X

Is the Sampled Area within a Wetland? Yes ____ No X

If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?		X	
Water Table Present?		X	
Saturation Present? (includes capillary fringe)		X	

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants. Sampling Point: Wetland A-U1

Tree Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Herb Stratum (Plot size: 5 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Poa pratensis*	45	yes	UPL
2. *Festuca rubra*	45	yes	FACU
3. *Trifolium repens*	10	no	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		

Woody Vine Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- ___ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ___ No X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Wetland A-U1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-3	10YR 3/2	100					sandy loam	
3-16	10YR 2/2	95	10YR 4/6	5	C	PL	loamy clay	
							loamy clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- X Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hampshire Country Club City/County: Mamaroneck/Westchester Sampling Date: 7/24/18

Applicant/Owner: Hampshire Recreation, LLC State: NY Sampling Point: Pond 5-W1

Investigator(s): David Kennedy Section, Township, Range: Village of Mamaroneck

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): concave

Slope (%): <5 Lat: 40° 56' 15.74" N Long: 73° 44' 14.50" W Datum: WGS 84

Soil Map Unit Name: Udorthents, wet substratum (Uc) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ___	Is the Sampled Area within a Wetland? Yes X No ___
Hydric Soil Present?	Yes X No ___	
Wetland Hydrology Present?	Yes X No ___	If yes, optional Wetland Site ID: Pond 5

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- X Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___ No X	Depth (inches): ___	
Water Table Present?	Yes X No ___	Depth (inches): 2	
Saturation Present? (includes capillary fringe)	Yes X No ___	Depth (inches): 0	**Wetland Hydrology Present?** Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Pond 5-W1

Tree Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Herb Stratum (Plot size: 5 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Typha angustifolia*	40	yes	OBL
2. *Persicaria amphibea*	10	no	OBL
3. *Onoclea sensibilis*	10	no	FACW
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	60 = Total Cover		

Woody Vine Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation

X Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Pond 5-W1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 2/1	100					sandy clay	
8-16	10YR 4/2	95	10YR 6/6	3	C	PL	sandy clay	
			10YR 4/6	2	C	PK	sandy clay, trace gravel	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

__ Histosol (A1)
__ Histic Epipedon (A2)
__ Black Histic (A3)
__ Hydrogen Sulfide (A4)
__ Stratified Layers (A5)
__ Depleted Below Dark Surface (A11)
__ Thick Dark Surface (A12)
__ Sandy Mucky Mineral (S1)
__ Sandy Gleyed Matrix (S4)
__ Sandy Redox (S5)
__ Stripped Matrix (S6)
__ Dark Surface (S7) (**LRR R, MLRA 149B**)
__ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
__ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
__ Loamy Mucky Mineral (F1) (**LRR K, L**)
__ Loamy Gleyed Matrix (F2)
X Depleted Matrix (F3)
__ Redox Dark Surface (F6)
__ Depleted Dark Surface (F7)
__ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

__ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
__ Coast Prairie Redox (A16) (**LRR K, L, R**)
__ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
__ Dark Surface (S7) (**LRR K, L**)
__ Polyvalue Below Surface (S8) (**LRR K, L**)
__ Thin Dark Surface (S9) (**LRR K, L**)
__ Iron-Manganese Masses (F12) (**LRR K, L, R**)
__ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
__ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
__ Red Parent Material (TF2)
__ Very Shallow Dark Surface (TF12)
__ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ________

Depth (inches): ________

Hydric Soil Present? **Yes** X **No** ___

Remarks:

Pond edge.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hampshire Country Club City/County: Mamaroneck/Westchester Sampling Date: 7/24/18

Applicant/Owner: Hampshire Recreation, LLC State: NY Sampling Point: Pond 5-U1

Investigator(s): David Kennedy Section, Township, Range: Village of Mamaroneck

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): flat

Slope (%): ~2 Lat: 40° 56' 15.93" N Long: 73° 44' 14.49" W Datum: WGS 84

Soil Map Unit Name: Udorthents, wet substratum (Uc) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___ No X	Is the Sampled Area within a Wetland? Yes ___ No X
Hydric Soil Present?	Yes ___ No X	
Wetland Hydrology Present?	Yes ___ No X	If yes, optional Wetland Site ID: ___

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ Water-Stained Leaves (B9)
___ High Water Table (A2)	___ Aquatic Fauna (B13)
___ Saturation (A3)	___ Marl Deposits (B15)
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)
___ Sparsely Vegetated Concave Surface (B8)	

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Pond 5-U1

Tree Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	30	yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	30 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15 feet)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Herb Stratum (Plot size: 5 feet)			
1. *Poa pratensis*	15	yes	UPL
2. *Dactylis glomerata*	10	yes	UPL
3. *Artemesia vugaris*	10	yes	UPL
4. *Digitaria sanguinalis*	10	yes	FACU
5. *Bidens frondosa*	5	no	FACW
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	50 = Total Cover		

Woody Vine Stratum (Plot size: 30 feet)			
1. *Parthenocissus quinquefolia*	5	yes	FACU
2.			
3.			
4.			
	5 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 17 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation
___ Dominance Test is >50%
___ Prevalence Index is ≤3.0[1]
___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ___ No X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Pond 5-U1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
06	10YR 3/3	100					sandy clay	
6-16	10YR 4/6	100					silty clay with gravel	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hampshire Country Club City/County: Mamaroneck/Westchester Sampling Date: 7/24/18

Applicant/Owner: Hampshire Recreation, LLC State: NY Sampling Point: Pond 6-W1

Investigator(s): David Kennedy Section, Township, Range: Village of Mamaroneck

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): concave

Slope (%): <5 Lat: 40° 56' 17.69" N Long: 73° 44' 11.13" W Datum: WGS 84

Soil Map Unit Name: Udorthents, wet substratum (Uc) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology X significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ___	Is the Sampled Area within a Wetland? Yes X No ___
Hydric Soil Present?	Yes X No ___	
Wetland Hydrology Present?	Yes X No ___	If yes, optional Wetland Site ID: Pond 6

Remarks: (Explain alternative procedures here or in a separate report.)

Golf course irrigation pond constructed *circa* 1974. Hydrologic inputs to the artificial pond are from an adjacent groundwater well and stormwater discharge from the neighboring residential development.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ Water-Stained Leaves (B9)	
X High Water Table (A2)	X Aquatic Fauna (B13)	
X Saturation (A3)	___ Marl Deposits (B15)	
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)	
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)	
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)	
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)	
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)	
X Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)	
___ Sparsely Vegetated Concave Surface (B8)		

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes X	No ___	Depth (inches): 2
Saturation Present? (includes capillary fringe)	Yes X	No ___	Depth (inches): 1

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Hydrologic inputs to the artificial pond are from an adjacent groundwater well and stormwater discharge from the neighboring residential development.

VEGETATION – Use scientific names of plants.

Sampling Point: Pond 6-W1

Tree Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Herb Stratum (Plot size: 5 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Cyperus flavescens*	20	yes	OBL
2. *Typha angustifolia*	15	yes	OBL
3. *Polygonum amphibia*	10	yes	OBL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	45 = Total Cover		

Woody Vine Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation
X Dominance Test is >50%
___ Prevalence Index is ≤3.0[1]
___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ______

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Pond 6-W1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-7	10YR 3/1	98	10YR 4/6	2	C	Ml	loamy clay	trace gravel
7-18	10YR 5/1	90	10YR 4/6	4	C	PL	sandy clay	
			Gley1 4/N	4	D	M	sandy clay	
			10YR 5/8	2	C	PL	sandy clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes X No ___

Remarks:

Pond edge.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hampshire Country Club City/County: Mamaroneck/Westchester Sampling Date: 7/24/18

Applicant/Owner: Hampshire Recreation, LLC State: NY Sampling Point: Pond 6-U1

Investigator(s): David Kennedy Section, Township, Range: Village of Mamaroneck

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): flat

Slope (%): 0 Lat: 40° 56' 17.81" N Long: 73° 44' 11.03" W Datum: WGS 84

Soil Map Unit Name: Udorthents, wet substratum(Uc) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___ No X	**Is the Sampled Area within a Wetland?** Yes ___ No X
Hydric Soil Present?	Yes ___ No X	
Wetland Hydrology Present?	Yes ___ No X	If yes, optional Wetland Site ID: ___

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ Water-Stained Leaves (B9)	
___ High Water Table (A2)	___ Aquatic Fauna (B13)	
___ Saturation (A3)	___ Marl Deposits (B15)	
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)	
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)	
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)	
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)	
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)	
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)	
___ Sparsely Vegetated Concave Surface (B8)		

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants. Sampling Point: Pond 6-U1

Tree Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 feet)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Herb Stratum (Plot size: 5 feet)			
1. *Poa pratensis*	80	yes	UPL
2. *Festuca rubra*	18	no	FACU
3. *Plantago major*	2	no	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		

Woody Vine Stratum (Plot size: 30 feet)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation
___ Dominance Test is >50%
___ Prevalence Index is ≤3.0[1]
___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ___ No X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Pond 6-U1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-7	10YR 3/3	100					silty clay	
7-16	10YR 4/4	100					silty clay with gravel	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ___ **No** X

Remarks:

Gravel refusal at 16 inches.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hampshire Country Club City/County: Mamaroneck/Westchester Sampling Date: 7/24/18

Applicant/Owner: Hampshire Recreation, LLC State: NY Sampling Point: GCDS 1-W1

Investigator(s): David Kennedy Section, Township, Range: Village of Mamaroneck

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): concave

Slope (%): <5 Lat: 40° 56' 09.09" N Long: 73° 44' 33.15" W Datum: WGS 84

Soil Map Unit Name: Udorthents, wet substratum (Uc) NWI classification: PUBHx

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No ___		Is the Sampled Area within a Wetland? Yes X No ___
Hydric Soil Present? Yes X No ___		
Wetland Hydrology Present? Yes X No ___		If yes, optional Wetland Site ID: Pond 13

Remarks: (Explain alternative procedures here or in a separate report.)

Golf Course Drainage System 1 (data plot adjacent to Pond 13)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes X No ___ Depth (inches): 3

Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 1

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: GCDS 1-W1

Tree Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Herb Stratum (Plot size: 5 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Typha latifolia*	65	yes	OBL
2. *Rumex crispus*	20	yes	FAC
3. *Plantago major*	50	no	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	135 = Total Cover		

Woody Vine Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes X No ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL Sampling Point: GCDS 1-W1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 3/1	95	10YR 4/6	5	C	PL	loamy clay	
6-18	10YR 4/1	90	10YR 4/6	5	C	PL	sandy clay	
			10YR 6/6	5	C	PK	sandy clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes X No ___

Remarks:

Pond edge.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hampshire Country Club City/County: Mamaroneck/Westchester Sampling Date: 7/24/18

Applicant/Owner: Hampshire Recreation, LLC State: NY Sampling Point: GCDS 1-U1

Investigator(s): David Kennedy Section, Township, Range: Village of Mamaroneck

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): concave

Slope (%): <5 Lat: 40° 56' 09.07" N Long: 73° 44' 33.19" W Datum: WGS 84

Soil Map Unit Name: Udorthents, wet substratum (Uc) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___ No X	Is the Sampled Area within a Wetland?	Yes ___ No X
Hydric Soil Present?	Yes ___ No X		
Wetland Hydrology Present?	Yes ___ No X	If yes, optional Wetland Site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

Golf Course Drainage System 1 (data plot adjacent to Pond 13)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: GCDS 1-U1

Tree Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 feet)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Herb Stratum (Plot size: 5 feet)			
1. *Artemesia vulgaris*	20	yes	UPL
2. *Trifolium repens*	20	yes	FACU
3. *Plantago lanceolata*	20	yes	FACU
4. *Digitaria sanguinalis*	10	no	FACU
5. *Rumex crispus*	10	no	FAC
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	80 = Total Cover		

Woody Vine Stratum (Plot size: 30 feet)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- ___ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ___ No X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: GCDS 1-U1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-9	10YR 4/3	100					sandy loam	
9-18	10YR 3/3	100					sandy loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hampshire Country Club City/County: Mamaroneck/Westchester Sampling Date: 7/24/18

Applicant/Owner: Hampshire Recreation, LLC State: NY Sampling Point: GCDS 3-W1

Investigator(s): David Kennedy Section, Township, Range: Village of Mamaroneck

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): none

Slope (%): 0 Lat: 40° 55' 57.40" N Long: 73° 44' 20.42" W Datum: WGS 84

Soil Map Unit Name: Udorthents, wet substratum (Uc) NWI classification: PUBHh

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ___	Is the Sampled Area within a Wetland? Yes X No ___
Hydric Soil Present?	Yes X No ___	
Wetland Hydrology Present?	Yes X No ___	If yes, optional Wetland Site ID: Pond 10

Remarks: (Explain alternative procedures here or in a separate report.)

Golf Course Drainage System 3 (Sample plot adjacent to Pond 10).

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- X Saturation Visible on Aerial Imagery (C9)
- X Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___ No X	Depth (inches): ___	
Water Table Present?	Yes X No ___	Depth (inches): 2	
Saturation Present? (includes capillary fringe)	Yes X No ___	Depth (inches): 1	**Wetland Hydrology Present?** Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: GCDS 3-W1

Tree Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	20 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15 feet)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
Herb Stratum (Plot size: 5 feet)			
1. *Phragmites australis*	40	yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	40 = Total Cover		
Woody Vine Stratum (Plot size: 30 feet)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes X No ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: GCDS 3-W1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-9	105YR 2/1	1008					hemic (mucky peat)	
9-18	10YR 3/2	100					clay (trace gravel)	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- X Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ___

Depth (inches): ___

Hydric Soil Present? **Yes** X **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hampshire Country Club City/County: Mamaroneck/Westchester Sampling Date: 7/24/18

Applicant/Owner: Hampshire Recreation, LLC State: NY Sampling Point: GCDS 3-U1

Investigator(s): David Kennedy Section, Township, Range: Village of Mamaroneck

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): none

Slope (%): <5 Lat: 40° 55' 57.47" N Long: 73° 44' 20.64" W Datum: WGS 84

Soil Map Unit Name: Udorthents, wet substratum (Uc) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___ No X	Is the Sampled Area within a Wetland? Yes ___ No X
Hydric Soil Present?	Yes ___ No X	
Wetland Hydrology Present?	Yes ___ No X	If yes, optional Wetland Site ID: ___

Remarks: (Explain alternative procedures here or in a separate report.)

Golf Course Drainage System 3 (data plot adjacent to Pond 10)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: GCDS 3-U1

Tree Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Herb Stratum (Plot size: 5 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Festuca rubra*	80	yes	FACUL
2. *Trifolium repens*	10	no	FACU
3. *Plantago major*	10	no	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		

Woody Vine Stratum (Plot size: 30 feet)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- __ Rapid Test for Hydrophytic Vegetation
- __ Dominance Test is >50%
- __ Prevalence Index is ≤3.0[1]
- __ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- __ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ___ No X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: GCDS 3-U1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 4/3	100					sandy loam	
6-18	10YR 3/3	100					sandy loam, trace gravel	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ___ **No** X

Remarks:

Appendix E

Photograph No. 1: View of Pond 5 (Golf Course Drainage System 2), facing north (July 24, 2018).

Photograph No. 2: View of Pond 6 (Golf Course Drainage System 2), facing east (July 24, 2018).


Photograph No. 3: View of wetland soil boring at the Pond 6 data plot (July 24, 2018).


Photograph No. 4: View of Wetland A, facing southwest.


Photograph No. 5: View of wetland and upland data plot locations for Pond 13 (Golf Course Drainage System 1), facing southeast (July 24, 2018).


Photograph No. 6: View of wetland data plot location for Pond 10 (Golf Course Drainage System 3), facing east (July 24, 2018).

Photograph No. 6: View of tide gate openings at the eastern terminus of Pond 10 (Golf Course Drainage System 3), facing southeast (July 24, 2018).

Photograph No. 7: View of tide gate openings along the northern shoreline of Delancey Cove, facing north (July 24, 2018). The tide gates regulate flow through culverts connecting Delancey Cove to Pond 10.

Appendix F

HAMPSHIRE RECREATION, LLC
1025 Cove Road
Mamaroneck, New York 10543

August 14, 2018

Mr. Ronald Pinzon
Chief, Eastern Permits Section
United States Army Corps of Engineers
New York District
Regulatory Branch
Jacob K. Javits Federal Building
26 Federal Plaza, Room 1937
New York, New York 10278-0090

Re: Request for Jurisdictional Determination for the Hampshire Country Club Property
1025 Cove Road
Village of Mamaroneck
Westchester County, New York

Dear Mr. Pinzon:

As owner of the above-referenced property, please accept this letter as authorization for the U.S. Army Corps of Engineers to perform a site inspection in association with the wetland jurisdictional determination (JD) request for the property.

Sincerely,

Susan L Goldberger

Susan L. Goldberger
Authorized Representative

R Flood Extent Diagrams; Mamaroneck Evacuation Notices


10 Year Storm 9'
NORTH
Kimley»Horn


10 Year Storm 9'
NORTH
Kimley»Horn


25 Year Storm 10’
NORTH
Kimley»Horn


25 Year Storm 10'
NORTH
Kimley»Horn

50 Year Storm 11’


50 Year Storm 11’
NORTH
Kimley»Horn


100 Year Storm 12'
NORTH
Kimley»Horn


100 Year Storm 12’
NORTH
Kimley»Horn

Mamaroneck emergency and evacuation notice for Long Island Sound Shore areas

Printer-Friendly Version

This is an emergency message related to the status of Hurricane Sandy in the Village of Mamaroneck.

The Village has declared a state of emergency related to Hurricane Sandy, through and until Wednesday morning, October 31, 2012. On that morning we will reassess the situation and provide a public update.

Based on National Weather Service rainfall predictions of a maximum of 2 to 3 inches, we do not anticipate river-based flooding. Therefore, there is not presently an evacuation in place for neighborhoods prone to river-flooding.

There is a mandatory evacuation in place for the Orienta and Shore Acres neighborhoods that are at-risk for coastal storm-surge flooding. Residents who stay will not be reachable by emergency crews. At the present time, Flagler Drive and Rushmore Avenue are under water.

The National Weather Service has projected coastal tidal surges as high as 6 to 11 feet above normal tides Monday night into Tuesday. Extreme wave action is projected to reach as high as 15-feet in some areas.

This danger and evacuation especially applies to the following streets:

Shore Acres Drive
Orienta Avenue
Rushmore Avenue
The Crescent
Cove Road
Flagler Drive
Greacen Point
Bleeker Avenue

The Town of Mamaroneck has opened the emergency evacuation shelter at the Mamaroneck High School. If you need to go to the shelter, please bring at least 3 days worth of clothes, medicine and food to address any special dietary needs. The Shelter will also assist with any pets that need to be relocated, but pets will not be allowed in the shelter.

For more information, please visit the Village website at villageofmamaroneck.org

Richard Slingerland, Village Manager

Mamaroneck Daily Voice serves Larchmont & Mamaroneck
News 08/27/2011

Mamaroneck Governments Specify Evacuation Areas

by Brian Donnelly

https://dailyvoice.com/new-york/mamaroneck/news/mamaroneck-governments-specify-evacuation-areas/437258/

MAMARONECK, N.Y. -- The Village and Town of Mamaroneck both declared a state of emergency Friday afternoon and issed a mandatory evacuation of low-lying and coastal areas. The following is a list of the specific neighborhoods and streets that have to evacuate by 5 p.m. Saturday.

Village of Mamaroneck:- Taylors Lane- Colonial Court- Barrymore Lane- Shore Acres- Flagler Drive- Rushmore Ave- Greacen Pt- Skibo- Nine Acres- Orienta- The Crescent- Seven Oaks- Seahaven- Nautilus- Constable- Bay Head- Pirates Cove - adjacent to the Mamaroneck and Sheldrake Rivers or near where flooding occurred in 2007 - along Mamaroneck Ave and Fenimore Road.

Village Trustee John Hofstetter urges anyone living in these areas, or people who know of anyone living in these areas, to evacuate by 5 p.m. Assistant village manager Dan Sarnoff warned that emergency responders may not be able to access these areas in the event a tree blocks the road or flooding.

Town of Mamaroneck:- Hommocks Road- Pryer Manor Road- Pheasant Run- Wildwood Circle- Premium Point

A temporary shelter at the Mamaroneck High School's Post Road gym will be available to residents in all three municipalities at 5 p.m. Saturday.

The Town of Mamaroneck, which closed the Hommocks pool Saturday at 12 p.m., will provide transportation to the shelter. Beginning at 4:30 p.m., busses will be available at the Strait Gate Church parking lot on the corner of Madison Street and Old White Plains Road.

Those who don't live near the church parking lot are adviced to call their local police department's non-emergency number, which are as follows:

Village Police - 914-777-1122Town Police - 914-381-6100Larchmont Police - 914-834-1000

S WJWW Letter

MEMORANDUM

TO: Paul Kutzy, P.E.
Westchester Joint Water Works

FROM: William Merklin, P.E.
Michael Savarese, P.E.
Stephen Laun, P.E.
D&B Engineers and Architects, P.C.

DATE: February 14, 2018

RE: Evaluation of Hampshire Country Club Development
D&B No. 3619

Introduction:

D&B was requested by Westchester Joint Water Works (WJWW) to utilize the hydraulic model of their distribution system to evaluate their ability to provide additional flow for increased demands associated with the proposed Hampshire Country Club development located between Eagle Knolls Road and Orienta Avenue in the Town of Mamaroneck.

The hydraulic modeling was performed using the software WaterCAD by Bentley Systems Inc. with a hydraulic model of the WJWW distribution system that had been previously developed and calibrated. The projected water supply demand estimate for the Hampshire Country Club development was provided by WJWW in the form of a letter and drawing from Kimley-Horn of New York, P.C. (Attachment No. 1).

Hampshire Country Club Development Evaluation Assumptions:

The following parameters were utilized in the hydraulic model to conduct the evaluation:

- Maximum day and peak hourly flow conditions during both the irrigation and non-irrigation seasons.

- Existing conditions of the distribution system (Kenilworth pump station operational) and the proposed conditions of the distribution system (16" diameter main in place, Macy Road pump station operational, new pumps at the Weaver Street pump station, and expansion of the intermediate pressure zone).

- Worst-case scenario water supply demands provided by Kimley-Horn in their letter requesting a water availability evaluation, 34,490 gallons per day (23.95 gpm) for maximum day domestic and commercial usage by the development, an additional 31,844 gallons per day (22.11 gpm) for maximum day residential irrigation usage, and 10,000 gallons per day (6.94 gpm) for maximum day golf course irrigation usage during the irrigation season.

Hampshire Country Club Development Evaluation Results:

D&B conducted hydraulic model runs in accordance with the above stated assumptions for the maximum day and peak hourly flow conditions to evaluate the effect of adding additional demand to the system from the Hampshire Country Club development. The results of each model run are included in the "Hydraulic Modeling Results Table" (Attachment No. 2).

During the non-irrigation period, the distribution system was able to handle the additional demand with approximately a one psi reduction in local pressure. All observed pressures throughout the service area remained above the required normal working pressure of 35 psi, as recommended in the Recommended Standards for Water Works (Ten State Standards).

During the irrigation season, the distribution system was able to handle the additional demand with approximately a one psi reduction in local pressure. All observed pressures throughout the service area remained above the required normal working pressure of 35 psi, as recommended in the Recommended Standards for Water Works (Ten State Standards).

Enclosures:
Attachment No. 1: Kimley-Horn of New York, P.C. Water Supply Connection Request Letter and Plan
Attachment No. 2: Hydraulic Modeling Results

Kimley»Horn
of New York, P.C.

September 20, 2017

Mr. Terry O'Neill
Westchester Joint Water Works
1625 Mamaroneck Avenue
Mamaroneck, New York 10543

Re: Hampshire Country Club
1025 Cove Road
Mamaroneck, New York

Dear Mr. O'Neill,

This letter is being submitted by Kimley-Horn of New York P.C. on behalf of Hampshire Recreation LLC c/o New World Realty Advisors for the above referenced project.

This is a follow up to our meeting on September 19, 2017 in regards to the Hampshire Country Club redevelopment. Based on the conversations during the meeting, below is a revised water demand that includes irrigation demands for individual homes and the redeveloped 9 hole golf course.

As part of the Draft Environmental Impact Statement (DEIS) completeness process, the Village has asked us to request a confirmation from Westchester Joint Water Works that the proposed connection point is acceptable from the proposed development. For your reference the following provides information on the proposed development water demand.

Proposed Water Flow

The total estimated water demand for the proposed development is 81,234 gallons per day. The domestic flows were calculated with an estimated peak rate of 110 gpm utilizing the industry standard values for wastewater. For the individual irrigation demands it is assumed that 5,000 square feet will be irrigated for the Carriage Homes and 10,000 square feet will be irrigated for the Single Family Homes. The irrigation flows for both the Carriage Homes and the Single Family Homes were calculated with an estimated peak rate of .5 inches per square foot per week. Additionally, the irrigation flows for the redeveloped 9 hole golf course were based on the average annual consumption of the existing 18 hole golf course. The anticipated water demand calculations are illustrated below.

Unit Type	Number of Units	Bedrooms/Unit	Hydraulic Load (gpd/bedroom)	Design Flow Rate (gpd)
Carriage Home	61	3	110	20,130
Single Family Home	44	4	110	19,360
Total	**105**			**39,490**

Unit Type	Number of Units	Average Lot Area to be Irrigated (SF)	Hydraulic Load (.5 in/SF/week)	Design Flow Rate (gpd)
Carriage Home	61	5,000	.04 FT	13,037
Single Family Home	44	10,000	.04 FT	18,807
Total	**105**			**31,844**

Area	Historical 18 Hole Golf Course Water Demand (gpd)	Hydraulic Load (gpd)	Design Flow Rate (gpd)
Redeveloped 9 Hole Golf Course	18,000	10,000	10,000
Total			**10,000**

Flow Contributor	Total Design Flow (gpd)
Domestic Demand	39,490
Irrigation Demand	31,844
Golf Course Demand	10,000
Total	**81,334**

Please provide written response to your opinion on the proposed system design, location and the adequacy of the system to provide the proposed water demand.

If you require any more information, please don't hesitate to call me at 914-368-9200 or mike.junghans@kimley-horn.com.

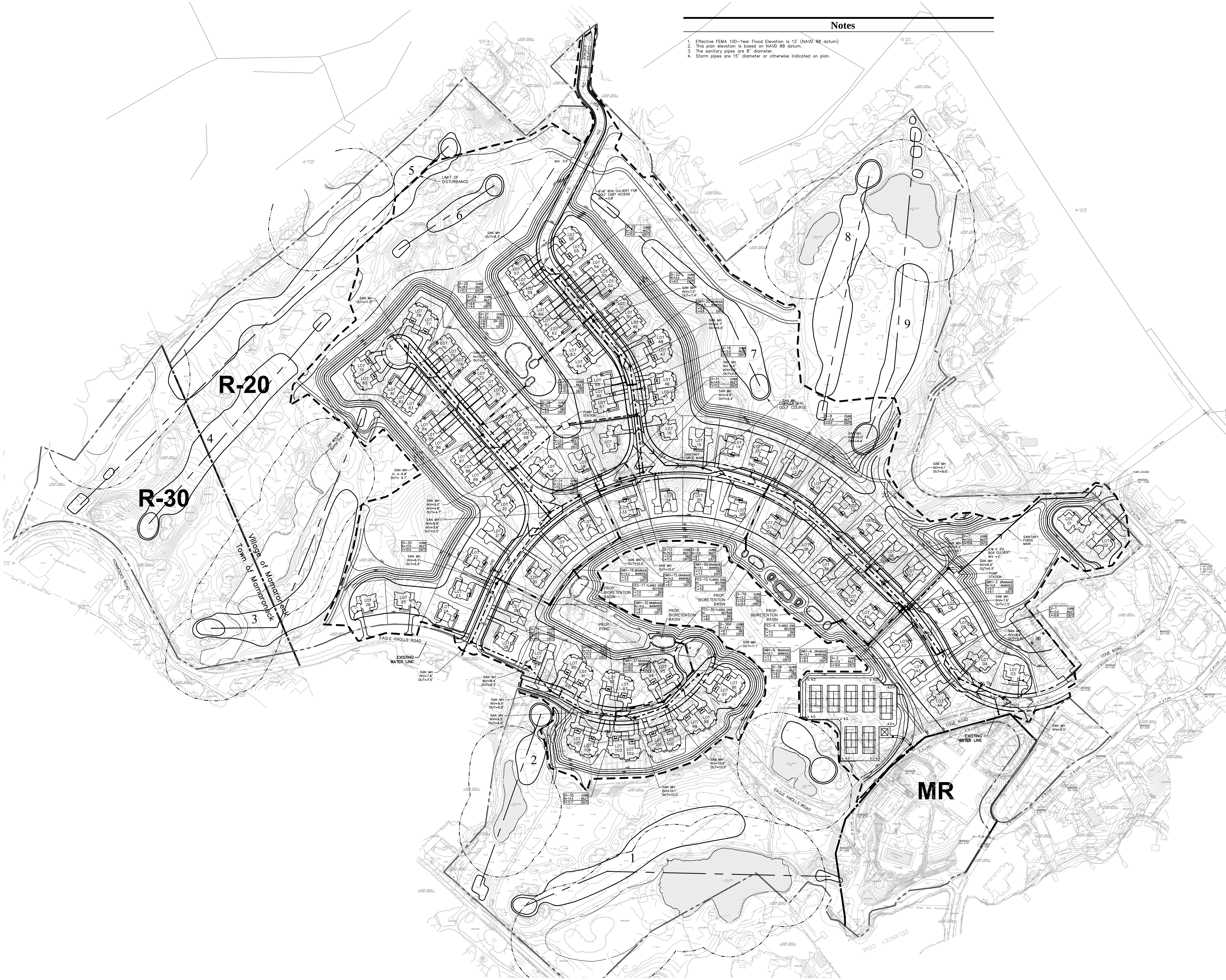
Very truly yours,

KIMLEY-HORN OF NEW YORK, P.C.

Michael W. Junghans, P.E.
Senior Project Manager

cc. Dan Pfeffer – HR
Tom Nappi – HR
Robert Wasp – SITES Remediation & Technologies

\\VHB\PROJ\WHITEPLAINS\28677.02 HAMPSHIRE SUBDIVISION\CAD\LD\PLANSET\28677.02_PLOT



Notes

1. Effective FEMA 100–Year Flood Elevation is 12′ (NAVD 88 datum)
2. This plan elevation is based on NAVD 88 datum.
3. The sanitary pipes are 8″ diameter.
4. Storm pipes are 15″ diameter or otherwise indicated on plan.

VHB

Vanasse Hangen Brustlin, Inc.

Transportation
Land Development
Environmental Services

50 Main Street - Suite 360
White Plains, NY 10606
914.467.6600 • FAX 914.761.3759

N

100 0 100 200
SCALE IN FEET

No.	Revision	Date	Appvd.
1	REVISED LAYOUT TO PRESERVE EXISTING GOLF COURSE	09/28/16	MWJ

Designed by JC | Drawn by JC | Checked by MWJ

CAD checked by MWJ | Approved by MWJ

Scale 1"=100' | Date June 25, 2015

Project Title

Hampshire Country Club
Planned Residential Development (P.R.D.)

Village of Mamaroneck, NY

Issued for

VILLAGE REVIEW

NOT FOR CONSTRUCTION

Drawing Title

Grading & Utility Plan

STATE OF NEW YORK · MICHAEL W. JUNGHANS · 072072 · LICENSED PROFESSIONAL ENGINEER

Michael W. Junghans
N.Y. Professional Engineer
NY Lic. No. 072072

Drawing Number

C-3

Sheet of

Project Number
28677.02

28677.02_PLOT.DWG

Westchester Joint Water Works
Hydraulic Modeling For Hampshire Country Club Development
D&B Engineers and Architects, P.C.
D&B No. 3619.19

Season	Condition	Minimum Pressure Observed (PSI)	Maximum Pressure Observed Observed (PSI)
Non-Irr	Base Conditions Non-Irr	104	117
	Average Day	103	117
Irrigation	Base Conditions Irrigation	88	112
	Max Day	87	111
	Peak Hour	87	N/A

T Sewer Flow Calculations

Sewer Flow Calculation

1) Design Flow from Proposed Buildings

STRUCTURE	# UNITS	BEDROOMS/UNIT	HYDRAULIC LOAD (GPD/BEDROOM)[1]	DESIGN FLOW RATE (GPD)
CARRIAGE HOMES	61.00	3.00	110.00	20130.00
SINGLE FAMILY	44.00	4.00	110.00	19360.00
			Total	39490.00

Flow rate with Peaking Factor of 4 [2] =	**157960.00**	gpd

2)Design Flow from I & I

	# UNITS	PIPE DIAMETER (IN)	PIPE LENGTH (SINGLE, FT)	PIPE LENGTH (TOTAL, MI.)	FLOW RATE (GPD/IN DIA./MILE)	TOTAL FLOW (GPD)	
LATERALS	105.00	4.00	100.00	1.99	500.00	3977.27	
MAIN	1.00	8.00	4425.00	0.84	500.00	3352.27	
					TOTAL	**7329.55**	gpd

Summary of Design Flow (Including Peaking Factor of 4)

Average daily flow =	**165289.55**	**gpd**
=	**0.26**	**cfs**
Peak hour flow =	**6887.06**	**gph**

Minimum Sewer Pipe Capacity Calculation

Material	PVC	
Manning's n	0.010	
Pipe Diameter	8.000	in
Slope (User)	0.004	ft/ft
Length	250	ft
Upstrem Invert	11	ft
Downstream Invert	**10**	ft
Slope (Calculated)	0.004	ft/ft
Full Flow Velocity	2.85	fps
Flow Capacity	**0.99**	**cfs**

Minimum pipe capacity is greater than design flow
0.99 cfs > 0.26 cfs OK

Notes:

[1] Unit flow values based on NYSDEC Design Standards for Intermediate Sized Wastewater Treatment Systems, Dated 3/5/2014, Table B-3, pp. B-17.

[2] Peaking factor of 4 based on Recommended Standards for Wastewate Facilities (10 States Standards), 2014 edition.

U Pest Management Plan

BEST MANAGEMENT PRACTICES
FOR NEW YORK STATE GOLF COURSES

10.0 INTEGRATED PEST MANAGEMENT

Integrated Pest Management (IPM) involves the combination of plant selection, cultural practices, pest and environmental condition monitoring, biological controls and judicious pesticide use to manage pest controls. A successful IPM Plan permits the existence of pest species at a level which will not compromise vegetative health. The implementation of regular maintenance strategies and cultural practices will facilitate the provision of optimum turf growing habitat with minimal chemical interference. Monitoring of environmental conditions will allow professionals to recognize a threshold at which chemical application is necessary to maintain acceptable turf grass and playing conditions. In the event that regular maintenance techniques fail to control pest species, treatment of infested or damaged areas along with similar areas susceptible to the same pest or disease would be initiated.

Fertilizer application can be minimized by manipulating the growing environment to retain the fertilizers in the root zone for sufficient periods. An optimal growing environment can be achieved through course design, use of acceptable turf grass and soils, and a dedicated maintenance program which ensures adequate environmental conditions persist.

Scouting practices will occur regularly to monitor pest presence and other turf stressors throughout the growing season. Regular records will be kept in order to document patterns, successes and failures.

10.1 CULTURAL PRACTICES

Almost every aspect of golf course management affects the likelihood and severity of pest problems. Although practices required for playability sometimes supersede the optimal IPM choice, manipulating cultural practices should be a key part of an IPM approach. As such, the appropriate implementation such practices have the potential to encourage environmental protection through the conservation of water and minimization of chemical application.

10.1.1 Mowing

Mowing is a basic yet important cultural practice that can greatly influence turf growth and environmental conditions. The Hampshire Country Club Superintendent will be well-educated in the most effective and modern innovations in mowing equipment, height, frequency, techniques, and patterns that can be put in practice to produce optimal turf and environmental conditions that are favorable to reduce the need for fertilizer and pesticide application. For example, Verti-cutting of fairways is a practice that not only provides healthier grass but also increases the effectiveness of introduced pesticides. By applying pesticides more efficiently, the amount of chemicals utilized will be reduced. Such innovative practices will be implemented to the greatest extent practicable.

10.1.2 Tree Removal and Trimming

Trimming selected trees will increase sunlight and air circulation in the turf. Excessive shade and poor air circulation not only weakens turf grass but are directly correlated with the occurrence of increased rates of disease. When the factors that enhance and contribute to turf grass disease are controlled, pesticide application is reduced.

10.1.3 Plant Conditioning

Enhancing the preventative maintenance program through an effective equipment replacement schedule will allow the turf grass to be mowed and maintained more efficiently on a daily basis. Therefore, the grass will require less fertilizer to maintain adequate growing conditions and color. For example: maintaining sharp and accurately adjusted mowing blades assists in maintaining healthy plant tissue and roots. Grass mowed by dull blades incurs significant damage due to tearing, which leaves open wounds, invites disease, and leads to shorter root systems. Damaged turf also attracts more insects and is more susceptible to cart traffic damage. Unhealthy turf will not assimilate available fertilizer and water as well as healthy turf.

Other plant conditioning involves mowing frequency. When grass is allowed to grow without frequent mowing, it suffers severe damage when finally mowed. General industry practice does not allow more than 25% of the aboveground plant to be cut at any one time. Without a proper equipment maintenance program, this would not be possible.

10.1.4 Controlling Cart Traffic

Soil compaction due to cart activity may result in poor oxygen and gas exchange, restricted water percolation and increased runoff (loss of natural irrigation potential), reduced infiltration of fertilizer / limited fertilizer effectiveness, increased weed germination, thinner, less healthy turf. In order to prevent damage and an increased need for chemical application, adequate cart paths will be maintained throughout the course and cart traffic will be controlled.

10.1.5 Drainage Improvement

Installation of drainage and sump systems throughout the course will improve drainage and decrease soil compaction and increase turf health.

10.2 COMPREHENSIVE SOIL TESTING

Through periodic soil testing an accurate prediction of turf fertility needs will prevent application of excess fertilizer. This will promote a healthier turf environment and minimize the application of fertilizers. A healthier plant (not too weak and not too lush) will require fewer pesticide applications. Specific pH testing will provide amendment recommendations that balance the soil to facilitate proper fertilizer usage.

10.3 CHEMICAL TECHNICIAN TRAINING

Chemical technicians will be required to obtain their New York Commercial Pesticide Applicator license. Certification and continual education programs will be emphasized for personnel associated with chemical application. The dedicated use of U.S. Environmental Protection Agency (EPA), and New York State Department of Environmental Agency (NYCEC)-approved chemicals and adherence to their proper method of application will be strictly observed.

10.4 IMPROVED IRRIGATION APPLICATION

A computerized irrigation system is used to enhance irrigation applications and will also aid in system optimization, reducing pesticide usage, fertilizer applications, power costs, water usage, and manpower. Reduced water usage will result in decreased soil compaction, fertilizer leaching, disease susceptibility, weed populations, and insect populations. Irrigation will occur only when necessary to provide the turf grass with an acceptable growing environment.

10.6 PEST THRESHOLD TOLERANCE LEVELS

When it is determined through scouting that a pest level has reached the threshold to cause unacceptable damage or turf loss action will be taken. The threshold levels used to make this determination have either been determined scientifically or are based on site specific experience.

To avoid unacceptable damage or loss multiple cultural, mechanical, and biological management methods will be used. Chemical control is reserved as a last option, and only used when other methods are insufficient for maintaining acceptable turfgrass quality and playability.

When chemical control is warranted, scouting and past management successes often allow for early intervention, which may result in the use of lower toxicity treatments. The course superintendent will consider all options and select the least disruptive, but effective option.

10.7 SEASONAL PESTICIDE APPLICATION

Timing is one of several critical factors that reduce pesticide applications and achieve maximum results. Seasonal pesticide applications will be directed toward the eradication of pests having season-specific turf impacts. The primary aspect of application will be dedicated to high impact areas. By targeting stressed turf locations, chemical applications will be limited to a specific location.

10.8 PESTICIDE APPLICATION TECHNIQUES AND ROTATION

Calibration and rotation of pesticide use is critical in obtaining maximum results from each chemical application. Miscalculations of pesticide quantities utilized may result in turf and environmental damage and may promote genetic pesticide tolerance(s) in pest populations. Proper rotation of pesticide(s) can significantly reduce the opportunity for a pest to genetically achieve chemical resistance to future generations. Altering the pH of the carrying agent can also dramatically increase the individual pesticide's effectiveness. For example: organophosphate effectiveness is reduced in high pH water. Tests have shown that adding citric acid to the water, which lowers the pH, can increase the pesticide's effectiveness as much as 30%-50%.

Catagory Name	Company Name	Product Name	Unit
Fungicide	Prime Source LLC	Curalan EG	LB
		Honor	LB
		Lexicon	GAL
		Xzemplar	GAL
	Bayer	26-GT	GAL
		Banol	GAL
		Bayleton Flo	GAL
		Chipco 26019 Flo	GAL

Catagory Name	Company Name	Product Name	Unit
Fungicide	Bayer	Chipco Signature	LB
		Interface Stressgard	GAL
		Signature Xtra Stressgard	LB
		Tartan	GAL
	Growth Products	Companion	GAL
	Lesco / Site One	Manicure Ultra	LB
		T-storm Flowable	GAL
	NuFarm	Strider	GAL
		Transom 4.5 F	GAL
	Phoenix	Dovetail	GAL
		Raven	GAL
		Wingman 4L	GAL
	Prime Source LLC	Chlorothalonil 82.5DF	LB
	Quali-Pro	Chlorothalonil DF	LB
		Enclave	GAL
		Mefenoxam 2 AQ	GAL
		Propiconazole 14.3	GAL
		Strobe 2L	GAL
		Strobe T	GAL
		Tebuconazole 3.6F	GAL
		TM 4.5	GAL
	Sipcam Advan	Echo Ultimate T&O	LB
	Syngenta	Appear	GAL
		Daconil Action	GAL
		Daconil Ultrex	LB
		Heritage	LB
		Heritage Action	LB
		Instrata	GAL
		Secure	GAL

Catagory Name	Company Name	Product Name	Unit
Growth Regulator	Bayer	Proxy	GAL
	Quali-Pro	Ethephon 2 SL	GAL
		Pac-Low	GAL
		Tide Paclo 2SC	GAL
		T-NEX	GAL
		T-Nex 1 AQ	GAL
	Valent	ProGibb T&O	GAL
	Total		
Herbicide	Bayer	Acclaim Extra	GAL
		Specticle Total	GAL
	Dow	Dimension Ultra 40 WP	LB
	Gowan Company	Sedgehammer	LB
	Loveland	Kleenup Pro	GAL
		Rifle	GAL
	NuFarm	Prosedge	LB
		Prosedge 2	LB
		Sureguard SC	GAL
	PBI/Gordon	Bensumec 4LF	GAL
	Quali-Pro	3-D	GAL
		Dithiopry 40 WSB	LB
		Quinclorac 1.5L	GAL
	Syngenta	Pennant Magnum	GAL
		Tenacity	GAL
	Total		
Insecticide	Lesco / Site One	Bandit 2F	GAL
	Phoenix	Hawk-I 75WSP	LB
	Quali-Pro	Bifenthrin Golf & Nursery 7.9F	GAL
		Chlorpyrifos 4E	GAL
		Imidacloprid 2F	GAL
		Imidacloprid 75WSB	LB
		Lambda GC-O	GAL
	Syngenta	Provaunt Ins.	LB
	Total		

10.9 PESTICIDE RECORDKEEPING

In accordance with New York regulations, records of all pesticide applications will be made within two (2) working days of the application and maintained onsite. Records will be made available upon request to NYDEC representatives, USDA authorized representatives, and licensed health care professionals. An annual pesticide report will be submitted to the NYDEC in accordance with state law. In addition, records of all pest control activity, past infestations, or other problems will be maintained on site in order to provide guidance in selecting future courses of action.

10.10 BIO-STIMULANTS AND BIOLOGICAL CONTROLS

A continuous program to provide natural alternatives will be implemented and refined in response to turf grass conditions on the course. These programs will include, but will not be limited to, the following:

10.10.1 Bio-Stimulants

Bio-stimulants are used to improve the health of the soil, increase microbial activity, and improve the cation exchange capacity. The desired result of these sources would be to provide the soil with an increased ability to store nutrients, filter pesticides, and increase the proficiency of the turf grass in assimilating fertilizers and water.

10.10.2 Biological Controls

The inclusion of naturally occurring desirable pests will be used, where practical, to provide an alternative to chemical pesticides. Proper use of such natural organisms will be monitored in order to ensure attractiveness and appropriateness.

10.10.3 Grass Carp

Lake maintenance programs may include the stocking of sterile triploid grass carp to reduce the necessity for lake maintenance chemicals.

10.11 FERTILIZER SELECTION

The use of slow-release fertilizers will be implemented. Two benefits for the use of such fertilizers include:

a. By definition, slow-release fertilizers provide for little or no nitrate leaching.

b. Turf grass growth is moderated throughout the period of release.

The objective of the fertilizing program on this course is to provide a healthy turf through effective management. It is the intent of the operator to maintain a verdant turf environment. This will allow for a healthy turf system while maintaining course integrity.

Catagory Name	Company Name	Product Name	Unit
Adjuvant	Aquatrols	Blast	GAL
		Dispatch Sprayable	GAL
		Primer Select	GAL
		Radiance	GAL
		Revolution	GAL

Catagory Name	Company Name	Product Name	Unit
Adjuvant	Aquatrols	Pervade	GAL
	Loveland	LI-700	GAL
		Revert	GAL
	Syntech	Eximo	LB
	Total		
BioStimulant	Floratine	Per 4 Max	GAL
	Turf Fuel	Respo Fuel	GAL
	Total		
Fertilizer	Earthworks	Replenish 5-4-5 GG	LB
	Floratine	P-48	LB
		Trical 35-SP	LB
	Grow Star	18-24-12 Starter	LB
	Growth Products	28-0-0	GAL
		Cal Mag 7-0-3	GAL
		Classic 18-3-6	GAL
		Iron Max AC 6% 15-0-0	GAL
		Restore	GAL
		Sodium Knockout 5-0-0	GAL
		TKO	GAL
		TKO Phosphite 0-29-26	GAL
		X-Xtra Iron	GAL
	Lesco / Site One	20-20-20	LB
	Loveland	12-24-14 SIG 30%XCU	LB
		18-0-18 SIG 75% BCU	LB
		Feature Pro LQ	GAL
		Prospect	GAL
		Signature 0-0-50 Duration	LB
		SST Calcium	GAL
	Nutrite	17-0-17	LB
	Ocean Organics	NuRelease	GAL
	PBI / Gordon	Ferromec	GAL

Catagory Name	Company Name	Product Name	Unit
Fertilizer	Plant Food Co	10-10-10 Blu-Gro	GAL
		16-2-7	GAL
		18-3-4	GAL
		Adams Earth biostimulant	GAL
		DKP Extra 4-20-22	GAL
		Micro Mix	GAL
		Phosphite 30	GAL
		PHusion Calcium Sulfate	LB
		Sugar Cal 10%	GAL
	Sanctuary	12-0-12	LB
	Turf Fuel	Element 6	GAL
		Lessen 11	GAL
	Total		
Soil Catalyst	Floratine	Calphlex	GAL
	Growth Products	Essential Plus	GAL
	LidoChem	Exalt	LB

10.12 TURF GRASS SELECTION

The varieties and cultivars of turf used on the golf course will be continually evaluated. As new varieties with improved disease or insect resistance come to market they will be included in future overseeding practices. Furthermore, cultural and chemical practices will be used to promote the proliferation of desirable varieties, reducing the overall need for pesticide use in the future.

10.13 ONSITE WEATHER STATION

A weather station is used on-site to provide accurate records and allow the management of pesticides, water, and fertilizers to occur more efficiently. Weather information for the course is publicly available and is hosted on the Weather Underground website. Weather data for the golf course can be found by searching for the Orienta KNYMAMAR11 weather station.

11.0 PESTICIDE SAFETY

11.1 STORAGE

Pesticides will be stored in a separate IPM Control Center. The IPM Control Center consists of a chemical storage building that will not rust and does not require routine painting. Pesticides will be stored within this structure; the building will be locked and posted as required. The chemical storage building has a solid flooring system, as opposed to a grated flooring system, to allow for easier clean up in the event of a spill and reduces the possibility of cross contamination of spilled chemicals. The wiring is moisture proof, and smash guards cover the incandescent light fixtures. An emergency eyewash and shower will be located on site. An emergency spill response kit, fire extinguishers, protective clothing, respirators, and first aid supplies are kept in an accessible area immediately inside the facility.

11.2 HANDLING AND APPLICATION

Prior to handling pesticides, applicators will be given manufacturers label sheets that include warnings and precautions on the use, mixing, and disposal of the chemical. Based on the type and nature of the chemical being used, adequate hand, eye, and face protection will be used, as well as protective clothing, rubber boots, and respirators. Applicators will be given instructions on the proper use, handling, mixing, and application of all chemicals used in the facility. Compatibility and adjuvant will be checked and determined based on the manufacturer's recommendations. Only enough chemical will be mixed for each application that can be used in the area to which it will be applied.

11.3 DISPOSAL

Empty chemical containers will be disposed of in accordance with the manufacturer's recommended instructions. When a chemical has an expired shelf life, disposal will occur as recommended by the manufacturer, supplier, or the NYDEC. Their recommendations will be followed in disposing of such chemicals and their empty containers.

11.4 RECORD KEEPING

Records of al chemicals purchased, used, and applied will be in accordance with local and state regulations. The purpose of such record keeping will be to verify proper use, comparative analysis of results of applications, and to facilitate the discovery of errors in application, mixing, or proper use.

V Traffic Analyses and Backup

Kimley»Horn
of New York, P.C.

FEIS Chapter M Appendix

Kimley»Horn
of New York, P.C.

FEIS Chapter M Appendix

Response to Comments M1, M2, M3, M18

- Construction Traffic Activity
- Synchro Analysis during construction (Hommocks Rd/ US1)
- Accident Projections

Comment M.1

Fill Truck Trip Calculations

Fill Assumptions In-Situ Fill (CY)	Expansion Factor	Uncompacted Fill	Truck Capacity CY	Trucks
84,104	1.33333333	112139	16	7009

	Phases	Mobilization	Main Platform Fill	Demobilization	Structure/Foundation/Roads/Utilities/Fitout/Spurs Fill				Demobilization	Total
						Initial Period	Middle Period	Completion Period		
	Duration	0.5 Months	9 Months	0.25 Months		12 Months	24 Months	6 Months	0.5 Months	52.25 Months
1	Full Work Days (months x 20.5)	10.25	184.44	5.12		245.91	491.83	92.22	10.25	1040
2	Uncompacted Fill (from engineer)	0	70823	0	0	13771	27542	0	0	112137
3	Compacted Fill (2/1.333)	0	53118	0	0	10328	20657	0	0	84103
4	Fill Trucks (Uncompacted Fill or 2/16)	0	4426	0	0	861	1721	0	0	7009
5	Truck Trips Per Day (4/1)	0	24	0	0	4	4	0	0	7

Comment M.1

Average Daily and Peak Hour Truck and Non-Truck Visits to the Hampshire Country Club Site during Construction

(with projected peak-hour trips)

		Mobilization	Main Platform Fill	Demobilization	Structure/Foundation/Roads/Utilities/Fitout/Spurs Fill				Demobilization
						Initial Period	Middle Period	Completion Period	
	Duration	**0.5 Months**	**9 Months**	**0.25 Months**		**12 Months**	**24 Months**	**6 Months**	**0.5 Months**
	Vehicle Type								
1	Single Unit 5-Axle	2 Misc.	24 Fill	2 Misc.		3.5 Fill 0.5 Concrete 0 Topsoil 0 Paving 0 Driveway 0 Tennis/Parking	3.5 Fill 0.5 Concrete 0.2 Topsoil 1 Paving 0.5 Driveway 0 Tennis/Parking	0 Fill 0 Concrete 0.2 Topsoil 1 Paving 0.5 Driveway 2 Tennis/Parking	1 Misc.
					Subtotal	4	5.7	3.7	
2	Tractor Trailer	0.2 Misc.	0.2 Misc.	0.2 Misc.		0.2 General 0.0 Wood 0.0 Materials/Fitout	0.2 General 0.6 Wood 0.5 Materials/Fitout	0.1 General 0.0 Wood 0.5 Materials/Fitout	0.2 Misc.
					Subtotal	0.2	1.3	0.6	
3	Over Sized (carrying heavy equipment)	1	0	0.5		0	0	0	0.75
4	Single Unit 3-Axle	1 General Delivery	2 General Delivery	2 General Delivery		4 General Delivery	0.5 Mechanical/Electrical 5 - General Delivery	0.5 Mechanical/Electrical 4 - General Delivery	2 General Delivery
					Subtotal	4	5.5	4.5	
5	Total Trucks	4.2	26.2	4.7		8.2	12.5	8.8	3.95
6	Total Truck Trips (5 x 2)	8	52	9		16	25	18	8
7	Estimate of % of daily Truck Trips in the Peak Hour	33%	25%	33%		33%	30%	33%	33%
8	Max Truck Trips Per Hour (6*7)	3	13	3		5	8	6	3
9	Private Auto/Pickup Vehicles per Day (employees)	15	25	20		40	50	40	15
10	Estimate of % of Employees In/Out in Peak Hour	67%	67%	67%		67%	67%	67%	67%
11	Max Car Trips Per Hour (9*10)	10	17	13		27	33	27	10
	Max Per-hour Trips								
12	Truck (8)	3	13	3		5	8	6	3
13	Car (11)	10	17	13		27	33	27	10
14	Total (12+13)	13	30	16		32	41	33	13

Comment M.2

PM Peak Hour
Synchro Analysis Comparison
US Route 1 & Hommocks Rd/Weaver St

Intersection	Approach	Lane Group	DEIS Build LOS/Delay	No-Build with Construction Trips LOS/Delay	Change in Delay
Boston Post Rd & Hommocks Rd/Weaver St	EB	L	D/49.2	D/49.4	**0.2**
		TR	D/47.7	D/47.5	**-0.2**
	WB	L	D/48.0	D/48.2	**0.2**
		TR	D/44.8	D/45.1	**0.3**
	NB	L	E/56.4	E/56.4	**0**
		TR	C/31.4	C/31.1	**-0.3**
	SB	L	C/27.5	C/28.3	**0.8**
		TR	D/41.1	D/41.1	**0**
	Intersection		**D/39.7**	**D/39.7**	**0**

Volume Calculation Worksheet

	DEIS No-Build		Maximum Truck Phase: Add Construction traffic (1)				
			13	*16.75* (1)	Total Const	No-Build + ALL	Combined
	Vol	HV %	Trucks	Workers	Traffic	Const Vehs	HV %
Weaver St							
EB							
L	116	0.02			**0**	116	0.02
T	81	0.01		1	**1**	82	0.01
R	91	0.06			**0**	91	0.06
Hommocks Rd							
WB							
L	54	0.02	3	3	**6**	60	0.07
T	78	0.01		1	**1**	79	0.01
R	34	0.01	4	0	**4**	38	0.10
US Rt 1							
NB							
L	147	0.01			**0**	147	0.01
T	704	0.02			**0**	704	0.02
R	51	0.02	3	3	**6**	57	0.07
SB							
L	61	0.01	3	0	**3**	64	0.06
T	783	0.03			**0**	783	0.03
R	106	0.02			**0**	106	0.02

(1) 100% of trucks and 50% of workers use Hommocks Rd to access the site.

Comment M.2

No-Build_During Construction-Max Trucks — PM Peak Hour

6: US 1/Boston Post Rd & Weaver Street/Hommocks Road — 03/23/2019

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	116	82	91	60	79	38	147	704	57	64	783	106
Future Volume (vph)	116	82	91	60	79	38	147	704	57	64	783	106
Satd. Flow (prot)	1770	1589	0	1574	1583	0	1745	3394	0	1589	3299	0
Flt Permitted	0.631			0.532			0.132			0.192		
Satd. Flow (perm)	1113	1589	0	863	1583	0	240	3394	0	319	3299	0
Satd. Flow (RTOR)												
Confl. Peds. (#/hr)	42		20	20		42	44		22	22		44
Confl. Bikes (#/hr)			6									6
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	1%	6%	7%	1%	10%	1%	2%	7%	6%	3%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	129	192	0	67	130	0	163	845	0	71	988	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		12			16		5	2		1	6	
Permitted Phases	12			16			2			6		
Total Split (s)	30.0	30.0		30.0	30.0		18.0	63.0		13.0	58.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Act Effct Green (s)	39.6	39.6		39.6	39.6		68.4	59.1		59.4	53.0	
Actuated g/C Ratio	0.29	0.29		0.29	0.29		0.50	0.43		0.44	0.39	
v/c Ratio	0.40	0.41		0.27	0.28		0.69	0.57		0.36	0.77	
Control Delay	49.4	47.5		48.2	45.1		56.4	31.1		28.3	41.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	49.4	47.5		48.2	45.1		56.4	31.1		28.3	41.1	
LOS	D	D		D	D		E	C		C	D	
Approach Delay		48.3			46.1			35.2			40.2	
Approach LOS		D			D			D			D	
Queue Length 50th (ft)	104	156		52	101		76	296		32	396	
Queue Length 95th (ft)	181	246		104	170		118	363		57	483	
Internal Link Dist (ft)		190			209			263			1683	
Turn Bay Length (ft)	145			150			180			140		
Base Capacity (vph)	324	463		251	461		269	1474		217	1285	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.40	0.41		0.27	0.28		0.61	0.57		0.33	0.77	

Intersection Summary

Cycle Length: 136

Actuated Cycle Length: 136

Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green

Control Type: Actuated-Coordinated

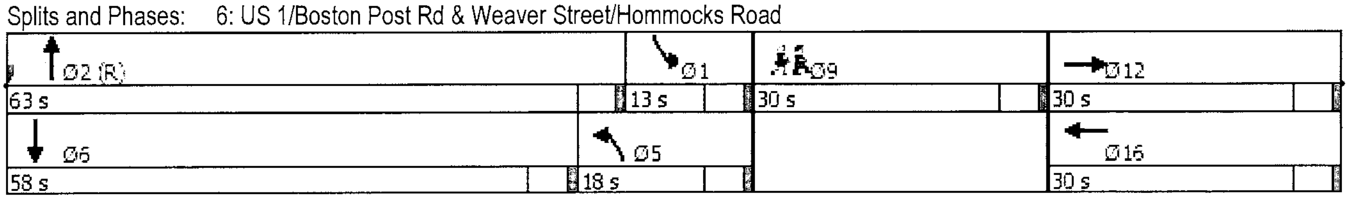
Maximum v/c Ratio: 0.77

Intersection Signal Delay: 39.7 — Intersection LOS: D

Intersection Capacity Utilization 64.5% — ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 6: US 1/Boston Post Rd & Weaver Street/Hommocks Road



Comment M.3

Accident projections for the Intersection of Hommocks Road at Boston Post Road

	Accidents 2013 through 2015	AM and PM Peak-Hour Volume	Pk Hr as a % of Weekly Volume	Weekly Volume	Weeks Per Year	Annual Traffic	3-years of Traffic (MEV)	Accident Rate (per MEV)
Historical	17	4287	3.27%	131074	52.14	6834583	20.50	0.83

Construction Traffic	0.5 Months	9 Months	0.25 Months	24 Months	6 Months	0.5 Months	52.25 Months (MEV)	Accident Rate (per MEV)	Accidents
Work Days	10.25	184.50	5.12	491.85	92.20	10.25			
Trucks	4.2	26.2	4.7	12.5	8.8	3.95			
Employees	15	25	20	50	40	15			
Employees via Hommocks (60%)	9	15	12	30	24	9			
Trips	203	5772	137	30028	4535	203	0.0409	0.83	0.034

Post Construction		AM and PM Peak-Hour Volume	Pk Hr as a % of Weekly Volume	Weekly Volume	Weeks Per Year	Annual Traffic (MEV)	Accident Rate (per MEV)	Additional Accidents per year	Years for 1 Accident
		69	3.27%	2110	52.14	0.11000379	0.83	0.091	11.0

Kimley»Horn
of New York, P.C.

FEIS Chapter M
Appendix

Response to Comment M9, M42

Revised Intersection Analyses & Summary Table with twice the counted level of Pedestrian Activity and with Cooper Avenue Closed

Revised Table M8 and M9 reflecting twice the counted level of pedestrian activity and Cooper Avenue as an emergency access only.

Build Levels of Service - High Pedestrian Analysis (LOS/Delay)								
Intersection	Approach	Lane Group	AM Peak Hour		PM Peak Hour		Sat Peak Hour	
			No-Build	Build	No-Build	Build	No-Build	Build
Boston Post Rd & Hommocks Rd/Weaver St	EB	L	E/62.7	E/64.0	D/49.1	D/49.2	D/45.8	D/45.9
		TR	D/52.7	D/52.8	D/47.5	D/47.7	D/44.1	D/44.2
	WB	L	E/56.7	E/66.7	D/47.2	D/48	D/43.1	D/43.6
		TR	D/51.5	D/52.2	D/44.6	D/44.8	D/41.1	D/41.2
	NB	L	D/42.0	D/42.0	E/56.4	E/56.4	D/50.0	D/50
		TR	E/72.0	E/73.8	C/31.0	C/31.4	C/33.2	C/33.5
	SB	L	E/76.2	E/76.2	C/26.4	C/27.5	C/28.3	C/29.3
		TR	D/38.1	D/38.1	D/41.1	D/41.1	D/42.4	D/42.4
	Intersection		**E/57.3**	**E/58.4**	**D/39.5**	**D/39.7**	**D/39.6**	**D/39.8**
Boston Post Rd & Orienta Ave/ Delancey Ave	EB	L	D/43.6	D/43.6	D/43.7	D/43.4	D/45.3	D/45.2
		R	B/10.4	B/10.4	B/12.8	B/12.5	B/13.0	B/12.8
	WB	L	D/44.8	D/44.8	D/42.3	D/42.6	D/40.4	D/40.5
		R	A/9.0	A/9.0	A/8.6	A/8.7	A/8.5	A/8.4
	NB	TR	D/42.3	D/42.4	D/39.1	D/39.2	D/41.1	D/41.2
	SB	TR	C/23.3	C/23.4	C/23.4	C/23.7	C/21.2	C/21.4
	Intersection		**C/27.8**	**C/28.1**	**C/23.1**	**C/23.4**	**C/24.8**	**C/24.8**
Boston Post Rd & Old Boston Post Rd/ Richbell Rd	EB	L	D/49.8	D/49.9	D/44.5	D/44.6	D/41.8	D/42.1
		R	D/41.9	D/41.7	D/40.1	D/39.9	A/9.7	A/9.6
	WB	L	D/40.5	D/40.4	D/40.1	D/39.8	D/36.3	D/36.2
		TR	D/43.5	D/43.4	D/39.7	D/39.4	C/26.8	C/27.0
	NB	L	B/18.9	B/18.1	B/14.2	B/14.5	B/14.7	B/14.8
		T	B/18.8	B/19	B/13.5	B/13.7	B/14.8	B/14.9
	SB	TR	C/28.7	C/28.8	C/24.5	C/24.8	C/24.8	C/24.9
	Intersection		**C/27.4**	**C/27.5**	**C/23.1**	**C/23.3**	**C/21.4**	**C/21.5**

A new analysis has been performed to address the stated concerns. The traffic volumes used in the DEIS analysis were compared to ATR data collected over the course of a week, March 14-20, 2016. The data confirmed that the counts used in the DEIS are representative of typical vehicular volumes. The ATR data showed higher volumes than the DEIS counts for the northbound approach of Boston Post Road at Orienta Avenue, so the volumes in the new analysis were increased by the difference. Volumes at the intersection of Boston Post Road were revised to reflect that Cooper Avenue is now proposed to be an emergency-only access.

The pedestrian counts were collected when there was activity at the school, including the ice rink and pool. A substantial number of pedestrians and bicyclists were recorded. To present a conservative analysis representative of times of higher pedestrian activity, all pedestrian and bicyclist volumes were doubled for the new analysis.

