Exhibit 32

Exhibit 33

Exhibit 34

Exhibit 35

Available Soils and Onsite Dispersal Suitability

The underlying geology of the site is Catoctin Formation – Metabasalt commonly known as Greenstone. Typical soil series found on the property and associated with Greenstone are Rabun and Davidson soil series. New drainfield areas for the Carriage House and Tasting Room on the greater Trump properties have been in these types of soils. Dispersal for these facilities has been to deeper conventional trenches with moderately slower permeabilities (85 to 95 mpi percolation rates). Drainfields have been larger to accommodate the slower permeabilities. No site specific soil borings or Saturated Hydraulic Conductivity Measurements have been performed on the Golf Course Property Area. The existing drainfield for the Albemarle House will not be adequate for the new facility and will need to be expanded and/or replaced.

Conclusions

The size of the property (314.67 acres) and predominate soil series (Rabun and Davidson) encountered at the Trump Golf Course indicate that an onsite dispersal system will be feasible at the facility. Exact dispersal locations, sizes, and technologies will be determined by site specific field evaluations and be dependent upon VDH approval.

Sincerely,

Michael Craun PE

Old Dominion Engineering
2036 Forest Drive • Waynesboro, VA 22980
PHONE (540) 942-5600 • FAX (540) 213-0297

Old Dominion Engineering

August 16, 2013

VDH – Albemarle County
1138 Rose Hill Drive
Charlottesville, VA 22906

SUBJECT: **ONSITE WASTEWATER TREATMENT AND DISPOSAL PRELIMINARY FEASIBILTY FOR TRUMP GOLF COURSE**

Property Owner: Trump Virginia Acquisitions, LLC
Property Location: TM 102-35, 35
Property Size: 314.67 acres,

Property Use

The proposed use for the property is a golf course and club house with pro shop, locker rooms, and food service for the golf patrons. Water usage estimates will be developed as the full program of estimated golf course rounds per year, club house seating, pro shop square footage, and locker room facilities are finalized. The onsite waste water system will be classified as a Large AOSS per Virginia Department of Health (VDH) definitions.

Sewage Treatment Facilities and Effluent Quality Requirements

The proposed development will generate irregular flows of moderately high strength wastewater effluent (<600mg/l BOD/TSS). The project lies in the Chesapeake Bay Watershed and will fall under the Chesapeake Bay Protection provisions of the VDH regulations (enactment date 12/7/2013) which require end of pipe mandatory effluent treatment concentration limits of Total Nitrogen for those systems in the Chesapeake Bay Watershed. The existing system at the Albemarle House is a conventional residential system and due to the change of building use and increased water usage will require an upgrade to meet current VDH regulations.

Separate building sewers will collect sanitary wastewater and kitchen wastewater. The treated effluent quality will be TL2/TL3 with Total Nitrogen reduction in order to provide for system reliability/longevity and groundwater protection.

The following components will require removal in the treatment process:

- Biochemical Oxygen Demand
- Suspended Solids
- Total Nitrogen
- Fats, Oils, and Grease

The anticipated treatment scheme includes primary settling with a high grade effluent filter, grease trap with a high grade effluent filter, flow equalization prior to treatment, recirculating vertical flow wetland treatment unit/s, pump distribution to onsite dispersal. The system is classified as a decentralized onsite waste water treatment and dispersal system and will be regulated under VDH "Mass Drainfield" and Chesapeake Bay Watershed Protection Regulations.

Exhibit 37

Trump National Golf Club
CHARLOTTESVILLE, VA

EXECUTIVE SUMMARY

1. Tasks and Focus

This is a preliminary version of the Trump National Golf Club, Charlottesville Virginia (the "Golf Course") Integrated Golf Course Best Management Practices (the "IGCBMP"). This plan is designed to offer site-specific guidance for the management of the Golf Course and to assist the facility with a successful grow-in period.

The Best Management Practices outlined in this IGCBMP focus on sustainable long-term integrated pest management techniques. The final version of this plan will also integrate the management-related risk mitigation measures recommended in the risk assessment. This IGCBMP provides low-risk alternatives for nutrient and turfgrass chemical use; it presents best management practices for the protection of ground and surface waters; it introduces specific application of newly registered biopesticides; and it outlines traditional, organic and alternative levels of turfgrass management.

While certain aspects of the Golf Course design are conceptual pending final engineering design, the principles and obligations described in this IGCBMP represent firm commitments by the project. All final materials and procedures adopted as-well-as final plans and construction drawings produced by the Golf Course architects and engineers will adhere to the principles presented herein. This IGCBMP provides coverage for a preliminary set of plans, revisions and adjustments that will be documented with final drawings and eventual as-built drawings. A final IGCBMP will be prepared subsequent to Special Use Permit approval.

The IGCBMP represents a commitment by Trump National Golf Club, Charlottesville Virginia to act in a manner consistent with the Albemarle County Code regarding the Golf Course. This will help ensure an environmentally sensitive and sustainable golfing environment. The IGCBMP will be used in concurrence with other documents regarding the design, grading and construction of the Golf Course and appropriate management strategies and practices for reducing potential environmental impacts.

2. Best Management Practices and Integrated Pest Management

The Best Management Practices (BMPs) and Integrated Pest Management (IPM) strategies described in this document have helped to greatly reduce the use of fertilizers and pesticides on golf courses. The primary means of controlling turfgrass pests is biological and, wherever practical, growing turf under natural conditions that allow it to withstand pest attacks without chemical intervention. Chemicals and/or biopesticides are employed only if other cultural practices have failed to provide adequate controls, and then only in minimal amounts. Some fungus diseases are ubiquitous and form the exception, requiring routine seasonal treatment irrespective of damage.

The Best Management Practices and Integrated Pest Management strategies described herein have been used successfully by numerous golf course facilities nationwide. A number of strategies contribute to positive environmental results:

- Selection of appropriate grasses to create a healthy sod capable of combating most pest infestations through biological means without chemical intervention. The grass types proposed in this report offer excellent adaptability and hardiness and emulate existing native vegetation currently found on the site. The turf-type fine fescues offer excellent flexibility for managing turfgrass pests and will perform extremely well under the climate encountered in Albemarle County, Virginia;

- Establishment of tolerance levels for most pests, as opposed to eradication. No action is taken for most pests unless an infestation exceeds a stipulated threshold and all other forms of cultural management have failed;

- Reliance on environmental and mechanical controls. For example, avoiding aerifier holes during moth egg-laying season can deny entry to armyworm *(Pseudaletia unipuncta)* and black cutworm *(4p-offs ipsilon)* larvae. Avoidance of phosphorus and potassium deficiencies can prevent or minimize the occurrence of take-all patch *(Gaeumannomyees graminis)* fungus disease;

- Understanding pest life cycles so that chemicals are applied when they will have maximum efficacy with minimal applications and exposure to the environment;

- Spot application of chemicals only as necessary;

- Installation of a computerized prescription/fertigation sprinkler systems to replace water only as it evaporates or is absorbed by plants. This is the single most important strategy for reducing water consumption and eliminating surface run-off and leaching of chemicals into ground water flows while preventing fungus infections associated with damp conditions. In practice, 80% efficiency in matching evapotranspiration is achievable with advanced irrigation systems.

- Quality control and performance standards for design, construction, grassing and grow-in that minimize conflicts with existing and future land uses, and provides a safe location for the tees, fairways, greens, and practice areas in relation to adjacent roadways and improvements, both on and off of the project site.

- Reduction of turf areas requiring a high level of maintenance. The irrigated turfgrass areas in this IGCBMP consist of greens, tees, and fairways, and ponds where water levels will need to be maintained, and roughs that will receive irrigation primarily during the grow-in period.

The IGCBMP for the Golf Course voluntarily goes beyond traditional regulatory compliance levels. The Virginia Department of Agriculture and Consumer Services and the Virginia Department of Environmental Quality will be consulted periodically about biological, parasitic or predator controls that

could further reduce the use of chemical treatment. The Golf Course will also work with the United States Department of Agriculture (USDA).

3. The Environmental Principles for Golf Courses in the United States

The IGCBMP describes a set of voluntary principles that seek to produce environmental excellence in golf course planning and siting, design, construction, maintenance, and facility operations. This document recognizes that both the principles and guidelines deliver solid environmental and sustainable ecological approaches for the Golf Course. The guidelines assume the project will go beyond traditional regulatory compliance. Most significantly, the principles promote environmentally sound golf courses as quality golf courses.

Trump National Golf Club agrees to abide by and implement the recommendations contained within this IGCBMP. The Trump National Golf Club is committed to following the principles attached because of the project's goals of maintaining environmental stewardship and quality. The IGCBMP takes into account the guidelines developed by the United States Golf Association (USGA) and the Golf Course Superintendents' Association of America (GCSAA). This plan also uses Best Management Practices to prevent and/or minimize adverse impacts of the Golf Course on ground and surface water resources. Monitoring of surface water quality and ground water quantity will be provided by the owner(s) according to a plan prepared specifically for the Golf Course.

4. Turf Management

The IGCBMP describes how IPM will be used during the grow-in, development, and management period of the Golf Course. Superintendents of existing golf courses were queried about fertilizer and irrigation practices, as well as pest-related problems relative to the differing grass types and micro-climates. Key pests and/or specific turf related diseases, weeds, and insects that will occur naturally have been identified. Listed herein are 45 weeds, 25 diseases, and 16 insect turf pests that are known to occur in regional golf courses. Seventeen of these are identified as key pests (seven weeds, six diseases, and four insects). Forty-one pesticides including the organic and newly introduced biopesticides have been identified for risk screening and possible use against these 86 pests in the operation of other golf courses in a worst case pest infestation scenario. We estimate that less than 20 turfgrass products may actually be needed if the IPM program proves reasonably effective.

Additional baseline soil sampling and irrigation water quality analysis will be conducted on the Golf Course and the results will be integrated into the following turfgrass management programs:

- The grassing and grow-in specification will be modified to include the addition of native graminoids catalogued for the Golf Course and wetland habitats;

- The grow-in program will include hydro seeding specifications with naturally occurring humic acids and biostimulants to assist with the native habitat restoration;
- Non-mowing of the secondary roughs and native habitats until after July 15th of each year to maintain the nesting environment of various birds and preserve the grassland habitat with beneficial insects as feed for these birds.
- The nutrient program will be modified to include "spoon-feeding" ultra low volumes of fertilizers and buffering agents within the first flush of the supplemental irrigation;
- The proposed list of chemicals/biopesticides includes the lower risk turfgrass products most recently registered and approved under EPA's safer pesticide use process; and
- A high level of environmental safety will be designed within supply storage areas.

5. **Pesticide Spill and Response Plan**

A written discharge spill response plan will be part of the training provided to each employee at the Golf Course. This plan will conform to relevant laws. A copy of this plan will be readily available. Local police and fire departments will be notified that this document has been completed. The local fire department will be provided with a current copy of all chemicals and pesticides stored in the pesticide storage area. The Material Safety Data Sheets (MSDS) will be provided for each compound or constituent located in the storage area. In the case of minimal discharge, employees will have the necessary protective equipment and clothing readily available. Any hazardous materials will be disposed of through a licensed hazardous waste disposal firm.

In the event that a minor pesticide spill or leak resulting from the hoses or nozzles of the turfgrass sprayer is discovered, the damaged equipment will cease to operate immediately. All safety containment valves will be closed and the emergency spill prevention materials (absorbent cloth designed to capture liquid materials) will be utilized to absorb spilled concentrations of pesticides or fertilizers that remain on or near the turfgrass sprayer. In the event that a leak has been discovered within the sprayer or tank itself, an auxiliary tank will be used as a transfer station to collect the remaining concentrations of chemical or fertilizer. For all areas outside of the buffer zones, the amount of spilled material will be allowed to drain in the crown and thatch layers of turfgrass. For those areas inside sensitive zones, should such a spill occur, the Golf Course staff will apply activated charcoal and detoxifying absorbent materials to neutralize and stabilize the spill.

6. **Maintenance Facility**

The maintenance and storage facility will conform to the appropriate Virginia regulations for bulk chemical storage and hazardous waste. The fire department will be supplied with a copy of the floor plan and will be provided a copy of the access security code. The facility will be landscaped and designed to conform and blend with the rest of the project. An all-weather access road shall serve the maintenance building and provide emergency and service vehicle access.

In addition to storing Golf Course equipment, maintenance facilities are designed, developed, and installed as comprehensive integrated systems offering safety in the storage and handling of fertilizer and pesticide materials. Modern golf course facilities prove themselves in several ways, such as increased employee safety, reduced insurance rate growth, eliminated or significantly reduced costs and liability of both storage and disposal of waste residue, and ease and affordability of maintenance. The facility's design will have a significant impact on efficiency, annual maintenance spending and, ultimately, the quality of the Golf Course.

A wash pad will be designed as a closed loop recycle wash water center. Strict discharge limits have been set by EPA for oil, greases, solvents, fuels, grinding compounds, heavy metals, detergents, insecticides, fungicides, herbicides, and nitrates. Simply washing these materials down the drain, into the ground or into a waterway is neither legal nor environmentally responsible. Recycling systems for wash water are designed as closed looped systems and address direct Total Maximum Daily Loading (TMDL) discharge into a sewer or water quality basin, The wash water system functions by utilizing a three-step process:

- Grass clippings are removed from the wash water to minimize the release of hydrocarbons, including potential fertilizer and pesticide residues.
- The wash water is recycled continuously while physically removing oil and solid particles. This process prepares the water for filtration.
- The wash water is filtered with carbon packs prior to discharge into the waste stream. These carbon packs contain the only biosolid residues that will be shipped to a hazardous waste facility.

