Nutrient Management Planning for New York State Golf Courses

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Protecting the Environment
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BEST MANAGEMENT PRACTICES

Nutrient Management Planning for New York State Golf Courses

NICK MENCHYK
Assistant Professor,
Department of Urban Horticulture and Design,
Farmingdale State College,
State University of New York

Introduction

Mineral nutrient (fertilizer) applications to landscapes are recognized as a persistent risk to water quality. Increasing precision of fertilizer applications on golf courses is an essential aspect of golf course best management practices (BMPs) and provides a stress and pest tolerant turfgrass and successful playing surface. The first step to improving application efficiency is proper spatial assessment of nutrient requirements that calibrate nutrient applications to plant growth.

Electromagnetic induction (EMI) has been adapted for mapping golf course soils in order to develop a targeted sampling strategy based on rapid assessment of soil texture. Once nutrient levels are determined, the values are interpreted using the Minimal Level of Sustainable Nutrition (MLSN) soil nutrient interpretation guidelines. Finally, the turfgrass growth potential (GP) model provides predicted nutrient needs based on variable plant demand through the growing season. This ensures nutrients are applied in amounts and at times when plants are most capable of uptake and utilization, thereby minimizing risk to water quality.

Soil *Mapping*

Spatial assessment of golf course soils has improved due to the availability of online soil mapping resources, such as the Natural Resources Conservation Service's Web Soil Survey (WSS), and the use of EMI technology to map golf course landscapes. EMI-based soil mapping uses georeferenced points to identify soil variability based on rapid assessment of electrical conductivity, which is a function of soil water status and a predictable correlation to soil texture.

Step 1: *Launch the WSS.*

Go to WSS, then click on the large green button labeled "Start WSS."

Step 2: *Determine the area of interest (AOI).*

The WSS will initially load a map of the lower 48 states (Figure 1). From this page, enter the property address in the left toolbar to zoom in on a more detailed map.