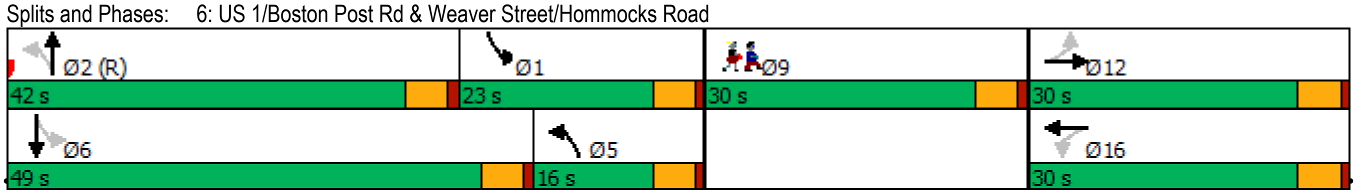
The new analysis shows that the pedestrian volumes have only a very minor impact on vehicular delay. There is no significant difference between the delays reported in the DEIS and the new analysis, which is provided in the table. The intersection of Boston Post Road at Hommocks Road/Weaver Street operates with an exclusive pedestrian signal phase, therefore it is not expected that an increase in pedestrian volumes would significantly affect vehicular delay.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	73	152	52	56	145	33	84	584	136	177	507	65
Future Volume (vph)	73	152	52	56	145	33	84	584	136	177	507	65
Satd. Flow (prot)	1687	1650	0	1652	1549	0	1602	3258	0	1604	3208	0
Flt Permitted	0.439			0.380			0.176			0.098		
Satd. Flow (perm)	632	1650	0	610	1549	0	290	3258	0	165	3208	0
Satd. Flow (RTOR)												
Confl. Peds. (#/hr)	300		100	100		300	64		26	26		64
Confl. Bikes (#/hr)									4			4
Peak Hour Factor	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Heavy Vehicles (%)	7%	3%	2%	2%	4%	6%	10%	4%	3%	5%	6%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	97	272	0	75	237	0	112	960	0	236	763	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		12			16		5	2		1	6	
Permitted Phases	12			16			2			6		
Total Split (s)	30.0	30.0		30.0	30.0		16.0	42.0		23.0	49.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Act Effct Green (s)	32.2	32.2		32.2	32.2		46.8	37.0		58.8	44.0	
Actuated g/C Ratio	0.26	0.26		0.26	0.26		0.37	0.30		0.47	0.35	
v/c Ratio	0.60	0.64		0.48	0.60		0.53	1.00		0.87	0.68	
Control Delay	62.7	52.7		56.7	51.5		42.0	72.0		76.2	38.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	62.7	52.7		56.7	51.5		42.0	72.0		76.2	38.1	
LOS	E	D		E	D		D	E		E	D	
Approach Delay		55.3			52.8			68.9			47.1	
Approach LOS		E			D			E			D	
Queue Length 50th (ft)	75	213		56	183		49	407		138	274	
Queue Length 95th (ft)	#126	253		91	223		70	387		179	271	
Internal Link Dist (ft)		190			209			263			1683	
Turn Bay Length (ft)	145			150			180			140		
Base Capacity (vph)	162	425		157	398		226	964		286	1129	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.60	0.64		0.48	0.60		0.50	1.00		0.83	0.68	

Intersection Summary

Cycle Length: 125
Actuated Cycle Length: 125
Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.00
Intersection Signal Delay: 57.3 Intersection LOS: E
Intersection Capacity Utilization 63.4% ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6: US 1/Boston Post Rd & Weaver Street/Hommocks Road

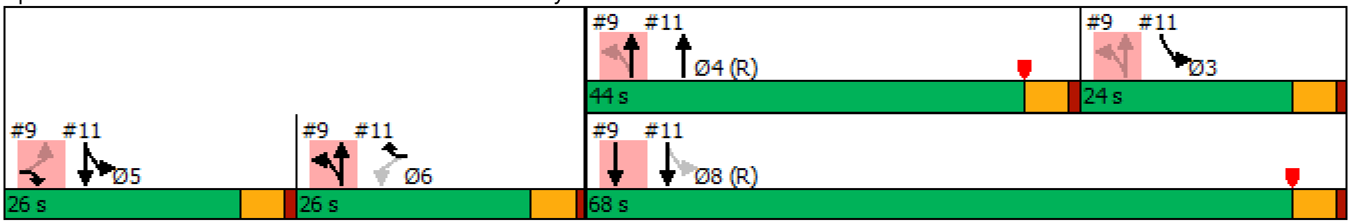


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø3	Ø4
Lane Configurations								
Traffic Volume (vph)	27	168	81	772	877	14		
Future Volume (vph)	27	168	81	772	877	14		
Satd. Flow (prot)	1736	1599	0	3487	3025	0		
Flt Permitted	0.950			0.835				
Satd. Flow (perm)	1730	1599	0	2922	3025	0		
Satd. Flow (RTOR)		189						
Confl. Peds. (#/hr)	2		22			22		
Confl. Bikes (#/hr)						10		
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89		
Heavy Vehicles (%)	4%	1%	3%	3%	4%	8%		
Parking (#/hr)					5			
Shared Lane Traffic (%)								
Lane Group Flow (vph)	30	189	0	958	1001	0		
Turn Type	Perm	Prot	custom	NA	NA			
Protected Phases		5	6	6 4	8		3	4
Permitted Phases	5		3 4	3				
Total Split (s)	26.0	26.0	26.0		68.0		24.0	44.0
Total Lost Time (s)	5.0	5.0			5.0			
Act Effct Green (s)	17.8	17.8		87.2	63.0			
Actuated g/C Ratio	0.15	0.15		0.73	0.52			
v/c Ratio	0.12	0.48		0.39	0.63			
Control Delay	43.6	10.3		1.3	22.5			
Queue Delay	0.0	0.1		0.4	0.8			
Total Delay	43.6	10.4		1.7	23.3			
LOS	D	B		A	C			
Approach Delay	15.0			1.7	23.3			
Approach LOS	B			A	C			
Queue Length 50th (ft)	20	0		22	278			
Queue Length 95th (ft)	47	62		18	343			
Internal Link Dist (ft)	246			90	543			
Turn Bay Length (ft)		70						
Base Capacity (vph)	302	435		2444	1588			
Starvation Cap Reductn	0	0		863	211			
Spillback Cap Reductn	0	17		0	295			
Storage Cap Reductn	0	0		0	0			
Reduced v/c Ratio	0.10	0.45		0.61	0.77			

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 69 (58%), Referenced to phase 4:NBTL and 8:SBT, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 13.0 Intersection LOS: B
Intersection Capacity Utilization 64.2% ICU Level of Service C
Analysis Period (min) 15

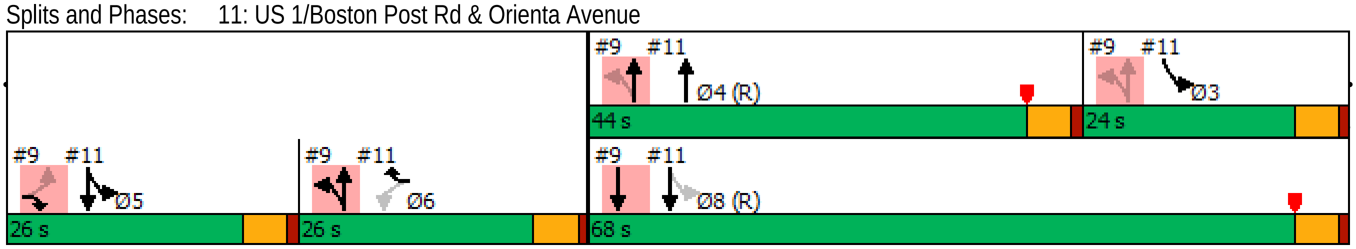
Splits and Phases: 9: US 1/Boston Post Rd & Delancey Ave



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø3	Ø5	Ø8
Lane Configurations									
Traffic Volume (vph)	79	220	633	123	362	682			
Future Volume (vph)	79	220	633	123	362	682			
Satd. Flow (prot)	1601	1501	3375	0	1648	1757			
Flt Permitted	0.950				0.168				
Satd. Flow (perm)	1579	1501	3375	0	291	1757			
Satd. Flow (RTOR)		247							
Confl. Peds. (#/hr)	8			16	16				
Confl. Bikes (#/hr)				2					
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89			
Heavy Vehicles (%)	9%	4%	3%	11%	9%	4%			
Shared Lane Traffic (%)									
Lane Group Flow (vph)	89	247	849	0	407	766			
Turn Type	Perm	Prot	NA		custom	NA			
Protected Phases		6	4		3 5	5 8	3	5	8
Permitted Phases	6				8				
Total Split (s)	26.0	26.0	44.0				24.0	26.0	68.0
Total Lost Time (s)	5.0	5.0	5.0						
Act Effct Green (s)	24.2	24.2	39.0		85.8	85.8			
Actuated g/C Ratio	0.20	0.20	0.32		0.72	0.72			
v/c Ratio	0.28	0.49	0.77		0.60	0.61			
Control Delay	44.8	9.0	42.3		22.4	4.5			
Queue Delay	0.0	0.0	0.0		26.1	0.5			
Total Delay	44.8	9.0	42.3		48.4	4.9			
LOS	D	A	D		D	A			
Approach Delay	18.5		42.3			20.0			
Approach LOS	B		D			C			
Queue Length 50th (ft)	60	0	311		212	58			
Queue Length 95th (ft)	111	70	384		310	56			
Internal Link Dist (ft)	450		2270			90			
Turn Bay Length (ft)									
Base Capacity (vph)	318	500	1096		724	1303			
Starvation Cap Reductn	0	0	0		321	185			
Spillback Cap Reductn	0	0	0		0	0			
Storage Cap Reductn	0	0	0		0	0			
Reduced v/c Ratio	0.28	0.49	0.77		1.01	0.69			

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 69 (58%), Referenced to phase 4:NBTL and 8:SBT, Start of Yellow	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.77	
Intersection Signal Delay: 27.8	Intersection LOS: C
Intersection Capacity Utilization 58.6%	ICU Level of Service B
Analysis Period (min) 15	

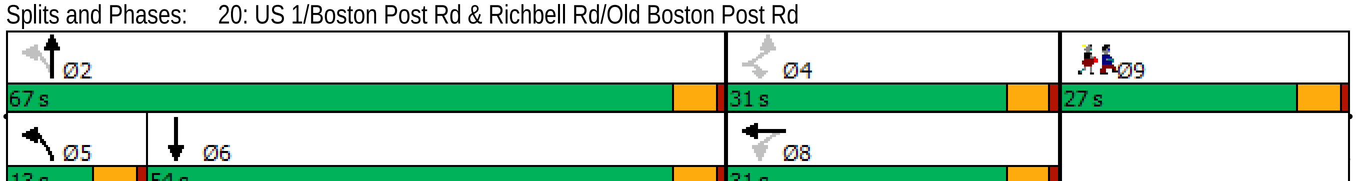
Splits and Phases: 11: US 1/Boston Post Rd & Orienta Avenue



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	96	0	93	86	65	68	96	813	0	0	675	65
Future Volume (vph)	96	0	93	86	65	68	96	813	0	0	675	65
Satd. Flow (prot)	1736	0	1568	1678	1667	0	1646	3271	0	0	3266	0
Flt Permitted	0.596			0.950			0.172					
Satd. Flow (perm)	1066	0	1500	1624	1667	0	290	3271	0	0	3266	0
Satd. Flow (RTOR)												
Confl. Peds. (#/hr)	20		22	22		20	120					120
Confl. Bikes (#/hr)												8
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Heavy Vehicles (%)	4%	2%	3%	4%	3%	3%	6%	3%	2%	2%	4%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	113	0	109	101	156	0	113	956	0	0	870	0
Turn Type	Perm		Perm	Perm	NA		pm+pt	NA			NA	
Protected Phases					8		5	2			6	
Permitted Phases	4		4	8			2					
Total Split (s)	31.0		31.0	31.0	31.0		13.0	67.0			54.0	
Total Lost Time (s)	5.0		5.0	5.0	5.0		5.0	5.0			5.0	
Act Effct Green (s)	17.0		17.0	17.0	17.0		43.4	43.4			33.5	
Actuated g/C Ratio	0.20		0.20	0.20	0.20		0.51	0.51			0.39	
v/c Ratio	0.54		0.37	0.31	0.47		0.38	0.58			0.68	
Control Delay	49.8		41.9	40.5	43.5		18.9	18.8			28.7	
Queue Delay	0.0		0.0	0.0	0.0		0.0	0.0			0.0	
Total Delay	49.8		41.9	40.5	43.5		18.9	18.8			28.7	
LOS	D		D	D	D		B	B			C	
Approach Delay		45.9			42.3			18.8			28.7	
Approach LOS		D			D			B			C	
Queue Length 50th (ft)	69		64	59	94		41	237			264	
Queue Length 95th (ft)	136		125	116	169		78	320			348	
Internal Link Dist (ft)		483			489			1683			2270	
Turn Bay Length (ft)			140	100			175					
Base Capacity (vph)	412		579	627	644		308	2395			2090	
Starvation Cap Reductn	0		0	0	0		0	0			0	
Spillback Cap Reductn	0		0	0	0		0	0			0	
Storage Cap Reductn	0		0	0	0		0	0			0	
Reduced v/c Ratio	0.27		0.19	0.16	0.24		0.37	0.40			0.42	

Intersection Summary
Cycle Length: 125
Actuated Cycle Length: 85.5
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 27.4 Intersection LOS: C
Intersection Capacity Utilization 57.2% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 20: US 1/Boston Post Rd & Richbell Rd/Old Boston Post Rd

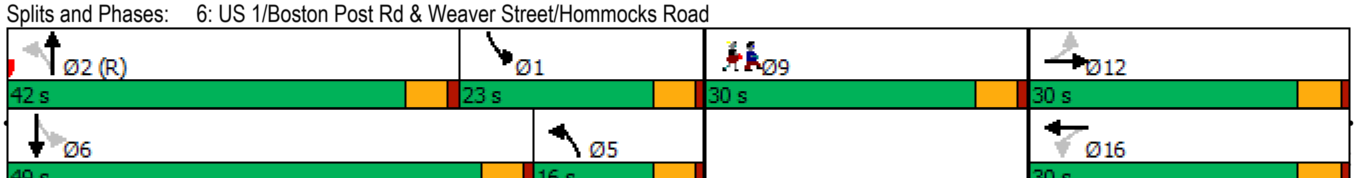


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	73	153	52	76	150	34	84	584	140	177	507	65
Future Volume (vph)	73	153	52	76	150	34	84	584	140	177	507	65
Satd. Flow (prot)	1687	1651	0	1652	1550	0	1602	3254	0	1604	3208	0
Flt Permitted	0.425			0.379			0.176			0.098		
Satd. Flow (perm)	616	1651	0	609	1550	0	290	3254	0	165	3208	0
Satd. Flow (RTOR)												
Confl. Peds. (#/hr)	300		100	100		300	64		26	26		64
Confl. Bikes (#/hr)									4			4
Peak Hour Factor	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Heavy Vehicles (%)	7%	3%	2%	2%	4%	6%	10%	4%	3%	5%	6%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	97	273	0	101	245	0	112	966	0	236	763	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		12			16		5	2		1	6	
Permitted Phases	12			16			2			6		
Total Split (s)	30.0	30.0		30.0	30.0		16.0	42.0		23.0	49.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Act Effct Green (s)	32.2	32.2		32.2	32.2		46.8	37.0		58.8	44.0	
Actuated g/C Ratio	0.26	0.26		0.26	0.26		0.37	0.30		0.47	0.35	
v/c Ratio	0.61	0.64		0.65	0.61		0.53	1.00		0.87	0.68	
Control Delay	64.0	52.8		66.7	52.2		42.0	73.8		76.2	38.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	64.0	52.8		66.7	52.2		42.0	73.8		76.2	38.1	
LOS	E	D		E	D		D	E		E	D	
Approach Delay		55.7			56.5			70.5			47.1	
Approach LOS		E			E			E			D	
Queue Length 50th (ft)	75	214		79	190		49	~413		138	274	
Queue Length 95th (ft)	#128	253		#138	230		70	390		179	271	
Internal Link Dist (ft)		190			209			263			1683	
Turn Bay Length (ft)	145			150			180			140		
Base Capacity (vph)	158	425		156	399		226	963		286	1129	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.61	0.64		0.65	0.61		0.50	1.00		0.83	0.68	

Intersection Summary

Cycle Length: 125
Actuated Cycle Length: 125
Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.00
Intersection Signal Delay: 58.4 Intersection LOS: E
Intersection Capacity Utilization 64.5% ICU Level of Service C
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6: US 1/Boston Post Rd & Weaver Street/Hommocks Road

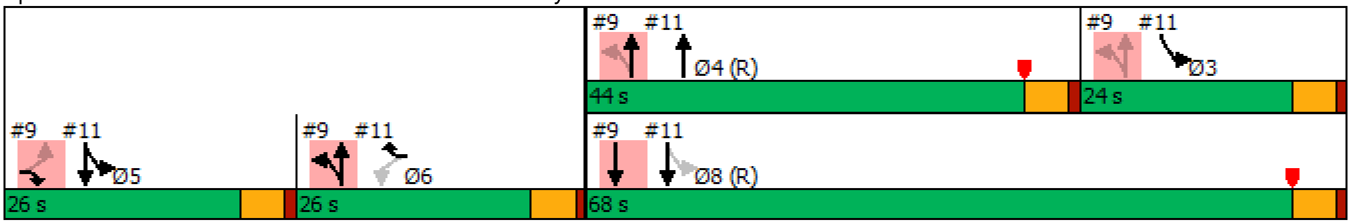


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø3	Ø4
Lane Configurations								
Traffic Volume (vph)	27	169	86	787	880	14		
Future Volume (vph)	27	169	86	787	880	14		
Satd. Flow (prot)	1736	1599	0	3487	3025	0		
Flt Permitted	0.950			0.818				
Satd. Flow (perm)	1730	1599	0	2863	3025	0		
Satd. Flow (RTOR)		190						
Confl. Peds. (#/hr)	2		22			22		
Confl. Bikes (#/hr)						10		
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89		
Heavy Vehicles (%)	4%	1%	3%	3%	4%	8%		
Parking (#/hr)					5			
Shared Lane Traffic (%)								
Lane Group Flow (vph)	30	190	0	981	1005	0		
Turn Type	Perm	Prot	custom	NA	NA			
Protected Phases		5	6	6 4	8		3	4
Permitted Phases	5		3 4	3				
Total Split (s)	26.0	26.0	26.0		68.0		24.0	44.0
Total Lost Time (s)	5.0	5.0			5.0			
Act Effct Green (s)	17.8	17.8		87.2	63.0			
Actuated g/C Ratio	0.15	0.15		0.73	0.52			
v/c Ratio	0.12	0.48		0.40	0.63			
Control Delay	43.6	10.3		1.4	22.5			
Queue Delay	0.0	0.1		0.4	0.9			
Total Delay	43.6	10.4		1.8	23.4			
LOS	D	B		A	C			
Approach Delay	14.9			1.8	23.4			
Approach LOS	B			A	C			
Queue Length 50th (ft)	20	0		24	281			
Queue Length 95th (ft)	47	61		21	345			
Internal Link Dist (ft)	246			90	543			
Turn Bay Length (ft)		70						
Base Capacity (vph)	302	436		2435	1588			
Starvation Cap Reductn	0	0		846	210			
Spillback Cap Reductn	0	18		0	298			
Storage Cap Reductn	0	0		0	0			
Reduced v/c Ratio	0.10	0.45		0.62	0.78			

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 69 (58%), Referenced to phase 4:NBTL and 8:SBT, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 12.9 Intersection LOS: B
Intersection Capacity Utilization 64.9% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 9: US 1/Boston Post Rd & Delancey Ave

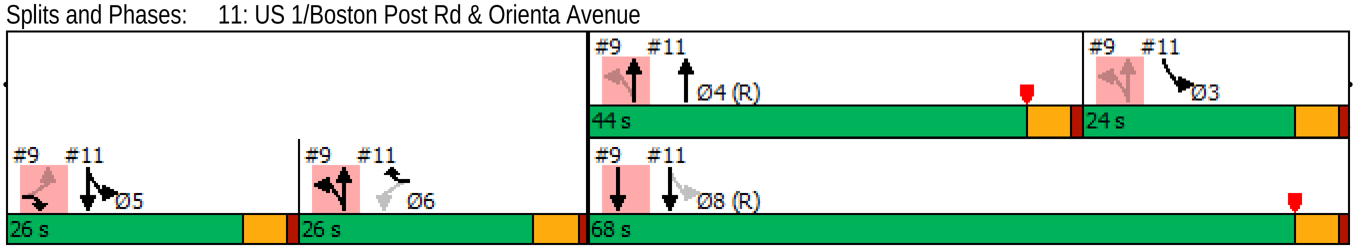


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø3	Ø5	Ø8
Lane Configurations									
Traffic Volume (vph)	79	239	634	123	367	682			
Future Volume (vph)	79	239	634	123	367	682			
Satd. Flow (prot)	1601	1501	3375	0	1648	1757			
Flt Permitted	0.950				0.168				
Satd. Flow (perm)	1579	1501	3375	0	291	1757			
Satd. Flow (RTOR)		269							
Confl. Peds. (#/hr)	8			16	16				
Confl. Bikes (#/hr)				2					
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89			
Heavy Vehicles (%)	9%	4%	3%	11%	9%	4%			
Shared Lane Traffic (%)									
Lane Group Flow (vph)	89	269	850	0	412	766			
Turn Type	Perm	Prot	NA		custom	NA			
Protected Phases		6	4		3 5	5 8	3	5	8
Permitted Phases	6				8				
Total Split (s)	26.0	26.0	44.0				24.0	26.0	68.0
Total Lost Time (s)	5.0	5.0	5.0						
Act Effct Green (s)	24.2	24.2	39.0		85.8	85.8			
Actuated g/C Ratio	0.20	0.20	0.32		0.72	0.72			
v/c Ratio	0.28	0.52	0.78		0.61	0.61			
Control Delay	44.8	9.0	42.4		22.6	4.4			
Queue Delay	0.0	0.0	0.0		27.9	0.5			
Total Delay	44.8	9.0	42.4		50.5	4.9			
LOS	D	A	D		D	A			
Approach Delay	17.9		42.4			20.8			
Approach LOS	B		D			C			
Queue Length 50th (ft)	60	0	311		216	57			
Queue Length 95th (ft)	111	73	384		317	54			
Internal Link Dist (ft)	450		2270			90			
Turn Bay Length (ft)									
Base Capacity (vph)	318	517	1096		724	1303			
Starvation Cap Reductn	0	0	0		319	185			
Spillback Cap Reductn	0	0	0		0	0			
Storage Cap Reductn	0	0	0		0	0			
Reduced v/c Ratio	0.28	0.52	0.78		1.02	0.69			

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 69 (58%), Referenced to phase 4:NBTL and 8:SBT, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 28.1 Intersection LOS: C
Intersection Capacity Utilization 58.9% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 11: US 1/Boston Post Rd & Orienta Avenue



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	97	0	93	86	67	68	79	814	0	0	675	65
Future Volume (vph)	97	0	93	86	67	68	79	814	0	0	675	65
Satd. Flow (prot)	1736	0	1568	1678	1672	0	1646	3271	0	0	3266	0
Flt Permitted	0.589			0.950			0.172					
Satd. Flow (perm)	1053	0	1500	1624	1672	0	290	3271	0	0	3266	0
Satd. Flow (RTOR)												
Confl. Peds. (#/hr)	20		22	22		20	120					120
Confl. Bikes (#/hr)												8
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Heavy Vehicles (%)	4%	2%	3%	4%	3%	3%	6%	3%	2%	2%	4%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	114	0	109	101	159	0	93	958	0	0	870	0
Turn Type	Perm		Perm	Perm	NA		pm+pt	NA			NA	
Protected Phases					8		5	2			6	
Permitted Phases	4		4	8			2					
Total Split (s)	31.0		31.0	31.0	31.0		13.0	67.0			54.0	
Total Lost Time (s)	5.0		5.0	5.0	5.0		5.0	5.0			5.0	
Act Effct Green (s)	17.2		17.2	17.2	17.2		43.4	43.4			33.5	
Actuated g/C Ratio	0.20		0.20	0.20	0.20		0.51	0.51			0.39	
v/c Ratio	0.54		0.36	0.31	0.47		0.32	0.58			0.68	
Control Delay	49.9		41.7	40.4	43.4		18.1	19.0			28.8	
Queue Delay	0.0		0.0	0.0	0.0		0.0	0.0			0.0	
Total Delay	49.9		41.7	40.4	43.4		18.1	19.0			28.8	
LOS	D		D	D	D		B	B			C	
Approach Delay		45.9			42.2			18.9			28.8	
Approach LOS		D			D			B			C	
Queue Length 50th (ft)	70		64	59	96		33	240			265	
Queue Length 95th (ft)	137		125	116	172		66	320			348	
Internal Link Dist (ft)		483			489			1683			2270	
Turn Bay Length (ft)			140	100			175					
Base Capacity (vph)	406		579	627	645		307	2392			2089	
Starvation Cap Reductn	0		0	0	0		0	0			0	
Spillback Cap Reductn	0		0	0	0		0	0			0	
Storage Cap Reductn	0		0	0	0		0	0			0	
Reduced v/c Ratio	0.28		0.19	0.16	0.25		0.30	0.40			0.42	

Intersection Summary

Cycle Length: 125

Actuated Cycle Length: 85.7

Control Type: Semi Act-Uncoord

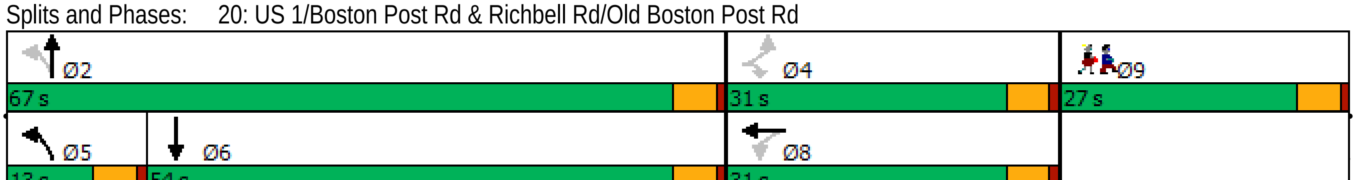
Maximum v/c Ratio: 0.68

Intersection Signal Delay: 27.5 Intersection LOS: C

Intersection Capacity Utilization 56.4% ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 20: US 1/Boston Post Rd & Richbell Rd/Old Boston Post Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	116	81	91	54	78	34	147	704	51	61	783	106
Future Volume (vph)	116	81	91	54	78	34	147	704	51	61	783	106
Satd. Flow (prot)	1770	1588	0	1652	1635	0	1745	3410	0	1668	3299	0
Flt Permitted	0.640			0.534			0.132			0.195		
Satd. Flow (perm)	1128	1588	0	909	1635	0	240	3410	0	340	3299	0
Satd. Flow (RTOR)												
Confl. Peds. (#/hr)	42		20	20		42	44		22	22		44
Confl. Bikes (#/hr)			6									6
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	1%	6%	2%	1%	1%	1%	2%	2%	1%	3%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	129	191	0	60	125	0	163	839	0	68	988	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		12			16		5	2		1	6	
Permitted Phases	12			16			2			6		
Total Split (s)	30.0	30.0		30.0	30.0		18.0	63.0		13.0	58.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Act Effct Green (s)	39.7	39.7		39.7	39.7		68.3	59.1		59.3	53.0	
Actuated g/C Ratio	0.29	0.29		0.29	0.29		0.50	0.43		0.44	0.39	
v/c Ratio	0.39	0.41		0.23	0.26		0.69	0.57		0.32	0.77	
Control Delay	49.1	47.5		47.2	44.6		56.4	31.0		26.4	41.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	49.1	47.5		47.2	44.6		56.4	31.0		26.4	41.1	
LOS	D	D		D	D		E	C		C	D	
Approach Delay		48.1			45.5			35.1			40.1	
Approach LOS		D			D			D			D	
Queue Length 50th (ft)	104	155		46	97		76	293		30	396	
Queue Length 95th (ft)	181	245		94	164		118	360		55	483	
Internal Link Dist (ft)		190			209			263			1683	
Turn Bay Length (ft)	145			150			180			140		
Base Capacity (vph)	328	463		265	476		269	1482		230	1285	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.39	0.41		0.23	0.26		0.61	0.57		0.30	0.77	

Intersection Summary

Cycle Length: 136

Actuated Cycle Length: 136

Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green

Control Type: Actuated-Coordinated

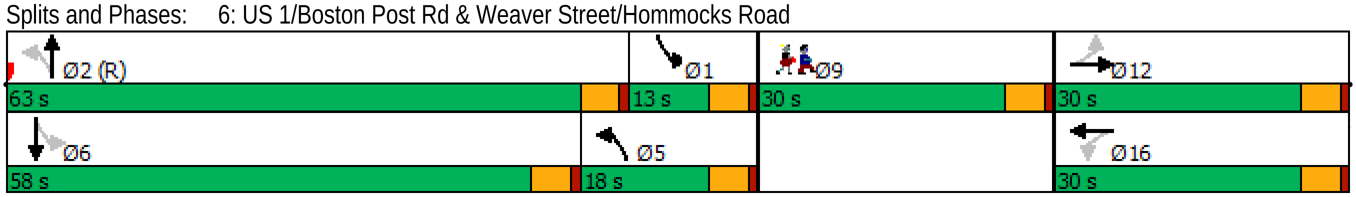
Maximum v/c Ratio: 0.77

Intersection Signal Delay: 39.5 Intersection LOS: D

Intersection Capacity Utilization 64.5% ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 6: US 1/Boston Post Rd & Weaver Street/Hommocks Road

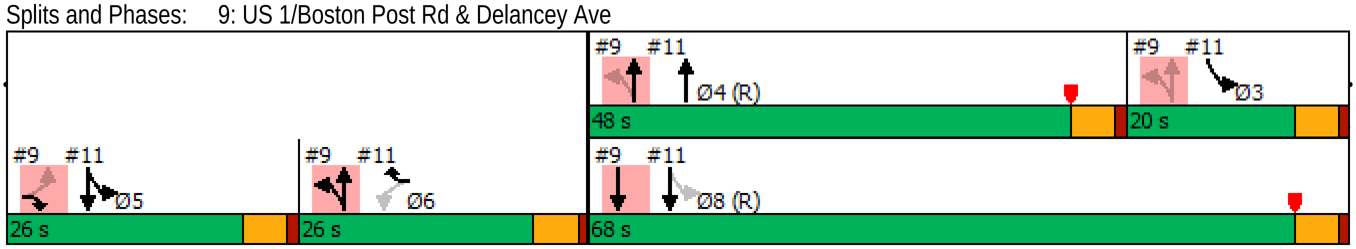


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø3	Ø4
Lane Configurations								
Traffic Volume (vph)	14	57	93	881	919	25		
Future Volume (vph)	14	57	93	881	919	25		
Satd. Flow (prot)	1787	1583	0	3486	2991	0		
Flt Permitted	0.950			0.840				
Satd. Flow (perm)	1756	1583	0	2938	2991	0		
Satd. Flow (RTOR)		61						
Confl. Peds. (#/hr)	10		22			22		
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93		
Heavy Vehicles (%)	1%	2%	13%	2%	5%	4%		
Parking (#/hr)					5			
Shared Lane Traffic (%)								
Lane Group Flow (vph)	15	61	0	1047	1015	0		
Turn Type	Perm	Prot	custom	NA	NA			
Protected Phases		5	6	6 4	8		3	4
Permitted Phases	5		3 4	3				
Total Split (s)	26.0	26.0	26.0		68.0		20.0	48.0
Total Lost Time (s)	5.0	5.0			5.0			
Act Effct Green (s)	15.8	15.8		89.2	63.0			
Actuated g/C Ratio	0.13	0.13		0.74	0.52			
v/c Ratio	0.06	0.23		0.42	0.65			
Control Delay	43.7	12.8		1.1	22.9			
Queue Delay	0.0	0.0		0.3	0.5			
Total Delay	43.7	12.8		1.5	23.4			
LOS	D	B		A	C			
Approach Delay	18.9			1.5	23.4			
Approach LOS	B			A	C			
Queue Length 50th (ft)	10	0		20	286			
Queue Length 95th (ft)	30	38		19	359			
Internal Link Dist (ft)	246			90	543			
Turn Bay Length (ft)		70						
Base Capacity (vph)	307	327		2521	1570			
Starvation Cap Reductn	0	0		812	197			
Spillback Cap Reductn	0	2		0	125			
Storage Cap Reductn	0	0		0	0			
Reduced v/c Ratio	0.05	0.19		0.61	0.74			

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 69 (58%), Referenced to phase 4:NBTL and 8:SBT, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 12.5 | Intersection LOS: B
Intersection Capacity Utilization 69.1% | ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 9: US 1/Boston Post Rd & Delancey Ave



No-Build | PM Peak Hour

11: US 1/Boston Post Rd & Orienta Avenue

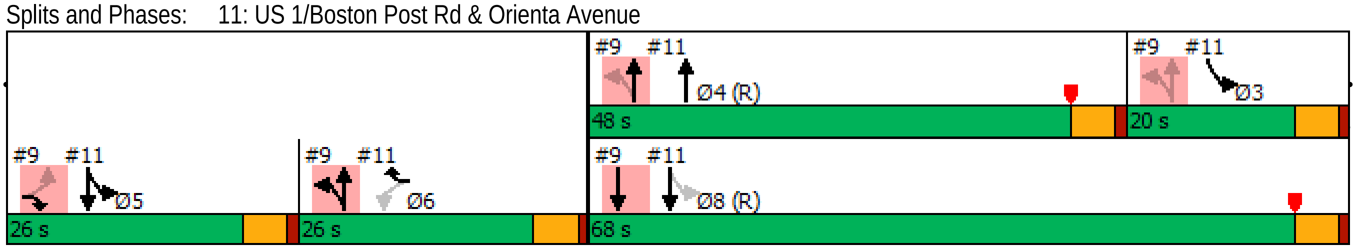
08/22/2018

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø3	Ø5	Ø8
Lane Configurations									
Traffic Volume (vph)	73	234	740	140	197	774			
Future Volume (vph)	73	234	740	140	197	774			
Satd. Flow (prot)	1694	1487	3449	0	1710	1757			
Flt Permitted	0.950				0.148				
Satd. Flow (perm)	1648	1487	3449	0	266	1757			
Satd. Flow (RTOR)		252							
Confl. Peds. (#/hr)	16			14	14				
Confl. Bikes (#/hr)				2					
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93			
Heavy Vehicles (%)	3%	5%	2%	3%	5%	4%			
Shared Lane Traffic (%)									
Lane Group Flow (vph)	78	252	947	0	212	832			
Turn Type	Perm	Prot	NA		custom	NA			
Protected Phases		6	4		3 5	5 8	3	5	8
Permitted Phases	6				8				
Total Split (s)	26.0	26.0	48.0				20.0	26.0	68.0
Total Lost Time (s)	5.0	5.0	5.0						
Act Effct Green (s)	26.2	26.2	43.0		83.8	83.8			
Actuated g/C Ratio	0.22	0.22	0.36		0.70	0.70			
v/c Ratio	0.22	0.48	0.77		0.34	0.68			
Control Delay	42.3	8.6	39.1		13.6	7.4			
Queue Delay	0.0	0.0	0.0		6.5	0.9			
Total Delay	42.3	8.6	39.1		20.1	8.3			
LOS	D	A	D		C	A			
Approach Delay	16.6		39.1			10.7			
Approach LOS	B		D			B			
Queue Length 50th (ft)	50	0	338		67	168			
Queue Length 95th (ft)	100	75	420		138	226			
Internal Link Dist (ft)	450		2270			90			
Turn Bay Length (ft)									
Base Capacity (vph)	359	521	1235		690	1303			
Starvation Cap Reductn	0	0	0		420	219			
Spillback Cap Reductn	0	0	0		0	0			
Storage Cap Reductn	0	0	0		0	0			
Reduced v/c Ratio	0.22	0.48	0.77		0.79	0.77			

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 69 (58%), Referenced to phase 4:NBTL and 8:SBT, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 23.1 | Intersection LOS: C
Intersection Capacity Utilization 53.1% | ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 11: US 1/Boston Post Rd & Orienta Avenue

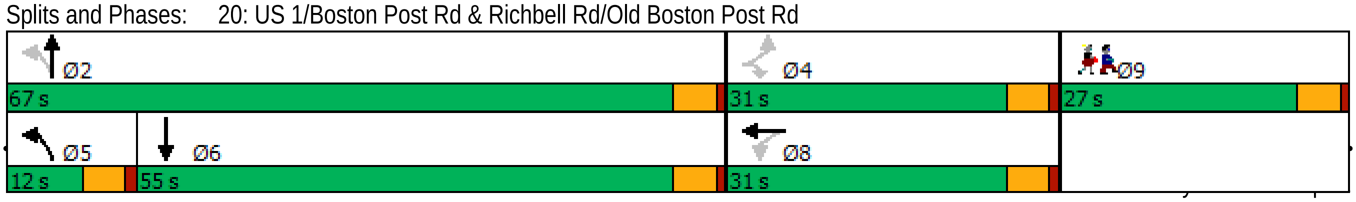


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	98	0	91	107	41	56	78	797	0	0	858	96
Future Volume (vph)	98	0	91	107	41	56	78	797	0	0	858	96
Satd. Flow (prot)	1787	0	1599	1728	1644	0	1728	3303	0	0	3277	0
Flt Permitted	0.688			0.950			0.137					
Satd. Flow (perm)	1241	0	1535	1678	1644	0	247	3303	0	0	3277	0
Satd. Flow (RTOR)												
Confl. Peds. (#/hr)	34		20	20		34	52					52
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	1%	0%	1%	1%	3%	1%	1%	2%	2%	2%	4%	4%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	108	0	100	118	107	0	86	876	0	0	1048	0
Turn Type	Perm		Perm	Perm	NA		pm+pt	NA			NA	
Protected Phases					8		5	2			6	
Permitted Phases	4		4	8			2					
Total Split (s)	31.0		31.0	31.0	31.0		12.0	67.0			55.0	
Total Lost Time (s)	5.0		5.0	5.0	5.0		5.0	5.0			5.0	
Act Effct Green (s)	14.7		14.7	14.7	14.7		45.2	45.2			35.7	
Actuated g/C Ratio	0.19		0.19	0.19	0.19		0.57	0.57			0.45	
v/c Ratio	0.47		0.35	0.38	0.35		0.29	0.47			0.71	
Control Delay	44.5		40.1	40.1	39.7		14.2	13.5			24.5	
Queue Delay	0.0		0.0	0.0	0.0		0.0	0.0			0.0	
Total Delay	44.5		40.1	40.1	39.7		14.2	13.5			24.5	
LOS	D		D	D	D		B	B			C	
Approach Delay		42.4			39.9			13.5			24.5	
Approach LOS		D			D			B			C	
Queue Length 50th (ft)	37		34	40	36		10	72			161	
Queue Length 95th (ft)	137		124	142	130		63	297			463	
Internal Link Dist (ft)		483			489			1683			2270	
Turn Bay Length (ft)	140			100			175					
Base Capacity (vph)	498		615	672	659		300	2646			2290	
Starvation Cap Reductn	0		0	0	0		0	0			0	
Spillback Cap Reductn	0		0	0	0		0	0			0	
Storage Cap Reductn	0		0	0	0		0	0			0	
Reduced v/c Ratio	0.22		0.16	0.18	0.16		0.29	0.33			0.46	

Intersection Summary

Cycle Length: 125
Actuated Cycle Length: 79.4
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.71
Intersection Signal Delay: 23.1 Intersection LOS: C
Intersection Capacity Utilization 56.6% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 20: US 1/Boston Post Rd & Richbell Rd/Old Boston Post Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	116	86	91	63	80	35	147	704	70	62	783	106
Future Volume (vph)	116	86	91	63	80	35	147	704	70	62	783	106
Satd. Flow (prot)	1770	1594	0	1652	1635	0	1745	3393	0	1668	3299	0
Flt Permitted	0.635			0.525			0.132			0.185		
Satd. Flow (perm)	1120	1594	0	894	1635	0	240	3393	0	323	3299	0
Satd. Flow (RTOR)												
Confl. Peds. (#/hr)	42		20	20		42	44		22	22		44
Confl. Bikes (#/hr)			6									6
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	1%	6%	2%	1%	1%	1%	2%	2%	1%	3%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	129	197	0	70	128	0	163	860	0	69	988	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		12			16		5	2		1	6	
Permitted Phases	12			16			2			6		
Total Split (s)	30.0	30.0		30.0	30.0		18.0	63.0		13.0	58.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Act Effct Green (s)	39.7	39.7		39.7	39.7		68.3	59.1		59.3	53.0	
Actuated g/C Ratio	0.29	0.29		0.29	0.29		0.50	0.43		0.44	0.39	
v/c Ratio	0.40	0.42		0.27	0.27		0.69	0.58		0.34	0.77	
Control Delay	49.2	47.7		48.0	44.8		56.4	31.4		27.5	41.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	49.2	47.7		48.0	44.8		56.4	31.4		27.5	41.1	
LOS	D	D		D	D		E	C		C	D	
Approach Delay		48.3			45.9			35.4			40.2	
Approach LOS		D			D			D			D	
Queue Length 50th (ft)	104	161		54	99		76	303		31	396	
Queue Length 95th (ft)	181	252		108	168		118	371		55	483	
Internal Link Dist (ft)		190			209			263			1683	
Turn Bay Length (ft)	145			150			180			140		
Base Capacity (vph)	326	464		260	476		269	1474		223	1285	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.40	0.42		0.27	0.27		0.61	0.58		0.31	0.77	

Intersection Summary

Cycle Length: 136

Actuated Cycle Length: 136

Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green

Control Type: Actuated-Coordinated

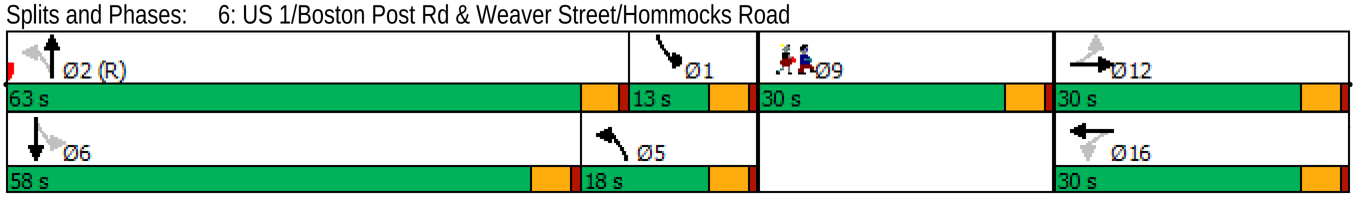
Maximum v/c Ratio: 0.77

Intersection Signal Delay: 39.7 Intersection LOS: D

Intersection Capacity Utilization 64.8% ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 6: US 1/Boston Post Rd & Weaver Street/Hommocks Road

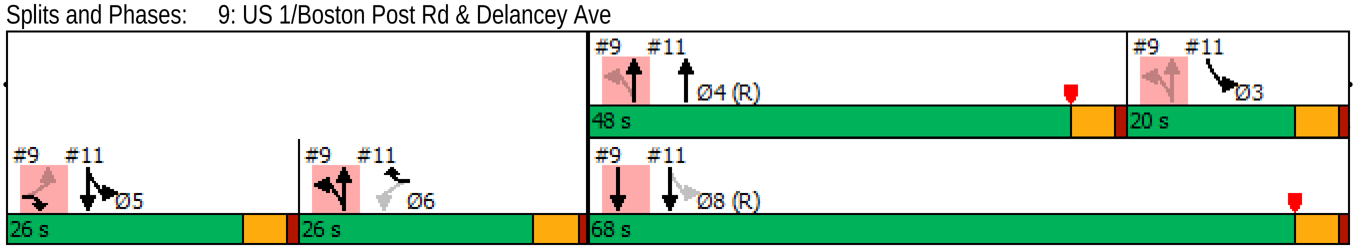


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø3	Ø4
Lane Configurations								
Traffic Volume (vph)	14	62	96	888	934	25		
Future Volume (vph)	14	62	96	888	934	25		
Satd. Flow (prot)	1787	1583	0	3485	2991	0		
Flt Permitted	0.950			0.829				
Satd. Flow (perm)	1756	1583	0	2899	2991	0		
Satd. Flow (RTOR)		67						
Confl. Peds. (#/hr)	10		22			22		
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93		
Heavy Vehicles (%)	1%	2%	13%	2%	5%	4%		
Parking (#/hr)					5			
Shared Lane Traffic (%)								
Lane Group Flow (vph)	15	67	0	1058	1031	0		
Turn Type	Perm	Prot	custom	NA	NA			
Protected Phases		5	6	6 4	8		3	4
Permitted Phases	5		3 4	3				
Total Split (s)	26.0	26.0	26.0		68.0		20.0	48.0
Total Lost Time (s)	5.0	5.0			5.0			
Act Effct Green (s)	16.0	16.0		89.0	63.0			
Actuated g/C Ratio	0.13	0.13		0.74	0.52			
v/c Ratio	0.06	0.25		0.42	0.66			
Control Delay	43.4	12.5		1.2	23.2			
Queue Delay	0.0	0.0		0.4	0.5			
Total Delay	43.4	12.5		1.5	23.7			
LOS	D	B		A	C			
Approach Delay	18.1			1.5	23.7			
Approach LOS	B			A	C			
Queue Length 50th (ft)	10	0		20	293			
Queue Length 95th (ft)	30	40		20	367			
Internal Link Dist (ft)	246			90	543			
Turn Bay Length (ft)		70						
Base Capacity (vph)	307	332		2510	1570			
Starvation Cap Reductn	0	0		800	195			
Spillback Cap Reductn	0	3		0	145			
Storage Cap Reductn	0	0		0	0			
Reduced v/c Ratio	0.05	0.20		0.62	0.75			

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 69 (58%), Referenced to phase 4:NBTL and 8:SBT, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 12.7 Intersection LOS: B
Intersection Capacity Utilization 69.8% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 9: US 1/Boston Post Rd & Delancey Ave

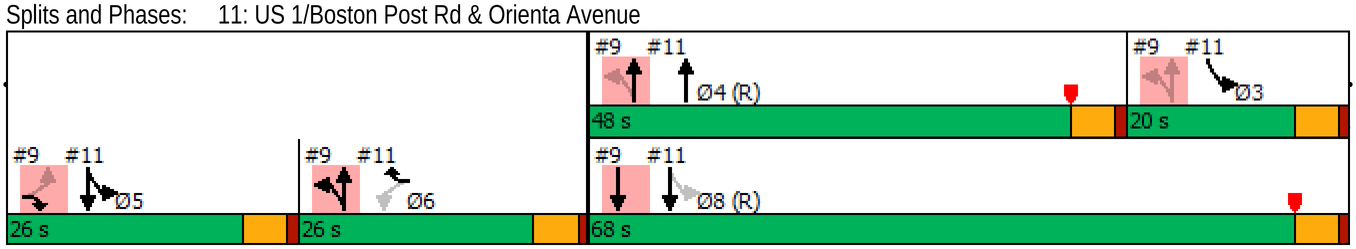


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø3	Ø5	Ø8
Lane Configurations									
Traffic Volume (vph)	73	243	741	144	217	774			
Future Volume (vph)	73	243	741	144	217	774			
Satd. Flow (prot)	1694	1487	3449	0	1710	1757			
Flt Permitted	0.950				0.146				
Satd. Flow (perm)	1648	1487	3449	0	263	1757			
Satd. Flow (RTOR)		261							
Confl. Peds. (#/hr)	16			14	14				
Confl. Bikes (#/hr)				2					
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93			
Heavy Vehicles (%)	3%	5%	2%	3%	5%	4%			
Shared Lane Traffic (%)									
Lane Group Flow (vph)	78	261	952	0	233	832			
Turn Type	Perm	Prot	NA		custom	NA			
Protected Phases		6	4		3 5	5 8	3	5	8
Permitted Phases	6				8				
Total Split (s)	26.0	26.0	48.0				20.0	26.0	68.0
Total Lost Time (s)	5.0	5.0	5.0						
Act Effct Green (s)	26.0	26.0	43.0		84.0	84.0			
Actuated g/C Ratio	0.22	0.22	0.36		0.70	0.70			
v/c Ratio	0.22	0.50	0.77		0.38	0.68			
Control Delay	42.6	8.7	39.2		15.1	7.2			
Queue Delay	0.0	0.0	0.0		8.6	0.9			
Total Delay	42.6	8.7	39.2		23.6	8.0			
LOS	D	A	D		C	A			
Approach Delay	16.5		39.2			11.4			
Approach LOS	B		D			B			
Queue Length 50th (ft)	50	0	341		82	156			
Queue Length 95th (ft)	100	76	423		159	209			
Internal Link Dist (ft)	450		2270			90			
Turn Bay Length (ft)									
Base Capacity (vph)	356	526	1235		689	1303			
Starvation Cap Reductn	0	0	0		411	216			
Spillback Cap Reductn	0	0	0		0	0			
Storage Cap Reductn	0	0	0		0	0			
Reduced v/c Ratio	0.22	0.50	0.77		0.84	0.77			

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 69 (58%), Referenced to phase 4:NBTL and 8:SBT, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 23.4 Intersection LOS: C
Intersection Capacity Utilization 53.9% ICU Level of Service A
Analysis Period (min) 15

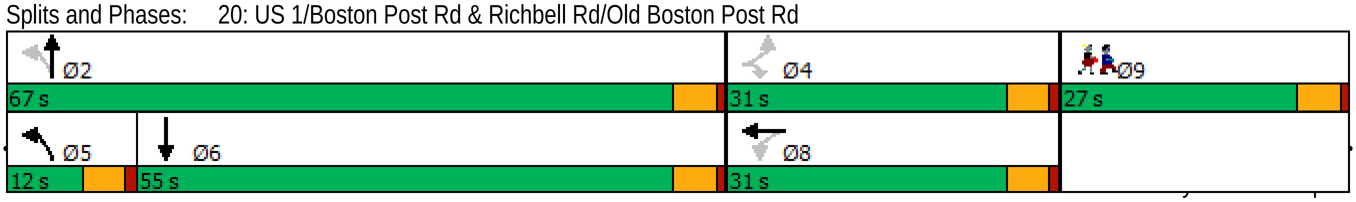
Splits and Phases: 11: US 1/Boston Post Rd & Orienta Avenue



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	102	0	92	107	42	56	79	797	0	0	858	96
Future Volume (vph)	102	0	92	107	42	56	79	797	0	0	858	96
Satd. Flow (prot)	1787	0	1599	1728	1646	0	1728	3303	0	0	3277	0
Flt Permitted	0.687			0.950			0.136					
Satd. Flow (perm)	1239	0	1535	1678	1646	0	245	3303	0	0	3277	0
Satd. Flow (RTOR)												
Confl. Peds. (#/hr)	34		20	20		34	52					52
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	1%	0%	1%	1%	3%	1%	1%	2%	2%	2%	4%	4%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	112	0	101	118	108	0	87	876	0	0	1048	0
Turn Type	Perm		Perm	Perm	NA		pm+pt	NA			NA	
Protected Phases					8		5	2			6	
Permitted Phases	4		4	8			2					
Total Split (s)	31.0		31.0	31.0	31.0		12.0	67.0			55.0	
Total Lost Time (s)	5.0		5.0	5.0	5.0		5.0	5.0			5.0	
Act Effct Green (s)	15.1		15.1	15.1	15.1		45.4	45.4			35.9	
Actuated g/C Ratio	0.19		0.19	0.19	0.19		0.57	0.57			0.45	
v/c Ratio	0.48		0.35	0.37	0.35		0.30	0.47			0.71	
Control Delay	44.6		39.9	39.8	39.4		14.5	13.7			24.8	
Queue Delay	0.0		0.0	0.0	0.0		0.0	0.0			0.0	
Total Delay	44.6		39.9	39.8	39.4		14.5	13.7			24.8	
LOS	D		D	D	D		B	B			C	
Approach Delay		42.4			39.6			13.8			24.8	
Approach LOS		D			D			B			C	
Queue Length 50th (ft)	39		34	40	37		11	74			163	
Queue Length 95th (ft)	141		124	142	131		65	301			467	
Internal Link Dist (ft)		483			489			1683			2270	
Turn Bay Length (ft)	140			100			175					
Base Capacity (vph)	493		611	668	655		298	2636			2278	
Starvation Cap Reductn	0		0	0	0		0	0			0	
Spillback Cap Reductn	0		0	0	0		0	0			0	
Storage Cap Reductn	0		0	0	0		0	0			0	
Reduced v/c Ratio	0.23		0.17	0.18	0.16		0.29	0.33			0.46	

Intersection Summary	
Cycle Length: 125	
Actuated Cycle Length: 80	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.71	
Intersection Signal Delay: 23.3	Intersection LOS: C
Intersection Capacity Utilization 56.7%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 20: US 1/Boston Post Rd & Richbell Rd/Old Boston Post Rd

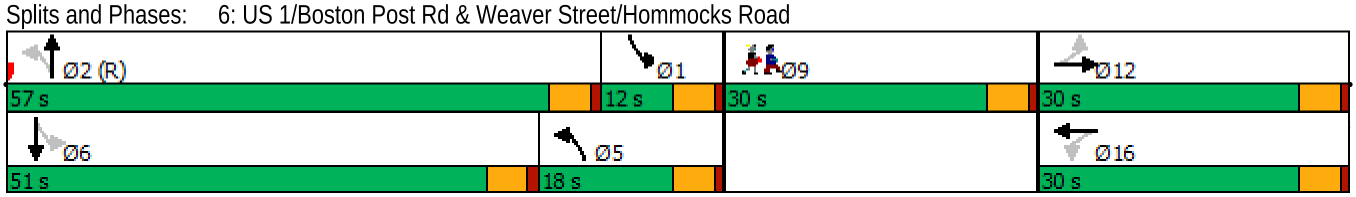


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	150	61	122	41	61	46	149	799	61	47	731	147
Future Volume (vph)	150	61	122	41	61	46	149	799	61	47	731	147
Satd. Flow (prot)	1787	1567	0	1668	1624	0	1745	3431	0	1668	3304	0
Flt Permitted	0.668			0.545			0.141			0.147		
Satd. Flow (perm)	1241	1567	0	930	1624	0	255	3431	0	255	3304	0
Satd. Flow (RTOR)												
Confl. Peds. (#/hr)	10		28	28		10	62		48	48		62
Confl. Bikes (#/hr)									4			10
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	1%	1%	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	156	191	0	43	112	0	155	896	0	49	914	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		12			16		5	2		1	6	
Permitted Phases	12			16			2			6		
Total Split (s)	30.0	30.0		30.0	30.0		18.0	57.0		12.0	51.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Act Effct Green (s)	39.2	39.2		39.2	39.2		61.8	52.9		52.0	46.0	
Actuated g/C Ratio	0.30	0.30		0.30	0.30		0.48	0.41		0.40	0.36	
v/c Ratio	0.41	0.40		0.15	0.23		0.63	0.64		0.29	0.78	
Control Delay	45.8	44.1		43.1	41.1		50.0	33.2		28.3	42.4	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	45.8	44.1		43.1	41.1		50.0	33.2		28.3	42.4	
LOS	D	D		D	D		D	C		C	D	
Approach Delay		44.9			41.7			35.6			41.7	
Approach LOS		D			D			D			D	
Queue Length 50th (ft)	120	146		30	81		71	314		21	355	
Queue Length 95th (ft)	202	232		68	141		113	387		43	438	
Internal Link Dist (ft)		190			209			263			1683	
Turn Bay Length (ft)	145			150			180			140		
Base Capacity (vph)	377	476		282	493		276	1407		181	1178	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.41	0.40		0.15	0.23		0.56	0.64		0.27	0.78	

Intersection Summary

Cycle Length: 129
Actuated Cycle Length: 129
Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 39.6 Intersection LOS: D
Intersection Capacity Utilization 66.3% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 6: US 1/Boston Post Rd & Weaver Street/Hommocks Road

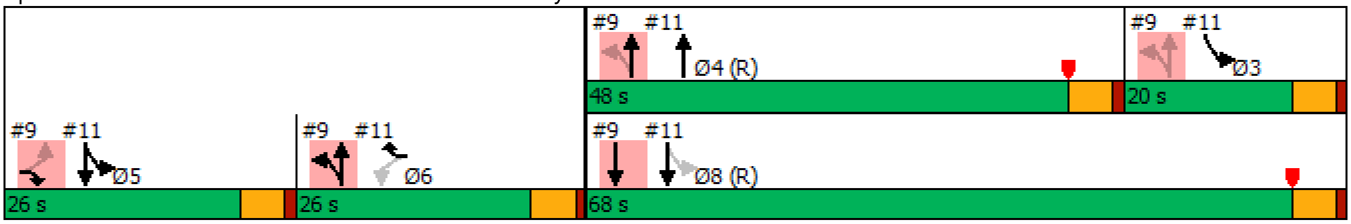


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø3	Ø4
Lane Configurations								
Traffic Volume (vph)	18	65	44	970	840	25		
Future Volume (vph)	18	65	44	970	840	25		
Satd. Flow (prot)	1787	1599	0	3567	3051	0		
Flt Permitted	0.950			0.955				
Satd. Flow (perm)	1714	1599	0	3410	3051	0		
Satd. Flow (RTOR)		68						
Confl. Peds. (#/hr)	24		32					
Confl. Bikes (#/hr)						14		
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95		
Heavy Vehicles (%)	1%	1%	1%	1%	3%	4%		
Parking (#/hr)					5			
Shared Lane Traffic (%)								
Lane Group Flow (vph)	19	68	0	1067	910	0		
Turn Type	Perm	Prot	custom	NA	NA			
Protected Phases		5	6	6 4	8		3	4
Permitted Phases	5		3 4	3				
Total Split (s)	26.0	26.0	26.0		68.0		20.0	48.0
Total Lost Time (s)	5.0	5.0			5.0			
Act Effct Green (s)	14.5	14.5		90.5	63.0			
Actuated g/C Ratio	0.12	0.12		0.75	0.52			
v/c Ratio	0.09	0.27		0.40	0.57			
Control Delay	45.3	13.0		0.9	21.0			
Queue Delay	0.0	0.0		0.5	0.2			
Total Delay	45.3	13.0		1.3	21.2			
LOS	D	B		A	C			
Approach Delay	20.1			1.3	21.2			
Approach LOS	C			A	C			
Queue Length 50th (ft)	13	0		12	242			
Queue Length 95th (ft)	35	40		13	304			
Internal Link Dist (ft)	246			90	543			
Turn Bay Length (ft)		70						
Base Capacity (vph)	299	335		2669	1601			
Starvation Cap Reductn	0	0		1015	0			
Spillback Cap Reductn	0	2		0	137			
Storage Cap Reductn	0	0		0	0			
Reduced v/c Ratio	0.06	0.20		0.65	0.62			

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 69 (58%), Referenced to phase 4:NBTL and 8:SBT, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.82
Intersection Signal Delay: 10.9 — Intersection LOS: B
Intersection Capacity Utilization 67.9% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 9: US 1/Boston Post Rd & Delancey Ave



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø3	Ø5	Ø8
Lane Configurations									
Traffic Volume (vph)	51	157	857	131	192	713			
Future Volume (vph)	51	157	857	131	192	713			
Satd. Flow (prot)	1711	1516	3497	0	1710	1809			
Flt Permitted	0.950				0.111				
Satd. Flow (perm)	1687	1516	3497	0	200	1809			
Satd. Flow (RTOR)		165	16						
Confl. Peds. (#/hr)	8			22	22				
Confl. Bikes (#/hr)				6					
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95			
Heavy Vehicles (%)	2%	3%	1%	1%	5%	1%			
Shared Lane Traffic (%)									
Lane Group Flow (vph)	54	165	1040	0	202	751			
Turn Type	Perm	Prot	NA		custom	NA			
Protected Phases		6	4		3 5	5 8	3	5	8
Permitted Phases	6				8				
Total Split (s)	26.0	26.0	48.0				20.0	26.0	68.0
Total Lost Time (s)	5.0	5.0	5.0						
Act Effct Green (s)	27.5	27.5	43.0		82.5	82.5			
Actuated g/C Ratio	0.23	0.23	0.36		0.69	0.69			
v/c Ratio	0.14	0.35	0.82		0.35	0.60			
Control Delay	40.4	8.5	41.1		17.6	5.5			
Queue Delay	0.0	0.0	0.0		2.5	0.4			
Total Delay	40.4	8.5	41.1		20.1	5.9			
LOS	D	A	D		C	A			
Approach Delay	16.4		41.1			8.9			
Approach LOS	B		D			A			
Queue Length 50th (ft)	33	0	377		75	115			
Queue Length 95th (ft)	74	60	465		148	150			
Internal Link Dist (ft)	450		2270			90			
Turn Bay Length (ft)									
Base Capacity (vph)	386	474	1263		664	1341			
Starvation Cap Reductn	0	0	0		343	205			
Spillback Cap Reductn	0	0	0		0	0			
Storage Cap Reductn	0	0	0		0	0			
Reduced v/c Ratio	0.14	0.35	0.82		0.63	0.66			

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 69 (58%), Referenced to phase 4:NBTL and 8:SBT, Start of Yellow

Control Type: Actuated-Coordinated

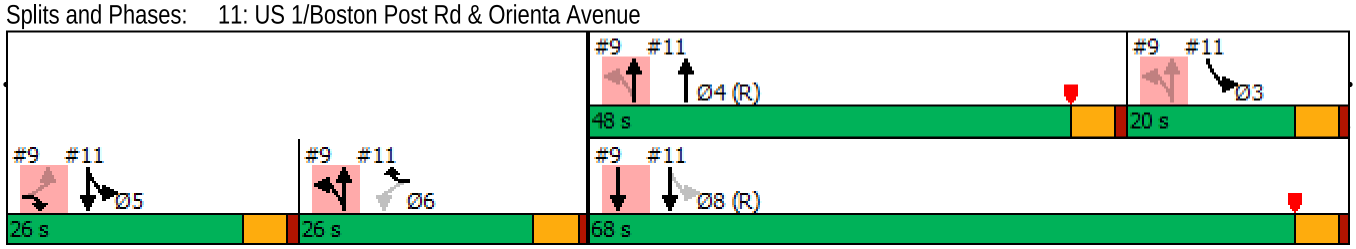
Maximum v/c Ratio: 0.82

Intersection Signal Delay: 24.8 Intersection LOS: C

Intersection Capacity Utilization 54.6% ICU Level of Service A

Analysis Period (min) 15

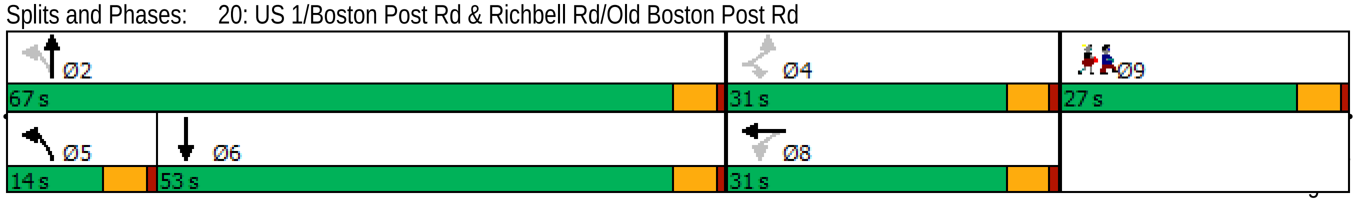
Splits and Phases: 11: US 1/Boston Post Rd & Orienta Avenue



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰		↱	↰	↱		↰	↑↑			↑↱	
Traffic Volume (vph)	116	0	122	106	56	71	86	838	0	0	729	102
Future Volume (vph)	116	0	122	106	56	71	86	838	0	0	729	102
Satd. Flow (prot)	1787	0	1568	1728	1654	0	1728	3336	0	0	3361	0
Flt Permitted	0.669			0.950			0.172					
Satd. Flow (perm)	1230	0	1531	1708	1654	0	310	3336	0	0	3361	0
Satd. Flow (RTOR)			128		46						14	
Confl. Peds. (#/hr)	20		8	8		20	38					38
Confl. Bikes (#/hr)									10			10
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	1%	2%	3%	1%	4%	2%	1%	1%	2%	2%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	122	0	128	112	134	0	91	882	0	0	874	0
Turn Type	Perm		Perm	Perm	NA		pm+pt	NA			NA	
Protected Phases					8		5	2			6	
Permitted Phases	4		4	8			2					
Total Split (s)	31.0		31.0	31.0	31.0		14.0	67.0			53.0	
Total Lost Time (s)	5.0		5.0	5.0	5.0		5.0	5.0			5.0	
Act Effct Green (s)	16.0		16.0	16.0	16.0		41.0	41.0			30.4	
Actuated g/C Ratio	0.21		0.21	0.21	0.21		0.53	0.53			0.40	
v/c Ratio	0.48		0.30	0.31	0.35		0.27	0.49			0.65	
Control Delay	41.8		9.7	36.3	26.8		14.7	14.8			24.8	
Queue Delay	0.0		0.0	0.0	0.0		0.0	0.0			0.0	
Total Delay	41.8		9.7	36.3	26.8		14.7	14.8			24.8	
LOS	D		A	D	C		B	B			C	
Approach Delay		25.3			31.1			14.8			24.8	
Approach LOS		C			C			B			C	
Queue Length 50th (ft)	39		0	35	27		12	75			131	
Queue Length 95th (ft)	152		52	133	120		69	311			375	
Internal Link Dist (ft)		483			489			1683			2270	
Turn Bay Length (ft)			140	100			175					
Base Capacity (vph)	524		726	728	731		374	2707			2356	
Starvation Cap Reductn	0		0	0	0		0	0			0	
Spillback Cap Reductn	0		0	0	0		0	0			0	
Storage Cap Reductn	0		0	0	0		0	0			0	
Reduced v/c Ratio	0.23		0.18	0.15	0.18		0.24	0.33			0.37	

Intersection Summary	
Cycle Length: 125	
Actuated Cycle Length: 76.7	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.65	
Intersection Signal Delay: 21.4	Intersection LOS: C
Intersection Capacity Utilization 60.0%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 20: US 1/Boston Post Rd & Richbell Rd/Old Boston Post Rd

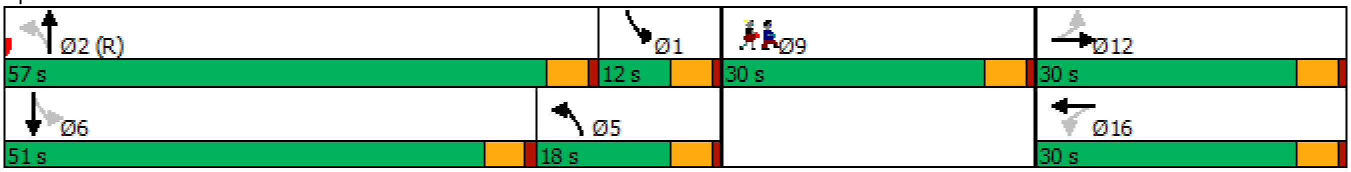


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	150	64	122	52	64	46	149	799	74	48	731	147
Future Volume (vph)	150	64	122	52	64	46	149	799	74	48	731	147
Satd. Flow (prot)	1787	1572	0	1668	1627	0	1745	3420	0	1668	3304	0
Flt Permitted	0.663			0.541			0.141			0.141		
Satd. Flow (perm)	1231	1572	0	923	1627	0	255	3420	0	244	3304	0
Satd. Flow (RTOR)												
Confl. Peds. (#/hr)	10		28	28		10	62		48	48		62
Confl. Bikes (#/hr)									4			10
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	1%	1%	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	156	194	0	54	115	0	155	909	0	50	914	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		12			16		5	2		1	6	
Permitted Phases	12			16			2			6		
Total Split (s)	30.0	30.0		30.0	30.0		18.0	57.0		12.0	51.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Act Effct Green (s)	39.2	39.2		39.2	39.2		61.8	52.9		52.0	46.0	
Actuated g/C Ratio	0.30	0.30		0.30	0.30		0.48	0.41		0.40	0.36	
v/c Ratio	0.42	0.41		0.19	0.23		0.63	0.65		0.30	0.78	
Control Delay	45.9	44.2		43.6	41.2		50.0	33.5		29.3	42.4	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	45.9	44.2		43.6	41.2		50.0	33.5		29.3	42.4	
LOS	D	D		D	D		D	C		C	D	
Approach Delay		45.0			42.0			35.9			41.7	
Approach LOS		D			D			D			D	
Queue Length 50th (ft)	120	149		39	83		71	321		22	355	
Queue Length 95th (ft)	#202	236		81	144		113	395		44	438	
Internal Link Dist (ft)		190			209			263			1683	
Turn Bay Length (ft)	145			150			180			140		
Base Capacity (vph)	374	478		280	494		276	1402		177	1178	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.42	0.41		0.19	0.23		0.56	0.65		0.28	0.78	

Intersection Summary

Cycle Length: 129
Actuated Cycle Length: 129
Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 39.8 Intersection LOS: D
Intersection Capacity Utilization 66.5% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6: US 1/Boston Post Rd & Weaver Street/Hommocks Road

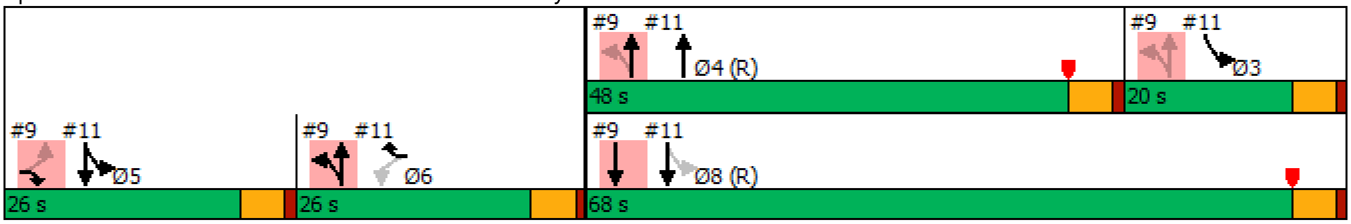


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø3	Ø4
Lane Configurations								
Traffic Volume (vph)	18	68	46	978	850	25		
Future Volume (vph)	18	68	46	978	850	25		
Satd. Flow (prot)	1787	1599	0	3567	3051	0		
Flt Permitted	0.950			0.955				
Satd. Flow (perm)	1714	1599	0	3410	3051	0		
Satd. Flow (RTOR)		72						
Confl. Peds. (#/hr)	24		32					
Confl. Bikes (#/hr)						14		
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95		
Heavy Vehicles (%)	1%	1%	1%	1%	3%	4%		
Parking (#/hr)					5			
Shared Lane Traffic (%)								
Lane Group Flow (vph)	19	72	0	1077	921	0		
Turn Type	Perm	Prot	custom	NA	NA			
Protected Phases		5	6	6 4	8		3	4
Permitted Phases	5		3 4	3				
Total Split (s)	26.0	26.0	26.0		68.0		20.0	48.0
Total Lost Time (s)	5.0	5.0			5.0			
Act Effct Green (s)	14.8	14.8		90.2	63.0			
Actuated g/C Ratio	0.12	0.12		0.75	0.52			
v/c Ratio	0.09	0.28		0.40	0.58			
Control Delay	45.2	12.7		0.9	21.2			
Queue Delay	0.0	0.0		0.5	0.2			
Total Delay	45.2	12.8		1.4	21.4			
LOS	D	B		A	C			
Approach Delay	19.5			1.4	21.4			
Approach LOS	B			A	C			
Queue Length 50th (ft)	13	0		13	245			
Queue Length 95th (ft)	35	41		14	310			
Internal Link Dist (ft)	246			90	543			
Turn Bay Length (ft)		70						
Base Capacity (vph)	299	339		2662	1601			
Starvation Cap Reductn	0	0		1002	0			
Spillback Cap Reductn	0	3		0	174			
Storage Cap Reductn	0	0		0	0			
Reduced v/c Ratio	0.06	0.21		0.65	0.65			

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 69 (58%), Referenced to phase 4:NBTL and 8:SBT, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.83
Intersection Signal Delay: 11.0 Intersection LOS: B
Intersection Capacity Utilization 68.5% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 9: US 1/Boston Post Rd & Delancey Ave

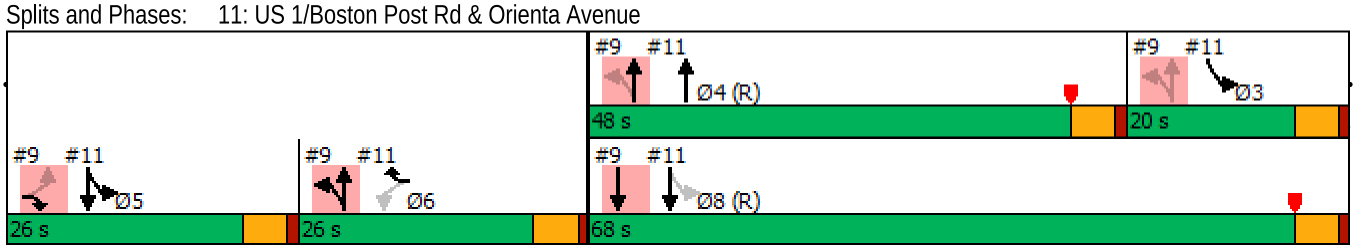


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø3	Ø5	Ø8
Lane Configurations									
Traffic Volume (vph)	51	168	857	133	206	713			
Future Volume (vph)	51	168	857	133	206	713			
Satd. Flow (prot)	1711	1516	3496	0	1710	1809			
Flt Permitted	0.950				0.110				
Satd. Flow (perm)	1687	1516	3496	0	198	1809			
Satd. Flow (RTOR)		177	16						
Confl. Peds. (#/hr)	8			22	22				
Confl. Bikes (#/hr)				6					
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95			
Heavy Vehicles (%)	2%	3%	1%	1%	5%	1%			
Shared Lane Traffic (%)									
Lane Group Flow (vph)	54	177	1042	0	217	751			
Turn Type	Perm	Prot	NA		custom	NA			
Protected Phases		6	4		3 5	5 8	3	5	8
Permitted Phases	6				8				
Total Split (s)	26.0	26.0	48.0				20.0	26.0	68.0
Total Lost Time (s)	5.0	5.0	5.0						
Act Effct Green (s)	27.2	27.2	43.0		82.8	82.8			
Actuated g/C Ratio	0.23	0.23	0.36		0.69	0.69			
v/c Ratio	0.14	0.37	0.83		0.38	0.60			
Control Delay	40.5	8.4	41.2		18.7	5.4			
Queue Delay	0.0	0.0	0.0		2.7	0.4			
Total Delay	40.5	8.4	41.2		21.4	5.8			
LOS	D	A	D		C	A			
Approach Delay	15.9		41.2			9.3			
Approach LOS	B		D			A			
Queue Length 50th (ft)	33	0	378		87	108			
Queue Length 95th (ft)	75	62	467		164	140			
Internal Link Dist (ft)	450		2270			90			
Turn Bay Length (ft)									
Base Capacity (vph)	383	481	1263		663	1341			
Starvation Cap Reductn	0	0	0		333	204			
Spillback Cap Reductn	0	0	0		0	0			
Storage Cap Reductn	0	0	0		0	0			
Reduced v/c Ratio	0.14	0.37	0.83		0.66	0.66			

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 69 (58%), Referenced to phase 4:NBTL and 8:SBT, Start of Yellow
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.83
Intersection Signal Delay: 24.8 Intersection LOS: C
Intersection Capacity Utilization 55.5% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 11: US 1/Boston Post Rd & Orienta Avenue



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	119	0	123	106	57	71	88	839	0	0	729	102
Future Volume (vph)	119	0	123	106	57	71	88	839	0	0	729	102
Satd. Flow (prot)	1787	0	1568	1728	1655	0	1728	3336	0	0	3361	0
Flt Permitted	0.667			0.950			0.171					
Satd. Flow (perm)	1226	0	1531	1708	1655	0	308	3336	0	0	3361	0
Satd. Flow (RTOR)			129		45						14	
Confl. Peds. (#/hr)	20		8	8		20	38					38
Confl. Bikes (#/hr)									10			10
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	1%	2%	3%	1%	4%	2%	1%	1%	2%	2%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	125	0	129	112	135	0	93	883	0	0	874	0
Turn Type	Perm		Perm	Perm	NA		pm+pt	NA			NA	
Protected Phases					8		5	2			6	
Permitted Phases	4		4	8			2					
Total Split (s)	31.0		31.0	31.0	31.0		14.0	67.0			53.0	
Total Lost Time (s)	5.0		5.0	5.0	5.0		5.0	5.0			5.0	
Act Effct Green (s)	16.2		16.2	16.2	16.2		41.2	41.2			30.4	
Actuated g/C Ratio	0.21		0.21	0.21	0.21		0.54	0.54			0.39	
v/c Ratio	0.48		0.30	0.31	0.35		0.27	0.50			0.65	
Control Delay	42.1		9.6	36.2	27.0		14.8	14.9			24.9	
Queue Delay	0.0		0.0	0.0	0.0		0.0	0.0			0.0	
Total Delay	42.1		9.6	36.2	27.0		14.8	14.9			24.9	
LOS	D		A	D	C		B	B			C	
Approach Delay		25.6			31.2			14.9			24.9	
Approach LOS		C			C			B			C	
Queue Length 50th (ft)	40		0	35	28		12	76			132	
Queue Length 95th (ft)	155		52	133	123		70	311			375	
Internal Link Dist (ft)		483			489			1683			2270	
Turn Bay Length (ft)			140	100			175					
Base Capacity (vph)	520		723	724	727		373	2705			2347	
Starvation Cap Reductn	0		0	0	0		0	0			0	
Spillback Cap Reductn	0		0	0	0		0	0			0	
Storage Cap Reductn	0		0	0	0		0	0			0	
Reduced v/c Ratio	0.24		0.18	0.15	0.19		0.25	0.33			0.37	

Intersection Summary

Cycle Length: 125

Actuated Cycle Length: 77

Control Type: Semi Act-Uncoord

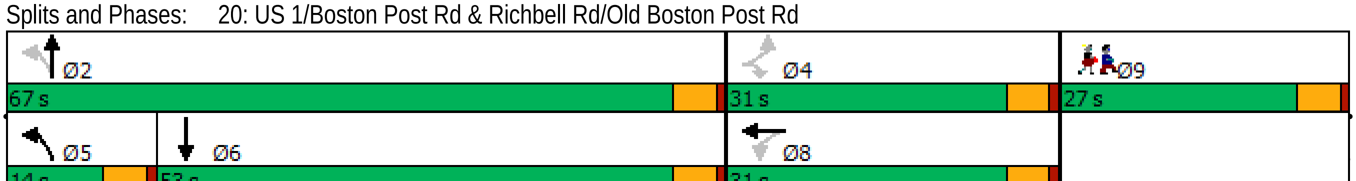
Maximum v/c Ratio: 0.65

Intersection Signal Delay: 21.5 Intersection LOS: C

Intersection Capacity Utilization 60.4% ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 20: US 1/Boston Post Rd & Richbell Rd/Old Boston Post Rd



Kimley-Horn of New York, P.C.

