A3876

Turfgrass nutrient management planning

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Contents

What is a nutrient management plan?

A nutrient management plan (NMP) is a document that identifies the appropriate timing, amount, and form of nitrogen and phosphorus than can be applied to an area based on the properties of the soil, topography, land use, and the proximity of the fertilized areas to surface and groundwater resources.

Turf NMPs are used as tools to meet goals, such as maintaining functional healthy and aesthetically pleasing turfgrass while minimizing nonpoint source pollution of water resources. NMPs can also be useful tools for managing costs and documenting the effectiveness of past practices. Many turfgrass managers already implement a number of practices meant to minimize the environmental impact of their operations. NMPs help document these efforts, which is useful if accusations of environmental pollution are made. NMPs make sense from environmental, economic, and risk management points of view.

In Wisconsin, NMPs are required by the Wisconsin Department of Natural Resources (WDNR) administrative rule NR-151 for fertilized turfgrass areas larger than five acres in size. This document was designed to help you develop NMPs according to the WDNR standards for fertilized turfgrass areas. However, it will be necessary to read the turf portions of NR-151 (NR 151.10-15) and the WDNR Turf Nutrient Management Technical Standard (1100) for the current requirements and any changes to the administrative rule in the future. These documents are available at www.turf.wisc.edu or from the WDNR.

NMPs consist of the following components:

- A narrative description with general information about the site, types of land use, turf species present, soil types, and environmentally sensitive areas
- An overall site map showing topography, designated land uses, soil test locations, environmentally sensitive areas, and surface water bodies
- Recommended fertilizer application rates and restrictions for the designated land uses and environmentally sensitive areas
- Soil test results (including the method of soil test used, i.e. Bray-1 or Mehlich-3)
- A fertilizer-spill response plan

This document will help you collect the required information and assemble it into NMPs.

Soil sampling for a nutrient management plan

Identifying representative areas

A common question is, "How many soil samples do I need to take?" The precise answer depends on how many representative areas you have. NR 151 states that fertilizers should be applied based on "appropriate" soil tests. According to the WDNR technical standard, *appropriate* means a soil test for each area that is managed differently, has a different soil type, or exhibits obviously different grass growth. This might mean a single sample for general grounds and a sample for each individual athletic field. However, you may decide to break the general grounds into more than one sample if you suspect that differences exist among the sites. Combining soil cores from areas low in soil phosphorus with those that are high in soil phosphorus will lead to a meaningless average. Taking too many samples will lead to a situation in which it will not be practical to manage each of the different areas separately. In general, it is a good idea to take separate samples for turfgrass areas with substantially different soil compositions, or which have received different fertilizer programs in the past. Use a map or diagram of the site to identify where samples were collected. For additional information on soil sampling, see *Sampling Garden Soils and Turf Areas for Testing* (A2166).

Sampling technique makes a big difference

After deciding how many different areas to test, the next step is to pull the sample. As mundane as this task sounds, proper sampling is very important. For example, soil P levels are greatly influenced by the depth of the sample. A two-inch deep soil sample is likely to contain double or triple the amount of available P than a six-inch sample. Hence, it is important to maintain a constant sampling depth. But what depth should you choose? In Wisconsin, the interpretation of whether available P is low, optimal, or high is based on research that examined hundreds of paired turfgrass tissue and soil samples. Those research soil samples were obtained to a six-inch depth (four-inch depth for golf greens and tees). Therefore, your samples should also be taken to a six-inch depth, so they can be directly compared to the research data. For consistent and accurate results, follow these steps:

1. Take at least ten cores for each sample, regardless of size of the area.
2. The cores should be six inches deep (four inches for golf greens and tees).
3. Remove turf foliage and thatch, and break the cores and mix them together in a clean plastic bucket, as soil testing laboratories usually will not mix samples at all.
4. Place two cups of the mixed soil in an appropriately labeled bag. Use a labeling system you can remember, as the soil testing lab will report back the results using the same labeling numbers you submitted.

A soil test interpretation is only as good as its supporting data

Several different soil nutrient extracting chemicals exist, including the Bray-1, Bray-2, Mehlich-1, Mehlich-3, Morgan, and Olsen extractants. For the results of a soil test to be meaningful, the relationship between the soil P level and a crop response must be known. The process of gathering information on how crops respond to different soil nutrient levels is called calibration. Unfortunately, very few soil tests have been properly calibrated, due to the large amount of work involved. However, the Bray-1 and Mehlich-3 soil tests have been properly calibrated for turfgrass grown on both native soil and sand-based root zones in Wisconsin. For more information on how the new interpretations were developed, see Kussow and Houlihan's article in *The Grass Roots* (May/June 2006). The WDNR requires either the Bray-1 or the Mehlich-3 test be used when preparing NMPs.

Now that we have established that the Bray-1 and the Mehlich-3 are the most reliable soil tests for turfgrass areas in Wisconsin, the next question is, "Which one should you choose?" In brief, it makes little difference. Both tests provide reliable results for both phosphorus and potassium. However, there are differences in cost of the tests and micronutrient results which are described below.

The Mehlich-3 test is a relatively new test that is gaining in nationwide popularity. It works very well across a wide range of soil types and pH levels, and provides micronutrient levels in addition to phosphorus and potassium. For this reason, many golf course superintendents prefer the Mehlich-3, especially if they have sand-based root zones in which micronutrients can be insufficient. The primary disadvantage of the Mehlich-3 is the higher cost per sample, which is related to the more expensive analytical equipment required for analysis.

The Bray-1 test has been recognized since 1945 and is widely used in the Midwestern states. The cost per test tends to be significantly lower than the Mehlich-3. The Bray-1 works very well on acid soils. However, in certain high pH soils the Bray-1 test can underestimate available P. Research undertaken in the Department of Soil Science at UW-Madison found that the Bray test works well even on the highest pH soils found in Wisconsin. The same is not always true in Minnesota and Iowa.

Which soil testing lab?

Unlike the rules for agricultural NMPs in Wisconsin, turfgrass soil samples are not required to be analyzed by a soil testing lab with certification from the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP). However, using one of these laboratories ensures soil test results and recommendations will be generated through analytical procedures approved by the University of Wisconsin with consistent results. Laboratories must continually perform with a certain level of success to remain certified. Be sure to ask the laboratory to use either the Bray-1 test or the Mehlich-3 test for your soil samples.