7. Summary

The IGCBMP was developed based on the philosophy that the growth and maintenance of healthy turf will minimize the need for pesticides. The IGCBMP has been developed for the grow-in, development and management period of the Golf Course, and offers a maintenance and conservation program suitable for protecting the environmental resources of the project.

It is intended to fulfill several functions:

Adopt the principles of *Golf & The Environment, Environmental Principles for Golf Courses* (1996), the first product of a continuous dialogue among environmental and industry leaders managed by the Center for Resource Management, and Golf Course Superintendents' Association of America;

- Illustrate how Best Management Practices (BMPs) can be used during the design, construction and maintenance of the Golf Course;
- Restrict the planting of inappropriate species on the site and identify applicable Best Management Practices (BMPs) or source controls as pre-design for Natural Resources Inventory

and Evaluation. This is a source control for water quality enhancement through the use of Best Management Practices;

- Understand the differences between managing fertile soils with turf-type grasses and infertile soil complexes with graminoids, native plants and woody species. Identify where and how landscape design elements of the project may be supplemented, modified and/or better-focused to increase wildlife and ecological benefits of the overall project;

Detail the management techniques and frequency of maintenance required for each of the proposed turfgrass and landscape types;

- Demonstrate a detailed plan for operating and maintaining the Golf Course in a safe, effective, and environmentally responsible manner;
- Use natural resources efficiently. Offer site-specific recommendations to the Golf Course on methods of designing and growing-in the Golf Course to reduce the need for pesticides and to minimize the impacts of management;
- Present alternative methods using Best Management Practices (BMPs) that will customize the IGCBMP near special management zones, thus, reducing traditional forms of turfgrass chemical control;
- Provide a source of information to Golf Course personnel regarding current pest prevention controls and establish base line pest thresholds in accordance with IPM principles;
- Educate the reader on the basic concepts of Integrated Pest Management (IPM) and explain how these concepts will be put into practice within the scope of the (IGCBMP); and
- Document outstanding development and management practices. Promote the understanding that environmentally sound golf courses are quality golf courses.

8. Mitigation Measures

This IGCBMP will be amended in the future to reflect mitigation measures.

Trump National Golf Club
CHARLOTTESVILLE, VA

Chapter I

Project Overview and Site Description

1.1 Project Overview

The objective of the Trump National Golf Club, Charlottesville Virginia is to develop a premier 18 hole golfing facility. The property is situated adjacent to Carters Mountain Road and is designated as Tax Map 102, Parcels 35 and 35C on Albemarle County tax maps. The total property encompasses approximately 314.67 acres. The balance of the property consists of fields, ponds, and wooded areas. The existing Albemarle House will serve as a clubhouse. The Golf Course will also include a driving range.

The IGCBMP for the Golf Course is designed to offer site-specific guidance and to assist the facility with a successful grow-in period and sustainable long-term integrated pest management program. The plan addresses potential risks to ground and surface water quality by providing low-risk alternatives for nutrient and chemical use, presents acceptable best management practices for the protection of ground and surface waters, and outlines traditional levels of turfgrass management that will be used to evaluate potential risks to the environment. Protocols are presented in this ICGMP for managing and protecting existing, created and restored habitats. The level of environmental management outlines feasible measures for reducing chemical use to levels which will not degrade water quality.

While aspects of the design of the Golf Course are conceptual pending final engineering, the principles and obligations described in this IGCBMP represent firm commitments. All final materials and procedures adopted, and final plans and construction drawings produced by the architects and engineers of the Golf Course will adhere to the principles presented herein. This IGCBMP provides coverage for a preliminary set of plans, revisions and adjustments that will be documented with final drawings and eventually as-built drawings. The plan adopts and supports the principles from *Golf & The Environment, Environmental Principles for Golf Courses* (1996), a product of a dialogue among environmental and industry leaders.

Golf & The Environment is managed by the Center for Resource Management, and Golf Course Superintendents Association of America. The Environmental Principles for Golf Courses summarizes and outlines a set of principles which seek to produce environmental excellence in golf course planning and siting, design, construction, maintenance and facility operations (*Golf & The Environment*, 1996). The guidelines from this document assume the project will voluntarily go beyond traditional regulatory compliance levels (see Appendix A of this report). Most significantly, the principles promote environmentally sound golf courses as quality golf courses. The Golf Course agrees to abide by and implement the recommendations contained within this IGCBMP.

The IGCBMP developed for the Golf Course is based on the premise that one needs to first establish healthy sustainable turfgrass which, in top condition and guided by the appropriate best management practices, is capable of fighting off turfgrass pests and diseases with minimal application of fertilizers and pesticides. The maintenance of healthy turfgrass depends on several factors including appropriate turf selection, prescribed supplemental irrigation, careful selection of pest control options, and state-of-the-art

turfgrass equipment. The design of the Golf Course allows for diversity among plant communities and landscaping as opposed to the traditional monoculture systems. This plan describes methods used to create new habitats and provides safeguards for protecting plant and animal communities during the site design, development and management period. Each section of this text, primarily addresses the Golf Course grow-in and short-term maintenance, offering a program for protection of the natural resources and sustainable land management policies for the Golf Course.

1.2 Golf Course Description

The 18 hole Golf Course will be designed to accommodate players with varying skill levels. This premier Golf Course will balance and integrate the game of golf, while at the same time maintaining a special focus on minimal disturbance, environmental sensitivity, and native plant and habitat restoration.

1.3 Soils

The full description of the soils with appropriate grow-in and buffering material recommendations will be prepared in the final IGCBMP. A copy of the soil sampling results will be attached as Appendix B of this report when the soil sampling results for turfgrass nutrient and grow-in recommendations become available. Earth excavation, filling, stockpiling and storage details will be prepared and described under the proposed earthwork operations for the project. The grading plan application will be supported by construction staging plans and supplemental drawings that will describe the balancing of earthwork calculations proposed for the project.

1.4 Water Use Issues

Irrigation water will be obtained from existing ponds that are fed by storm water runoff. The ponds might be supplemented by existing onsite wells. A pump station will distribute the water to the Golf Course. Between the two ponds that are expected to provide water for irrigation, there is an existing water supply on the property of approximately 43 Million gallons of water with a drainage area of 225 acres for resupply of the water to the ponds. In a one year period, if only one fourth of the normal rainfall in the drainage shed to the ponds actually made it to the ponds, there would be approximately 68 million gallons of water available for supplemental irrigation. Based on these numbers and calculations of rainfall in Virginia, these (2) ponds are adequate in size to provide the additional water demands for irrigation of the 65 acres on the Golf Course.

1.4.1 Water Supply and Storage Analysis

A full water demand, water supply and storage analysis will be completed as part of the final IGCBMP and upon the completion of the additional aquifer testing and hydraulic characteristic analysis in support of the Water Allocation Permit Application.

1.4.2 Irrigation System Specification and Capabilities

The Golf Course will install a computer controlled irrigation system to minimize over-watering. The irrigation system will be a state-of-the-art (i.e., Toro® or RainBird® Maxi) and linked to a DTN Weather Center Computer and Lightning Prediction System (see Appendix C). The system will be engineered to water the entire Golf Course each night (unless raining) and to supply a minimum of 1" of water per week or as needed to meet turf demand.

The irrigation system will include an on-site weather station (in addition to remote wind, temperature and rain sensors) to track temperature, relative humidity, solar radiation, wind direction and speed, and precipitation. This data is read by the central computer, which computes local evapotranspiration and then adjusts the run time for each individually controlled sprinkler head to exactly match the evapotranspiration loss on a day-to-day basis. Soil moisture probes will be installed as needed to assure proper irrigation of various management areas.

The goal of computerized irrigation is to apply water at a rate which very closely matches evapotranspiration losses of the turf. By not adding water in excess of turf requirements, irrigation runoff or oversaturation and leaching can be avoided. In practice, 80% or higher efficiency in meeting this goal is achievable as opposed to 50% efficiency with conventional quick-couple systems.

The spacing of sprinklers will be designed to minimize surface runoff and avoid inadvertent drift. Field controls will be placed for maximum visibility. Valve-in-head sprinklers will be used with individual control wires linking each of the irrigation heads back to the field controllers. Heads on fairways and roughs can be paired at the controller on an average of two heads per station. Green and tee sprinkler heads will be operated individually. Greens will be irrigated with full and/or part-circle sprinkler heads to allow the superintendent to irrigate in a more efficient manner. This reduces disease potential and results in lower usage of pesticides. Quick coupler snap valves will be installed near the native plant restoration areas to provide supplemental water during grow-in.

In the event that Rainbird® is chosen as the irrigation system, the programming and operation of the irrigation heads may be controlled by an individual decoder system.

1.4.3 Treated Wastewater

No reclaimed water will be used for irrigation.

1.5 Forest, Vegetation and Habitat

Native plant communities including riparian habitat and wetlands will be catalogued and mapped by regional biologists. A formal forest management program, based on woodland mapping, statistical inventory, and analysis will be developed. In addition, the foresters will further guide the owner with the implementation of the forestry program through tree marking and assistance with tree planting where needed. Ongoing records will be kept of these activities to serve as a history of management and for future reference.

No records or evidence of endangered, threatened, or sensitive plants have been found in the disturbed areas of the Golf Course as of this date. Care has been taken in the design of the Golf Course to protect wetlands with significant setbacks. Wherever possible, the design will leave existing plant communities and vegetation in place and create roughs and buffers that require little or no supplemental water or fertilizer, and which are attractive in unmowed conditions.

1.6 Wildlife

A complete wildlife management protocol will be developed pending the results of field surveys. At this stage of the project, designated wildlife habitats will not be altered by construction or normal maintenance. In addition, plant species have been chosen for the restored areas that will provide wildlife benefits such as cover or edible fruits and berries, and that create natural roosting and feeding grounds for birds outside the developed areas.

In order to assist the Golf Course maintenance department in addressing potential impacts from residential geese populations, we recommend considering the benefits of utilizing border collies to minimize damage that may result from uncontrolled populations. Border collies have proven to be the most efficient way in deterring geese without harm from grazing on the Golf Course. We also recommend that the Golf Course monitor the success with the latest in laser technology. This has most recently materialized as a very viable control option when dealing with resident geese populations.

Rodents

The following Best Management Practices for the Golf Course implementing Integrated Pest Management is to provide wherever feasible the following rodent control strategies.

Passive Control Strategies

Managed turfgrass will be maintained at mowing heights designed to discourage suitable habitat for underground rodents;

Non-play areas of the Golf Course will be planted and designed with low maintenance grass types suitable for songbirds and will include wherever feasible fragmented habitats designed to centralize rodent populations.

Woody shrubs and deciduous vegetation will be provided in the undisturbed portions of the site to encourage controlled habitats and micro-environments for resident rodent populations;

Selective control measures and habitat modification will be used prior to winter (handpicking of weeds, clearing, mowing, pruning, etc.) to minimize food and decrease protection from predators;

Pest populations will be monitored, which might include best available trapping methods to monitor nuisance pest populations; and

Fragmented areas will include perch trees and snags to encourage owl and hawk habitat. Corridors of natural open space will include managed turfgrass maintained at lower mowing heights to encourage feeding opportunities for predators.

Active Control Strategies

Live-trapping will be used with oatmeal, fruit and vegetables to relocate nuisance pests. Nuts and favorite foods will be placed in controlled habitat micro-environments;

Repellants and snap traps will be used to control voles, predator scents will be used to protect woody species and trees, sonic vibrations repellers and underground fencing may be installed in the controlled habitat micro-environments;

Professional exterminators will be used only when and where necessary to assist with underground chemical control strategy options. Local extension personnel will be consulted for pest specific expertise.

The above BMPs have been proposed to limit chemical control strategies and to encourage natural predator intervention.

1.7 Mitigation of Impacts During Construction

The Golf Course will implement the following provisions prior to and during construction of the Golf Course:

Install protective fencing and define areas of existing vegetation that should not be disturbed; Establish designated sediment/erosion control infiltration areas to protect surface water features;

Install temporary seeding or matting, silt fencing, hay bales, and filter fabric as necessary for erosion and sediment control until permanent vegetation is complete;

Establish shoulders to direct surface runoff into the existing soils and undisturbed portions of the secondary roughs;

Install fencing and silt barriers (filter fabric or straw bales) to identify construction circulation corridors through otherwise undisturbed areas within the Golf Course;

Ensure that contractors comply with regulations and any special requirements outlined in the Final Development Plan;

Stabilize material not used as fill for topsoil, seeding and sodding; Designate construction equipment and employee access entrance(s);

Designate staging areas that minimally disturb existing vegetation for: employee parking, equipment parking, maintenance and fuel compound, storage of construction materials, (sand, gravel, irrigation materials, etc.), and construction management offices and restrooms; and

Provide list of equipment to be used on site throughout construction.