FEIS Chapter M Appendix Response to Comment M18 Surrounding Street Truck Activity

Comment M.18

Traffic Databank

716 S Sixth Ave
Mount Vernon, NY 10550

Site Code:
Station ID:
SB BOSTON POST RD S OF ORIENTA AVE
MAMARONECK,NY
Latitude: 0' 0.0000 Undefined

SB

Start Time	Motor	Cars Trailer	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Doubl	5 Axle Doubl	>6 Axl Doubl	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Bicycl	Not Class	Total	
03/10/16	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
01:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
02:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
03:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
04:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
05:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
06:00	0	126	37	2	2	0	0	2	1	0	1	0	0	0	0	171	
07:00	0	498	148	3	17	0	0	6	0	0	0	0	0	1	0	673	
08:00	0	431	127	1	14	0	0	6	0	0	0	0	0	0	0	579	
09:00	0	424	125	1	13	0	0	2	0	0	0	0	0	1	0	566	
10:00	0	403	119	0	16	0	0	7	0	0	0	0	0	0	0	545	
11:00	0	459	137	1	21	0	0	6	0	0	0	0	0	0	0	624	27
12 PM	0	426	127	1	13	0	0	9	0	0	0	0	0	1	0	577	
13:00	0	418	124	2	17	0	0	6	0	0	0	0	0	0	0	567	
14:00	0	501	149	4	18	0	0	10	1	0	0	0	0	0	0	683	
15:00	0	475	142	0	16	0	0	8	0	0	0	0	0	0	0	641	
16:00	0	690	206	1	24	0	0	10	0	0	0	0	0	0	0	931	
17:00	0	609	181	1	22	0	0	14	0	0	0	1	0	0	0	828	37
18:00	0	453	135	0	12	0	0	12	0	0	1	0	0	1	0	614	
19:00	0	344	102	0	14	0	0	4	0	0	0	0	0	1	0	465	
20:00	0	232	69	0	5	0	0	5	0	0	0	0	0	0	0	311	
21:00	0	164	48	0	4	0	0	3	0	0	0	0	0	0	0	219	
22:00	0	102	30	0	0	0	0	1	0	0	0	0	0	0	0	133	
23:00	0	52	15	0	0	0	0	0	0	0	0	0	0	0	0	67	
Total	0	6807	2021	17	228	0	0	111	2	0	2	1	0	5	0	9194	
Percent	0.0%	74.0%	22.0%	0.2%	2.5%	0.0%	0.0%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%		

Comment M.18

Traffic Databank

716 S Sixth Ave
Mount Vernon, NY 10550

Site Code:
Station ID:
NB BOSTON POST RD S OF ORIENTA AVE
MAMARONECK,NY
Latitude: 0' 0.0000 Undefined

NB

Start Time	Motor	Cars Trailer	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Doubl	5 Axle Doubl	>6 Axl Doubl	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Bicycl	Not Class	Total	
03/10/16	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
01:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
02:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
03:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
04:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
05:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
06:00	0	156	60	0	6	0	0	5	0	0	0	0	0	0	0	227	
07:00	0	355	136	0	16	0	0	12	1	1	0	0	0	0	0	521	
08:00	0	530	203	0	21	0	0	16	0	0	1	0	0	0	0	771	
09:00	0	427	164	0	20	0	0	10	0	1	0	0	0	0	0	622	
10:00	0	409	156	0	19	0	0	15	0	0	0	0	0	1	0	600	
11:00	0	497	191	0	21	0	0	16	0	1	0	0	0	0	0	726	38
12 PM	0	461	176	0	18	0	0	11	0	0	0	0	0	1	0	667	
13:00	0	467	180	0	17	0	0	14	0	0	1	0	0	0	0	679	
14:00	0	511	195	0	21	0	0	16	0	0	0	0	0	0	0	743	
15:00	0	589	226	0	25	0	0	17	1	0	3	0	0	1	0	862	
16:00	0	539	205	0	20	0	0	17	0	0	0	1	0	0	0	782	
17:00	0	523	199	0	23	0	0	15	0	1	0	0	0	0	0	761	39
18:00	0	481	183	0	17	0	0	13	0	0	0	0	1	0	0	695	
19:00	0	387	148	0	20	0	0	12	0	0	1	0	0	0	0	568	
20:00	0	270	102	0	12	0	0	9	1	1	1	0	0	1	0	397	
21:00	0	219	84	0	8	0	0	8	0	0	0	1	0	0	0	320	
22:00	0	151	58	0	4	0	0	4	1	1	1	0	0	0	0	220	
23:00	0	80	31	0	4	0	0	3	0	0	0	0	0	0	0	118	
Total	0	7052	2697	0	292	0	0	213	4	6	8	2	1	4	0	10279	
Percent	0.0%	68.6%	26.2%	0.0%	2.8%	0.0%	0.0%	2.1%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%		

Comment M.18

Traffic Databank

716 S Sixth Ave
Mount Vernon, NY 10550

Site Code:
Station ID:
SB BOSTON POST RD S OF ORIENTA AVE
MAMARONECK,NY
Latitude: 0' 0.0000 Undefined

SB

Start Time	Motor	Cars Trailer	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Doubl	5 Axle Doubl	>6 Axl Doubl	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Bicycl	Not Class	Total	
03/11/1																	
6	0	25	8	0	0	0	0	0	0	0	0	0	0	0	0	33	
01:00	0	11	3	0	0	0	0	0	0	0	0	0	0	0	0	14	
02:00	0	8	3	0	0	0	0	0	0	0	0	0	0	0	0	11	
03:00	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	7	
04:00	0	23	7	0	0	0	0	0	0	0	0	0	0	0	0	30	
05:00	0	64	20	0	0	0	0	1	1	0	0	0	0	0	0	86	
06:00	0	129	39	1	2	0	0	3	0	0	0	0	0	0	0	174	
07:00	0	527	157	6	20	0	0	12	0	0	0	0	0	0	0	722	
08:00	0	439	130	1	18	0	0	9	0	0	1	0	0	0	0	598	
09:00	0	403	119	1	13	0	0	8	0	0	0	0	0	0	0	544	
10:00	0	430	128	1	15	0	0	7	0	0	0	0	0	1	0	582	
11:00	0	494	147	0	21	0	0	12	1	0	0	0	0	1	0	676	35
12 PM	0	499	148	1	21	0	0	10	0	0	1	0	0	0	0	680	
13:00	0	501	148	1	18	0	0	10	0	0	0	1	0	0	0	679	
14:00	0	490	146	0	16	0	0	6	0	0	0	0	0	0	0	658	
15:00	0	504	149	3	17	0	0	5	0	0	0	0	0	0	0	678	
16:00	0	564	168	2	17	0	0	8	0	0	0	0	0	1	0	760	
17:00	0	628	187	0	26	0	0	11	0	0	0	0	0	0	0	852	37
18:00	0	542	161	0	13	0	0	6	0	0	0	0	0	1	0	723	
19:00	0	356	106	0	16	0	0	5	1	0	0	0	0	0	0	484	
20:00	0	241	72	0	9	0	0	4	0	0	0	0	0	0	0	326	
21:00	0	191	56	0	6	0	0	2	0	0	0	0	0	0	0	255	
22:00	0	156	46	0	1	0	0	0	0	0	0	0	0	0	0	203	
23:00	0	96	28	0	0	0	0	0	0	0	0	0	0	0	0	124	
Total	0	7327	2177	17	249	0	0	119	3	0	2	1	0	4	0	9899	
Percent	0.0%	74.0%	22.0%	0.2%	2.5%	0.0%	0.0%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		

Comment M.18

Traffic Databank
716 S Sixth Ave
Mount Vernon, NY 10550

Site Code:
Station ID:
NB BOSTON POST RD S OF ORIENTA AVE
MAMARONECK,NY
Latitude: 0' 0.0000 Undefined

NB

Start Time	Motor	Cars Trailer	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Doubl	5 Axle Doubl	>6 Axl Doubl	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Bicycl	Not Class	Total	
03/11/1																	
6	0	37	15	0	1	0	0	0	0	0	0	0	0	0	0	53	
01:00	0	18	7	0	0	0	0	0	0	0	0	0	0	0	0	25	
02:00	0	9	4	0	0	0	0	0	0	0	0	0	0	0	0	13	
03:00	0	13	3	0	0	0	0	0	0	0	0	0	0	0	0	16	
04:00	0	16	7	0	0	0	0	0	0	0	0	0	0	0	0	23	
05:00	0	42	17	0	2	0	0	0	0	0	0	0	0	0	0	61	
06:00	0	146	56	0	6	0	0	3	0	0	0	0	0	0	0	211	
07:00	0	451	173	0	19	0	0	12	1	0	0	0	0	0	0	656	
08:00	0	529	202	0	22	0	0	17	0	0	0	0	0	0	0	770	
09:00	0	458	175	0	18	0	0	12	0	0	0	0	0	0	0	663	
10:00	0	415	158	0	18	0	0	12	1	1	2	0	0	1	0	608	
11:00	0	481	183	0	23	0	0	14	0	0	0	1	0	0	0	702	38
12 PM	0	513	196	0	18	0	0	14	1	0	0	0	0	1	0	743	
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14:00	0	495	189	0	21	0	0	16	0	1	0	0	0	0	0	722	
15:00	0	627	239	0	23	0	0	16	0	0	2	0	0	0	0	907	
16:00	0	593	226	0	22	0	0	19	1	0	1	1	1	0	0	864	
17:00	0	555	212	0	21	0	0	13	0	2	0	2	0	0	0	805	38
18:00	0	503	193	0	21	0	0	16	0	0	0	0	0	0	0	733	
19:00	0	422	161	0	17	0	0	14	0	1	0	0	0	0	0	615	
20:00	0	279	107	0	14	0	0	5	0	0	1	0	0	0	0	406	
21:00	0	242	92	0	11	0	0	5	0	0	0	0	0	0	0	350	
22:00	0	168	64	0	7	0	0	5	0	0	0	0	0	0	0	244	
23:00	0	108	41	0	4	0	0	2	1	0	0	0	0	0	0	156	
Total	0	7618	2911	0	310	0	0	208	5	5	6	4	1	2	0	11070	
Percent	0.0%	68.8%	26.3%	0.0%	2.8%	0.0%	0.0%	1.9%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%		

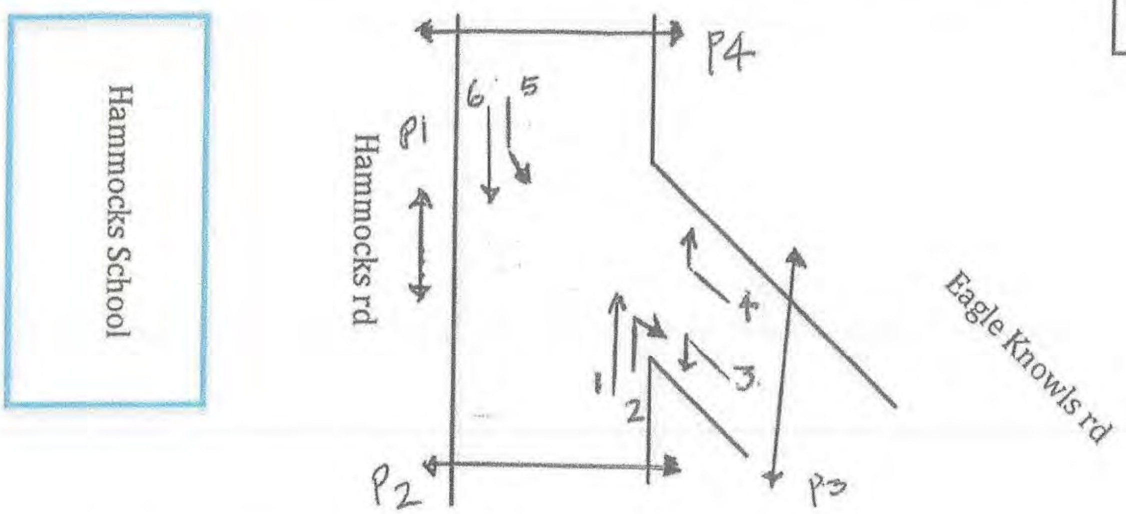
Job Title: Mamaroneck Project **Weather :** cloudy
Location: Mamaroneck ny **Field Tech:**
Date: 3 /15/ 2016 Tuesday DAY# 1

TDC TRAFFIC DATA COLLECTIONS
914-302-6326 fax-914-629-6815 cell

Comment M.18

TIME	1					2					3					4					5					6								
	C	T	SB	PB	B	C	T	SB	PB	B	C	T	SB	PB	B	C	T	SB	PB	B	C	T	SB	PB	B	C	T	SB	PB	B	P1	P2	P3	P4
7-7:15p																1					3					1	1						1	
7:30		1														2					1													
7:45	3															15					3									X	5	1		3
8:00	3				3						1					48				4	17					3								
8:15	4										1					12	1			2	3					3								
8:30	2															2					4				1	1								2
8:45	4															5					5					3								2
9:00	4															4					3					3								
9:15	6															1					2					2								

KEY:
C=cars
T=truck 3+axle
SB= school bus
PB=Public trans
B=Bicycle



This intersection is not signalized

Kimley»Horn
of New York, P.C.

FEIS Chapter M Appendix

Response to Comment M34

Vicinity Development Traffic

Hampshire Vicinity Developments

EXHIBIT 3M-8.1

Project Site

Project Site

Vicinity Developments

1 690 Mamaroneck Ave (21units)

2 270 Waverly Ave (96 units)

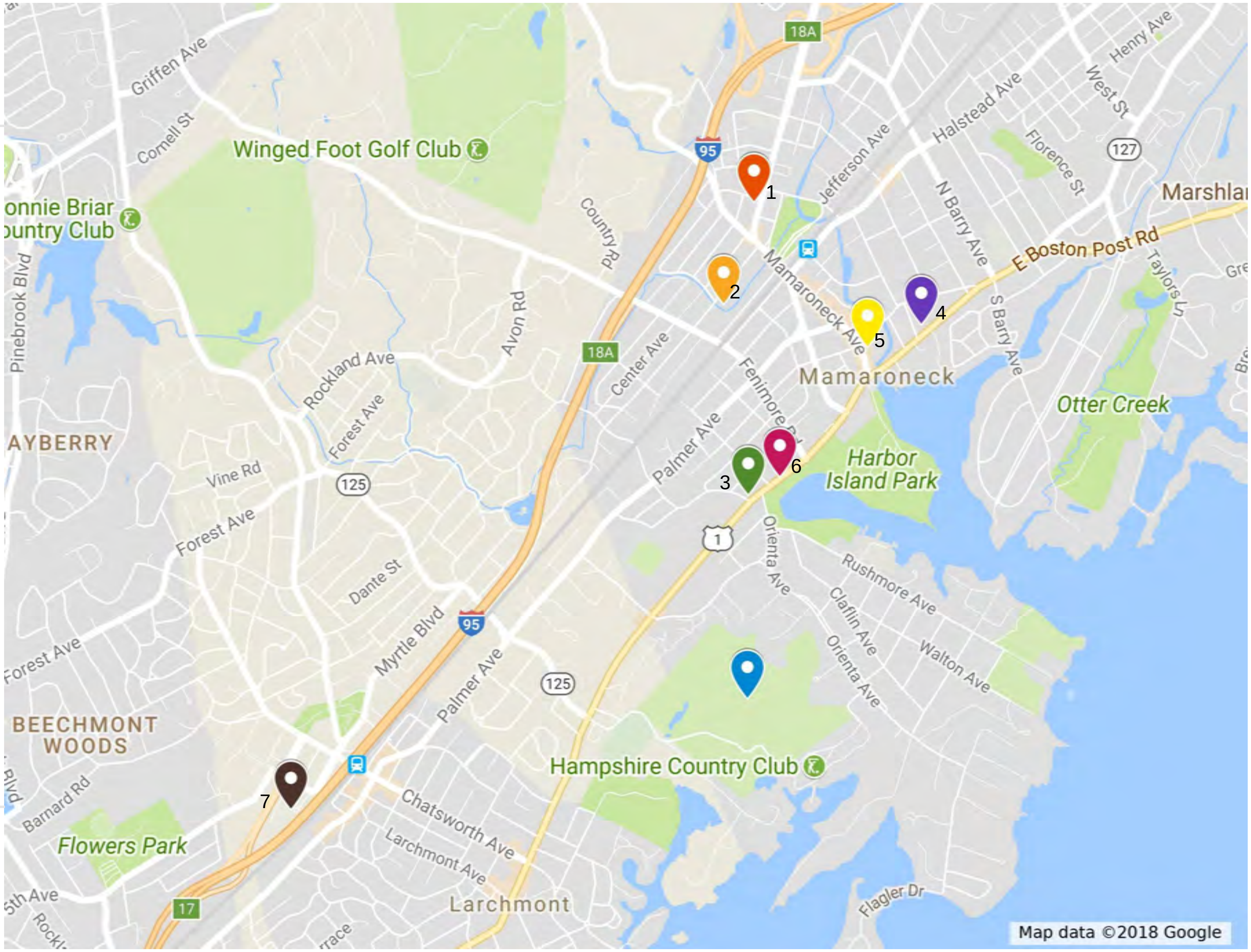
3 620 W Boston Post Rd (6 units)

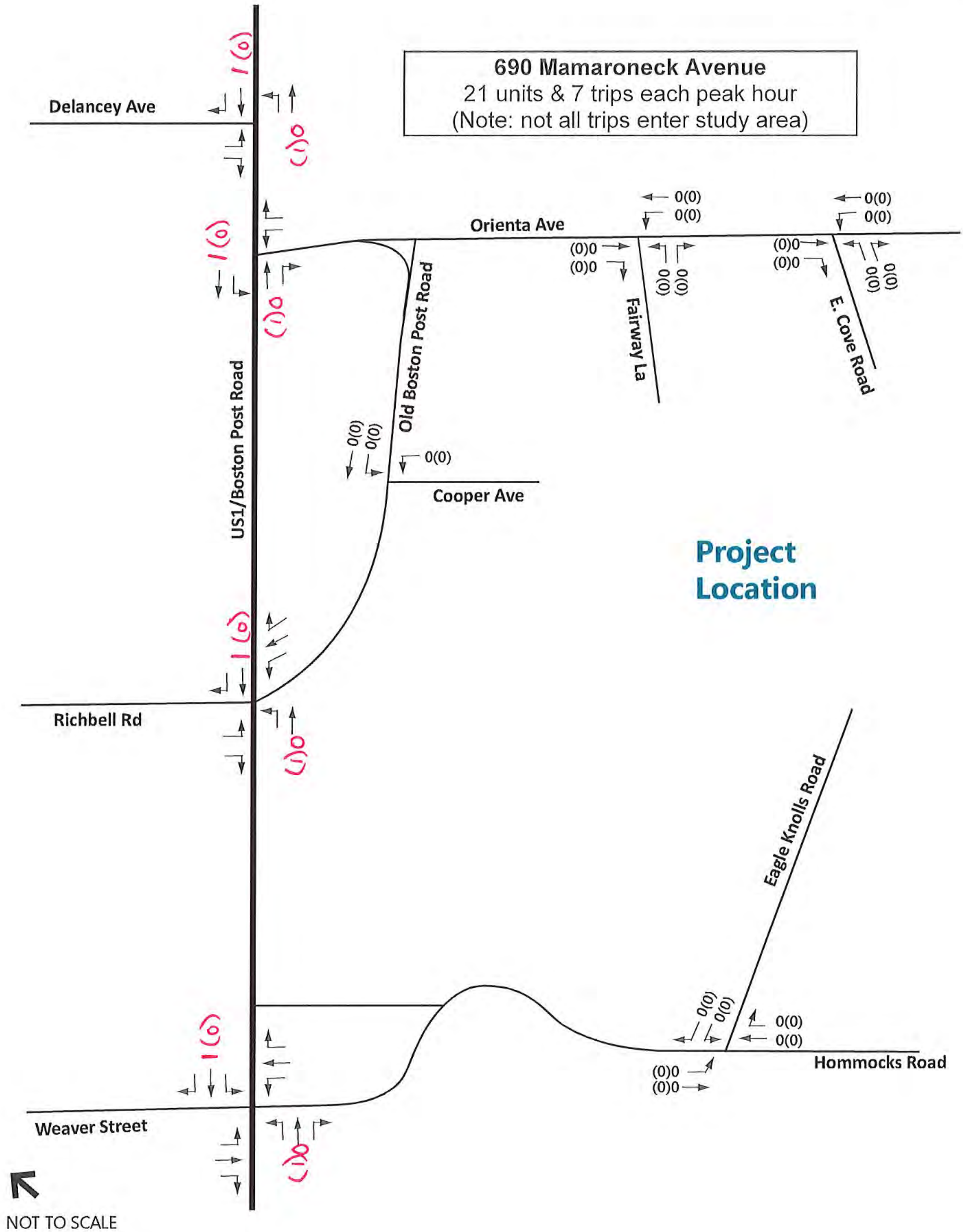
4 422 E Boston Post Rd (13 units)

5 151 Mamaroneck Ave (10 units)

6 532 W Boston Post Rd (7 units)

7 The Cambium (149 units)

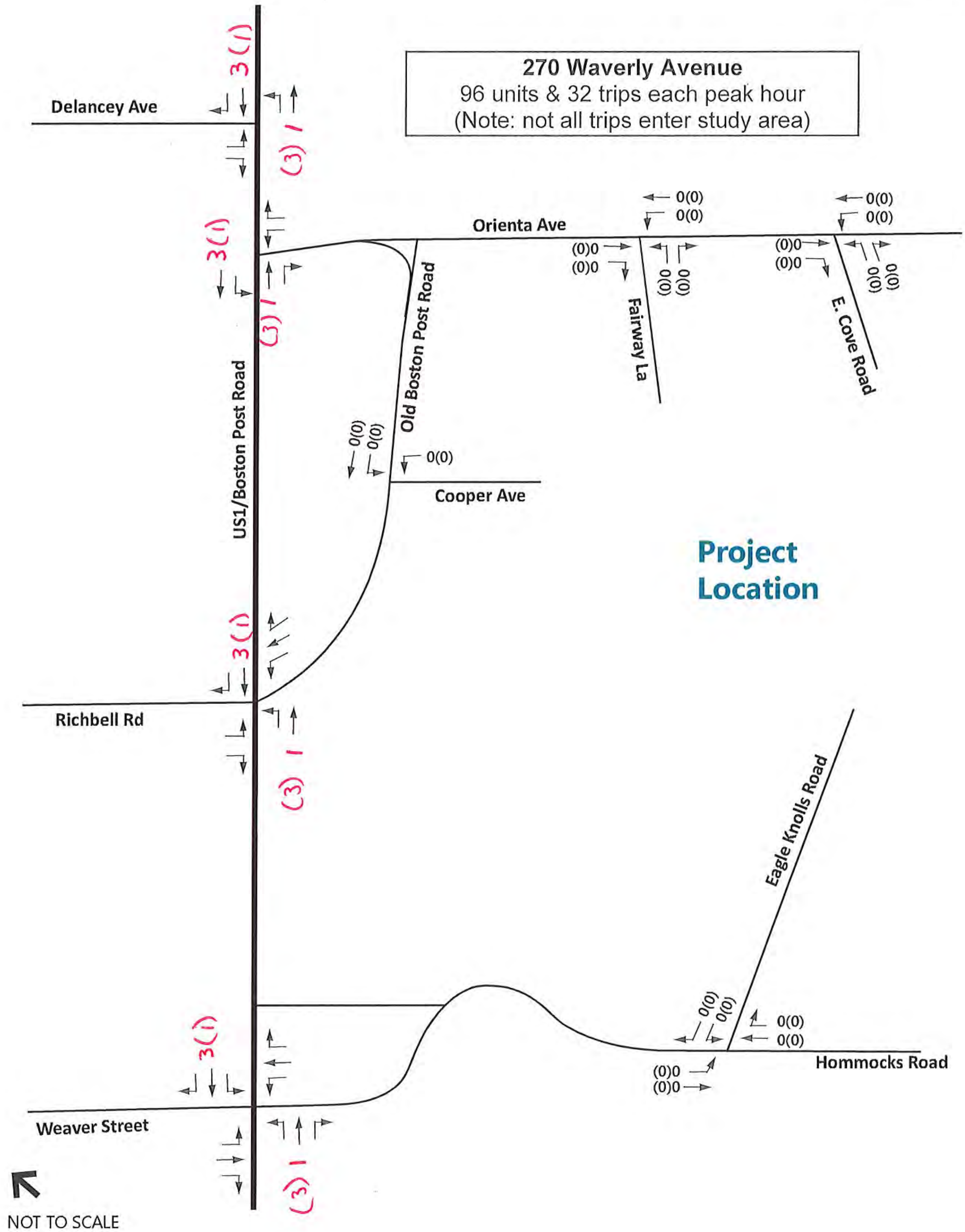




00= AM Peak Hour

(00)=PM Peak Hour

Vicinity Development Weekday Hour Volumes

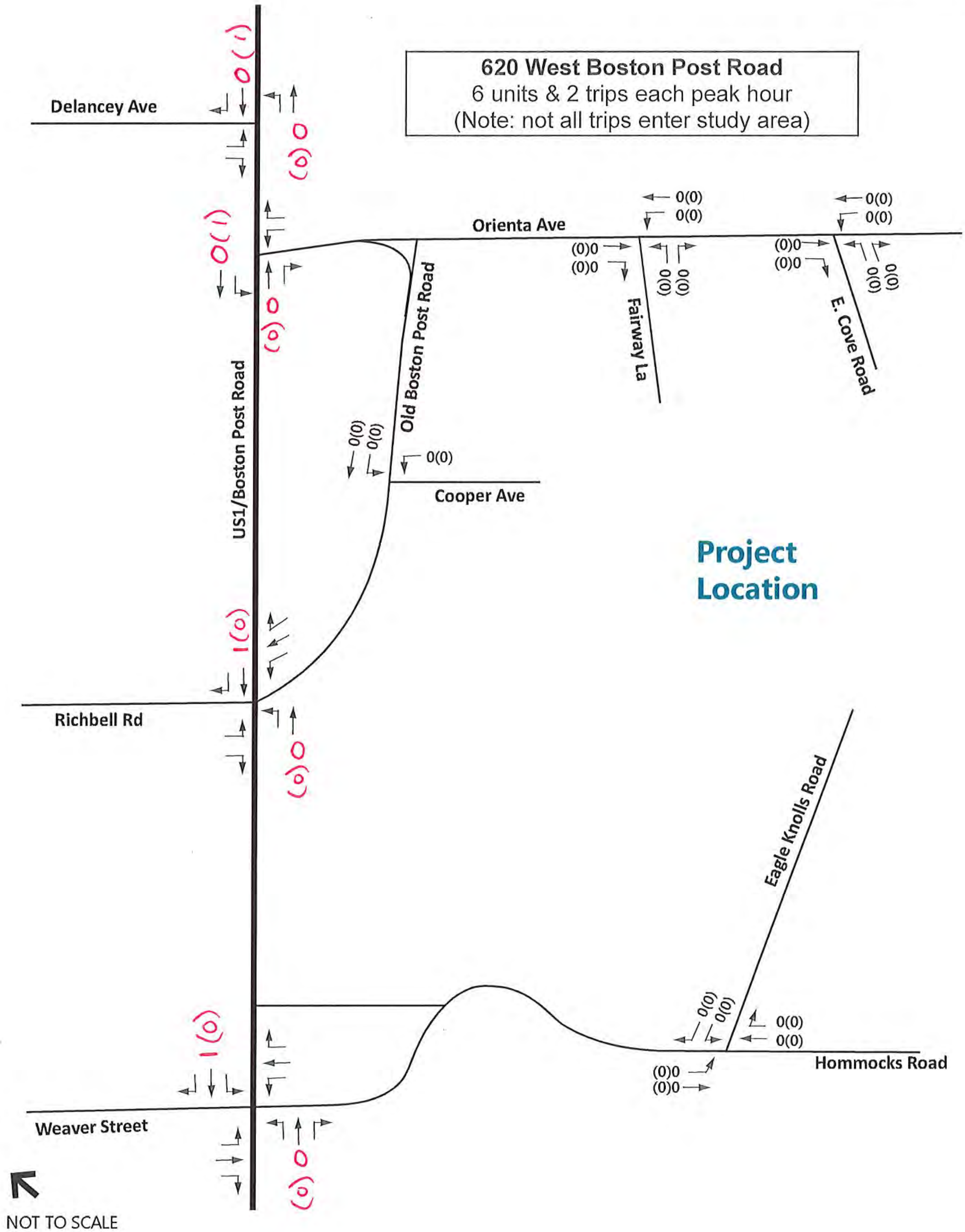


Hampshire Country Club - PRD | Village of Mamaroneck, NY

00= AM Peak Hour

(00)=PM Peak Hour

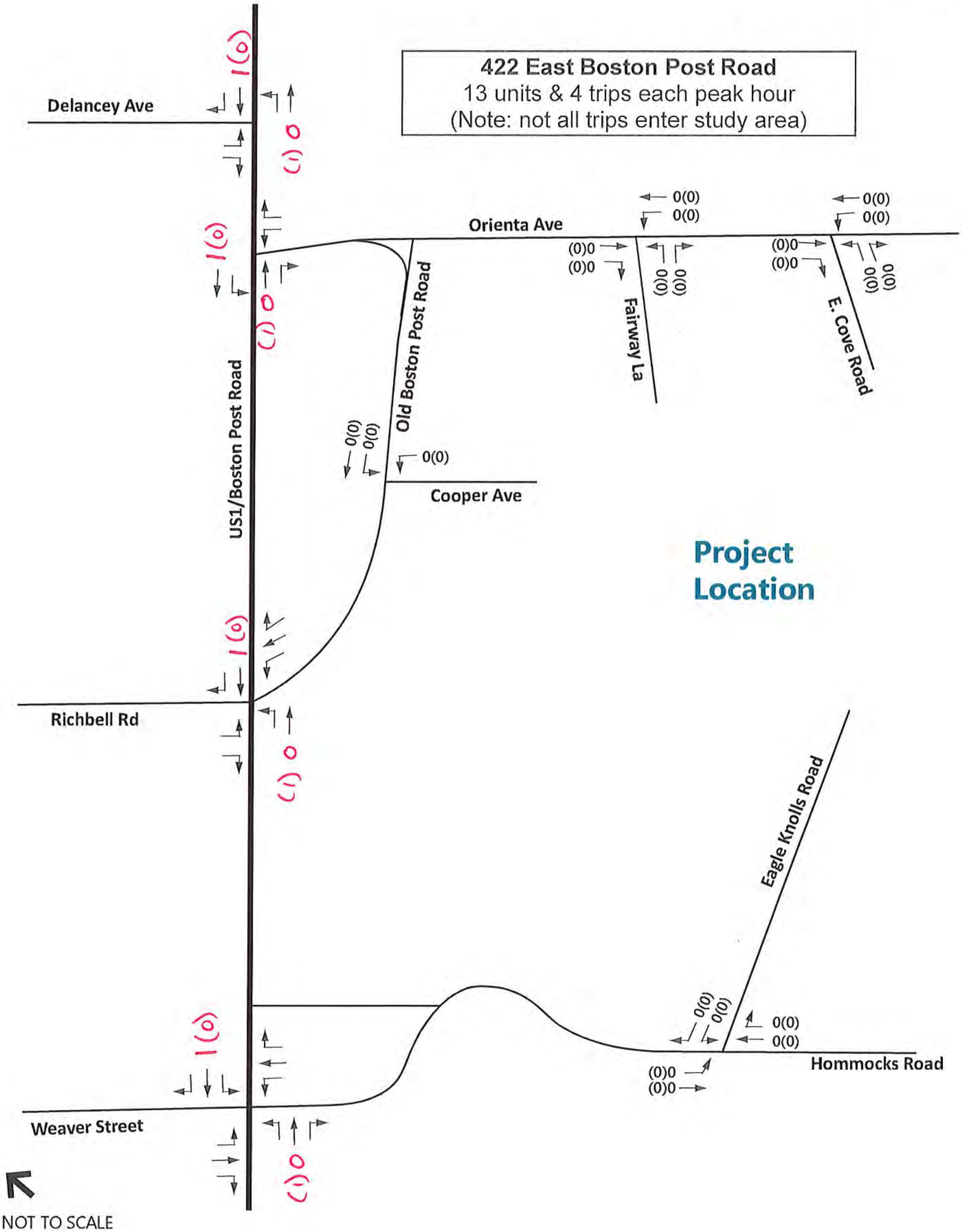
Vicinity Development Weekday Hour Volumes



00= AM Peak Hour

(00)=PM Peak Hour

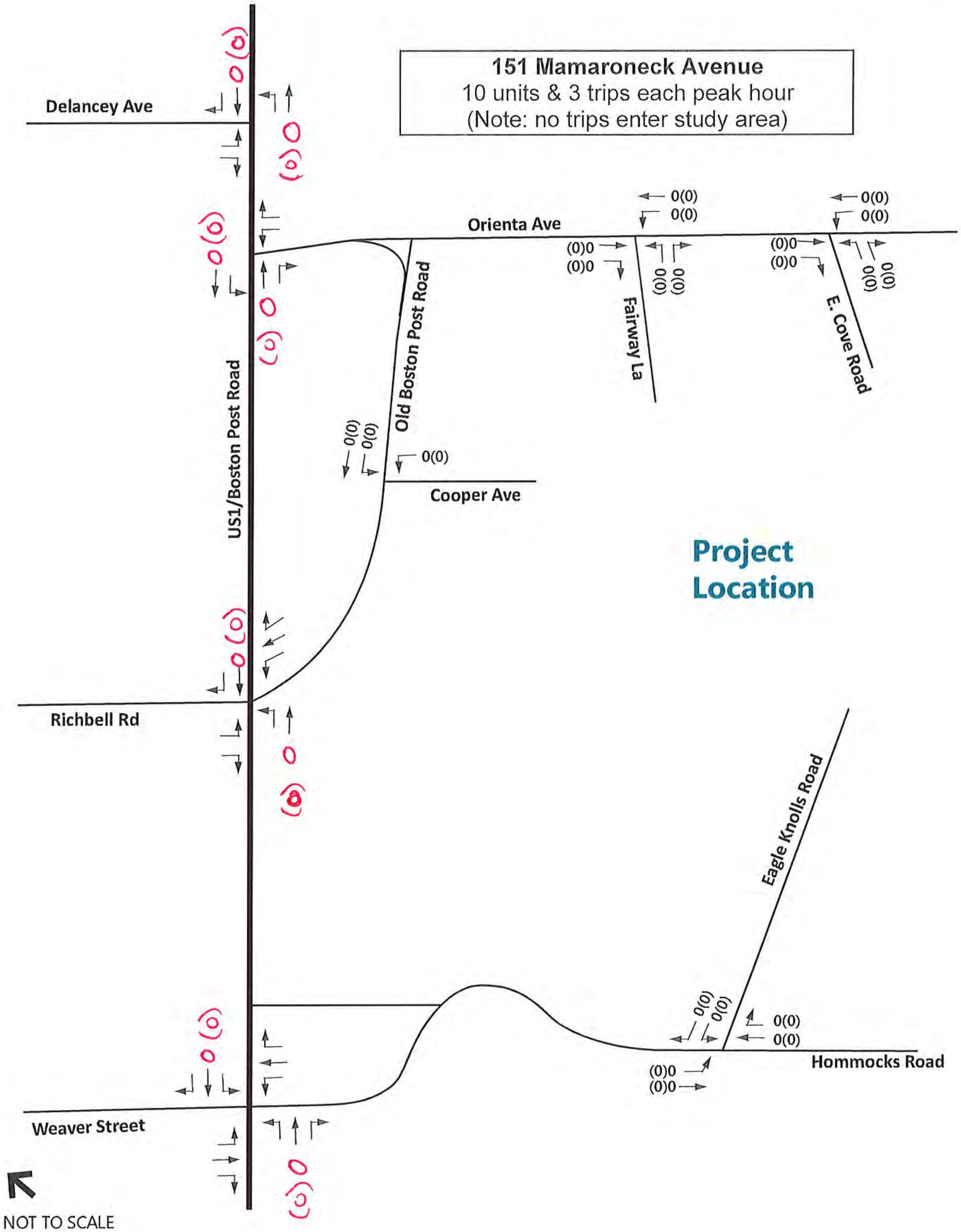
Vicinity Development Weekday Hour Volumes



00= AM Peak Hour

(00)=PM Peak Hour

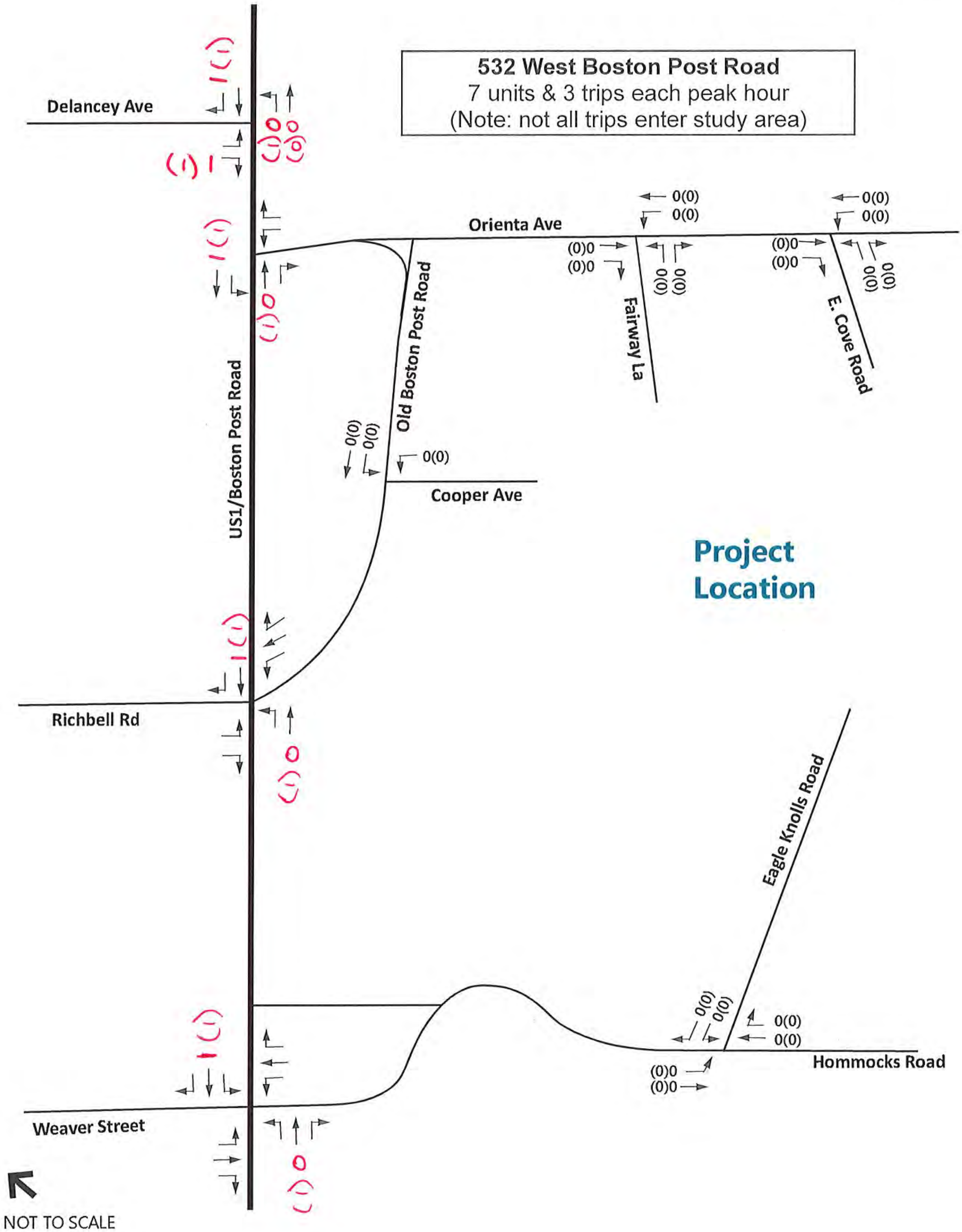
Vicinity Development Weekday Hour Volumes



00= AM Peak Hour

(00)=PM Peak Hour

Vicinity Development Weekday Hour Volumes

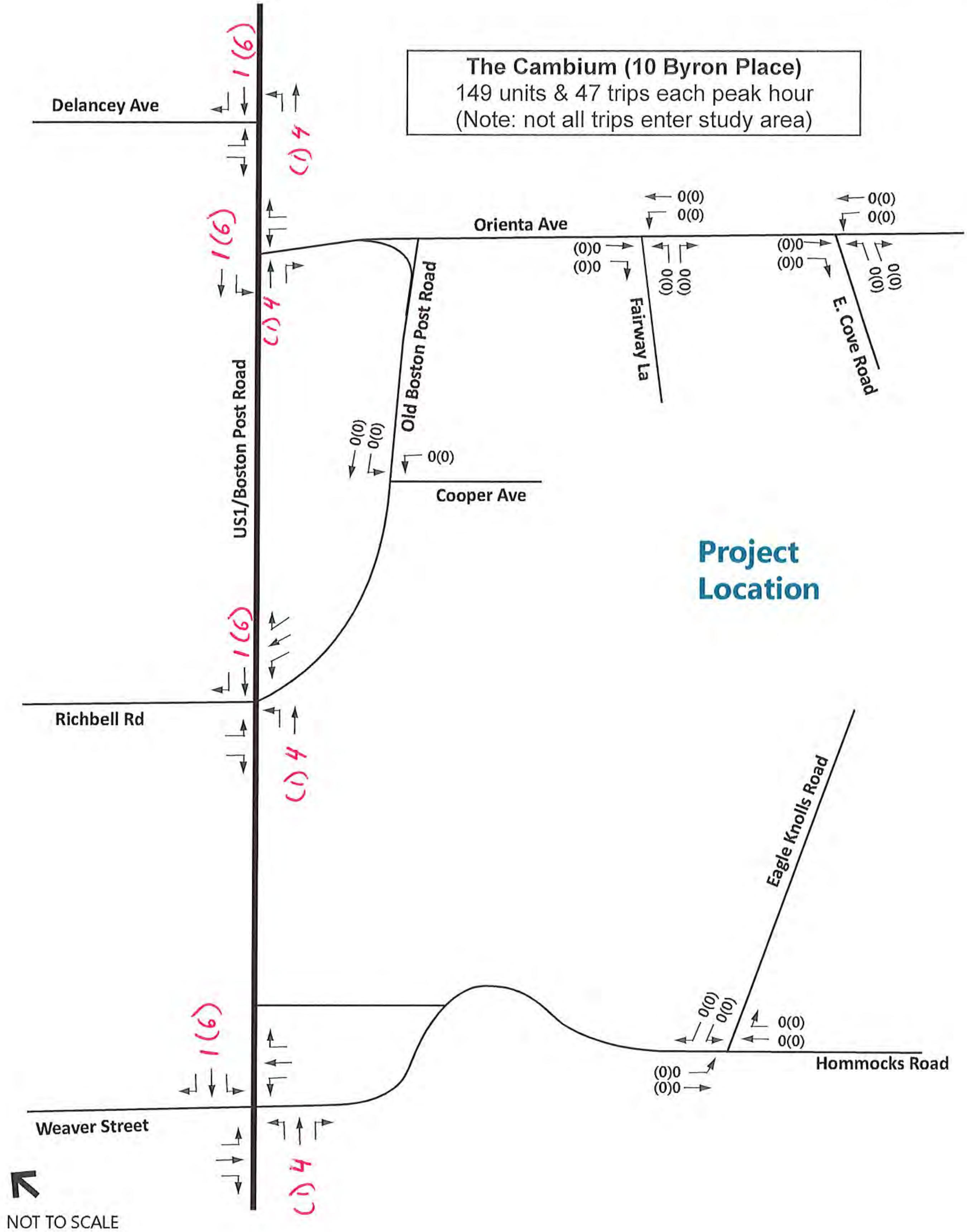


Hampshire Country Club - PRD | Village of Mamaroneck, NY

00= AM Peak Hour

(00)=PM Peak Hour

Vicinity Development
Weekday Hour Volumes

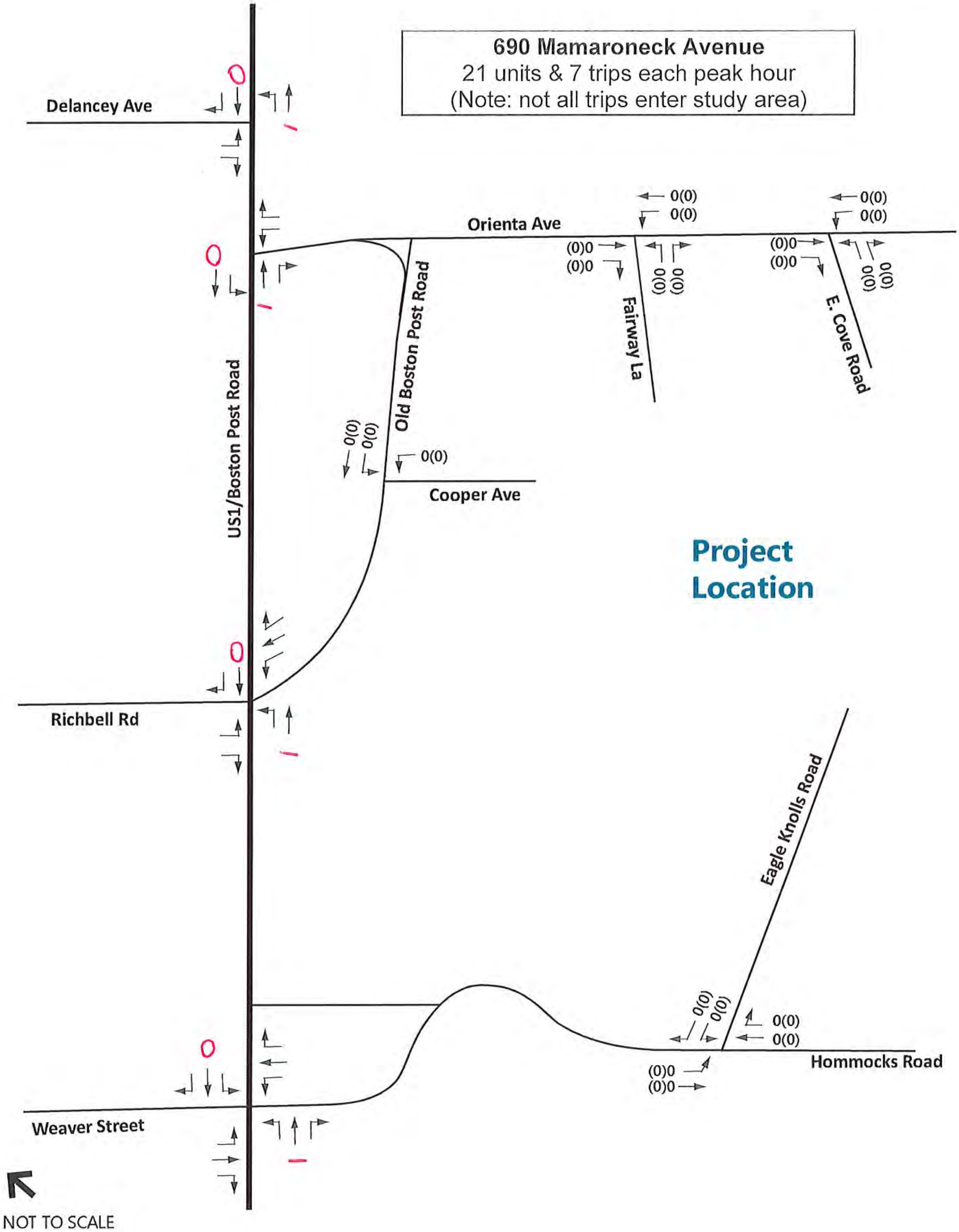


Hampshire Country Club - PRD | Village of Mamaroneck, NY

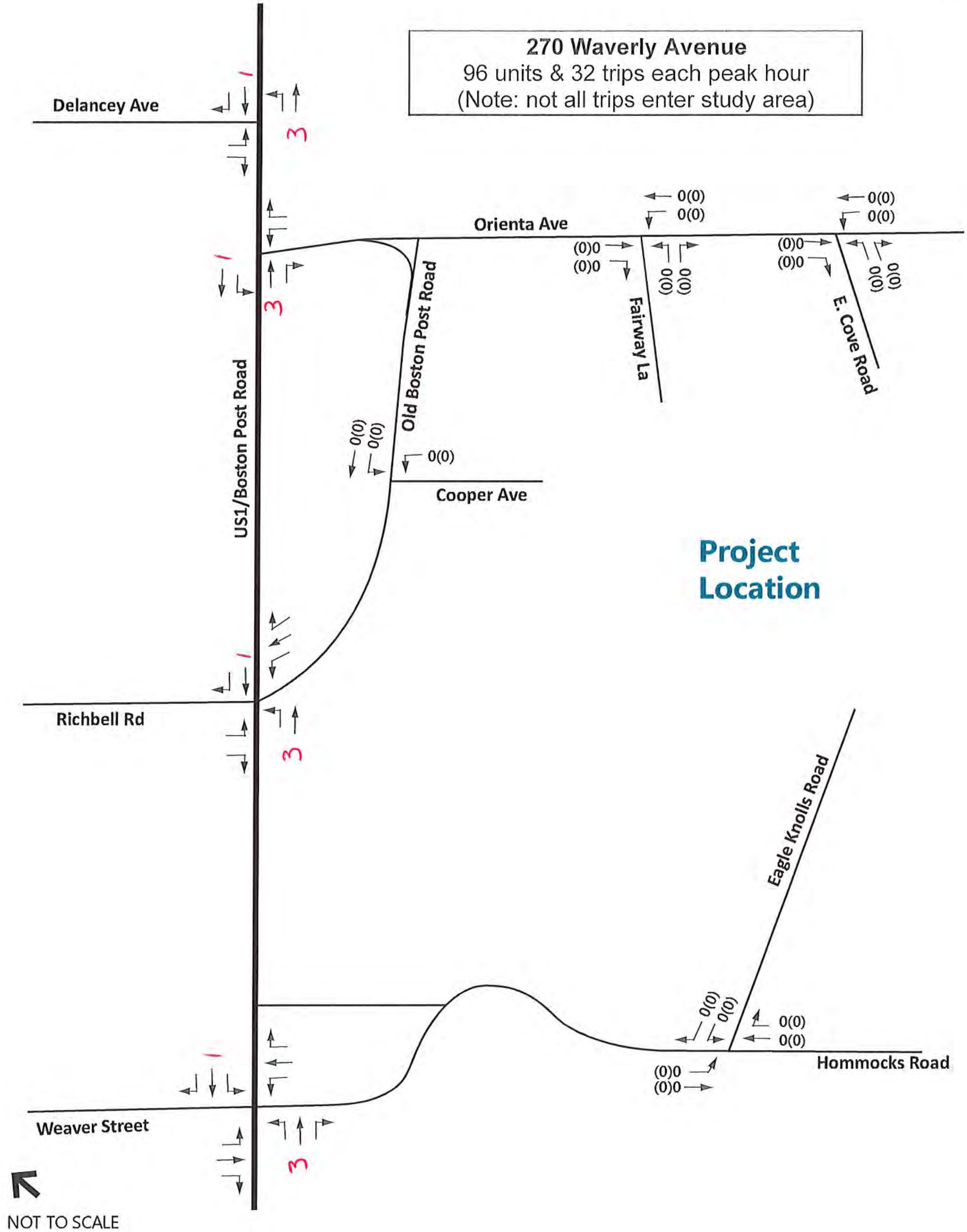
00= AM Peak Hour

(00)=PM Peak Hour

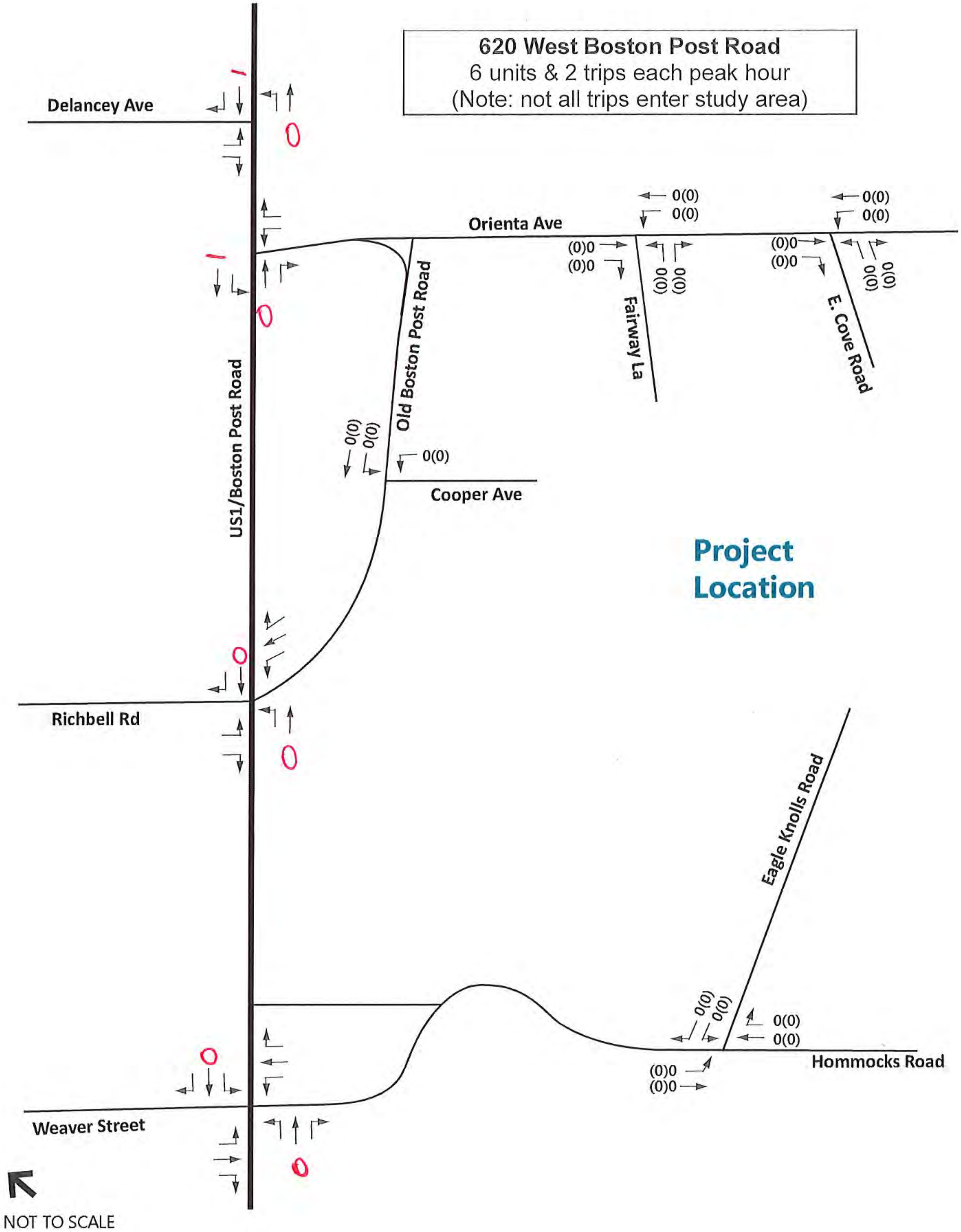
Vicinity Development Weekday Hour Volumes



Vicinity Development Saturday Peak Hour Volumes

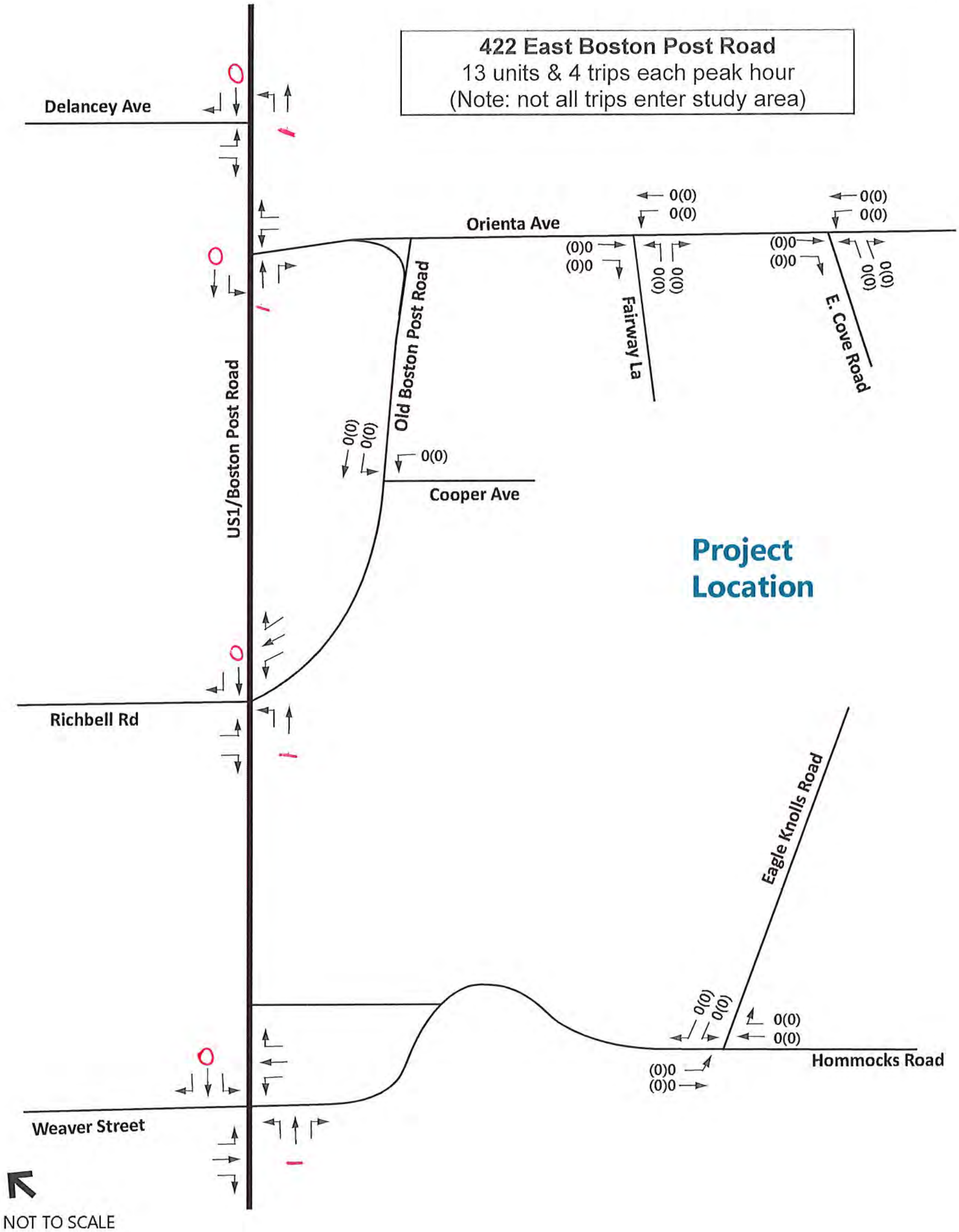


Vicinity Development Saturday Peak Hour Volumes

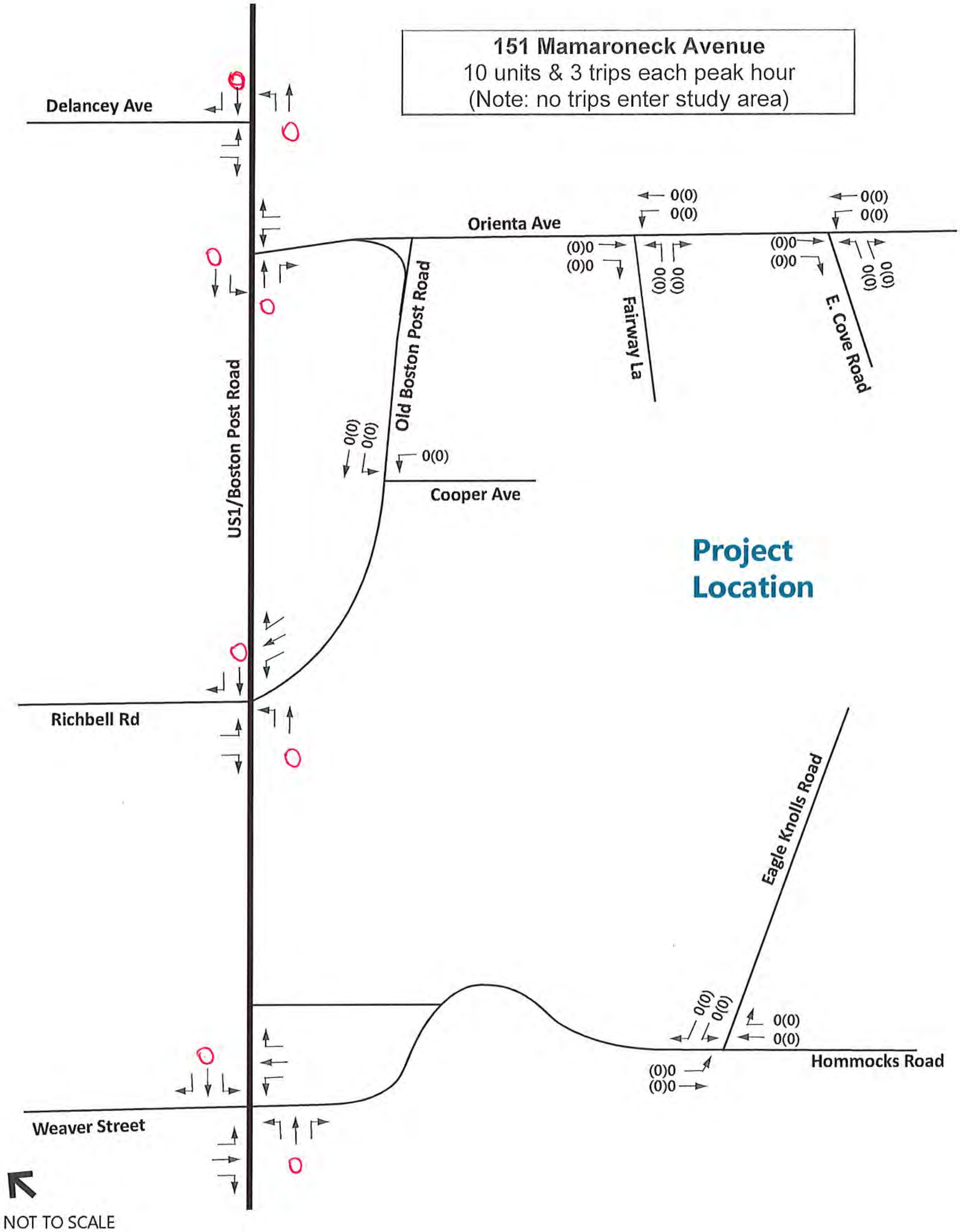


Hampshire Country Club - PRD | Village of Mamaroneck, NY

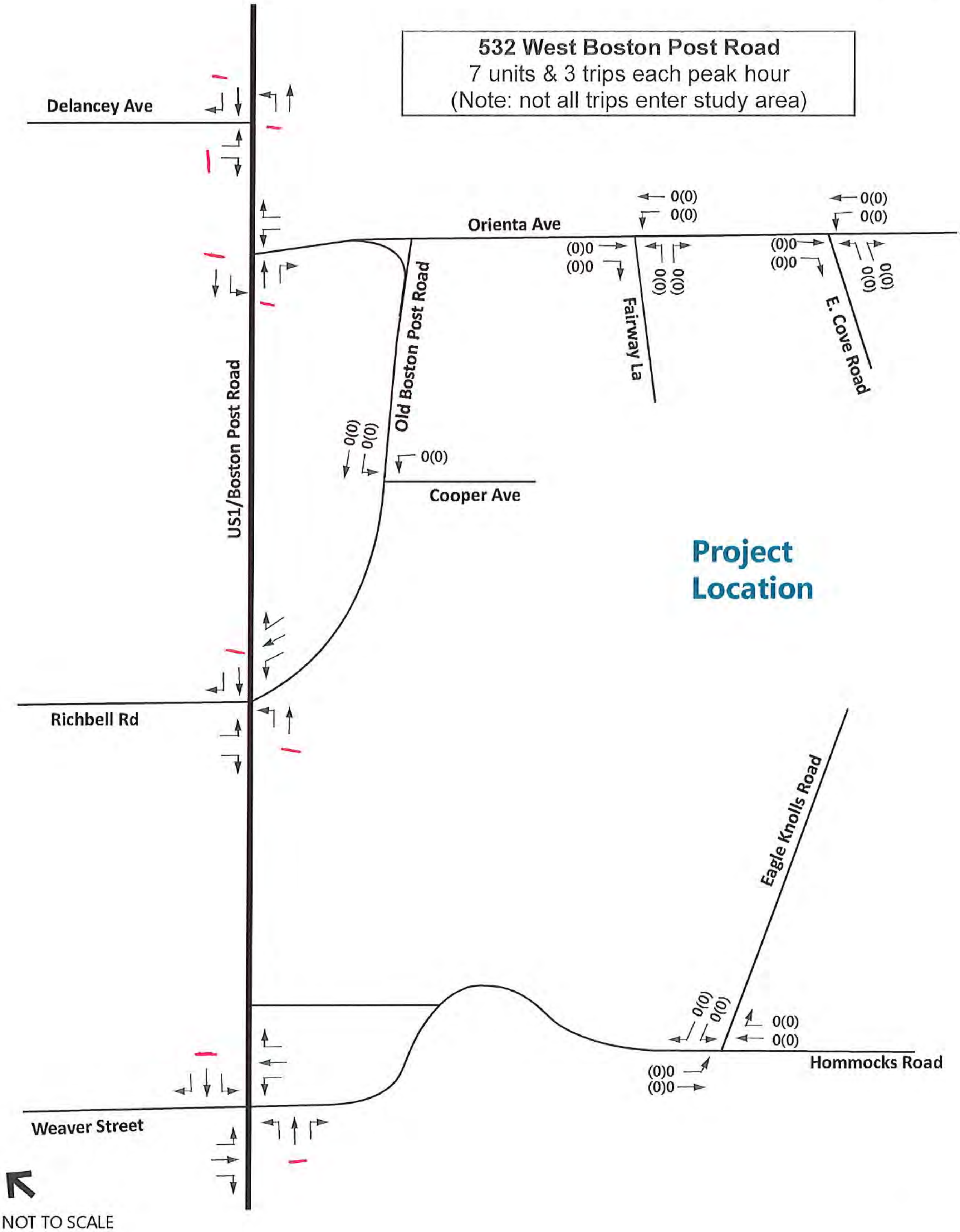
Vicinity Development Saturday Peak Hour Volumes



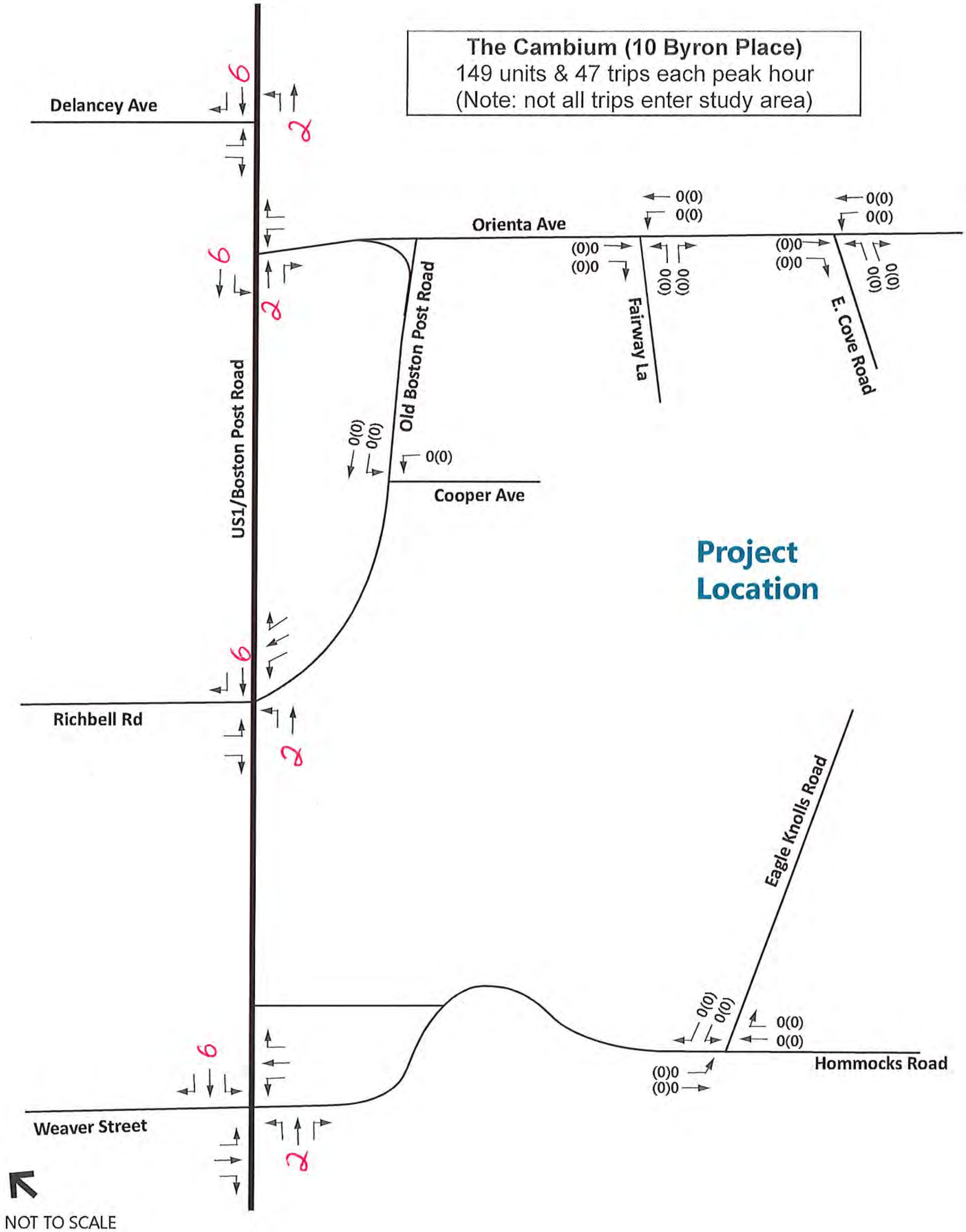
Vicinity Development Saturday Peak Hour Volumes



Vicinity Development Saturday Peak Hour Volumes



Vicinity Development Saturday Peak Hour Volumes



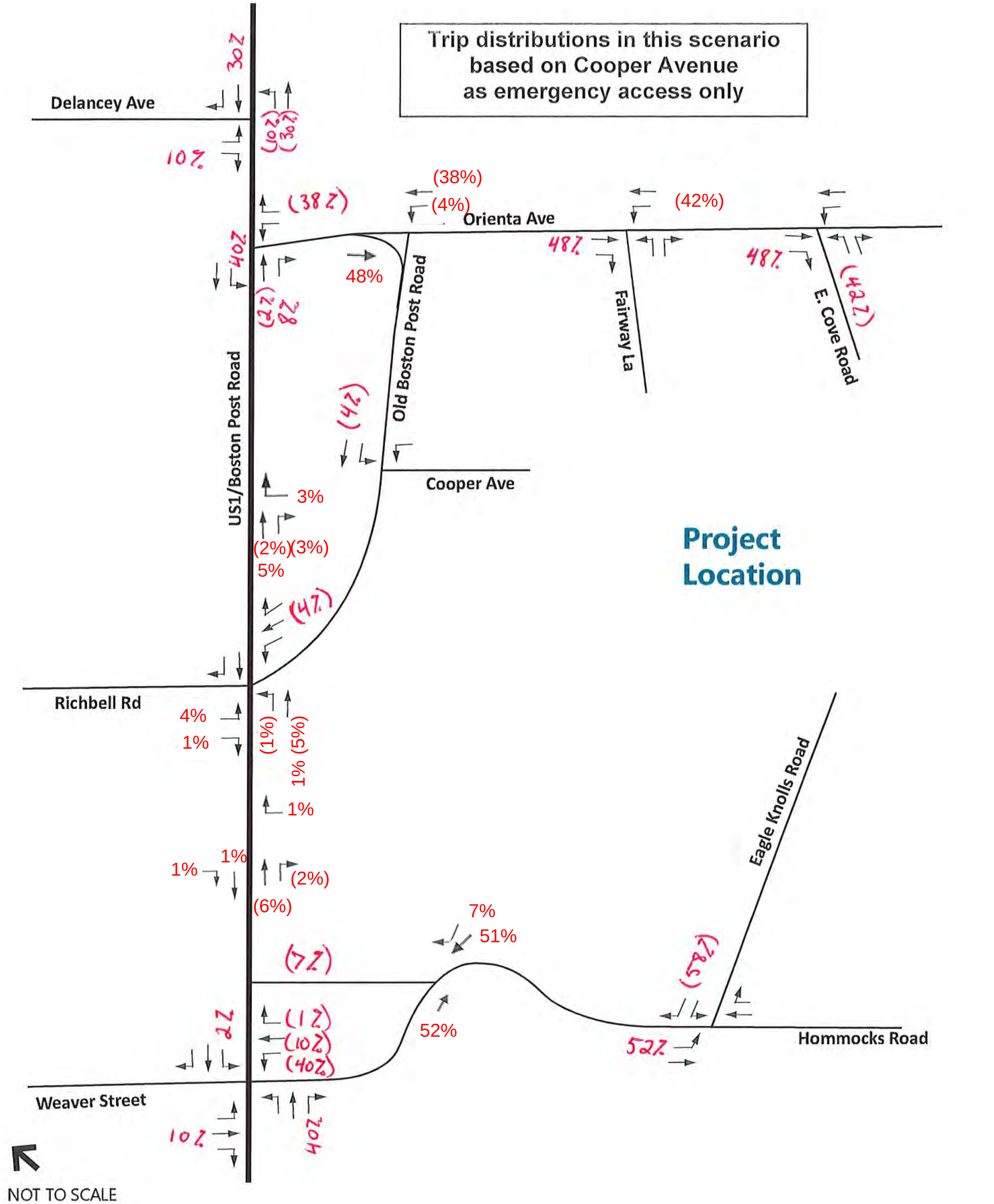
Vicinity Development Saturday Peak Hour Volumes

Kimley»Horn
of New York, P.C.