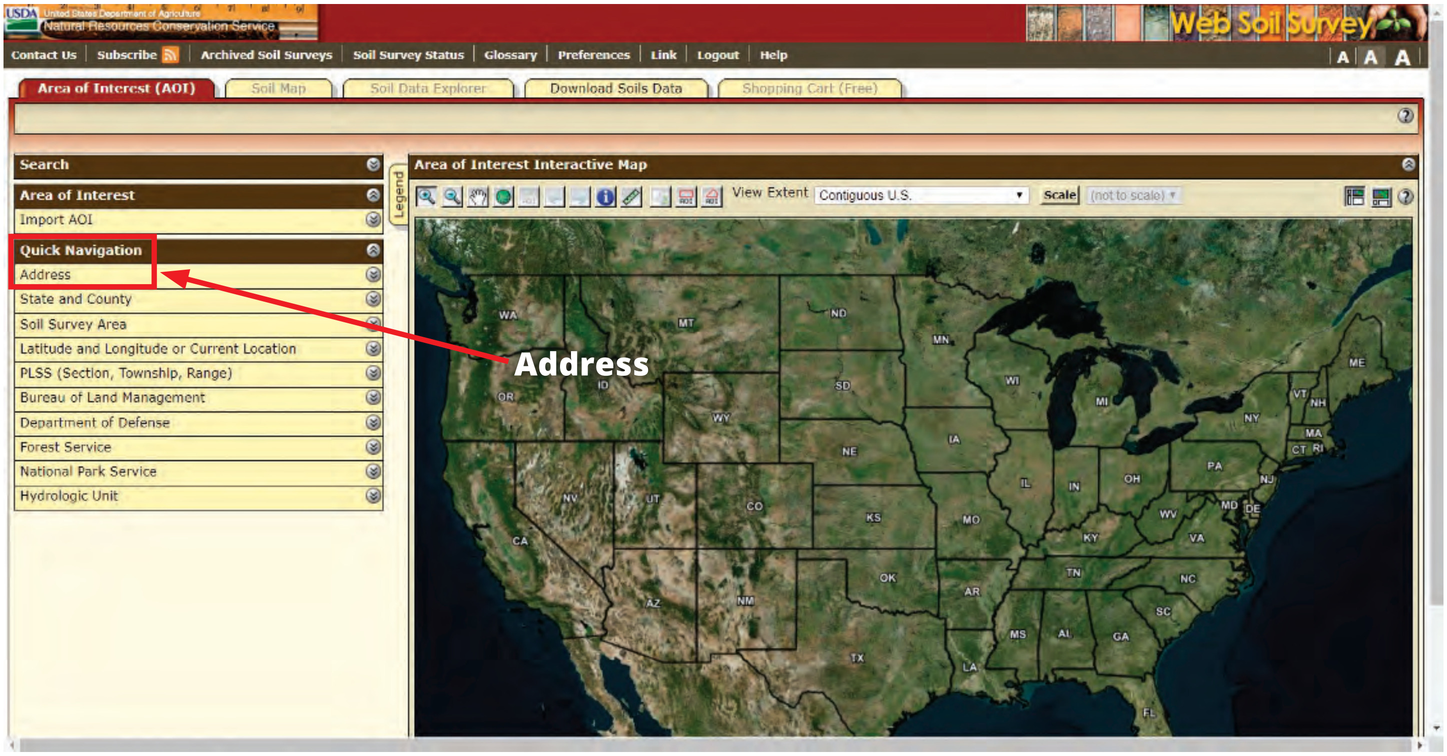

Figure 1. Landing page of the WSS, where you can type in a property's address.

The next step of using the WSS is to determine a specific AOI on the zoomed-in map. This generates the soil data for the AOI and allows for further exploration of a multitude of soil attributes (Figure 2).