1.8 Sediment and Erosion Controls

Sediment and erosion control systems will be described as part of the overall application. Drainage safeguards and/or biofilters will be designed to protect water quality and will be engineered as part of a comprehensive erosion control plan. They are easily implemented, affordable and can provide effective filtration for drainage or leachate. Many of the recommendations by the U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS), can be adapted for turfgrass use (Bottcher and Baldwin, 1986). The NRCS defines these areas within the following categories:

Wet Biofilters:

Regulated runoff impoundment – The Golf Course will use detention with associated filtration through plant material within the basin prior to runoff discharge. This is used to reduce runoff quantity and nutrient and pesticide discharge.

Infiltration Adsorption Areas:

Land Absorption Areas - An adequate land absorption area is provided for drainage or runoff of turf and impervious surfaces so that soil and plants absorb nutrients. This is part of the drainage plan, contour plan and water quality protection strategy.

Subsurface Drainage - Infiltrated surface water, primarily from greens, will be filtered through existing soils and vegetative material.

Dry Biofilters:

Supplemental Buffer Planting Area - Planting vegetation to stabilize the soil and reduce erosion and runoff.

Grassed Outlets - A natural or constructed outlet is maintained with vegetative cover in order to prevent soil erosion and filter nutrients. Dry ponds and Golf Course fairways serve in this capacity.

If runoff occurs, it will be directed away from sensitive areas (tributaries and riparian habitat, shallow ground water recharge, wetlands, etc.) and into areas where infiltration can occur. The golf course drainage will optimize the removal of runoff from the playing surfaces while not causing a drainage problem on hydrologically connected areas. Slopes will be maintained to allow the Golf Course to be playable while maintaining positive drainage.

1.9 Drainage

Drainage and routing plan mapping will be used to detail specific Golf Course construction and grading documents for the drainage management plan. The drainage management plan will include the topsoil management plan, temporary sediment and erosion control plans, site specific drainage plan typicals, cut and fill plans, and supplemental lake construction details.

1.10 Buffers

A complete description of the proposed buffers will be presented pending the results of the Water Quality Risk Assessment.

1.11 Native Grasses

This section will be completed in the future.

Chapter II

Best Management Practices and Integrated Pest Management

The integrated pest management strategy outlined in this IGCBMP includes site-specific tolerance levels for each pest and specific remedies, including types and quantities of organic and synthetic fertilizers, chemicals and/or biopesticides, and other mitigation measures to be taken. Some aspects of the sustainable programs we have prepared including the Best Management Practices (BMPs) described in this document, may change over time.

No changes will be made in the chemicals/biopesticides presented in this plan unless approved by the appropriate state and local agencies. The philosophy and goals described in this chapter, will govern the adoption of any newly proposed pest management strategies including the addition or deletion of the specific alternatives to the turfgrass chemical products contained in this report.

2.1 Legal Requirement of Best Management Practices

In the late 1970's and early 1980's, the U.S. Environmental Protection Agency (EPA) began to recognize the impacts of non-point source pollution on environmental quality. Congress responded by enacting legislation that required implementation of Best Management Practices (BMPs) by States and specific industries throughout the country. As the resulting Clean Water Act (CWA) regulations evolved, the EPA established a set of processes or procedures intended to better address non-point sources of pollution. Non-point source (NPS) pollution was not defined within the CWA; the EPA subsequently adopted regulatory definitions of NPS pollution as contamination caused by diffuse sources that are not regulated as point sources. These sources are typically associated with agricultural or silvicultural activities, runoff from construction activities and/or urban runoff.

Non-point source pollution does not result from a discharge at a specific location such as a single pipe but generally arises from land runoff, precipitation, atmospheric deposition, or percolation (Environmental Law and Policy, 1994). The EPA Office of Water Regulations and Standards' list of primary NPS pollutants includes nutrients, chemical fertilizers and pesticides, man-enhanced sediments, suspended solids, bacteria and microbial pollutants, oil and salts from roadways, and runoff from industrial and commercial sites. Sedimentation and sediment transport of other pollutants has been documented by EPA as the main source of non-point source pollution in the continental United States (1987 Water Quality Act: Section 208 Revised).

The EPA originally required area-wide waste treatment plans (Sect. 208 CWA, 1972) which eventually resulted in the demand for the creation of Best Management Practices to address non-point source pollution. According to the EPA's definition, a BMP can be a structural measure, a process-based measure, or a combination of the two. In CWA 319, states were further required to include methods of identifying BMPs and the inclusion of proposed BMP measures to reduce NPS pollution in assessment reports. This section added the requirement that BMPs address ground water impacts as well as surface water concerns. Since 1987, the EPA has recognized BMPs as an integral component of pollution prevention plans regardless of the environmental media involved.

2.2 Integrated Pest Management (IPM)

Integrated Pest Management (IPM) is an interdisciplinary program that considers the merits of the predominant pest control tactics and incorporates them into a single system to prevent unacceptable levels of pest damage. The control methods are designed not to eradicate pest populations, but to economieally manage them while minimizing possible effects on people, property and the environment. IPM is a decision-making process for pest prevention and control. It does not eliminate the use of pesticides; rather it limits their use to appropriate amounts and to occasions only after other measures of control have been considered and applied. IPM provides flexibility that enhances environmental and economic factors while reducing the reliance on chemical controls.

IPM focuses attention on conducting and monitoring soil nutrition, making it possible to apply specific nutrients during periods of maximum plant uptake. Soils analyses and plant tissue sampling results are often compared with the irrigation water quality results, helping to minimize the potential for sodium build-up in soils. This practice helps to reduce reliance on synthetic fertilizers and establishes an

effective program for choosing traditional and/or slow release organic fertilizer supplements with low burn or leaching potential.

The IPM system requires the monitoring of pest populations so that when pest pressure exceeds the action level, an appropriate treatment may be implemented. The treatment may be one of a variety of control measures and must be tailored for each tee, green, fairway and rough. This strategic method of pest management provides a form of risk reduction and environmental control.

IPM programs are innovative ways of decreasing management costs and obtaining a more balanced and effective means to control pests. They are secured by management and staff on the Golf Course combining new thought processes with existing and more state-of-the-art turfgrass technology. The IPM program does not preclude pesticide use, but seeks to reduce dependency on pesticides. The objective of any IPM program is to reduce pest populations while keeping pesticide applications to a minimum (Erusha, 1995).

Effective IPM rests on four basic principles:

(1) Prevention seeks to keep pests from entering the crops in the first place, thus stopping problems before they arise;

(2) Suppression attempts to reduce pests below the level at which they would be economically damaging;

(3) Tolerance strives to accept certain pests whose presence, however minimal, may prove beneficial; and

(4) Resistance stresses the effort to develop healthy, vigorous strains of crops that will be resistant to certain pests.

The Golf Course landscape in general offers significant opportunities for managing various plant communities and the playable portions of the project will feature low maintenance and non-invasive turf-type grasses. The ICGMP has been developed to assist the Golf Course superintendent in managing the Golf Course in an environmentally responsible way. The plan establishes management programs for the finely managed turfgrass areas and outlines the qualities necessary for managing and protecting the native habitats and environments of the Golf Course.

The Golf Course superintendent and maintenance staff will be provided with the following resources:

- Expertise to make informed choices for managing and enhancing the vegetative buffers with native plants, and written BMPs that ensure wetland preservation and reduction in soil and sediment erosion;

- Access to consultants, including permaculturist and native plant specialists, who will assist with the IPM program and maximize the results during the grow-in period;
- Availability of local ecologists to help make informed choices concerning native plants and opportunities for wetland creation and riparian enhancement;
- Proper equipment and diagnostic tools for pest identification; and
- Sufficient staff time to consistently monitor each management unit (tee, green, fairway and rough).

2.4 Field Monitoring and Control Systems

Field monitoring systems will provide the basis for developing thresholds and determining if action will be necessary to control a pest. The monitoring system should be simple, accurate, and part of the daily practice in turfgrass management, requiring no more than two hours per day. Each member of the monitoring team must thoroughly understand the potential pest species, including its phenology or life cycle.

Before any organism can be identified as a pest, an understanding is necessary of the role that beneficial organisms play. For example, a secondary pathogen may be a pest under certain conditions but might also provide a beneficial role in other turfgrass situations. Examples include *anthracnose-Colletotrichum graminicola* and dollar spot- *Scierotinia homoeocarpa* fungus which may help to eliminate the grass pest *Poa annua* in Kentucky bluegrass turf, and the beneficial microscopic nematode *Steinernema carpocapsae* which attacks turfgrass larval insects.

The importance of the pest will be noted on a scouting form and include the biological, cultural, environmental and physical factors that affect the presence of the species (see Appendix D). The on-site documentation will aid in identifying areas prone to repeated outbreaks. For example, an excellent time to observe mycelium is prior to poling the dew from the playing surfaces. The visible detection of sclerotia is a good indication of the potential movement of the pathogen into the host biotic tissue.

Salt content, pH and nutrient levels must also be monitored and properly managed. Healthy turf can resist, outgrow and recover from some pest and disease pressures. For this reason, the observation team will note any visual reduction in turfgrass quality. The information obtained through turfgrass surface monitoring will provide site-specific pest history and quantify threshold levels for disease, insect and weed occurrences.

Detailed point sampling (counting the number of weeds, insects and percentage of disease) will measure the density of the pest population relative to the damage on the area of turfgrass. This information will be used to fine tune the threshold action levels for each management unit such as tees or greens (for pest thresholds, see Chapter IV, Section 5).

Because pest presence is so weather dependent, observation of pest populations for several years is necessary to develop a useful history of pest occurrences. It is expected to require at least three years of data to develop a comprehensive base-line of pest occurrence and thresholds of allowable pest damage. This site specific data base will be correlated with the accumulated weather data creating a customized predictive planning tool. To assist the Golf Course superintendent in developing pest management strategies, the Golf Course will call upon regional and national turfgrass specialists in Integrated Pest Management as necessary, including the offices of the United States Golf Association (USGA), and the Golf Course Superintendents Association of America (GCSAA).

2.5 The Role of the Golf Course Superintendent

The Golf Course Superintendents Association of America (GCSAA) was founded to professionally prepare future generations of golf course superintendents. The organization has assumed an environmental leadership role by offering Environmental Management and continuing education programs. Superintendents who successfully complete the study requirements in a specialization receive a certificate from GCSAA. The Golf Course will require the Golf Course superintendent to achieve GCSAA certification and focus on continuing education with IPM standards. Fewer than 25% of all active GCSAA members achieve certification and this requirement is intended to assure that the Golf Course superintendent is among the top ranked and recognized professional in the field.

The Golf Course Superintendent will have overall responsibility for implementing the IPM and BMP plan developed for the Golf Course. He or she will see that a step-by-step plan is to measure potential pest infestations. Thus, plant protective programs will be adopted that outlines the most reasonable preventive and/or curative measures when dealing with each potential or repeated plant pathogen.

The Golf Course superintendent will be assisted by qualified professional staff as required to maintain the course and equipment. Those who handle chemicals will obtain all certifications required by state or federal regulations. Collectively, the superintendent and the maintenance staff will be responsible for:

- Definition of thresholds and appropriate responses for each management unit such as greens, tees, fairways, roughs and landscaped areas; and
- Information gathering for both reporting purposes and refinement of future treatment regimes;
- -Monitoring, recordkeeping and treatment evaluation.

Chapter III

Turf Management and Non-Turf Areas

Integrated Pest Management starts with preparation of the Golf Course soils and the selection of grass cultivars optimized for the site. The growth of turf that is disease and pest resistant requires proper seeding and maintenance during the critical grow-in period and an on-going program of soil testing and plant nutrition. The nutritional programs must be designed to meet the minimum needs of the turf while avoiding excessive or ill-timed applications of turfgrass chemicals that would promote leaching into the ground and/or surface waters.

3.1 Soils

Soil composition is the starting point for IPM at the Golf Course. Properly structured soil supports healthy turf that can crowd out undesired weeds during grow-in and fend off pest attacks with minimal chemical intervention. Soil composition also greatly influences the risks of ground water contamination from the transport of nutrients and/or pesticides.

Soils are comprised of a wide variety of mineral and organic complexes. Organics derived from decomposition of plant and animal matter are generally classified, based on their water solubility in terms of pH, as humic acid, fulvic acid, or humic (MacCarthy et al., 1990). Both the organic matter and mineral complexes in soils function in cation exchange (CEC), pH buffering, and water retention. Though the organic component seldom is greater than 6% by dry weight of the soil, it contributes the most to each of these functions. A typical mineral fraction will have a CEC of 0.05 to 0.3 mol kg whereas the organic component will range from 1 to 2 mol kg, depending on the pH buffering.

These and other characteristics contribute to the benefits of organic matter in soils by providing slow-release sources of nitrogen, phosphorous, and potassium useful to plants and organisms, as well as buffering soil pH. Microbial activity and heat retention are improved with increasing levels of organic matter compounds. These benefits combine to create healthy root development through improved nutrient availability.

Water quality is enhanced by organics in soils which provide a mechanism of binding, water retention, and microbial degradation. These characteristics minimize the risk of leaching (Stevenson and He, 1990). Research also supports the critical role of ambient humidity on the fate of organic pollutants (Chiou, 1990).

3.2 Turfgrass Selection

Greens, tees, and fairways are planted with grasses that meet the requirements of the game and that also lend themselves to being managed in an environmentally sensitive manner. These playing surfaces require a high level of maintenance because of the need for the turfgrass to resist and recover from damage incurred during play and from repeated close and frequent mowing. It is important to establish appropriate turfgrass for each playing surface (greens, tees, fairways, roughs).