DATCP-certified soil testing laboratories

UW Soil & Plant Analysis Laboratory
5711 Mineral Point Rd
Madison, WI 53705
(608) 262-4364
soil-lab@uwmadmail.services.wisc.edu

UW Soil & Forage Lab
8396 Yellowstone Dr.
Marshfield, WI 54449
(715) 387-2523
jbpeter1@facstaff.wisc.edu

Dairyland Laboratories
217 E. Main Street
Arcadia, WI 54612
(608) 323-2123
info@dairylandlabs.com

A & L Great Lakes Laboratories, Inc.
3505 Conestoga Dr.
Fort Wayne, IN 46808
(260) 483-4759
lparker@algreatlakes.com

Mowers Soil Testing Plus, Inc.
117 E. Main St
Toulon, IL 61483
(309) 286-2761
swiedman@mowersplus.com

AgSource Cooperative Services
Soil & Forage Lab
106 N. Cecil Street
Bonduel, WI 54107
(715) 758-2178
aglab@agsource.com

Rock River Laboratory
710 Commerce Drive,
P.O. Box 169
Watertown, WI 53094
(920) 261-0446
don_meyer@rockriverlab.com

Obtaining maps of soil properties for a nutrient management plan

What you'll need:

- A computer with a broadband connection to the internet (dial-up connections are too slow).
- Internet Explorer 6 or above or Firefox 2.0 and above (other web browsers may work too) with pop-up blockers disabled. If pop-ups are blocked, though, you won't be able to generate maps.
- Adobe Reader (If not already installed on your computer, this software can be downloaded for free from www.adobe.com.)
- A color printer

Step 1:

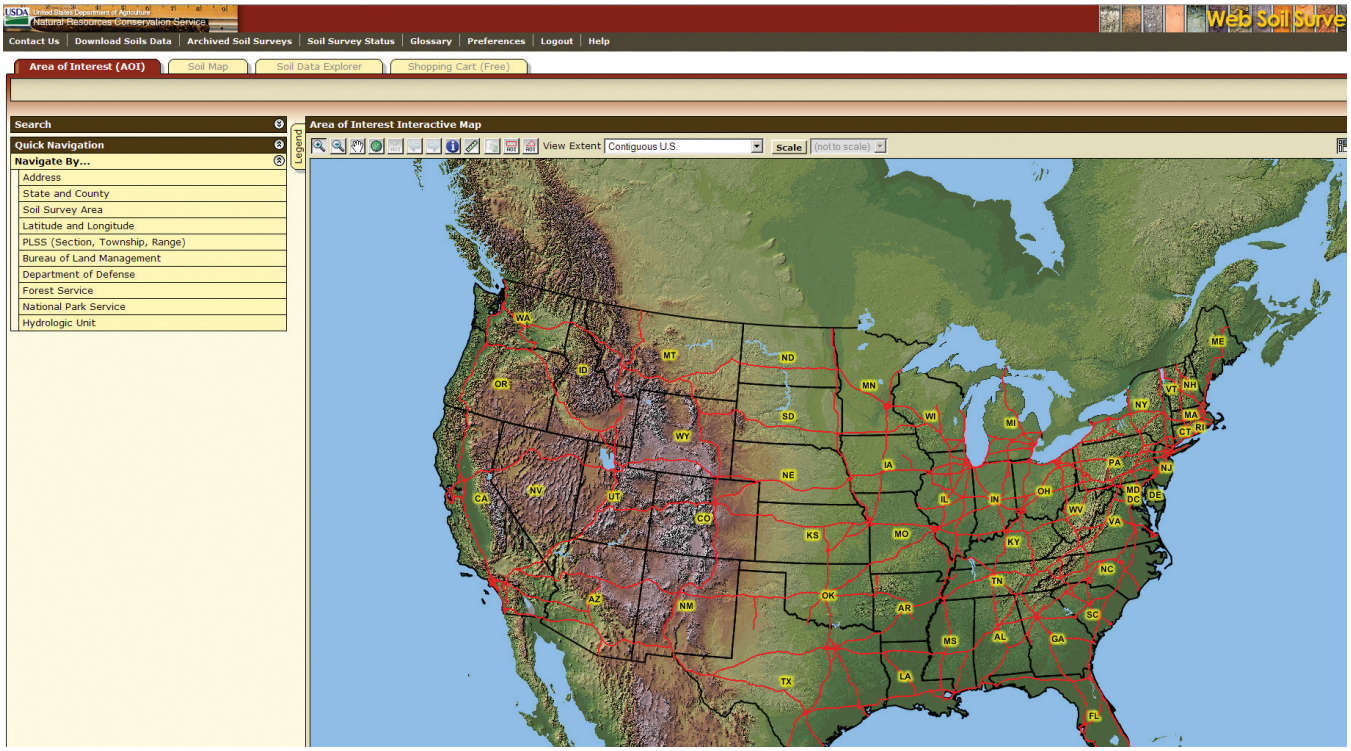
Visit the Web Soil Survey web site (websoilsurvey.nrcs.usda.gov/app/)

Find this site by typing the address above into your web browser, or by typing "USDA Web Soil Survey" into a web search engine. Once you've arrived at the web soil survey site, click on the big green button that reads "Start WSS."

Step 2:

Find your property

Find your property by entering in the address in the "Navigate By…" section or by zooming in on the map with the zoom tool (a magnifying glass with a plus sign).