FEIS Chapter M Appendix

Response to Comment M35

Project Traffic



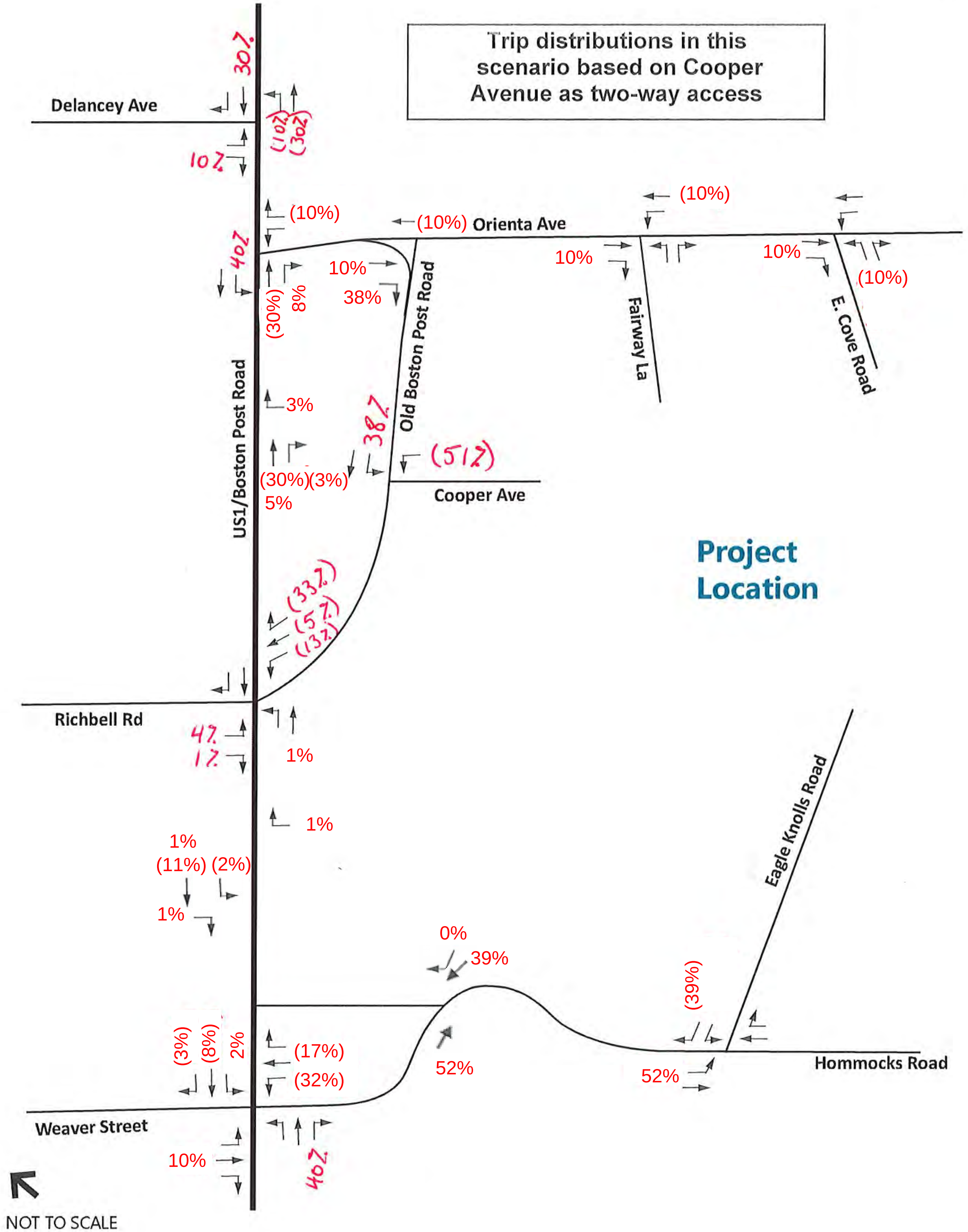
00= Arrival

(00)=Departure

Trip Distributions

Proposed Access

(Cooper Avenue Closed,
Except if needed for Emergency Access)



Hampshire Country Club - PRD | Village of Mamaroneck, NY

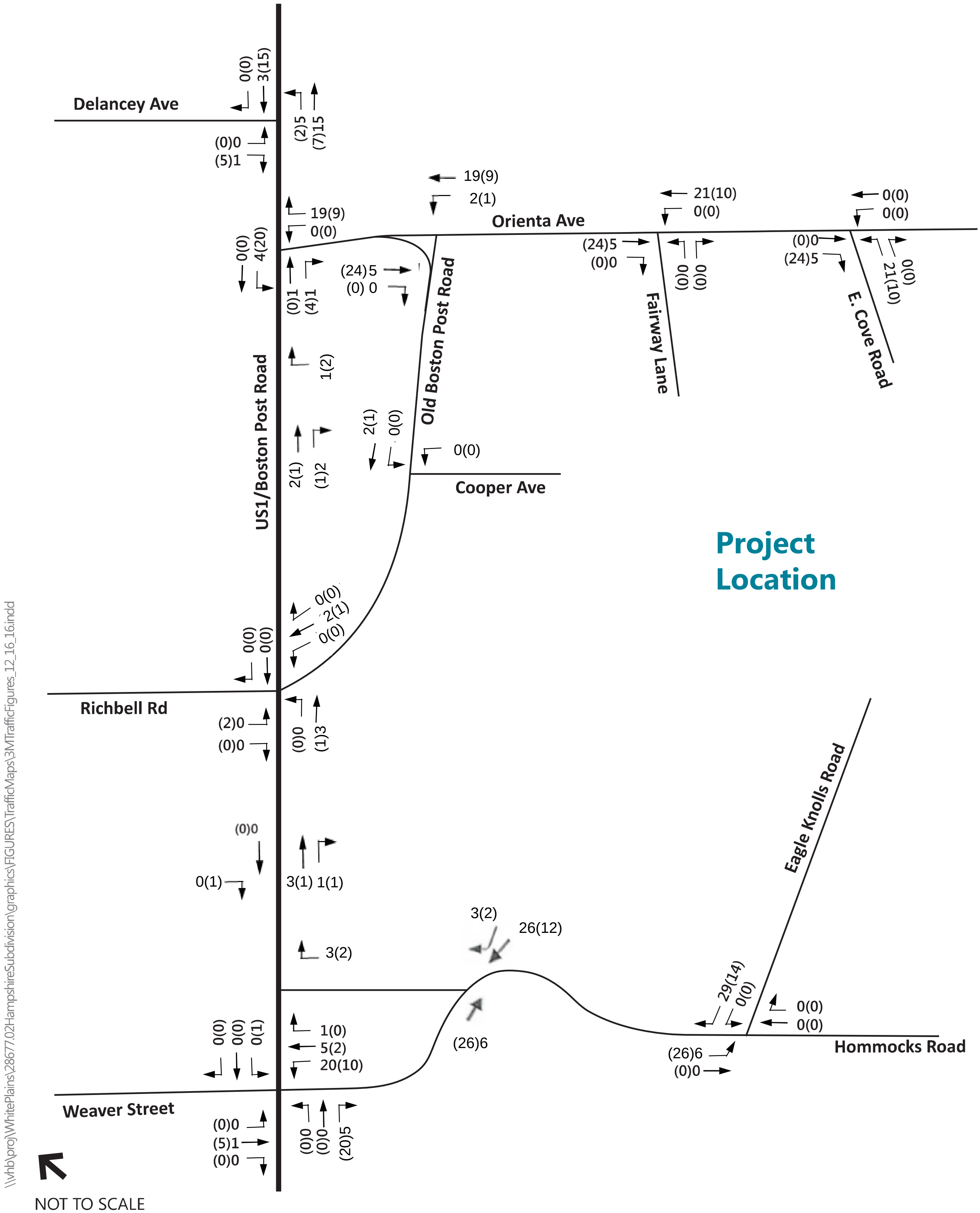
00= Arrival

(00)=Departure

Trip Distributions

Alternative Access

(Cooper Avenue Two-way Access)



Hampshire Country Club - PRD | Village of Mamaroneck, NY

00= AM Peak Hour

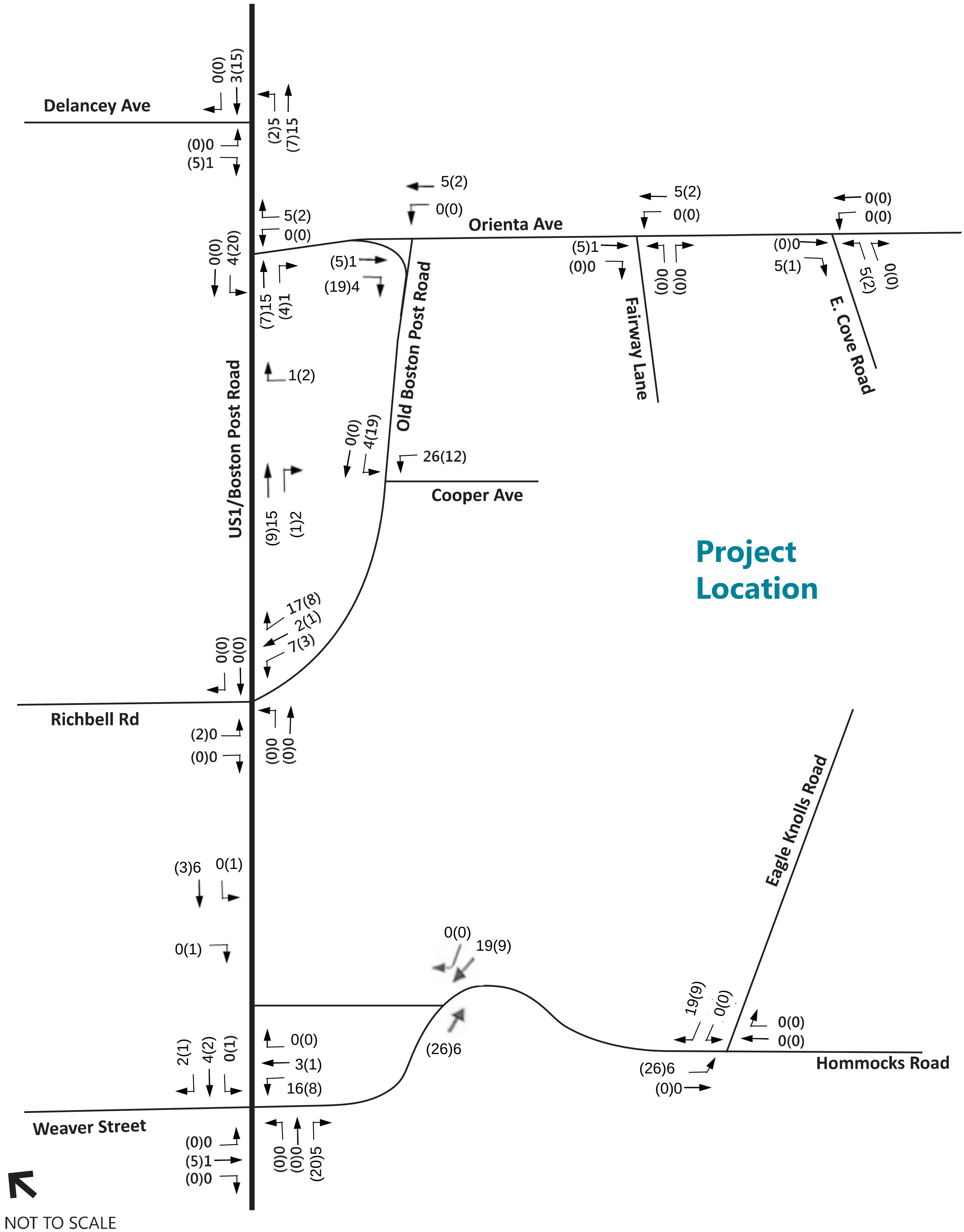
(00)=PM Peak Hour

Project Generated Weekday Peak Hour Volumes

Proposed Access

(Cooper Avenue Closed,
Except if needed for Emergency Access)

Exhibit 3M-13 B



Hampshire Country Club - PRD | Village of Mamaroneck, NY

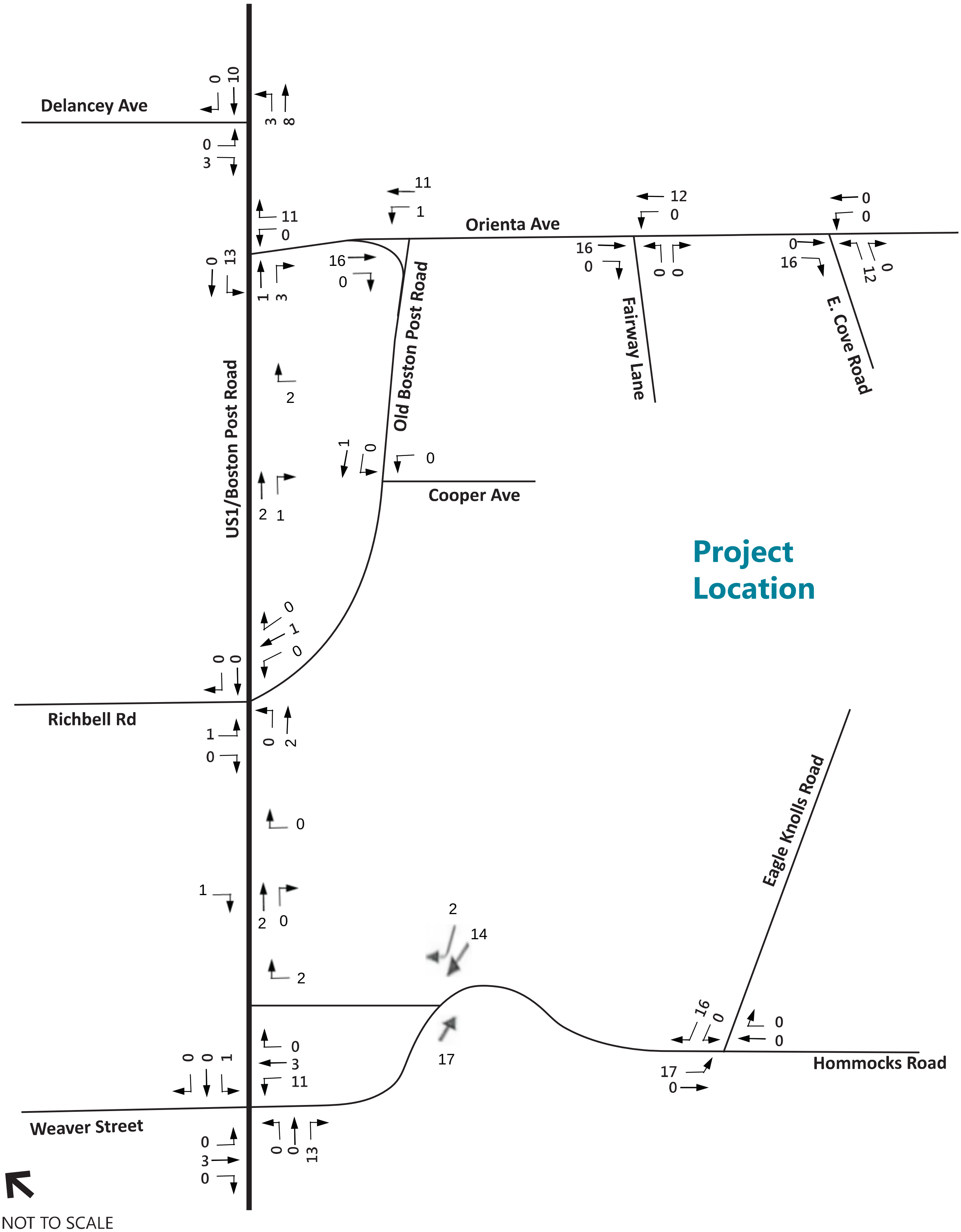
00= AM Peak Hour

(00)=PM Peak Hour

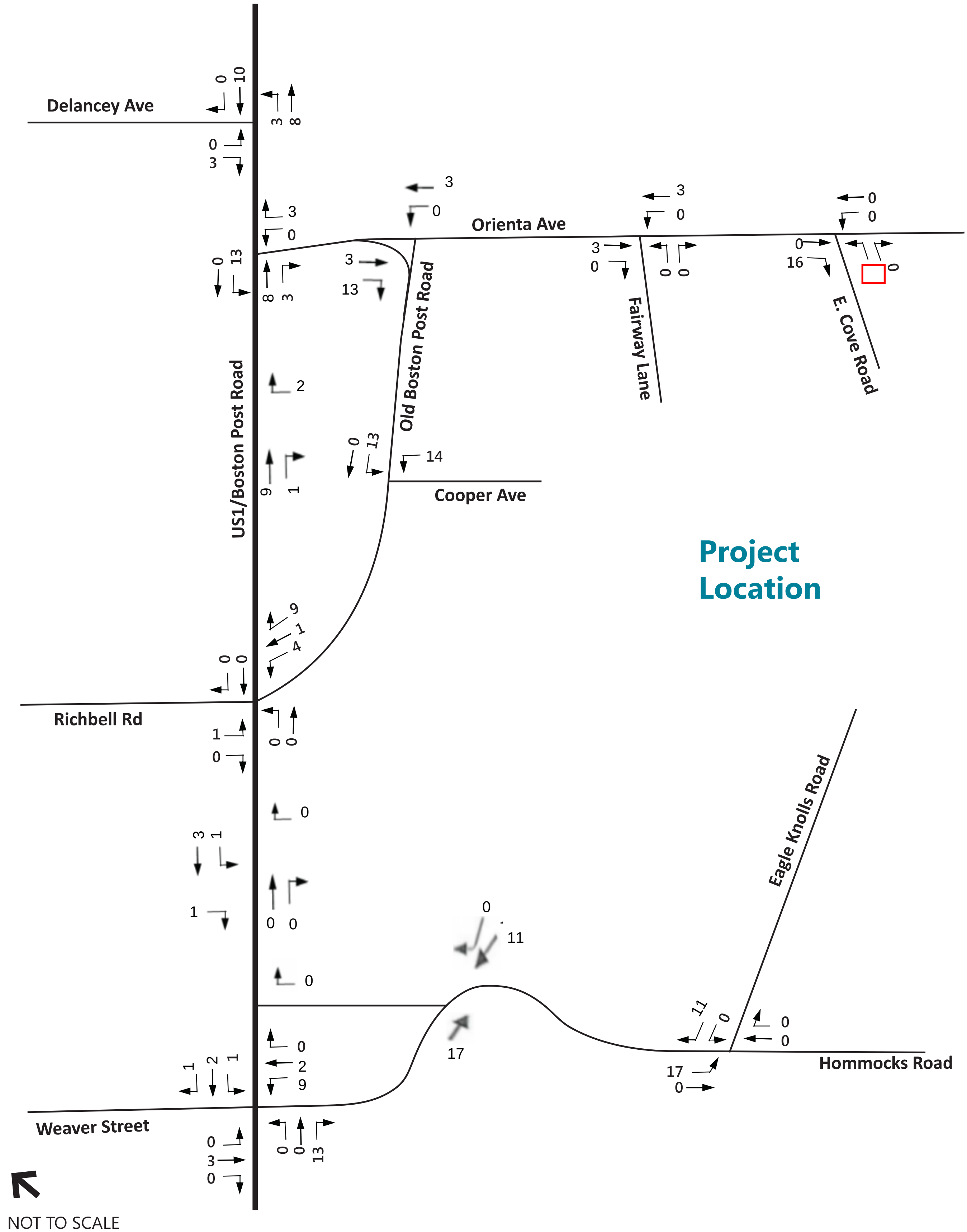
Project Generated Weekday Peak Hour Volumes

Alternative Access

(Cooper Avenue Two-way Access)



Project Generated Saturday Peak Hour Volumes
Proposed Access
(Cooper Avenue Closed, Except when needed for Emergency Access)



Hampshire Country Club - PRD | Village of Mamaroneck, NY

Project Generated Saturday Peak Hour Volumes

Alternative Access

(Cooper Avenue Two-way Access)

Kimley»Horn
of New York, P.C.

FEIS Chapter M Appendix

Response to Comment M36

V/C Values for LOS E Lane Groups

Table showing V/C ratio values for locations with LOS "E" or worse.
(with pedestrians doubled)

Levels-of-Service and Volume-to-Capacity Ratios for Lane Groups with LOS E or Worse					
Scenario	**Approach**	**Lane Group**	**LOS**	**Delay**	**V/C**
Boston Post Rd & Hommocks Rd/Weaver St					
No-Build AM	EB	L	E	62.7	0.60
	WB	L	E	56.7	0.48
	NB	TR	E	72.0	1.00
	SB	L	E	76.2	0.87
No-Build PM	NB	L	E	56.4	0.69
Build AM	EB	L	E	64.0	0.61
	WB	L	E	66.7	0.65
	NB	TR	E	73.8	1.00
	SB	L	E	76.2	0.87
Build PM	NB	L	E	56.4	0.69

Hampshire Country Club Planned Residential Development
Village of Mamaroneck,
Westchester County, New York
Final Environmental Impact Statement

W Community Facility Providers Correspondence

FEIS Outreach

June 14, 2018

Jill Fisher, Superintendent
Town of Mamaroneck Recreation Department
740 West Boston Post Road
Mamaroneck, NY 10543

Re: Hampshire Country Club, Final Environmental Impact Statement

Dear Superintendent Fisher:

We are planning consultants currently in the process of preparing a Final Environmental Impact Statement (EIS) for the proposed Planned Residential Subdivision and associated development of 44 one-family homes and 61 two- and three-family semi-detached townhomes on the current Hampshire Country Club property within the Village of Mamaroneck. The Proposed Project would also include development of seven tennis courts and preservation of approximately 36 acres of shared open space. The existing golf course use would be downsized to a 9-hole course, and the existing clubhouse and associated recreational facilities would remain in use. As outlined in the Draft Environmental Impact Statement from December 2017, utilizing the Residential Demographic Multipliers by Rutgers University Center for Urban Policy Research (June 2006), the Proposed Action is projected to generate approximately 57 public school children and 14 private school children. These 71 school children would be spread throughout the 13 grades (K-12). A copy of the DEIS can be accessed at http://www.village.mamaroneck.ny.us/Pages/MamaroneckNY_planning/Hampshire%20Application/SEQRA%20Documents/DEIS_FULL%2012_2017.pdf

The project site (the "Site") is located at 1025 Cove Road and consists of approximately 106.2 acres (***See Exhibit 1***). The Site is located adjacent to the Hommocks Ice Rink, Pool, and Hommocks Middle School. A portion of the Site borders the Long Island Sound. We have attached an initial site plan of the Proposed Project for your review (***See Exhibit 2***).

Since our last communication with your department, we have been asked by the Planning Board (the Lead Agency) to discuss the existing conditions and potential impact of the proposed Project on Town facilities in the area, including field and other recreational facilities. In this context, we would appreciate your written responses to the following items, which we would include in the FEIS:

Existing Conditions

(1) Number of Hommocks Pool visitors in total and from the Town of Mamaroneck during the average summer month in 2017;
(2) Number of Hommocks Park Ice Rink visitors during the average winter month in 2017-2018;

50 Main Street
Suite 360
White Plains, New York 10606
P 914.467.6600
F 914.761.3759

(3) Number of Memorial Park Tennis Court visitors during the average warm-weather month in 2017-2018;
(4) Any current issues of capacity at the Pool, Tennis Courts or Ice Rink, or other recreational facilities;
(5) Any current issues of capacity in recreational programming, including the Youth Hockey League and kayaking, tennis, golf, swimming or other recreational programs;
(6) Any planned changes or upgrades to Town recreational facilities, including sports fields.

Potential Impacts

(1) Anticipated issues of capacity at the Pool, Tennis Courts, Ice Rink or other recreational facilities as a result of the proposed project; and
(2) Recreation Department concerns regarding the proposed project (if any).

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

Town of Mamaroneck
Town Center
740 West Boston Post Road, Mamaroneck, NY 10543-3353

RECREATION DEPARTMENT

TEL: 914/381-7865
FAX: 914/381-7813
recreationdept@townofmamaroneck.org

July 6, 2018

Ms. Abigail Rudow, Planner
VHB
50 Main Street
Suite 360
White Plains, NY 10606

Re: Hampshire Country Club, Final Environmental Impact Statement

Dear Ms. Rudow:

As per your request, please find our responses to the following items:

Existing Conditions

(1) Number of Hommocks Pool visitors in total and from the Town of Mamaroneck during the average summer months in 2017: July and August are our busiest months and our monthly attendance is approximately 10,500 patrons per month. Our pool permit holders are mainly Town residents, however, we do sell a few non-resident pool permits as well. Town residents include those in the Unincorporated Town and the Villages of Mamaroneck and Larchmont. Permit holders are entitled to bring a guest.

(2) Number of Hommocks Park Ice Rink visitors during the average winter months in 2017-2018: The ice rink is busiest during the period of December – March and the monthly attendance for public skating sessions averages 7,000 patrons. In addition to public skating, the rink also hosts a variety of recreational skating programs such as a skating lessons, in-house hockey leagues and ice rentals for various groups which operate around the public session times.

(3) Numbers of Memorial Park Tennis Court visitors during the average warm-weather month in 2017-2018: 170.

(4) Any current issues of capacity at the Pool, Tennis Courts or Ice Rink, or other recreational facilities: In the summer, the outdoor training pool can easily reach capacity of 200. Weekdays during the summer months are quite busy due to hosting a variety of recreational aquatic programming and making the pool available to the local municipal and school district day camps. No capacity issues currently at the ice rink or tennis courts.

(5) Any current issues of capacity in recreational programming, including Youth Hockey League and kayaking, tennis, golf, swimming or other recreational programs: No.

(6) Any planned changes or upgrades to Town recreational facilities, including sports fields: Possible future expansion of Hommocks Park Ice Rink to include additional locker rooms and showers. We are also studying the potential to expand the existing outdoor pool area in order to add a splash pad/spray ground feature.

Town of Mamaroneck
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RECREATION DEPARTMENT

TEL: 914/381-7865
FAX: 914/381-7813
recreationdept@townofmamaroneck.org

Potential Impacts

(1) Anticipated issues of capacity at the Pool, Tennis Courts or Ice Rink or other recreational facilities as a result of the proposed project: Parking is currently an issue between the pool, school and rink, so the possibility of trying to accommodate even more vehicles may not be physically possible given the current parking lots on site now. Potential capacity issue with the number of campers using the pool during the summertime between Town and the Villages of Larchmont and Mamaroneck. We may need to limit the number of campers on site using the pool facility in the future.

(2) Recreation Department concerns regarding the proposed project (if any): Flow of traffic along Hommocks Road which is already slow and potentially dangerous with so many school aged children in the vicinity. Based on the capacity issues listed above, the prospect of additional facility users could become an issue.

If you have any further questions please feel free to contact me at (914) 381-7865 or jfisher@townofmamaroneckny.org.

Sincerely,

Jill Fisher
Superintendent of Recreation

cc: Stephen V. Altieri, Town Administrator

www.vhb.com

June 13, 2018

Larchmont/Mamaroneck Basketball Association
Via Email
rbbeers@aol.com

Re: Hampshire Country Club, Final Environmental Impact Statement

To Whom It May Concern:

We are planning consultants currently in the process of preparing a Final Environmental Impact Statement (EIS) for the proposed Planned Residential Subdivision and associated development of 44 one-family homes and 61 two- and three-family semi-detached townhomes on the current Hampshire Country Club property within the Village of Mamaroneck. The Proposed Project would also include development of seven tennis courts and preservation of approximately 36 acres of shared open space. The existing golf course use would be downsized to a 9-hole course, and the existing clubhouse and associated recreational facilities would remain in use. As outlined in the Draft Environmental Impact Statement from December 2017, utilizing the Residential Demographic Multipliers by Rutgers University Center for Urban Policy Research (June 2006), the Proposed Action is projected to generate approximately 57 public school children and 14 private school children. These 71 school children would be spread throughout the 13 grades (K-12). A copy of the DEIS can be accessed at http://www.village.mamaroneck.ny.us/Pages/MamaroneckNY_planning/Hampshire%20Application/SEQRA%20Documents/DEIS_FULL%2012_2017.pdf

The project site (the "Site") is located at 1025 Cove Road and consists of approximately 106.2 acres (***See Exhibit 1***). The Site is located adjacent to the Hommocks Ice Rink, Pool, and Hommocks Middle School. A portion of the Site borders the Long Island Sound. We have attached an initial site plan of the Proposed Project for your review (***See Exhibit 2***).

We have been asked by the Planning Board (the Lead Agency) to discuss the existing conditions and potential impact of the Proposed Project on youth leagues and field/court availability in the area. In this context, we would appreciate your written responses to the following items, which we would include in the FEIS:

Existing Conditions

(1) Number and age range of children enrolled in the 2017-2018 season;
(2) List of the municipalities from which children may participate in your league; and
(3) Estimated rate of participation in your League for school aged children in your service area;
(4) List of existing courts or recreational facilities used for League practice or play;
(5) Frequency of use and length of use (sports season) of those courts and/or recreational facilities; and
(6) Any existing problems with capacity of the League and/or court space.

Potential Impacts

(1) Anticipated impacts of the Proposed Project on League capacity and/or court availability. Specifics in terms of individual team or court capacity, if available, would be very helpful in our impact assessment; and
(2) Basketball League concerns regarding the Proposed Project (if any).

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

From:	Rob Beers
To:	Rudow, Abigail
Cc:	Monastra, Valerie
Subject:	[External] Re: Larchmont/Mamaroneck Basketball Association Information for EIS
Date:	Saturday, June 30, 2018 12:51:51 PM
Attachments:	image001.gif

Abi -

Apologies for the delayed reply. During the off-season basketball stuff gets shuttled to the back burner. I need a break after the work during the season. Regarding the questions in the attached, I answer by your bullets:

1. 1,175 kids played in the LMBA during the 2017/18 season.
2. Communities served are Larchmont/Mamaroneck and Rye Neck.
3. There are roughly 325 kids per grade in the Larchmont/Mamaroneck district. Rye Neck is much smaller, so let's say 100 kids per grade. We serve kids from grades one through twelve. So 425 times 12 gets 5,100 kids total in the district, so we serve roughly 23% of the district kids.
4. We use all four Larchmont/Mamaroneck elementary schools for practices; Hommocks middle school for our clinics; and Mamaroneck and Rye Neck high schools for games. On rarae occasions we use other facilities.
5. Our season runs from late November through mid-March. Facilities - or lack thereof - is the biggest limiting factor regarding league size so for frequency, we use them each as much as possible. Other groups compete for the spaces as well.
6. Yes, see above. We need more. As things currently stand, we are over capacity - late registrants are many times turned away - and the communities are growing. I honestly do not know how we will be able to accommodate more kids.

I address impacts the same way:
1. I do not think there will be any direct impact on the league except that at current capacity, assuming some of your foreseen 71 kids register, that many more kids will be turned away.
2. No specific concerns. I do not relish the thought of telling kids they cannot play but my hands are tied. I imagine the impact of that many kids on the school system will be much more troublesome.

Rob Beers, LMBA Commissioner

-----Original Message-----
From: Rudow, Abigail <ARudow@VHB.com>
To: rbbeers <rbbeers@aol.com>
Cc: Monastra, Valerie <VMonastra@VHB.com>
Sent: Thu, Jun 14, 2018 11:42 am
Subject: Larchmont/Mamaroneck Basketball Association Information for EIS

To Whom It May Concern,

I am a planning consultant currently working on an Environmental Impact Statement for the proposed development at the Hampshire Country Club property in the Village of Mamaroneck. This development will include 105 new residential housing units. An Environmental Impact Statement is meant to help discover any negative impacts that the new development may have on the community. The Village of Mamaroneck Planning Board has asked us to discuss any impacts on the recreational facilities and youth leagues in the area as a part of this process. To assist in this endeavor, I would greatly appreciate any information you have on the items in the attached letter. I have also attached a more detailed description of the proposed development for your review. Please feel free to email or call me with any questions or concerns.

Sincerely,

Abi Rudow

Abigail Rudow
Planner

50 Main Street
Suite 360
White Plains, NY 10606-1900
P 914.467.6616 **|** **F** 914.761.3759
arudow@vhb.com

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June 14, 2018

Larchmont-Mamaroneck Little League
P.O. Box 61
Larchmont, New York
10538
Via Email and USPS
admin@lmlittleleague.org

Re: Hampshire Country Club, Final Environmental Impact Statement

To Whom It May Concern:

We are planning consultants currently in the process of preparing a Final Environmental Impact Statement (EIS) for the proposed Planned Residential Subdivision and associated development of 44 one-family homes and 61 two- and three-family semi-detached townhomes on the current Hampshire Country Club property within the Village of Mamaroneck. The Proposed Project would also include development of seven tennis courts and preservation of approximately 36 acres of shared open space. The existing golf course use would be downsized to a 9-hole course, and the existing clubhouse and associated recreational facilities would remain in use. As outlined in the Draft Environmental Impact Statement from December 2017, utilizing the Residential Demographic Multipliers by Rutgers University Center for Urban Policy Research (June 2006), the Proposed Action is projected to generate approximately 57 public school children and 14 private school children. These 71 school children would be spread throughout the 13 grades (K-12). A copy of the DEIS can be accessed at
http://www.village.mamaroneck.ny.us/Pages/MamaroneckNY_planning/Hampshire%20Application/SEQRA%20Documents/DEIS_FULL%2012_2017.pdf

The project site (the "Site") is located at 1025 Cove Road and consists of approximately 106.2 acres (***See Exhibit 1***). The Site is located adjacent to the Hommocks Ice Rink, Pool, and Hommocks Middle School. A portion of the Site borders the Long Island Sound. We have attached an initial site plan of the Proposed Project for your review (***See Exhibit 2***).

We have been asked by the Planning Board (the Lead Agency) to discuss the existing conditions and potential impact of the Proposed Project on youth leagues and field availability in the area. In this context, we would appreciate your written responses to the following items, which we would include in the FEIS:

Existing Conditions

(1) Number and age range of children enrolled in the 2017-2018 season;
(2) List of the municipalities from which children may participate in your league;
(3) Estimated rate of participation in your league for school aged children in your service area;
(4) List of existing fields or recreational facilities used for Little League practice or play;

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50 Main Street
Suite 360
White Plains, New York 10606
P 914.467.6600
F 914.761.3759

(5) Frequency of use and length of use (sports season) of those fields and/or recreational facilities; and
(6) Any existing problems with capacity of the League and/or field space.

Potential Impacts

(1) Anticipated impacts of the Proposed Project on League capacity and/or field availability. Specifics in terms of individual team or field capacity, if available, would be very helpful in our impact assessment; and
(2) Any other Little League concerns regarding the Proposed Project (if any).

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

CC: Bill Nachtigal, President – Larchmont-Mamaroneck Little League

From:	Bill Nachtigal
To:	Rudow, Abigail
Cc:	Paul Sutter
Subject:	Re: RE: RE: RE: [External] Re: Larchmont-Mamaroneck Little League Information for EIS
Date:	Friday, July 20, 2018 9:20:54 AM
Attachments:	image001.gif

Hi Abi,

Here is information. Questions, please let us know. I have also copied Paul Sutter on this email. We are currently transitioning my role as President to Paul. Please include us both in any follow up correspondence.

Thank you.

Bill

Existing Conditions

1. **Number and age range of children enrolled in the 2017-2018 season:** approximately 1500 participants ranging from pre-k to grade 12, the majority being from K-8. Approximately 75% of participation is from Mamaroneck School District.
2. **List the Municipalities from which children may participate in your league:** Villages of Larchmont, Mamaroneck and Rye Neck including both the Mamaroneck and Rye Neck school districts.
3. **Estimated rate of participation in your league for school aged children in your service area:** 25%-30% of school aged children predominantly between the grades of K-8.
4. **List of existing fields or recreational facilities used for Little League practice or play:** Harbor Island Park, Lorenzen Park, Flint Park, Florence Park and Pine Brook Park. To a lesser extent Mamaroneck and Rye Neck School District facilities.
5. **Frequency of use and length of use (sports season) of those fields and/or recreational spaces:** We have spring, summer and fall seasons running April-June, June-August, and Sep-Oct respectively. Spring and summer includes late afternoons/evenings on weekdays and all day on weekends. Fall is primarily weekend use all day.
6. **Any existing problems with capacity of the league/or field space:** Absolutely! Every year it is challenging to coordinate field space/time given all the various youth sports organizations that share parks and facilities. Further, every year there are private teams that are also allocated field space making capacity issues worse. It should also be noted that during our spring season there is very limited, if any time/space available for formal practices as the majority of capacity is taken up by game play.

Potential Impacts

1. **Anticipated impacts of the proposed project on league capacity and/or field availability. Specifics in terms of individual team or field capacity, if available, would be very helpful in our impact assessment.** We are confident that in any given year 25%-30% of additional children in our age range will participate in LMLL which will result in more teams, games, practices and the need for additional field capacity.
2. **Any other little league concerns regarding the proposed project if any:** We are currently facing constraints on our ability to use existing fields due to resident concerns about parking and traffic around Lorenzen Park. Given that this project is in the area of Flint Park and we expect that with more housing there will be more traffic, we believe that this increase in traffic could further impact our ability to use existing fields in Flint Park.

On Thursday, June 14, 2018, 12:02:21 PM EDT, Rudow, Abigail <ARudow@VHB.com> wrote:

June 15, 2018

Dr. Robert Shaps, Superintendent of Schools
Mamaroneck Union Free School District
1000 West Boston Post Road
Mamaroneck, New York 10543

Via email and USPS
rshaps@mamkschools.org
cc: JRice@mamkschools.org

Re: Hampshire Country Club, Final Environmental Impact Statement

Dear Dr. Shaps:

We are planning consultants currently in the process of preparing the Final Environmental Impact Statement (EIS) for the proposed Planned Residential Subdivision and associated development of 44 one-family homes and 61 two- and three-family semi-detached townhomes on the current Hampshire Country Club property within the Village of Mamaroneck. The Proposed Project would also include development of seven tennis courts and preservation of approximately 36 acres of shared open space. The existing golf course use would be downsized to a 9-hole course, and the existing clubhouse and associated recreational facilities would remain in use.

The project site (the "Site") is located at 1025 Cove Road and consists of approximately 106.2 acres (***See Exhibit 1***). The Site is located adjacent to the Hommocks Ice Rink, Pool, and Hommocks Middle School. A portion of the Site borders the Long Island Sound. We have attached an initial site plan of the Proposed Project for your review (***See Exhibit 2***).

As you know, and as outlined in the Draft Environmental Impact Statement from December 2017, utilizing the Residential Demographic Multipliers by Rutgers University Center for Urban Policy Research (June 2006), the DEIS estimated that the Proposed Action is projected to generate approximately 57 public school children and 14 private school children. A copy of the DEIS can be accessed at http://www.village.mamaroneck.ny.us/Pages/MamaroneckNY_planning/Hampshire%20Application/SEQRA%20Documents/DEIS_FULL%2012_2017.pdf.

Based on your testimony at the public hearing on February 14 and the concerns raised from members of the community regarding MUFSD enrollment and crowding, we have been asked by the Planning Board (the Lead Agency) to assess the impacts of the Proposed Project on the District, including if there is a need for new capital facilities as a result of the children generated by the Proposed Project.

In this context, we would appreciate your written responses to the following items, which we would include in the FEIS:

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\\vhb\proj\WhitePlains\28677.03\docs\VARIOUS\Community Facility Outreach\Community facilities request_School District.docx

Existing Conditions

(1) Capacity and enrollment of existing schools in the Mamaroneck Union Free School District, by school and grade for the past five years.
(2) A copy of the 2015 detailed analysis for school children generation using the ESI and high-value school district demographic multipliers, as well as the source documentation for the analysis (mentioned in your public hearing testimony).
(3) Any existing studies that reflect capital facility needs by school building for the current school population.

Potential Impacts

(1) MUFSD has indicated the need for new portable buildings as recently as 2017 for other schools in the District. Please provide what you project will be the need for new capital facilities as a result of the 57 children generated by the Proposed Project.
(2) Any other School District concerns regarding the Proposed Project.

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

Sincerely,

Abigail Rudow

Abigail Rudow

Planner
arudow@vhb.com

MAMARONECK UNION FREE SCHOOL DISTRICT

Robert I. Shaps, Ed.D
Superintendent of Schools

1000 W. Boston Post Road * Tel 914 220-3005
Mamaroneck, NY 10543* Fax 914 220-3010
rshaps@mamkschools.org

August 3, 2018

Ms. Abigail Rudow
Planner
VHB
50 Main Street
Suite 360
White Plains, NY 10606

Re: Hampshire Country Club Final Environmental Impact Statement

Dear Ms. Rudow,

As stated in your letter dated June 15, 2018 VHB is requesting additional information from the Mamaroneck UFSD in order to complete a Final Environmental Impact Statement in connection with the Hampshire Country Club development project. While I am willing to meet your request for additional information, I am perplexed that VHB, a firm managing development is incapable of sourcing readily available residential demographic multipliers.

District Response:

Existing Conditions

1. Capacity and enrollment of existing schools in the Mamaroneck Union Free School District, by school and grade for the past five years.

Historical school enrollment data is available at www.mamkschools.org located within the District data dashboard. School capacity is based on several factors including Board of Education class size guidelines, total number of instructional spaces, and enrollment. Based on the aforementioned conditions, our current capacity for the 2018-19 school year is as follows:

Central Elementary	28 classrooms utilized / 4 classrooms available
Chatsworth Elementary	32 classrooms utilized / 1 classroom available
Mamaroneck Ave Elem	41 classrooms utilized / 1 classroom available
Murray Ave Elementary	42 classrooms utilized / fully utilized – no available classrooms
Hommocks Middle School	100% classroom utilization
Mamaroneck High School	100% classroom utilization

2. A copy of the 2015 detailed analysis for school children generation using the ESI and high-value school district demographic multipliers, as well as the source documentation for the analysis:

Location	Unit Type	Units	ESI Multiplier	SAC	High Value District Multiplier (1.1)
Hampshire Country Club	61 three bedroom "Carriage Houses"	61	0.687	42	67
Hampshire Country Club	44 four bedroom Single Family Homes	44	0.969	43	48

(ESI documentation included)

3. Any existing studies that reflect capital facility needs by school building for the current school population.

Mamaroneck UFSD is required to submit a Five-Year Building Conditions Survey to the New York State Education Department itemizing all capital needs. This information is publicly available to interested parties. The breakdown of identified capital needs by school is as follows:

Central Elementary	$4,659,121
Chatsworth Elementary	$6,314,057
Hommocks Middle School	$7,873,992
Mamaroneck Ave Elem	$7,354,077
Mamaroneck High School	$16,623,744
Murray Ave Elementary	$6,497,799
Total	$50,372,236*

*assuming a 25% escalation for differed work revised total: $60,709,381

Potential Impacts

1. MUFSD has indicated the need for new portable buildings as recently as 2017, for other schools in the District. Please provide what you project will be the need for new capital facilities as a result of the 57 children generated by the proposed project.

The Mamaroneck UFSD Board of Education declined to pursue portable classrooms for the 2018-19 school year. As stated at the February 13, 2018 Village of Mamaroneck Public Hearing, I do not agree with the school impact enrollment projections presented by VHB (57 students). We believe the proposed project will generate no less than 85 students in grades K – 12.

Sincerely,

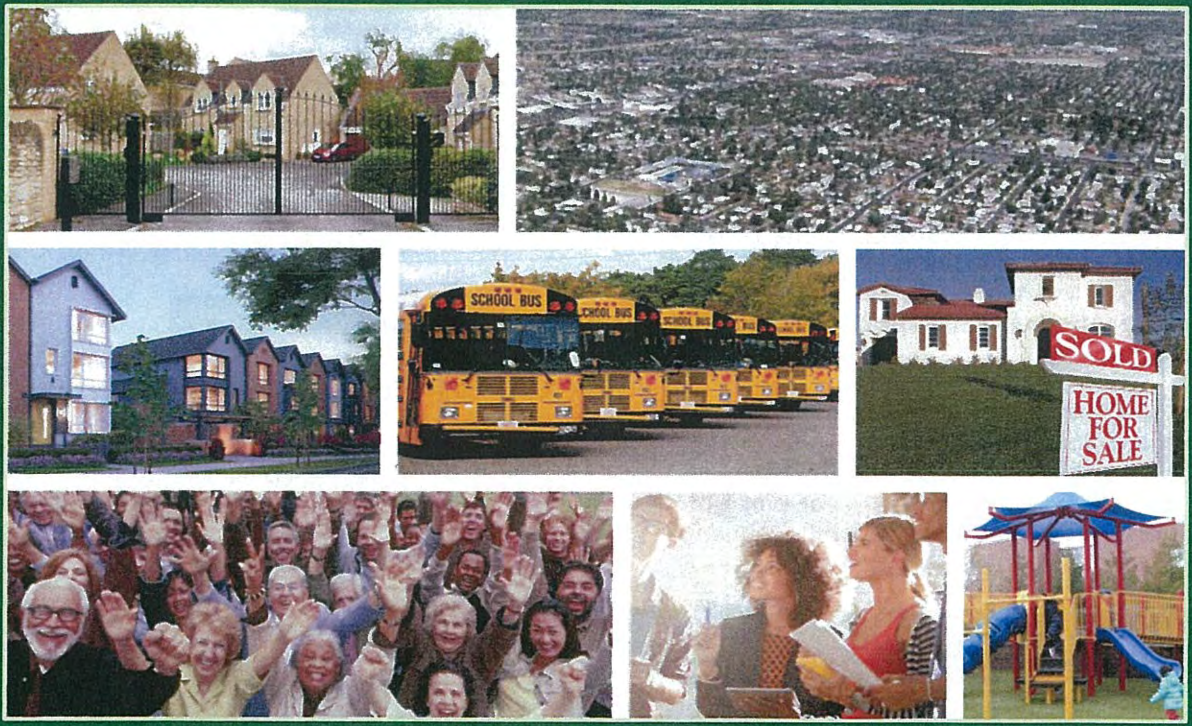
Robert I. Shaps
Superintendent of Schools

Cc: Mr. Greg Cutler, Village Planner, Village of Mamaroneck

WHO MOVES INTO NEW YORK HOUSING?

2015 Residential Demographic Multipliers

November 2017



plan with confidence

COMMUNITY DATAANALYTICS

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1435 Walnut St., 4th Floor | Philadelphia, PA 19102 | econsultsolutions.com

2015 ESI Residential Demographic Multipliers

ECONSULT SOLUTIONS
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Report created in November 2017
Derived from 2011-2015 ACS-PUMS

Overview

This report presents two sets of 2015 residential demographic multipliers produced by Econsult Solutions, Inc. (ESI):

a) School-age children (SAC) per household, and
b) Total persons per household, also known as average household size (AVHH).

The multipliers are developed by ESI's Community Data Analytics (CDA) team, using the most current American Community Survey (ACS) Public Use Microdata Sample (PUMS) records. The estimates are based on a mover sample that contains households whose householders moved into a unit between 2008 and 2015.

What is a Demographic Multiplier?

A residential demographic multiplier is an average ratio of demographic measures per occupied housing unit or per household. Common examples are SAC (persons age 5 to 17), AVHH, public school-age children or attendees.

Multipliers are reported by housing configuration defined by multiple characteristics, such as structure type, size, housing tenure, and housing value or rent. This specificity is needed to match the housing component of development projects.

Demographic Multipliers are Critical to Development Impact Analysis

Demographic multipliers serve a critical role in development impact studies which planners, developers, school districts, local governments, and policymakers rely on to make land use and zoning decisions.

Government officials have a duty to maintain a sustainable living environment and prevent their residents from suffering school overcrowding, gridlock, gaps in public services, and fiscal distress. As such, they need impact analysis to assess development proposals. Should a development potentially generate negative impacts, decision makers need to mitigate these effects by scaling down the project, changing the housing mix, charging impact fees, imposing alternate conditions such as free public facilities, open space, and infrastructure improvement.

Demographic multipliers provide vital inputs to estimating added populations in development impact studies. They are critical to assessing impact fees and consequent costs to public services.

However, the popular Fannie Mae demographic multiplier series still widely used was released 11 years ago based on the 2000 census 5-percent PUMS. The use of outmoded data can produce inaccurate estimates of development impacts, overestimating or underestimating how new developments will affect school enrollment, traffic patterns, and municipal finances. An urgent need exists to devise current demographic multipliers that reflect recent demographic changes.

Improved Multipliers

ESI multipliers are developed to provide up-to-date information and to minimize biases in estimating development impacts.

ESI multipliers have the following enhancements:

- They are derived from the most recent 2011-2015 ACS PUMS.
- A large and more stable mover sample is used.
- Due to a larger sample, the estimates are associated with a smaller margin of error and a narrower range between the lower and upper limits.
- ESI multipliers can be updated each year after the annual ACS PUMS is distributed.
- The large sample enables the generation of multipliers for small areas.

Except for the District of Columbia, multipliers reported in this report are at the state level, and should not be considered as representative to local demographic conditions.

Mover Sample Multipliers: New York

Housing Configurations	School-Age Children			Total Persons		
	Per Household Estimates	90 Percent Confidence Interval		Per Household Estimates	90 Percent Confidence Interval	
		Lower	Upper		Lower	Upper
All Housing Types						
Own or Rent						
All Sizes	0.419	0.413	0.424	2.457	2.448	2.466
1 Bedroom or Studio	0.108	0.104	0.111	1.597	1.587	1.607
2 Bedroom	0.362	0.354	0.370	2.418	2.404	2.432
3 Bedroom	0.687	0.673	0.700	3.159	3.140	3.178
4 Bedroom	0.969	0.942	0.996	3.741	3.706	3.775
Own Only						
1 Bedroom or Studio	0.060	0.051	0.070	1.584	1.555	1.613
2 Bedroom	0.179	0.168	0.189	2.124	2.097	2.151
3 Bedroom	0.480	0.467	0.494	2.832	2.809	2.856
Rent Only						
1 Bedroom or Studio	0.112	0.108	0.116	1.598	1.588	1.609
2 Bedroom	0.403	0.393	0.412	2.484	2.468	2.500
3 Bedroom	0.860	0.841	0.880	3.435	3.404	3.466
Single-Family Units						
All Single-Family, Own or Rent						
All Sizes	0.622	0.611	0.633	2.981	2.964	2.998
3 Bedroom	0.580	0.564	0.596	2.932	2.909	2.956
4 Bedroom	0.924	0.895	0.952	3.600	3.563	3.638
Detached, Own or Rent						
All Sizes	0.634	0.622	0.646	3.004	2.987	3.022
Attached, Own or Rent						
All Sizes	0.550	0.524	0.577	2.847	2.801	2.894
Multi-Family Units						
All Multi-Family, Own or Rent						
All Sizes	0.334	0.328	0.340	2.238	2.227	2.249
2 Bedroom	0.386	0.376	0.395	2.467	2.451	2.484
2-4 Unit Structure, Own or Rent						
All Sizes	0.466	0.455	0.477	2.584	2.568	2.600
5+ Unit Structure, Own or Rent						
All Sizes	0.261	0.254	0.269	2.048	2.034	2.062

Multiplier estimates pertain to a mover sample, i.e. units that householders moved into the unit between 2008 and 2015.
If the value of the lower limit is negative, zero is reported.

Refined Housing Configurations

The table reports on multipliers for selected housing configurations. ESI has prepared multipliers for over 80 configurations such as 2-bedroom townhomes, 3-bedroom single-family rental units, and studio units in a rental apartment.

Users are welcomed to contact ESI for more details on these additional multipliers. Multipliers for custom geographies or samples other than the mover sample can be generated upon request.

Glossary

2-4 Unit. A housing unit in multifamily structures containing 2, 3, or 4 units.

5+ Unit. A housing unit in multifamily structures containing 5 or more units.

American Community Survey (ACS). An ongoing survey taken each year by the Census Bureau. It provides 1-year, 3-year, and 5-year estimates of demographic, housing, social, and economic information.

Average Household Size. Average household size is a measure obtained by dividing the number of people in households by the number of households. It is equivalent to the total persons per household multiplier. People in group quarters are excluded.

Bedroom. The room in a housing unit designed to be used as bedroom; a one-room unit such as studio, efficiency, or in-law apartment is considered as having no bedroom.

Confidence Interval. It is a probability-dependent interval of a sample estimate factoring into the margin of errors. Following the Census Bureau tradition, a probability of 90 percent is used. In other words, there is a 90-percent chance that the "true" multiplier falls within lower and upper limits.

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This illustrates how school-age children multipliers are used to estimate the impact to the public school system. The development proposal contains 190 units with the following housing mix. [Impacts on population, traffic, and other impacts can be similarly projected.]

Single-Family Home, Detached	Units
3 Bedroom	40
4 Bedroom	20
3-Bedroom Townhome	50
5-Story Condominium & Apartment	
2 Bedroom	80

After Step 3, a table of matching geographically-specific SAC is created.

	Units	SAC, mid-point estimate
Single-Family Home, Detached		
3 Bedroom	40	0.485
4 Bedroom	20	0.816
3-Bedroom Townhome (treated as single-family attached)	50	0.425
5-Story Condominium & Apartment (treated as 5+ unit multifamily)		
2 Bedroom	80	0.284

The number of SAC is estimated before vacancy adjustment is conducted (figures are rounded to the nearest integer).

	Units	SAC, mid-point estimate	Number of SAC	Total SAC
Single-Family Homes, Detached				
3 Bedroom	40	0.485	19	
4 Bedroom	20	0.816	16	
3-Bedroom Townhome	50	0.425	21	
5-Story Condominium & Apartment				
2 Bedroom	80	0.284	23	
				79

Assume an occupancy rate of 94 percent; and local public school participation rate of 73 percent, i.e. 27 of the 100 SAC are home-schooling, attending private and other non-public schools, etc.

The mid-point estimate of SAC who will attend public schools from this development:

79 x 94% x 73% = 54

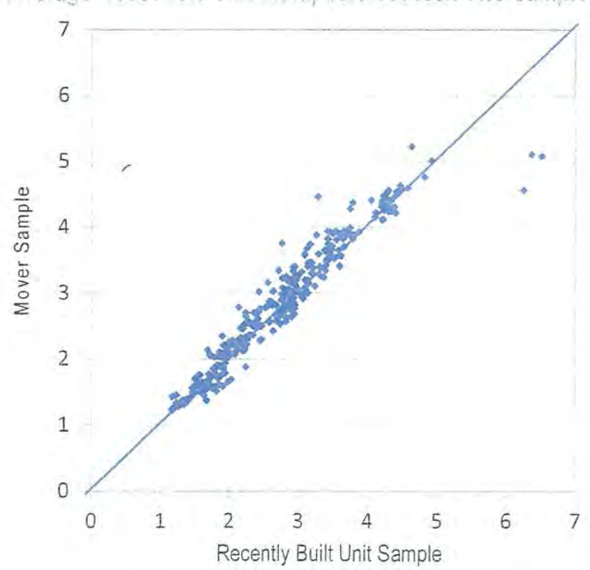
Technical Notes

Comparing the Mover Sample with the Recently Built Sample. The housing downturn between 2007 and 2012 significantly reduced the sample size of the recently-built unit sample used to generate traditional multipliers. As a result, statistically valid multipliers are not available for less popular housing configurations and some age- or grade group-differentiated multipliers.

To solve this problem, ESI created a mover sample based on the assumption that movers to new and older units have similar attributes as those who live in recently built units. The size of the mover sample is on average about 4.4 times larger the recently built unit sample. The mover samples is less affected by housing activity and has better potential to estimate local multipliers for an aggregate of several PUMAs.

At the state level, the AVHH from the two samples highly correlate, with a Pearson r of 0.966. Below is a scatterplot of 362 AVHH pairs in Arkansas, California, Georgia, New Jersey, and Ohio.

Average Household Size Multipliers between Two Samples



Historical Comparison. Mover-based demographic multipliers using historical data are being examined by ESI and will be reported to the public. Comparing the 2000 and 2015 multipliers from 10-year recently built unit samples is being performed by the CDA team but sample size issue of the 2015 multipliers makes historical comparison of some configurations difficult. One possible solution is to extend the earliest year of structure built to 2000.

Other ESI Demographic Multipliers. ESI also generates multipliers like local public school attendees, vehicles available, workers who drive or use public transit to work, average household income, persons who are foreign born, and so on. While the mover sample is the staple, ESI can provide multipliers based on samples like recently built units, condominium units, specialized housing, or samples for small geography.

Resources and References

Users can find resources on demographic multipliers at http://www.econsultsolutions.com/cda-library. This includes materials the CDA team uses to guide research on estimation methodology and how to improve impact analysis. Below are selected works on demographic multipliers:

Burchell, Robert W. & David Listokin. 1978. *The Fiscal Impact Handbook: Estimating Local Costs and Revenues of Land Development*. New Brunswick, NJ: Center for Urban Policy Research.

Burchell, Robert W., David Listokin, & William Dolphin. 2006. *Fannie Mae Foundation Residential Demographic Multipliers: Projections of the Occupants of New Housing*. [Report series for the US, 50 states and the District of Columbia].

Listokin, David, Ioan Voicu, William Dolphin, & Matthew Camp. 2006. *Who Lives in New Jersey Housing? New Jersey Demographic Multipliers*. New Brunswick, NJ: Center for Urban Policy Research.

Wong, Sidney. 2016. "A New Technique for More Accurate Impact Assessment," http://www.econsultsolutions.com/a-new-technique-for-more-accurate-impact-assessment/

Wong, Sidney. 2016. "Demographic Multipliers: Data Mining & Measuring Development Impacts," *Planning and Technology Today*, 113 (Summer/Fall):6-7.

Wong, Sidney, Daniel Miles, Gabrielle Connor, Brooke Queenan, & Alison Shott. 2017. "Residential Demographic Multipliers: Using Public Use Microdata Sample Records to Estimate Housing Development Impacts," *Cityscape: A Journal of Policy Development and Research*, 19(3): 312-24.

Contact

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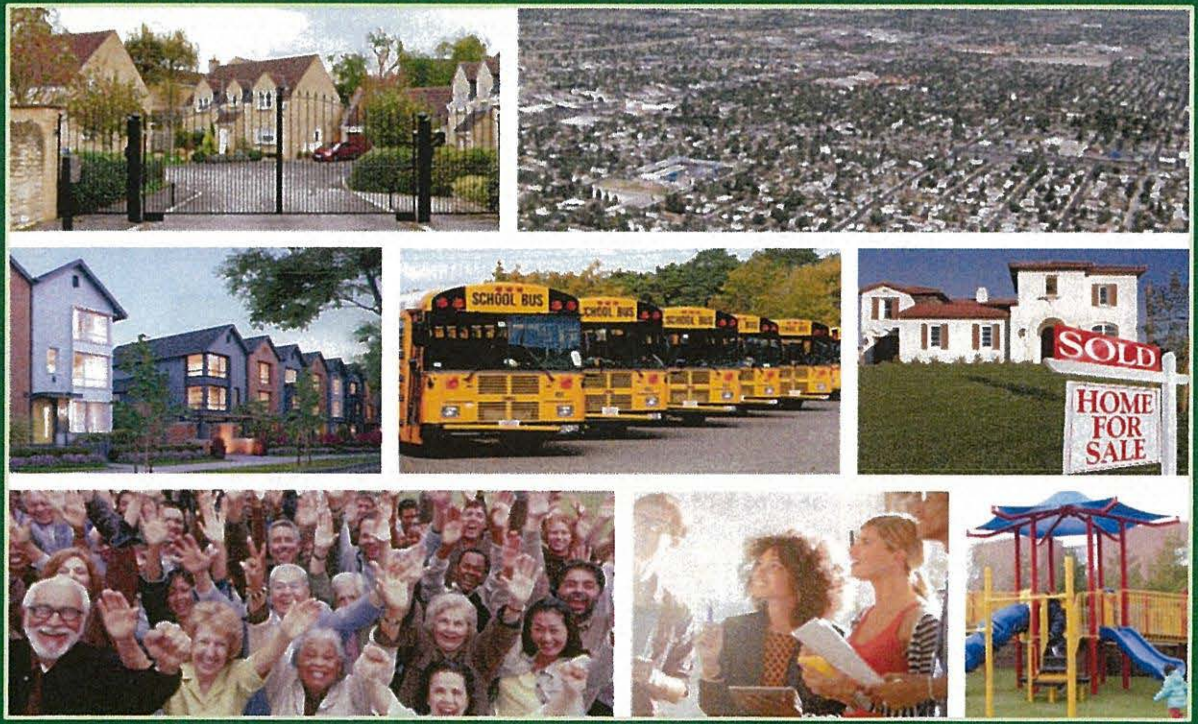
Dr. Sidney Wong, CDA Project Lead
wong@econsultsolutions.com

WHO MOVES INTO NEW YORK HOUSING?

2015 Residential Demographic Multipliers

November 2017



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2015 ESI Residential Demographic Multipliers

Version created in November 2017
Derived from 2011-2015 ACS 5-PUMS

Overview

This report presents two sets of 2015 residential demographic multipliers produced by Econsult Solutions, Inc. (ESI):

a) School-age children (SAC) per household, and
b) Total persons per household, also known as average household size (AVHH).

The multipliers are developed by ESI's Community Data Analytics (CDA) team, using the most current American Community Survey (ACS) Public Use Microdata Sample (PUMS) records. The estimates are based on a mover sample that contains households whose householders moved into a unit between 2008 and 2015.

What is a Demographic Multiplier?

A residential demographic multiplier is an average ratio of demographic measures per occupied housing unit or per household. Common examples are SAC (persons age 5 to 17), AVHH, public school-age children or attendees.

Multipliers are reported by housing configuration defined by multiple characteristics, such as structure type, size, housing tenure, and housing value or rent. This specificity is needed to match the housing component of development projects.

Demographic Multipliers are Critical to Development Impact Analysis

Demographic multipliers serve a critical role in development impact studies which planners, developers, school districts, local governments, and policymakers rely on to make land use and zoning decisions.

Government officials have a duty to maintain a sustainable living environment and prevent their residents from suffering school overcrowding, gridlock, gaps in public services, and fiscal distress. As such, they need impact analysis to assess development proposals. Should a development potentially generate negative impacts, decision makers need to mitigate these effects by scaling down the project, changing the housing mix, charging impact fees, imposing alternate conditions such as free public facilities, open space, and infrastructure improvement.

Demographic multipliers provide vital inputs to estimating added populations in development impact studies. They are critical to assessing impact fees and consequent costs to public services.

However, the popular Fannie Mae demographic multiplier series still widely used was released 11 years ago based on the 2000 census 5-percent PUMS. The use of outmoded data can produce inaccurate estimates of development impacts, overestimating or underestimating how new developments will affect school enrollment, traffic patterns, and municipal finances. An urgent need exists to devise current demographic multipliers that reflect recent demographic changes.

Improved Multipliers

ESI multipliers are developed to provide up-to-date information and to minimize biases in estimating development impacts.

ESI multipliers have the following enhancements:

- They are derived from the most recent 2011-2015 ACS PUMS.
- A large and more stable mover sample is used.
- Due to a larger sample, the estimates are associated with a smaller margin of error and a narrower range between the lower and upper limits.
- ESI multipliers can be updated each year after the annual ACS PUMS is distributed.
- The large sample enables the generation of multipliers for small areas.

Except for the District of Columbia, multipliers reported in this report are at the state level, and should not be considered as representative to local demographic conditions.

Mover Sample Multipliers: New York

Housing Configurations	School-Age Children			Total Persons		
	Per Household Estimates	90 Percent Confidence Interval		Per Household Estimates	90 Percent Confidence Interval	
		Lower	Upper		Lower	Upper
All Housing Types						
Own or Rent						
All Sizes	0.419	0.413	0.424	2.457	2.448	2.466
1 Bedroom or Studio	0.108	0.104	0.111	1.597	1.587	1.607
2 Bedroom	0.362	0.354	0.370	2.418	2.404	2.432
3 Bedroom	0.687	0.673	0.700	3.159	3.140	3.178
4 Bedroom	0.969	0.942	0.996	3.741	3.706	3.775
Own Only						
1 Bedroom or Studio	0.060	0.051	0.070	1.584	1.555	1.613
2 Bedroom	0.179	0.168	0.189	2.124	2.097	2.151
3 Bedroom	0.480	0.467	0.494	2.832	2.809	2.856
Rent Only						
1 Bedroom or Studio	0.112	0.108	0.116	1.598	1.588	1.609
2 Bedroom	0.403	0.393	0.412	2.484	2.468	2.500
3 Bedroom	0.860	0.841	0.880	3.435	3.404	3.466
Single-Family Units						
All Single-Family, Own or Rent						
All Sizes	0.622	0.611	0.633	2.981	2.964	2.998
3 Bedroom	0.580	0.564	0.596	2.932	2.909	2.956
4 Bedroom	0.924	0.895	0.952	3.600	3.563	3.638
Detached, Own or Rent						
All Sizes	0.634	0.622	0.646	3.004	2.987	3.022
Attached, Own or Rent						
All Sizes	0.550	0.524	0.577	2.847	2.801	2.894
Multi-Family Units						
All Multi-Family, Own or Rent						
All Sizes	0.334	0.328	0.340	2.238	2.227	2.249
2 Bedroom	0.386	0.376	0.395	2.467	2.451	2.484
2-4 Unit Structure, Own or Rent						
All Sizes	0.466	0.455	0.477	2.584	2.568	2.600
5+ Unit Structure, Own or Rent						
All Sizes	0.261	0.254	0.269	2.048	2.034	2.062

Multiplier estimates pertain to a mover sample, i.e. units that householders moved into the unit between 2008 and 2015. If the value of the lower limit is negative, zero is reported.

Refined Housing Configurations

The table reports on multipliers for selected housing configurations. ESI has prepared multipliers for over 80 configurations such as 2-bedroom townhomes, 3-bedroom single-family rental units, and studio units in a rental apartment.

Users are welcomed to contact ESI for more details on these additional multipliers. Multipliers for custom geographies or samples other than the mover sample can be generated upon request.

2015 ESI Residential Demographic Multipliers

Glossary

2-4 Unit. A housing unit in multifamily structures containing 2, 3, or 4 units.

5+ Unit. A housing unit in multifamily structures containing 5 or more units.

American Community Survey (ACS). An ongoing survey taken each year by the Census Bureau. It provides 1-year, 3-year, and 5-year estimates of demographic, housing, social, and economic information.

Average Household Size. Average household size is a measure obtained by dividing the number of people in households by the number of households. It is equivalent to the total persons per household multiplier. People in group quarters are excluded.

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2 Bedroom	80	0.284	23	
				79

Assume an occupancy rate of 94 percent; and local public school participation rate of 73 percent, i.e. 27 of the 100 SAC are home-schooling, attending private and other non-public schools, etc.

The mid-point estimate of SAC who will attend public schools from this development:

79 x 94% x 73% = 54

2015 ESI Residential Demographic Multipliers

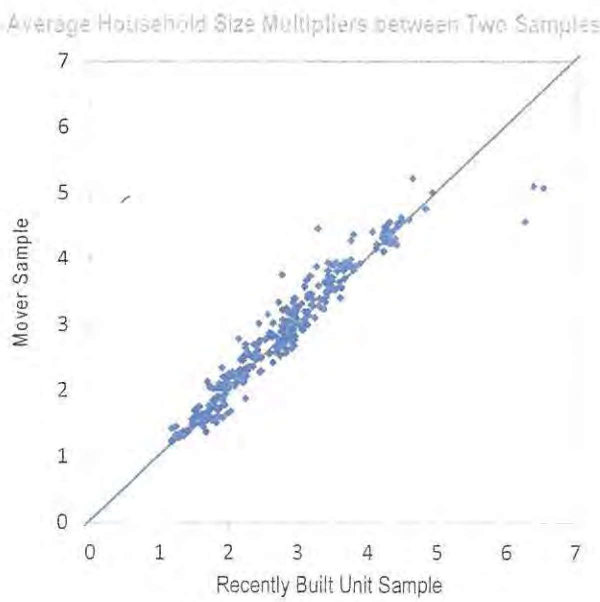
ECONSULT SOLUTIONS

Technical Notes

Comparing the Mover Sample with the Recently Built Sample. The housing downturn between 2007 and 2012 significantly reduced the sample size of the recently-built unit sample used to generate traditional multipliers. As a result, statistically valid multipliers are not available for less popular housing configurations and some age- or grade group-differentiated multipliers.

To solve this problem, ESI created a mover sample based on the assumption that movers to new and older units have similar attributes as those who live in recently built units. The size of the mover sample is on average about 4.4 times larger the recently built unit sample. The mover samples is less affected by housing activity and has better potential to estimate local multipliers for an aggregate of several PUMAs.