The following criteria were used for deciding the appropriate turfgrass species for the Golf Course:

(1) Climatological and soil conditions of the site
(2) Desirability for golf in the playing & environmental setting
(3) Drought tolerance
(4) Resistance to disease and insects
(5) Resistance to annual grasses and weeds
(6) Establishment in sunny and shady environments
(7) Winter recovery and tolerance to snowmold conditions
(8) Compatibility with other grasses including fortis and sedges
(9) Irrigation water quality
(10) Availability of seed that is clean of harmful pests and grown in accordance with good turf growing practices
(11) Total dissolvable salts (TDS)
(12) Tolerance to high salt conditions.

3.2.1. Turfgrass Options and Characteristics

The Golf Course will be seeded with the new upright cool-season creeping bentgrass on tees, fairways and greens. Bentgrass was chosen as the most resistant to disease, insects and mites. Previous studies have affirmed that annual bluegrass *(Poa annua)* has been very invasive on existing golf courses. As such, the turf-types depicted in this report will allow the playing surfaces of the Golf Course to be managed with programs designed to limit cultivar segregation and reduce the potential for non-natives to become invasive on the native, riparian, and wetland habitats. The turf-types chosen and the open space buffers provided by the primary and secondary turf-types will protect these wetland environments.

Bentgrass *(Agrostis L.)* includes about 125 species five of which are used as turfgrasses, including creeping bentgrass *(Agrostis palustris, A. stoloniftra),* colonial bentgrass *(Agrostis capillaris),* dryland bentgrass *(Agrostis castellana),* velvet bentgrass *(Agrostis canna),* and redtop *(Agrostis alba, A. gigantea).* All of these are used extensively in turfgrass with the exception of Redtop (Turgeon, 1991). Table 1 describes four potential varieties and the differences that exist with each of the turf-types listed. It is the intent of the Golf Course to use the most highly advanced state-of-the-art grass types available and to establish these surfaces with certified seed only. Final grass types chosen will include the most highly advanced turf-types for establishment and grow-in including nursery sod production.

Prior to the selection of creeping bentgrass cultivars, the Golf Course will consult with regional turfgrass agronomist from the United States Golf Association and the turfgrass seed companies. The project will also review the latest USDA National Turfgras; Evaluation Performance (NTEP) evaluations for bentgrass cultivars. The Golf Course superintendent will represent the owner's interest when choosing the appropriate turfgrass types for Albemarle County, Virginia and will supply the necessary information to the Golf Course architect in order to assist with making informed choices for local bentgrass performance.

Table 1. Characteristics of Bentgrass Turfgrass

TURFGRASS SPECIES	OPTIMAL MOWING HEIGHTS	WEAR TOLERANCE	CHARACTERISTICS
Creeping bentgrass	1/8 inch to 1/2 inch New cultivars are more upright and require less nitrogen fertilizer. Best height for fairways is between 7/16 inch to 9/16 inch	Excellent May be used as a mono stand or blended. New varieties are extremely aggressive against *Poa annua*.	Medium to dark green Excellent playing characteristics and recovery potential. Responds quickly to cultural practices.
Colonial bentgrass	0.3 inch to 0.8 inch Tolerates close mowing heights. Similar environmental adaptation as creeping red fescue.	Adapts well in temperate-oceanic climates.	Dark bluish color. Adapts to infertile soils and drought conditions.
Velvet bentgrass	0.2 inch to 0.4 inch Forms very dense turfgrass but high cultural maintenance	Restricted to temperate-oceanic climates.	High maintenance, limited availability.
Redtop	1.5 inch to 2 inch Coarse-textured, may be used as a nurse crop.	Does not respond to fertilizer or irrigation practices.	Found in grasslands and may be used in wetland retention buffers.

The re-vegetation of the primary and secondary roughs using non-native fine-leafed fescues is ideally suited on areas grown under droughty conditions. During summer drought, the fine-leafed fescues, even in dormancy, provide an excellent lie for golf balls. Both chewings fescue and red fescue perform best under droughty soil conditions, with minimal nitrogen fertilization levels (Beard, 1982).

Most turfgrass species evolved and were introduced from the cool-humid areas around the North Sea in Eurasia. These species include the bentgrass, fescue, bluegrass and orchard grass (Hanson & Juska, 1969). Turfgrass species, like all living things, respond to the environment. Certain species have a specific tolerance limit for the environmental factors. However, it is climate that largely determines whether a turf species is suitable to the site conditions; soil factors within a given climatic zone determine the extent of adaptation for specific turfgrass (Ward, 1969). A substantial amount of turfgrass is grown on land that is subject to reconstruction, using soils not native to the site, recycled wastes, or other soil substitutes.

Kentucky Blue and Fescue Turfgrass

Kentucky bluegrass *(Poa pratensis L.)* is a cool-season turfgrass with excellent recovery and wear qualities suitable for climatic conditions found in Albemarle County, Virginia. Kentucky bluegrass provides very good pest resistance, contains performance standards that work well under different management programs and is typically used in mixes with enhanced endophytes, such as perennial ryegrass, for improved insect and disease resistance.

The most important characteristic of Kentucky bluegrass is that it produces rhizomes (underground creeping stems). The rhizomes produce a tightly knit sod that binds soil and creates sufficient crown surface area to recuperate from wear and droughty conditions. Thus, with limited thatch build up and proper mowing heights, Kentucky bluegrass will become more tolerant of cold winters and will outperform ryegrass and fescue. Prior to 1970, few Kentucky bluegrass cultivars were adapted to the close mowing heights required on golf course fairways. More recently, a number of improved cultivars have been released which can be used in blends for best overall performance (Nelson, 1990),

There are over 100 different species of fescue grasses. However, only six are commonly used as turfgrass. These are divided into two sub generic types based on leaf texture:

- The coarse fescue (including *Festuca arundinaceae* – tall fescue, *Festuca elatior or pratensis-meadow* fescue); and
- The fine fescue *(Festuca rubrea, trichophylla* – creeping red fescue and slender creeping fescue), *Festuca rubra commutate* – chewings fescue and *Festuca ovina longifolia, Festuca ovina* – hard fescue and sheep fescue. (Turgeon, 1991).

Many of these low maintenance varieties contain turfgrass endophytes which provide resistance to surface feeding insects (sod webworm, cutworms) and have been linked to improved stress and disease tolerance. Once established these varieties tolerate minimal applications of nitrogen fertility. Fine fescue creates high-quality turf when maintained between 1"-2". The individuality of the six fescue turfgrass cultivars is depicted in Table 2. Only four of the varieties are recommended and have potential use for the Golf Course: creeping red, chewings, hard and sheep.

Tall fescue is a coarse textured, bunch-type species that has adapted to a wide range of soil and climatic conditions. Tall fescue forms a turf of low shoot density and does not blend well with other cools season grasses including red fescue. Poor quality seed may be contaminated with seed of other hay and pasture species, such as orchard and timothy, and ryegrass (Hanson, et, al., 1969). This fescue has a very aggressive nature that performs better at higher cut heights and often spreads into areas that were not originally planned for seed. More recent studies have revealed that tall fescue contains the toxic funguses ergotamine and ergovaline. These studies have shown that fungus-infected tall fescue can cause sickness and low conception rates in livestock, rabbits and other small animals. Tall fescue grows in a mat-like structure and does not produce the kind of vegetative structure required by small animals such as songbirds, rabbits, field mice, etc. Meadow fescue was used to some extent in pastures that were seeded with poor quality lawn

Table 2. Characteristics of Kentucky Bluegrass and Fescue Turfgrass

KENTUCKY BLUEGRASS	OPTIMAL MOWING HEIGHTS	WEAR TOLERANCE	CHARACTERISTICS
pH of 5.0 or higher Introduced from Europe during the Colonial Period	New cultivars 0.75 to 1.5" Optimum: 1" or higher for most	Most adaptable cool-season turfgrass Excellent wear and cold weather hardiness	Research continues to improve both hardiness and pest tolerance Numerous cultivars for blending
FESCUE SPECIES	**OPTIMAL MOWING HEIGHTS**	**WEAR TOLERANCE**	**CHARACTERISTICS**
Creeping red pH: 5.5-6.5 Introduced from Europe during the Colonial Period	1.5 to 2" New cultivars have been sought to improve close mowing tolerances. Strong creepers: Durlawn, Novarubra, Ruby Weak creepers: Polar and Dawson	Low to Moderate Intolerant of wet conditions and high fertility	Pennlawn for close- mowing Arctared excellent low temperature hardiness; low temperature discoloration results in a distinct reddish color.
Chewings pH: 5.5-6.5 Introduced from Europe during the Colonial Period. First cultivated in New Zealand	.5" to 2" Chewings tolerates more closer mowing heights. Similar environmental adaptation as creeping red.	Noncreeping, bunch-type grass.	Barfalla, Highlight, Koket and Jade for close mowing. Jamestown for resistance to Fusarium patch.
Hard pH: 5.0 -6.5 Introduced from Europe	2"-3" Less drought tolerant, but more tolerant of moist, fertile soils than sheep fescue.	Noncreeping, bunch-type grass similar to sheep fescue.	Low maintenance
Sheep pH: 4.0 -8.5 Indigenous in Northern Hemisphere	2"-3" Well-drained, droughty, sandy or gravelly acid soils of low fertility.	Noncreeping, bunch-type grass with stiff, bluish green leaves.	Very low maintenance. Not adapted to intensive culture.
Tall pH: 4.7-8.5 Indigenous to Europe. Introduced to America 1800's.	1.5"-4" Adapts to a wide range of soil conditions. Heat and drought stress tolerant.	Low to moderate. Irrigation for survival and optimum growing quality.	Many fine-leafed provide high-quality turf Low to moderate
Meadow pH: 4.7-8.5 Introduced from Europe during the Colonial Period	Similar to Tall Fescue	Less persistent under drought and heat stresses	Found in grasslands

seed. They have little value as a turfgrass. The grass grows satisfactorily on dry, sandy, gravelly or rocky soils. There are no varieties in commercial production.

Table 3 provides the proposed square footage for each playing surface successfully used at a similar golf

Table 3. Turfgrass and Total Square Foot Estimates for The Lamington Farm Golf Course (95.00 acres of Managed Turfgrass)

Area/Use	Grass Type	Acreage	Square Footage
Tee Surface & Practice Tee	L93, A4, or Dominant Plus Creeping Bentgrass or Chewings Fine Fescue, Colonial/Highland Bentgrass and/or a small percentage of newer bents	5.50	239,580
Fairway Surface & Collars	100% L93 or Blended Creeping Bentgrass Putter/Providence/Jamestown or Chewings, FineCreeping Red Fescue, & Colonial/Highland Bentgrass	35.00	1,524,600
Greens Surface/Practice Green (Includes Aprons)	L93, A4, or Dominant Plus or Penn-A1/A4/G2, G6, Providence or similar varieties	4.50	196,020
Driving Range	Same as Fairways and Collars	10.00	435,600
Primary Roughs	Kentucky bluegrass/No Glade/Award/Rambo	40.00	1,742,400
Secondary Roughs & Native Habitat	Fescue, Little bluestem, Redtop, Grassy Heathland Species	10.00	435,600
Pond Water Storage	N/A	4.00 est.	174,240.00
Clubhouse & Parking	N/A	5.00 est.	217,800.00
Maintenance Building	N/A	0.75 est.	32,670.00
Total Irrigated Turfgrass	N/A	105.00	4,573,800
Total Property Acreage	N/A	506.00	22,041,360.00

course and which are proposed cultivars for each area of play for the Golf Course.

Note: Table 4 lists cultivars of grasses, successfully used at a similar golf course and proposed for the Golf Course for each area of play, and the recommended seeding rates for the blended turfgrass mix. The fescue and the bluegrass proposed list includes several potentially available cultivars for use. Only seed certified for use in Virginia will be sown.

Table 4. Proposed Grassing Specifications for The Lamington Farm Golf Course

Playing Surface	Turf-Types	Recommended Seeding Rates
Tees	100% Bentgrass or 50% Slender Creeping 25% Cindy Creeping Red 10% Longfellow Chewings 15% Colonial/Highland Bentgrass* or Newer Bents	90 lbs./ac 4-5 lbs/1,000 ft^2 or 170 lbs./ac
Fairways	40% Putter Creeping Bentgrass * 40% Providence Bentgrass* 20% Jamestown II Creeping Fescue * or Newer Bents	4-5 lbs/1,000 ft^2 or 170 lbs./ac
Primary Roughs	40% Kentucky Bluegrass 25% Award 25% Rambo 10% No Glade or 50% Slender Creeping 25% Cindy Creeping Red 20% Longfellow Chewings 5% Perennial Ryegrass	4 lbs/1,000 ft^2 170 lbs./ac
Secondary Roughs and Native Habitat Areas	20% Little bluestem 20% Indiangrass 15% Hard fescue 15% Switchgrass 15% Weeping Lovegrass 5% Sideoats grama 5% Tufted hairgrass 5% Redtop	40-80lbs./ac
Putting Green	Creeping Bentgrass, A4, G2 Dominant Plus or L-93, or SR-1021, Penn-A1/A4/G6, Providence or similar newer varieties of bentgrass	90 lbs./ac

* Note: Newer bentgrass cultivars may be substituted for Highland/Colonial.