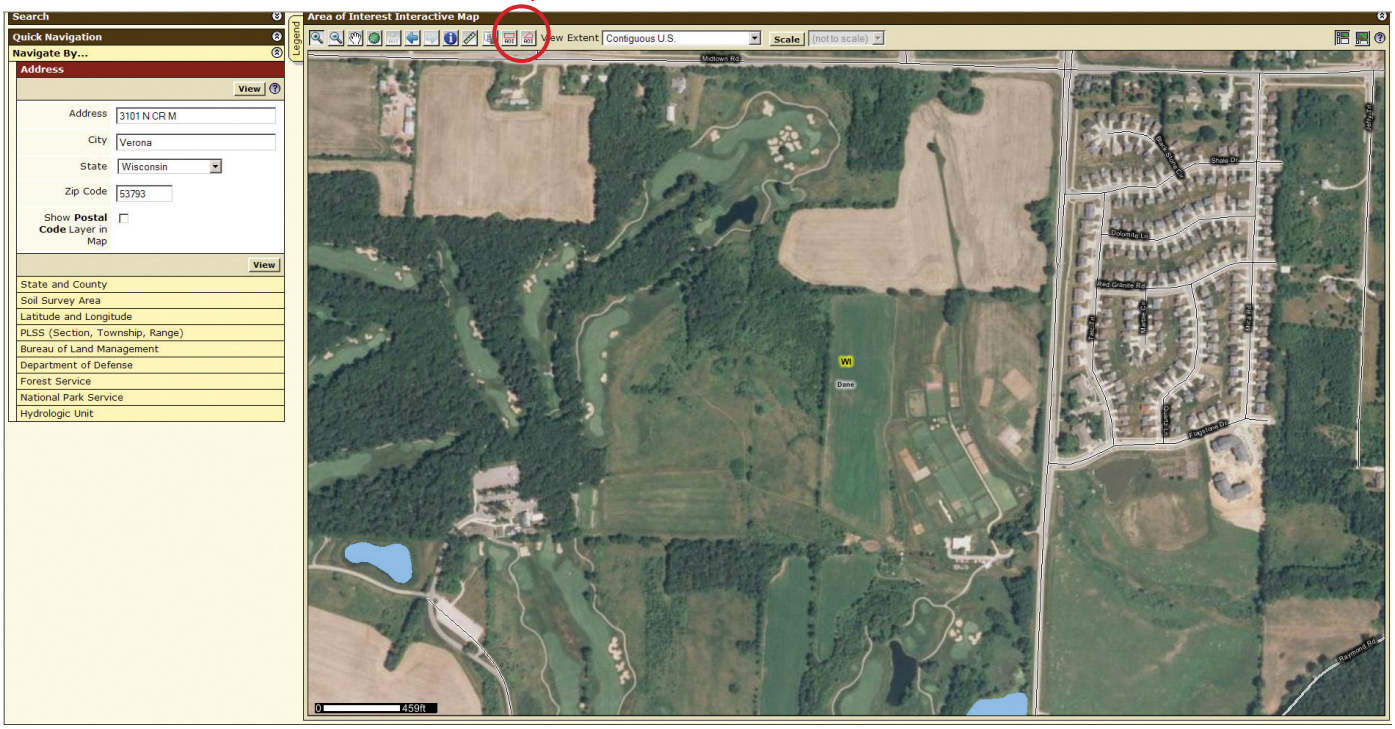
Step 3:

Select the "Area of Interest" (AOI)

To do this, you'll need to use one of two virtual tools, which can be found in the toolbar above the map. They both have the letters AOI and a red rectangle or polygon (see figure below). To use the AOI rectangle, click and hold the cursor on the upper-left corner of your property and drag the cursor down to the lower-right corner and release the mouse button. It's usually best to select the entire property even if the entire property is not fertilized. However, there will also be some situations in which selecting only the fertilized portion(s) makes the most sense.

The AOI polygon tool is often more useful than the AOI rectangle tool for irregularly shaped properties. However, it may take a little longer to learn how to use the polygon tool. Click once on any part of the property border and drag the mouse along the border until you reach a corner. Then, click the mouse once and drag in a new direction. After you have encircled your property with the polygon tool, double click the mouse to finalize the selection. If you are unhappy with the area you selected, just click the "clear AOI" button (located to the left of the map) and try again.

Area of Interest buttons



Step 4:

Find and print maps

1. Soil map and topographic map

a. Click on the tab that reads "Soil Map." It's near the top of the page.

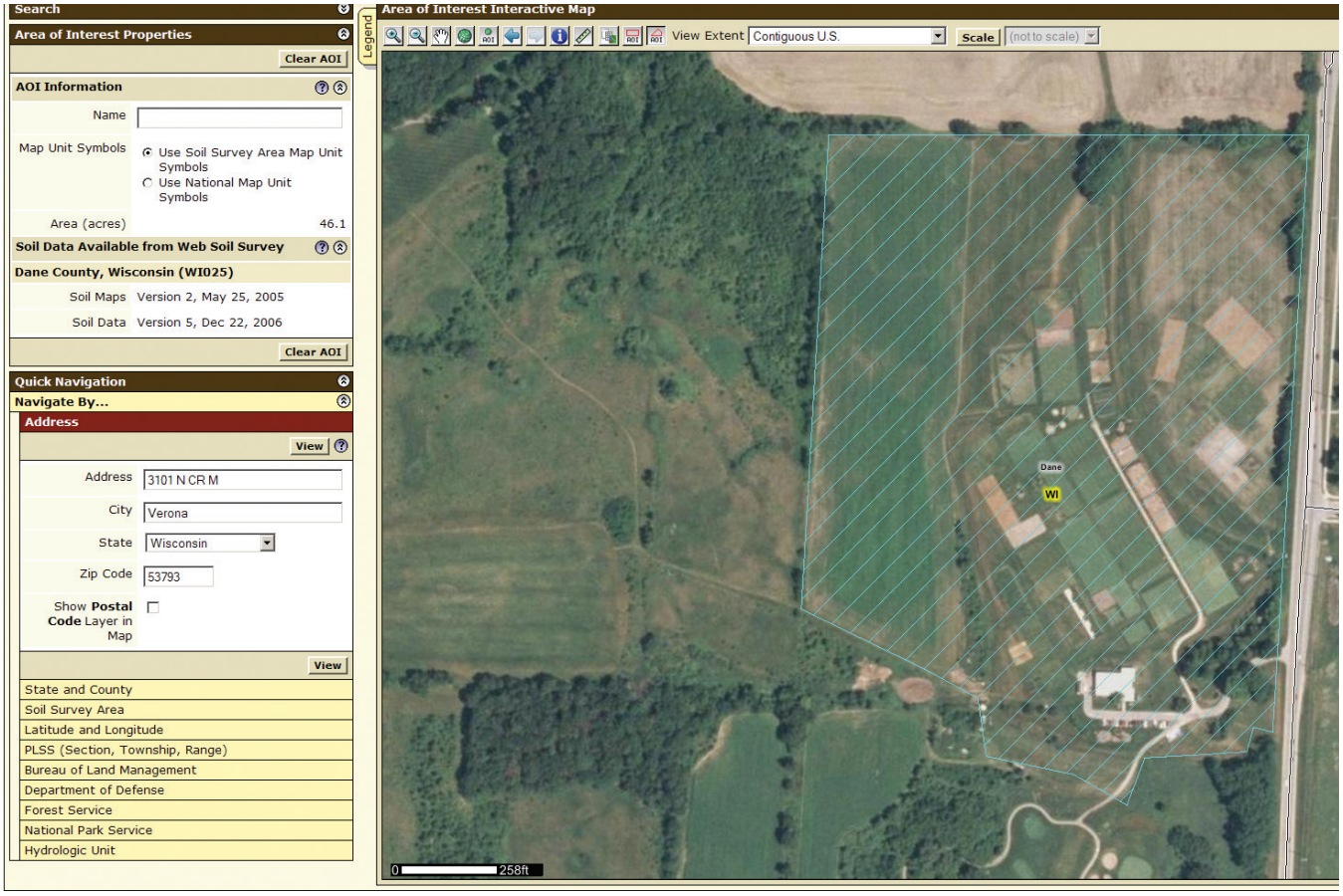
b. Click "Printable Version" in the upper-right corner of the screen. A new box will appear in which you can assign the map a customized title if you wish. Click "View" in the lower-right corner of this screen to continue. After a minute or so, another window will open with a map that you can print. If you have a browser with a pop-up blocker enabled, you must disable it before this window will appear.