At the state level, the AVHH from the two samples highly correlate, with a Pearson *r* of 0.966. Below is a scatterplot of 362 AVHH pairs in Arkansas, California, Georgia, New Jersey, and Ohio.



Historical Comparison. Mover-based demographic multipliers using historical data are being examined by ESI and will be reported to the public. Comparing the 2000 and 2015 multipliers from 10-year recently built unit samples is being performed by the CDA team but sample size issue of the 2015 multipliers makes historical comparison of some configurations difficult. One possible solution is to extend the earliest year of structure built to 2000.

Other ESI Demographic Multipliers. ESI also generates multipliers like local public school attendees, vehicles available, workers who drive or use public transit to work, average household income, persons who are foreign born, and so on. While the mover sample is the staple, ESI can provide multipliers based on samples like recently built units, condominium units, specialized housing, or samples for small geography.

Resources and References

Users can find resources on demographic multipliers at http://www.econsultsolutions.com/cda-library. This includes materials the CDA team uses to guide research on estimation methodology and how to improve impact analysis. Below are selected works on demographic multipliers:

Burchell, Robert W. & David Listokin. 1978. *The Fiscal Impact Handbook: Estimating Local Costs and Revenues of Land Development*. New Brunswick, NJ: Center for Urban Policy Research.

Burchell, Robert W., David Listokin, & William Dolphin. 2006. *Fannie Mae Foundation Residential Demographic Multipliers: Projections of the Occupants of New Housing*. [Report series for the US, 50 states and the District of Columbia].

Listokin, David, Ioan Voicu, William Dolphin, & Matthew Camp. 2006. *Who Lives in New Jersey Housing? New Jersey Demographic Multipliers*. New Brunswick, NJ: Center for Urban Policy Research.

Wong, Sidney. 2016. "A New Technique for More Accurate Impact Assessment." http://www.econsultsolutions.com/a-new-technique-for-more-accurate-impact-assessment/

Wong, Sidney. 2016. "Demographic Multipliers: Data Mining & Measuring Development Impacts." *Planning and Technology Today*, 113 (Summer/Fall):6-7.

Wong, Sidney, Daniel Miles, Gabrielle Connor, Brooke Queenan, & Alison Shott. 2017. "Residential Demographic Multipliers: Using Public Use Microdata Sample Records to Estimate Housing Development Impacts." *Cityscape: A Journal of Policy Development and Research*, 19(3): 312-24.

Contact

Econsult Solutions, Inc. is a Philadelphia-based consultant providing economic studies, impact analysis, and GIS and PUMS analytics services. For more information please contact:

Dr. Sidney Wong, CDA Project Lead
wong@econsultsolutions.com

www.vhb.com

August 16, 2018

Dr. Robert Shaps, Superintendent of Schools
Mamaroneck Union Free School District
1000 West Boston Post Road
Mamaroneck, New York 10543

Via email and USPS
rshaps@mamkschools.org
cc: JRice@mamkschools.org
Mr. Greg Cutler, Village Planner, Village of Mamaroneck

Re: Hampshire Country Club, Final Environmental Impact Statement

Dear Dr. Shaps:

We received your letter dated August 3, 2018. Thank you for the information you provided on existing capacity and capital facility needs in the Mamaroneck Union Free School District. This information will be incorporated into the Final Environmental Impact Statement.

We also appreciate you providing the materials from Econsult Solutions, Inc. (ESI) with the residential demographic multipliers referenced during the Public Hearing on Hampshire's DEIS. The Village Planning Board requested that Hampshire evaluate potential Project-specific impacts on School District resources, accounting for the methodology you referenced in your testimony during the DEIS Public Hearing. Accordingly, we believed it would be most prudent to request from the School District the specific report relied upon to compile the projections cited in your testimony, so that we could ensure that we are relying the same methodology.

We have reviewed ESI's 2015 Residential Demographic Multipliers report, and would like to clarify a point concerning the School District's projection that Hampshire's proposed 105-unit Planned Residential Development would generate no less than 85 students. We respectfully submit that the School District's projection incorrectly applies the multipliers contained in the ESI Report.

Specifically, ESI indicates that "For more accurate projection results, users should differentiate the housing mix with as much detail as possible." The Proposed Action consists of 44 detached 4-bedroom single-family homes, and 61 3-bedroom attached carriage townhomes. In accordance with ESI's guidance concerning differentiating the housing mix, it would appear that the most appropriate multiplier to use for the 44 4-bedroom detached single family homes proposed would be 0.924 because it corresponds with the "All Single-Family, Own or Rent, 4 Bedroom" category. The ESI report guidelines also indicated that a "townhome" is classified as a single-family attached unit. Thus, it would appear that the most appropriate

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multiplier to use for the 61 attached townhome units would be 0.550 because it corresponds with the single-family "attached" category.

The School District selected the multiplies from ESI's general "all housing types" category (i.e., 0.969 for any 4-bedroom unit and 0.687 for any 3-bedroom unit). These generalized multipliers do not differentiate between unit type, and therefore, do not accurately reflect the housing mix associated with the Proposed Action.

These multipliers produce an estimate of total number of school aged children generated by a project. According to the ESI report, the total number of projected school aged children should be adjusted to reflect analysis "the state or regional SAC (School Age Children) with the local public school participation rate." The purpose of this adjustment is to subtract from the total number of school aged children the population that will likely attend private schools. It did not appear from the materials provided that the School District adjusted its projections to account for the public school participation rate in the District.

Using publicly available data from the NYS Education Department, VHB has calculated the appropriate public school participation rate as 87.8%. The Public School Participation Rate was calculated as follows:

Nonpublic School Enrollment, Mamaroneck District of Residence, 2017 – 2018 *(source: NYS Education Department, Information and Reporting Services)*	780
Total Mamaroneck UFSD Enrollment, 2017 – 2018 (*source: Mamaroneck UFSD Data Dashboard 2018)*	5,588
Public School Participation Rate *(Public School enrollment / Total school enrollment)*	87.8 %

As shown below, the analysis, following the process outlined in the ESI report, results in a total estimate of 66 Public School Age Children to be generated by the Proposed Action.

Projected Public School-Children Generated

Unit Type	Number of Units	ESI Multiplier	School Age Children (Public and Private School)	Public School Participation Rate	Total Public School Age Children
4-bedroom Single-Family Home	44	0.924	41		
3-bedroom Carriage Home	61	0.550	34		
TOTAL	105		75	87.8 %	66

For comparison, the same analysis conducted using the Rutgers University multipliers utilized in the Draft Environmental Impact Statement resulted in an estimate of 71 total school age children and 57 public school age children. The analysis presented above according to the ESI multipliers estimates four more total school age children and nine more public school age children.

It should also be noted that the ESI report does not reference a High Value District Multiplier. VHB assumed that ESI did not include an additional "high value" district adjustment because this factor is accounted for in the application of the Public School Participation Rate. It is assumed that a higher percentage of students would elect to attend the public school district over a private school where the public school system is high performing. To check this assumption, VHB reviewed the Public School Participation Rates of nearby school districts. The data showed that nearby high performing school districts, including Bronxville UFSD and Scarsdale UFSD, have high public school participation rates (89.1% and 93.1%, respectively), while New Rochelle, slightly lower performing, has a lower participation rate at 85.4%. Therefore, VHB concludes that the application of the Public School Participation Rate accurately reflects the Public School Age Children generation in the Mamaroneck UFSD without the added High Value District Multiplier.

This assumption is further corroborated by the planning analysis conducted by the Village of Mamaroneck Planning Department in 2016 (attached to this letter). The Village Planning Department surveyed the population of various local multifamily residential developments in the Village of Mamaroneck School District, including the Fairway Green townhouse development just north of the Hampshire development site. This survey indicated that the multifamily and townhome residential developments in the Village generated between .04 and .11 school aged children per multifamily unit. This data demonstrates that actual school aged children population rate for multifamily and townhome development is significantly lower than the local multipliers used by either the ESI, or Rutgers (the ESI multifamily rate for all sizes is 0.334 and the rate for townhomes is .550).

Finally, applying the per student programmatic cost estimated in Chapter 3N of the DEIS of $15,893 to the 66 new public school students indicates that the proposed project could result in an additional cost of $1,048,938 to the Mamaroneck Union Free School District. As demonstrated in Chapter 3O of the DEIS, the estimated property tax revenues to the school district is $2,604,098. Using these figures, the Mamaroneck Union Free School District would receive an annual surplus of tax revenue of $1,555,160. Even if the Proposed Action resulted in 85 school aged children, the school district would still receive an annual surplus of tax revenue of approximately $1,253,193.

We would welcome the opportunity to meet with you in person and review our analysis. As Hampshire is moving close to finalizing a draft FEIS, which will include the above analysis, we would suggest conducting a meeting as soon as possible. In the meantime, please feel free to contact me at 914-467-6616 or arudow@vhb.com.

Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

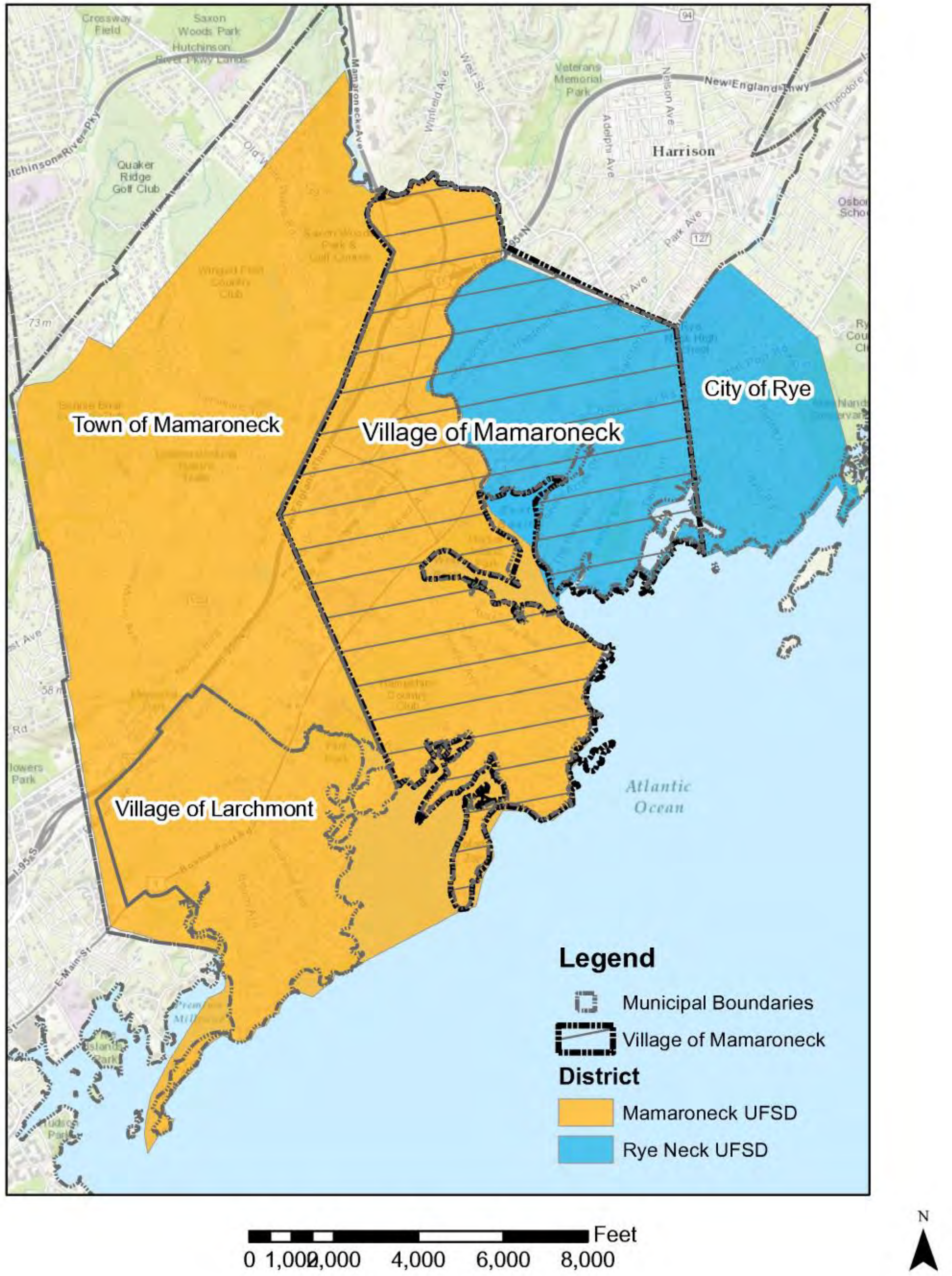
Population, Life Cycle, and Development impacts on Village of Mamaroneck School Enrollment

VILLAGE OF MAMARONECK PLANNING DEPARTMENT

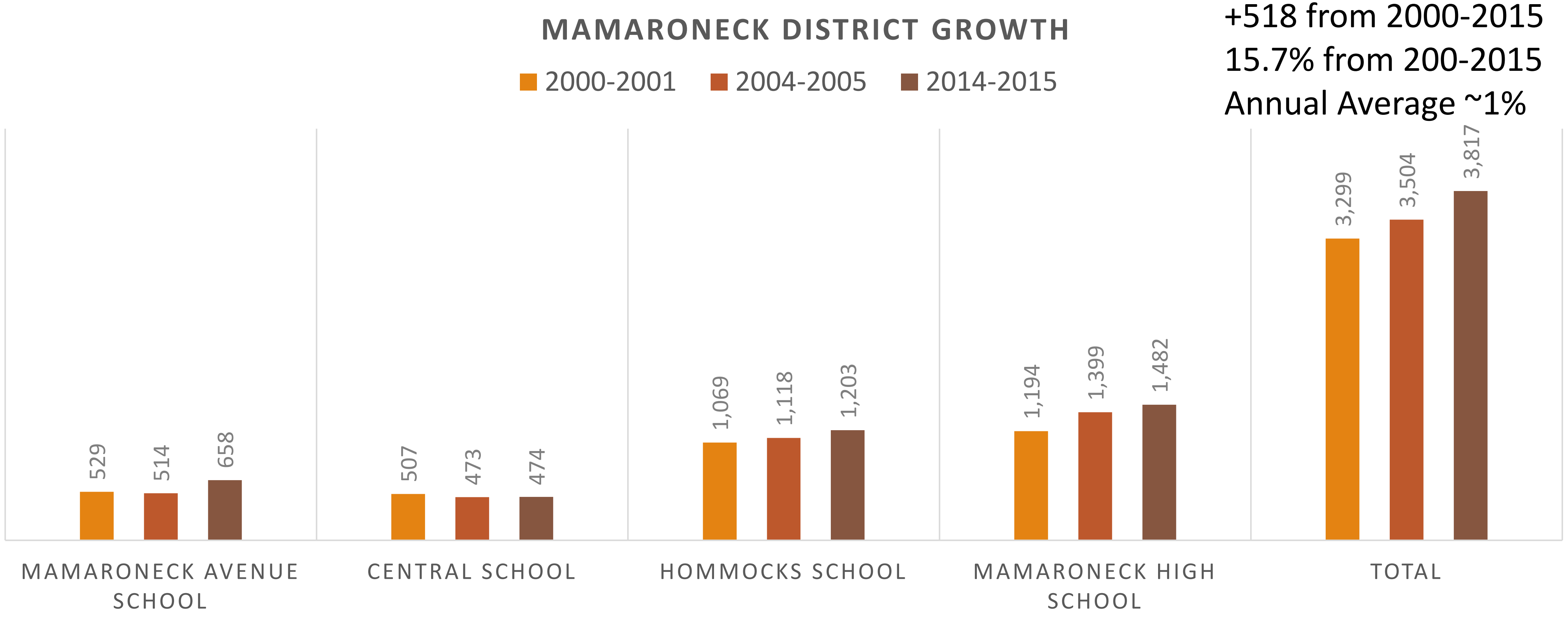
CUMULATIVE IMPACT STUDY

FOR INTERACTIVE VERSION PLEASE VISIT: HTTP://ARCG.IS/1QWCCFZ

Village of Mamaroneck & School Districts



Enrollment 2000-2014- Mamaroneck UFSD



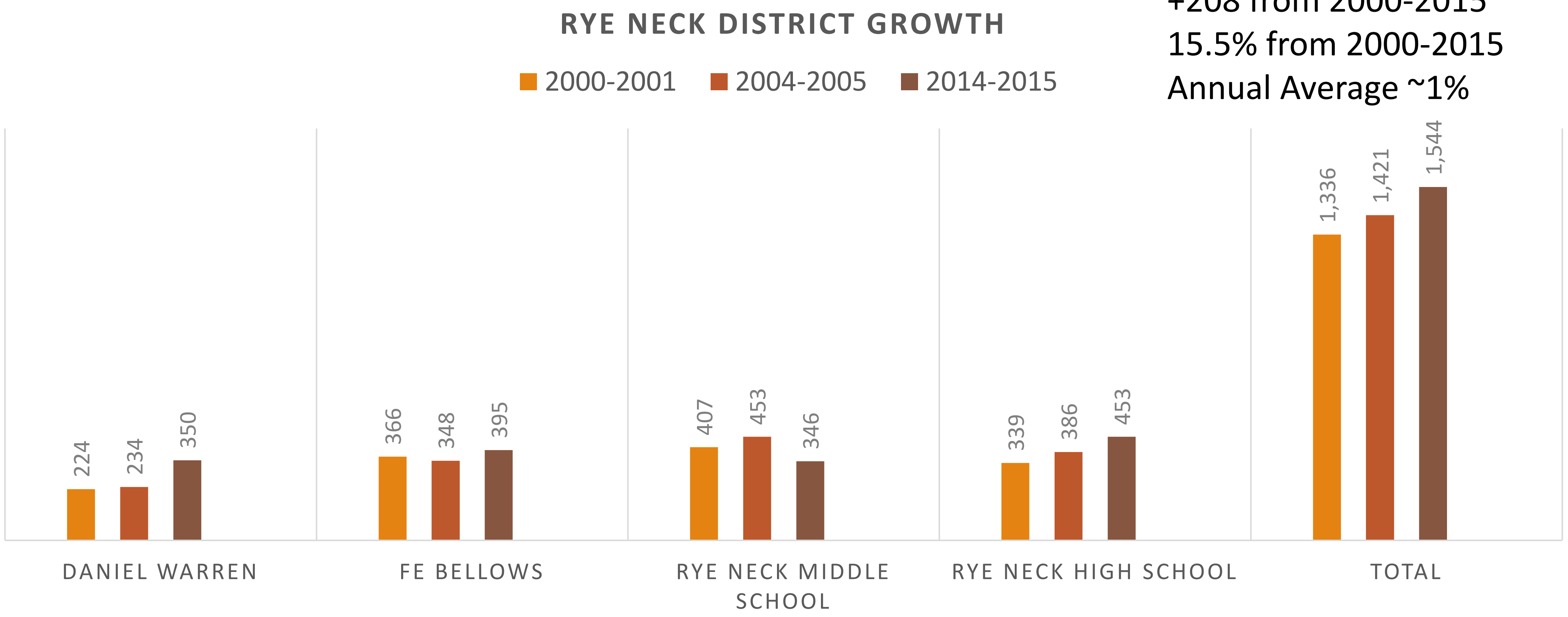
+518 from 2000-2015
15.7% from 200-2015
Annual Average ~1%

*Excluding schools that do not serve Village of Mamaroneck children.
*Enrollment numbers include students that live in Town of Mamaroneck and Village of Larchmont.

Source: NYS School Report Cards 2000, 2005, and 2014 NYSED. https://reportcards.nysed.gov

Enrollment 2000-2014- Rye Neck UFSD

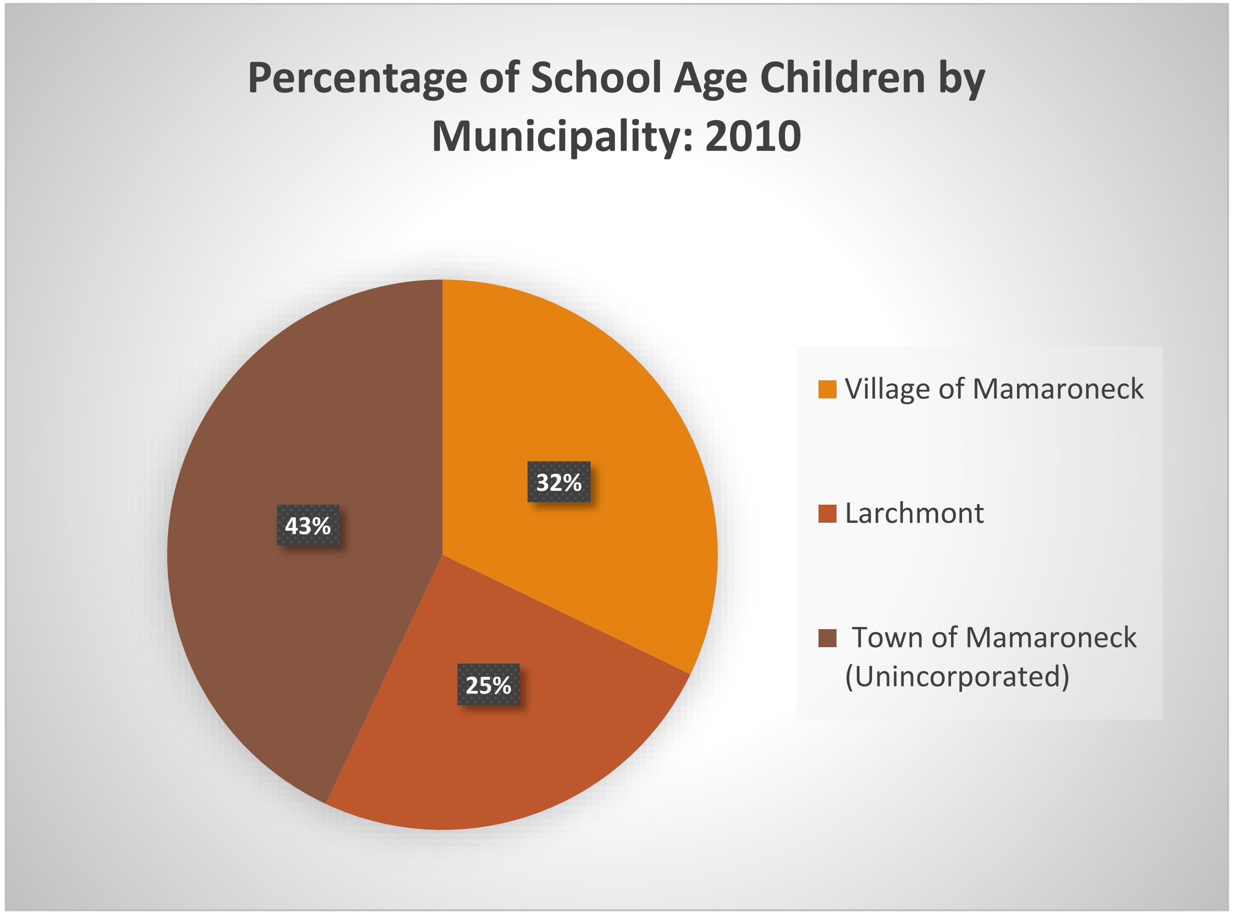
+208 from 2000-2015
15.5% from 2000-2015
Annual Average ~1%



* Enrollment numbers include students that live in City of Rye.

Source: NYS School Report Cards 2000, 2005, and 2014 NYSED. https://reportcards.nysed.gov

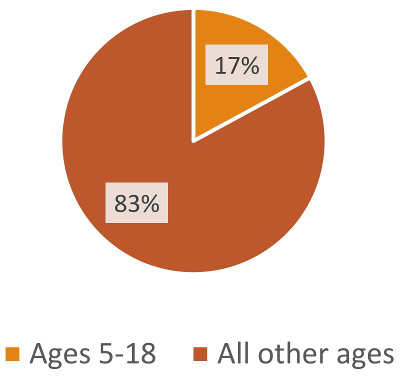
Percentage of School Age Children by Municipality Mamaroneck School District



Source: 2010 Census

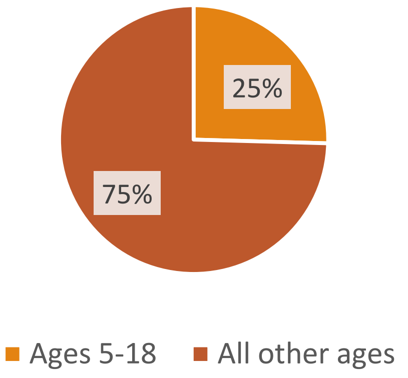
School Age Children as Percentage of Population Mamaroneck School District

Village of Mamaroneck School Age Children as Percentage of Population



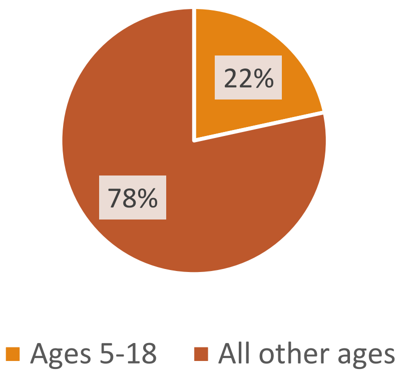
Total Population: 11,315
School Age: 1,933

Village of Larchmont School Age Children as Percentage of Population



Total Population: 5,864
School Age: 1,492

Town of Mamaroneck School Age Children as Percentage of Population

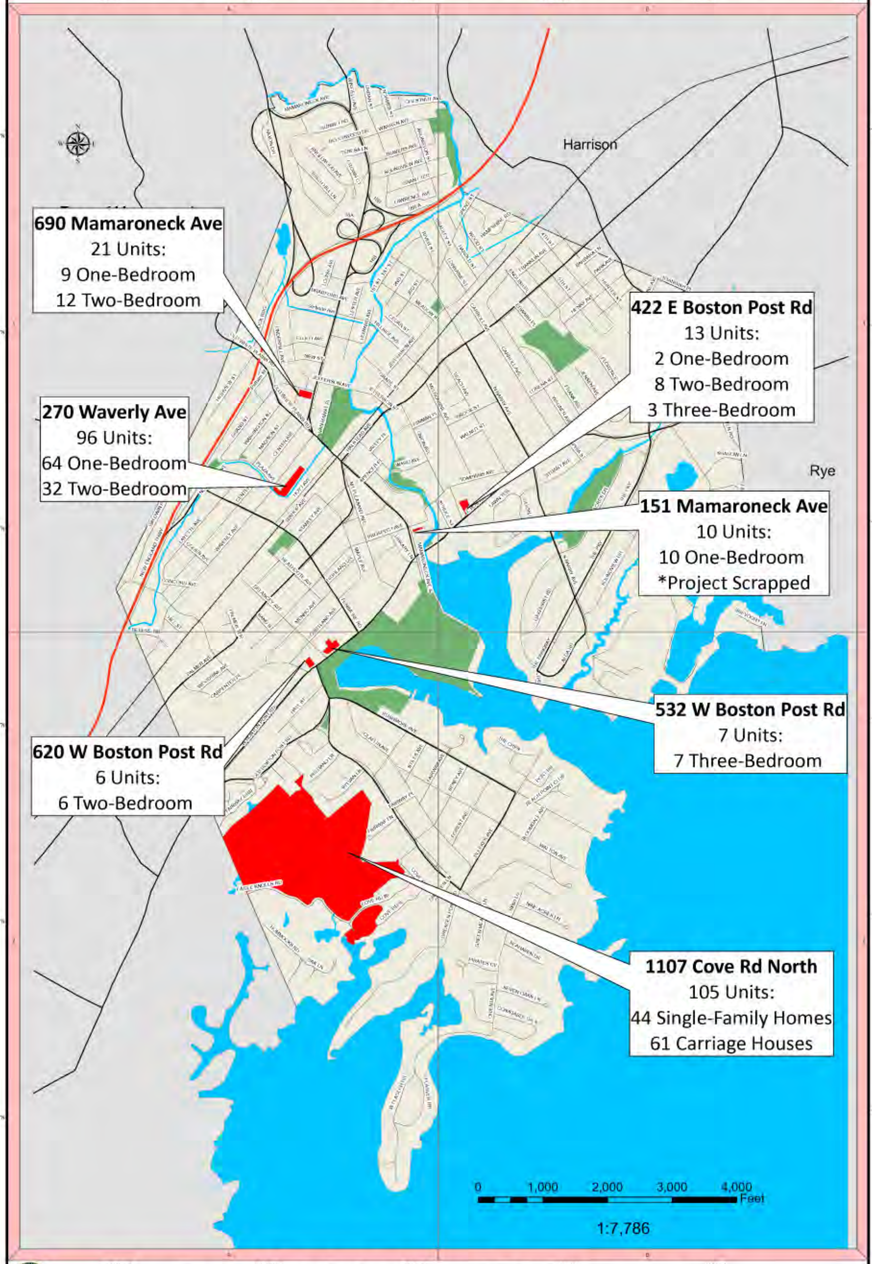


Total Population: 11,977
School Age: 2,587

*Rye Neck populations excluded from Village of Mamaroneck Calculation.
*Town of Mamaroneck School Age Population refers to unincorporated town. Includes portions of population that attend New Rochelle School District.

Source: 2010 Census

Village of Mamaroneck, New York



Proposed & Approved Developments

School children generation in recent multifamily developments | Local Multipliers

Data were provided by the Mamaroneck Union Free School District and Rye Neck Union Free District on the number of children in each development, and then applied to various proposed and recently approved developments within the Village of Mamaroneck.

Location	# of Students	# of Units	Multiplier
Avalon (Rentals)	25	225	0.11
Fairway Green (Townhouse)	5	53	0.09
Sweetwater Condos	4	90	0.04
Parkview Station	4	50	0.08
Condos (Combined)	8	140	0.06
TOTAL	38		

Source: Mamaroneck Union Free School District.

School age children projections- Proposed Developments

Project	Total Units	1 Bedrooms	2 Bedrooms	3 Bedrooms	Local Multiplier Forecast*	Rutgers Multiplier Forecast Estimated School Children
690 Mamaroneck Avenue	21	9	12		2	3
620 W Boston Post Road	6		6		1	1
270 Waverly Avenue (Sheldrake Lofts)	96	64	32		11	10
422 E Boston Post Road	13	2	8	3	1	3
Approved: 532 W Boston Post Road	7			7	1	2
Totals	**153**	**85**	**58**	**10**	**16**	**19**

*Local multiplier does not account for number of bedrooms, only total units.

Source: Rutgers University, Center for Urban Policy Research Residential Demographic Multipliers (for New York) http://www.dataplace.org/static/pdfs/NEW%20YORK%20multipliers.pdf

Development Context- Rye Neck UFSD

- No new multi-family developments in Rye Neck from 2000-2015.
- Three major developments in past thirty years:

Continental Manor 1988-39 Units

Rye Wood Farms 1986-40 Units

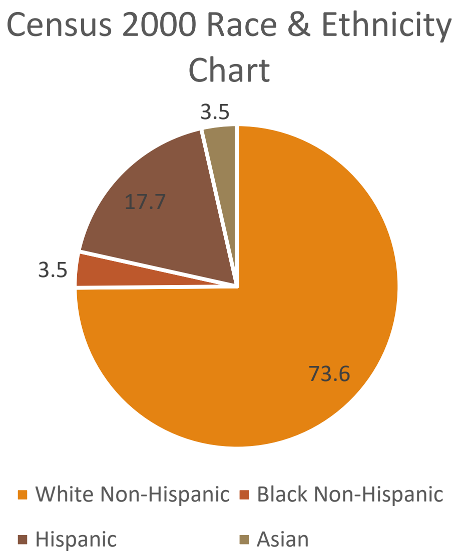
Barrymore 1988-37 Units

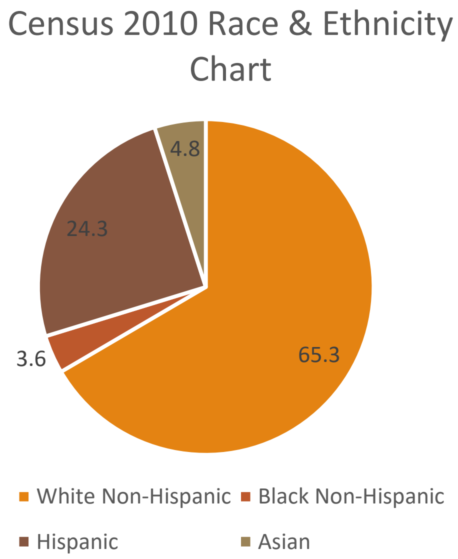
Development Context- Mamaroneck UFSD

- Multiple developments have occurred within Mamaroneck UFSD since 2000 including the Avalon, Sweetwater Condos, and Parkview Station.
- Three multifamily developments had considerably low school child generation rates- lower than the Rutgers multiplier.

Demographic Shifts- Race & Ethnicity

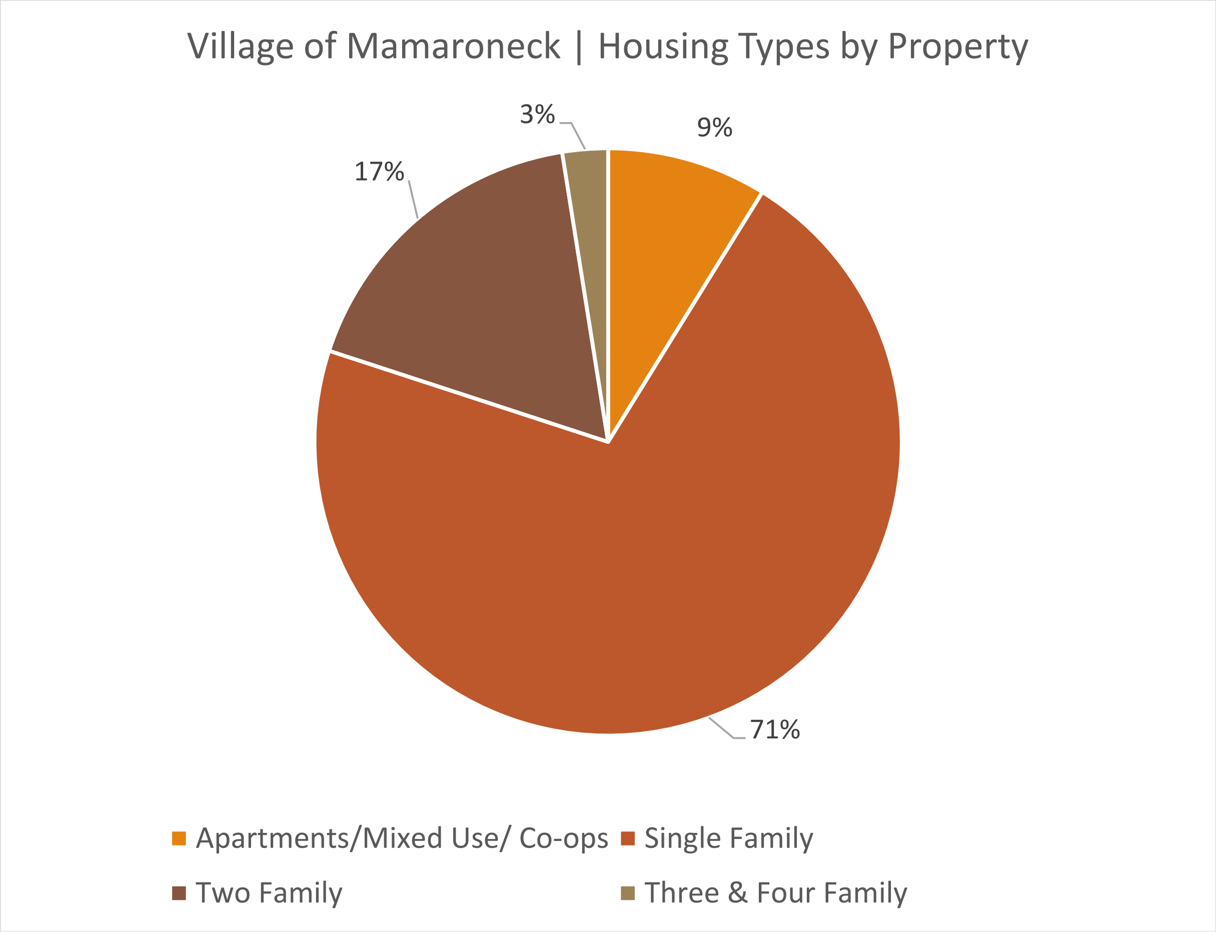
Race	2000 (% of Population)	2010 (% of Population)	Change
White Non-Hispanic	73.6	65.3	-8.3%
Black Non-Hispanic	3.5	3.6	+0.1%
Hispanic	17.7	24.3	+6.6%
Asian	3.5	4.8	+1.3%





Source: 2000 & 2010 Census data for tracts within Village of Mamaroneck

Existing housing types



Class Size

- Mamaroneck Union Free School District Common Branch: 22
- Rye Neck Common Branch: 21
- Westchester County Common Branch: 22

Cost Benefit Analysis-Existing Developments

Mamaroneck UFSD				
Complex	Total School Tax Actual	Students	Pupil Spending	Difference
Avalon	$638,982.82	25	$556,517.25	$82,465.57
Fairway Green	$482,308.55	5	$111,303.45	$371,005.10
Sweetwater	$271,471.65	4	$89,042.76	$182,428.89
Parkview Station	$156,925.46	4	$89,042.76	$67,882.70
Regatta	$242,634.61	21	$467,474.49	($224,839.88)
Rye Neck UFSD				
Continental Manor	$123,998.67	5	$105,559.48	$18,439.19
Barrymore	$83,851.25	2	$42,223.79	$41,627.46
Top of the Ridge	$377,198.82	17	$358,902.22	$18,296.60
			Total:	$557,305.63

Total annual tax benefit to the Mamaroneck UFSD: $478,942
Total annual tax benefit to the Rye Neck UFSD: $78,363

Per pupil spending was calculated as spending derived from local property taxes and excludes all other funding streams including state funding and grant funding.

School tax spending was provided by the receiver of taxes in both the Town of Rye and Town of Mamaroneck.

*The Regatta school tax deficit will likely be reduced or non-existent in coming years as condominiums are converted from affordable to market rate.

Cost Benefit Analysis- Proposed Developments

Mamaroneck UFSD				
Proposed Developments	Estimated School Tax Revenue	Forecast Students	Pupil Spending	Difference
690 Mamaroneck Ave	$67,200.00	2	$44,521.38	$22,678.62
620 W Boston Post Road	$21,280.00	1	$22,260.69	($980.69)
270 Waverly Avenue	$296,256.80	11	$244,867.59	$51,389.21
532 Boston Post Rd	$97,255.20	1	$22,260.69	$74,994.51
Rye Neck UFSD				
422 E Boston Post Road	$81,559.80	1	$21,111.90	$60,447.90
			Total:	$208,529

Mamaroneck UFSD Benefit: $148,081
Rye Neck UFSD Benefit: $60,448

Per pupil spending was calculated as spending derived from local property taxes and excludes all other funding streams including state funding and grant funding.

Student forecast is derived from local school children data provided by Mamaroneck UFSD and Rye Neck UFSD.

Assessed value was calculated using archetypal assessment calculations. For example apartments were estimated to be assessed at a rate $200 per square foot. The current tax rate for each school district was applied to the estimated assessment to forecast property tax derived revenue.

Conclusions

- Turn over of single-family homes to younger families has a larger impact on the number of school age children than multi-family development, including both rentals and owner-occupied developments.
- Village of Mamaroneck has high performing school districts that will likely continue to attract young new families to single-family homes.
- New multi-family development has had limited impact on school districts.
- Rye Neck has experienced 16% growth rate over the past ten years, with virtually no multi-family development within the same period.
- Mamaroneck School district has also experienced a 16% growth rate over the same period while constructing 133 new multi-family residential units.
- Tax benefits outweigh tax burdens for multi-family developments.
- Further analysis required to calculate tax burden of detached single family home development. However, given the higher levels of school child generation associated with single family homes, it is expected that they will have a higher tax burden then multi-family homes.

June 14, 2018

Trent Spiridellis, Executive Vice President
Larchmont Mamaroneck Football Club
Via Email
trent_spiridellis@yahoo.com

Re: Hampshire Country Club, Final Environmental Impact Statement

To Whom It May Concern:

We are planning consultants currently in the process of preparing a Final Environmental Impact Statement (EIS) for the proposed Planned Residential Subdivision and associated development of 44 one-family homes and 61 two- and three-family semi-detached townhomes on the current Hampshire Country Club property within the Village of Mamaroneck. The Proposed Project would also include development of seven tennis courts and preservation of approximately 36 acres of shared open space. The existing golf course use would be downsized to a 9-hole course, and the existing clubhouse and associated recreational facilities would remain in use. As outlined in the Draft Environmental Impact Statement from December 2017, utilizing the Residential Demographic Multipliers by Rutgers University Center for Urban Policy Research (June 2006), the Proposed Action is projected to generate approximately 57 public school children and 14 private school children. These 71 school children would be spread throughout the 13 grades (K-12). A copy of the DEIS can be accessed at http://www.village.mamaroneck.ny.us/Pages/MamaroneckNY_planning/Hampshire%20Application/SEQRA%20Documents/DEIS_FULL%2012_2017.pdf

The project site (the "Site") is located at 1025 Cove Road and consists of approximately 106.2 acres (***See Exhibit 1***). The Site is located adjacent to the Hommocks Ice Rink, Pool, and Hommocks Middle School. A portion of the Site borders the Long Island Sound. We have attached an initial site plan of the Proposed Project for your review (***See Exhibit 2***).

We have been asked by the Planning Board (the Lead Agency) to discuss the existing conditions and potential impact of the Proposed Project on youth leagues and field availability in the area. In this context, we would appreciate your written responses to the following items, which we would include in the FEIS:

Existing Conditions

(1) Number and age range of children enrolled in the 2017-2018 season;
(2) List of the municipalities from which children may participate in your league;
(3) Estimated rate of participation in your league for school aged children in your service area;
(4) List of existing fields or recreational facilities used for league practice or play;
(5) Frequency of use and length of use (sports season) of those fields and/or recreational facilities; and
(6) Any existing problems with capacity of the league and/or field space.

Potential Impacts

(1) Anticipated impacts of the Proposed Project on league capacity and/or field availability. Specifics in terms of individual team or field capacity, if available, would be very helpful in our impact assessment; and
(2) Any other league concerns regarding the Proposed Project (if any).

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

www.vhb.com

June 14, 2018

Mamaroneck Youth Football League
180 E. Prospect Ave. #154
Mamaroneck, NY 10543
Via Email and USPS
myflonline@gmail.com

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50 Main Street
Suite 360
White Plains, New York 10606
P 914.467.6600
F 914.761.3759

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Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

www.vhb.com

June 14, 2018

Brendan Collins, President
Mamaroneck Youth Hockey Association
P.O. Box 405
Larchmont, NY 10538
Via Email and USPS
Brendanpcollins@gmail.com

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The project site (the "Site") is located at 1025 Cove Road and consists of approximately 106.2 acres (***See Exhibit 1***). The Site is located adjacent to the Hommocks Ice Rink, Pool, and Hommocks Middle School. A portion of the Site borders the Long Island Sound.

We have attached an initial site plan of the Proposed Project for your review (***See Exhibit 2***).

We have been asked by the Planning Board (the Lead Agency) to discuss the existing conditions and potential impact of the Proposed Project on youth leagues and recreational facility availability in the area. In this context, we would appreciate your written responses to the following items, which we would include in the FEIS:

Existing Conditions

(1) Number and age range of children enrolled in the 2017-2018 season;
(2) List of the municipalities from which children may participate in your league;
(3) Estimated rate of participation in your league for school aged children in your service area;
(4) List of existing rinks or recreational facilities used for league practice or play;

50 Main Street
Suite 360
White Plains, New York 10606
P 914.467.6600
F 914.761.3759

(5) Frequency of use and length of use (sports season) of those rinks and/or recreational facilities; and
(6) Any existing problems with capacity of the league and/or recreational space.

Potential Impacts

(1) Anticipated impacts of the Proposed Project on league capacity and/or rink availability. Specifics in terms of individual team or recreational facility capacity, if available, would be very helpful in our impact assessment; and
(2) Any other league concerns regarding the Proposed Project (if any).

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

www.vhb.com

June 14, 2018

Christopher Glinski, President
Larchmont/Mamaroneck Youth Lacrosse Association
Via Email
glinskic@colonnadeproperties.com

Re: Hampshire Country Club, Final Environmental Impact Statement

To Whom It May Concern:

We are planning consultants currently in the process of preparing a Final Environmental Impact Statement (EIS) for the proposed Planned Residential Subdivision and associated development of 44 one-family homes and 61 two- and three-family semi-detached townhomes on the current Hampshire Country Club property within the Village of Mamaroneck. The Proposed Project would also include development of seven tennis courts and preservation of approximately 36 acres of shared open space. The existing golf course use would be downsized to a 9-hole course, and the existing clubhouse and associated recreational facilities would remain in use. As outlined in the Draft Environmental Impact Statement from December 2017, utilizing the Residential Demographic Multipliers by Rutgers University Center for Urban Policy Research (June 2006), the Proposed Action is projected to generate approximately 57 public school children and 14 private school children. These 71 school children would be spread throughout the 13 grades (K-12). A copy of the DEIS can be accessed at http://www.village.mamaroneck.ny.us/Pages/MamaroneckNY_planning/Hampshire%20Application/SEQRA%20Documents/DEIS_FULL%2012_2017.pdf

The project site (the "Site") is located at 1025 Cove Road and consists of approximately 106.2 acres (***See Exhibit 1***). The Site is located adjacent to the Hommocks Ice Rink, Pool, and Hommocks Middle School. A portion of the Site borders the Long Island Sound. We have attached an initial site plan of the Proposed Project for your review (***See Exhibit 2***).

We have been asked by the Planning Board (the Lead Agency) to discuss the existing conditions and potential impact of the Proposed Project on youth leagues and field availability in the area. In this context, we would appreciate your written responses to the following items, which we would include in the FEIS:

Existing Conditions

(1) Number and age range of children enrolled in the 2017-2018 season;
(2) List of the municipalities from which children may participate in your league;
(3) Estimated rate of participation in your league for school aged children in your service area;
(4) List of existing fields or recreational facilities used for league practice or play;
(5) Frequency of use and length of use (sports season) of those fields and/or recreational facilities; and

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50 Main Street
Suite 360
White Plains, New York 10606
P 914.467.6600
F 914.761.3759

(6) Any existing problems with capacity of the league and/or field space.

Potential Impacts

(1) Anticipated impacts of the Proposed Project on league capacity and/or field availability. Specifics in terms of individual team or field capacity, if available, would be very helpful in our impact assessment; and
(2) Any other league concerns regarding the Proposed Project (if any).

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

June 14, 2018

Mamaroneck Junior Soccer League
Via Email
mamaroneckrecsoccer@gmail.com

Re: Hampshire Country Club, Final Environmental Impact Statement

To Whom It May Concern:

We are planning consultants currently in the process of preparing a Final Environmental Impact Statement (EIS) for the proposed Planned Residential Subdivision and associated development of 44 one-family homes and 61 two- and three-family semi-detached townhomes on the current Hampshire Country Club property within the Village of Mamaroneck. The Proposed Project would also include development of seven tennis courts and preservation of approximately 36 acres of shared open space. The existing golf course use would be downsized to a 9-hole course, and the existing clubhouse and associated recreational facilities would remain in use. As outlined in the Draft Environmental Impact Statement from December 2017, utilizing the Residential Demographic Multipliers by Rutgers University Center for Urban Policy Research (June 2006), the Proposed Action is projected to generate approximately 57 public school children and 14 private school children. These 71 school children would be spread throughout the 13 grades (K-12). A copy of the DEIS can be accessed at http://www.village.mamaroneck.ny.us/Pages/MamaroneckNY_planning/Hampshire%20Application/SEQRA%20Documents/DEIS_FULL%2012_2017.pdf

The project site (the "Site") is located at 1025 Cove Road and consists of approximately 106.2 acres (***See Exhibit 1***). The Site is located adjacent to the Hommocks Ice Rink, Pool, and Hommocks Middle School. A portion of the Site borders the Long Island Sound. We have attached an initial site plan of the Proposed Project for your review (***See Exhibit 2***).

We have been asked by the Planning Board (the Lead Agency) to discuss the existing conditions and potential impact of the Proposed Project on youth leagues and field availability in the area. In this context, we would appreciate your written responses to the following items, which we would include in the FEIS:

Existing Conditions

(1) Number and age range of children enrolled in the 2017-2018 season;
(2) List of the municipalities from which children may participate in your league;
(3) Estimated rate of participation in your league for school aged children in your service area;
(4) List of existing fields or recreational facilities used for league practice or play;
(5) Frequency of use and length of use (sports season) of those fields and/or recreational facilities; and
(6) Any existing problems with capacity of the league and/or field space.

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White Plains, New York 10606
P 914.467.6600
F 914.761.3759
www.vhb.com

Potential Impacts

(1) Anticipated impacts of the Proposed Project on league capacity and/or field availability. Specifics in terms of individual team or field capacity, if available, would be very helpful in our impact assessment; and
(2) Any other league concerns regarding the Proposed Project (if any).

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

www.vhb.com

vhb

June 14, 2018

Sandy Mary Korkatzis, Superintendent
Village of Mamaroneck Parks and Recreation
PO Box 369 attention Recreation
123 Mamaroneck Avenue
Mamaroneck, NY 10543

Via email and USPS
Recreation@vomny.org

Re: Hampshire Country Club, Final Environmental Impact Statement

Dear Superintendent Korkatzis:

We are planning consultants currently in the process of preparing a Final Environmental Impact Statement (EIS) for the proposed Planned Residential Subdivision and associated development of 44 one-family homes and 61 two- and three-family semi-detached townhomes on the current Hampshire Country Club property within the Village of Mamaroneck. The Proposed Project would also include development of seven tennis courts and preservation of approximately 36 acres of shared open space. The existing golf course use would be downsized to a 9-hole course, and the existing clubhouse and associated recreational facilities would remain in use. As outlined in the Draft Environmental Impact Statement from December 2017, utilizing the Residential Demographic Multipliers by Rutgers University Center for Urban Policy Research (June 2006), the Proposed Action is projected to generate approximately 57 public school children and 14 private school children. These 71 school children would be spread throughout the 13 grades (K-12). A copy of the DEIS can be accessed at http://www.village.mamaroneck.ny.us/Pages/MamaroneckNY_planning/Hampshire%20Application/SEQRA%20Documents/DEIS_FULL%2012_2017.pdf

The project site (the "Site") is located at 1025 Cove Road and consists of approximately 106.2 acres (***See Exhibit 1***). The Site is located adjacent to the Hommocks Ice Rink, Pool, and Hommocks Middle School. A portion of the Site borders the Long Island Sound. We have attached an initial site plan of the Proposed Project for your review (***See Exhibit 2***).

We have been asked by the Planning Board (the Lead Agency) to discuss the existing conditions and potential impact of the proposed Project on Village facilities in the area, including field and other recreational facilities. In this context, we would appreciate your written responses to the following items, which we would include in the FEIS:

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50 Main Street
Suite 360
White Plains, New York 10606
P 914.467.6600
F 914.761.3759

Existing Conditions

(1) Any current issues of capacity at existing Village recreational facilities;
(2) Any current issues of capacity in recreational programming, including the kayaking program, day camp, or other recreational programs;
(3) Any planned changes or upgrades to Village recreational facilities, including sports fields.

Potential Impacts

(1) Anticipated issues of capacity at the Pool, Tennis Courts, Ice Rink or other recreational facilities as a result of the proposed project; and
(2) Recreation Department concerns regarding the proposed project (if any).

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

DEIS Outreach

www.vhb.com

February 12, 2016

Jill Fisher, Superintendent
Town of Mamaroneck Recreation Department
740 West Boston Post Road
Mamaroneck, NY 10543

Re: Hampshire Country Club, Draft Environmental Impact Statement

Dear Ms. Fisher:

We are planning consultants currently in the process of preparing a Draft Environmental Impact Statement (DEIS) for the proposed Planned Residential Subdivision and associated development of 44 one-family homes and 61 two- and three-family semi-detached townhomes on the current Hampshire Country Club property within the Village of Mamaroneck. The Proposed Project would also include construction of eight tennis courts and preservation of approximately 73 acres of shared open space. The existing clubhouse and associated recreational facilities would remain in use.

The project site (the "Site") is located at 1025 Cove Road and consists of approximately 106.2 acres (***See Exhibit 1***). The Site is located adjacent to the Hommocks Park Ice Rink, Pool, and Hommocks Middle School. A portion of the Site borders the Long Island Sound.

Access to the Site would be provided through the existing Eagle Knolls Road from the west, Cove Road from the east, and an extended Cooper Avenue running down from the north. We have attached an initial site plan of the Proposed Project for your review (***See Exhibit 2***).

We have been asked by the Planning Board (the Lead Agency) to discuss the existing conditions and potential impact of the proposed Project on Town facilities in the area. In this context, we would appreciate your written responses to the following items, which we would include in the DEIS:

Existing Conditions

(1) Number of Hommocks Pool visitors in total and from the Town of Mamaroneck during the average summer month in 2015;
(2) Number of Hommocks Park Ice Rink visitors in total and from the Town of Mamaroneck during the average winter month in 2015-2016;
(3) Any current issues of capacity at the Pool or Ice Rink;
(4) Typical busiest day of the week, and typical busiest period of the week (i.e. Thursdays, 6-8pm) for Hommocks Pool;
(5) Typical busiest day of the week, and typical busiest period of the week (i.e. Thursdays, 6-8pm) for Hommocks Park Ice Rink;
(6) 2015-2016 Enrollment in the Youth Hockey League;

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50 Main Street
Suite 360
White Plains, New York 10606
P 914.467.6600
F 914.761.3759

Potential Impacts

(1) Anticipated issues of capacity at the Pool or Ice Rink as a result of the proposed project; and
(2) Recreation Department concerns regarding the proposed project (if any).

A detailed description of the impacts of the Proposed Project will be provided in the DEIS. You will have an opportunity to review and comment on the DEIS once it is ready for distribution.

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

www.vhb.com

February 12, 2016

Larchmont Mamaroneck Basketball Association
Via Email

Re: Hampshire Country Club, Draft Environmental Impact Statement

To Whom It May Concern:

We are planning consultants currently in the process of preparing a Draft Environmental Impact Statement (DEIS) for the proposed Planned Residential Subdivision and associated development of 44 one-family homes and 61 two- and three-family semi-detached townhomes on the current Hampshire Country Club property within the Village of Mamaroneck. The Proposed Project would also include construction of eight tennis courts and preservation of approximately 73 acres of shared open space. The existing clubhouse and associated recreational facilities would remain in use.

The project site (the "Site") is located at 1025 Cove Road and consists of approximately 106.2 acres (***See Exhibit 1***). The Site is located adjacent to the Hommocks Ice Rink, Pool, and Hommocks Middle School. A portion of the Site borders the Long Island Sound.

Access to the Site would be provided through the existing Eagle Knolls Road from the west, Cove Road from the east, and an extended Cooper Avenue running down from the north. We have attached an initial site plan of the Proposed Project for your review (***See Exhibit 2***).

We have been asked by the Planning Board (the Lead Agency) to discuss the existing conditions and potential impact of the Proposed Project on youth leagues in the area. In this context, we would appreciate your written responses to the following items, which we would include in the DEIS:

Existing Conditions

(1) Number of children enrolled in the 2015-2016 season;
(2) List of the municipalities from which children may participate in your league; and
(3) Any existing problems with capacity of the League.

Potential Impacts

(1) Basketball League concerns regarding the Proposed Project (if any).

A detailed description of the impacts of the Proposed Project will be provided in the DEIS. You will have an opportunity to review and comment on the DEIS once it is ready for distribution.

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

Engineers | Scientists | Planners | Designers

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White Plains, New York 10606
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F 914.761.3759

Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

www.vhb.com

February 12, 2016

Larchmont-Mamaroneck Little League
Via Email

Re: Hampshire Country Club, Draft Environmental Impact Statement

To Whom It May Concern:

We are planning consultants currently in the process of preparing a Draft Environmental Impact Statement (DEIS) for the proposed Planned Residential Subdivision and associated development of 44 one-family homes and 61 two- and three-family semi-detached townhomes on the current Hampshire Country Club property within the Village of Mamaroneck. The Proposed Project would also include construction of eight tennis courts and preservation of approximately 73 acres of shared open space. The existing clubhouse and associated recreational facilities would remain in use.

The project site (the "Site") is located at 1025 Cove Road and consists of approximately 106.2 acres (***See Exhibit 1***). The Site is located adjacent to the Hommocks Ice Rink, Pool, and Hommocks Middle School. A portion of the Site borders the Long Island Sound.

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We have been asked by the Planning Board (the Lead Agency) to discuss the existing conditions and potential impact of the Proposed Project on youth leagues in the area. In this context, we would appreciate your written responses to the following items, which we would include in the DEIS:

Existing Conditions

(1) Number of children enrolled in the 2015-2016 season;
(2) List of the municipalities from which children may participate in your league; and
(3) Any existing problems with capacity of the League.

Potential Impacts

(1) Little League concerns regarding the Proposed Project (if any).

A detailed description of the impacts of the Proposed Project will be provided in the DEIS. You will have an opportunity to review and comment on the DEIS once it is ready for distribution.

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

50 Main Street
Suite 360
White Plains, New York 10606
P 914.467.6600
F 914.761.3759

Sincerely,

Abigail Rudow

Abigail Rudow

Planner
arudow@vhb.com

From:	Rudow, Abigail
To:	Bill Nachtigal
Subject:	RE: Request for Information
Date:	Wednesday, March 2, 2016 2:59:08 PM

Good Afternoon Bill,
Thank you for getting back to me. I completely understand this is a busy time of year. Any information you have will be helpful and greatly appreciated.
We are working on behalf of the Hampshire Country Club, and will be submitting an Environmental Impact Statement to Stewart Sterk, Chair of the Village of Mamaroneck Planning Board.
Please let me know if you have any further questions, and best of luck with the start of the season.
Sincerely,
Abi Rudow

Abigail Rudow
Planner

P 914.467.6616
www.vhb.com

From: Bill Nachtigal [mailto:billnachtigal@yahoo.com]
Sent: Wednesday, March 02, 2016 11:11 AM
To: Rudow, Abigail
Subject: Request for Information

Hello Abigail,
We received your request for information. We are swamped with activity right now in getting our Spring season up and running so would need some time to pull together any information we may be able to provide. Also, it wasn't clear from your email who it is from the Village of Mamaroneck that you are working with. In order to respond we would need that information.
Regards,
Bill Nachtigall
President LMLL

www.vhb.com

February 12, 2016

Mamaroneck Junior Soccer League
Via Email

Re: Hampshire Country Club, Draft Environmental Impact Statement

Dear Ms. Kelley:

We are planning consultants currently in the process of preparing a Draft Environmental Impact Statement (DEIS) for the proposed Planned Residential Subdivision and associated development of 44 one-family homes and 61 two- and three-family semi-detached townhomes on the current Hampshire Country Club property within the Village of Mamaroneck. The Proposed Project would also include construction of eight tennis courts and preservation of approximately 73 acres of shared open space. The existing clubhouse and associated recreational facilities would remain in use.

The project site (the "Site") is located at 1025 Cove Road and consists of approximately 106.2 acres (***See Exhibit 1***). The Site is located adjacent to the Hommocks Ice Rink, Pool, and Hommocks Middle School. A portion of the Site borders the Long Island Sound.

Access to the Site would be provided through the existing Eagle Knolls Road from the west, Cove Road from the east, and an extended Cooper Avenue running down from the north. We have attached an initial site plan of the Proposed Project for your review (***See Exhibit 2***).

We have been asked by the Planning Board (the Lead Agency) to discuss the existing conditions and potential impact of the Proposed Project on youth leagues in the area. In this context, we would appreciate your written responses to the following items, which we would include in the DEIS:

Existing Conditions

(1) Number of children enrolled in the 2015-2016 season;
(2) List of the municipalities from which children may participate in your league; and
(3) Any existing problems with capacity of the League.

Potential Impacts

(1) Soccer League concerns regarding the Proposed Project (if any).

A detailed description of the impacts of the Proposed Project will be provided in the DEIS. You will have an opportunity to review and comment on the DEIS once it is ready for distribution.

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

Engineers | Scientists | Planners | Designers

50 Main Street
Suite 360
White Plains, New York 10606
P 914.467.6600
F 914.761.3759

Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

www.vhb.com

February 12, 2016

Mamaroneck Youth Football League
Via Email

Re: Hampshire Country Club, Draft Environmental Impact Statement

To Whom It May Concern:

We are planning consultants currently in the process of preparing a Draft Environmental Impact Statement (DEIS) for the proposed Planned Residential Subdivision and associated development of 44 one-family homes and 61 two- and three-family semi-detached townhomes on the current Hampshire Country Club property within the Village of Mamaroneck. The Proposed Project would also include construction of eight tennis courts and preservation of approximately 73 acres of shared open space. The existing clubhouse and associated recreational facilities would remain in use.

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We have been asked by the Planning Board (the Lead Agency) to discuss the existing conditions and potential impact of the Proposed Project on youth leagues in the area. In this context, we would appreciate your written responses to the following items, which we would include in the DEIS:

Existing Conditions

(1) Number of children enrolled in the 2015-2016 season;
(2) List of the municipalities from which children may participate in your league; and
(3) Any existing problems with capacity of the League.

Potential Impacts

(1) Football League concerns regarding the Proposed Project (if any).

A detailed description of the impacts of the Proposed Project will be provided in the DEIS. You will have an opportunity to review and comment on the DEIS once it is ready for distribution.

If you need further clarification for the project or the requested information please feel free to contact me at 914-467-6616 or arudow@vhb.com. Otherwise, I look forward to your written response. Please also provide a contact name and number in case we have additional questions.

Engineers | Scientists | Planners | Designers

50 Main Street
Suite 360
White Plains, New York 10606
P 914.467.6600
F 914.761.3759

Sincerely,

Abigail Rudow

Planner
arudow@vhb.com

X Real Estate Listings and Development Comparables

RYE BROOK

KINGFIELD

NEW YORK

Townhomes from the $900,000's

ASPEN: **2,423 to 3,200 sq. ft., 3 bedrooms, 2.5 to 3.5 baths, 2-car garage**

- Open floor plan with eat-in kitchen
- Upper level loft
- Master bedroom suite with walk-in dressing room
- Walk-in Pantry and Mudroom
- Blue-stone Terrace (or large deck where conditions allow)
- Optional finished lower level with full bath
- Optional upper level den/office/master dressing room
- Optional gas fireplace and handbuilt mantel/surround
- Optional skylight

CYPRESS: **2,655 to 3,447 sq. ft., 3 bedrooms, 2.5 to 4.5 baths, 2-car garage, gas fireplace**

- End unit featuring open floor plan with grand island kitchen
- Dramatic double height Living/Dining rooms with French doors
- Main level master suite
- Over-sized master Dressing room
- Upper level loft
- Main level laundry
- Blue-stone Terrace (or large deck where conditions allow)
- Optional finished lower level with full bath
- Master bedroom option of French doors to stone terrace or deck

CHESTNUT: **2,626 to 3,382 sq. ft., 3 bedrooms, 2.5 to 3.5 baths, 2-car garage, gas fireplace**

- End unit featuring open floor plan with gourmet kitchen opening to terrace
- Sun-filled main level Den
- Walk-in Pantry and Mudroom
- Expansive upper level laundry room
- Blue-stone Terrace (or large deck where conditions allow)
- Optional finished lower level with full bath
- Optional 3-stop Elevator

KINGFIELD | 3 International Drive, Suite 110 Rye Brook, New York 10573 | 914.481.4000 | kingfieldryebrook.com

HOULIHAN LAWRENCE

REFINE SEARCH RESULTS

Viewing 6 Results Open Houses Saved Viewed

Price (High to Low)

4 HIGHCLERE COURT

LARCHMONT , NY

WESTCHESTER COUNTY

$2,999,000

DOWN FROM $3,250,000

LAST REDUCED ON: 04/03/2018

6	5.1	7,000	0.82
BEDROOMS	BATHROOMS	SQUARE FEET	ACRES

71 EDGEWOOD AVENUE

LARCHMONT , NY
WESTCHESTER COUNTY

$2,995,000

5	5.2	5,888	0.25
BEDROOMS	BATHROOMS	SQUARE FEET	ACRES

8 HIGHCLERE COURT

LARCHMONT , NY
WESTCHESTER COUNTY

$2,795,000

5	4.1	4,908	0.79
BEDROOMS	BATHROOMS	SQUARE FEET	ACRES

PRICE REDUCED

15 THOMPSON PLACE

LARCHMONT , NY
WESTCHESTER COUNTY

$2,495,000
DOWN FROM $2,595,000
LAST REDUCED ON: 05/24/2018

5	4.1	4,441	0.25
BEDROOMS	BATHROOMS	SQUARE FEET	ACRES

PRICE REDUCED

20 GATE HOUSE LANE

MAMARONECK , NY
WESTCHESTER COUNTY

$2,198,124
DOWN FROM $2,358,000
LAST REDUCED ON: 04/10/2018

5	4.1	4,800	0.71
BEDROOMS	BATHROOMS	SQUARE FEET	ACRES

NEW

55 HARRISON DRIVE

LARCHMONT , NY
WESTCHESTER COUNTY

$1,885,000

4	4.1	4,342
BEDROOMS	BATHROOMS	SQUARE FEET

Pamela R Joyce
Houlihan Lawrence Inc.
pjoyce@houlihanlawrence.com
Ph: (914) 582-9940

Jump to a location

12 Total Listings from email

1 / 28

17 Kilmer Road
Larchmont, NY 10538

$1,360,000

Sold
VIEW DETAILS

4 Beds, **3** Baths, **2,426** Sq Ft, Built in **1902, 0.195** Acres, **Detached**

1 / 20

50 Sheldrake Avenue
Larchmont, NY 10538-1343

$1,450,000

Sold
VIEW DETAILS

4 Beds, **3** Baths, **2,538** Sq Ft, Built in **1930, 0.249** Acres, **Detached**

1 / 27

740 Orienta Avenue
Mamaroneck, NY 10543
Virtual Tour

$1,582,000

Sold
VIEW DETAILS

4 Beds, **5** Baths, **3,070** Sq Ft, Built in **1961, 0.340** Acres, **Detached**

100 Willow Avenue
Larchmont, NY 10538-3521

$1,625,000

Sold
VIEW DETAILS

4 Beds, **5** Baths, **2,417** Sq Ft, Built in **1897, 0.110** Acres, **Detached**

1 / 30

1 / 26

616 Stiles Avenue

Mamaroneck, NY 10543-4429

Virtual Tour

$1,850,000

Sold

VIEW DETAILS

5 Beds, **5** Baths, **4,500** Sq Ft, Built in **1957, 0.270** Acres, **Detached**

1 / 28

12 Colonial Avenue

Larchmont, NY 10538-1621

$1,852,000

Sold

VIEW DETAILS

4 Beds, **4** Baths, **3,332** Sq Ft, Built in **2008, 0.172** Acres, **Detached**

1 / 10

16 Dante Street

Larchmont, NY 10538-1639

$1,895,000

Sold

VIEW DETAILS

4 Beds, **4** Baths, **3,679** Sq Ft, Built in **2017, 0.190** Acres, **Detached**

1 / 29

257 Murray Avenue

Larchmont, NY 10538-1604

Virtual Tour

$1,915,000

Sold

VIEW DETAILS

4 Beds, **5** Baths, **4,389** Sq Ft, Built in **1928, 0.290** Acres, **Detached**

732 Cove Road

Mamaroneck, NY 10543-4324

Virtual Tour

$2,170,000

Sold

VIEW DETAILS

6 Beds, **6** Baths, **5,300** Sq Ft, Built in **2016, 0.570** Acres, **Detached**

1 / 26

91 N Chatsworth Avenue

1 / 8

Larchmont, NY 10538-2201

$2,773,500

Sold

VIEW DETAILS

6 Beds, **7** Baths, **5,584** Sq Ft, Built in **2017, 0.290** Acres, **Detached**

23 Glen Eagles Drive

1 / 5

Larchmont, NY 10538-1206

$2,950,000

Sold

VIEW DETAILS

5 Beds, **5** Baths, **5,234** Sq Ft, Built in **2017, 0.232** Acres, **Detached**

2 Colonial Lane

1 / 10

Larchmont, NY 10538-1623

$2,965,000

Sold

VIEW DETAILS

6 Beds, **7** Baths, **4,985** Sq Ft, Built in **2017, 0.294** Acres, **Detached**

606 FAIRWAY AVENUE

MAMARONECK , NY 10543
WESTCHESTER COUNTY

$2,495,000
DOWN FROM $2,595,000
LAST REDUCED ON: 06/24/2019

5	*5.2*	*4,639*	*0.35*
BEDROOMS	BATHROOMS	SQUARE FEET	ACRES

1040 COVE ROAD

MAMARONECK , NY 10543
WESTCHESTER COUNTY

$3,395,000
DOWN FROM $3,595,000
LAST REDUCED ON: 07/01/2019

6 BEDROOMS *4.1* BATHROOMS *5,368* SQUARE FEET *0.4* ACRES

16 GATE HOUSE LANE

MAMARONECK , NY
WESTCHESTER COUNTY

$2,999,000

5 BEDROOMS *6.1* BATHROOMS *7,093* SQUARE FEET *1.32* ACRES

Hampshire Country Club Planned Residential Development
Village of Mamaroneck,
Westchester County, New York
Final Environmental Impact Statement

Y Construction Noise Study

Memorandum

To: Hampshire Recreation, LLC

Date: August 24, 2018

Project #: 28677.03

From: Jason Ross, Director of Noise and Vibration

Re: Hampshire Country Club Planned Residential Development - Construction Noise Study

---

Introduction

The Applicant ("Hampshire Recreation, LLC") proposes to develop a new Planned Residential Development ("PRD") of single-family homes and semi-detached carriage houses located on a portion of the existing Hampshire County Club golf course in the Village of Mamaroneck, NY. The proposed PRD would consist of 105 residential units (comprising 44 single-family detached housing lots and 61 carriage homes, which consist of 28 two-family and 33 three-family semi-detached housing lots) on the Project Site (the "Proposed Action"). The Proposed Action would also include development of seven tennis courts, 36 acres of common open space, and the existing golf course would be downsized to a 9-hole course.

VHB has conducted a study of construction noise associated with the Proposed Action. The noise study includes a summary of applicable construction-related noise policies and ordinances, background on sound level concepts, ambient noise measurements at noise-sensitive locations in the study area, predictions of future construction noise including stationary equipment and construction trucking operations, an assessment of potential construction noise effects, and recommendations for best management practices to reduce construction noise.

Noise Policies and Ordinances

Construction will be conducted in accordance with the Village of Mamaroneck, Noise Ordinance (Chapter 254) to minimize potential impact. The village ordinance prohibits construction activities including "... the erection, construction or reconstruction of buildings or major repairs to buildings, the excavation, clearing, filling or grading of land or the placement or removal of earth, stone or building material of any kind, whether or not the work involved the use of machinery or power tools, such that the sound therefrom creates unreasonable noise across a residential real property boundary, other than between the hours of 8:00 a.m. and 6:00 p.m., Monday through Saturday..." Additionally, no such activity shall be permitted on Sundays or on any of the following holidays: New Year's Day, Martin Luther King's Birthday, Presidents' Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Yom Kippur, Thanksgiving and Christmas.