Seed that is purchased shall be labeled in accordance with the United States Department of Agriculture and Regulations under the Federal Seed Act and Association of Official Seed Certification Agencies (AOSCA). The owner or owner's representative will have the right to reject any seed not meeting the design specifications.

3.3 Establishment of Playing Surfaces

The grasses for the specific playing areas summarized in Tables 3 and 4 were chosen for their specific environmental and individual growing characteristics:

Tees, Greens and Fairways: Will be seeded with creeping bentgrass, the blend will be specified in the grassing specifications developed by the Golf Course Architect for the Contractor who will be responsible for the grassing and revegetation of all disturbed areas.

Primary Roughs: Will consist of a bluegrass or fescue ryegrass mix. The step cut may be totally eliminated on all or portions of the Golf Course where the introduction of true natives is more desirable.

Secondary and Native Areas: The restored areas out of play, but which have been altered by construction, will be revegetated with a mix of grassy species: 15% of the mix will contain Hard fescue *(F. ovina var. duriuscula-Festuca longifolia),* 20% Little bluesteni *(andropogon scoparius)* 20% Indiangrass *(Sorghastrum nutans),* 15% Switchgrass, 15% Weeping Lovegrass *(Eragrostis curvula)* 5% Sideoats grama *(Bouteloua curtipendula) 5 %* Tufted hairgrass *(Deschampsia caespitosa)* and 5% Redtop *(Agrostis alba).* Certain species will be propagated while others will be placed. Additional species may be introduced pending the results and recommendations of the various consultants.

Wetland Plantings: Will be done throughout the created detention areas and ponds.

Native Areas: Natural areas altered by construction may be revegetated using local vegetation, depending upon plant quality and design considerations. Otherwise they will be re-established using a combination of native species mixed with other forbs and maritime plant communities to enhance the overall quality of the site for aesthetic and wildlife uses. Certain species will be propagated while others will be placed.

3.4 Soil Test Results and Plant Nutrient Recommendations

Plant nutrient recommendations will be determined based upon the results of the soil sampling. Section 3.4.1 will also be modified to address the results of the soil sampling analysis.

3.4.1 Added Nutrients During Pre-Plant or Grow-in

Before seeding, additional site-specific soil tests will be performed to determine the appropriate amount of preplant nutrients. The amount of soil nutrients required assumes the material will be incorporated into the top 6" soil surface prior to seeding. Once the soils have been blended and/or graded, they will need additional tests in order to determine the appropriate amount of elemental limestone, calcium or sulphur.

The Golf Course will conduct a phosphorus saturation test on the soils after fine grading is complete in order to establish the amount of phosphate-phosphorus (P_2O_5) that should be applied within the soil prior to seeding. The intent will be to release 10 lbs/ac of available phosphorus. This will enhance cool season grass germination. The amount of preplant P_2O_5/ac will remain the same regardless of the tilled depth of the soils. Phosphorus is relatively immobile when applied to the surface of either soil or turf because it binds to aluminum and iron in the soil.

As with phosphorus, nitrogen is needed during the grow-in phase to help promote rapid turfgrass cover. An initial application of 1.5 lb of N/1,000 $ft^2$with a 2-to-1 ratio of nitrogen to potassium is proposed. On soils with low organic matter, as much as 2 lbs of N/1000 ft^2/yr can be tied up in the soil organic fraction that will initially be unavailable to the plant (Petrovic, 1990). Therefore, more nitrogen must be applied in the grow-in phase than on established Golf Courses to aid in plant maturation and to compensate for loss (conversion to an unavailable form) to the soil. Frequent, lower rate applications of nitrogen containing fertilizers are important during the grow-in phase to provide optimal levels of plant-available nitrogen without losses to leaching.

In addition to soluble nitrogen, approximately 125 lbs/acre of a water insoluble nitrogen source (i.e., IBDU,) will be applied prior to seeding. This will provide an additional .75 lbs of nitrogen while the cotyledons are taking root. The aim is to allow a readily available source of nitrogen to be absorbed by the plants while they are rooting in order to gain establishment within the first 7-21 day period.

To stimulate rapid establishment and lateral movement of the fescue seedlings, fertilizer feedings should begin the third week following seeding. They should continue during the next 5-7 week period and be timed to match turf uptake capabilities. It is during this time that soils are typically deficient of materials necessary for adequate plant growth.

3.4.2 Fertilizing of Putting Green Surfaces

Specific finish grading plans and greens mix material specifications will be provided to the general contractor. All sand materials used in the construction of the greens profile will be sent to a certified USGA greensmix laboratory: Putting green surfaces shall be compacted and smoothed to meet the blending operations and design grades detailed in the construction documents.

The Golf Course will work 10 lbs/1000 square feet of 19-26-5 fertilizer (N-P-K ratio or similar) into the top three inches of the putting green surfaces, thoroughly mixing by discing or rotovation. This material must be a fine particle, chemically homogeneous product having a minimum of 75 % of the total nitrogen derived from urea and methylene urea plus a minimum of 26% monoammonium phosphate or equal. No lime or sulfur shall be applied to putting surfaces unless directed by the Golf Course Superintendent after the approved greens mix has been tested for existing pH.

Before seeding, the Golf Course will apply and work into the top two inches of the greens mix, the following biostimulants and nitrogen fertilizer sources at the specified rate per thousand square feet of putting surface:

- 10 pounds of magnesium sulfate (epsom salts);
- 10 pounds of milorganite fertilizer;
- 11 pounds of POLY-S coated urea;
- 80 pounds of Sand Aid (see 4.7.2 Biostimulant/Stress Management Materials); and

- 20 pounds of Pro Turf STEP manufactured by the Anderson Company (or an approved micro-nutrient supplement).

The Golf Course will conduct soil audits to evaluate the soil profiles. The tests will reveal any additional soil nutrients necessary at preplant without exceeding the loading limits or cation exchange capacity of the existing soils. The soil tests will be performed prior to seeding to determine nutritional needs of nitrogen, phosphorus, potassium (N, P, K), base saturation, and extractable minors. These tests and amendments will be performed in order to obtain a soil pH range of 6.5-6.8 for all of the Golf Course tee, fairway, green, and primary rough playing surfaces.

Additional applications of soluble micro-nutrients (STEP or other suitable micronutrients) may be required during establishment and maturation, and shall be applied by the contractor at the direction of the Golf Course superintendent and the designer/architect. Starting approximately four weeks after germination, fertilization should begin using weekly, alternate applications of Lesco green fertilizer and Lesco starter fertilizer. The minimum rate of application shall be one-half pound of nitrogen per one thousand square feet. This schedule should be seen as flexible program and will be adjusted according to the final soil test results preformed prior to grassing.

3.4.3 Fertilizing Established Turf

Golf courses can be managed so that nitrates from fertilizers do not impact ground water supplies if they avoid over-watering and over-fertilization (Petrovic, 1990). Nearly 50% of the nitrogen fertilizer applied to turfgrass is assimilated by the plant. Much of the remaining fraction is stored in the soil and/or released to the atmosphere. Thus, there is a very limited amount of fertilizer nitrogen remaining that can be leached into ground water or transported as runoff into surface water. Leaf tissue analysis will be conducted annually during the peak growing season to determine the need for nitrogen. The implementation of a precision fertility program as part of the IPM plan helps minimize the risk of increasing nitrate/nitrogen concentrations in ground and surface water.

When research has shown nitrate leaching from turfgrass areas, it also reveals that fortunately, the leaching can be controlled by best management practices (e.g., Cohen, et al., 1990). Excessive leaching most often occurs when excessive amounts of highly water-soluble nutrients are used and/or highly water-soluble nitrogen sources (urea, ammonium nitrate, calcium nitrate, ammonium sulfate, or potassium nitrate) are applied at inappropriate times and rates. The problem is exacerbated when water soluble fertilizers are applied to turf in dormant or semi-dormant states, or when excessive irrigation or unexpected heavy rains follow fertilization. The Golf Course's management will avoid these conditions through leaf tissue analysis, timing of applications, and attention to weather forecasts.

Research into high sand content sites, such as golf greens, reveals that properly managed putting surface areas are not prone to heavy nitrate leaching. This is especially true with lower nitrogen application rates and increased use of slow release nitrogen sources. Slow release nitrogen sources require microbial activity or hydrolysis to convert the nitrogen to a form available to the plant. When soluble nitrogen sources are used, the potential for ground water contamination can be eliminated by matching applications to plant uptake. For example, a study done by Morton, et al., 1988 addressed the influence of irrigation and

fertilization on nitrogen losses from turf on a sandy loam soil. The authors concluded normal fertilization and irrigation on a mix of cool-season turfgrasses resulted in nitrogen losses no different from the unfertilized controls. Another study (Snyder, et al., 1984) also observed that controlling irrigation reduces the potential for nitrate leaching to very low levels on sand based greens.

Timing fertilizer application to coincide with the period of active plant growth and nutrient uptake will optimize nitrate absorption and reduce the amount of soluble nitrogen available for leaching. Slow-release fertilizers that do not release excessive nitrogen during heavy rain will be applied during the wet months. When evapotranspiration is closely matched by irrigation during seasonably wet months and periods of active plant growth, water soluble nitrogen can be applied at rates of up to 1.0 lb N/1000 ft2/month without any significant accumulation or leaching. The Golf Course proposes soluble nitrogen application rates between .50-. 75 lb N/1000 ft2per

Table 5 illustrates a range of soluble and insoluble nitrate sources and illustrates recommended application rates for each formulation that have been successfully used at a similar golf course and are planned for the Golf Course. The proportion of highly soluble and slow-release nitrogen fertilizers used on the Golf Course will vary with management area and time of year. Roughly 50 to 60% of fertilizers applied to greens and tees will be in water soluble farms, while the remaining 40 to 50% will be of the slow-release variety. Typical application rates for greens and tees are approximately 1 lb N/1000 ft2per growing month.

A higher proportion of nitrogen applications (up to 65%) on fairways will be slow-release or delayed-release formulations. Total nitrogen added per year on fairways after grow-in will be approximately 2-3 lbs/1000 ft2. To maximize utilization of the applied nitrogen sources, each application will be applied between .25 -.75 lbs/1000 ft2. This will allow for a more precise controlled release application and reduce the risk of over-fertilization.

Table 5. Nitrogen Fertilizer Annual Usage for a similar golf course, which are projected to be approximately the same for the Golf Course.

Table 5. Nitrogen Fertilizer Annual Usage for The Lamington Farm Golf Course in Somerset County, Bedminster, New Jersey

I. GROUP (Greens/Tees)		
Water-Soluble[1]	**Single Application**	**Maximum Yearly**
1. Lesco 16-32-16	.10-.20 lb/N/1000 sq. ft.	
2. Lesco Green-Flo 30-0-0	.25-.50 lb/N/1000 sq. ft.	
3. Lesco 30-0-17	.10-.20 lb/N/1000 sq. ft.	Greens and Tees[2] will receive 5-6 lbs/N/1000 sq. ft./yr of water soluble products
4. Lesco 20-20-20	.10-.20 lb/N/1000 sq. ft.	
5. Oro More12-62-0	.10-.20 lb/N/1000 sq. ft.	
6. Oro More 20-5-30	.10-.20 lb/N/1000 sq. ft.	
7. Oro Power 6-2-8	.30-.75 lb/N/1000 sq. ft.	
8. Plant Marvel 20-20-20	.10-.20 lb/N/1000 sq. ft.	
9. Urea 45-0-0	.30-.75 lb/N/1000 sq. ft.	
10. Scotts Fluid 20-5-30	.10-.20 lb/N/1000 sq. ft.	
Slow Release (Primarily)		
1. Scotts 22-0-16	.50-.75 lb/N/1000 sq. ft.	Greens and Tees will receive 3-4 add'l lbs/N/ 1000 sq.ft./yr of water insoluble products
2. Scotts 19-26-5 [3]	.50-.75 lb/N/1000 sq. ft.	
3. Scotts 15-0-30	.50-.75 lb/N/1000 sq. ft.	
4. STEP (trace elements)[4]	.50-.75 lb/N/1000 sq. ft.	
5. Lesco 29-0-0	.50-.75 lb/N/1000 sq. ft.	
6. Lesco 21-4-11	.50-.75 lb/N/1000 sq. ft.	
7. Lesco 14-2-14	.50-.75 lb/N/1000 sq. ft.	
8. Lebanon 16-4-8	.50-.75 lb/N/1000 sq. ft.	
9. Agway 0-0-50	1-2 lb/K/1000 sq. ft.	
10. Alternative Nitrogen Sources [5]	varies, based on product	
II. GROUP (Fairways/Roughs)		
Water-Soluble [1]		
1. Colt 45-T 40-0-15	.25-.33lb/N/1000 sq. ft.	
2. Urea 45-0-0	.25-.33 lb/N/1000 sq. ft.	Fairways will receive 3-4 lbs/ N/1000 sq.ft/yr/ of water-soluble products
3. Calcium Nitrate 15-0-0	.25-.33 lb/N/1000 sq. ft.	
4. Ammonium Nitrate 34-0-0	.25-.33 lb/N/1000 sq. ft.	
5. Turf Royal 21-7-14	.25-.33 lb/N/1000 sq. ft.	
6. Lesco 33-0-17	.25-.33 lb/N/1000 sq. ft.	
7 Lesco 23-0-23	.25-33 lb/N/1000 sq. ft.	
8. Ammonium Sulfate 21-0-0	.25-.33 lb/N/1000 sq. ft.	
Slow Release (Primarily)		
1. Lesco 28-3-5 mini	.75-2.0 lb N/1000 sq. ft.	Fairways and Roughs will also receive 4-5 lbs N/1000 sq.ft./yr of water insoluble products[6]
2. Lesco 35-0-0 mini	.75-2.0 lb N/1000 sq. ft.	
3. Lesco 24-3-12 mini	.75-2.0 lb N/1000 sq. ft.	
4. Lesco 10-15-15 [3]	.75-2.0 lb N/1000 sq. ft.	
5. Par Ex 28-3-8	.75-2.0 lb N/1000 sq. ft.	
6. Scott 32-3-10	.75-2.0 lb N/1000 sq. ft.	
7. Scott 22-0-22	.75-2.0 lb N/1000 sq. ft.	
8. CropMag 36	3.0-6.0 lb N/1000 sq. ft.	
9. Alternative Nitrogen Sources [5]	varies, based on product	

[1] -Formulations will be selected in accordance to field inspection, soil and tissue testing. The above rates include 1-3 lbs during grow-in.
[2] -Tees typically use 20-30% more (N) fertilizer than the greens.
[3] -Starter materials will be used during the first year of construction and for establishment of nursery grasses.
[4] -Trace elements will be added according to soil tests.
[5] -Refer to products on Table 6 for choice in Natural Organic Materials.
[6] -Roughs will receive 60% less (N) fertilizer than the fairways and will be governed by the mitigation measure results of the WQRA.
[7] -Granular applications will not exceed these rates and will be adjusted according to the amount of fertigation applied to the golf course.