c. Close the print version and return to the web version of the soil map and click on the "Legend" tab on the upper-left side of the map.

d. Scroll down to the bottom of the legend and click on "Topographic Map." This will be the second-to-last item on the legend. Click on the "X" in the upper-right corner of the legend, and the soils map should be shown with a topographic map.

e. Click "Printable Version" in the upper-right corner of the screen. A new box will appear in which you can assign the map a customized title if you wish. Click "View" in the lower-right corner of this screen to continue. After a minute or so, another window will open with a map that you can print.

f. Click on the legend tab again and select the "Aerial Photograph" option near the bottom of the legend. This will remove the topographic map and replace it with the aerial photograph.



2. Soil slope map

a. Click on the tab that reads "Soil Data Explorer."

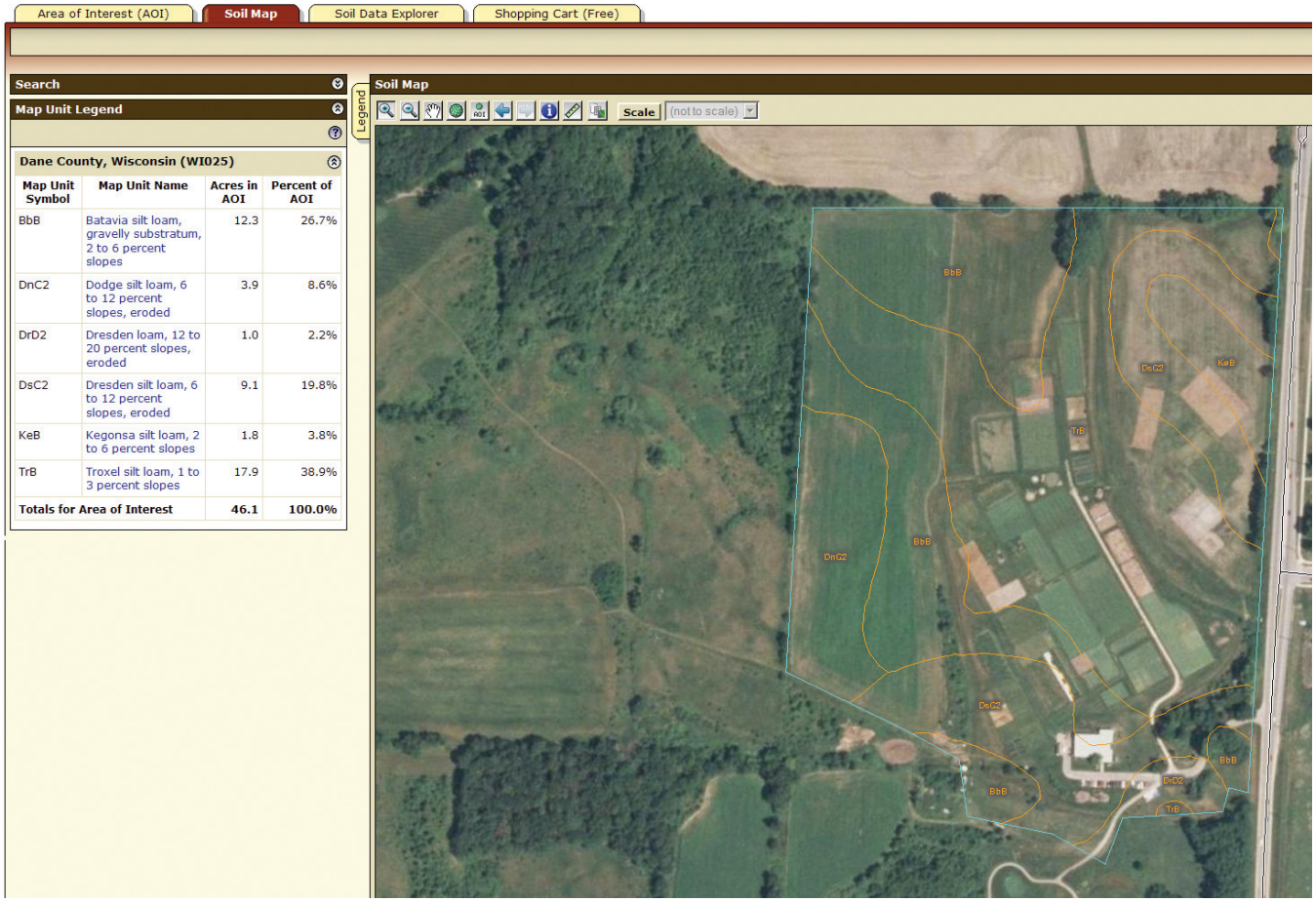
b. Click on the tab below and to the right of "Soil Data Explorer" that reads "Soil Properties and Qualities."

c. To the left of the map, click on the yellow bar that reads "Soil Qualities and Features".

d. Click on the yellow bar that reads "Representative Slope".

e. Click "View Rating".

f. Click "Printable Version" in the upper-right corner of the screen. A new box will appear in which you can assign the map a customized title if you wish. Click "view" in the lower-right corner of this screen to continue. After a minute or so, another window will open with a map that you can print. If you have a browser with a pop-up blocker enabled, you must disable it before this window will appear.