To comply with Article 8 of the New York State Environmental Conservation Law and 6 NYCRR Part 617 regulations, noise impact must be evaluated as a potential issue in making a determination of environmental significance. The New York State Department of Environmental Conservation (NYSDEC) has issued a program policy "Assessing and Mitigation Noise Impacts" which provides guidance on the methods to assess potential noise impact and avoid or reduce significant adverse impacts for fulfillment of SEQRA regulations. The SEQRA process and the NYSDEC noise policy focuses on noise that would be generated by the Proposed Action and activities that are within the control of the property owner. According to NYSDEC noise policy, the goal for any permitted operation is to minimize increases in sound levels. The NYSDEC policy has guideline thresholds for assessing the effects of long-term permanent sources

50 Main Street
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of noise. If a Proposed Action would increase ambient noise levels by 3 to 6 dBA, there is potential for adverse noise impact and there may be a need for mitigation for the most sensitive receptors. For increases in noise of 6 to 10 dBA, there is a greater potential for impact and mitigation is generally needed. For increases in ambient noise of 10 dBA or more, mitigation is warranted where reasonable. NYSDEC policy states that the addition of any noise source, in a non-industrial setting, should not raise the ambient noise level above a maximum of 65 dBA. Therefore, given the temporary nature of construction noise, increases in ambient noise of 10 dBA or more which would increase levels above 65 dBA are considered reasonable impact criteria that would warrant construction noise mitigation or best management practices.

Sound Level Concepts

Sound is the rapid fluctuations of air pressure above and below ambient pressure levels. Noise is defined as unwanted or excessive sound. Sound becomes unwanted when it interferes with normal activities such as sleep, work, communication, or recreation. How people perceive sound depends on several measurable physical characteristics, including:

Sound Level - Sound level is based on the amplitude change in pressure and is related to the loudness or intensity. Human hearing covers a wide range of changes in sound pressure amplitude. Therefore, sound levels are most often measured on a logarithmic scale of decibels (dB) relative to 20 micro-pascals. The dB scale compresses the audible range of acoustic pressure levels, which can vary from the threshold of hearing (0 dB) to the threshold of pain (120 dB). Because sound levels are measured in dB, the addition of two sound levels is not linear. For example, adding two equal sound levels results in a 3 dB increase in the overall level. Research indicates the general relationships between sound level and human perception are as follows:

- A 3-dB increase is a doubling of acoustic energy and is approximately the smallest difference in sound level that can be perceived in most environments.
- A 10-dB increase is a tenfold increase in acoustic energy and is generally perceived as a doubling in loudness to the average person.

Frequency - Sounds are comprised of acoustic energy distributed over a range of frequencies. Acoustic frequencies, commonly referred to as tone or pitch, are typically measured in Hertz (Hz). Human hearing generally ranges from 20 to 20,000 Hz; however, the human ear does not perceive sound levels from each frequency as equally loud. To compensate for this phenomenon in perception, a frequency filter known as A-weighting is commonly used to evaluate environmental noise levels, and sound levels are denoted as "dBA."

- Sound levels reported in octave or one-third-octave frequency bands are often used to describe the frequency content of different sounds. Some sources of sound can generate "pure tones," which is when there is a concentration of sound within a narrow frequency range such as a whistle. Humans can hear pure tones very well, and such conditions can be a cause of increased annoyance.

A variety of sound level descriptors can be used for environmental noise analyses. These descriptors relate to the way sound varies in level over time. The following is a list of common sound level descriptors:

Energy-Average Sound Level (Leq) - Leq is a single value, which represents the same acoustic energy as the fluctuating levels that exists over a given period of time. The Leq takes into account how loud noise events are during the period, how long they last, and how many times they occur. Leq is commonly used to describe environmental noise and relates well to human annoyance.

Statistical Sound Levels – Sound level metrics, such as L01, L10, L50 or L90, represent the levels that are exceeded for a particular percentage of time over a given period. For example, L10 is the level that is exceeded for 10 percent of the time. Therefore, it represents the higher end of the range of sound levels. The L90, on the other hand, is the level that is exceeded 90 percent of the time, and therefore, is representative of the background sound level.

Maximum Sound Level (Lmax) – Many sources of sound, including mobile sources and stationary sources, change over time. Stationary sources associated with energy facilities can often generate different sound levels depending on the operational condition of the equipment. It is common to describe sound in terms of the maximum (Lmax) sound level emissions. Table 1 presents a list of the maximum sound levels of common outdoor and indoor sources.

Table 1: Maximum Sound Levels of Common Outdoor and Indoor Sources

Outdoor Source	Sound Level (dBA)	Indoor Source
	110	Rock Band at 5 m
Jet Over Flight at 300 m	**105**	
	100	Inside New York Subway Train
Gas Lawn Mower at 1 m	**95**	
	90	Food Blender at 1 m
Diesel Truck at 15 m	**85**	
Noisy Urban Area—Daytime	**80**	Garbage Disposal at 1 m
	75	Shouting at 1 m
Gas Lawn Mower at 30 m	**70**	Vacuum Cleaner at 3 m
Suburban Commercial Area	**65**	Normal Speech at 1 m
	60	
Quiet Urban Area—Daytime	**55**	Quiet Conversation at 1 m
	50	Dishwasher Next Room
Quiet Urban Area—Nighttime	**45**	
	40	Empty Theater or Library
Quiet Suburb—Nighttime	**35**	
	30	Quiet Bedroom at Night
Quiet Rural Area—Nighttime	**25**	Empty Concert Hall
Rustling Leaves	**20**	
	15	Broadcast and Recording Studios
	10	
	5	
Reference Pressure Level	**0**	Threshold of Hearing

Source: Highway Noise Fundamentals. Federal Highway Administration, September 1980.

Existing Noise Conditions

Noise-sensitive receptors near the subject site include residences such as those on Rock Ridge Road, Fairway Green, Old Post Lane, Cooper Avenue, Protano Lane, Sylvan Lane, Orienta Avenue, Fairway Lane, Cove Road (East, North, and South), Eagle Knolls Road, , Cove Road, and Hommocks Road. Additionally, the Hommocks Middle School on Hommocks Road is adjacent to the subject site. The predominant sources of existing noise at these receptors include traffic on Boston Post Road (Route 1), local roads, and other sources such as landscaping equipment associated with maintenance of the golf course.

Ambient sound measurements were conducted at six locations (See Figure 1) around the subject site at locations representative of the closest receptors. Measurements were conducted using a Larson Davis model 831 sound level meter certified to have Type I accuracy according to the ANSI S1.4 "Specifications for Sound Level Meters." The sound level meter was calibrated in the field prior to and after the measurements and by a laboratory traceable to the National Institute of Standards and Technology within one year of the field measurements.

Measurement data collected included overall A-weighted sound levels and one-third-octave band sound levels, which provide information on the frequency content (i.e. low or high-pitched) character of sound. Data collection included one-second time histories and results for the entire measurement duration including minimum, maximum, percentile values (L01, L10, L33, L50, L90, and L99), and the energy-average sound level (Leq). Atmospheric observations of wind speed, wind direction, air temperature, precipitation, and relative humidity were made in the field and from a nearby online weather station. Observations were also made of the predominant sources of sound.

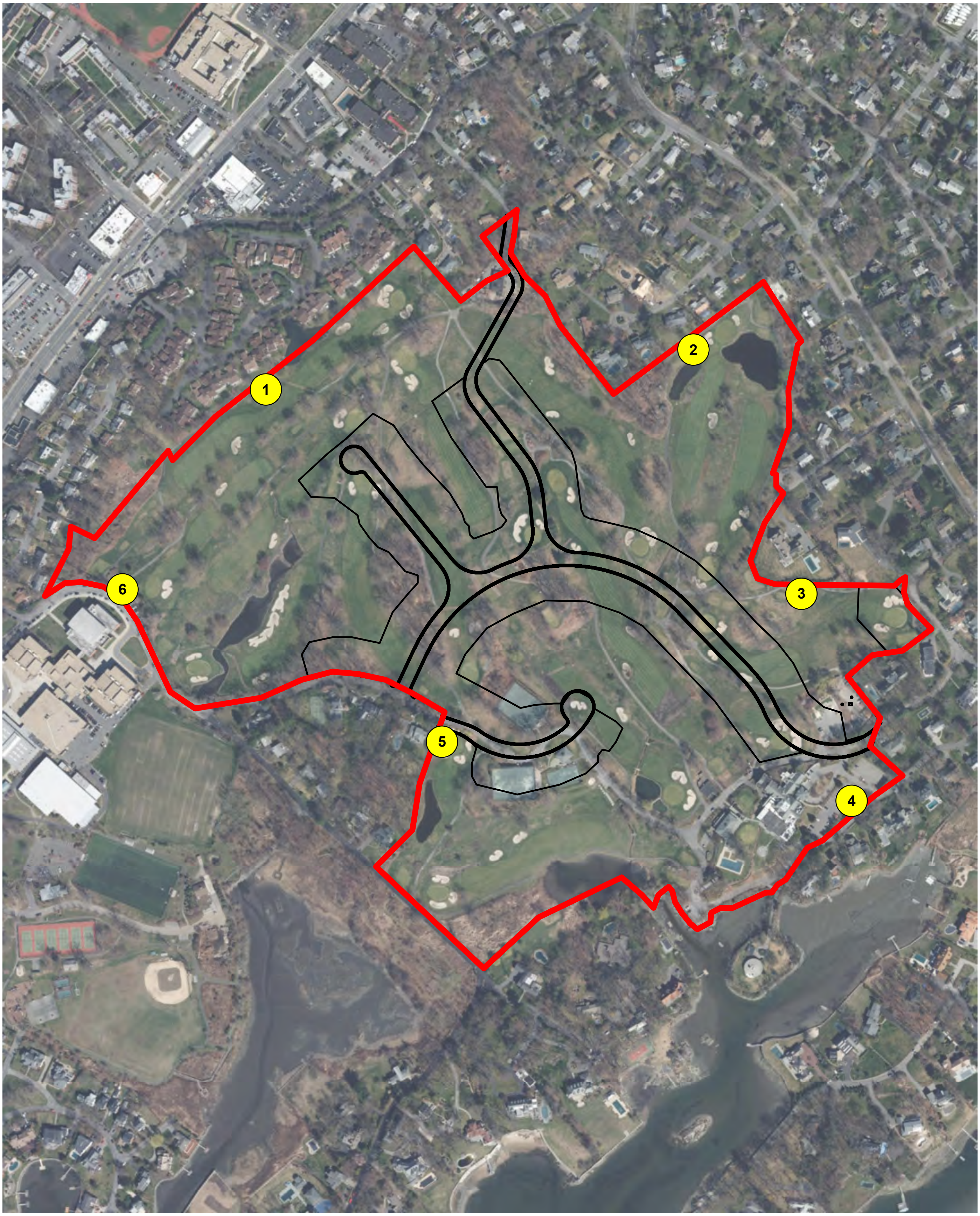
Ambient measurements were conducted on July 30, 2018 between approximately 9:00 AM and noon. Atmospheric conditions included air temperature between 68 and 72 degrees, with 53 to 70% relative humidity, winds generally 5 to 10 mph, and no precipitation. As shown in Table 2, the measurements show that energy-equivalent sound levels ranged from 47 to 56 dBA. Generally, ambient sound levels ranged from 47 to 56 dBA. At Site 2, sound levels were 68 dBA (Leq) during a period when landscaping equipment was in close proximity to the microphone.

Table 2: Ambient Sound Measurement Results

Receptor	Address	Start Time	Duration (min)	Sound Level (dBA)								
				Leq	Lmax	L01	L10	L33	L50	L90	L99	Lmin
1	Near 1202 Fairway Green	8:57 AM	20	**53**	69	66	53	48	48	45	43	42
2	Near 930 Sylvan Lane	9:29 AM	20	**56**[A]	63	62	58	56	55	52	51	51
3	Near 1000 Fairway Lane	9:58 AM	20	**52**	65	64	55	51	49	47	44	44
4	1058 Cove Road	10:34 AM	20	**47**	58	54	50	47	46	43	41	41
5	541 Eagle Knolls Rd	11:07 AM	20	**48**	63	60	50	45	44	42	41	40
6	Near Hommocks Middle School	11:41 AM	20	**53**	64	61	57	52	50	48	47	46

A Noise measurement at this site excludes a period of time when landscaping equipment was within close proximity to the microphone. During that period of time, the ambient Leq sound level was 68 dBA.

Source, VHB, 2018.



0 175 350 700 Feet

Noise Monitoring Location

Project Site

Proposed Project New Roadways and Property Boundary

Hampshire Country Club - PRD | Village of Mamaroneck, NY

Noise Monitoring Locations

Construction Noise Predictions

Construction of the PRD would introduce new sources of noise which have the potential to impact existing receptors adjacent to the property or new receptors that would be introduced during the phased development. Construction noise depends on the phase of construction which include site grading and fill, building erection, final fit out, and landscaping.

The loudest phase of noise is the earthwork phase which includes bringing in fill by truck, excavators and back hoes to move soil around the site, grading, and a vibratory compactor (dual drum) to compact the soil. Based on the composition of the bedrock, blasting will be required for removal.

A New York State licensed blasting contractor will prepare a written Blasting Plan in accordance the with the Village of Mamaroneck Village Code Chapter 120 and the New York Department of Transportation "Geotechnical Engineering Manual: Procedure for Blasting" latest edition (Appendix 5), providing a detailed description of the means and methods of the proposed rock removal program. The blasting contractor will implement acoustic overpressure and vibration monitoring as required by the Blasting Plan to minimize the risk of structural damage to nearby structures. Since blasting involves relatively short (a few seconds) noise exposures in the community, it is not considered a significant cause of human annoyance.

The Proposed Action will be constructed in one phase, with construction of roads and related improvements anticipated to last between 18 and 24 months and residential construction anticipated to last between 24 and 36 months. It is estimated that the initial construction period would be approximately 9 months with an estimated 16-yard truck visits per day (or 24 per day on a 5-day week schedule). After that, truck activity is expected to diminish to approximately 3-4 per day as the 105 units are built out.

All construction trucks accessing the Project Site will be required to use I-95, exiting at either Exit 17 (to and from the south) or Exit 19 (to or from the north) to use Boston Post Road (US Route 1) to get to and from Hommocks Road and Eagle Knolls Road. There will be no truck access allowed via Orienta Avenue or East Cove Road. When school is in session, truck access to the Project Site will only be permitted between 8:15 am and 2:30 pm, as well as between 4:00 pm and 6:00 pm.

Construction noise has been modeled using standard methods for residential development projects in a manner that is consistent with federal guidelines. Cadna-A sound prediction software has been used. Cadna-A is an internationally-accepted sound prediction program that implements the International Standards Organization 9613-2 sound propagation standard. This model takes into account the sound emissions of equipment, the areas where the construction equipment will be, the ground cover, terrain, and intervening objects such as buildings.

The construction noise model accounts for the types of construction equipment, the number of each type of equipment, the amount of time they typically operate during a work period (usage factor), and the distance between receptor locations and the areas where construction will occur. For typical daytime construction activities, construction noise is evaluated according to the energy-average Leq. The reference noise emissions of the equipment anticipated for construction of the Project is based on the Federal Highway Administration's Roadway Construction Noise Model, as shown in Table 3.

Table 3: Stationary Construction Equipment Noise Emissions

Construction Equipment	Number	Maximum Sound Level at 50 feet (dBA)	Utilization Factor
Backhoe	**2**	**80**	**40%**
Excavator	**2**	**85**	**40%**
Vibratory Compactor	**1**	**80**	**20%**

Source: RCNM, 2011.

Construction Noise Assessment

Table 4 and Figure 2 present the results of the construction noise assessment. This table presents the existing measured sound levels, predicted construction noise levels, and the results of the assessment relative to the NYSDEC guidelines. The evaluation considers construction noise levels which exceed ambient levels by 10 dBA and also exceed 65 dBA (Leq) to warrant noise mitigation or best management practices.

Construction including trucking operations and stationary equipment would generate noise levels ranging from 49 to 65 dBA (Leq) at adjacent receptor locations. Noise levels would generally increase over existing ambient conditions by three to eight dBA at most locations. At some locations particularly close to the proposed earthwork, construction noise would increase existing ambient conditions by up to 13 dBA (Leq). The increases in construction noise is primarily due to the stationary earthwork equipment. There would be up to 24 daily truck trips, however, since the truck passbys are relatively brief events lasting only approximately 10 seconds, the overall noise exposure from the trucks is substantially less than the stationary equipment.

Locations where construction would increase existing ambient conditions by 10 dBA or more include residences on Eagles Knolls Road, Sylvan Lane, and Cove Road North which are near the limits of earthwork construction. Future noise levels which include existing ambient noise and construction noise would typically be 60 to 65 dBA (Leq) at these receptors. Although future noise levels would not exceed 65 dBA (Leq), they would approach this threshold and therefore best management practices should be considered.

Table 4: Construction Noise Assessment

August 24, 2018 | **FIGURE 2**

Hampshire Country Club PRD | Construction Noise Analysis

Legend

- Receptors
- Approximate Limits of Earthwork
- Site Boundary

Construction Noise Contours

- 50 dBA (Leq)
- 55 dBA (Leq)
- 60 dBA (Leq)
- 65 dBA (Leq)
- 70 dBA (Leq)

Source: NYSDOP

Receptor	Address	Existing Noise Level (Leq, dBA)	Construction Noise Level (Leq, dBA)	Future (Existing and Construction) Noise Level (Leq, dBA)	Increase over Ambient (Leq, dBA)	Impact?
R1	541 Eagles Knolls Rd	48	61	61	13	**No**
R2	521 Eagles Knolls Rd	48	61	61	13	**No**
R3	521 Eagle Knolls Rd (2)	48	61	61	13	**No**
R4	45 Hommocks Rd	48	55	56	8	**No**
R5	Hommocks School	53	55	57	4	**No**
R6	7 Hommocks Rd	53	52	56	2	**No**
R7	2 Rock Ridge Rd	53	53	56	3	**No**
R8	4 Rock Ridge Rd	53	50	55	2	**No**
R9	8 Rock Ridge Rd	53	49	54	2	**No**
R10	12 Rock Ridge Rd	53	49	54	2	**No**
R11	16 Rock Ridge Rd	53	49	54	2	**No**
R12	20 Rock Ridge Rd	53	50	54	2	**No**
R13	1001-1002 Fairway Green	53	52	55	3	**No**
R14	901-905 Fairway Green	53	53	56	3	**No**
R15	801-805 Fairway Green	53	54	56	4	**No**
R16	601-605 Fairway Green	53	56	58	5	**No**
R17	501-505 Fairway Green	53	56	58	5	**No**
R18	401-405 Fairway Green	53	55	57	5	**No**
R19	74 Post Lane	53	56	58	5	**No**
R20	37 Post Lane	53	60	60	8	**No**
R21	970 Proano Ln	53	61	61	9	**No**
R22	939 Sylvan Ln	53	59	60	7	**No**
R23	945 Sylvan Ln	53	61	61	9	**No**
R24	950 Sylvan Ln	53	65	65	12	**No**
R25	940 Sylvan Ln	56	56	59	3	**No**
R26	1002 Fairway Green	56	52	57	1	**No**
R27	511 Orienta Ave	53	50	55	2	**No**
R28	521 Orienta Ave	53	50	55	2	**No**
R29	531 Orienta Ave	53	50	55	2	**No**
R30	555 Orienta Ave	53	51	55	2	**No**
R31	921 Fairway Ln	53	52	56	2	**No**
R32	931 Fairway Ln	53	53	56	3	**No**
R33	1000 Fairway Ln	53	58	59	6	**No**

Receptor	Address	Existing Noise Level (Leq, dBA)	Construction Noise Level (Leq, dBA)	Future (Existing and Construction) Noise Level (Leq, dBA)	Increase over Ambient (Leq, dBA)	Impact?
R34	925 Cove Rd	53	56	58	5	**No**
R35	917 Cove Rd East	53	57	59	5	**No**
R36	742 Cove Rd	53	57	59	6	**No**
R37	727 Cove Rd	53	60	61	8	**No**
R38	1013 Cove Rd North	53	59	60	7	**No**
R39	1031 Cove Rd South	47	53	54	7	**No**
R40	1022 Cove Rd North	47	58	59	11	**No**
R41	1044 Cove Rd South	47	52	53	6	**No**
R42	1058 Cove Rd South	47	52	54	6	**No**
R43	1100 Cove Rd South	47	52	54	6	**No**
R44	1110 Cove Rd South	47	52	53	6	**No**
R45	1120 Cove Rd South	47	51	53	5	**No**
R46	11 Oak Ln	47	50	52	5	**No**
R47	3 Oak Ln	47	50	52	4	**No**

Source: VHB, 2018.

Construction Noise Mitigation / Best Management Practices

As discussed in the previous section, construction noise levels would increase existing ambient conditions by more than 10 dBA at certain locations close to the proposed earthwork construction. Although noise levels would not exceed 65 dBA (Leq), best management practices to reduce construction noise should be implemented. The predominant source of construction noise is the stationary equipment since trucking operations generate relatively brief noise exposure. In efforts to reduce potential noise impacts during construction, noise reduction measures would include the following:

- Construction activities will be limited to daytime and week day hours in accordance with the Village ordinance.
- Supplemental stationary construction equipment, such as generators or air compressors, will be located as far as possible from noise-sensitive sites.

- Of the various types of construction equipment, diesel engines can be the most significant noise source. The contractor will ensure that all equipment is operating properly and is fitted with the appropriate noise-reducing features such as exhaust mufflers and engine compartment shields.
- Most wheeled and tracked construction equipment is required to have back-up alarms for safety purposes. Due to their tonal character, these alarms are often a significant noise concern. Special back-up alarms may be implemented including ambient-adjusted alarms which only sound five decibels higher than ambient conditions or "quackers" which have a less tonal character. Flagging may also be used to eliminate the need for back-up alarms.
- Mitigation may include re-routing truck routes and minimizing idling times.
- Acoustic enclosures may be used to reduce emissions from small construction equipment, such as generators.
- Temporary noise barriers or noise blankets can be installed between construction equipment and sensitive receptors to provide significant noise reduction (typically five to 15 decibels).
- As more detailed information on the construction equipment and methods become available as the project design advances, the contractor shall prepare a noise control plan to further evaluate the potential for construction noise impact and identify specific mitigation measures that will be implemented.
- A key aspect to minimizing the effects of construction noise is maintaining good communication with the nearby residences and informing them of the schedule of construction activities and the approaches that will be taken to minimize construction noise.

Z Wetland Functional Assessment

Wetland Functional Assessment

Hampshire Country Club Property

Cove Road
Village of Mamaroneck and
Town of Mamaroneck,
Westchester County,
New York

Prepared for: **Hampshire Recreation, LLC**
c.o. New World Realty Advisors
1500 Broadway, 15th Floor
New York, NY 10036

Prepared by: vhb
50 Main Street, Suite 360
White Plains, New York 10606

July 2019 Update

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Figure 2 - Drainage System and Wetland Map

Attachment B - Representative Site Photographs

Attachment C - Wetland Functional Assessment Data Forms

Attachment D - Nelson, Pope & Voorhis Wetlands Characterization Assessment, 2012

Attachment E - *Curriculum Vitae* of David Kennedy

1.0

Introduction

This wetland functional assessment has been prepared by VHB Engineering, Surveying and Landscape Architecture, P.C. (VHB) for the 106.2-acre Hampshire County Club golf course property, located between East Boston Post Road and the Long Island Sound, in Westchester County, New York (the "Project Site," see Attachment A, Figure 1). The Village/Town of Mamaroneck municipal boundary line passes through the Project Site, creating a 98.9-acre portion located within the Village of Mamaroneck and a smaller 7.3-acre portion within the Town of Mamaroneck.

The Project Site is currently developed with fairways, greens, roughs, treed areas and water features that are part of an 18-hole golf course. The remainder of the Project Site is developed with recreational membership club facilities, including a 35,000 square-foot (sf) clubhouse, swimming pool, tennis courts, maintenance facilities and other support uses.

The golf course water features noted above include seven ponds and several ditches associated with the golf course drainage system, as well as two vegetated marshes. These features are regulated as "wetlands" by the Board of Trustees of the Village of Mamaroneck, pursuant to Village Code Chapter 192 (Freshwater Wetlands), and by the Town Board of the Town of Mamaroneck, pursuant to Town Code Chapter 114 (Wetlands and Watercourses).

Hampshire Recreation, LLC is proposing a new Planned Residential Development (PRD) consisting of 105 residential units, parking areas, seven tennis courts and approximately 36 acres of common open space at the Project Site. The existing golf course use would be downsized to a 9-hole golf course to to facilitate the development of the PRD, which would be built in its entirety within the portion of the Project Site located within the Village of Mamaroneck. No development is proposed within the Town of Mamaroneck. As such, the Planning Board of the Village of Mamaroneck is serving as the Lead Agency for the State Environmental Quality Review Act (SEQRA) review of the proposed PRD. Therefore, in accordance with the requirements of the Village Planning Board as Lead Agency, this report provides a detailed description of the regulated wetlands at the Project Site and summarizes the results of a wetland functional assessment performed by VHB in May 2016.

2.0

Wetland Functional Assessment

2.1 Site and Wetland Overview

The Project Site is comprised of various habitats that are predominantly anthropogenic (i.e., created or altered by humans) in origin. Specifically, based upon field surveys conducted in May 2016, the Project Site supports the following ecological communities, as described in the New York Natural Heritage Program (NYNHP) publication *Ecological Communities of New York State*[1]

- Urban Structure Exterior
- Paved Road/Path
- Unpaved Road/Path
- Mowed Lawn
- Mowed Lawn with Trees
- Farm Pond/Artificial Pond
- Ditch/Artificial Intermittent Stream
- Common Reed Marsh

The latter three communities encompass the regulated wetlands at the Project Site, which include the ponds and ditches comprising the golf course drainage system, as well as an additional isolated wetland feature (see Attachment A, Figure 2). As described in detail in Section 2.3 below, the majority of the wetlands at the Project Site are anthropogenic features that were created or altered to provide drainage and irrigation for the golf course, and to serve as water hazards. The wetlands have been adversely impacted due to historic and current stormwater inputs and golf course management practices. The primary hydrological influences to the wetlands at the Project Site include stormwater and groundwater. Additionally, some of the site wetland features are tidally-influenced from the marine waters of Delancey Cove, located to the south of the Project Site. In general, the boundaries of the golf course

▼

[1] Edinger, G.J., D.J. Evans, S. Gebauer, T.G. Howard, D.M. Hunt, and A.M. Olivero (editors). 2014. *Ecological Communities of New York State.* Second Edition. A revised and expanded edition of Carol Reschke's Ecological Communities of New York State. New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY.

wetlands are well-defined, due to the abrupt transitions (i.e., rock-lined or grass-lined banks) that have been constructed along the boundaries of these surface water features and the adjacent maintained turf areas of the golf course.

2.2 Methodology

The wetland functional assessment was conducted according to the methods developed by Denis W. Magee (with technical contributions from Garrett G. Hollands), as described in "*A Rapid Procedure for Assessing Wetland Functional Capacity based on Hydrogeomorphic (HGM) Classification*"[2] (the "Magee-Hollands Method"). According to the aforementioned resource, the Magee-Hollands Method was developed and is intended to be applied to six distinct wetland classes within "the glaciated Northeast-Midwest Region" (depressional, slope, lacustrine fringe, extensive peatlands, flats and riverine wetlands). In accordance with the Magee-Hollands Method, the functional capacity for each of eight principal wetland functions is assessed, based partially on review of "desktop" resources (e.g., aerial imagery, maps and other references), but primarily upon field observations of hydrological, geological and biological characteristics of the wetland and the surrounding watershed uses and land uses. The eight wetland functions are:

- Modification of Groundwater Discharge
- Modification of Groundwater Recharge
- Storm and Flood Water Storage
- Modification of Stream Flow
- Modification of Water Quality
- Export of Detritus
- Contribution to Abundance and Diversity of Wetland Vegetation
- Contribution to Abundance and Diversity of Wetland Fauna

During the assessment, relative value weights are assigned to assorted variables applying to each of the eight aforementioned wetland functions. The sum of the variable weights for each wetland function is then totaled and divided by the maximum potential score for that function, in order to derive a Functional Capacity Index (FCI) score. The FCI score is then compared to the FCI index range for other wetlands of the same wetland class (e.g., depressional wetlands, etc.) based upon data from over 1,000 assessments performed on wetlands in the glaciated Northeast-Midwest Region, within which the Magee-Hollands Method was developed.

Field data for the wetland functional assessment were collected at the Project Site on May 17-18, 2016, by VHB Project Scientist David Kennedy, MS (*Curriculum Vitae* included as Attachment E) and recorded on Magee-Hollands Method data forms

▼

[2] Magee, Denis W., with technical contributions by Garret G. Hollands. 1998. *A Rapid Procedure for Assessing Wetland Functional Capacity based on Hydrogeomorphic (HGM) Classification.* Normandeau Associates, Bedford Massachusetts.

(copies included as Attachment C). Additional information regarding the Project Site wetlands was collected during an interview with golf course superintendent Mr. Scott Olsen. Relevant information obtained from Mr. Olsen is included within the text of this report. Additionally, VHB reviewed the 2012 *Wetland Characterization Assessment* prepared by Nelson, Pope & Voorhis, LLC (NP&V) (copy included as Attachment D) to obtain additional background information regarding the wetlands at the Project Site.

Based upon field observations of surface water connections or other hydrological connections, the various wetland features at the Project Site were grouped as four distinct wetlands for the purpose of this wetland functional assessment (see Attachment A, Figure 2) . For consistency, the four wetlands have been identified primarily according to the naming conventions utilized in the aforementioned NP&V report, as amended by VHB based upon current site observations:

- Golf Course Drainage System 1 (Pond 13, Pond 16 and Drainage Ditch 1)
- Golf Course Drainage System 2 (Pond 5 and Pond 6)
- Golf Course Drainage System 3 (Pond 10, Pond 11, Pond 18, vegetated wetland and Drainage Ditch 2)
- Isolated Wetland A

Following the Magee-Hollands Method procedures, the four wetland groupings identified above were all classified under the depressional wetland class, due to the fact that they occur within topographic depressions and have either no outlets or intermittent outlets.

2.3 Results

The Magee-Hollands FCI Scores for each of the eight analyzed wetland functions within the four Project Site wetlands are presented in Table 1 below.

Table 1 – Summary of Magee-Hollands Wetland Functional Capacity Scores

Wetland Function	Golf Course Drainage System 1 (FCI Score)	Golf Course Drainage System 2 (FCI Score)	Golf Course Drainage System 3 (FCI Score)	Isolated Wetland A (FCI Score)
Modification of Groundwater Discharge (FCI Range = 0.19-1.0)	0.55	0.50	0.55	0.28
Modification of Groundwater Recharge (FCI Range = 0.19-1.0)	0.57	0.43	0.62	0.62
Storm and Flood Water Storage (FCI Range = 0.15-1.0)	0.55	1.0	0.52	1.0
Modification of Stream Flow (FCI Range = 0.11-1.0)	0.44	0.0	0.44	0.0
Modification of Water Quality (FCI Range = 0.22-1.0)	1.0	1.0	1.0	0.77
Export of Detritus (FCI Range = 0.27-1.0)	0.39	0.0	0.44	0.0
Contribution to Abundance and Diversity of Wetland Vegetation (FCI Range = 0.13-1.0)	0.20	0.13	0.46	0.60
Contribution to Abundance and Diversity of Wetland Fauna (FCI Range = 0.11-1.0)	0.39	0.36	0.55	0.44

The following provides a summary of the functional capacity of the four wetlands at the Project Site, based upon the Magee-Hollands FCI scores, site observations, the NP&V report and information provided by Mr. Olsen. As detailed in Attachment D, the NP&V report identified the presence of fish in all ponds and streams and noted the use of the site by egrets.

Golf Course Drainage System 1

This wetland system is comprised of Ponds 13 and 16, with associated drainage ditches and pipes. Pond 16 is an artificial structure located at and beyond the northwestern property boundary. The pond was constructed in 1982, in order to accommodate stormwater runoff from the adjoining condominium development, as well as to provide drainage for the golf course. Reportedly, Pond 16 has also been subject to illicit stormwater discharges from adjacent commercial uses. As stormwater is a primary hydrological source, Pond 16, contains high levels of algae, organic matter and sediment deposits. According to Mr. Olsen, the pond is periodically treated with herbicides and/or organic microbe applications. The plant community within the pond is dominated by submerged aquatic vegetation, with no emergent plants observed during the wetland assessment. The NP&V report identified frogs in Pond 16.

Water exits Pond 16 via a subgrade pipe that outfalls to a drainage ditch (Ditch 1) that connects to Pond 13. The ditch is largely unvegetated and contains a mineral substrate comprised primarily of gravels and clays. A similar pipe/ditch combination drains the northcentral portion of the golf course and also discharges to Pond 13.

Pond 13 was reportedly a naturally occurring pond that was modified and expanded between 1960 and 1976. With the exception of scattered patches of emergent vegetation, the majority of the pond is largely unvegetated. The pond contains algal deposits and has been impacted by both organic and mineral sediment deposits from stormwater runoff. Two large culvert openings with manually-operated gate valves occur within a concrete and fieldstone wall located at the terminus of the pond along the western property boundary near Hummocks Road. The culverts reportedly run under Hummocks Road to a subgrade vault located beneath the school athletic field, which in turn discharges via a culvert to the tidal wetlands of Delancey Cove to the south. The culvert gate valves were observed to be open at the time of the May 2016 wetland assessment. According to Mr. Olsen, the gate valves are left open continuously, and the water level within Pond 13 is therefore subject to a two-foot range as a result of tidal influence. As also observed during the wetland assessment, two smaller culvert openings occur within the fieldstone wall at the western terminus of Pond 13. The culverts appear to discharge stormwater from Hummocks Road to the pond.

Based on the Magee-Hollands assessment, the primary functions of Golf Course Drainage System 1 are Modification of Water Quality and Storm and Floodwater

Storage, which are the functions that the ponds and ditches that comprise the system were created and/or modified for. It is important to note that as a result of providing these functions for the adjacent condominium development and the golf course, water quality within the system itself is low. The system also provides a moderate degree of functionality with respect to Modification of Groundwater Recharge/Discharge functions to/from the underlying groundwater table, which appears to be located close to the ground surface through much of the low-lying portions of the golf course. Given the lack of a permanent outlet, the system offers limited functionality with respect to Export of Detritus. As the system does not support significant vegetative communities, Contribution to Abundance and Diversity of Wetland Vegetation functionality is low. Due to this factor, as well as low overall water quality, the system does not offer a significant degree of functionality with respect to Contribution to Abundance and Diversity of Wetland Fauna.

Golf Course Drainage System 2

This wetland system is comprised of Ponds 5 and 6, with associated subgrade drainage pipes located at the northeastern portion of the golf course. Ponds 5 and 6 are artificial structures that were constructed between 1960 and 1994 for irrigation and stormwater drainage purposes. According to Mr. Olsen, groundwater from two irrigation wells is pumped into Pond 5 from June to September, in order to supply the golf course irrigation system. Accordingly, water levels within the pond reportedly fluctuate by as much as four feet. Pond 6 receives overflow from Pond 5 via a 12-inch subgrade pipe, and water levels within this pond reportedly fluctuate by up to 18 inches. Although interconnected, the ponds do not have outlets to other wetlands or surface waters.

Both Ponds 5 and 6 also receive stormwater inputs via overland flow and via golf course drainage pipes. Additionally, Pond 6 receives stormwater inputs from the residential neighborhood to the north and east of the golf course via at least one culvert. As observed during the wetland assessment, both ponds support submerged aquatic vegetation and contain high levels of algae and organic sediments. The ponds are reportedly treated with herbicides and/or organic microbe applications, as needed.

The primary Magee-Hollands assessment functions of Golf Course Drainage System 2 are the Modification of Water Quality and Storm and Floodwater Storage functions provided by this artificially created system. The system also provides a moderate degree of functionality with respect to Modification of Groundwater Recharge/Discharge functions. However, it is important to note that groundwater discharge within the system is due primarily to pumping of groundwater to supply the golf course irrigation system, rather than natural discharge of groundwater. Due to the lack of an outlet, the system does not provide Modification of Stream Flow or Export of Detritus functions. The system provides limited Contribution to

Abundance and Diversity of Wetland Vegetation functionality and very limited Contribution to Abundance and Diversity of Wetland Fauna functionality.

Golf Course Drainage System 3

This system is comprised of Ponds 10, 11, 18 and Drainage Ditch 2. Additionally, the system includes a vegetated emergent wetland located contiguous to Pond 10.

Drainage Ditch 2 and associated subgrade pipes provide drainage for the eastern and southern portions of the golf course. Portions of the ditch appear to have been a natural stream that was modified in association with the creation of the golf course. The uppermost (northern) reaches of the ditch are primarily stone- or gravel-lined and largely unvegetated, while further to the south the stream is characterized by finer-grained sediments and supports emergent vegetation communities.

An intermittent connection exists between Drainage Ditch 2 and Pond 18, which is located adjacent to the north of Eagle Knolls Road. Pond 18 is an anthropogenic structure that was created for stormwater storage and aesthetic purposes. The pond is comprised of two levels ("upper" and "lower") that are hydrologically connected. Water is transported by a recirculation pump from the lower level of the pond to the upper level, where it discharges through a fountain and flows back to the lower level via a stone spillway/waterfall. The pond receives stormwater drainage from paved areas located near the golf course clubhouse. The stormwater discharges to the upper level of Pond 18 via a culvert. An overflow located within the lower level of the pond discharges water to Ditch 2 during significant storm events. As such, Pond 18 and Ditch 2 are hydrologically linked via this intermittent connection. The lower level of Pond 18 was observed to contain significant algal growth at the time of the wetland assessment.

Beyond Pond 18, Ditch 2 crosses beneath Eagle Knolls Road and empties into Pond 10, located at the southern end of the golf course. Pond 10 is reportedly a natural feature that has been modified in association with the golf course. The pond is a shallow and largely unvegetated feature that appears to receive intermittent tidal water via three culvert outlets equipped with manually-operated gate valves. The culverts are set at different elevations within a concrete headwall located at the southeastern end of the pond. The gate valves were all observed to be in the open position at the time of the wetland assessment. The three culverts are connected to concrete control structures with tide gates set at different elevations within an embankment located along the shoreline of Delancey Cove. The control structures and tide gates appear to have been designed to allow for drainage from Pond 10 to Delancey Cove to occur during storm events, while preventing tidal waters from entering Pond 10. However, at the time of the wetland assessment, water was observed discharging to Pond 10 through two of the three culverts, and evidence of tidal wetland flora was observed within portions of the pond.

The western portion of Pond 10 is contiguous with and hydrologically connect to a densely vegetated emergent wetland that is dominated by common reed (*Phragmites australis*). Pond 10 also receives water from Pond 11 via a subgrade culvert. Pond 11 was reportedly constructed in 1998 to improve drainage at the southern portion of the golf course. Scattered emergent vegetation, submergent vegetation, algal growth and organic matter were observed within the Pond 11 at the time of the wetland assessment.

Similar to the other two golf course drainage systems, the primary functions of Golf Course Drainage System 3 are Modification of Water Quality and Storm and Floodwater Storage. In particular, these functions are facilitated by the emergent wetland located to the west of Pond 10. As a result of providing these two functions, overall water quality within Golf Course Drainage System 3 is low. The system also provides a moderate degree of functionality with respect to the Modification of Groundwater Recharge/Discharge functions. Given the lack of a permanent outlet, the system offers limited functionality with respect to Export of Detritus. Due primarily to the emergent wetland to the west of Pond 10, as well as the vegetated lower reaches of Ditch 2, the system provides a higher level of functionality for the Diversity of Wetland Vegetation and Contribution to Abundance and Diversity of Wetland Fauna functions, as compared to the other two golf course drainage systems.

<u>Isolated Wetland A</u>

Isolated Wetland A is a common reed-dominated emergent marsh located along the northwestern property boundary with the adjacent residential development. Unlike the three golf course drainage systems, Isolated Wetland A was not constructed or altered for stormwater purposes, although the feature appears to receive overland flow from higher topography within the immediate surrounding area. No surface water was observed within the feature at the time of the wetland functional assessment, however saturated soils were observed several inches below the surface. Evidence of historic clearing was observed along the border of the wetland with the adjacent residential properties.

Based on the Magee-Hollands assessment, the chief functions performed by Isolated Wetland A are Storm and Floodwater Storage and Modification of Water Quality. These functions are due primarily to the fact that the wetland has no outlet, as well as the surficial soils and continuance vegetation cover within the wetland. The wetland also provides a relatively high degree of functionality with respect to Modification of Groundwater Recharge and Contribution to Abundance and Diversity of Wetland Vegetation. Wetland A offers limited functionality for Modification of Groundwater Discharge and Contribution to Abundance and Diversity of Wetland Fauna. Due to the lack of an outlet, Wetland A does not provide any functionality for Export of Detritus and Modification of Stream Flow.

3.0

Conclusions

The wetlands at the Project Site are primarily anthropogenic features that were created or altered to provide drainage and irrigation for the golf course, and to serve as water hazards. These features have been adversely impacted due to stormwater inputs from onsite and offsite sources, as well golf course management practices. The results of the Magee-Hollands wetland functional assessment indicate that the primary functions performed by the Project Site wetlands are the Modification of Groundwater Quality and Storm and Floodwater Storage functions that these features were created or historically altered to perform. As a result of performing these functions, water quality is impaired and bottom substrates within the wetlands have been impacted by mineral and organic sediments. The Project site wetlands as a whole also offer a moderate degree of functionality with respect to the Modification of Groundwater Recharge and Modification of Groundwater Discharge functions to/from the underlying groundwater table. Due to their disturbed condition, impaired water quality and siltation impacts, overall functionality is low for the Diversity of Wetland Vegetation and Contribution to Abundance and Diversity of Wetland Fauna functions. Similarly, due primarily to the lack of permanent outlets, overall functionality is low to non-existent for the Export of Detritus and Modification of Stream flow functions.

Based upon the foregoing results of the wetland functional assessment, the wetlands at the Project Site are currently best-suited for their intended functions as stormwater management features and golf course water hazards.

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Attachment A

FIGURE 1 – EXCERPT OF USGS TOPOGRAPHIC MAP

SITE NAME: Hampshire Country Club
STREET ADDRESS: 1025 Cove Road Mamaroneck, NY 10543
BASE MAP SOURCE: United States Geological Survey Topographic Map – Mamaroneck, New York Quadrangle (2013)

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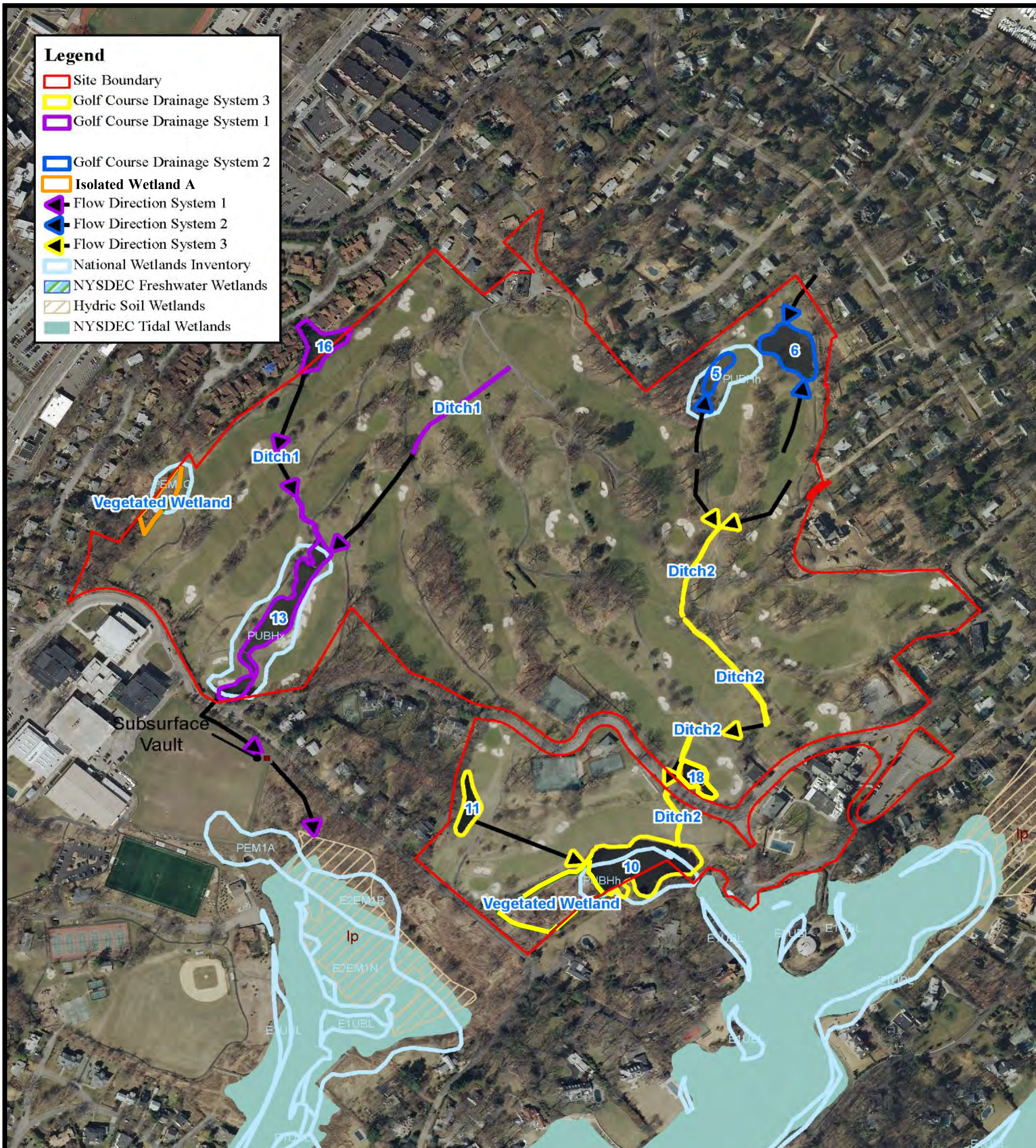

FIGURE 2 – DRAINAGE SYSTEM AND WETLAND MAP

SITE NAME: Hampshire Country Club
STREET ADDRESS: 1025 Cove Road Mamaroneck, NY 10543
BASE MAP SOURCE: *Wetland Characterization Assessment* - Figure 5, prepared by Nelson, Pope and Voorhis, LLC (September 17, 2012), as revised by VHB based on current conditions as observed on May 17-18, 2016

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Attachment B

Photograph No. 1: Pond 16 of Golf Course Drainage System 1 (May 17, 2016).

Photograph No. 2: Ditch 1 of Golf Course Drainage System 1 (May 17, 2016).

Photograph No. 3: Pond 13 of Golf Course Drainage System 1 (May 17, 2016).

Photograph No. 4: Culverts with gate valves at the western end of Pond13, within Golf Course Drainage System 1 (May 17, 2016).

Photograph No. 5: Ditch 2 of Golf Course Drainage System 3 (May 18, 2016).

Photograph No. 6: Lower level (foreground) and upper level (background, with fountain) of Pond 18 of Golf Course Drainage System 3 (May 17, 2016).

Photograph No. 7: Gate valves at the southeastern end of Pond 10. of Golf Course Drainage System 3 (May 18, 2016).

Photograph No. 8: Concrete control structures located along the shoreline of Delancey Cove. The control structures allow intermittent tidal flow to Golf Course Drainage System 3 (May 18, 2016).

Photograph No. 9: Pond 10 (foreground) and contiguous vegetated wetland (background) of Golf Course Drainage System 3 (May 18, 2016).

Photograph No. 10: Pond 11 of Golf Course Drainage System 3 (May 18, 2016).

Photograph No. 11: Isolated Wetland A (May 17, 2016).

Photograph No. 12: Emergent wetland vegetation along the boundary of Isolated Wetland A (May 17, 2016).

Attachment C

WETLAND INVENTORY DATA - CHARACTERIZATION OF WETLAND

Project Name: Hampshire Country Club Date: 5/17/16

Field Investigators: David Kennedy, MS, Project Scientist, VHB

Golf Course Drainage System 1 (Pond #s 13 + 16, ditches)

SURFACE WATER FLOW VECTORS

- ☒ Depressional - 100% Percent/Acreage
- ☐ Slope - _______ Perecent/Acreage
- ☐ Extensive Peatland - ____ Percent/Acreage
- ☐ Lacustrine Fringe - ____ Percent/Acreage
- ☐ Riverine - _____ Percent/Acreage

VEGETATION TYPES

Forested Wetland

- ☐ Evergreen Needle-leaved - _______________ Percent/Acreage
- ☐ Deciduous Broad-leaved - _______________ Percent/Acreage
- ☐ Deciduous Needle-leaved - _______________ Percent/Acreage

Scrub Shrub

- ☐ Evergreen Needle-leaved - _______________ Percent/Acreage
- ☐ Evergreen Broad-leaved - _______________ Percent/Acreage
- ☐ Deciduous Broad-leaved - _______________ Percent/Acreage
- ☐ Deciduous Needle-leaved - _______________ Percent/Acreage

Emergent Wetland

- ☒ Persistent - 3% Percent/Acreage
- ☒ Non-persistent - 2% Percent/acreage
- ☒ Aquatic Bed - 5% Percent/Acreage

Total - 10%

SOIL TYPES

Histosol:

- ☐ Fibric
- ☐ Hemic
- ☒ Sapric (ponds)

Mineral Hydric Soil:

- ☒ Gravelly
- ☐ Sandy
- ☐ Silty
- ☒ Clayey

(drainage ditches)

GEOLOGY

Surficial: glacial till

Bedrock: pelitic schists

Hampshire CC - Golf Course Drainage System 1

PRE-EMPTIVE STATUS

- ☐ Public Ownership
- ☐ Wildlife Management Area
- ☐ Fisheries Management Area
- ☐ Designated State or Federal Protected Wetland
- ☐ Documented Habitat for State or Federal Listed Species
- ☐ Regionally Scarce Wetland Category
- ☐ Historic/Archaeological Area

PLANT SPECIES

NAME	OW	FW	F	FU	DOM	C	S	TS	LS	H
Potamogeton sp.	X				X					X
Iris versicolor	X				X					X
Phragmites australis		X								X

OW-Obligate Wetland
FW- Facultative Wetland
F – Facultative
FU – Facultative Upland

Dom – Dominant
C- Canopy
S- Sapling
TS – Tall Shrub

LS- Low Shrub
H - Herb

Hampshire CC - Golf Course Drainage System 1

WETLAND INVENTORY DATA - CHARACTERIZATION OF MODEL VARIABLES

LANDSCAPE VARIABLES

Size:

- ☒ Small (< 10 ACRES)
- ☐ Medium (10-100 ACRES)
- ☐ Large (> 100 ACRES)

Wetland Juxtaposition:

- ☐ Connected Upstream and Downstream
- ☐ Only Connected Above
- ☒ Only Connected Below (culvert + tide gate to tidal wetland)
- ☐ Other wetlands Nearby But Not Connected
- ☐ Wetland Isolated

Fire Occurrence and Frequency:

- ☐ Natural; Predictable Frequency
- ☐ Natural; Sporadic Frequency
- ☐ Human-Caused; Predictable
- ☐ Human-Caused; Sporadic
- ☐ Rare Event
- ☒ No Evidence

Regional Scarcity:

- ☒ Not Scarce (> 5% of total wetland area of region)
- ☐ Scarce (< 5% of total wetland areas of region)

Watershed Land Use:

- ☒ > 50% Urbanized
- ☐ 25-50% Urbanized
- ☐ 0-25% Urbanized

HYDROLOGICAL VARIABLES

Surface Water Level Fluctuation of Wetlands:

- ☒ High Fluctuation Stormwater + Tidal influences
- ☐ Low Fluctuation
- ☐ Never Inundated

Frequency of Overbank Flooding:

- ☒ Return Interval > 5 years
- ☐ Return Interval 2-5 Yeasts
- ☐ Return Interval 1-2 Years
- ☐ No Overbank Flooding

pH:

- ☐ Acid <5.5
- ☐ Circumneutral 5.5-7.4
- ☒ Alkaline > 7.4 (7.5)
- ☐ No Water

Surficial Geologic Deposit Under Wetland:

- ☐ Low Permeability Stratified Deposits
- ☐ High Permeability Stratified Deposits
- ☒ Glacial Till

Wetland Land Use:

- ☒ High Intensity (i.e. agriculture) (Stormwater, fertilizer + chemical applications)
- ☐ Moderate Intensity (i.e. forestry)
- ☐ Low Intensity (i.e. open space)

Wetland Water Regime:

- ☒ Wet: Permanently Flooded, Intermittently Exposed, Semi-Permanently Flooded
- ☐ Drier: Seasonally Flooded, Temporarily Flooded, Saturated

Basin Topographic Gradient:

- ☐ High Gradient > 2%
- ☒ Low Gradient < 2%

Degree of Outlet Restriction:

- ☒ Restricted Outflow (culverts + tide gates)
- ☐ Unrestricted Outflow
- ☐ No Outflow

Ratio of Wetland Area to Watershed Area:

- ☐ High > 10%
- ☒ Low < 10%

Microrelief of Wetland Surface:

- ☐ Pronounced > 45 cm
- ☐ Well Developed 15-45 cm
- ☒ Poorly Developed < 15 cm
- ☐ Absent

Inlet/Outlet Class:

- ☐ No Inlet/No Outlet
- ☒ No Inlet/Intermittent Outlet (culvert + tide gate)
- ☐ No Inlet/Perennial Outlet
- ☐ Intermittent Inlet/No Outlet
- ☐ Intermittent Inlet/Intermittent Outlet
- ☐ Intermittent Outlet/Perennial Outlet
- ☐ Perennial Inlet/No Outlet
- ☐ Perennial Inlet/Intermittent Outlet
- ☐ Perennial Inlet/Perennial Outlet

Nested Piezometer Data:

- ☐ Recharge
- ☐ Discharge
- ☐ Horizontal Flow
- ☒ Not Available

Relations of Wetlands' Substrate Elevation to Regional Piezometric Surface:

- ☐ Piezometer Surface Above or at Substrate Elevation
- ☐ Piezometer Surface Below Substrate Elevation
- ☒ Not Available

Evidence of Sedimentation:

- ☐ No Evidence Observed
- ☒ Sediment Observed on Wetland Substrate (stormwater sediment deposits)
- ☐ Fluvaquent Soils

Evidence of Seeps and Springs:

- ☒ No Seeps or Springs
- ☐ Seeps Observed
- ☐ Perennial Spring
- ☐ Intermittent Spring

SOIL VARIABLES

Soil Lacking:

- ☐

Histosol:

- ☐ Fibric
- ☐ Hemic
- ☒ Sapric (ponds)

Hampshire CC - Golf Course Drainage System 1

Mineral Hydric Soil:

- ☒ Gravelly
- ☐ Sandy
- ☐ Silty
- ☒ Clayey

VEGETATION VARIABLES

Vegetation Lacking:

- ☐

Dominant Wetland Type:

- ☐ Forested – Evergreen – Needle-leaved
- ☐ Forested – Deciduous – Broad-leaved
- ☐ Forested – Deciduous – Needle-leaved
- ☐ Scrub Shrub – Evergreen – Broad-leaved
- ☐ Scrub Shrub – Evergreen – Needle-leaved
- ☐ Scrub Shrub – Deciduous – Broad-leaved
- ☐ Scrub Shrub – Decisuous – Needle-leaved
- ☒ Emergent – Persistent
- ☐ Emergent – Non-persistent
- ☒ Aquatic Bed

Number of Types & Relative Proportions:

Number of Types:

- ☐ Actual #
- ☐ 5
- ☐ 4
- ☐ 3
- ☒ 2
- ☐ 1

Evenness of Distribution:

- ☐ Even Distribution
- ☐ Moderately Even Distribution
- ☒ Highly Uneven Distribution

Vegetation Density/Dominance:

- ☒ Sparce (0-20%)
- ☐ Low Density (20-40%)
- ☐ Medium Density (40-60%)
- ☐ High Density (60-80%)
- ☐ Very High Density (80-100%)

Vegetation Interspersion:

- ☐ High (small groupings, diverse and interspersed)
- ☐ Moderate (broken irregular rings)
- ☒ Low (~~large~~ small patches, ~~concentric rings~~ isolated)

Number of Layers and Percent Cover:

Number of Layers:

- ☐ 6 or > (actual #)
- ☐ 5
- ☐ 4
- ☐ 3
- ☒ 2
- ☐ 1

Percent Cover:

- ☒ Submergents: 5
- ☐ Floating:
- ☐ Moss-lichen:
- ☐ Short Herb:
- ☒ Tall Herb: 5
- ☐ Dwarf shrub:
- ☐ Short shrub:
- ☐ Tall shrub:
- ☐ Sapling:
- ☐ Tree:

Plant Species Diversity:

- ☒ Low 1-2 plots sampled
- ☐ Medium 3-4 plots sampled
- ☐ High 5 or more plots sampled

Proportion of Animal Plant Foods:

- ☒ Low (5-25%)
- ☐ Medium (25-50%)
- ☐ High (> 50%)

Cover Distribution:

- ☐ Continuous Cover
- ☐ Small Scattered Patches
- ☒ 1 or More Large Patches; Parts of Site Open
- ☐ Solitary, Scattered Stems

Dead Woody Material:

- ☐ Abundant (50% of wetland surface)
- ☐ Moderately Abundant (25-50% of surface)
- ☒ Low Abundance (0-25% of surface)

Interspersion of Cover and Open Water:

- ☒ < 25% Scattered or Peripheral
- ☐ 26-75 % Scattered or Peripheral
- ☐ > 75% Scattered or Peripheral
- ☐ 100% Cover or Open Water

Stream Sinuosity:

- ☐ Highly Convoluted (Index 1.50 or >)
- ☐ Moderately Convoluted (Index 1.25-1.50)
- ☒ Straight/Slightly Irregular (Index 1.10-1.25) (ditches)

Presence of Islands:

- ☐ Several to Many
- ☐ One or Few
- ☒ Absent

PROJECT NAME: Hampshire CC - Golf Course Drainage System I

MODIFICATION OF GROUNDWATER DISCHARGE										
Wetland ID(s): Drainage System I HGM Type: D		HGM TYPES:								
VARIABLES	CONDITIONS	(D)		S		R		F		
		Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	
Indicators of Disfunction										
Inlet/Outlet Class	perennial inlet/no outlet	0		0		0		0		
Nested Piezometer Data	recharge	0		0		0		0		
Relationship to Regional Piezometric Surface	wetland substrate elevation above piezometric surface	0		0		0		0		
Direct Indicators of Function										
Presence of Springs and Seeps	evidence of perennial steeps or springs	18		15		15		18		
Neated Piezometer Data	discharge condition	18		15		15		18		
Relationship to Regional Piezometric Surface	wetland substrate elevation below piezometric surface	18		15		15		18		
Inlet/Outlet Class	no inlet/perennial outlet	18		15		15		18		
Primary Variables										
Microrelief of Wetland Surfaces	pronounced well developed poorly developed absent	3 2 (1) 0		3 2 1 0		3 2 1 0		3 2 1 0		
Inlet/Outlet Class	perennial inlet/perennial outlet intermittent inlet/perennial outlet all other classes	3 2 (0)		3 2 0		0 0 0		3 2 0		
pH	alkaline circumneutral acid no water present	(3) 2 0 0		3 2 0 0		3 2 0 0		3 2 0 0		
Surficial Geologic Deposit Under Wetland	high permeability stratified deposits low permeability stratified deposits glacial till	3 2 (1)		3 2 1		3 2 1		3 2 1		
Wetland water regime	wet; permanently flooded, intermittently exposed semipermanently, flooded drier; seasonally flooded, temporarily flooded, saturated	(3) 1		0 0		3 1		3 1		
Soil Type	histosol (ponds) mineral hydric soil (ditches) both	3 1 (2)		3 1		3 1		3 1		
	Total Score: Functional Capacity Index:	10/18 0.55								
	Model Range Index Range:	3-18 .19-1.0		2-15 .16-1.0		3-15 .22-1.0		3-18 .19-1.0		

PROJECT NAME: Hampshire CC Golf Course - Drainage System 1

MODIFICATION OF GROUNDWATER RECHARGE

Wetland ID(s): Drainage System 1
HGM Type: D

HGM TYPES: (D) circled

VARIABLES	CONDITIONS	D Wgt	D Scr	L Wgt	L Scr	EP Wgt	EP Scr	R Wgt	R Scr	F Wgt	F Scr
Indicators of Disfunction											
Inlet/Outlet Class	no inlet/perennial outlet; intermittent inlet/perennial outlet	0								0	
Nested Piezometer Data:	discharge condtion	0		0		0		0		0	
Relationship to Regional Piezometric Surface	wetland substrate elevation above piezometric surface	0		0		0		0		0	
Presence of Seeps and Springs	presence of seeps or springs	0		0		0		0		0	
Direct Indicators of Function											
Inlet/Outlet Class	perennial inlet/no outlet	21								21	
Nested Piezometer Data	recharge condition	21								21	
Relationship to Regional Peizometeric Surface	wetland substrate elevation below piezometric surface	21								21	
Primary Variables											
Microrelief of Wetland Surface	poorly developed	(3)		3		1		3		3	
	absent	3		3		1		3		3	
	well developed	2		2		2		2		2	
	pronounced	1		1		3		1		1	
Inlet/Outlet Class	perennial inlet/intermittent outlet	3		0		0		0		3	
	all other classes	(0)		0		0		0		0	
pH	acid	3		3		3		3		3	
	circumneutral	2		2		2		2		2	
	alkaline	(1)		1		1		1		1	
	no water present	0		0		0		0		0	
Surficial Geologic Deposit Under Wetland	glacial till	(3)		1		1		1		3	
	low permeability stratified deposits	2		2		2		2		2	
	high permeability stratified deposits	1		3		3		3		1	
Surface Water Level Fluctuation of the Wetland	high fluctuation	(3)		3		0		3		3	
	low fluctuation	2		2		0		2		2	
	never inundated	1		1		0		1		1	

Hampshire CC Golf Course - Drainage System 1

Wetland ID(s): Drainage System 1 HGM Type: D		HGM TYPES:				
VARIABLES	CONDITIONS	(D)	L	EP	R	F
		Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr
Wetland Water Regime	drier; seasonally flooded, temporarily flooded, saturated	3	3	0	3	3
	wet; permanently flooded, intermittently exposed, semipermanently flooded	(1)	1	0	1	1
Soil Type	gravelly or sandy mineral hydric	3	3	0	3	3
	silty or clayey mineral hydric	2	2	0	2	2
	sapric histosol	(1)	1	0	1	1
	fibric or hemic histosol	0	0	3	0	0
	Total Score:	12/21				
	Model Score:	4-21	4-18	2-12	4-18	4-21
	Functional Capacity Index:	0.57				
	Index Range:	.19-1.0	.22-1.0	0.16-1.0	.22-1.0	.19-1.0

* This model should be applied to both year long and seasonal recharge wetlands

* If the wetland is seasonally fluctuating between recharge and discharge, then reduce the above score by one half (1/2), because the wetland only functions in a recharge mode for roughly half of the year

PROJECT NAME: Hampshire CC - Drainage System 1

STORM AND FLOOD-WATER STORAGE							
Wetland ID(s): Drainage System 1 HGM Type: D		HGM TYPES:					
VARIABLES	CONDITIONS	D	S	L	EP	R	F
		Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr
Indicators of disfunction	none						
Direct Indicators of Function	no outlet	27	21				30
Primary Variables Inlet/Outlet Class	perennial inlet/intermittent outlet	3	3	0	0	0	3
	intermittent inlet/intermittent outlet	2	2	0	0	0	2
	non-inlet/intermittent outlet	(1)	1	0	0	0	1
	non-inlet/perennial outlet	1	1	0	0	0	1
	intermittent inlet/perennial outlet	1	1	0	0	0	1
	perennial inlet/perennial outlet	1	1	0	0	0	1
Degree of Outlet Restriction	restricted	(3)	0	0	0	0	3
	unrestricted	0	0	0	0	0	0
Basin Topographic Gradient	low gradient	(3)	3	0	3	3	3
	high gradient	1	1	0	0	1	1
Wetland Water Regime	drier: seasonally flooded, temporarily flooded, saturated	3	3	3	0	3	3
	wet: permanently flooded, intermittently exposed, semipermanently flooded	(1)	1	1	0	1	1
Surface Water Level Fluctuation of the Wetland	high fluctuation	(3)	0	3	0	3	3
	low fluctuation	2	0	2	0	2	2
	never inundated	0	0	0	0	0	0
Ratio of Wetland Area to Watershed Area	large	3	3	3	0	3	3
	small	(1)	1	1	0	1	1
Microrelief of Wetland Surface	prounounced	3	3	3	3	3	3
	well developed	2	2	2	2	2	2
	poorly developed	(1)	1	1	1	1	1
	absent	0	0	0	0	0	0

Hampshire CC - Drainage System 1

STORM AND FLOOD-WATER STORAGE													
Wetland ID(s): Drainage System 1 HGM Type: D		HGM TYPES:											
VARIABLES	CONDITIONS	D (circled)		S		L		EP		R		F	
		Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr
Frequency of Overbank Flooding	overbank flooding absent return interval of >5 yrs. return interval of 2-5 yrs. return interval of 1-2 yrs.	0 0 (circled) 0 0		0 0 0 0		0 1 2 3		0 0 0 0		0 1 2 3		0 1 2 3	
Vegetation Density/Dominance	high/very high moderate sparse/low no vegetation	3 2 1 (circled) 0		3 2 1 0		3 2 1 0		3 2 1 0		3 2 1 0		3 2 1 0	
Dead Woody Material	abundant moderately abundant sparse absent	3 2 1 (circled) 0		3 2 1 0		3 2 1 0		3 2 1 0		3 2 1 0		3 2 1 0	
	Total Score: Functional Capacity Index:	15/27 0.55											
	Model Range: Index Range:	4-27 0.15-1.0		4-21 0.19-1.0		2-21 0.09-1.0		0-12 0-1.0		3-24 0.12-1.0		4-30 0.13-1.0	

PROJECT NAME: Hampshire CC - Drainage System 1

MODIFICATION OF STREAM FLOW (This model is identical for all HGM types)		
VARIABLES	**CONDITIONS**	**WEIGHTS**
Indicators of Disfunction	No Outlet	0
Direct Indicators of Function	None	

Primary Variables

Storm and Flood Water Storage Function Model Score		X	Modification of Groundwater Discharge Function Model Score			
High*	3	X	High	3	=	9
Mod	2	X	High	3	=	6
Low	1	X	High	3	=	3
High	3	X	Mod	2	=	6
(Mod)	(2)	(X)	(Mod)	(2)	=	(4)
Low	1	X	Mod	2	=	2
High	3	X	Low	1	=	3
Mod	2	X	Low	1	=	2
Low	1	X	Low	1	=	1

Total Score: 4

Total Score: 4/9

Model Range: 1-9

Function Capacity Index: .44

Index Range:

*High = FCI of 0.67-1.0, Mod = FCI of 0.34-0.66, Low = FCI of 0-0.33 for the Storm and Flood Water Storage and Modification of Ground Water Discharge Function Model Scores.