NOTE: Water-soluble products will be used during periods of active plant growth and during periods of less frequent rains.

3.4.4 Organic Fertilizers

One rapidly emerging field of alternatives is the use of "natural organic" fertilizers to reduce or suppress fungus disease. In laboratory, greenhouse and field studies, it has been shown that the natural organic fertilizers (Ringer®, Sustane®, and All Gro Compost®) can suppress disease development from 50% to 100% (Nelson, 1990). The suppression and the severity were noted on a wide range of diseases including ones projected for this site: brown patch, dollar spot and pythium root rot. These nitrogen sources were not found to leach from cool *season* golf greens.

Table 6 presents alternative nitrogen sources available and rates of application consistent with those recommended by each manufacturer.

Table 6. Alternative Nitrogen Sources

Slow Release Synthetic Material

Trade Name	Manufacturer	Analysis	Release	Formulation
Nutralene®	Nor-Am	40-0-0	12-16 weeks	Methylene Urea
Polyon®	Pursell Ind.	42-0-0	9-12 weeks	Osmotic Polymer Coated Urea

Natural Organic Material

Nature Safe®	Griffen Ind.	10-2-8	5-12 weeks	Hydrolyzed Feather meal
Resurge®	Quad Five	7-7-7	12-16 weeks	Feather meal
Turf®	Ringer	12-2-6	5-7 weeks	Feed grade animal protein
Sustane®	Sustane Corp.	5-2-4	12-16 weeks	Turkey waste composted

Table 6 (continued)
Recommended Rate of Application

Product®	lbs.N/1,000 ft 2	lbs. of Product/1,000 ft 2	Total lbs./Acre
Nutralene®	0.75 - 2.00	1.90 - 5.00	83 - 217
Polyon®	0.75 - 2.00	1.80 - 4.80	78 - 209
Nature Safe®	0.50 - 1.00	5.00 - 12.0	217 - 450
Resurge®	1.00 - 2.00	15.0 - 30.0	653 - 1,306
Turf®	1.00 - 2.00	8.50 - 17.0	370 - 740
Sustane®	1.00 - 2.00	20.0 - 40.0	871 - 1,742

Note: Natural organic materials manufactured from wastewater sewage sludge will not be used at the Golf Course because of potential contamination with heavy metals.

3.4.5 Recommended Hydro Seeding Specifications for the Native Plant Restoration Program

The native and ecological areas have been designed to be visually compatible with the habitat and grasslands that currently exist on the property and have been cataloged as true native grass types found in Albemarle County, Virginia. The project desires a shorter transition of grasses near the primary playing surfaces and a moderately more taller and dominant stand for the out of play areas. The natives proposed will be predominantly grass types and woody species selected and made available through bonafide contractors and/or ecological seed banks that are capable of meeting the project's plant list and seed bank needs.

In order to assist with the grow-in period and speed-up the germination of the seeded grass types we are recommending the disturbed portions of the playable primary roughs, transition roughs and native and ecological habitats be restored utilizing a Finn hydro-seeder. The following specification is designed with commercially available nutrient and biostimulant products designed to speed-up the establishment period and to reduce the need to irrigate during the grow-in. The following nutrient recommendation as part of the preplant, grow-in and hydro seed mix specification are presented. The specification has been used very successfully on similar native restoration projects utilizing very low supplemental irrigation rates.

The hydro seeding process may be assisted by a hydro-seeder. Table 7 provides the nutrient and biostimulant products listed for the native plant restoration grow-in program. The products are manufactured by Floratine Products Group, Inc., in Collierville, TN.

Table 7. Hydro Seeding Specification for the Native Habitat Revegetation

Hydro Seed Material	Rate of Application	Contact
Stick Plus Fiber Mulch	20 lbs./ac	Mr. Al Schrand
Synthetic Fiber Tackifier	10 lbs./ac	Finn Corporation 9281
FINN MB Soil Bacteria	1 2-5.0 gallons/ac	LeSaint Drive Fairfield
Finn Hydro Germinator	20 ounces/50 lbs. of seed	Ohio 45014-5457
Finn HST Hydro Soil	2.5 gallons/ac	(800)-543-7166
Hydro Plan Fertilizer	10-44-6 at 7.5 lbs./ac	

3.4.6 Fertilizer Injection

The Golf Course will install a state-of-the-art prescription irrigation system. The system will supply plant nutrients in ultra low amounts and buffering agents at prescribed periods via a process known as "spoon-feeding". The prescribed rates for the application of nutrients will be directly tied to the soil and plant tissue testing program. Buffering agents will focus on meeting the parameters of the

irrigation suitability tests and will be used to adjust the water quality parameters for total soluble salts and bicarbonates.

Fertigation is extremely beneficial during the grow-in period and helps to fortify nutrient deficiencies on fallow soils disturbed during the construction process. However, the most important aspect of the fertigation process is the judicious use of plant nutrients that allows the turfgrass to be managed under ideal and optimum growing conditions. Fertigation focuses on making available specific slow release fertilizer in readily available concentrations resulting in immediate plant uptake with virtually no nutrient waste or plant loss. The prescribed material is injected during the first flush of the supplemental irrigation process and is followed by a subsequent prescribed amount of irrigation to the appropriate turfgrass zones. Thus, the programming of the fertigation system delivers the nutrient irrigation water only to the appropriate prescribed areas of turfgrass at micro-managed water soluble foliar rates. This reduces the amount of fertilizer concentrations in the environment and the potential for traditional granular fertilizer applications to impact ground and surface water quality. Furthermore, this will minimize the use of fertilizers and turfgrass chemicals on the Golf Course.

All foliar applications will be based on the results of the soil and plant tissue analysis. The total amount of nitrogen, potassium and phosphorus will be applied according to the rates listed in Table 5 of this report. However, granular applications will be adjusted according to the amount of fertigation applied during the growing periods. Fertigation will not be applied during the dormant periods of plant growth. Table 8 depicts the estimate of micro and macro-nutrients including the irrigation water application rates to be considered on average for 100 acres of irrigated turfgrass with injectable plant nutrient materials.

Table 8. Proposed Fertigation Nutrients and Application Methods

Integrated Granular Nutrients Including Injectable Fertigation Materials	Grow-in Phase [1]	Mature Phase [1]
nitrogen	500 - 2000 gallons	300 - 1500 gallons
phosphorus [3]	400 - 1500 gallons	0 - 300 gallons
potassium	500 - 2000 gallons	300 - 1500 gallons
micro-nutrient package	200 - 450 gallons	200 - 450 gallons
humic acid or bio-stimulants	200 - 450 gallons	200 - 450 gallons
pH fairway	TBD	TBD
Fertigation Materials Only		
nitrogen	2000 - 5000 gallons	1500 - 3000 gallons
phosphorus	1500 - 4500 gallons	100 - 500 gallons
potassium	2000 - 5000 gallons	1500 - 3000 gallons
micro-nutrient package	300 - 1000 gallons	100 - 500 gallons
humic acid or bio-stimulants	300 - 1000 gallons	100 - 500 gallons
pH fairway	TBD	TBD

[1] Only on turfgrass areas that have been seeded or sodded and require irrigation. Soil chemical analysis and plant tissue testing will be completed prior to applying the proposed rates. Irrigation suitability tests will be performed to determine the appropriate rates of pH fairway buffering material
[2] All applications will be adjusted so as not to exceed the total yearly amounts listed for organic, synthetic and alternative sources turfgrass fertilizer depicted in Table 5. All sources of nutrients will comply with the mitigation proposed in the WQRA.
[3] More phosphorus will be necessary during the grow-in period. A phosphorus isotherm test will be conducted to determine the exact amount of phosphorus that will be needed to release and make available phosphorus to the new seedlings.
[4] Potassium will be made available to assist in root development and to combat stress during grow-in. Adjustments will be made upon the results of the soil tests after grow-in.

The fertigation equipment will be installed at the pump stations for the Lamington Farm golf course.

Note: At least three qualified fertigation equipment sources from the following injection companies (i.e., PlantStar, Werecon, Nutrifeed Turf Feeding Systems, and DGT/Voltmatic) will be considered in the bid specification documents for the Golf Course. The fertigation system will be designed to match the efficiency of the proposed pump stations and will be designed to accommodate at least three injectable sources of material for application in a single cycle of supplemental irrigation.

Nutrient Management Mitigation

Nutrient mitigation will be a direct result of the Water Quality Risk Assessment. The Golf Course superintendent may be required to adjust the nitrogen/nitrate rates as well as the proposed levels of phosphorus and potassium.

3.5 Restored Areas

The secondary roughs or areas restored after construction will be re-vegetated with a mix of grassy species: 15% of the mix will contain Hard fescue *(F. ovina var. duriuscula-Festuca longifolia),* 40% Little bluestem *(anciropogon scoparius)* 10% Indiangrass *(Sorghastrum nutans),* 10% Switchgrass, 10% Weeping Lovegrass *(Eragrostis curvula)* and 5% Redtop *(Agrostis alba).* Certain species will be propagated while others will be placed.

3.5.1 Naturalized Restoration Plan

This section will be finished after Special Use Permit approval.

Chapter IV

Integrated Pest Management for the Golf Course

Proper detection and identification of insects and mites in turf, combined with pest tolerance thresholds, is the key to an Integrated Pest Management system that will produce optimal results with minimal undesirable side effects. Numerous IPM strategies have been perfected for this purpose. In an IPM program, the mere presence of an insect in turf is not a valid reason for taking steps for control. Rather, a thorough knowledge of the pest population is needed before the proper response can be formulated. Some potential pests will be more problematic than others. These are rated in a Pest Infestation Index in this chapter, and thresholds for action are provided for each of the anticipated pests.

4.1. Pest Sampling Guidelines

The Golf Course superintendent and/or the assistant Golf Course superintendent will monitor each golf hole for indications of reduced turfgrass quality. The superintendent will be responsible for the correct identification and documentation of any fungi, insects or weeds found, and will look first for environmental adjustments that might reduce or eliminate the pest. Improving ventilation, selectively removing vegetative growth, and physically removing small pest populations are examples of steps to be taken before other

intervention methods are considered. Soil, pH, nutrient content, sodium levels, temperature and moisture content will also be evaluated to determine if they could be contributing to the pest presence.

Samples of unidentified insects, weeds, nematodes or pathogens will be forwarded to a reputable laboratory for assistance in proper identification and procedural control. If the need arises to obtain and determine a control option, the assistance of an appropriate environmental firm, state agency, or extension service specialist will be sought.

4.1.1 Visual Inspection

The old-fashioned technique of looking closely at the turf is still the most valuable. If, upon pulling up on the turf, the roots break off easily, the staff will look for the sawdust of billbugs. If frass (insect fecal pellets) are present, a disclosing solution can be used to determine if turf caterpillars are present.

If a pest is detected, it is important to know the extent of the problem. The transect method involves walking in a line across the affected turf; and counting the number of damaged areas observed. Square foot samples are often useful if billbugs, mites or scales are suspected. A square-foot flap of turf is cut and the visible grubs in the soil are counted. Alternately, a standard golf course cup cutter may be used to take turf and soil samples. The cup cutter sample is multiplied by 10 to determine the number of insects per unit area.

4.1.2 Disclosing Solutions

Many turf insects and mites defy easy detection by the human eye. Therefore, a disclosing solution of pyrethrum or soap is used. A disclosing solution of 1.0 oz. of household dish washing detergent (Joy® liquid is known not to cause turf damage) in two gallons of water is effective. The water is applied to a one-square yard area with a common garden sprinkling can. Within 3-5 minutes the caterpillars will come to the surface where they can be easily counted. Occasionally, billbug adults and other insects are also flushed out.