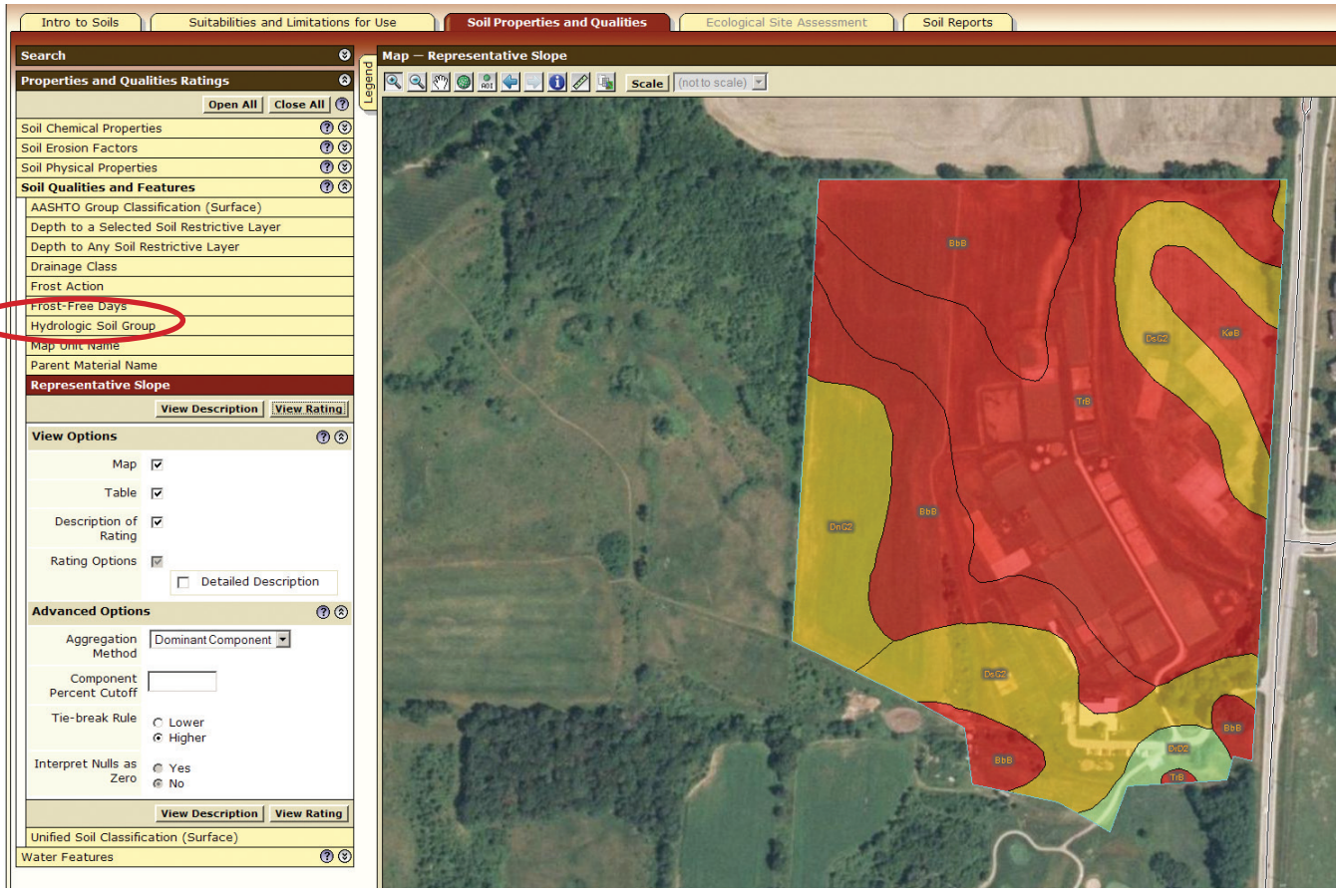


3. Hydrologic soil group

a. Click on the yellow bar that reads "Hydrologic Soil Group."

b. Click "View Rating."

c. Click "Printable Version" in the upper-right corner of the screen. A new box will appear in which you can assign the map a customized title if you wish. Click "view" in the lower-right corner of this screen to continue. After a minute or so, another window will open with a map that you can print. If you have a browser with a pop-up blocker enabled, you must disable it before this window will appear.



4. Depth to bedrock map

a. Click on the yellow bar that reads "Depth to a Selected Soil Restrictive Layer." If this is unavailable, click on the yellow bar below that reads "Depth to Any Soil Restrictive Layer."

b. Click "View Rating"

c. Click "Printable Version" in the upper-right corner of the screen. A new box will appear in which you can assign the map a customized title if you wish. Click "view" in the lower-right corner of this screen to continue. After a minute or so, another window will open with a map that you can print. If you have a browser with a pop-up blocker enabled, you must disable it before this window will appear.

5. Water table map

a. Click on the yellow bar that reads "Water Features."

b. Click on the yellow bar that reads "Depth to Water Table."

c. In the advanced options, set the beginning and ending months to accurately reflect when you typically begin and end applying fertilizer. For example, at the O.J. Noer Turfgrass Research and Education Center, the first annual fertilization typically occurs in May and the final application occurs in October.

d. Click "View Rating."

e. Click "Printable Version" in the upper-right corner of the screen. A new box will appear in which you can assign the map a customized title if you wish. Click "view" in the lower-right corner of this screen to continue. After a minute or so, another window will open with a map that you can print. If you have a browser with a pop-up blocker enabled, you must disable it before this window will appear.

How to read the maps

The soil map

The soil map printout contains four pieces of information: the map itself, the Map Legend, Map Information, and Map Unit Legend. The map legend defines the symbols and lines used on the map. Each individual soil type (or soil map unit) is delineated by an orange line. Inside each line are three letters sometimes followed by a number (i.e. TrB or KrD2). These are the abbreviations for the individual soil map units. The Map Unit Legend relates these abbreviations to the full map unit name, the number of acres in the area of interest, and the percentage of the area that is represented within the particular map unit. The Map Information Section provides general information about the creation of the map, including the dates corresponding to the soil data and aerial photograph.

Other soil property maps

The other soil property maps are interpreted in a similar fashion to the soil map. However, in addition to the soil map units, these maps carry additional information. For example, the "Representative Slope" map will show the individual map units and abbreviations, but each map unit will be colored depending on its representative slope. The value ranges corresponding to the colors on the map are found in the Map Legend. The average slope of a specific soil map unit is listed in a table under the soil property heading (in this case, Representative Slope). A description of the specific soil property (hydrologic group, representative slope, etc) is found below the table.

Potential problems and solutions

Problem 1: *Technical issues such as "the web soil survey doesn't run properly on my computer," "the maps won't print," or "I can't disable the pop-up blocker."* There are an infinite number of potential technical problems that can occur and be extremely frustrating. A good solution is to visit the local library, which will likely have computers equipped to run the web soil survey and generate printable maps. Also, libraries often have computer support staff willing to assist you.

Problem 2: *The site was built after aerial photographs were taken*. Unfortunately, there is no easy solution to this problem. For now, you'll need to approximate the property borders and possibly hand draw the locations of the fertilized areas. Hopefully, the aerial photographs will be updated in the near future. You should consider contacting your County Land Information Officer (LIO) to see if updated aerial photographs can be obtained. A directory of County LIOs can be found at: www.co.dane.wi.us/lio/lion/lios.asp.