PROJECT NAME: Hampshire CC-Drainage System 1

MODIFICATION OF WATER QUALITY													
Wetland ID(s): Drainage System 1 HGM Type: D		HGM TYPES:											
VARIABLES	CONDITIONS	D		S		L		EP		R		F	
		Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr
Indicators of disfunction	None												
Direct Indicators of Function	Evidence of Sedimentation	18		15		12		12		12		18	
Primary Variables Wetland Land Use	low intensity moderate intensity high intensity	3 2 1		3 2 1		3 2 1		3 2 1		3 2 1		3 2 1	
Degree of Outlet Restriction	restricted outflow no outlet unrestricted outflow	3 2 1		0 0 0		0 0 0		0 0 0		0 0 0		3 2 1	
Inlet/Outlet Type	no outlet intermittent outlet perennial outlet	3 2 1		3 2 1		0 0 0		0 0 0		0 0 0		3 2 1	
Dominant Wetland Type	forested wetland scrub-shrub emergent wetland aquatic bed no vegetation	3 2 2 1 0		3 2 2 0 0		3 2 2 0 0		3 2 2 0 0		3 2 2 0 0		3 2 2 0 0	
Cover Distribution	forming a continuous cover growing in small scattered patches one or more large patches solitary scattered stems no vegetation	3 2 1 1 0		3 2 1 1 0		3 2 1 1 0		3 2 1 1 0		3 2 1 1 0		3 2 1 1 0	
Soil Type	histosol or clayey soil silty soil sandy or gravelly soil	3 2 1		3 2 1		3 2 1		3 0 0		3 2 1		3 2 1	
	Total Score:	18/18											
	Functional Capacity Index:	1.0											
	Model Range:	4-18		3-15		2-12		1-12		2-12		4-18	
	Index Range:	0.22-1.0		0.20-1.0		0.16-1.0		0.8-1.0		0.16-1.0		0.22-1.0	

PROJECT NAME: Hampshire CC - Drainage System 1

EXPORT OF DETRITUS							
Wetland ID(s): Drainage System 1 HGM Type: D		HGM TYPES:					
VARIABLES	CONDITIONS	(D)	S	L	EP	R	F
		Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr
Indicators of Disfunction	no outlet	0	0		0		0
Direct Indicators of Function	none						
Primary Variables Wetland Land Use	moderate intensity low intensity high intensity	3 2 (1)	3 2 1	3 2 1	3 2 1	3 2 1	3 2 1
Degree of Outlet Restriction	unrestricted outflow restricted outflow	3 (1)	0 0	0 0	0 0	0 0	3 1
Inlet/Outlet Class	perennial outlet intermittent outlet	3 (1)	3 1	0 0	0 0	0 0	3 1
Wetland Water Regime	drier; seasonally flooded, temporarily flooded, saturated wet; permanently flooded, intermittently exposed, semipermanently flooded	3 (1)	3 1	3 1	0 1	3 1	3 1
Vegetation Density/Dominance	high/very high medium sparse/low no vegetation	3 2 (1) 0	3 2 1 0	3 2 1 0	3 2 1 0	3 2 1 0	3 2 1 0
Soil type	mineral hydric soil histosol both	3 1 (2)	3 1	3 1	3 1	3 1	3 1
	Total Score:	7/18					
	Functional Capacity Index:	0.39					
	Model Range:	5-18	4-15	3-12	2-10	3-12	5-18
	Index Range:	0.27-1.0	0.26-1.0	0.25-1.0	0.20-1.0	0.25-1.0	0.27-1.0

PROJECT NAME: Hampshire CC - Drainage System 1

CONTRIBUTION TO ABUNDANCE AND DIVERSITY OF WETLAND VEGETATION (This model is identical for all HGM types)		
VARIABLES	**CONDITIONS**	**WEIGHTS**
Indicators of Disfunction	No Vegetation	0
Direct Indicators of Function	None	
Primary Variables		Score:
Plant Species Diversity	high diversity 5 medium diversity 3 low diversity (1)	
Vegetation Density/Dominance	high/very high 5 medium 3 sparse/low (1)	
Wetland Juxtaposition	connected to upstream and downstream 5 connected above or below 3 other wetlands nearby but not connected (400 m or closer) (1) isolated 0 (culvert connection only)	
		Total Score: 3/15 Model Range: 2-15
		Functional Capacity Index: 0.20 Index Range: 0.13-1.0

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PROJECT NAME: Hampshire CC - Drainage System 1

CONTRIBUTION TO ABUNDANCE AND DIVERSITY OF WETLAND FAUNA (This model is identical for all HGM types except Slope Wetlands for which "Interspersion of Vegetation Cover and Open Water" does not apply)		
VARIABLES	**CONDITIONS**	**WEIGHTS**
Direct Indicators of Disfunction	None	
Direct Indicators of Function	None	
<u>Primary Variables</u> Watershed Land Use	low intensity (0-25% urbanized) moderate intensity (25-50% urbanized) high intensity (>50% urbanized)	3 2 1 (circled)
Wetland Land Use	low intensity moderate intensity high intensity	3 2 1 (circled)
Wetland Water Regime	wet: permanently flooded, intermittently exposed, semipermanently flooded drier: seasonally flooded, temporarily flooded, saturated	3 (circled) 1
Microrelief of Wetland Surface	pronounced well developed poorly developed absent	3 2 1 (circled) 0
Number of Wetland Types and Relative Proportions	5 or more types 3-4 types 1-2 types no vegetation	3 2 1 (circled) 0
	even distribution moderately even distribution highly uneven distribution no vegetation	3 2 1 (circled) 0
Vegetation Interspersion	high interspersion moderate interspersion low interspersion no vegetation	3 2 1 (circled) 0

Hampshire CC - Drainage System I

CONTRIBUTION TO ABUNDANCE AND DIVERSITY OF WETLAND FAUNA (CONT'D)		
Variables	**Conditions**	**Weights**
Number of Layers and Percent Cover	5 or more layers	3
	3-4 layers	2
	1-2 layers	(1)
	no vegetation	0
	layers well developed (>50% cover)	3
	layers with moderate cover (26-50% cover)	2
	layers poorly distinguishible (<25% cover)	(1)
	no vegetation	0
Interspersion of Vegetation Cover and Open Water	26-75%scattered or peripheral	3
	>75% scattered or peripheral	2
	<25% scattered or peripheral	(1)
	100% cover or open water	1
	no vegetation	0
Size	large (>100 acres)	3
	medium (10-100 acres)	2
	small (<10 acres)	(1)
Wetland Juxtaposition	other wetlands within 400 m and connected above or below	3
	other wetlands within 400 m but not connected	(1)
	wetland isolated	0
Slope Wetlands: Model Range: 4-33 Functional Capacity Index: Index Range: 0.12-1.0	All other HGM types: Total Score: 14/36 Model Range: 4-36 Functional Capacity Index: 0.39 Index Range: 0.11-1.0	

WETLAND INVENTORY DATA - CHARACTERIZATION OF WETLAND

Project Name: Hampshire Country Club Date: 5/18/16

Field Investigators: David Kennedy, MS, Project Scientist, VHB

Golf Course Drainage System 2 (Pond #s 5+6 + subgrade culverts)

SURFACE WATER FLOW VECTORS

- ☒ Depressional - 100% Percent/Acreage
- ☐ Slope - ______ Perecent/Acreage
- ☐ Extensive Peatland - ____ Percent/Acreage
- ☐ Lacustrine Fringe - ____ Percent/Acreage
- ☐ Riverine - _____ Percent/Acreage

VEGETATION TYPES

Forested Wetland

- ☐ Evergreen Needle-leaved - ______________ Percent/Acreage
- ☐ Deciduous Broad-leaved - ______________ Percent/Acreage
- ☐ Deciduous Needle-leaved - ______________ Percent/Acreage

Scrub Shrub

- ☐ Evergreen Needle-leaved - ______________ Percent/Acreage
- ☐ Evergreen Broad-leaved - ______________ Percent/Acreage
- ☐ Deciduous Broad-leaved - ______________ Percent/Acreage
- ☐ Deciduous Needle-leaved - ______________ Percent/Acreage

Emergent Wetland

- ☒ Persistent - 1% Percent/Acreage
- ☐ Non-persistent - 10% Percent/acreage
- ☒ Aquatic Bed - 30% Percent/Acreage

Total - 41%

SOIL TYPES

Histosol:

- ☐ Fibric
- ☒ Hemic
- ☐ Sapric

Mineral Hydric Soil:

- ☐ Gravelly
- ☐ Sandy
- ☒ Silty
- ☒ Clayey

GEOLOGY

Surficial: glacial till

Bedrock: Pelitic Schists

Hampshire CC - Golf Course Drainage System 2

PRE-EMPTIVE STATUS

- ☐ Public Ownership
- ☐ Wildlife Management Area
- ☐ Fisheries Management Area
- ☐ Designated State or Federal Protected Wetland
- ☐ Documented Habitat for State or Federal Listed Species
- ☐ Regionally Scarce Wetland Category
- ☐ Historic/Archaeological Area

PLANT SPECIES

NAME	OW	FW	F	FU	DOM	C	S	TS	LS	H
Lemna minor	X									X
Potamogeton sp.	X				X					X
Iris versicolor	X									X

OW-Obligate Wetland
FW- Facultative Wetland
F – Facultative
FU – Facultative Upland

Dom – Dominant
C- Canopy
S- Sapling
TS – Tall Shrub

LS- Low Shrub
H - Herb

Hampshire CC - Golf Course Drainage System 2

WETLAND INVENTORY DATA - CHARACTERIZATION OF MODEL VARIABLES

LANDSCAPE VARIABLES

Size:

- [x] Small (< 10 ACRES)
- [ ] Medium (10-100 ACRES)
- [ ] Large (> 100 ACRES)

Wetland Juxtaposition:

- [ ] Connected Upstream and Downstream
- [ ] Only Connected Above
- [ ] Only Connected Below
- [x] Other wetlands Nearby But Not Connected
- [ ] Wetland Isolated

Fire Occurrence and Frequency:

- [ ] Natural; Predictable Frequency
- [ ] Natural; Sporadic Frequency
- [ ] Human-Caused; Predictable
- [ ] Human-Caused; Sporadic
- [ ] Rare Event
- [x] No Evidence

Regional Scarcity:

- [x] Not Scarce (> 5% of total wetland area of region)
- [ ] Scarce (< 5% of total wetland areas of region)

Watershed Land Use:

- [x] > 50% Urbanized
- [ ] 25-50% Urbanized
- [ ] 0-25% Urbanized

HYDROLOGICAL* VARIABLES

Surface Water Level Fluctuation of Wetlands:

- [x] High Fluctuation
- [ ] Low Fluctuation
- [ ] Never Inundated

groundwater withdrawals for irrigation. Fluctuations up to 4'±

Frequency of Overbank Flooding:

- [x] Return Interval > 5 years
- [ ] Return Interval 2-5 Yeasts
- [ ] Return Interval 1-2 Years
- [ ] No Overbank Flooding

pH:

- [ ] Acid <5.5
- [ ] Circumneutral 5.5-7.4
- [x] Alkaline > 7.4 7.5
- [ ] No Water

Surficial Geologic Deposit Under Wetland:

- [ ] Low Permeability Stratified Deposits
- [ ] High Permeability Stratified Deposits
- [x] Glacial Till

Wetland Land Use:

- [x] High Intensity (i.e. agriculture) Stormwater chemical + fertilizer application
- [ ] Moderate Intensity (i.e. forestry)
- [ ] Low Intensity (i.e. open space)

Wetland Water Regime:

- [x] Wet: Permanently Flooded, Intermittently Exposed, Semi-Permanently Flooded
- [ ] Drier: Seasonally Flooded, Temporarily Flooded, Saturated

Basin Topographic Gradient:

- [x] High Gradient > 2%
- [ ] Low Gradient < 2%

Degree of Outlet Restriction:

- [ ] Restricted Outflow
- [ ] Unrestricted Outflow
- [x] No Outflow

Ratio of Wetland Area to Watershed Area:

- [x] High > 10%
- [ ] Low < 10%

Microrelief of Wetland Surface:

- [ ] Pronounced > 45 cm
- [ ] Well Developed 15-45 cm
- [ ] Poorly Developed < 15 cm
- [x] Absent

Inlet/Outlet Class: Stormwater + groundwater only

- [x] No Inlet/No Outlet
- [ ] No Inlet/Intermittent Outlet
- [ ] No Inlet/Perennial Outlet
- [ ] Intermittent Inlet/No Outlet
- [ ] Intermittent Inlet/Intermittent Outlet
- [ ] Intermittent Outlet/Perennial Outlet
- [ ] Perennial Inlet/No Outlet
- [ ] Perennial Inlet/Intermittent Outlet
- [ ] Perennial Inlet/Perennial Outlet

Nested Piezometer Data:

- [ ] Recharge
- [ ] Discharge
- [ ] Horizontal Flow
- [x] Not Available

Relations of Wetlands' Substrate Elevation to Regional Piezometric Surface:

- [ ] Piezometer Surface Above or at Substrate Elevation
- [ ] Piezometer Surface Below Substrate Elevation
- [x] Not Available

Evidence of Sedimentation:

- [ ] No Evidence Observed
- [x] Sediment Observed on Wetland Substrate Stormwater sediment deposits
- [ ] Fluvaquent Soils

Evidence of Seeps and Springs:

- [x] No Seeps or Springs
- [ ] Seeps Observed
- [ ] Perennial Spring
- [ ] Intermittent Spring

SOIL VARIABLES

Soil Lacking:

- [ ]

Histosol:

- [ ] Fibric
- [x] Hemic
- [ ] Sapric

* The primary hydrological source for the two irrigation ponds is groundwater withdrawals from an adjacent well. Minor contributions from drainage culverts. The ponds are the primary irrigation source for the golf course

Hampshire CC - Golf Course Drainage System 2

Mineral Hydric Soil:

- ☐ Gravelly
- ☐ Sandy
- ☒ Silty
- ☒ Clayey

VEGETATION VARIABLES

Vegetation Lacking:

- ☐

Dominant Wetland Type:

- ☐ Forested – Evergreen – Needle-leaved
- ☐ Forested – Deciduous – Broad-leaved
- ☐ Forested – Deciduous – Needle-leaved
- ☐ Scrub Shrub – Evergreen – Broad-leaved
- ☐ Scrub Shrub – Evergreen – Needle-leaved
- ☐ Scrub Shrub – Deciduous – Broad-leaved
- ☐ Scrub Shrub – Decisuous – Needle-leaved
- ☒ Emergent – Persistent
- ☐ Emergent – Non-persistent
- ☒ Aquatic Bed

Number of Types & Relative Proportions:

Number of Types:

- ☐ Actual #
- ☐ 5
- ☐ 4
- ☐ 3
- ☒ 2
- ☐ 1

Evenness of Distribution:

- ☐ Even Distribution
- ☐ Moderately Even Distribution
- ☒ Highly Uneven Distribution

Vegetation Density/Dominance:

- ☐ Sparce (0-20%)
- ☒ Low Density (20-40%)
- ☐ Medium Density (40-60%)
- ☐ High Density (60-80%)
- ☐ Very High Density (80-100%)

Vegetation Interspersion:

- ☐ High (small groupings, diverse and interspersed)
- ☐ Moderate (broken irregular rings)
- ☒ Low (large patches, + small patches ~~concentric rings~~)

Number of Layers and Percent Cover:

Number of Layers:

- ☐ 6 or > (actual #)
- ☐ 5
- ☐ 4
- ☐ 3
- ☒ 2
- ☐ 1

Percent Cover:

- ☒ Submergents: 20
- ☒ Floating: 20
- ☐ Moss-lichen:
- ☐ Short Herb:
- ☒ Tall Herb: 1
- ☐ Dwarf shrub:
- ☐ Short shrub:
- ☐ Tall shrub:
- ☐ Sapling:
- ☐ Tree:

Plant Species Diversity:

- ☒ Low 1-2 plots sampled
- ☐ Medium 3-4 plots sampled
- ☐ High 5 or more plots sampled

Proportion of Animal Plant Foods:

- ☒ Low (5-25%)
- ☐ Medium (25-50%)
- ☐ High (> 50%)

Cover Distribution:

- ☐ Continuous Cover
- ☐ Small Scattered Patches
- ☒ 1 or More Large Patches; Parts of Site Open
- ☐ Solitary, Scattered Stems

Dead Woody Material:

- ☐ Abundant (50% of wetland surface)
- ☐ Moderately Abundant (25-50% of surface)
- ☒ Low Abundance (0-25% of surface)

Interspersion of Cover and Open Water:

- ☒ < 25% Scattered or Peripheral
- ☐ 26-75 % Scattered or Peripheral
- ☐ > 75% Scattered or Peripheral
- ☐ 100% Cover or Open Water

Stream Sinuosity: N/A

- ☐ Highly Convoluted (Index 1.50 or >)
- ☐ Moderately Convoluted (Index 1.25-1.50)
- ☐ Straight/Slightly Irregular (Index 1.10-1.25)

Presence of Islands:

- ☐ Several to Many
- ☐ One or Few
- ☒ Absent

PROJECT NAME: Hampshire CC - Golf Course Drainage System 2

MODIFICATION OF GROUNDWATER DISCHARGE										
Wetland ID(s): Drainage System 2 HGM Type: D		HGM TYPES:								
VARIABLES	CONDITIONS	(D)		S		R		F		
		Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	
Indicators of Disfunction										
Inlet/Outlet Class	perennial inlet/no outlet	0		0		0		0		
Nested Piezometer Data	recharge	0		0		0		0		
Relationship to Regional Piezometric Surface	wetland substrate elevation above piezometric surface	0		0		0		0		
Direct Indicators of Function										
Presence of Springs and Seeps	evidence of perennial steeps or springs	18		15		15		18		
Neated Piezometer Data	discharge condition	18		15		15		18		
Relationship to Regional Piezometric Surface	wetland substrate elevation below piezometric surface	18		15		15		18		
Inlet/Outlet Class	no inlet/perennial outlet	18		15		15		18		
Primary Variables										
Microrelief of Wetland Surfaces	pronounced well developed poorly developed absent	3 2 1 (0)		3 2 1 0		3 2 1 0		3 2 1 0		
Inlet/Outlet Class	perennial inlet/perennial outlet intermittent inlet/perennial outlet all other classes	3 2 (0)		3 2 0		0 0 0		3 2 0		
pH	alkaline circumneutral acid no water present	(3) 2 0 0		3 2 0 0		3 2 0 0		3 2 0 0		
Surficial Geologic Deposit Under Wetland	high permeability stratified deposits low permeability stratified deposits glacial till	3 2 (1)		3 2 1		3 2 1		3 2 1		
Wetland water regime	wet; permanently flooded, intermittently exposed semipermanently, flooded	(3)		0		3		3		
	drier; seasonally flooded, temporarily flooded, saturated	1		0		1		1		
Soil Type	histosol mineral hydric soil both	3 1 (2)		3 1		3 1		3 1		
	Total Score: Functional Capacity Index:	9/18 0.50								
	Model Range Index Range:	3-18 .19-1.0		2-15 .16-1.0		3-15 .22-1.0		3-18 .19-1.0		

PROJECT NAME: Hampshire CC - Golf Course Drainage System 2

MODIFICATION OF GROUNDWATER RECHARGE											
Wetland ID(s): Drainage System 2 HGM Type: D		HGM TYPES:									
VARIABLES	CONDITIONS	(D)		L		EP		R		F	
		Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr
Indicators of Disfunction											
Inlet/Outlet Class	no inlet/perennial outlet; intermittent inlet/perennial outlet	0								0	
Nested Piezometer Data:	discharge condtion	0		0		0		0		0	
Relationship to Regional Piezometric Surface	wetland substrate elevation above piezometric surface	0		0		0		0		0	
Presence of Seeps and Springs	presence of seeps or springs	0		0		0		0		0	
Direct Indicators of Function											
Inlet/Outlet Class	perennial inlet/no outlet	21								21	
Nested Piezometer Data	recharge condition	21								21	
Relationship to Regional Peizometeric Surface	wetland substrate elevation below piezometric surface	21								21	
Primary Variables											
Microrelief of Wetland Surface	poorly developed absent well developed pronounced	3 (3) 2 1		3 3 2 1		1 1 2 3		3 3 2 1		3 3 2 1	
Inlet/Outlet Class	perennial inlet/intermittent outlet all other classes	3 (0)		0 0		0 0		0 0		3 0	
pH	acid circumneutral alkaline no water present	3 2 (1) 0		3 2 1 0		3 2 1 0		3 2 1 0		3 2 1 0	
Surficial Geologic Deposit Under Wetland	glacial till low permeability stratified deposits high permeability stratified deposits	(3) 2 1		1 2 3		1 2 3		1 2 3		3 2 1	
Surface Water Level Fluctuation of the Wetland	high fluctuation* low fluctuation never inundated *artificially maintained from pumped groundwater	3 2 1		3 2 1		0 0 0		3 2 1		3 2 1	

Hampshire CC - Golf Course Drainage System 2

Wetland ID(s): Drainage System 2 HGM Type: D		HGM TYPES:				
VARIABLES	**CONDITIONS**	**D** (circled)	**L**	**EP**	**R**	**F**
		Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr
Wetland Water Regime	drier; seasonally flooded, temporarily flooded, saturated	3	3	0	3	3
	wet; permanently flooded, intermittently exposed, semipermanently flooded	1 (circled)	1	0	1	1
Soil Type	gravelly or sandy mineral hydric	3	3	0	3	3
	silty or clayey mineral hydric (circled)	2	2	0	2	2
	sapric histosol	1 (circled)	1	0	1	1
	fibric or hemic histosol (circled)	0	0	3	0	0
	Total Score:	9/21				
	Model Score:	4-21	4-18	2-12	4-18	4-21
	Functional Capacity Index:	0.43				
	Index Range:	.19-1.0	.22-1.0	0.16-1.0	.22-1.0	.19-1.0

* This model should be applied to both year long and seasonal recharge wetlands

* If the wetland is seasonally fluctuating between recharge and discharge, then reduce the above score by one half (1/2), because the wetland only functions in a recharge mode for roughly half of the year

PROJECT NAME: Hampshire CC - Golf Course Drainage System 2

STORM AND FLOOD-WATER STORAGE							
Wetland ID(s): Drainage System 2 HGM Type: D		HGM TYPES:					
VARIABLES	**CONDITIONS**	**D**	**S**	**L**	**EP**	**R**	**F**
		Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr
Indicators of disfunction	none						
Direct Indicators of Function	no outlet	27	21				30
Primary Variables Inlet/Outlet Class	perennial inlet/intermittent outlet	3	3	0	0	0	3
	intermittent inlet/intermittent outlet	2	2	0	0	0	2
	non-inlet/intermittent outlet	1	1	0	0	0	1
	non-inlet/perennial outlet	1	1	0	0	0	1
	intermittent inlet/perennial outlet	1	1	0	0	0	1
	perennial inlet/perennial outlet	1	1	0	0	0	1
Degree of Outlet Restriction	restricted	3	0	0	0	0	3
	unrestricted	0	0	0	0	0	0
Basin Topographic Gradient	low gradient	3	3	0	3	3	3
	high gradient	1	1	0	0	1	1
Wetland Water Regime	drier: seasonally flooded, temporarily flooded, saturated	3	3	3	0	3	3
	wet: permanently flooded, intermittently exposed, semipermanently flooded	1	1	1	0	1	1
Surface Water Level Fluctuation of the Wetland	high fluctuation	3	0	3	0	3	3
	low fluctuation	2	0	2	0	2	2
	never inundated	0	0	0	0	0	0
Ratio of Wetland Area to Watershed Area	large	3	3	3	0	3	3
	small	1	1	1	0	1	1
Microrelief of Wetland Surface	prounounced	3	3	3	3	3	3
	well developed	2	2	2	2	2	2
	poorly developed	1	1	1	1	1	1
	absent	0	0	0	0	0	0

Hampshire CC - Golf Course Drainage System 2

STORM AND FLOOD-WATER STORAGE

Wetland ID(s): Drainage System 2
HGM Type: D

HGM TYPES:

VARIABLES	CONDITIONS	(D) Wgt	(D) Scr	S Wgt	S Scr	L Wgt	L Scr	EP Wgt	EP Scr	R Wgt	R Scr	F Wgt	F Scr
Frequency of Overbank Flooding	overbank flooding absent	0		0		0		0		0		0	
	return interval of >5 yrs.	0		0		1		0		1		1	
	return interval of 2-5 yrs.	0		0		2		0		2		2	
	return interval of 1-2 yrs.	0		0		3		0		3		3	
Vegetation Density/Dominance	high/very high	3		3		3		3		3		3	
	moderate	2		2		2		2		2		2	
	sparse/low	1		1		1		1		1		1	
	no vegetation	0		0		0		0		0		0	
Dead Woody Material	abundant	3		3		3		3		3		3	
	moderately abundant	2		2		2		2		2		2	
	sparse	1		1		1		1		1		1	
	absent	0		0		0		0		0		0	
	Total Score:	27/27											
	Functional Capacity Index:	1.0											
	Model Range:	4-27		4-21		2-21		0-12		3-24		4-30	
	Index Range:	0.15-1.0		0.19-1.0		0.09-1.0		0-1.0		0.12-1.0		0.13-1.0	

PROJECT NAME: Hampshire CC - Golf Course Drainage System 2

MODIFICATION OF STREAM FLOW (This model is identical for all HGM types)		
VARIABLES	**CONDITIONS**	**WEIGHTS**
Indicators of Disfunction	No Outlet (circled)	0 (circled)
Direct Indicators of Function	None	

Primary Variables

Storm and Flood Water Storage Function Model Score		X	Modification of Groundwater Discharge Function Model Score				Total Score:
High*	3	X	High	3	=	9	
Mod	2	X	High	3	=	6	
Low	1	X	High	3	=	3	
High	3	X	Mod	2	=	6	
Mod	2	X	Mod	2	=	4	
Low	1	X	Mod	2	=	2	
High	3	X	Low	1	=	3	
Mod	2	X	Low	1	=	2	
Low	1	X	Low	1	=	1	

Total Score: 0/9

Model Range: 1-9

Function Capacity Index: 0.0

Index Range:

*High = FCI of 0.67-1.0, Mod = FCI of 0.34-0.66, Low = FCI of 0-0.33 for the Storm and Flood Water Storage and Modification of Ground Water Discharge Function Model Scores.

PROJECT NAME: Hampshire CC - Golf Course Drainage System 2

MODIFICATION OF WATER QUALITY							
Wetland ID(s): Drainage System 2 HGM Type: D		HGM TYPES:					
VARIABLES	CONDITIONS	(D)	S	L	EP	R	F
		Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr
Indicators of disfunction	None						
Direct Indicators of Function	Evidence of Sedimentation	(18)	15	12	12	12	18
Primary Variables Wetland Land Use	low intensity moderate intensity high intensity	3 2 1	3 2 1	3 2 1	3 2 1	3 2 1	3 2 1
Degree of Outlet Restriction	restricted outflow no outlet unrestricted outflow	3 2 1	0 0 0	0 0 0	0 0 0	0 0 0	3 2 1
Inlet/Outlet Type	no outlet intermittent outlet perennial outlet	3 2 1	3 2 1	0 0 0	0 0 0	0 0 0	3 2 1
Dominant Wetland Type	forested wetland scrub-shrub emergent wetland aquatic bed no vegetation	3 2 2 1 0	3 2 2 0 0	3 2 2 0 0	3 2 2 0 0	3 2 2 0 0	3 2 2 0 0
Cover Distribution	forming a continuous cover growing in small scattered patches one or more large patches solitary scattered stems no vegetation	3 2 1 1 0	3 2 1 1 0	3 2 1 1 0	3 2 1 1 0	3 2 1 1 0	3 2 1 1 0
Soil Type	histosol or clayey soil silty soil sandy or gravelly soil	3 2 1	3 2 1	3 2 1	3 0 0	3 2 1	3 2 1
	Total Score:	18/18					
	Functional Capacity Index:	1.00					
	Model Range:	4-18	3-15	2-12	1-12	2-12	4-18
	Index Range:	0.22-1.0	0.20-1.0	0.16-1.0	0.8-1.0	0.16-1.0	0.22-1.0

PROJECT NAME: Hampshire Country Club - Golf Course Drainage System 2

EXPORT OF DETRITUS							
Wetland ID(s): Drainage System 2 HGM Type: D		HGM TYPES:					
VARIABLES	CONDITIONS	D (circled)	S	L	EP	R	F
		Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr
Indicators of Disfunction	no outlet (circled)	0 (circled)	0		0		0
Direct Indicators of Function	none						
Primary Variables Wetland Land Use	moderate intensity low intensity high intensity	3 2 1	3 2 1	3 2 1	3 2 1	3 2 1	3 2 1
Degree of Outlet Restriction	unrestricted outflow restricted outflow	3 1	0 0	0 0	0 0	0 0	3 1
Inlet/Outlet Class	perennial outlet intermittent outlet	3 1	3 1	0 0	0 0	0 0	3 1
Wetland Water Regime	drier; seasonally flooded, temporarily flooded, saturated wet; permanently flooded, intermittently exposed, semipermanently flooded	3 1	3 1	3 1	0 1	3 1	3 1
Vegetation Density/Dominance	high/very high medium sparse/low no vegetation	3 2 1 0	3 2 1 0	3 2 1 0	3 2 1 0	3 2 1 0	3 2 1 0
Soil type	mineral hydric soil histosol	3 1	3 1	3 1	3 1	3 1	3 1
	Total Score:	0/18					
	Functional Capacity Index:	0.0					
	Model Range:	5-18	4-15	3-12	2-10	3-12	5-18
	Index Range:	0.27-1.0	0.26-1.0	0.25-1.0	0.20-1.0	0.25-1.0	0.27-1.0

PROJECT NAME: Hampshire CC - Golf Course Drainage System 2

CONTRIBUTION TO ABUNDANCE AND DIVERSITY OF WETLAND VEGETATION (This model is identical for all HGM types)		
VARIABLES	**CONDITIONS**	**WEIGHTS**
Indicators of Disfunction	No Vegetation	0
Direct Indicators of Function	None	
Primary Variables		Score:
Plant Species Diversity	high diversity 5 medium diversity 3 low diversity (1)	
Vegetation Density/Dominance	high/very high 5 medium 3 sparse/low (1)	
Wetland Juxtaposition	connected to upstream and downstream 5 connected above or below 3 other wetlands nearby but not connected (400 m or closer) (1) isolated 0	
		Total Score: 3/15 Model Range: 2-15
		Functional Capacity Index: 0.20 Index Range: 0.13-1.0

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PROJECT NAME: Hampshire CC - Golf Course Drainage System 2

CONTRIBUTION TO ABUNDANCE AND DIVERSITY OF WETLAND FAUNA (This model is identical for all HGM types except Slope Wetlands for which "Interspersion of Vegetation Cover and Open Water" does not apply)		
VARIABLES	**CONDITIONS**	**WEIGHTS**
Direct Indicators of Disfunction	None	
Direct Indicators of Function	None	
Primary Variables Watershed Land Use	low intensity (0-25% urbanized) moderate intensity (25-50% urbanized) high intensity (>50% urbanized)	3 2 (1)
Wetland Land Use	low intensity moderate intensity high intensity	3 2 (1)
Wetland Water Regime	wet: permanently flooded, intermittently exposed, semipermanently flooded drier: seasonally flooded, temporarily flooded, saturated	(3) 1
Microrelief of Wetland Surface	pronounced well developed poorly developed absent	3 2 1 (0)
Number of Wetland Types and Relative Proportions	5 or more types 3-4 types 1-2 types no vegetation	3 2 (1) 0
	even distribution moderately even distribution highly uneven distribution no vegetation	3 2 (1) 0
Vegetation Interspersion	high interspersion moderate interspersion low interspersion no vegetation	3 2 (1) 0

Hampshire CC - Golf Course Drainage System 2

CONTRIBUTION TO ABUNDANCE AND DIVERSITY OF WETLAND FAUNA (CONT'D)		
Variables	**Conditions**	**Weights**
Number of Layers and Percent Cover	5 or more layers 3-4 layers 1-2 layers no vegetation	3 2 (1) circled 0
	layers well developed (>50% cover) layers with moderate cover (26-50% cover) layers poorly distinguishible (<25% cover) no vegetation	3 2 (1) circled 0
Interspersion of Vegetation Cover and Open Water	26-75%scattered or peripheral >75% scattered or peripheral <25% scattered or peripheral 100% cover or open water no vegetation	3 2 (1) circled 1 0
Size	large (>100 acres) medium (10-100 acres) small (<10 acres)	3 2 (1) circled
Wetland Juxtaposition	other wetlands within 400 m and connected above or below other wetlands within 400 m but not connected wetland isolated	3 (1) circled 0
Slope Wetlands: Model Range: 4-33 Functional Capacity Index: Index Range: 0.12-1.0	All other HGM types: Total Score: 13/36 Model Range: 4-36 Functional Capacity Index: 0.36 Index Range: 0.11-1.0	

WETLAND INVENTORY DATA - CHARACTERIZATION OF WETLAND

Project Name: Hampshire Country Club Date: 5/12/06

Field Investigators: David Kennedy, MS, Project Scientist, VHB

SURFACE WATER FLOW VECTORS

Golf Course Drainage System 3 (Ponds 10, 11, 13, emergent wetland + ditches)

- ☒ Depressional - 100% Percent/Acreage
- ☐ Slope - ______ Perecent/Acreage
- ☐ Extensive Peatland - ____ Percent/Acreage
- ☐ Lacustrine Fringe - ____ Percent/Acreage
- ☐ Riverine - _____ Percent/Acreage

VEGETATION TYPES

Forested Wetland

- ☐ Evergreen Needle-leaved - ______________ Percent/Acreage
- ☐ Deciduous Broad-leaved - ______________ Percent/Acreage
- ☐ Deciduous Needle-leaved - ______________ Percent/Acreage

Scrub Shrub

- ☐ Evergreen Needle-leaved - ______________ Percent/Acreage
- ☐ Evergreen Broad-leaved - ______________ Percent/Acreage
- ☐ Deciduous Broad-leaved - ______________ Percent/Acreage
- ☐ Deciduous Needle-leaved - ______________ Percent/Acreage

Emergent Wetland

- ☐ Persistent - 40% Percent/Acreage
- ☐ Non-persistent - ______ Percent/acreage
- ☐ Aquatic Bed - 25% Percent/Acreage

Total - 65%

SOIL TYPES

Histosol:

- ☐ Fibric
- ☒ Hemic
- ☐ Sapric

Mineral Hydric Soil:

- ☒ Gravelly
- ☐ Sandy
- ☐ Silty
- ☒ Clayey

GEOLOGY

Surficial: glacial till

Bedrock: pelitic schists

Hampshire CC - Golf Course Drainage System 3

PRE-EMPTIVE STATUS

- ☐ Public Ownership
- ☐ Wildlife Management Area
- ☐ Fisheries Management Area
- ☐ Designated State or Federal Protected Wetland
- ☐ Documented Habitat for State or Federal Listed Species
- ☐ Regionally Scarce Wetland Category
- ☐ Historic/Archaeological Area

PLANT SPECIES

NAME	OW	FW	F	FU	DOM	C	S	TS	LS	H
Iris versicolor	X				X					X
Rudbectia lacinata		X								X
Phalaris arundinacea		X								X
Lemna minor	X				X					X
Phragmites australis		X			X					X
Potamogeton sp.	X				X					X
Polygonum cuspidatum										X
Spartina alterniflora	X									X

OW-Obligate Wetland
FW- Facultative Wetland
F – Facultative
FU – Facultative Upland

Dom – Dominant
C- Canopy
S- Sapling
TS – Tall Shrub

LS- Low Shrub
H - Herb

Hampshire CC - Golf Course Drainage System 3

WETLAND INVENTORY DATA - CHARACTERIZATION OF MODEL VARIABLES

LANDSCAPE VARIABLES

Size:

- [x] Small (< 10 ACRES)
- [ ] Medium (10-100 ACRES)
- [ ] Large (> 100 ACRES)

Wetland Juxtaposition:

- [ ] Connected Upstream and Downstream
- [ ] Only Connected Above
- [x] Only Connected Below — culverts/tide gates
- [ ] Other wetlands Nearby But Not Connected — to tidal wetlands
- [ ] Wetland Isolated

Fire Occurrence and Frequency:

- [ ] Natural; Predictable Frequency
- [ ] Natural; Sporadic Frequency
- [ ] Human-Caused; Predictable
- [ ] Human-Caused; Sporadic
- [ ] Rare Event
- [x] No Evidence

Regional Scarcity:

- [x] Not Scarce (> 5% of total wetland area of region)
- [ ] Scarce (< 5% of total wetland areas of region)

Watershed Land Use:

- [x] > 50% Urbanized
- [ ] 25-50% Urbanized
- [ ] 0-25% Urbanized

HYDROLOGICAL VARIABLES

Surface Water Level Fluctuation of Wetlands:

- [x] High Fluctuation — Pond 10 is tidally influenced
- [ ] Low Fluctuation
- [ ] Never Inundated

Frequency of Overbank Flooding:

- [ ] Return Interval > 5 years
- [ ] Return Interval 2-5 Yeasts
- [ ] Return Interval 1-2 Years
- [ ] No Overbank Flooding

pH:

- [ ] Acid <5.5
- [ ] Circumneutral 5.5-7.4
- [ ] Alkaline > 7.4
- [ ] No Water

Surficial Geologic Deposit Under Wetland:

- [ ] Low Permeability Stratified Deposits
- [ ] High Permeability Stratified Deposits
- [ ] Glacial Till

Wetland Land Use:

- [x] High Intensity (i.e. agriculture) — Stormwater chemical + fertilizer applications
- [ ] Moderate Intensity (i.e. forestry)
- [ ] Low Intensity (i.e. open space)

Wetland Water Regime:

- [x] Wet: Permanently Flooded, Intermittently Exposed, Semi-Permanently Flooded
- [ ] Drier: Seasonally Flooded, Temporarily Flooded, Saturated

Basin Topographic Gradient:

- [x] High Gradient > 2%
- [ ] Low Gradient < 2%

Degree of Outlet Restriction:

- [x] Restricted Outflow — culverts + tide gates
- [ ] Unrestricted Outflow
- [ ] No Outflow

Ratio of Wetland Area to Watershed Area:

- [ ] High > 10%
- [x] Low < 10%

Microrelief of Wetland Surface:

- [ ] Pronounced > 45 cm
- [ ] Well Developed 15-45 cm
- [x] Poorly Developed < 15 cm
- [ ] Absent

Inlet/Outlet Class:

- [ ] No Inlet/No Outlet
- [x] No Inlet/Intermittent Outlet
- [ ] No Inlet/Perennial Outlet
- [ ] Intermittent Inlet/No Outlet
- [ ] Intermittent Inlet/Intermittent Outlet
- [ ] Intermittent Outlet/Perennial Outlet
- [ ] Perennial Inlet/No Outlet
- [ ] Perennial Inlet/Intermittent Outlet
- [ ] Perennial Inlet/Perennial Outlet

Nested Piezometer Data:

- [ ] Recharge
- [ ] Discharge
- [ ] Horizontal Flow
- [x] Not Available

Relations of Wetlands' Substrate Elevation to Regional Piezometric Surface:

- [ ] Piezometer Surface Above or at Substrate Elevation
- [ ] Piezometer Surface Below Substrate Elevation
- [x] Not Available

Evidence of Sedimentation:

- [ ] No Evidence Observed
- [x] Sediment Observed on Wetland Substrate — stormwater deposits
- [ ] Fluvaquent Soils

Evidence of Seeps and Springs:

- [x] No Seeps or Springs
- [ ] Seeps Observed
- [ ] Perennial Spring
- [ ] Intermittent Spring

SOIL VARIABLES

Soil Lacking:

- [ ]

Histosol:

- [ ] Fibric
- [x] Hemic
- [ ] Sapric

Hampshire CC - Golf Course Drainage System 3

Mineral Hydric Soil:

- [x] Gravelly
- [ ] Sandy
- [ ] Silty
- [x] Clayey

VEGETATION VARIABLES

Vegetation Lacking:

- [ ]

Dominant Wetland Type:

- [ ] Forested – Evergreen – Needle-leaved
- [ ] Forested – Deciduous – Broad-leaved
- [ ] Forested – Deciduous – Needle-leaved
- [ ] Scrub Shrub – Evergreen – Broad-leaved
- [ ] Scrub Shrub – Evergreen – Needle-leaved
- [ ] Scrub Shrub – Deciduous – Broad-leaved
- [ ] Scrub Shrub – Decisuous – Needle-leaved
- [x] Emergent – Persistent
- [ ] Emergent – Non-persistent
- [x] Aquatic Bed

Number of Types & Relative Proportions:

Number of Types:

- [ ] Actual #
- [ ] 5
- [ ] 4
- [ ] 3
- [x] 2
- [ ] 1

Evenness of Distribution:

- [ ] Even Distribution
- [x] Moderately Even Distribution
- [ ] Highly Uneven Distribution

Vegetation Density/Dominance:

- [ ] Sparce (0-20%)
- [ ] Low Density (20-40%)
- [x] Medium Density (40-60%)
- [ ] High Density (60-80%)
- [ ] Very High Density (80-100%)

Vegetation Interspersion:

- [ ] High (small groupings, diverse and interspersed)
- [x] Moderate (broken irregular rings)
- [ ] Low (large patches, concentric rings)

Number of Layers and Percent Cover:

Number of Layers:

- [ ] 6 or > (actual #)
- [ ] 5
- [x] 4
- [ ] 3
- [ ] 2
- [ ] 1

Percent Cover:

- [x] Submergents: 25
- [x] Floating: 5
- [ ] Moss-lichen:
- [x] Short Herb: 5
- [x] Tall Herb: 40
- [ ] Dwarf shrub:
- [ ] Short shrub:
- [ ] Tall shrub:
- [ ] Sapling:
- [ ] Tree:

Plant Species Diversity:

- [ ] Low 1-2 plots sampled
- [x] Medium 3-4 plots sampled
- [ ] High 5 or more plots sampled

Proportion of Animal Plant Foods:

- [ ] Low (5-25%)
- [x] Medium (25-50%)
- [ ] High (> 50%)

Cover Distribution:

- [ ] Continuous Cover
- [ ] Small Scattered Patches
- [x] 1 or More Large Patches; Parts of Site Open
- [ ] Solitary, Scattered Stems

Dead Woody Material:

- [ ] Abundant (50% of wetland surface)
- [ ] Moderately Abundant (25-50% of surface)
- [x] Low Abundance (0-25% of surface)

Interspersion of Cover and Open Water:

- [ ] < 25% Scattered or Peripheral
- [x] 26-75 % Scattered or Peripheral
- [ ] > 75% Scattered or Peripheral
- [ ] 100% Cover or Open Water

Stream Sinuosity:

- [ ] Highly Convoluted (Index 1.50 or >)
- [ ] Moderately Convoluted (Index 1.25-1.50)
- [x] Straight/Slightly Irregular (Index 1.10-1.25)

Presence of Islands:

- [ ] Several to Many
- [ ] One or Few
- [x] Absent

PROJECT NAME: Hampshire CC - Golf Course Drainage System 3

MODIFICATION OF GROUNDWATER DISCHARGE										
Wetland ID(s): Drainage System 3 HGM Type: D		HGM TYPES:								
VARIABLES	CONDITIONS	(D)		S		R		F		
		Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	
Indicators of Disfunction										
Inlet/Outlet Class	perennial inlet/no outlet	0		0		0		0		
Nested Piezometer Data	recharge	0		0		0		0		
Relationship to Regional Piezometric Surface	wetland substrate elevation above piezometric surface	0		0		0		0		
Direct Indicators of Function										
Presence of Springs and Seeps	evidence of perennial steeps or springs	18		15		15		18		
Neated Piezometer Data	discharge condition	18		15		15		18		
Relationship to Regional Piezometric Surface	wetland substrate elevation below piezometric surface	18		15		15		18		
Inlet/Outlet Class	no inlet/perennial outlet	18		15		15		18		
Primary Variables										
Microrelief of Wetland Surfaces	pronounced well developed poorly developed absent	3 2 (1) 0		3 2 1 0		3 2 1 0		3 2 1 0		
Inlet/Outlet Class	perennial inlet/perennial outlet intermittent inlet/perennial outlet all other classes	3 2 (0)		3 2 0		0 0 0		3 2 0		
pH	alkaline circumneutral acid no water present	(3) 2 0 0		3 2 0 0		3 2 0 0		3 2 0 0		
Surficial Geologic Deposit Under Wetland	high permeability stratified deposits low permeability stratified deposits glacial till	3 2 (1)		3 2 1		3 2 1		3 2 1		
Wetland water regime	wet; permanently flooded, intermittently exposed semipermanently, flooded drier; seasonally flooded, temporarily flooded, saturated	(3) 1		0 0		3 1		3 1		
Soil Type	histosol mineral hydric soil both	3 1 (2)		3 1		3 1		3 1		
	Total Score: Functional Capacity Index:	10/18 0.55								
	Model Range Index Range:	3-18 .19-1.0		2-15 .16-1.0		3-15 .22-1.0		3-18 .19-1.0		

PROJECT NAME: Hampshire CC - Golf Course Drainage System 3

MODIFICATION OF GROUNDWATER RECHARGE						
Wetland ID(s): Drainage System 3 HGM Type: D		HGM TYPES:				
VARIABLES	CONDITIONS	(D) Wgt Scr	L Wgt Scr	EP Wgt Scr	R Wgt Scr	F Wgt Scr
Indicators of Disfunction						
Inlet/Outlet Class	no inlet/perennial outlet; intermittent inlet/perennial outlet	0				0
Nested Piezometer Data:	discharge condtion	0	0	0	0	0
Relationship to Regional Piezometric Surface	wetland substrate elevation above piezometric surface	0	0	0	0	0
Presence of Seeps and Springs	presence of seeps or springs	0	0	0	0	0
Direct Indicators of Function						
Inlet/Outlet Class	perennial inlet/no outlet	21				21
Nested Piezometer Data	recharge condition	21				21
Relationship to Regional Peizometeric Surface	wetland substrate elevation below piezometric surface	21				21
Primary Variables						
Microrelief of Wetland Surface	poorly developed absent well developed pronounced	(3) 3 2 1	3 3 2 1	1 1 2 3	3 3 2 1	3 3 2 1
Inlet/Outlet Class	perennial inlet/intermittent outlet all other classes	3 (0)	0 0	0 0	0 0	3 0
pH	acid circumneutral alkaline no water present	3 (2) 1 0	3 2 1 0	3 2 1 0	3 2 1 0	3 2 1 0
Surficial Geologic Deposit Under Wetland	glacial till low permeability stratified deposits high permeability stratified deposits	(3) 2 1	1 2 3	1 2 3	1 2 3	3 2 1
Surface Water Level Fluctuation of the Wetland	high fluctuation low fluctuation never inundated	(3) 2 1	3 2 1	0 0 0	3 2 1	3 2 1

Hampshire CC - Golf Course Drainage System 3

Wetland ID(s): Drainage System 3 HGM Type: D		HGM TYPES:				
VARIABLES	CONDITIONS	(D)	L	EP	R	F
		Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr
Wetland Water Regime	drier; seasonally flooded, temporarily flooded, saturated	3	3	0	3	3
	wet; permanently flooded, intermittently exposed, semipermanently flooded	(1)	1	0	1	1
Soil Type ~25%	(gravelly) or sandy mineral hydric	3	3	0	3	3
	silty or (clayey) mineral hydric	2	2	0	2	2
	sapric histosol	(1)	1	0	1	1
	(fibric or hemic histosol) ~75%	0	0	3	0	0
	Total Score:	13/21				
	Model Score:	4-21	4-18	2-12	4-18	4-21
	Functional Capacity Index:	0.62				
	Index Range:	.19-1.0	.22-1.0	0.16-1.0	.22-1.0	.19-1.0

* This model should be applied to both year long and seasonal recharge wetlands

* If the wetland is seasonally fluctuating between recharge and discharge, then reduce the above score by one half (1/2), because the wetland only functions in a recharge mode for roughly half of the year

PROJECT NAME: Hampshire CC - Golf Course Drainage System 3

STORM AND FLOOD-WATER STORAGE							
Wetland ID(s): Drainage System 3 HGM Type: D		HGM TYPES:					
VARIABLES	CONDITIONS	D (circled)	S	L	EP	R	F
		Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr
Indicators of disfunction	none						
Direct Indicators of Function	no outlet	27	21				30
Primary Variables Inlet/Outlet Class	perennial inlet/intermittent outlet	3	3	0	0	0	3
	intermittent inlet/intermittent outlet	2	2	0	0	0	2
	non-inlet/intermittent outlet	1 (circled)	1	0	0	0	1
	non-inlet/perennial outlet	1	1	0	0	0	1
	intermittent inlet/perennial outlet	1	1	0	0	0	1
	perennial inlet/perennial outlet	1	1	0	0	0	1
Degree of Outlet Restriction	restricted	3 (circled)	0	0	0	0	3
	unrestricted	0	0	0	0	0	0
Basin Topographic Gradient	low gradient	3	3	0	3	3	3
	high gradient	1 (circled)	1	0	0	1	1
Wetland Water Regime	drier: seasonally flooded, temporarily flooded, saturated	3	3	3	0	3	3
	wet: permanently flooded, intermittently exposed, semipermanently flooded	1 (circled)	1	1	0	1	1
Surface Water Level Fluctuation of the Wetland	high fluctuation	3 (circled)	0	3	0	3	3
	low fluctuation	2	0	2	0	2	2
	never inundated	0	0	0	0	0	0
Ratio of Wetland Area to Watershed Area	large	3	3	3	0	3	3
	small	1 (circled)	1	1	0	1	1
Microrelief of Wetland Surface	prounounced	3	3	3	3	3	3
	well developed	2	2	2	2	2	2
	poorly developed	1 (circled)	1	1	1	1	1
	absent	0	0	0	0	0	0

Hampshire CC - Golf Course Drainage System 3

STORM AND FLOOD-WATER STORAGE

Wetland ID(s): Drainage System 3
HGM Type: D

HGM TYPES:

VARIABLES	CONDITIONS	D Wgt Scr	S Wgt Scr	L Wgt Scr	EP Wgt Scr	R Wgt Scr	F Wgt Scr
Frequency of Overbank Flooding	overbank flooding absent	0	0	0	0	0	0
	return interval of >5 yrs.	0	0	1	0	1	1
	return interval of 2-5 yrs.	0	0	2	0	2	2
	return interval of 1-2 yrs.	0	0	3	0	3	3
Vegetation Density/Dominance	high/very high	3	3	3	3	3	3
	moderate	2	2	2	2	2	2
	sparse/low	1	1	1	1	1	1
	no vegetation	0	0	0	0	0	0
Dead Woody Material	abundant	3	3	3	3	3	3
	moderately abundant	2	2	2	2	2	2
	sparse	1	1	1	1	1	1
	absent	0	0	0	0	0	0
	Total Score:	14/27					
	Functional Capacity Index:	0.52					
	Model Range:	4-27	4-21	2-21	0-12	3-24	4-30
	Index Range:	0.15-1.0	0.19-1.0	0.09-1.0	0-1.0	0.12-1.0	0.13-1.0

PROJECT NAME: Hampshire CC - Golf Course Drainage System 3

MODIFICATION OF STREAM FLOW (This model is identical for all HGM types)		
VARIABLES	**CONDITIONS**	**WEIGHTS**
Indicators of Disfunction	No Outlet	0
Direct Indicators of Function	None	

Primary Variables

Storm and Flood Water Storage Function Model Score		X	Modification of Groundwater Discharge Function Model Score				Total Score: 4
High*	3	X	High	3	=	9	
Mod	2	X	High	3	=	6	
Low	1	X	High	3	=	3	
High	3	X	Mod	2	=	6	
(Mod)	(2)	(X)	(Mod)	(2)	=	(4)	
Low	1	X	Mod	2	=	2	
High	3	X	Low	1	=	3	
Mod	2	X	Low	1	=	2	
Low	1	X	Low	1	=	1	

Total Score: 4/9

Model Range: 1-9

Function Capacity Index: 0.44

Index Range: 0.11-1.0

*High = FCI of 0.67-1.0, Mod = FCI of 0.34-0.66, Low = FCI of 0-0.33 for the Storm and Flood Water Storage and Modification of Ground Water Discharge Function Model Scores.

PROJECT NAME: Hampshire CC - Golf Course Drainage System 3

MODIFICATION OF WATER QUALITY							
Wetland ID(s): Drainage System 3 HGM Type: D		HGM TYPES:					
VARIABLES	CONDITIONS	(D) circled Wgt Scr	S Wgt Scr	L Wgt Scr	EP Wgt Scr	R Wgt Scr	F Wgt Scr
Indicators of disfunction	None						
Direct Indicators of Function	Evidence of Sedimentation	(18) circled	15	12	12	12	18
Primary Variables Wetland Land Use	low intensity moderate intensity high intensity	3 2 1	3 2 1	3 2 1	3 2 1	3 2 1	3 2 1
Degree of Outlet Restriction	restricted outflow no outlet unrestricted outflow	3 2 1	0 0 0	0 0 0	0 0 0	0 0 0	3 2 1
Inlet/Outlet Type	no outlet intermittent outlet perennial outlet	3 2 1	3 2 1	0 0 0	0 0 0	0 0 0	3 2 1
Dominant Wetland Type	forested wetland scrub-shrub emergent wetland aquatic bed no vegetation	3 2 2 1 0	3 2 2 0 0	3 2 2 0 0	3 2 2 0 0	3 2 2 0 0	3 2 2 0 0
Cover Distribution	forming a continuous cover growing in small scattered patches one or more large patches solitary scattered stems no vegetation	3 2 1 1 0	3 2 1 1 0	3 2 1 1 0	3 2 1 1 0	3 2 1 1 0	3 2 1 1 0
Soil Type	histosol or clayey soil silty soil sandy or gravelly soil	3 2 1	3 2 1	3 2 1	3 0 0	3 2 1	3 2 1
	Total Score: Functional Capacity Index:	18/18 1.0					
	Model Range: Index Range:	4-18 0.22-1.0	3-15 0.20-1.0	2-12 0.16-1.0	1-12 0.8-1.0	2-12 0.16-1.0	4-18 0.22-1.0

PROJECT NAME: Hampshire CC - Golf Course Drainage System 3

EXPORT OF DETRITUS													
Wetland ID(s): Drainage System 3 HGM Type: D		HGM TYPES:											
VARIABLES	CONDITIONS	D (circled)		S		L		EP		R		F	
		Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr
Indicators of Disfunction	no outlet	0		0				0				0	
Direct Indicators of Function	none												
<u>Primary Variables</u> Wetland Land Use	moderate intensity low intensity high intensity	3 2 1 (circled)		3 2 1		3 2 1		3 2 1		3 2 1		3 2 1	
Degree of Outlet Restriction	unrestricted outflow restricted outflow	3 1 (circled)		0 0		0 0		0 0		0 0		3 1	
Inlet/Outlet Class	perennial outlet intermittent outlet	3 1 (circled)		3 1		0 0		0 0		0 0		3 1	
Wetland Water Regime	drier; seasonally flooded, temporarily flooded, saturated wet; permanently flooded, intermittently exposed, semipermanently flooded	3 1 (circled)		3 1		3 1		0 1		3 1		3 1	
Vegetation Density/Dominance	high/very high medium sparse/low no vegetation	3 2 (circled) 1 0		3 2 1 0		3 2 1 0		3 2 1 0		3 2 1 0		3 2 1 0	
Soil type	mineral hydric soil histosol — both	3 1	2 (circled)	3 1		3 1		3 1		3 1		3 1	
	Total Score:	8/18											
	Functional Capacity Index:	0.44											
	Model Range:	5-18		4-15		3-12		2-10		3-12		5-18	
	Index Range:	0.27-1.0		0.26-1.0		0.25-1.0		0.20-1.0		0.25-1.0		0.27-1.0	

PROJECT NAME: Hampshire CC - Golf Course Drainage System 3

CONTRIBUTION TO ABUNDANCE AND DIVERSITY OF WETLAND VEGETATION (This model is identical for all HGM types)		
VARIABLES	CONDITIONS	WEIGHTS
Indicators of Disfunction	No Vegetation	0
Direct Indicators of Function	None	
Primary Variables		Score:
Plant Species Diversity	high diversity 5 medium diversity (3) low diversity 1	
Vegetation Density/Dominance	high/very high 5 medium (3) sparse/low 1	
Wetland Juxtaposition	connected to upstream and downstream 5 connected above or below 3 other wetlands nearby but not connected (400 m or closer) (1) isolated 0	
		Total Score: 7/15 Model Range: 2-15
		Functional Capacity Index: 0.46 Index Range: 0.13-1.0

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PROJECT NAME: Hampshire CC - Golf Course Drainage System 3

CONTRIBUTION TO ABUNDANCE AND DIVERSITY OF WETLAND FAUNA (This model is identical for all HGM types except Slope Wetlands for which "Interspersion of Vegetation Cover and Open Water" does not apply)		
VARIABLES	**CONDITIONS**	**WEIGHTS**
Direct Indicators of Disfunction	None	
Direct Indicators of Function	None	
Primary Variables Watershed Land Use	low intensity (0-25% urbanized) moderate intensity (25-50% urbanized) high intensity (>50% urbanized)	3 2 (1)
Wetland Land Use	low intensity moderate intensity high intensity	3 2 (1)
Wetland Water Regime	wet: permanently flooded, intermittently exposed, semipermanently flooded drier: seasonally flooded, temporarily flooded, saturated	(3) 1
Microrelief of Wetland Surface	pronounced well developed poorly developed absent	3 2 (1) 0
Number of Wetland Types and Relative Proportions	5 or more types 3-4 types 1-2 types no vegetation	3 2 (1) 0
	even distribution moderately even distribution highly uneven distribution no vegetation	3 (2) 1 0
Vegetation Interspersion	high interspersion moderate interspersion low interspersion no vegetation	3 (2) 1 0

Hampshire CC - Golf Course Drainage System 3

CONTRIBUTION TO ABUNDANCE AND DIVERSITY OF WETLAND FAUNA (CONT'D)		
Variables	**Conditions**	**Weights**
Number of Layers and Percent Cover	5 or more layers 3-4 layers 1-2 layers no vegetation	3 (2) 1 0
	layers well developed (>50% cover) layers with moderate cover (26-50% cover) layers poorly distinguishible (<25% cover) no vegetation	3 (2) 1 0
Interspersion of Vegetation Cover and Open Water	26-75%scattered or peripheral >75% scattered or peripheral <25% scattered or peripheral 100% cover or open water no vegetation	(3) 2 1 1 0
Size	large (>100 acres) medium (10-100 acres) small (<10 acres)	3 2 (1)
Wetland Juxtaposition	other wetlands within 400 m and connected above or below other wetlands within 400 m but not connected wetland isolated (c-ivert)	3 (1) 0
Slope Wetlands: Model Range: 4-33 Functional Capacity Index: Index Range: 0.12-1.0	All other HGM types: Total Score: 20/36 Model Range: 4-36 Functional Capacity Index: 0.55 Index Range: 0.11-1.0	

WETLAND INVENTORY DATA - CHARACTERIZATION OF WETLAND

Project Name: Hampshire Country Club Date: 5/17/16

Field Investigators: David Kennedy, MS, Project Scientist, VHB

Isolated Wetland A (northwestern portion of property)

SURFACE WATER FLOW VECTORS

- ☒ Depressional - 100% Percent/Acreage
- ☐ Slope - ______ Perecent/Acreage
- ☐ Extensive Peatland - ____ Percent/Acreage
- ☐ Lacustrine Fringe - ____ Percent/Acreage
- ☐ Riverine - _____ Percent/Acreage

VEGETATION TYPES

Forested Wetland

- ☐ Evergreen Needle-leaved - ____________ Percent/Acreage
- ☐ Deciduous Broad-leaved - ____________ Percent/Acreage
- ☐ Deciduous Needle-leaved - ____________ Percent/Acreage

Scrub Shrub

- ☐ Evergreen Needle-leaved - ____________ Percent/Acreage
- ☐ Evergreen Broad-leaved - ____________ Percent/Acreage
- ☐ Deciduous Broad-leaved - ____________ Percent/Acreage
- ☐ Deciduous Needle-leaved - ____________ Percent/Acreage

Emergent Wetland

- ☒ Persistent - 100% Percent/Acreage
- ☐ Non-persistent - ____________ Percent/acreage
- ☐ Aquatic Bed - ____________ Percent/Acreage

Total - 100%

SOIL TYPES

Histosol:

- ☐ Fibric
- ☒ Hemic
- ☐ Sapric

Mineral Hydric Soil:

- ☒ Gravelly
- ☐ Sandy
- ☐ Silty
- ☒ Clayey

GEOLOGY

Surficial: glacial till

Bedrock: pelitic schists

Hampshire CC - Isolated Wetland A

PRE-EMPTIVE STATUS

- ☐ Public Ownership
- ☐ Wildlife Management Area
- ☐ Fisheries Management Area
- ☐ Designated State or Federal Protected Wetland
- ☐ Documented Habitat for State or Federal Listed Species
- ☐ Regionally Scarce Wetland Category
- ☐ Historic/Archaeological Area

PLANT SPECIES

NAME	OW	FW	F	FU	DOM	C	S	TS	LS	H
Phragmites australis		X			X					X
Vitis riparia			X		X					
Polygonum pensylvanicum		X			X					X
Calestegia sepium			X		X					X
Rosa multiflora				X			X			
Polygonum cuspidatum				X						X
Salix babylonica		X				X				
Salix discolor		X				X				

OW-Obligate Wetland
FW- Facultative Wetland
F – Facultative
FU – Facultative Upland

Dom – Dominant
C- Canopy
S- Sapling
TS – Tall Shrub

LS- Low Shrub
H - Herb

Hampshire CC - Isolated Wetland A

WETLAND INVENTORY DATA - CHARACTERIZATION OF MODEL VARIABLES

LANDSCAPE VARIABLES

Size:

- ☒ Small (< 10 ACRES)
- ☐ Medium (10-100 ACRES)
- ☐ Large (> 100 ACRES)

Wetland Juxtaposition:

- ☐ Connected Upstream and Downstream
- ☐ Only Connected Above
- ☐ Only Connected Below
- ☐ Other wetlands Nearby But Not Connected
- ☒ Wetland Isolated

Fire Occurrence and Frequency:

- ☐ Natural; Predictable Frequency
- ☐ Natural; Sporadic Frequency
- ☐ Human-Caused; Predictable
- ☐ Human-Caused; Sporadic
- ☐ Rare Event
- ☒ No Evidence

Regional Scarcity:

- ☒ Not Scarce (> 5% of total wetland area of region)
- ☐ Scarce (< 5% of total wetland areas of region)

Watershed Land Use:

- ☒ > 50% Urbanized
- ☐ 25-50% Urbanized
- ☐ 0-25% Urbanized

HYDROLOGICAL VARIABLES

Surface Water Level Fluctuation of Wetlands:

- ☐ High Fluctuation
- ☒ Low Fluctuation
- ☐ Never Inundated

Frequency of Overbank Flooding:

- ☒ Return Interval > 5 years
- ☐ Return Interval 2-5 Yeasts
- ☐ Return Interval 1-2 Years
- ☐ No Overbank Flooding

pH:

- ☐ Acid <5.5
- ☐ Circumneutral 5.5-7.4
- ☐ Alkaline > 7.4
- ☒ No Water

Surficial Geologic Deposit Under Wetland:

- ☐ Low Permeability Stratified Deposits
- ☐ High Permeability Stratified Deposits
- ☒ Glacial Till

Wetland Land Use:

- ☒ High Intensity (i.e. ~~agriculture)~~ evidence of clearing, runoff from golf course
- ☐ Moderate Intensity (i.e. forestry)
- ☐ Low Intensity (i.e. open space)

Wetland Water Regime:

- ☐ Wet: Permanently Flooded, Intermittently Exposed, Semi-Permanently Flooded
- ☒ Drier: Seasonally Flooded, Temporarily Flooded, Saturated

Basin Topographic Gradient:

- ☐ High Gradient > 2%
- ☒ Low Gradient < 2%

Degree of Outlet Restriction:

- ☐ Restricted Outflow
- ☐ Unrestricted Outflow
- ☒ No Outflow

Ratio of Wetland Area to Watershed Area:

- ☒ High > 10%
- ☐ Low < 10%

Microrelief of Wetland Surface:

- ☐ Pronounced > 45 cm
- ☐ Well Developed 15-45 cm
- ☒ Poorly Developed < 15 cm
- ☐ Absent

Inlet/Outlet Class:

- ☒ No Inlet/No Outlet
- ☐ No Inlet/Intermittent Outlet
- ☐ No Inlet/Perennial Outlet
- ☐ Intermittent Inlet/No Outlet
- ☐ Intermittent Inlet/Intermittent Outlet
- ☐ Intermittent Outlet/Perennial Outlet
- ☐ Perennial Inlet/No Outlet
- ☐ Perennial Inlet/Intermittent Outlet
- ☐ Perennial Inlet/Perennial Outlet

Nested Piezometer Data:

- ☐ Recharge
- ☐ Discharge
- ☐ Horizontal Flow
- ☒ Not Available

Relations of Wetlands' Substrate Elevation to Regional Piezometric Surface:

- ☐ Piezometer Surface Above or at Substrate Elevation
- ☐ Piezometer Surface Below Substrate Elevation
- ☒ Not Available

Evidence of Sedimentation:

- ☒ No Evidence Observed
- ☐ Sediment Observed on Wetland Substrate
- ☐ Fluvaquent Soils

Evidence of Seeps and Springs:

- ☒ No Seeps or Springs
- ☐ Seeps Observed
- ☐ Perennial Spring
- ☐ Intermittent Spring

SOIL VARIABLES

Soil Lacking:

☐

Histosol:

- ☐ Fibric
- ☒ Hemic
- ☐ Sapric

Hampshire CC - Isolated Wetland A

Mineral Hydric Soil:

- ☒ Gravelly
- ☐ Sandy
- ☐ Silty
- ☒ Clayey

VEGETATION VARIABLES

Vegetation Lacking:

☐

Dominant Wetland Type:

- ☐ Forested – Evergreen – Needle-leaved
- ☐ Forested – Deciduous – Broad-leaved
- ☐ Forested – Deciduous – Needle-leaved
- ☐ Scrub Shrub – Evergreen – Broad-leaved
- ☐ Scrub Shrub – Evergreen – Needle-leaved
- ☐ Scrub Shrub – Deciduous – Broad-leaved
- ☐ Scrub Shrub – Decisuous – Needle-leaved
- ☒ Emergent – Persistent
- ☐ Emergent – Non-persistent
- ☐ Aquatic Bed

Number of Types & Relative Proportions:

Number of Types:

- ☐ Actual #
- ☐ 5
- ☐ 4
- ☐ 3
- ☐ 2
- ☒ 1

Evenness of Distribution:

- ☐ Even Distribution
- ☐ Moderately Even Distribution
- ☒ Highly Uneven Distribution

Vegetation Density/Dominance:

- ☐ Sparce (0-20%)
- ☐ Low Density (20-40%)
- ☐ Medium Density (40-60%)
- ☒ High Density (60-80%)
- ☐ Very High Density (80-100%)

Vegetation Interspersion:

- ☐ High (small groupings, diverse and interspersed)
- ☒ Moderate (broken irregular rings)
- ☐ Low (large patches, concentric rings)

Number of Layers and Percent Cover:

Number of Layers:

- ☐ 6 or > (actual #)
- ☐ 5
- ☐ 4
- ☒ 3
- ☐ 2
- ☐ 1

Percent Cover:

- ☐ Submergents:
- ☐ Floating:
- ☐ Moss-lichen:
- ☒ Short Herb: 15
- ☒ Tall Herb: 80
- ☐ Dwarf shrub:
- ☐ Short shrub:
- ☐ Tall shrub:
- ☐ Sapling:
- ☒ Tree: 5

Plant Species Diversity:

- ☐ Low 1-2 plots sampled
- ☒ Medium 3-4 plots sampled
- ☐ High 5 or more plots sampled

Proportion of Animal Plant Foods:

- ☒ Low (5-25%)
- ☐ Medium (25-50%)
- ☐ High (> 50%)

Cover Distribution:

- ☒ Continuous Cover
- ☐ Small Scattered Patches
- ☐ 1 or More Large Patches; Parts of Site Open
- ☐ Solitary, Scattered Stems

Dead Woody Material:

- ☐ Abundant (50% of wetland surface)
- ☐ Moderately Abundant (25-50% of surface)
- ☒ Low Abundance (0-25% of surface)

Interspersion of Cover and Open Water:

- ☐ < 25% Scattered or Peripheral
- ☐ 26-75 % Scattered or Peripheral
- ☐ > 75% Scattered or Peripheral
- ☒ 100% Cover or Open Water

Stream Sinuosity: N/A

- ☐ Highly Convoluted (Index 1.50 or >)
- ☐ Moderately Convoluted (Index 1.25-1.50)
- ☐ Straight/Slightly Irregular (Index 1.10-1.25)

Presence of Islands:

- ☐ Several to Many
- ☐ One or Few
- ☒ Absent

PROJECT NAME: Hampshire CC - Isolated Wetland A

MODIFICATION OF GROUNDWATER DISCHARGE					
Wetland ID(s): Isolated Wetland A HGM Type: D		HGM TYPES:			
VARIABLES	CONDITIONS	(D) Wgt Scr	S Wgt Scr	R Wgt Scr	F Wgt Scr
Indicators of Disfunction					
Inlet/Outlet Class	perennial inlet/no outlet	0	0	0	0
Nested Piezometer Data	recharge	0	0	0	0
Relationship to Regional Piezometric Surface	wetland substrate elevation above piezometric surface	0	0	0	0
Direct Indicators of Function					
Presence of Springs and Seeps	evidence of perennial steeps or springs	18	15	15	18
Neated Piezometer Data	discharge condition	18	15	15	18
Relationship to Regional Piezometric Surface	wetland substrate elevation below piezometric surface	18	15	15	18
Inlet/Outlet Class	no inlet/perennial outlet	18	15	15	18
Primary Variables					
Microrelief of Wetland Surfaces	pronounced well developed poorly developed absent	3 2 (1) 0	3 2 1 0	3 2 1 0	3 2 1 0
Inlet/Outlet Class	perennial inlet/perennial outlet intermittent inlet/perennial outlet all other classes	3 2 (0)	3 2 0	0 0 0	3 2 0
pH	alkaline circumneutral acid no water present	3 2 0 (0)	3 2 0 0	3 2 0 0	3 2 0 0
Surficial Geologic Deposit Under Wetland	high permeability stratified deposits low permeability stratified deposits glacial till	3 2 (1)	3 2 1	3 2 1	3 2 1
Wetland water regime	wet; permanently flooded, intermittently exposed semipermanently, flooded drier; seasonally flooded, temporarily flooded, saturated	3 (1)	0 0	3 1	3 1
Soil Type	histosol mineral hydric soil both	3 1 (2)	3 1	3 1	3 1
	Total Score: Functional Capacity Index:	5/18 0.28			
	Model Range Index Range:	3-18 .19-1.0	2-15 .16-1.0	3-15 .22-1.0	3-18 .19-1.0

PROJECT NAME: Hampshire CC

MODIFICATION OF GROUNDWATER RECHARGE											
Wetland ID(s): Isolated Wetland A HGM Type: D		HGM TYPES:									
VARIABLES	CONDITIONS	(D)		L		EP		R		F	
		Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr
Indicators of Disfunction											
Inlet/Outlet Class	no inlet/perennial outlet; intermittent inlet/perennial outlet	0								0	
Nested Piezometer Data:	discharge condtion	0		0		0		0		0	
Relationship to Regional Piezometric Surface	wetland substrate elevation above piezometric surface	0		0		0		0		0	
Presence of Seeps and Springs	presence of seeps or springs	0		0		0		0		0	
Direct Indicators of Function											
Inlet/Outlet Class	perennial inlet/no outlet	21								21	
Nested Piezometer Data	recharge condition	21								21	
Relationship to Regional Peizometeric Surface	wetland substrate elevation below piezometric surface	21								21	
Primary Variables											
Microrelief of Wetland Surface	poorly developed	(3)		3		1		3		3	
	absent	3		3		1		3		3	
	well developed	2		2		2		2		2	
	pronounced	1		1		3		1		1	
Inlet/Outlet Class	perennial inlet/intermittent outlet	3		0		0		0		3	
	all other classes	(0)		0		0		0		0	
pH	acid	3		3		3		3		3	
	circumneutral	2		2		2		2		2	
	alkaline	1		1		1		1		1	
	no water present	(0)		0		0		0		0	
Surficial Geologic Deposit Under Wetland	glacial till	(3)		1		1		1		3	
	low permeability stratified deposits	2		2		2		2		2	
	high permeability stratified deposits	1		3		3		3		1	
Surface Water Level Fluctuation of the Wetland	high fluctuation	3		3		0		3		3	
	low fluctuation	(2)		2		0		2		2	
	never inundated	1		1		0		1		1	

Hampshire CC

Wetland ID(s): Isolated Wetland A HGM Type: D		HGM TYPES:				
VARIABLES	CONDITIONS	D	L	EP	R	F
		Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr
Wetland Water Regime	drier; seasonally flooded, temporarily flooded, saturated	3	3	0	3	3
	wet; permanently flooded, intermittently exposed, semipermanently flooded	1	1	0	1	1
Soil Type	gravelly or sandy mineral hydric	3	3	0	3	3
	silty or clayey mineral hydric	2	2	0	2	2
	sapric histosol	1	1	0	1	1
	fibric or hemic histosol	0	0	3	0	0
	Total Score:	13/21				
	Model Score:	4-21	4-18	2-12	4-18	4-21
	Functional Capacity Index:	0.62				
	Index Range:	.19-1.0	.22-1.0	0.16-1.0	.22-1.0	.19-1.0

2

* This model should be applied to both year long and seasonal recharge wetlands

* If the wetland is seasonally fluctuating between recharge and discharge, then reduce the above score by one half (1/2), because the wetland only functions in a recharge mode for roughly half of the year

PROJECT NAME: Hampshire CC

STORM AND FLOOD-WATER STORAGE													
Wetland ID(s): Isolated Wetland A HGM Type: D		HGM TYPES:											
VARIABLES	CONDITIONS	(D)		S		L		EP		R		F	
		Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr
Indicators of disfunction	none												
Direct Indicators of Function	no outlet	(27)		21								30	
Primary Variables Inlet/Outlet Class	perennial inlet/intermittent outlet	3		3		0		0		0		3	
	intermittent inlet/intermittent outlet	2		2		0		0		0		2	
	non-inlet/intermittent outlet	1		1		0		0		0		1	
	non-inlet/perennial outlet	1		1		0		0		0		1	
	intermittent inlet/perennial outlet	1		1		0		0		0		1	
	perennial inlet/perennial outlet	1		1		0		0		0		1	
Degree of Outlet Restriction	restricted	3		0		0		0		0		3	
	unrestricted	0		0		0		0		0		0	
Basin Topographic Gradient	low gradient	3		3		0		3		3		3	
	high gradient	1		1		0		0		1		1	
Wetland Water Regime	drier: seasonally flooded, temporarily flooded, saturated	3		3		3		0		3		3	
	wet: permanently flooded, intermittently exposed, semipermanently flooded	1		1		1		0		1		1	
Surface Water Level Fluctuation of the Wetland	high fluctuation	3		0		3		0		3		3	
	low fluctuation	2		0		2		0		2		2	
	never inundated	0		0		0		0		0		0	
Ratio of Wetland Area to Watershed Area	large	3		3		3		0		3		3	
	small	1		1		1		0		1		1	
Microrelief of Wetland Surface	prounounced	3		3		3		3		3		3	
	well developed	2		2		2		2		2		2	
	poorly developed	1		1		1		1		1		1	
	absent	0		0		0		0		0		0	

Hampshire CC

STORM AND FLOOD-WATER STORAGE

Wetland ID(s): Isolated Wetland A
HGM Type: A

HGM TYPES:

VARIABLES	CONDITIONS	D (circled) Wgt Scr	S Wgt Scr	L Wgt Scr	EP Wgt Scr	R Wgt Scr	F Wgt Scr
Frequency of Overbank Flooding	overbank flooding absent	0	0	0	0	0	0
	return interval of >5 yrs.	0	0	1	0	1	1
	return interval of 2-5 yrs.	0	0	2	0	2	2
	return interval of 1-2 yrs.	0	0	3	0	3	3
Vegetation Density/Dominance	high/very high	3	3	3	3	3	3
	moderate	2	2	2	2	2	2
	sparse/low	1	1	1	1	1	1
	no vegetation	0	0	0	0	0	0
Dead Woody Material	abundant	3	3	3	3	3	3
	moderately abundant	2	2	2	2	2	2
	sparse	1	1	1	1	1	1
	absent	0	0	0	0	0	0
	Total Score:	27/27					
	Functional Capacity Index:	1.0					
	Model Range:	4-27	4-21	2-21	0-12	3-24	4-30
	Index Range:	0.15-1.0	0.19-1.0	0.09-1.0	0-1.0	0.12-1.0	0.13-1.0

PROJECT NAME: Hampshire CC - Isolated Wetland A

MODIFICATION OF STREAM FLOW (This model is identical for all HGM types)		
VARIABLES	**CONDITIONS**	**WEIGHTS**
Indicators of Disfunction	No Outlet	0
Direct Indicators of Function	None	

Primary Variables

Storm and Flood Water Storage Function Model Score		X	Modification of Groundwater Discharge Function Model Score				Total Score:
High*	3	X	High	3	=	9	
Mod	2	X	High	3	=	6	
Low	1	X	High	3	=	3	
High	3	X	Mod	2	=	6	
Mod	2	X	Mod	2	=	4	
Low	1	X	Mod	2	=	2	
High	3	X	Low	1	=	3	
Mod	2	X	Low	1	=	2	
Low	1	X	Low	1	=	1	

Total Score: 0/9

Model Range: 1-9

Function Capacity Index: 0.0

Index Range: 0.0-1.0

*High = FCI of 0.67-1.0, Mod = FCI of 0.34-0.66, Low = FCI of 0-0.33 for the Storm and Flood Water Storage and Modification of Ground Water Discharge Function Model Scores.