4.1.3 Trapping.

Some of the turf infesting insects are attracted to lights or chemical attractants (pheromones) and can be easily monitored. Most cutworms, sod webworms, and many night flying white grub adults can be collected in a light trap. Pheromone traps have been developed for cutworms, sod webworms, and armyworms. Other insects, such as billbugs, can be monitored by using simple pitfall traps placed along the side of turf areas.

Light traps generally use an ultraviolet (UV) bulb which is attractive to most night flying insects. By running a trap several nights a week and counting the cutworms, sod webworms or armyworm adults, an estimate can be made of when turf damage *could* occur. As an example, black cutworm adults are easily captured in a light trap and larvae can be expected on greens and tees about two weeks after peak adult catches,

Pheromone traps are even more precise than light traps because single species can be monitored. Pheromones exist for black cutworms and most of the armyworm complex. The numbers captured can be used in a manner similar to light trap counts.

A Pitfall trap used for monitoring billbugs is a 16 oz. cup buried in or next to turf with its rim level with the soil. Billbug adults fall into the trap and can be counted to monitor when activity begins. After two weeks of steady captures, it is time to sample for the larvae in the turf.

4.1.4 Disease Immunoassay Kits

Disease immunoassay kits may be used to aid in the identification of turfgrass disease. They may be used to detect and/or rule out the presence of a disease pathogen through positive indication. Currently, the kits are available for the following diseases: Brown patch, Dollar spot, and Pythium. The kits are used to assist in proper disease identification, to determine when it is *not* appropriate to apply a pesticide, and to reduce the potential for the wrong pesticide to be used because of misdiagnosis.

When fungus infestations are not readily identifiable by the Golf Course superintendent and his or her staff, samples will be sent to a laboratory for analysis. Chemical treatment will not occur until the fungus is properly identified so that the proper product is used. Laboratory results are usually available within 48 to 72 hours.

4.2 Environmental Monitoring

Since most pest activity is regulated by weather conditions, several methods have been developed which use weather monitoring to predict pest development. These methods (or models) suggest when activity will occur but not how much activity is present. When weather conditions are right, the staff is alerted to monitor for pests; however other steps already described will be required to determine if pests are actually present in sufficient numbers to cause damage to the turf.

4.2.1 Degree-day Models

"Degree-days" provide a method of measuring the degree of maturity an organism has reached due to weather conditions. Insects and mites develop more rapidly as they get warmer. Below a certain temperature threshold, little or no development takes place. There are no degree-day models available for the insects and mites on the Golf Course site. Degree-day models do exist for disease and pre-emergent weeds, however, and can be used to make predictions in conjunction with monitoring models established in the field.

Heating degree-days may be calculated manually if necessary (degree days = {daytime high (F°) -daytime low (F°)} divided by 2 - 50 F°). If a positive number remains, add this to the previous total to amass cumulative degree days. If the total is a negative number, the cumulative degree day is zero since negative heating degree days are non-existent.

4.2.2 Plant Phenology

Plant phenology is nature's degree-day model. Since plant development is also dependent on temperature, associating plant activity with insect activity can improve timing of controls.

4.3 Anticipated Pests

A list of known and probable weeds, insects, and fungus problems that can be expected at the Golf Course will be compiled from existing golf courses in the area, and other data taken from similar cool-season regions of the United States. By its nature, the list is not, and cannot be considered complete. However, it provides an adequate starting point that can be adapted and modified through actual field experience. The anticipated pest problems include 45 weed species, 25 turf diseases and 16 insects. However, only 21 key pests were identified and include 9 weeds, 8 diseases and 4 insects.

The pests of greatest concern to the greens and, to a lesser degree the tees, will be leaf contact pathogens. These pests can be identified by a combination of visual inspections and the use of turf disease detection kits (Reveal® or Dipstick). The following represents a general overview of the pest problems that might be encountered at the Golf Course. Pests are divided into three groups: weeds, diseases, and insects.

4.3.1 Weed Occurrence

Turfgrass weeds at existing golf courses in the area are minor in occurrence due to traditional low mowing practices and dense turfgrass competition. Weed problems associated with golf course turf are divided into two categories: grassy weeds (monocotyledons) and broadleaf weeds (dicotyledons). Mixed with other grassy plants, monocots will be allowed to flourish in the secondary roughs and areas left in a natural state. Handpicking or spot spray will be used in the primary roughs and fairways only. Table 9 is a list of annual monocotyledons turfgrass weeds anticipated and Table 10 is a list of perennial dicot broadleaf weeds. These grass weeds are the most likely to persist on cool-season turfgrass in the State of Virginia.

Table 9. Pest Identification-Annual Grass Weeds

Annual bluegrass	*Poa annua*
Barnyardgrass	*Echinochloa crusgalli*
Dallisgrass	*Paspalum dilatatum*
Goosegrass	*Eleusine indica*
Green foxtail	*Setaria viridis*
Large crabgrass	*Digitaria sanguinalis*
Purple nutsedge	*Cyperus rotundus*
Purpletop	*Tridens flavus*
Quackgrass	*Agropyron repens*
Small crabgrass	*Digitaria ischaemum*
Timothy	*Phleum pratense*
Yellow foxtail	*Setaria lutescens*
Yellow nutsedge	*Cyperus esculentus L.*

Table 10. Pest Identification-Perennial Broadleaf Weeds

Black Medic	*Medicago lupulina*
Broad-leaved plantain	*Plantago major*
Common chickweed	*Stellaria media*
Common speedwell	*Veronica officinalis*
Clover	*Trifolium repens*
Curly Dock	*Rumex crispus L.*
Dandelion	*Taraxacum officinale*
Ground Ivy	*Glechoma hederacea*
Heal-all	*Prunella vulgaris*
Henbit	*Lamium amplexicaule*
Knotweed	*Polygonum aviculare*
Lambsquarter	*Chenopodium album*
Mallow	*Malua rotundifolia*
Mouse-ear chickweed	*Cerastium vulgatum*
Nodding spurge	*Euphorbia maculata*
Oxalis	*Oxalis stricta*
Pearlwort	*Sagina procumbens*
Plantain	*Plantago rugelii*
Poison Ivy	*Rhus radicans*
Poison Oak	*Toxicodendron diversilobum*
Purslane speedwell	*Veronica peregrina*
Prostrate spurge	*Euphorbia prostrata*
Prostrate pigweed	*Amaranthus blitoides*
Ragweed	*Ambrosia sp.*
Red clover	*Trifolium pratense*
Sheep sorrel	*Rumex acetosella*
Shepherd's purse	*Capsella Bursa-pastoris*
Spotted spurge	*Euphorbia supina*
Stitchwort	*Stellaria graminea*
Thistle	*Cirsium sp.*
Yarrow	*Achillea millefolium*
Yellow wood sorrel	*Oxalis europaea*

4.3.2 Turfgrass Disease

There are six turfgrass diseases potentially posing a problem at the Golf Course: brown patch, dollar spot, fusarium patch, summer patch, take all patch, and pythium blight. The potential for disease pathogens points out the need to implement a visual monitoring and sampling control program once sod, seed, and hydromulching has been completed. Disease pressure under hot and humid growing conditions will probably remain the more persistent pest pathogen to control once the Golf Course matures and the grow-in period is complete. Cool-season disease and controls are presented in Table 11. The most likely turf diseases to be encountered at the Golf Course are presented in Table 12. The occurrence and severity will vary, depending on the time of year, weather conditions, fertility, and total dissolvable salts. Cultural practices that promote healthy turf will be employed to minimize weed occurrence.

Table 11 Key and Potential Turf Diseases in Somerset County, New Jersey and Non-Chemical Alternatives

Common Name	Scientific Name	Season	Cultural Strategies
anthracnose	*Co.letotrichum graminicola*	June-Sept brown patch	Provide adequate fertility. Avoid water stress (too much or too little) and compaction. Improve drainage, aerify as needed
Rhizoctonia so ani	June-Sept dollar spot	*sclerotinia homeocarpa*	Avoid excess Nand excess water in hot weather. Remove dew from putting greens. Improve air circulation (pruning as needed)
June-Sept			
downy mildew (yellow tuft)	*Sclerophthora macrospora*	May-Sept	Avoid N deficiency Remove guttation and dew from putting greens Maintain good soil moisture
fairy ring	several fungi	April-Oct	Avoid excessnand excess water Mask symptoms with iron sulfate
gray snow mold	*Typhula* spp	Nov-April	Mask symptoms with Nor iron Deep core and water
various leaf spots	*Bipolaris, Curvlaria Drechslera, Septoria,* et al.	April-Oct	Avoid lush growth in fall (avoid excess N in late fall). Mow until autumn growth ceases. Avoid extended snow cover, remove snow as soon as possible.
necrotic ring spot	*Leptosphaeria korrae*	June-Sept	Avoid excess N, especially in early spring Keep blades as dry as possible(avoid frequent, light irrigation)
pink snow !JIOld (Fusarium patch)	*Microdochium nivale*	Nov-April	Maximize root growth. Irrigate to maintain good soil moisture. Avoid fertilizer stress (too much or too little) Avoid compaction and excessivethatch
Pythium blight	*Pythium* spp	June-Aug	Avoid lush growth in fall (avoid excess N in late fall). Mow until autumn growth ceases. Avoid extended snow cover, remove snow as soon as possible
Pythium root rot	*Pythium spp.*	Mar-Nov red thread	Avoid excess N, do not water at night in hot weather Improve drainage, increase air ci rculation. Do not mow when wet. Can be server in hot humid weather.
Latisaria fucifonnis	April-Oct summer patch	*Magnaporthe poae*	Improve drainage, aerify, do not overwater Increase organic matter. Avoid N deficiency
July-Sept			and low pH. Do not overwater
take-all patch	*Gueumannomyces graminis*	Mar-June	Avoid over watering. Reduce compaction, improve drainage. Maintain adequate fertility. Lower pH in upper part of soil profile
		Sept-Nov	Avoid heavy lime applications Lower pH in upper part of soil profile (use acidifYing fertilizers or sulfur) Improve drainage Avoid P and K deficiency
yellow patch (cool season brown patch)	*Rhizoctonia cereals*	Nov-April	Avoid excess N.

bold- key pests standard type- potential pests

SOURCES. Gail Shumann, 1999. Professional Guide for IPM in Turf for Massachusetts U Mass Extension and Peter Landschoot, 1991
Managing Turf Diseases, Landscape Management

Table 12. Pest Identification- Turfgrass Disease and Noninfectious Biological Agents

Algae[1]	*Cyanobacteria* - Blue-green algae
Antbracnose	*Colletotrichum graminicola*
Bacterial wilt	*Xanthomonas spp.*
Brown patch	*Rhizoctonia solani*
Copper spot	*Gloeocercospora sorghi*
Crown and root rot	*Bipolaris tetramera*
Dollar spot	*Sclerotinia homoeocarpa Lanzia spp.*
Downy mildew	*Sclerophthora macrospora*
Fairy ring	*Marasmius oreades*
Fusarium patch	*Fusarium nivalis*
Helminthosporium leaf spot	*Bipolaris sorokiniana*
Leaf rust	*Puccinia spp.*
Melting out	*Drechslera poae*
Moss[2]	*Bryophyta spp.*
Necrotic ring spot	*Leptosphaerta korrae*
Nematodes[3]	*Crtconemoides, Meloidogyne, Helicotylenchus, Pratylenchus, spp.*
Pink patch	*Limonomyces roseipellis*
Powdery mildew	*Erysiphe raminis*
Pythium blights	*Pythium aphanidermatum* *Pythium ultimum*
Red thread	*Laetisarta fuciformis*
Slime molds	*Physarum cinereum*
Snow molds	*Typhula incarnata, T.ishikariensis*
Summer patch	*Magnoporthe poae*
Take all patch	*Gaeumannomyces graminis*
White patch	*elanotus phillipsii*

Biotic Agents of Noninfectious Diseases

[1] Develops on the surface of overly wet soils.

[2] Small plants that overgrow and compete with turf when wetness, poor nutrition, and soil conditions exist.

Nematode Diseases

[3] May be diverse and are dependent on the population of plant-parasitic and saprophytic density.

4.3.3 Turfgrass Insects

The Golf Course will experience minor outbreaks from turfgrass insects.

Turfgrass insects may be considered major pests on turf in Albemarle County, Virginia. However, the most common turfgrass insects that may potentially affect turfgrass quality are the black ataenius and white turfgrass grubs. Black cutworms may remain fairly persistent in putting green surfaces. However, the proposed grassing to the newer cultivars of bentgrass includes varieties which provide specific resistance to the surface feeding insects (e.g., sod webworm, cutworms).

A list of probable leaf and stem feeding insects are provided in Table 13. These are the more common turfgrass pathogens which have the ability to destroy healthy areas of turfgrass. Tolerable levels below threshold limits should pose no threat to the desirable playing quality of the Golf Course. Each insect will be monitored for baseline detection and an established threshold level will be developed.

Table 14 provides a timeline of insect activity at a similar golf course. Most turfgrass insect pests are cyclical and will typically require some form of treatment even under ideal environmental growing conditions. There has been a trend common amongst many golf course superintendents to monitor turfgrass quality and allow the insect to complete its natural life cycle. This concept has been more successful on warm-season grasses than on most cool-season turf.