Problem 3: *Site grading and soil modification has changed soil properties, so the maps are not accurate.* The solution to this problem is to document the scope of the changes and indicate the new properties. For example, the web soil survey indicates a steep slope in an area that was graded to be nearly flat for our research plots at the O.J Noer Turfgrass Research and Education Center. The NMP for the O.J. Noer Turfgrass Research and Education Center will include a note stating that, due to grading, the slopes shown in the map no longer exist. Alternatively, it is possible that new slopes were built on a previously flat area. These areas should also be identified.

Assembling a nutrient management plan

You can now begin assembling your NMP using your soil test results (pages 1-2) and your site property maps (pages 2-9). The various land use types on your site will determine the maximum allowable fertility rates based on the general nutrient recommendations below. Next, the soil property maps will be useful for identifying existing groundwater or surface water management areas (if any), which have more restrictive fertilizer requirements. The following sections will help you identify your land use area and find the amounts of fertilizer allowed.

General nutrient recommendations

The WDNR recommends different fertility rates depending on the use of the area. The three designated land uses are high-traffic areas, low-traffic areas, and newly established turfgrass. The definitions and recommendations for each land use follows.

High-traffic turfgrass areas

High-traffic turfgrass areas are defined as those that have more than ten users per acre per week and are regularly mowed and irrigated. For these areas, phosphorus should be applied according to the soil test interpretations listed in table 1. Annual nitrogen application amounts vary according to land use and soil type and should not exceed levels listed in table 2.

Table 1. Phosphorus interpretations and recommendations for Bray-1 and Mehlich-3 soil tests for high-traffic turfgrass areas

Phosphorus soil test level						Phosphorus fertilizer recommendations	
Use	Mehlich-3		Bray-1		Interpretation		
	ppm	lbs/acre	ppm	lbs/acre		lbs P_2O_5/1,000 ft^2	lbs P_2O_5/acre
General high traffic	0–15	0–30	0–12	0–24	Very low	5	260
	16–30	30–60	13–25	25–50	Low	3.5	175
	31–45	61–90	26–37	51–74	Medium	2	100
	46–60	91–120	38–50	75–100	Optimal	1	65
	> 60	> 120	> 50	> 100	Very high	0	0
Sand tees & greens	0–6	0–12	N/A[1]	N/A	Very low	3	130
	7–12	13–24	N/A	N/A	Low	2	90
	1–18	25–36	N/A	N/A	Medium	1	45
	19–24	37–48	N/A	N/A	Optimal	0.5	20
	> 24	> 48	N/A	N/A	Very high	0	0
Mineral soil tees & greens	0–6	0–12	N/A	N/A	Very low	5	220
	7–12	13–24	N/A	N/A	Low	3.5	150
	13–18	25–36	N/A	N/A	Medium	2	90
	19–24	37–48	N/A	N/A	Optimal	1	45
	> 24	> 48	N/A	N/A	Very high	0	0
Fairways	0–15	0–30	N/A	N/A	Very low	6	260
	16–30	30–60	N/A	N/A	Low	4	175
	31–45	61–90	N/A	N/A	Medium	2.5	100
	46–60	91–120	N/A	N/A	Optimal	1.5	65
	> 60	> 120	N/A	N/A	Very high	0	0

[1]Use the Bray-1 soil test interpretations for general high-traffic areas.

Table 2. Maximum recommended N for various high-traffic turfgrass areas according to soil type

Soil type	Land use	Annual maximum allowable N lbs N/1000 ft^2	Single application maximum** lbs N/1000 ft^2
Sand*	Athletic field	10	1
	Fairway	8	1
	General high-traffic area	8	1
	Putting green	8	1
	Tee box	10	1
Native or mineral soil	Athletic field	8	1
	Fairway	5	1
	General high-traffic area	5	1
	Putting green	5	1
	Tee box	8	1

* Over 70% of the root zone is composed of sand.

** Up to 2 lbs N/1000ft^2 may be used if the product is 100% natural organic or biosolid. Most organic-based fertilizers contain P and their use is not allowed unless a need for P is indicated by a soil test.

Table 3. Phosphorus interpretations and recommendations for Bray-1 and Mehlich-3 soil tests for low-traffic turfgrass areas

Phosphorus soil test level					Phosphorus fertilizer recommendations	
—Mehlich-3—		—Bray-1—		Interpretation		
ppm	lbs/acre	ppm	lbs/acre		lbs P_2O_5/ 1000 ft^2	lbs P_2O_5/ acre
0–10	0–20	0–5	0–10	Very low	3	131
11–15	21–30	6–10	11–20	Low	2	87
16–25	31–50	11–15	21–30	Medium	1	44
26–35	51–70	16–20	31–40	Optimal	0	0
> 35	> 70	> 20	> 40	Very high	0	0

Low-traffic turfgrass areas

Low-traffic turfgrass areas are those that typically receive fewer than ten users per acre per week. These also include areas that are not irrigated, regardless of amount of use. For these areas, use the soil test interpretations given in table 3 for determining the need for phosphorus. There are no land use or soil type adjustments for the nitrogen and phosphorus guidelines for low-traffic areas. Nitrogen applications on low-traffic turfgrass areas should not exceed 4 lbs N/1000 ft^2 annually when clippings are removed. When clippings are returned, not more than 3 lbs N/1000 ft^2 should be applied unless the turfgrass area is three years old or less, in which case up to 4 lbs N/1000 ft^2 may be applied.

Newly established turfgrass

The establishment period is defined as the 12-month period following seeding or installation of sod. In the event that soil testing prior to establishment is not practical, apply no more than 1 lb N/1000 ft^2 using a starter fertilizer, and document the reasons why soil tests were not obtained. If a soil test is obtained, or if the soil test levels are known from an earlier sampling, follow the phosphorus guidelines shown in table 4. Note the different interpretations for seeded and sodded areas.

Table 4. Soil test phosphorus interpretations and recommendations for Bray-1 and Mehlich-3 soil tests for newly established areas

Turf establishment	Phosphorus concentrations					Phosphorus fertilizer recommendations	
	—Mehlich-3—		—Bray-1—		Interpretation		
	ppm	lbs/acre	ppm	lbs/acre		lbs P_2O_5/ 1000 ft^2	lbs P_2O_5/ acre
Newly seeded area	0–25	0–50	0–15	0–30	Very low	3	131
	26–50	51–100	16–30	31–60	Low	2	87
	51–75	101–150	31–45	61–90	Medium	1	44
	76–100	151–200	46–50	91–100	Optimal	0	0
	> 100	> 200	> 50	> 100	Very high	0	0
Newly sodded area	0–20	0–40	0–10	0–20	Very low	3	131
	21–40	41–80	11–20	21–40	Low	2	87
	41–60	81–120	21–30	41–60	Medium	1	44
	61–80	121–160	31–40	61–80	Optimal	0	0
	> 80	> 160	> 40	> 80	Very high	0	0

Table 5. Maximum recommended nitrogen applications for newly established turfgrass areas

Soil type	Annual maximum allowable N lbs N/1000 ft^2	Single application maximum** lbs N/1000 ft^2
Sand*	10	1
Native or mineral soil	6	1

*Over 70% of the root zone is composed of sand.