PROJECT NAME: Hampshire CC

MODIFICATION OF WATER QUALITY								
Wetland ID(s): Isolated Wetland A HGM Type: D		HGM TYPES:						
VARIABLES	CONDITIONS	(D)	S	L	EP	R	F
		Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr	Wgt Scr
Indicators of disfunction	None						
Direct Indicators of Function	Evidence of Sedimentation	18	15	12	12	12	18
Primary Variables Wetland Land Use	low intensity moderate intensity high intensity	3 2 (1)	3 2 1	3 2 1	3 2 1	3 2 1	3 2 1
Degree of Outlet Restriction	restricted outflow no outlet unrestricted outflow	3 (2) 1	0 0 0	0 0 0	0 0 0	0 0 0	3 2 1
Inlet/Outlet Type	no outlet intermittent outlet perennial outlet	(3) 2 1	3 2 1	0 0 0	0 0 0	0 0 0	3 2 1
Dominant Wetland Type	forested wetland scrub-shrub emergent wetland aquatic bed no vegetation	3 2 (2) 1 0	3 2 2 0 0	3 2 2 0 0	3 2 2 0 0	3 2 2 0 0	3 2 2 0 0
Cover Distribution	forming a continuous cover growing in small scattered patches one or more large patches solitary scattered stems no vegetation	(3) 2 1 1 0	3 2 1 1 0	3 2 1 1 0	3 2 1 1 0	3 2 1 1 0	3 2 1 1 0
Soil Type	**histosol or clayey soil** silty soil sandy or **gravelly** soil	(3) 2 1	3 2 1	3 2 1	3 0 0	3 2 1	3 2 1
	Total Score:	14/18					
	Functional Capacity Index:	0.77					
	Model Range:	4-18	3-15	2-12	1-12	2-12	4-18
	Index Range:	0.22-1.0	0.20-1.0	0.16-1.0	0.8-1.0	0.16-1.0	0.22-1.0

PROJECT NAME: Hampshire CC

EXPORT OF DETRITUS													
Wetland ID(s): Isolated Wetland A HGM Type: D		HGM TYPES:											
VARIABLES	CONDITIONS	D (circled)		S		L		EP		R		F	
		Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr	Wgt	Scr
Indicators of Disfunction	no outlet (circled)	0		0				0				0	
Direct Indicators of Function	none												
<u>Primary Variables</u>													
Wetland Land Use	moderate intensity	3		3		3		3		3		3	
	low intensity	2		2		2		2		2		2	
	high intensity	1		1		1		1		1		1	
Degree of Outlet Restriction	unrestricted outflow	3		0		0		0		0		3	
	restricted outflow	1		0		0		0		0		1	
Inlet/Outlet Class	perennial outlet	3		3		0		0		0		3	
	intermittent outlet	1		1		0		0		0		1	
Wetland Water Regime	drier; seasonally flooded, temporarily flooded, saturated	3		3		3		0		3		3	
	wet; permanently flooded, intermittently exposed, semipermanently flooded	1		1		1		1		1		1	
Vegetation Density/Dominance	high/very high	3		3		3		3		3		3	
	medium	2		2		2		2		2		2	
	sparse/low	1		1		1		1		1		1	
	no vegetation	0		0		0		0		0		0	
Soil type	mineral hydric soil	3		3		3		3		3		3	
	histosol	1		1		1		1		1		1	
	Total Score:	0											
	Functional Capacity Index:	0.0											
	Model Range:	5-18		4-15		3-12		2-10		3-12		5-18	
	Index Range:	0.27-1.0		0.26-1.0		0.25-1.0		0.20-1.0		0.25-1.0		0.27-1.0	

PROJECT NAME: Hampshire CC - Isolated Wetland A

CONTRIBUTION TO ABUNDANCE AND DIVERSITY OF WETLAND VEGETATION (This model is identical for all HGM types)		
VARIABLES	**CONDITIONS**	**WEIGHTS**
Indicators of Disfunction	No Vegetation	0
Direct Indicators of Function	None	
Primary Variables		Score:
Plant Species Diversity	high diversity 5 medium diversity (3) low diversity 1	
Vegetation Density/Dominance	high/very high (5) medium 3 sparse/low 1	
Wetland Juxtaposition	connected to upstream and downstream 5 connected above or below 3 other wetlands nearby but not connected (400 m or closer) (1) isolated 0	
		Total Score: 9/15 Model Range: 2-15
		Functional Capacity Index: 0.60 Index Range: 0.13-1.0

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PROJECT NAME: Hampshire CC - Isolated Wetland A

CONTRIBUTION TO ABUNDANCE AND DIVERSITY OF WETLAND FAUNA
(This model is identical for all HGM types except Slope Wetlands for which "Interspersion of Vegetation Cover and Open Water" does not apply)

VARIABLES	CONDITIONS	WEIGHTS
Direct Indicators of Disfunction	None	
Direct Indicators of Function	None	
Primary Variables		
Watershed Land Use	low intensity (0-25% urbanized) moderate intensity (25-50% urbanized) high intensity (>50% urbanized)	3 2 1 (circled)
Wetland Land Use	low intensity moderate intensity high intensity	3 2 1 (circled)
Wetland Water Regime	wet: permanently flooded, intermittently exposed, semipermanently flooded drier: seasonally flooded, temporarily flooded, saturated	3 1 (circled)
Microrelief of Wetland Surface	pronounced well developed poorly developed absent	3 2 1 (circled) 0
Number of Wetland Types and Relative Proportions	5 or more types 3-4 types 1-2 types no vegetation	3 2 1 (circled) 0
	even distribution moderately even distribution highly uneven distribution no vegetation	3 2 1 (circled) 0
Vegetation Interspersion	high interspersion moderate interspersion low interspersion no vegetation	3 2 (circled) 1 0

Hampshire CC - Isolated Wetland A

CONTRIBUTION TO ABUNDANCE AND DIVERSITY OF WETLAND FAUNA (CONT'D)		
Variables	**Conditions**	**Weights**
Number of Layers and Percent Cover	5 or more layers	3
	3-4 layers	2 (circled)
	1-2 layers	1
	no vegetation	0
	layers well developed (>50% cover)	3 (circled)
	layers with moderate cover (26-50% cover)	2
	layers poorly distinguishible (<25% cover)	1
	no vegetation	0
Interspersion of Vegetation Cover and Open Water	26-75%scattered or peripheral	3
	>75% scattered or peripheral	2
	<25% scattered or peripheral	1
	100% cover or open water	1 (circled)
	no vegetation	0
Size	large (>100 acres)	3
	medium (10-100 acres)	2
	small (<10 acres)	1 (circled)
Wetland Juxtaposition	other wetlands within 400 m and connected above or below	3
	other wetlands within 400 m but not connected	1 (circled)
	wetland isolated	0
Slope Wetlands: Model Range: 4-33 Functional Capacity Index: Index Range: 0.12-1.0	All other HGM types: Total Score: 16/36 Model Range: 4-36 Functional Capacity Index: 0.44 Index Range: 0.11-1.0	

Attachment D

HAMPSHIRE COUNTRY CLUB

Mamaroneck, New York

WETLANDS CHARACTERIZATION ASSESSMENT

Prepared for:	New World Realty Advisors, LLC c/o Daniel Pfeffer 1500 Broadway, 25th Floor New York, NY 10036
Prepared by:	Nelson, Pope & Voorhis, LLC 572 Walt Whitman Road Melville, New York 11747
Date:	May 3, 2010
Revised:	*September 17, 2012*

1.0 INTRODUCTION AND REGULATORY FRAMEWORK

The above-referenced property was inspected by Sara N. da Silva on April 30 and May 2, 2010 for the purpose of delineating wetlands in accordance with the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (3 parameter approach). The subject property is occupied by an 18-hole golf course with a newly renovated clubhouse, outdoor dining patio, golf and swimming pool pavilion, tennis pavilion with two (2) tennis courts, and associated maintenance buildings (see aerial photograph in **Figure 1**). The property consists of fairways and greens for the golf course, seven (7) ponds, three (3) associated man-made stream systems, and two additional vegetated wetland areas. The golf course has been in operation since 1944.

Field observations of the property found that there is an extensive drainage system throughout the property that is comprised of a series of underdrain pipes that feed into the on-site ponds and associated man-made streams within the low-lying areas of the site. The boundaries of the ponds and man made streams on the property were determined to be at the well-defined edge of surface water, where the ponds and streams are either rock-lined or quickly transition from surface water to bank and then to maintained turf vegetation. Two vegetated wetland areas were identified; one in the northwest corner of the property and the second in the southwest corner of the property (see **Figure 4**).

In accordance with the Village of Mamaroneck and Town of Mamaroneck wetlands regulations (Chapters 192 and 114, respectively), field methods for delineating wetlands followed those methods that (a) meet the definition provided in Article 25-0103 of the New York State (NYS) Environmental Conservation Law (tidal wetlands), and (b) include all other areas 2,500 square feet or larger that can be defined as wetlands in accordance with the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (**1989**) (hereafter "Federal Manual"). The Federal Manual utilizes hydrology, hydric soils and hydrophytic vegetation as the three essential criteria which must be met for an area to be identified as a wetland. The Village and Town of Mamaroneck both reference the 1989 Federal Manual as the technical source for delineating jurisdictional wetlands. The Federal Manual provides technical criteria, field indicators, and recommended procedures to be followed in determining a jurisdictional wetland, as well as in determining the location of wetland boundaries. Data was recorded in the field on standard data collection sheets.

According to the Federal Manual, when more than 50 percent of the dominant species in a sampling area have an indicator status of obligate, facultative wetland, and/or facultative species, hydrophytic vegetation is present. If the vegetation fails to be dominated by these types of species, the area is usually not a wetland. However, field indicators for one or more of the three technical criteria for wetland identification are usually absent in disturbed areas. For instance, disturbed areas may not contain hydrophytic vegetation or hydrology under certain circumstances if the vegetation and/or hydrology have been significantly altered by human activities (i.e. filling, clearing, draining, mowing, other landscape maintenance, etc.). As per the Federal Manual, "if the [disturbance] activity occurred prior to the effective date of regulation or other jurisdiction, it may not be necessary to make a wetland determination for regulatory purposes" (page 50).

On the subject property, much of the low-lying areas exhibit wetland hydrology and hydric soils, but do not possess hydrophytic vegetation. These areas have been and continue to be maintained as fairways and greens with the assistance of an extensive underdrain system and turf maintenance typical of a golf course, and therefore are currently vegetated with associated upland grasses (e.g. Kentucky bluegrass). Review of historic aerial photographs going back to 1966 (*www.historicaerials.com*) reveal the site has been maintained as a golf course since prior to the effective date of State and Federal regulation in the 1970's. According to the Hampshire Country Club's website, the golf course was organized in 1944 and further supports the fact that the turf areas of the golf course have existed since prior to regulations.

To facilitate on-site gathering of data, preliminary information collected included the existing site survey (**PEAPC, undated**), the existing property boundary survey (**Richard A. Spinelli, L.S., 2010**), the Topographic Map of the Clubhouse area (**Gabriel E. Senor, P.C., March 13, 2012**), Federal Emergency Management Agency flood map data (**FEMA, 2009**), NYS Department of Environmental Conservation (NYSDEC) Freshwater and Tidal Wetlands Maps (**Westchester GIS, 2004**), National Wetlands Inventory Map (**Westchester GIS, 2009**) of the Mamaroneck quadrangle, soil survey data from the Westchester County Soil Survey (**Westchester GIS, 2006**), the Westchester hydric soils data (**Westchester GIS, 2006**), and spring 2007 and 2009 aerial photographs from the NYSGIS Orthophotoimagery Program.

As per FEMA, the property is located within a designated flood zone, Flood Zone AE (EL 12) (see **Figure 2**). Pursuant to NYS Building Code, this special flood hazard area requires that the bottom of the horizontal structural members (for multi-family structures) be located a minimum of 12 feet above mean sea level; or, for single family dwellings, a minimum freeboard of two feet be provided above the established base flood elevation (EL. 12 for the subject property). Any new structures situated within the Flood Zone would need to be appropriately designed for such conditions.

The New York State Department of Environmental Conservation (NYSDEC) Freshwater Wetlands Maps indicate that the ponds and associated streams currently on the property are not regulated by New York State. However, the National Wetlands Inventory indicates four (4) wetland areas on the site, including three ponds and one emergent marsh area (see **Figure 4**). Additionally, the Westchester Soil Survey information indicates the presence of hydric soils throughout low lying areas of the site (see **Figure 3**). Modifications to jurisdictional wetlands on the property and within 100 feet of the wetland boundary will require approvals by the Village of Mamaroneck, the Town of Mamaroneck, and the U.S. Army Corps of Engineers. Delancy Cove, located immediately off-site to the south of the subject property, is a regulated tidal wetland pursuant to Article 25 of the NYS Environmental Conservation Law (see **Figure 4**). Therefore pursuant to Article 25 of the NYS Environmental Conservation Law, the NYSDEC may regulate any new disturbance activities within 300 feet or up to the 10-foot elevation contour (whichever is farthest seaward) adjacent to the tidal wetlands. The Village of Mamaroneck and the Town of Mamaroneck both regulate activities within 100 feet of designated tidal wetlands.

2.0 EXISTING CONDITIONS ANALYSIS

The ponds and man made streams on the property appear to be ground and surface water fed features which function as part of the drainage system as well as water hazards for the golf course. No liners were observed along the edges of these features and it is evident that they are influenced by the underlying groundwater table. The ponds and man made streams/drainage ditches have well defined edges, and are largely rock lined. The water features on the property all appear to be interconnected via a network of underground pipes which serve to alleviate ponding conditions throughout low-lying areas of the property.

Based on field observations and information provided by the Hampshire Country Club's course superintendent, Tony Campanella, the golf course has three separate drainage systems that interconnect the man made system of streams and ponds, either through physical connections or via subsurface pipe conveyances. Two of these systems ultimately discharge to Delancy Cove, located immediately off-site to the south of the subject property. **Figure 5** illustrates the three drainage systems and connectivity of the various ponds and man made streams throughout the property, which is described in further detail below.

Drainage System 1: This system is comprised of Ponds #13 and #16 and associated subsurface and surface drainage connections. Pond #16 straddles the northwest property line between the golf course and the adjacent multi-family development. This pond is connected to Pond #13 via underground piping, which day-lights approximately mid-way between Pond #16 to the north side of Pond #13. A similar man-made stream/drainage ditch collects water from the north-central portion of the golf course and transitions to underground piping approximately mid-way to Pond #13, where it ultimately discharges. Pond #13 has a piped overflow under Hommocks Road and underneath the athletic field located on the west side of Hommocks Road to a subsurface vault. This vault then discharges to the tidal wetland located southwest of the vault.

Drainage System 2: This system consists of Ponds #5 and #6 in the northeastern portion of the course. In the early 1990's Pond #5 was modified and Pond #6 was created for storage of irrigation water. A well is located adjacent to these ponds that supplies the course's irrigation water. Stormwater from the immediately surrounding area is directed to these two ponds via overland flow. Additionally, it has been noted that at least one discharge pipe from the residences to the east of the ponds is directed to Pond #6.

Drainage System 3: This system consists of Ponds #10 and #11 and associated collection streams/ditches. Beginning in approximately the mid-points of both fairways #5 and #6, water is directed south toward a collection stream/drainage ditch located south of Pond #5. This stream continues south through the golf course, past Pond #18 and beneath Eagle Knolls Road. A stream/drainage ditch located on the west side of Eagle Knolls Road connects the system from the east side of the road and empties into Pond #10. It is noted that this stream/drainage ditch does not empty into Pond #18; rather it is directed to a subsurface pipe below Eagle Knolls Road. Pond #10 contains a tidal valve that controls the input and output of water between this pond and the adjacent tidal wetlands. Additionally, water from the area northeast of Pond #10 is directed to Pond #10, including a piped overflow from Pond #11.

Pond #18: Pond #18 is an isolated drainage system. The pond receives stormwater from inlets located within the Macadam Driveway and parking area adjacent to the pro shop, which is piped to a manhole for sediment removal prior to overflowing into the Upper Pond (southern portion of Pond #18). An emergency overflow pipe is located in the northeast corner of the Lower Pond (northern portion of Pond #18), which discharges into Drainage System 3 during significant rainfall events.

Further details regarding each pond are provided below.

Rock-lined stream

Review of historic aerials suggest that Pond #13 was a naturally occurring system that was modified and expanded between 1960 and 1976. Pond #13's connection to the athletic field on the west side of Hommocks Road is apparent as a pipe beneath Hommocks Road was visible at the western edge of this pond.

Pond #13

Fairway Green Townhouses pond (Pond #16).

The connection between Pond #13 and Pond #16 was evident also during field inspections. Underground piping and culverts from the Pond #16 were found to be contiguous with the stream which enters Pond #13. Pond #16 was reportedly built in 1982 for use by both the townhomes to the north and the golf course. This pond has notable silt and organic sediment build-up. An illicit discharge from a commercial use located to the north was previously detected and was contributing to the silt and organic inputs to the pond. This discharge has since been removed.

Ponds #5 and #6 were both artificially created, as historic aerials reveal that Pond #5 was constructed between 1960 and 1976 and Pond #6 was constructed between 1976 and 1994. As noted above, it is believed that Pond #5 was modified and Pond #6 was constructed in the early 1990s. These ponds are utilized for storage of irrigation water, and a pump is located in the vicinity of the ponds to provide water to the irrigation system. It is noted that a permit was issued by the Village in 2008 for the expansion of these ponds, but the work was never completed.

Pond #11 was reportedly created between 1997 and 1998 in an area that was identified as having poor drainage. As previously stated, this pond overflows to Pond #10 via subsurface piping.

The southern pond, identified on the survey as "Prickly Pear Inlet," or Pond #10 has a concrete control structure which separates it from the tidal wetlands of Delancey Cove immediately south of the property. The control structure contains two pipes which are set at different elevations so that one is partially submerged during low tides, while the other is raised higher though still within the range of tidal influence. On the landward side of this control structure, the lower pipe appeared to be closed, but the higher elevation pipe is currently in the open position. This pond is also a naturally occurring feature that has been modified over time.

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Pond #10 control structure

On the seaward side, this higher elevation pipe also appears to potentially be partially open and may allow some restricted connection of tidal flow. Though primarily freshwater, Prickly Pear Inlet does appear to have some evidence of saltwater influence based upon macroalgae characteristics observed in the lower portion of the inlet stream to the pond and trace evidence of what appeared to be former salt marsh vegetation (currently dead) along the inner fringe of the pond near the control structure.

Cove side of control structure

Pond #18 located to the northwest of the existing clubhouse (individually referred to as "Upper Pond" and "Lower Pond") are the water features in closest proximity to the clubhouse. Lower Pond was constructed in 1998 and is not lined. Upper Pond was added in 2005 with a waterfall feature that spills to Lower Pond and is also unlined. The maximum depth encountered in each pond is approximately 6 feet. Water levels within these ponds are periodically supplemented with additional water from on-site wells as the ponds appear to have no connection to the network of ponds and ditches on the site and therefore have no input of water from this system. No natural vegetation exists within or along the perimeter of these ponds as turf for the golf course is managed up to the edge of each pond. A soil boring (B-1) was installed east of the ponds, which indicated the depth to groundwater in the vicinity of these ponds is approximately 10 feet.

View of the waterfall structure on Pond 18

The ponds and streams were all found to contain fish. Frogs were observed in the northern most Fairway Green pond. A few pairs of ducks and two egrets were also observed utilizing the ponds, though to a much lesser degree than the numerous pairs of Canada Geese observed throughout the property. There was substantial evidence of heavy use by Canada geese on the turf leading up to the pond edges.

Plant identification was performed and wetland indicators assigned using the Region 1 USDA-NRCS plant list. No floating or submerged aquatic plants were observed in the ponds, although all contained some degree of unicellar algae typically associated with freshwater ponds. The southernmost stream flowing into Prickly Pear Inlet also contained macroalgae along its rocky bottom.

Adjacent to the west of Prickly Pear Inlet, an additional wetlands area was identified and field located with a hand-held Geographic Positioning System (GPS). This area is best characterized as an emergent marsh dominated by the invasive strain of common reed (*Phragmites australis*), a common wetland plant. The wetland area exhibited varying degrees of saturated soils and standing water, organic hydric soils and hydrophytic vegetation contiguous with the adjacent pond. Several specimens of bastard oak (*Quercus sinuata*), which is a southern tree characteristic of moist habitats, were also observed growing upon the drier hummocks within this marsh area.

Southern vegetated marsh

The vegetated wetland area in the northwestern corner of the site is also an emergent marsh dominated by *Phragmites australis* as well as jewelweed (*Impatiens capensis*), another hydrophytic species. This marsh also contained black willow (*Salix nigra*) and pussy willow (*Salix discolor*), both of which are characteristic of wetland conditions.

Northern vegetated marsh

The ponds appear to vary in depth and are capable of supporting fish populations. During the time of the site visit, all of the streams on the property were observed to contain standing or slowly flowing water that was a minimum of 2-3 inches deep or more. The last rain event occurred four days prior to the site visit, when nearly two inches of rain was reported to have fallen in the Mamaroneck area during the previous weekend (as per www.weather.com, accessed on 5/3/10).

Soil observations were performed around the perimeter of the ponds and in low-lying areas of the property using a hand held spade and soil auger. Observations revealed turf growing up to the edge of the ponds and streams, and hydric soil conditions occurring throughout these low-lying areas. Hydric organic soils (histosols) were evidenced by a variety of indicators, predominantly well-decomposed low-chroma organic soils immediately beneath the turf surface. In turf areas with these very poorly drained soils, groundwater was often observed within 6 to 12 inches of the surface, and saturated soils were often observed within 0 to 10 inches of the surface. Indicators of a fluctuating water table were also frequently observed as oxidized root channels within the upper 2 to 12 inches of the soil, and occasional patches of water stained leaves and lack of vegetation within the lowest lying areas of turf.

The boundaries of the ponds, streams/drainage ditches and two additional vegetated wetland areas on the property are illustrated in by **Figure 4.**

3.0 FINDINGS OF THIS ASSESSMENT

Review of available information as well as on-site observations have verified that the freshwater ponds currently on the property can be characterized as Town, Village and Federally-regulated wetlands, though they are not State-regulated wetlands. There are two areas of NYSDEC regulated tidal wetlands associated with Delancy Cove (located immediately off-site to the south of the subject property). Additionally, based on field observations and discussions with the golf course superintendent, Drainage System 1 and Drainage System 3 have physical connections to the tidal wetlands associated with Delancy Cove (see **Figure 5**).

Despite the presence of hydrology and hydric soils indicative of wetlands throughout low-lying areas of the property, these areas have been maintained as golf course and have been supporting turf vegetation for more than 60 years with the constant maintenance/mowing and turf management practices, as well as the installation and upkeep of the site’s underlying drainage system. This maintenance has precluded the establishment of any hydrophitic vegetation surrounding all of the ponds, with the exception of Pond #10. As a result, the on-site ponds (with the exception of Pond #10) would not meet the requirements of the Federal Manual 3-parameter approach for wetland delineation. Even though the ponds do not support hydrophitic vegetation, it is noted that the Village has historically asserted jurisdiction over these ponds pursuant to Chapter 192. It is noted that the Village and Town definition for freshwater wetlands (Chapter 192 and 114, respectively) includes wetlands identified on the NYSDEC regulatory maps and wetlands 2,500 SF or larger, even if they are not located on the NYSDEC regulatory maps. As a result, the drainage ditches located between the ponds would not be considered regulated under the Village and Town definition as each are less than 2,500 SF in size.

In accordance with the Village and Town Code, the regulatory adjacent area/buffer area surrounding a jurisdictional wetland (tidal or freshwater) or watercourse extends 100 feet horizontally away from its outermost boundary. A wetland/watercourse permit is therefore required to conduct regulated activities, including subdivision of land, within these buffer areas. The U.S. Army Corps of Engineers only regulates activities conducted within the boundaries of the jurisdictional wetlands and waterways. The NYSDEC would regulate any new disturbance activities within 300 feet or up to the 10-foot elevation contour (whichever is farthest seaward) adjacent to the Delancy Cove tidal wetlands (located immediately off-site to the south of the subject property) (see **Figure 4**). Note that NYSDEC tidal wetlands jurisdiction would not extend landward of Eagle Knolls Road or Hommocks Road as it is an existing substantial roadway existing since prior to 1977.

Future development may be permitted within the regulated wetland adjacent areas, particularly within those areas currently maintained turf/golf course. Neither the Town nor the Village wetland regulations specify a required setback for structures, sanitary systems or other proposed improvements; just that a permit is required for disturbance within 100 feet of the regulated wetland boundary (tidal and freshwater wetlands). Therefore, development setbacks will be subject to negotiations with the Village and the Town during the permit process and will likely depend on the type of use and other environmental benefits that may be proposed in association with the project (i.e., mitigation measures such as adjacent area vegetated buffers, wetland creation, stormwater management, etc.).

Pursuant to Article 25 of the NYSECL, NYSDEC standards for development within the regulated tidal wetlands adjacent area [i.e., 300 feet landward of the tidal wetlands boundary <u>or</u> to the 10 foot contour (whichever is more seaward) and not extending beyond the seaward edge of pavement associated with Eagle Knolls Road and Hommocks Road] include the following:

- 75 foot setback from the wetland boundary for principle buildings;
- Not more than 20 percent impervious coverage within the regulated wetland adjacent area;
- 20,000 SF minimum lot area for principle buildings served by public/community sewage disposal systems (however, clustering of principle buildings for multiple family dwellings is permitted).

The high groundwater table and organic soils throughout the low-lying areas of the property in conjunction with rock outcrops and underlying bedrock throughout the remainder of the site present significant constraints to development. These conditions require thoughtful planning and engineering of an extensive drainage system (meeting NYS stormwater management requirements) for any proposed development on the property. Allowances for the jurisdictional wetland areas and adjacent buffers, as well as planning for stormwater management practices, should be considered in the development of a yield map for the property, as well as for future development planning.

FIGURES

FIGURE 1
AERIAL PHOTOGRAPH

Source: NYSGIS Orthophotoimagery Program, 2007;
NPV GIS Library;
Scale: 1 inch = 500 feet

Hampshire Country Club, Mamaronek

Wetland Feasibility Assessment

FIGURE 2
FEMA FLOOD MAP

Source: NYSGIS Orthophotoimagery Program, 2007;
NPV GIS Library;
Scale: 1 inch = 500 feet

Hampshire Country Club,
Mamaronek

Wetland Feasibility Assessment

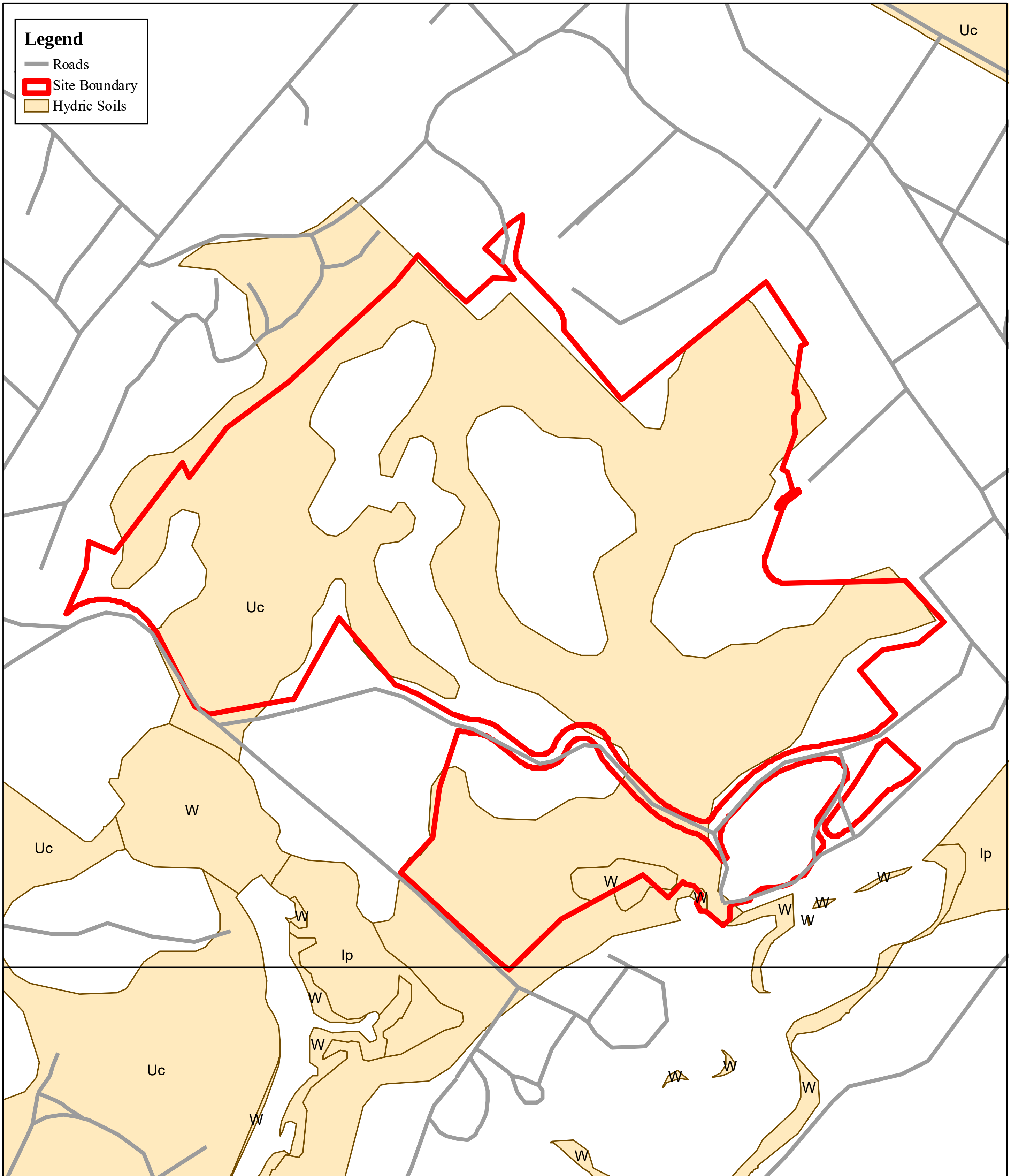

FIGURE 3
HYDRIC SOIL MAP

Source: NYSGIS Orthophotoimagery Program, 2007;
SSURGO, 2006;
Scale: 1 inch = 500 feet

Hampshire Country Club, Mamaronek

Wetland Feasibility Assessment

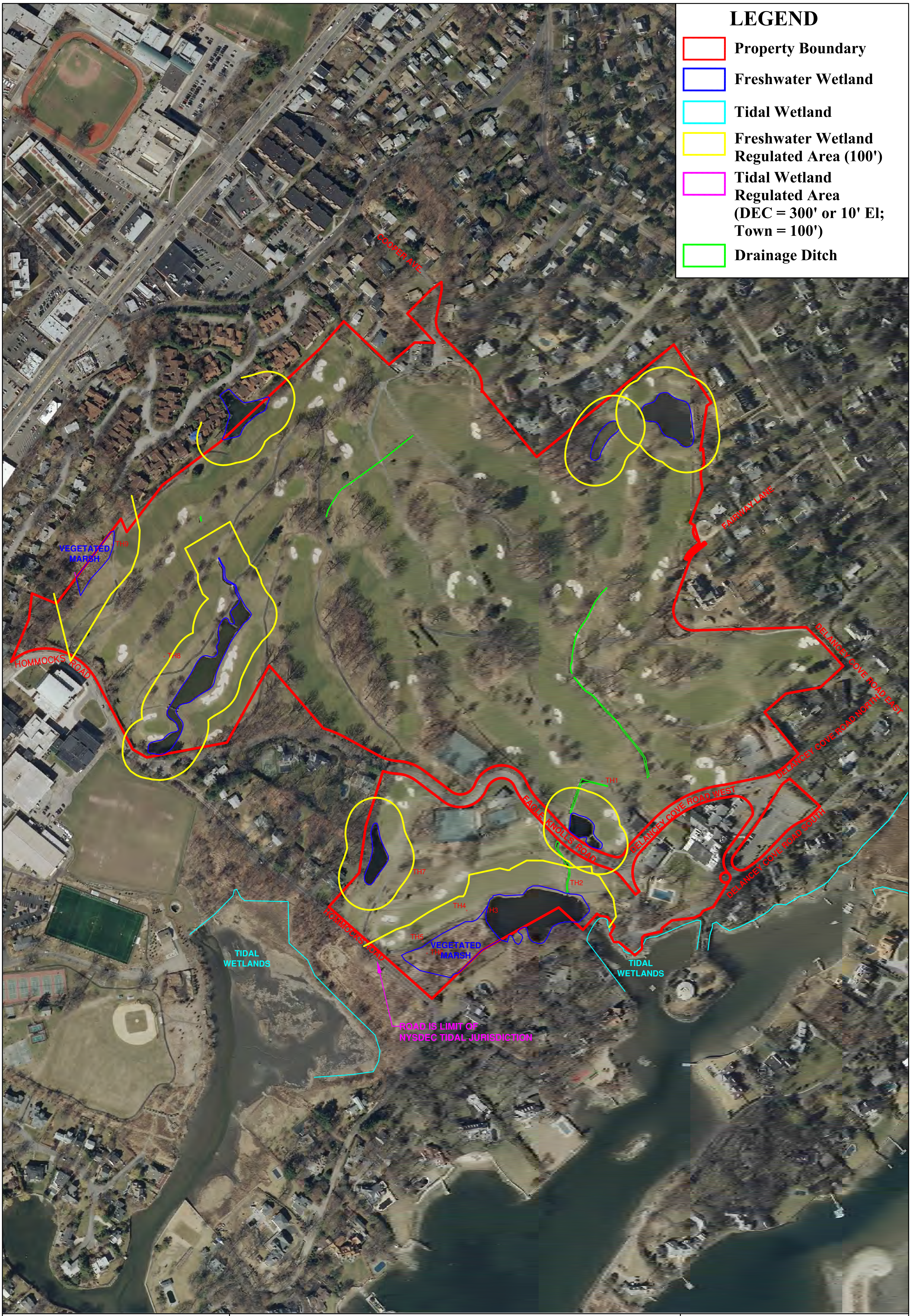

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FIGURE 4
REGULATED WETLAND AREAS

Source: NYSGIS Orthophotoimagery Program, 2009
Scale: 1" = 350'

NORTH

Hampshire Country Club, Mamaroneck

Wetland Feasibility Assessment

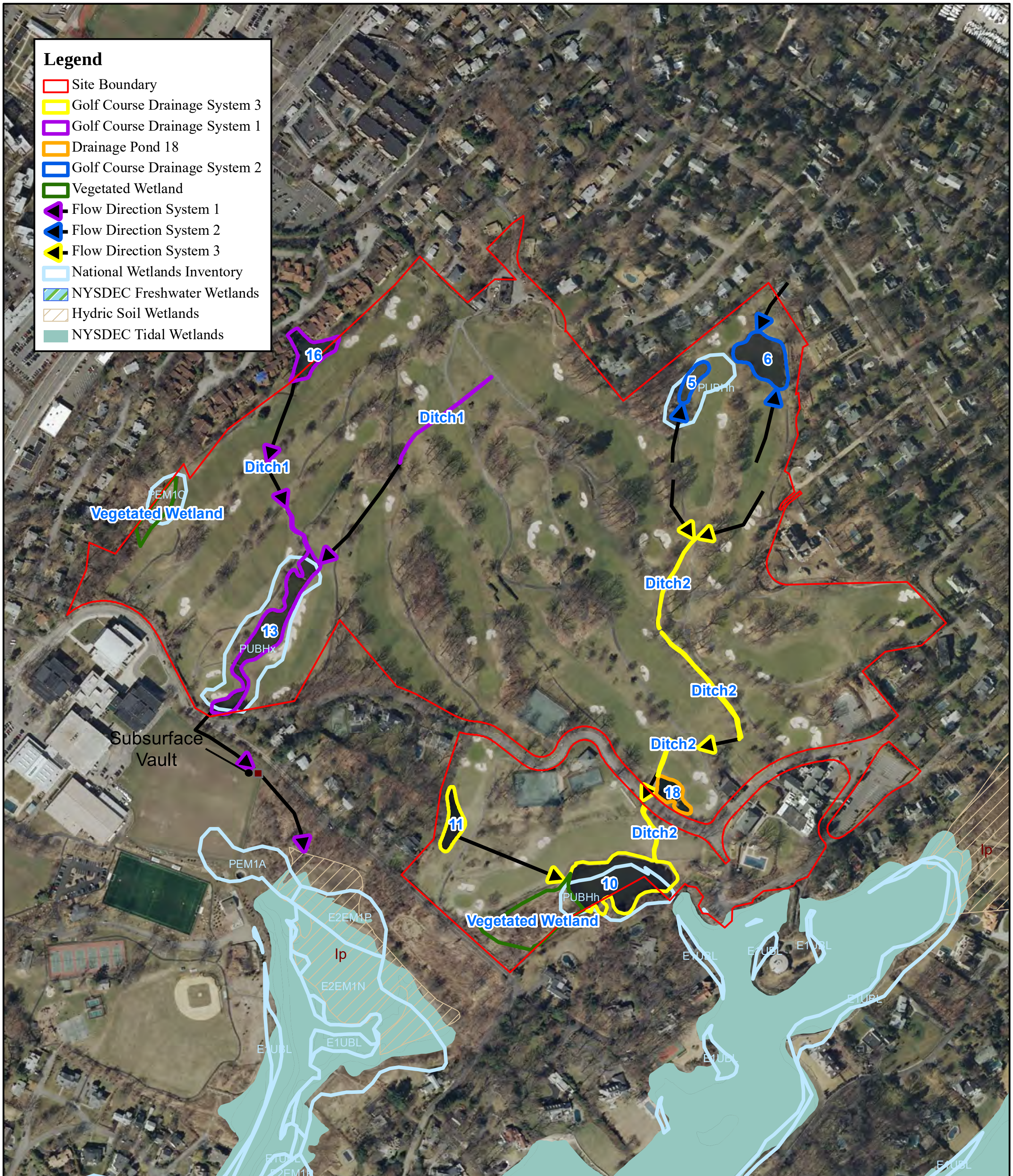

FIGURE 5
GOLF COURSE DRAINAGE

Source: NYSGIS Orthophotoimagery Program, 2009; NPV GIS Library;
Scale: 1 inch = 500 feet

N

Hampshire Country Club, Mamaronek

Wetland Feasibility Assessment

Attachment E

David Kennedy

Project Scientist

Education

MS, Geosciences, University of Arizona, 2005

BS, Environmental Science, Paul Smith's College, 2003

Training

NYSDEC iMap Invasive Species Training, 2016

Quality Parks Long Island Master Naturalist Program Graduate, 2015

New York State Wetland Forum Phase I Bog Turtle Habitat Assessment Training Course, 2015

Massachusetts Audubon Society Wetland Construction and Restoration Workshop, 2013

Winter Vegetation Identification for Wetland Delineation, Rutgers University, 2012

Summer Vegetation Identification for Wetland Delineation, Rutgers University, 2011

United States Army Corp of Engineers 38 Hour Wetland Delineation Training Program, 2010

Rutgers University Wetland Delineation Training Program, 2007

The Nyanza Project Tropical Lakes Research Program Graduate, Tanzania, East Africa, 2003-2004

OSHA Hazardous Waste Operations and Emergency Response Training, 2006-2014

David is an environmental and wetland scientist who conducts ecological surveys, habitat assessments, species inventories and rare/protected species evaluations. He also performs freshwater and tidal wetland delineations and provides wetland permitting services for clients with federal, state and local government agencies. David also conducts Phase I and Phase II Environmental Site Assessments, oversees environmental remediation projects and designs and oversees soil management plans.

11 years of professional experience

Silo Ridge Resort Community, Ecological and Wetland Services, Amenia, NY

David performed various tasks in association with the construction of the Silo Ridge Resort Community at a 670-acre property located in Dutchess County, NY and comprised of an existing golf course and extensive mountainous, forested, wetland and old field habitats. As part of the State Environmental Quality Review Act (SEQRA) and Town of Amenia review process, David prepared evaluations of the potential project impacts on existing ecological resources, including endangered and threatened species such as northern long-eared bat (*Myotis septentrionalis*), Indiana bat (*Myotis sodalis*) and bog turtle (*Glyptemys muhlenbergii*). As part of this effort, David initiated consultations with the United States Fish and Wildlife Service (USFWS) and prepared a federally-listed species assessment and avoidance/minimization/mitigation plan that was subsequently approved by the USFWS. The plan included preservation of extensive existing habitat, seasonal clearing restrictions, site lighting requirements and a pesticide management plan, as well as the creation of new species habitat and improvements to existing habitat. David further obtained United States Army Corps of Engineers (USACE) and New York State Department of Environmental Conservation (NYSDEC) wetlands permits in for the alteration of existing wetlands and creation of new wetlands, as well as impacts and mitigation measures associated with the construction of a site wastewater treatment plant. David also conducted a comprehensive ecological survey of a 188-acre adjoining parcel being considered for future expansion of the facility. The survey included vegetation and wildlife inventories, habitat identification and assessment, and rare/protected species evaluations. In association with this effort, David conducted vernal pool amphibian surveys and a breeding bird survey at the property. David further delineated multiple acres of wetland habitats at the property, pursuant to USACE and NYSDEC protocols.

Dredging, Bulkhead Replacement and Revetment Construction Project, Tidal Wetland Delineation and Permitting, East Marion, NY

David performed a tidal wetland delineation and ecological survey at an 18-acre former oyster processing facility for a proposed dredging, bulkhead replacement and revetment construction project located on Gardiners Bay in the Town of Southold, NY. David also obtained a Tidal Wetlands Permit from the New York State Department of Environmental Conservation (NYSDEC) and a United States Army Corps of Engineers (USACE) Individual Permit for the project. As part of the federal wetland permitting process, David also prepared and Essential Fish Habitat assessment for the National Oceanographic and Atmospheric Administration (NOAA) and endangered species assessment for the United States Fish and Wildlife Service (USFWS). In association with the NYSDEC and USACE permitting processes, David designed a wetland mitigation/ smooth cordgrass *(Spartina alterniflora*) planting plan that was approved by both agencies. The plan includes provisions for monitoring and ongoing maintenance of the planted wetland area. Additionally, David prepared a consistency analysis with New York State Department of State (NYSDOS) Coastal Policies, and subsequently received a Coastal Concurrence letter from the NYSDOS. David also prepared a consistency analysis Town of Southold Local Waterfront Revitalization Program (LWRP) Coastal Policies.

Enterprise Park at Calverton (EPCAL), DSGEIS Ecological Assessment and Comprehensive Habitat Protection Plan, Town of Riverhead, NY

David performed an ecological assessment in association with the Draft Supplemental Environmental Impact Statement (DSGEIS) for the proposed development of the 2,323.9-acre Enterprise Park at Calverton (EPCAL) property, which consists of portions of land formerly owned by the United States Department of the Navy (U.S. Navy) and known as the Naval Weapons Industrial Reserve Plant (NWIRP). The site supports extensive wooded wetland and surface water communities, and also includes the largest remaining native grassland habitat on Long Island. The site provides habitat for a number of rare wildlife and plant species, including several NYS-Endangered, -Threatened and Special Concern species. The DSGEIS ecological assessment included habitat characterization, species inventories and rare species assessments. David also performed an evaluation of potential impacts of the proposed action to on-site ecological resources for the DSGEIS and further prepared a comprehensive habitat protection plan (CHPP) for the site for approval by the New York State Department of Environmental Conservation (NYSDEC). The CHHP includes measures to protect and preserve existing habitats for resident wildlife and plant species, including the NYS-Endangered short-eared owl (*Asio flammeus*) and eastern tiger salamander (*Ambystoma tigrinum*) as well as the NYS-Threatened northern harrier (*Circus cyaneus*). The CHPP further provides for the preservation, creation, maintenance and enhancement of 596.4 acres of native grassland habitat as a wildlife preserve for grassland birds and other species.

enXco Solar Generating Facilities, Freshwater Wetlands and Wild, Scenic and Recreational Rivers Permitting, Various Locations, Long Island, NY

David coordinated with the New York State Department of Environmental Conservation (NYSDEC) and obtained NYSDEC Freshwater Wetlands Permits for the construction of solar generating facilities at government-owned properties in the Towns of Islip, Smithtown, and Riverhead, New York. David also obtained NYSDEC Wild, Scenic and Recreational Rivers (WSRR) Permits for the latter two facility locations. The permitting effort also include the approval of mitigation planting plans designed by David.

Proposed Natural Gas Facility, Freshwater Wetland Delineation, Towns of Monroe and Montgomery, NY

David performed a freshwater wetland delineation at a currently undeveloped, 107-acre property that is proposed for development with a natural gas facility. The property supports extensive palustrine, scrub/shrub, emergent, lacustrine and riverine wetland habitats. The delineation was performed over the course of three weeks, according to United States Army Corps of Engineers USACE) and New York State Department of Environmental Conservation (NYSDEC)-required protocols. Prior to the wetland delineation, David coordinated a pre-application meeting with NYSDEC biologists at the property, in order to determine those portions of the site wetlands that are under NYSDEC jurisdiction and to discuss potential project mitigation measures.

Rosehill Residential Development Project, Breeding Bird Survey, New Castle, NY

As part of an existing ecological conditions analysis for a proposed redevelopment plan, David performed a breeding bird survey on this 96-acre wooded property featuring ridgeline, wooded, old field, riverine, wetland and lacustrine habitats. The breeding bird survey was conducted according to Audubon, NY protocols and in accordance with Town of New Castle requirements. A total of 57 avian species were identified by David at various survey point locations during three separate surveys of the property during the spring migration/breeding season.

NSTAR Right-of-Way, Freshwater Wetland Delineations, Eastern MA

David was a contributing scientist in a delineation of freshwater wetlands along an approximately five-mile section of this utility company right-of-way, for which additional power transmission lines are proposed.

Landmark Colony, Ecological and Wetland Services, Staten Island, NY

David conducted an ecological survey for the preparation of an EAS and supplemental environmental studies for a new senior-age residential community in the Willowbrook area of Staten Island. The project site, which supports both woodland and developed habitats, is a 46-acre parcel owned by the City of New York and located within the New York City (NYC) Farm Colony-Sea View Hospital Historic District. The ecological survey included a habitat assessment, observed/expected vegetation and wildlife species inventories and an evaluation for the presence of rare/protected species and ecological communities. Existing conditions, potential impacts of the proposed project and mitigation measures were also addressed. As part of the NYC Environmental Quality Review (CEQR) of the project, David addressed comments from the NYC Department of Environmental Protection (DEP) and the NYC Department of Parks and Recreation. In addition, David performed a wetland delineation and secured a non-jurisdictional determination from the United States Army Corps of Engineers (USACE) for the project. David further conducted a Phase II Environmental Site Assessment, in order to evaluate the impacts of past site usage on soils and groundwater. The Phase II ESA included a geophysical survey, as well as soil, soil vapor and groundwater sampling and impact assessment.

NYSDOT Accelerated Bridge Program, Freshwater Wetland Permitting, Albany, NY

As part of a $31.3 million Accelerated Bridge Program to rehabilitate bridges in the Capital District and northern New York State, the New York State Department of Transportation designated 13 bridges as below par due to deteriorating bridge decks. Listed on the deficient bridge list, the structures range from 30-foot-long, two-lane bridges in rural environments to a 2,000-foot-long, four-lane bridge in an urban environment. David conducted wetland assessments and delineations, as well as USACE and NYSDEC wetland permitting associated with this bridge rehabilitation project.

St. Vincent's Hospital Property, Freshwater Wetland Delineation, Town of Harrison, NY

David performed a freshwater wetland delineation at this 79-acre hospital campus property, the majority of which is comprised of undeveloped woodlands. The woodland areas support extensive palustrine, riverine and emergent wetland habitats. The delineation was performed according to United States Army Corps of Engineers USACE) and New York State Department of Environmental Conservation (NYSDEC) wetland delineation protocols.

Heritage at Cutchogue, Existing Conditions, Impact Assessment and Mitigation Plan, Cutchogue, NY

David conducted a comprehensive ecological survey of this undeveloped 46 acre property, which supports woodland, shrubland, and old field habitats. The survey included a habitat assessment, vegetation and wildlife species inventories and an evaluation for the presence of rare species and ecological communities. David further prepared an Ecology Resources section for the Draft Environmental Impact Statement (DEIS) for a proposed condominium development. Existing conditions, potential impacts and mitigation measures were addressed.

Sunshine Children's Home and Rehabilitation Center, Wetland Functional Assessment and Mitigation Plan, Ossining, NY

David conducted a wetland functional assessment for three freshwater wetland habitats at this 33 acre, predominantly wooded property, which is the site of a rehabilitation center for sick children. The functional assessment was performed according to the Magee-Hollands method, which examines the functional capacity for each of eight principal wetland functions, based primarily upon field observations and measurements of hydrological, geological and biological characteristics of the wetland, the surrounding watershed and local land uses. David further provided technical assistance and wrote a summary report for a wetland mitigation plan for a proposed facility expansion. The functional assessment and mitigation plan were subsequently approved by the Town of New Castle.

Port Authority of New York and New Jersey Airport Capacity Study, Existing Ecological Conditions Assessment

David performed a comprehensive assessment of existing natural resources at the five Port Authority of New York and New Jersey airport properties (John F. Kennedy, LaGuardia, Newark, Stewart and Teterboro airports. The assessment included a summary of observed and expected flora and fauna, rare/protected species and wetland resources at the five airport properties.

Olivet Redevelopment Project, Freshwater Wetland Delineation and Permitting, Wingdale, NY

In association with a proposed residential development at a currently vacant municipal property, David delineated approximately 15 acres of freshwater wetlands, including palustrine, scrub/shrub, emergent, lacustrine and riverine wetland habitats. The delineation was performed over the course of a week, according to United States Army Corps of Engineers (USACE) and New York State Department of Environmental Conservation (NYSDEC)-required protocols.

Residences at Corporate Park, Existing Ecological Conditions and Impact Assessment and Freshwater Wetland Permitting, Town of Harrison, NY

In association with a proposed residential development at this 10.35 acre property, David conducted an ecological survey of observed and expected flora and fauna, as well as rare/protected species. David summarized the results of the ecological survey and provided an impact assessment and mitigation analysis of the proposed action in a Draft Environmental Impact Statement (DEIS). Mr. Kennedy further performed a wetland functional assessment and obtained a wetland permit for the project from the Town of Harrison.

Northwoods Property Existing Ecological Conditions Assessment, Manorville, NY

David performed an ecological assessment on this 662-acre wooded property located within the Long Island Central Pine Barrens. The ecological assessment included observed and expected plant and wildlife species inventories, as well as habitat characterization and evaluation. David additionally conducted a rare/protected species survey for several New York State-listed plant and wildlife species known to occur in the vicinity of the property, based upon New York State Natural Heritage Program (NYNHP) records. During field surveys, several of these species were identified on-site. David prepared a report and graphics which details the species locations and the existing habitat conditions. The report further identifies potential threats and mitigation efforts for the identified species.

Proposed Wireless Communications Facility, USFWS Coordination, South Farmingdale, NY

David prepared and submitted a protected species habitat evaluation to the United States Fish and wildlife Service for a proposed wireless communications facility at municipal water district property comprised of developed and undeveloped habitats. The evaluation included an assessment of potential northern long-eared bat (*Myotis septentrionalis*) habitat at the site and a request for concurrence with a proposed no effect determination for this mammal species. The USFWS subsequently issued a concurrence letter indicating that the project could proceed as planned with no further agency consultation or coordination.

Building Renovation Project, Wetland Delineation, Permitting and Mitigation Plan, Brooklyn, NY

In association with the New York State Department of Environmental Conservation (NYSDEC) Tidal Wetlands permitting process for this building renovation project, David delineated wetlands and obtained an NYSDEC Tidal Wetlands Permit. As part of the permitting process, David designed an upland native planting plan for the NYSDEC-regulated adjacent area of English Kills/Newtown Creek. The planting plan, which was approved and permitted by the NYSDEC, includes an appropriate native trees, shrubs and herbaceous plants that were noted by David within the general surrounding area of the project site.

Westchester County Airport Master Plan, Existing Ecological Conditions, Impact and Mitigation Assessment, Westchester County, NY

David performed a review of existing biological and wetland resources at Westchester County Airport, as part of the Westchester County Airport Master Plan. The review included research of government agency records and prior ecological assessments of the site. David further identified and characterized various terrestrial, palustrine and aquatic ecological communities and wildlife species during a field survey of the airport property.

Seaford Union Free School District, Tidal Wetland Permitting/Mitigation and Ecological Survey, Seaford, NY

David obtained tidal wetland permits from the New York State Department of Environmental Conservation (NYSDEC) and the United States Army Corps of Engineers (USACE) for the construction of an access driveway on an undeveloped parcel adjacent to the Seaford Harbor School. As part of this effort, David prepared a wetland mitigation and planting plan a mitigation for filling within portions of a tidal wetland habitat at the property. The mitigation plan, which was approved by the USACE and NYSDEC, included creation and planting of new tidal wetland habitat. David also conducted an ecological survey and prepared an ecology resources report for the subject property. The survey included an assessment of existing wooded and wetland habitats, vegetation and wildlife species inventories and an evaluation for the presence of rare species and ecological communities. Potential impacts of the proposed action and wetland mitigation measures were also addressed.

LaGuardia Airport Runway Area Safety Enhancements, Ecological Assessment and Impact Analysis, Queens, NY

David served as a project scientist for preparation of an Environmental Assessment for the construction of runway safety area improvements at LaGuardia Airport in accordance with NEPA and SEQRA requirements. The Environmental Assessment addressed the airport's unique environmental conditions along the Flushing Bay and Bowery Bay waterfronts in Queens. David performed an assessment of existing terrestrial ecological resources, including an inventory of observed and expected flora and fauna and an assessment of rare species and habitats, as well as an impact analysis on these natural resources.

Verizon Wireless Communications Site, Tidal Wetland Permitting and Phase I ESA, Captree Island, NY

David performed a wetland delineation and obtained a tidal wetland permit from the New York State Department of Environmental Conservation for the construction of a wireless communications facility located within and adjacent to regulated tidal wetlands. The permit included the approval of a wetland mitigation/planting plan designed by David. David further secured permit amendments from the New York State Department of Environmental Conservation in response to project design changes by the site engineer. Additionally, David completed a Phase I ESA of the site.

Proposed Solar Energy Generation Facility, Ecological Survey and Wetland Permitting, Calverton, NY

David conducted an ecological survey of this 45-acre site, which supports agricultural, woodland and wetland/aquatic habitats. The ecological survey included a habitat assessment, observed/expected vegetation and wildlife species inventories and an evaluation for the presence of rare/protected species and ecological communities. David further performed a wetland delineation at the site and secured a Determination of Non-Jurisdiction from the New York State Department of Environmental Conservation for a proposed solar power generating facility at the site. Additionally, David conducted a Phase I Environmental Site Assessment of the property, which included an evaluation of recognized environmental conditions and recommendations for further evaluation and remedial action.

City of White Plains, Existing Ecological Conditions and Impact Assessment and Open Space Study DGEIS, Westchester County, NY

As part of Draft Generic Environmental Impact Statement (DGEIS) to evaluate the potential impacts of the adoption of a new open space zoning classification within the City of White Plains, David performed an analysis of existing natural resources at five golf course properties. The analysis included field assessments and research of local, state and federal government agency records pertaining to wildlife, vegetation, protected species/habitats, wetlands and water resources at the five properties. David further performed an impact assessment of the proposed action and alternatives on the aforementioned resources.

Commercial Development Project, Wetland Mitigation, Riverhead, NY

As mitigation for the filling of an isolated freshwater wetland habitat, David designed a freshwater wetland restoration and planting plan in association with a proposed commercial development at an undeveloped property in Riverhead, NY. The plan, which was reviewed and approved by the Town of Riverhead, NY, included restoration of the original site hydrology, planting of native wetland trees, shrubs and herbaceous plants and provisions for monitoring and ongoing maintenance of the wetland habitat.

Arthur Kill Correctional Facility Redevelopment EAS, Existing Ecological Conditions, Impact and Mitigation Analysis, Staten Island, NY

David conducted an ecological survey for the preparation of an EAS and supplemental environmental studies for the redevelopment of this former prison facility. The 69-acre project site, which supports forested, early successional, tidal wetland, freshwater wetland and developed habitats. The ecological survey included a terrestrial and wetland habitat assessment, observed/expected vegetation and wildlife species inventories and an evaluation for the presence of rare/protected species and ecological communities. Existing conditions, potential impacts, and mitigation measures were also addressed.

Cold Spring Harbor Laboratory Waterfront Project, Tidal Wetland Delineation Mitigation and Permitting, Cold Spring Harbor, NY

David conducted a tidal wetland assessment for the proposed redevelopment of a waterfront property on the campus of Cold Spring Harbor Laboratory in the Village of Laurel Hollow, NY. David further delineated on-site wetlands, designed a wetland mitigation planting plan and obtained a tidal wetland permit from the New York State Department of Environmental Conservation (NYSDEC) for the project.

Country Pointe Development, Existing Conditions, Impact Assessment and Mitigation Plan, Plainview, NY

David conducted a comprehensive ecological survey of this 143 acre property, which supports woodland, meadow, landscaped and developed habitats. The survey included a habitat assessment, vegetation and wildlife species inventories and an evaluation for the presence of rare species and ecological communities. David further prepared an Ecology Resources section for the Draft Environmental Impact Statement (DEIS) for this proposed residential development. Existing conditions, potential impacts and mitigation measures were addressed. David additionally addressed public and government agency comments in Final Environmental Impact Statement (FEIS) for the proposed project. As a result of a challenge to the findings of the FEIS filed in New York State

Supreme Court, David prepared a 30 page affidavit defending the methods and findings of the ecological survey. The challenge was subsequently dismissed by the court in December 2015.

Proposed Solar Energy Generation Facility, Ecological Survey and Wetland Delineation/Permitting, Calverton, NY

David conducted an ecological survey of this 45-acre site, which supports agricultural, woodland and wetland/aquatic habitats. The ecological survey included a habitat assessment, observed/expected vegetation and wildlife species inventories and an evaluation for the presence of rare/protected species and ecological communities. David further performed a wetland delineation at the site and secured a Determination of Non-Jurisdiction from the New York State Department of Environmental Conservation for a proposed solar power generating facility at the site. Additionally, David conducted a Phase I Environmental Site Assessment of the property, which included an evaluation of recognized environmental conditions and recommendations for further evaluation and remedial action.

Woodbury Crossing Commercial Development, Ecological Survey and USFWS Coordination, Plainview, NY

David prepared and submitted a protected species habitat evaluation to the United States Fish and wildlife Service for a proposed commercial development at a property consisting of an existing commercial use and undeveloped, wooded habitats. The evaluation included an assessment of potential northern long-eared bat (*Myotis septentrionalis*) habitat at the site and a request for concurrence with a proposed no effect determination for this mammal species. The USFWS subsequently issued a concurrence letter indicating that the project could proceed as planned with no further agency consultation or coordination. David further performed and ecological survey and impact assessment of the proposed project.

Town of Islip Landfill Site Investigation, Freshwater Wetland Delineation/Permitting and Ecological Survey, Bay Shore, NY

David performed a comprehensive Phase II Environmental Site Assessment of this 24 acre inactive municipal landfill, incinerator and sewage treatment facility, which is proposed for commercial redevelopment. The investigation included soil vapor monitoring, surficial soil sampling, test pit excavation and groundwater monitoring well installation. David also conducted a freshwater wetland delineation and assisted with securing a New York State Department of Environmental Conservation freshwater wetlands permit for the Phase II investigation. He designed and oversaw the site restoration and mitigation plan following completion of the investigation. David further conducted an ecological survey of the site which included a habitat assessment, vegetation and wildlife species inventories and an evaluation for the presence of rare species and ecological communities.

Proposed Commercial Development, Rare/Protected Species Survey and USFWS Concurrence Request, Smithtown, NY

David performed an evaluation for the potential presence of federal and NYS protected species and communities at a 20-acre property that currently supports undeveloped woodlands and commercial/industrial operations. The assessment included a field survey for the NYS-Endangered plant slender crabgrass (*Digitaria filiformis*), which was identified in New York Natural Heritage Program (NYNHP) records for the site and vicinity. David further conducted a northern long-eared bat (*Myotis septentrionalis*) habitat evaluation and prepared a project review and no-effects concurrence request for United States Fish and Wildlife Service (USFWS) review.

Ronkonkoma Hub Transit-Oriented Development, Existing Ecological Conditions, Impact and Mitigation Assessment, Ronkonkoma, NY
David conducted an ecological survey of this 54 acre property. The survey included an assessment of both developed and undeveloped habitats, vegetation and wildlife species inventories and an evaluation for the presence of rare species and ecological communities. David further prepared an Ecology Resources section for the Draft Generic Environmental Impact Statement for this proposed mixed use development. Existing conditions, potential impacts and mitigation measures were addressed.

Arboretum DEIS, Ecological Survey and Impact Assessment, Farmingville, NY
David conducted an ecological survey for the preparation of a Draft Environmental Impact Statement (DEIS) on this 65-acre property. The project site, which currently supports old field, shrubland, woodland, agricultural and developed habitats, is proposed for construction of a mixed-use development. The ecological survey included a habitat assessment, observed/expected vegetation and wildlife species inventories and an evaluation for the presence of rare/protected species and ecological communities. Existing conditions, potential impacts, and mitigation measures were also addressed.

East Hampton Airport Construction Project, Existing Ecological Conditions and Impact Assessment, Town of East Hampton, Suffolk County, New York
As part of an environmental assessment for a proposed seasonal air traffic control tower construction project, David performed field surveys and researched government agency records pertaining to flora, fauna, endangered/threatened species, wetlands, water resources, coastal resources, floodplains and farmlands. David further prepared an assessment of existing conditions and expected impacts of the proposed action on the aforementioned resources.

Costco Environmental Site Assessments, Wetland and Ecological Services, Town of Islip Landfill Site Investigation, Bay Shore, NY
David performed a comprehensive Phase II Environmental Site Assessment of this 24 acre inactive municipal landfill, incinerator and sewage treatment facility, which is proposed for commercial redevelopment. The investigation included soil vapor monitoring, surficial soil sampling, test pit excavation and groundwater monitoring well installation. David also conducted a freshwater wetland delineation and assisted with securing a New York State Department of Environmental Conservation freshwater wetlands permit for the Phase II investigation. He designed and oversaw the site restoration and mitigation plan following completion of the investigation. David further conducted an ecological survey of the site which included a habitat assessment, vegetation and wildlife species inventories and an evaluation for the presence of rare species and ecological communities.

Avalon at Huntington Station, Existing Ecological Conditions, Impacts and Mitigation Assessment, Huntington, NY
David conducted an ecological survey of this 27 acre undeveloped property, which is proposed for a residential subdivision. The survey included a habitat assessment, vegetation and wildlife species inventories and an evaluation for the presence of rare species and ecological communities. David further prepared an Ecology Resources

section for the Draft Environmental Impact Statement for the proposed action. Existing conditions, potential impacts and mitigation measures were addressed.

Brookhaven Town Drainage Project, Freshwater and Tidal Wetland Permitting, Stony Brook, NY
David secured tidal and freshwater permits from the New York State Department of Environmental Conservation and the United States Army Corps of Engineers for the Town of Brookhaven for this highway drainage improvement project.

Brookhaven Village Square, Existing Ecological Conditions, Impact and Mitigation Assessment, Blumenfeld Development Group, Bellport, NY
David conducted an ecological survey of this 58 acre wooded property. The survey included a habitat assessment, vegetation and wildlife species inventories and an evaluation for the presence of rare species and ecological communities. David further prepared an Ecology Resources section for the Expanded Environmental Assessment Form for this proposed commercial/industrial development. Existing conditions, potential impacts and mitigation measures were addressed.

Center Square Development (Zoumas Property) Existing Ecological Conditions, and Impact Assessment, Wading River, NY
David conducted an endangered/threatened species survey of this 18 acre fallow agricultural property, which is proposed for a mixed use commercial development and open space preservation. The survey included a habitat assessment, vegetation and wildlife species inventories and an evaluation for the presence of rare species and ecological communities. David prepared a summary report which included conclusions and recommendations regarding the potential impacts of the proposed action.

Avalon at Great Neck Residential Development, Phase 1 and Phase 2 Environmental Site Assessments, Tidal Wetland Permitting, Great Neck, NY
David conducted Phase I and Phase II Environmental Site Assessments in order to assess impacts to soil and groundwater due to historic site usage at this marine terminal and major oil storage facility, which is proposed for residential redevelopment. The investigation included surficial and sub-surface soil sampling, groundwater monitoring well installation and sampling and an analysis of tidal influence on water table elevation beneath the site. David also conducted a wetland investigation and prepared a New York State Department of Environmental Conservation tidal wetland permit application package for the proposed residential redevelopment. David further provided technical support in the design of a wetland mitigation and restoration plan for the site

Proposed Wireless Communications Facility, Tidal Wetland Delineation and Permitting, West Gilgo Beach, NY
David performed tidal wetland delineations and permitting at two proposed locations for this public utility wireless communications facility.

Islip Pines Development, Existing Ecological Conditions, Impact and Mitigation Assessment, Holbrook, NY
David conducted an ecological survey of this 135 acre wooded property. The survey included a habitat assessment, vegetation and wildlife species inventories and an evaluation for the presence of rare species and ecological communities. David further prepared an Ecology Resources section for the Draft Environmental Impact Statement

for this proposed residential development. Existing conditions, potential impacts and mitigation measures were addressed.

LA Fitness, Freshwater Wetland Permitting Patchogue, NY
David performed wetland delineation and secured New York State Department of Environmental Conservation and Town of Brookhaven freshwater wetlands permits for the construction of a health club facility on this eight-acre wooded property. Preparation of a Town of Brookhaven Part 1 Environmental Assessment Form (EAF) for the proposed construction of a health club facility on this undeveloped property, which contains woodlands, a creek and freshwater wetlands.

Lowes Home Centers, Inc., Ecological Survey and Wetland Permitting, Commack, NY
David conducted an ecological survey of this 22 acre property as part of a retail home improvement center development project. The ecological assessment included wetland evaluation of a federally-regulated recharge basin located at the site. David further obtained a United States Army Corps of Engineers (USAC) Nationwide Permit for disturbance/expansion to the recharge basin. As part of this permitting effort, David designed a wetland mitigation/planting plan and coordinated with the New York State Department of Environmental Conservation (NYSDEC) to obtain a Water Quality Certificate, as required by the USACE. David also conducted Phase I and Phase II Environmental Site Assessments of the property, which included surficial and subsurface soil sampling, and bottom sediment sampling of underground injection control structures.

Proposed Wireless Communications Facility, Freshwater Wetland Delineation and Permitting, Islip, NY
David conducted freshwater wetland delineation and obtained a New York State Department of Environmental Conservation freshwater wetlands permit for this wireless communications facility site.

Highway Improvement Project, Freshwater and Tidal Wetlands Permitting, Incorporated Village of Lloyd Harbor, NY
David coordinated with the New York State Department of Environmental Conservation (NYSDEC) to secure freshwater and tidal wetlands permits for a traffic safety improvement project along six miles of public roadways within the Incorporated Village of Lloyd Harbor.

Silver Oak Stables, Freshwater Wetlands Permitting and Ecological Survey, Nissequogue, NY
David obtained a freshwater wetlands permit the New York State Department of Environmental for an extensive demolition and construction project at this 35 acre equestrian center and boarding facility. David also conducted an ecological survey and prepared an ecology resources report for the subject property. The survey included an assessment of existing meadow and wetland habitats, vegetation and wildlife species inventories and an evaluation for the presence of rare species and ecological communities. Potential impacts of the proposed action and wetland mitigation measures were also addressed in the report.

Solar Energy Generation Facility, Existing Ecological Conditions Assessment Southold, NY

David conducted an ecological survey of this 21 acre site, which supports agricultural, successional, woodland and wetland/aquatic habitats. The ecological survey included a habitat assessment, observed/expected vegetation and wildlife species inventories and an evaluation for the presence of rare/protected species and ecological communities. David further conducted a Phase I Environmental Site Inspection of the property, to identify and assess existing environmental concerns for future redevelopment.

Vintage Vines Development, Existing Ecological Conditions, Impact and Mitigation Assessment, Bridgehampton, NY

David performed an ecological assessment and tiger salamander survey for a proposed residential development on this 49 acre undeveloped property. He subsequently wrote the Ecology Resources section for the Draft Environmental Impact Statement, in which existing ecological conditions, potential impacts and mitigation measures were addressed. David also responded to public comments in the Final Environmental Impact Statement for the proposed action.

Prior Positions

Hydrogeologist, R&C Formation

Prior to VHB, David performed groundwater monitoring and evaluation activities at federal, state and local government sites, including the United States Department of Energy's Brookhaven National Laboratory facility.

Fish and Wildlife Technician, New York State Department of Environmental Conservation

Prior to VHB, David conducted biological assessments, population surveys, water quality evaluations and fish stocking of various local waters for the New York State Department of Environmental Conservation. David also participated in endangered species surveys, invasive species remediation projects, environmental education workshops and public outreach events.

Visiting Scientist Position, The Nyanza Project, Tanzania, East Africa

Prior to VHB, David performed multi-disciplinary scientific research activities as a student (2003) and visiting scientist/teaching assistant (2004) with The Nyanza Project, an international tropical lakes research program held annually at Lake Tanganyika, Tanzania, East Africa.

Publications

Eggermont, H., Kennedy, D., Hasiotis, S.T., Verschuren D. & Cohen, A. 2008. Distribution of living larval Chironomidae (Insecta: Diptera) along a depth transect at Kigoma Bay, Lake Tanganyika: implications for palaeoenvironmental reconstruction. African Entomology 16(2): 162-184.