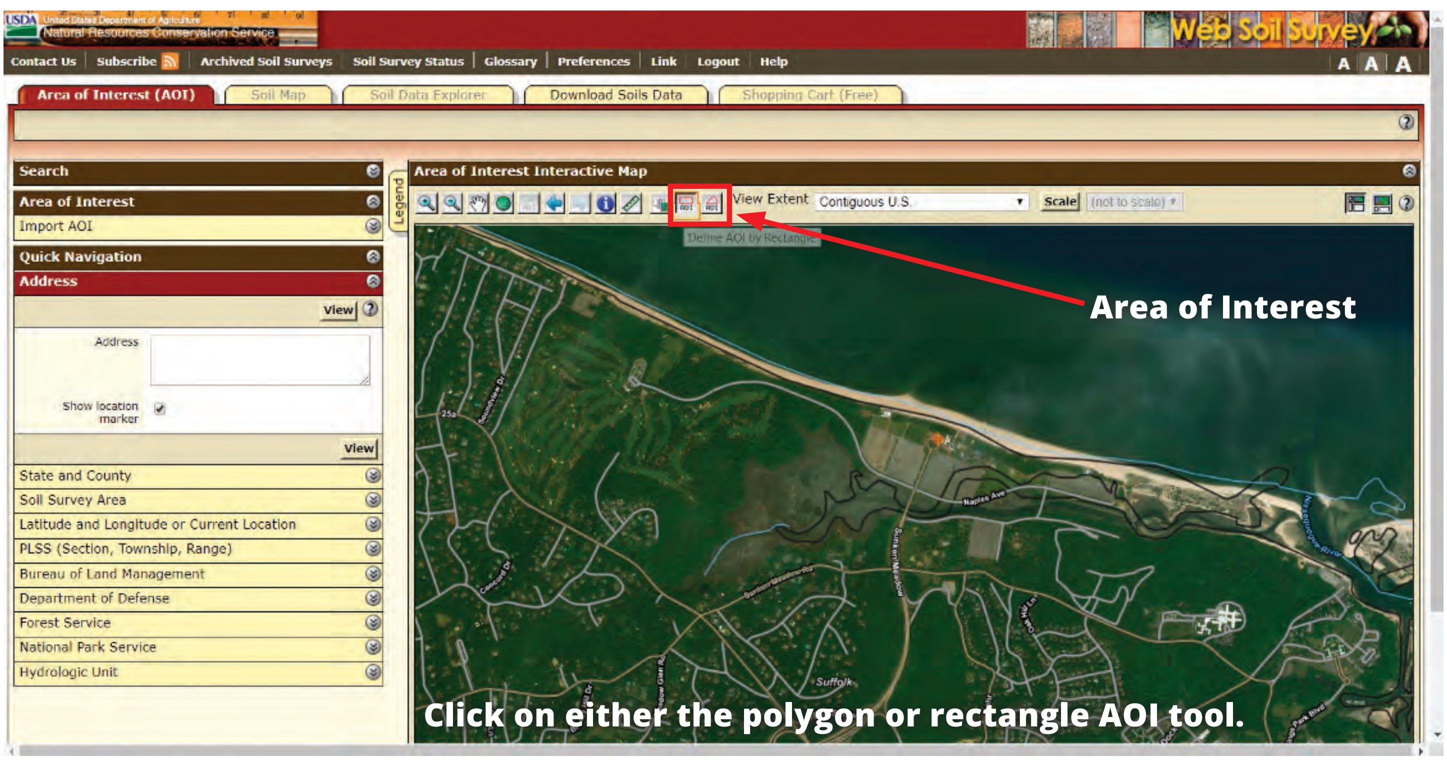

Figure 2. The area of interest tool enables you to explore soil attributes.

Step 3: ***Download soils data.***

Soil data can be downloaded using the tabs at the top of the page (Figure 3). Soil data includes information on the soil type (series/phase), slope, hydrologic group (runoff potential), drainage class, proximity to water bodies (ground and surface), and many more characteristics. This mapping can help identify different soils and management zones that will inform soil sampling procedures.

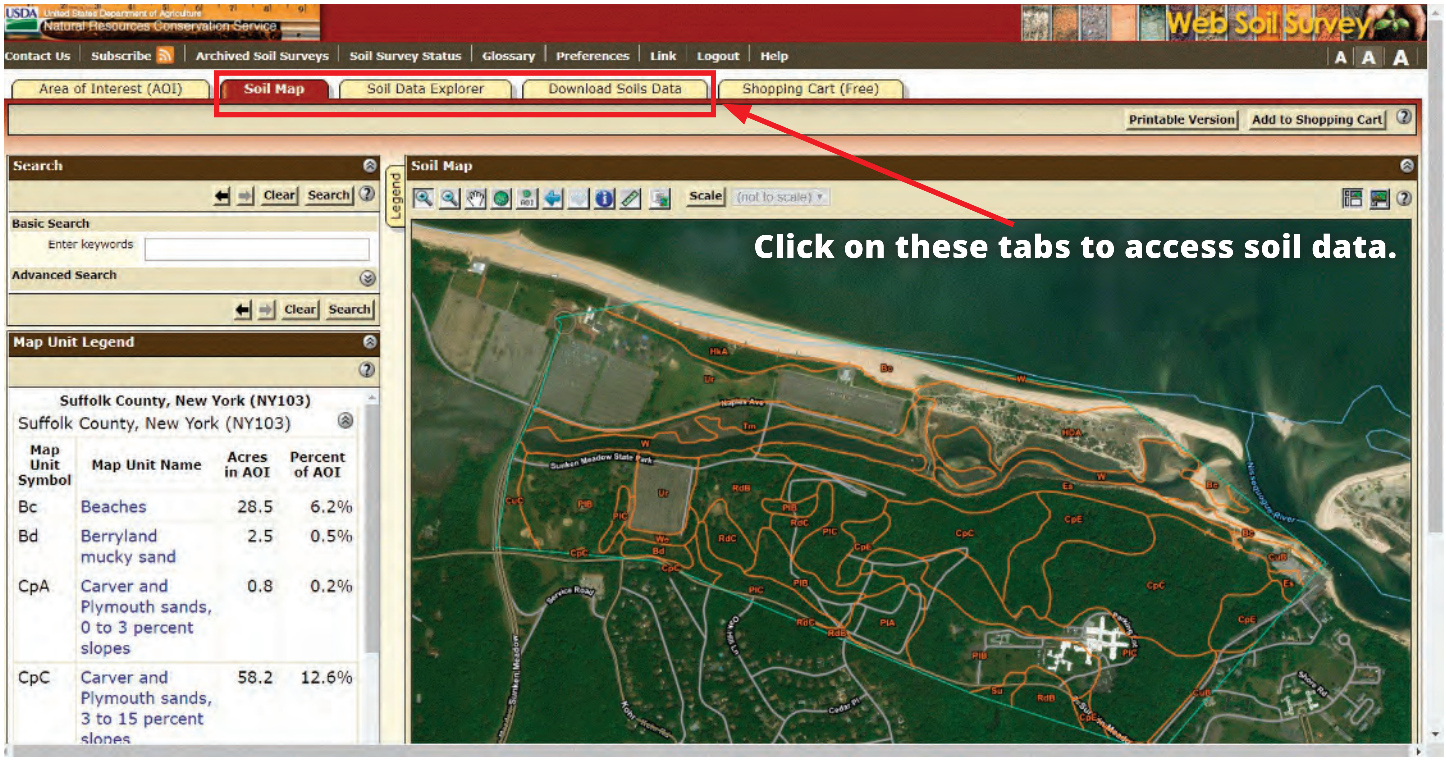

Figure 3. Accessing soil data.