**Up to 2 lbs N/1000ft^2 may be used if the product is 100% natural organic or biosolid.
Most organic-based fertilizers contain P and their use is not allowed unless a need for P is indicated by a soil test.

List the characteristics of representative areas

The next step is to begin writing the NMP document. You can use the template form provided at www.turf.wisc.edu or create your own. First, determine which of the categories your turf falls under and put that information into a table similar to the examples below. You should group areas that are treated similarly. In the examples below, the soil greens were separated from the sand greens because soil tests indicated that the sand greens had low soil test levels. Therefore, P will be applied to the sand greens but not to the soil greens. Also, notice that the maximum allowable N amount differs for the two areas (from table 2). The maximum allowable N for various areas can be found in the technical standard. You should complete the information shown in the examples below for each area that is on a different fertility plan.

Example 1

Site:	Soil greens
Location:	Holes 1-9, practice green
Size:	1.3 acres
Age:	35 years
Grass species:	Creeping bentgrass, annual bluegrass
Root zone or soil type:	Silt loam
Traffic:	High
Maximum allowable N/M/year:	5 lbs
Soil test P level	62–125 ppm Bray-1
Maximum allowable P_2O_5/M/year:	0 lbs

Example 2

Site:	Sand greens
Location:	Holes 10–18
Size:	1.1 acres
Age:	5 years
Grass species:	Creeping bentgrass
Root zone or soil type:	Sand
Traffic:	High
Maximum allowable N/M/year:	8 lbs
Soil test P level	25–45 ppm Bray-1
Maximum allowable P_2O_5/M/year:	0.5–2 lbs

Identify surface water management areas

Type I surface water management areas

Type I surface water management areas (SWMAs) are those areas on slopes within a specific distance from a lake or perennial stream or river. Such areas are considered environmentally sensitive because fertilizer applied to these slopes has the potential to be washed down the slope and eventually enter the surface water body. To prevent this from occurring, fertilizer that is primarily water-soluble should be used because it will dissolve rapidly and enter the soil quickly, decreasing the chance of it being lost to runoff.

To identify the Type I SWMAs on your site, draw a line on a site map 1000 feet from the edge of each navigable lake, pond, or flowage. Within this buffer, slopes steeper than 10% are considered Type I SWMAs. Next, draw another line on the map that extends 300 feet from the edge of each *perennial* stream or river. Perennial streams and rivers are indicated by a solid blue line on the topographic map obtained from the web soil survey. The slopes steeper than 10% within this buffer are also considered Type I SWMAs. Often, identification and management of Type I SWMA glacial pothole lakes, ponds without outlets, and non-perennial streams are not required by the DNR. However, contact the DNR for information on whether a body of water is considered navigable. Within Type I SWMAs, fertilizers containing 50% or less slow-release N should be used. Examples include sulfur-coated urea, polymer-coated urea, methylene ureas, and isobutylidene diurea (IBDU). The Type I SWMA should also be indicated on a map and described in a table such as the one shown in example 3. If slopes steeper than 10% do not exist within the 1000 or 300 ft. buffers, then the site has no Type I SWMAs. Simply state on the form that "No Type I Surface Water Management Areas exist."

Type II surface water management areas

Type II SWMAs are meant to protect the areas within 20 feet of any navigable body of water, including navigable intermittent streams. The restrictions in these areas are independent of topography. Defining and describing Type II SWMAs is easier than doing so for Type I SWMAs. However, the application restrictions for Type II SWMAs are more stringent. Type II SWMAs are areas within 20 feet of any navigable body of water, regardless of slope. Within these areas, only liquid N and P may be applied, and no more than 2 lbs N/1000 sq. ft./yr can be used. However, drop spreaders can be used to apply a granular fertilizer to putting greens and their surrounds within 20 ft. of a water body. Identify Type II SWMAs on a map or aerial photograph and indicate their location using a table as shown in example 4 below.

Example 3. Type I surface water management areas

Site:	Type I SWMAs are areas with slopes >10% within 1,000 feet of lake, pond (with an outlet), or wetland or areas with slopes >10% within 300 feet of a perennial stream or river.
Location:	Indicate locations of the steeply sloped areas here. The highest priority slopes are those which are large and slope directly or indirectly towards navigable water. Small slopes, like the ones found on bunker faces and tee banks, are usually not as environmentally important.
Size:	Indicate approximate acreage that falls within this category.
Restrictions:	Fertilizers with 50% or less slow-release N can be used in accordance with the rest of the NMP. For example, a fairway (maximum allowable N=5 lbs/M/yr) can still receive up to 5 lbs N/M/yr, except the majority of the N must be in the soluble form.

Example 4. Type II surface water management areas

Site:	Areas within 20 feet of lake, pond with an outlet, river, stream, or wetland.
Location:	Indicate locations here and/or refer reader to a map where the GMAs are delineated.
Size:	Indicate approximate acreage of Type II SWMAs
Restrictions:	Only foliar (liquid) N and P applications are allowed, except on greens and surrounds where drop spreaders may be used. No more than 2 lbs N/1000 sq. ft. can be applied annually.

Identify groundwater management areas

Groundwater management areas (GMAs) are meant to protect areas in which the potential for groundwater contamination is relatively high. GMAs exist where Hydrologic Group A[2] soils occur, or where the depth to apparent water table is less than 12 inches (30 cm), or where the depth to bedrock is less than 20 inches (50 cm). (Note that the Web Soil Survey maps report distances in centimeters.) All three pieces of information can be found on the soil survey maps. Indicate on a map where the GMAs exist and include a table similar to the one shown in example 5. Within a GMA, fertilizers with at least 50% slow-release N should be used. As you may find, sometimes an SWMA and a GMA overlap. That means that you must find a fertilizer with exactly 50% slow-release N, or you must apply soluble fertilizers at rates of 0.25 lbs N/1000 sq. ft. or less.

Fertilizer spill response plan

Standard language for the fertilizer spill response plan is included below. Include it in your plan, along with any other site-specific response plans included in your standard operating procedures. This information should be periodically communicated to employees.

If a spill occurs, initiate appropriate cleanup actions.