We anticipate the range of activity to be possibly severe for only two insect pests. Of the two, black ataenious will be easier to detect and control. Generally, large populations of white grubs are necessary before noticeable symptoms of turfgrass decline are evident. Cutworms will be more persistent but will be the easiest to control with either parasitic nematodes or through a biorational biopesticide approach using natural chemicals or Pheromones.

Additional information may be found in Appendix E Insect and Mite Management Summaries. The information is provided to assist with the field monitoring requirements for turfgrass insects and to suggest potential alternatives to traditional controls for turfgrass insects.

Table 13. Pest Identification - Turfgrass Insects

Common Name	Pathogen	Scientific Name	Founder
Annual bluegrass weevil	weevil (beetle)	*Hyperodes anthracinus*	Dietz
Ants	ants	*Formicidae*	
Black cutworm	moth	*Agrotis ipsilon*	Hufnagel
Bluegrass billbug	weevil (beetle)	*Sphenophorus parvulus*	Gyllenhal
Hairy chinch bug	true bug	*Blissus leucopterus hirtus*	Montandon
Sod webworm	moths	*Pyralidae; Crambinae*	
Bluegrass sod webworm	moth/ caterpillar	*Parapediasia teterrella*	Zincken
Larger sod webworm	moth/ caterpillar	*Pediasia trisecta*	Walker
White grubs	grubs (beetles)	*Scarabaeidae*	
Asiatic garden beetle	grub	*Maladera castanea*	Arrow
Black turfgrass ataenius	grub	*Ataenius spretulus*	Haldeman
Japanese beetle	grub	*Popillia japonica*	Newman
May/June beetles	grub	*Phyllophaga spp.*	
Northern masked chafer	grub	*Cyclocephala borealis*	Arrow
Oriental beetle	grub	*Anomala orientalis*	Waterhouse
Winter grain mite	mite	*Penthaleus major*	Duges

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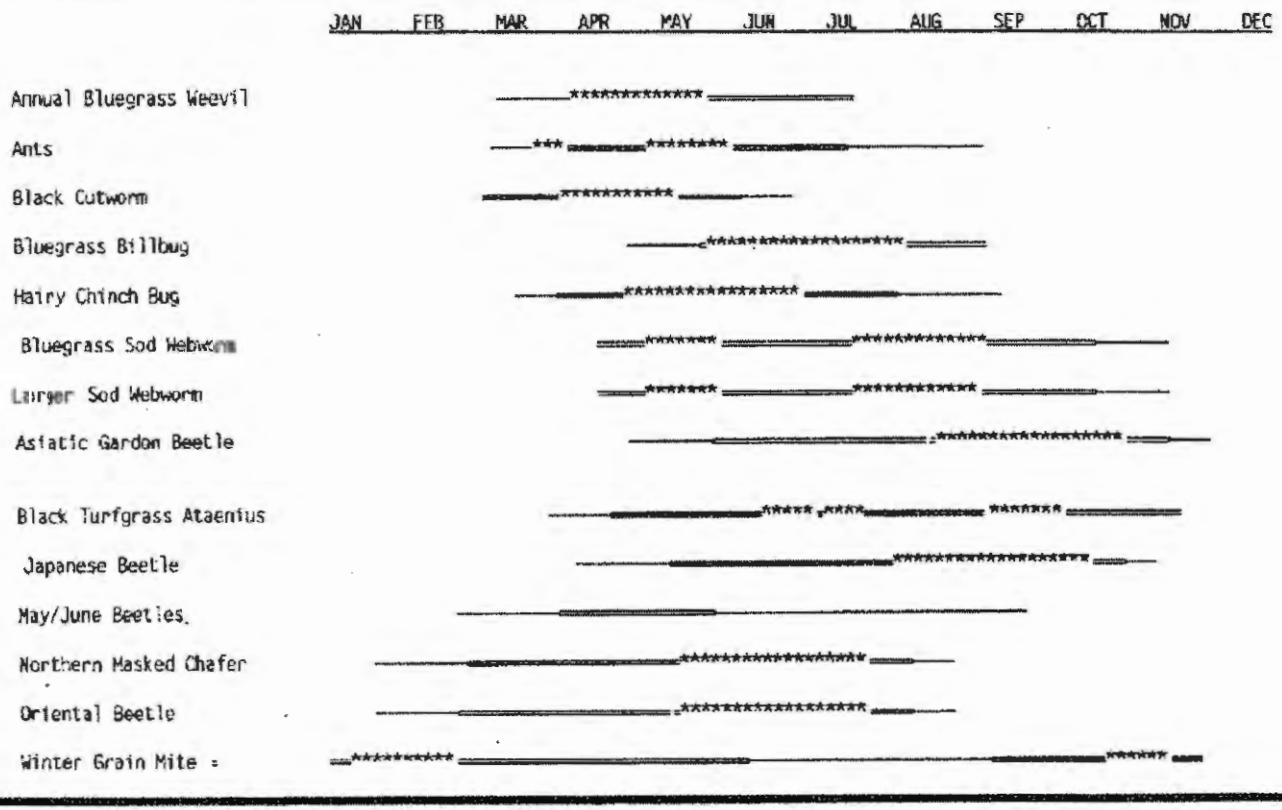
Table 14. Timeline Estimate of Insect Activity for Somerset County, New Jersey.



= possible occurrence, rarely at pest levels

= probable occurrence, occasionally at pest levels

= most commonly at pest levels

4.4. Location and Extent of Pest Infestation

In spite of being considered a monoculture, the turfgrass environment is actually quite complex and hosts a wide variety of organisms. The turf habitat carries a host of soil microbes involved with nutrient and material recycling. They provide the nutritional basis for soil, thatch, and foliar feeding animals. These herbivores in turn serve as "food" for secondary consumers known as predators and parasites.

There are only a few turfgrass organisms known to be potentially damaging as pathogens. These pathogens can be separated and identified as key, occasional, or potential pests. The extent and locality for each pest may be compared to the preliminary threshold levels along with the suggested methods of control. Although some level of control may be warranted, the object is to provide protection of beneficial turfgrass organisms as well. This may be accomplished by tolerating some level of natural pathogens. Allowing build-up of microorganisms and neutral fauna will help to balance the network of non-pests in the turfgrass environment. These pests present little or no chance for injury and comprise a vast majority of the insects and mites found in turfgrass today.

Tables 15, 16, 17, and 18 list the potential pest problems anticipated on each Golf Course. They are listed in the order of weeds, disease, and insects. Each pest listed has been given a Pest Index code that determines the probability of impact. A corresponding Frequency Index to determine the degree of likelihood is also provided. Key pests have been ranked for bentgrass, bluegrass, and turf-type fine leaf fescue and are compared with historical pest problems reported from existing golf courses.

Table 15. Location and Extent of Pest Infestation for Grassy Weeds

Pest Infestation Index

a. Weeds Monocotyledons	Pest Index	Location	Frequency Index
Annual bluegrass	K	T F G PR	5
Barnyardgrass	P	F PR SR	3
Dallisgrass	P	F PR SR	3
Goosegrass	K	F PR SR	5
Green foxtail	O	SR	1
Large crabgrass	K	F PR SR	5
Purple nutsedge	P	T F PR S R	4
Purpletop	O	PR SR	2
Quackgrass	P	F PR SR	3
Small crabgrass	K	T F PR SR	5
Timothy	O	PR SR	2
Yellow foxtail	O	F PR SR	2
Yellow nutsedge	O	F PR SR	2

Table 16. Location and Extent of Pest Infestation for Dicot Weeds

Pest Infestation Index

b. Weeds Dicotyledons	Pest Index	Location	Frequency Index
Black medic	O	PR SR	2
Broad-leaved plantain	K	T F PR SR	5
Common chickweed	O	T F G PR SR	4
Common speedwell	O	T F PR SR	2

Frequency of Severe Outbreaks: 1-Low.....5-High

Location Index: T=Tees F=Fairways G=Greens PR= Primary Roughs SR=Secondary Roughs

Pest Index: K=Key Pest P=Potential Pest O=Occasional Pest

Table 16 (continued). Location and Extent of Pest Infestation for Dicot Weeds

Pest Infestation Index

b. Weeds Dicotyledons:	Pest Index	Location	Frequency Index
Clover	K	T F G PR SR	5
Curly dock	O	F PR SR	2
Dandelion	K	T F PR SR	5
Ground ivy	O	F PR SR	2
Heal-all	P	F PR SR	3
Henbit	O	F PR SR	1
Knapweed	P	SR	4
Knotweed	P	T F PR SR	3
Lambsquarter	P	F PR SR	4
Mallow	P	F PR SR	2
Mouse-ear chickweed	K	T F G PR SR	5
Nodding spurge	O	T F PR SR	2
Oxalis	O	F PR SR	2
Pearlwort	P	T F G PR SR	5
Plantain	P	F PR SR	4
Poison ivy	P	SR	4
Poison oak	P	SR	2
Purslane speedwell	O	F PR SR	2
Prostrate spurge	O	T F PR SR	3
Prostrate pigweed	O	T F PR SR	2
Ragweed	P	SR	2
Red clover	K	T F PR SR	5
Shepherd's purse	O	T F PR SR	1
Sheep sorrel	P	F PR SR	3
Spotted spurge	O	T F PR SR	2
Stitchwort	O	F PR SR	2
Thistle	P	PR SR	3
Yarrow	O	T F G PR	2
Yellow wood sorrel	O	F PR SR	2

Frequency of Severe Outbreaks: 1-Low.....5-High
Location Index: T=Tees F=Fairways G=Greens PR= Primary Roughs SR=Secondary Roughs
Pest Index: K=Key Pest P=Potential Pest O=Occasional Pest

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Table 17. Disease and Noninfectious Biological Agents

Location and Extent of Pest Infestation

Pest Infestation Index

c. Disease and Noninfectious Biological Agents	Pest Index	Location	Frequency Index
Algae [1]	K	TFG	5
Anthracnose	K	TFG	5
Bacterial wilt	O	FR	2
Brown patch	P	TFGPR	3
Copper spot	P	TFG	3
Crown and root rot	P	TFG	4
Dollar spot	K	TFG	5
Downy mildew	O	TFPR	2
Fairy ring	P	TFG	3
Fusarium patch	P	TFGPR	3
Helminthosporium leaf spot	P	TFGPR	4
Leaf rust	P	TFG	3

Frequency of Severe Outbreaks: 1-Low.....5-High

Location Index: T=Tees F=Fairways G=Greens PR= Primary Roughs SR=Secondary Roughs

Pest Index: K=Key Pest P=Potential Pest O=Occasional Pest

Biotic Agents of Noninfectious Diseases

1 **Develops on the surface of overly wet soils**

2 **Small plants that overgrow and compete with turf when wetness and poor nutrition and soil conditions exist.**

Nematode Diseases

3 **May be diverse and are dependent on the population of plant-parasitic and saprophytic density.**

Table 17 Disease and Noninfectious Biological Agents (continued).

Location and Extent of Pest Infestation

Pest Infestation Index

c. Disease and Noninfectious Biological Agents	Pest Index	Location	Frequency Index
Melting out	P	T F G PR SR	4
Moss[2]	P	T G	3
Necrotic ring spot	K	T F G	5
Nematodes[3]	O	T F G	2
Pink patch	P	T F G	3
Powdery mildew	O	T F G PR	2
Pythium blights	K	T F G	5
Red thread	P	T F G PR SR	3
Slime molds	O	T F G PR SR	2
Snow molds	K	T F G PR SR	5
Summer patch	K	T F G PR	5
Take all patch	K	T F G PR	5
White patch	O	T F PR	2

Frequency of Severe Outbreaks: 1-Low.....5-High

Location Index: T=Tees F=Fairways G=Greens PR= Primary Roughs SR=Secondary Roughs

Pest Index: K=Key Pest P=Potential Pest O=Occasional Pest

Biotic Agents of Noninfectious Diseases

1 **Develops on the surface of overly wet soils**

2 **Small plants that overgrow and compete with turf when wetness and poor nutrition and soil conditions exist.**

Nematode Diseases

3 **May be diverse and are dependent on the population of plant-parasitic and saprophytic density.**

Table 18. **Location and Extent of Pest Infestation**

Pest Infestation Index

d. Insects	Pest Index	Location	Frequency Index
Annual bluegrass weevil	K	T F G PR SR	5
Ants	O	T F G PR SR	1
Black cutworm	P	T G	4
Bluegrass billbug	P	F R	3
Hairy chinch bug	P	T F G PR SR	3
Sod webworm	P	T G PR	4
Bluegrass sod webworm	P	T F PR SR	3
Larger sod webworm	P	T F G	3
White grubs	K	T F G PR SR	5
Asiatic garden beetle	P	T F G	4
Black turfgrass ataenius	K	T F G PR SR	5
Japanese beetle	P	T F G PR SR	4
May/June beetles	O	F PR SR	1
Northern masked chafer	K	T F G PR SR	5
Oriental beetle	P	T F G PR SR	3
Winter grain mite	O	T F G	1

Frequency of Severe Outbreaks: 1-Low.....5-High

Location Index: T=Tees F=Fairways G=Greens PR= Primary Roughs SR=Secondary Roughs

Pest Index: K=Key Pest P=Potential Pest O=Occasional Pest