For more information on using the WSS tool, see "Getting Started With Web Soil Survey" on the WSS website.

Figure 4. Soil mapping of the Red, Blue, and Green courses at Sunken Meadow State Park.

Soil *Sampling*

Proper soil sampling procedures need to be followed to accurately determine the chemical and physical properties that inform a nutrient management strategy. The steps below provide an overview of each step. See the New York BMP website for more detailed information on soil sampling procedures.

Step 1: *Identify sampling locations.*

In general, it is a good idea to identify sampling locations in turfgrass management areas with substantially different soil compositions, or areas that have received different fertilizer programs in the past (Soldat, 2009). In general, 10 sampling sites should be identified in each management area.

Step 2: *Time soil sampling appropriately.*

Soil samples should be collected when soils are active. Fall is the most common time to collect samples as this allows time to review results and apply lime and nutrients in advance of spring growth. Ideally, soil sampling should not be performed during the two months following fertilization or liming. Consistency in the timing of soil sampling allows comparison of test results from year to year.

Step 3: *Collect samples.*

Using a consistent sampling depth (4-6 inches deep, depending on turf management area) and sampling methodology, a representative sample of each different soil or management area identified must be taken. Approximately two cups of soil should be collected, plant material should be removed, and the soil should be thoroughly mixed. Once mixed, the samples should be accurately labeled and dried prior to submission to a laboratory for analysis.

Step 4: *Laboratory Analysis.*

Various testing labs and methodologies can be utilized to determine soil chemical and physical properties. Using an accredited laboratory is key to getting reliable results. The Mehlich-3 extraction method is typically recommended and preferred as it gives accurate readings for phosphorus (P), potassium (K), and micronutrients in a wide range of soil types and pH values. Using the same soil testing laboratory provides the basis for year-to-year comparison of soil test results.

Using *Soil Analysis Results*

Soil harvesting and testing are only as good as the method of interpretation and the subsequent management practices that address the soil's chemical and physical properties. For many years, turfgrass managers have had two soil interpretation choices: Base Cation Saturation Ratio (BCSR) and Sufficiency Level of Available Nutrients (SLAN). The BCSR method measures the percentage of basic cations on the soil colloids (Ca%, Mg%, and K%) and assumes an ideal ratio, while SLAN expresses nutrient levels as low, medium, optimum, or excessive (ppm) and the likelihood of a plant response following fertilization.

MLSN guidelines identify the minimum amounts of soil nutrients that provide acceptable turfgrass conditions, focusing on reducing inputs and costs, and improving sustainability while maintaining turfgrass performance and health.

Minimum Levels of Sustainable Nutrition (MLSN) guidelines.

Nutrient	MLSN Guideline (ppm)
Phosphorus (P)	21
Potassium (K)	37
Calcium (Ca)	331
Magnesium (Mg)	47
Sulfur (S)	7

Developing ***Nutrient Management Recommendations***

Soil nutrient mapping allows for the spatial assessment of nutrient needs that can be addressed efficiently by timing application to climatic and turfgrass growth rate. PACE Turf's free Climate Appraisal Form and GP model offer excellent resources for establishing baseline nutrient application schedules (Figure 5). Users input local weather data (30-year average temperature and rainfall) to estimate turfgrass growth, nutrient needs, and withdrawals from the soil.

Location: Sunken Meadow State Park, Kings Park, NY

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg T (F)	30.4	32.9	39.6	50.0	59.7	69.0	74.1	73.0	66.1	55.3	45.9	35.8
Rainfall (in)	3.7	3.0	4.2	4.5	4.2	4.2	4.0	3.9	4.5	4.6	3.8	4.2

Grass Maximum N/month lb/1000 sq ft =	0.50	
Optimum Growth Temperature (F) =	68	Set to 68 for cool season and 88 for warm season grass
Variance =	10	Set to 10 for cool season and 12 for warm season grass

% Growth Potential	0	0	2	20	71	100	83	88	98	45	9	1	Total lb/1000 sq ft	Removed from Soil ppm	Plus MLSN ppm
N lb/1000 sq ft	0.0	0.0	0.0	0.1	0.4	0.5	0.4	0.4	0.5	0.2	0.0	0.0	2.6	NA	NA
K lb/1000 sq ft	0.00	0.00	0.00	0.05	0.18	0.25	0.21	0.22	0.25	0.11	0.02	0.00	1.29	42	79
P lb/1000 sq ft	0.00	0.00	0.00	0.01	0.04	0.06	0.05	0.06	0.06	0.03	0.01	0.00	0.32	11	32
Ca lb/1000 sq ft	0.00	0.00	0.00	0.01	0.04	0.05	0.04	0.04	0.05	0.02	0.00	0.00	0.26	8	339
Mg lb/1000 sq ft	0.00	0.00	0.00	0.01	0.02	0.03	0.03	0.03	0.03	0.01	0.00	0.00	0.16	5	52
S lb/1000 sq ft	0.00	0.00	0.00	0.01	0.03	0.04	0.03	0.03	0.04	0.02	0.00	0.00	0.19	6	13
Fe lb/1000 sq ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.013	0	44
Mn lb/1000 sq ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.005	0	6

Figure 5. Growth potential model and nutrient management guidelines.

An annual nitrogen (N) rate is established and then applications can be calibrated monthly to plant growth and nutrient demand, which affects turfgrass growth and subsequent soil drawdowns of P, K, and micronutrients. The nutrient depletion estimate is detailed in the column titled "Removed from the soil ppm." Next to that is a column of "Plus MLSN ppm" values that should be compared with soil test values and the MLSN guidelines to maintain soil nutrient levels that support turfgrass growth.

It is important to recognize and differentiate high-traffic from low-traffic turf areas, as well as newly established from mature turf areas, as their nutrient needs vary considerably. The GP model also allows turfgrass managers to predict periods of abiotic stresses (slower turf growth) to schedule cultivation events and other necessary maintenance activities. Observing turf health/growth in the different management areas pre- and post-fertilization can help to minimize or eliminate unnecessary applications

Regular review of soil testing data is a key BMP and helps identify nutrient trends that can inform turfgrass management practices. This method works well for fertilization programs utilizing either granular or liquid applications. It is likely that utilizing the GP model in conjunction with MLSN guidelines will result in significant reductions in fertilization applications, lowering water quality risk.

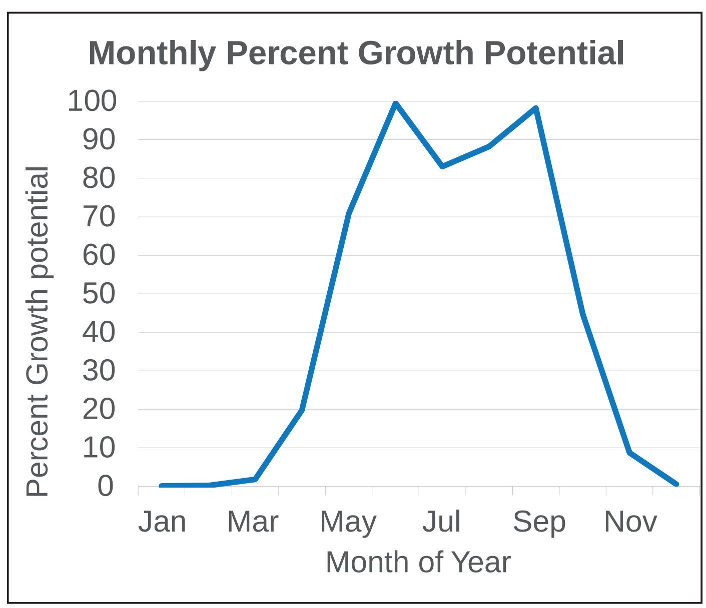

Figure 6. GP model for Kings Park, NY.

Summary

BMPs for water quality protection demand increased precision in nutrient management. Technological advancements in soil mapping, turfgrass nutrient demand, and growth rate allow golf course superintendents to accurately assess nutrient levels across the entire course and then calibrate nutrient needs to growth rate. This ensures nutrients are applied in amounts and at times when plants are most capable of uptake and utilization, thereby minimizing risk to water quality.

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