- Spills involving more than 250 lbs of dry or 25 gallons of liquid fertilizer must be immediately reported to the WDNR 24-hour spills hotline at 1-800-943-0003.
- Spills of lesser amounts are exempt from the reporting unless the spill adversely impacted or threatens to adversely impact the air, lands, or waters of the state, either as a single discharge or when accumulated along with past discharges.

General fertilizer application schedule

This section should provide an overview of the approximate amounts of N and P that are applied during each month of the growing season. It is meant to serve as a guide, affording a WDNR agent a quick understanding of the general timing and rates of fertilizer applications on the golf course. The locations should be the same as those areas listed in examples 1 and 2. See example 6 below.

Calibration and upkeep of fertilizer application equipment

Information on the frequency of the calibration of fertilizer equipment should be included somewhere in the plan. It might be wise to include exact dates of calibration, as well as the names of the employees conducting the calibration.

Establishment, overseeding, and re-establishment plan

Your NMP should include a section describing the routine procedures for establishment, overseeding, and re-establishment of turf areas. Examples include how divots are filled, athletic fields overseeded, or practice range tees maintained. Include information on timing and fertility practices used for seeding.

Example 5. Groundwater management areas

Site:	Areas with hydrologic group A soils, where the depth to apparent water table is less than 12 inches, OR where the depth to bedrock is less than 20 inches.
Location(s):	Indicate locations here, and/or refer reader to a map where the GMAs are delineated.
Size:	Indicate approximate acreage in GMAs.
Restrictions:	Fertilizers with 50% or more slow-release N can be used in accordance with the rest of the NMP. Fertilizers with less than 50% slow-release N can be applied at rates up to 0.25 lbs N/1000 sq. ft.

Example 6. General nutrient application schedule–Nitrogen/Phosphorus (lbs/1000 ft^2)

Location	April	May	June	July	Aug	Sept	Oct	Nov	Total
Soil greens	0/0	0.5/0	0.25/0	0.25/0	0.25/0	1/0	1/0	0/0	3.25/0
Sand greens	0/0	0.5/1	0.25/0	0.25/0	0.25/0	1/0	1/1	0/0	3.25/2
Tees	0/0	0.5/0	0.5/0	0.5/0	0.5/0	0.5/0	1/0	0/0	3.5/0
Fairways	0/0	1/0	0/0	0/0	0/0	1/0	1/0	0/0	3/0
Fairways 10, 12, 13	0/0	1/2	0/0	0/0	0/0	1/0	1/0	0/0	3/2
Roughs	0/0	0/0	0/0	0/0	0/0	0/0	1/0	0/0	1/0
Clubhouse lawns	0/0	1/0	0/0	1/0	0/0	0/0	1/0	0/0	3/0

[2]The Natural Resources Conservation Service has dual classifications for some soils. For example, an A/D soil means that if the soil is in its native condition it behaves like a Group D soil. If the soil has been artificially drained it will behave as a Group A soil and should be treated as a GMA.

Actual record-keeping

This is obviously a major component of NMPs. Fortunately, the majority of turfgrass managers already keep thorough fertilization records. You may continue to keep records as normal, while also keeping a copy of the records in the NMP. Example 7 shows the type of information to include.

Narrative description

The narrative description is intended to describe the site to someone who is completely unfamiliar with it. This section need not be very long, but it should include a short description of the site and location (i.e. XYZ golf course in central Dane County), the number of fertilized acres, the general soil type (sandy soils, silt loam soils, clay soils, and so on), the predominant grasses grown on the site, the size and extent of water bodies, and the locations and sizes of environmentally sensitive areas on the course (such as surface and groundwater management areas). This section should be placed at the beginning of the NMP.

Overall site map

A comprehensive map of the turfgrass area should be included in the final NMP. This map should identify all of the general fertilized areas, soil test locations, GMAs, SWMAs, and all other relevant features on the site. You can use an aerial photograph or a map drawn to scale. The best color aerial images can be obtained from www.bing.com/maps. This site should have recent, high-resolution, color aerial photographs for the entire state of Wisconsin. A good example of an overall area map is shown on the next page.

Qualifications of the nutrient management planner

According to the WDNR, a qualified nutrient management planner should possess either certification from a professional turf management organization, a Bachelor's Degree in turfgrass science or a related field, or experience equivalent to a Bachelor's Degree in turfgrass or a related field. Equivalent experience can include years spent professionally managing turfgrass, participation in educational events, and other professional development activities. As there is no clear definition of what constitutes "equivalent experience", the nutrient management planner must comprehensively document his or her qualifications.

Plan organization

Organize your NMP in a way that is easily updated and allows any reader to easily understand the soil and environmental protection areas on the site. A three-ring binder with a separate tab for each major section may be a good option for organizing your materials. The narrative description and overall site map should be near the front.

Frequently encountered issues

As you write your plan, you will likely come across areas that don't fit neatly into one of the categories. For these "gray areas," you should document the situation and provide justification for the decision that was made. Compile this miscellaneous data in a separate, marked section.

Sometimes situations occur in which the soil maps don't seem to match up with visual observations on the ground. For example, the depth to apparent water table map for one Wisconsin golf course indicated that the water table was six inches from the surface for the entire course. The superintendent had been working at the property for several years, and had never observed a shallow water table. In fact, he said they'd dug holes as deep as six feet without observing a water table. Therefore, the superintendent chose to not consider the entire course a groundwater management area, and bored 18-inch observation wells throughout the course with a small bucket auger. He monitored these wells throughout the season and documented the absence of water in them as evidence that the water table map was incorrect.

Sometimes, as in the example above, the soil maps are incorrect. In other cases, the soils have been heavily modified, drained, or re-graded. If the construction has seemingly altered the mapped properties to the extent that a SWMA or GMA no longer exists, document the changes using quantitative evidence (pictures, bore holes, infiltration tests, etc).

Example 7. Actual fertilization records

Date	Location	N rate (lbs/M)	P_2O_5 rate (lbs/M)	Fertilizer grade	N source	% Slow-release N	Form	Applicator
7/6/08	Sand greens	0.25	0	46-0-0	urea	0	liquid	Soldat
7/6/08	General grounds	0.50	0.10	20-4-3	urea, DAP	50	granular	Soldat
8/8/08	Athletic field #1	1	0	46-0-0	urea (SCU)	100	granular	Soldat


The aerial photographs provided by the Web Soil Survey are commonly not up-to-date. Do the best you can with the images available. They will eventually be updated; you will transfer over the relevant properties on to a more recent aerial image from www.bing.com/maps anyway.
16
15
17
4
5
3
14
18
6
13
2
1
Clubhouse
9
11
10
Maint. Bldg.
7
8
Old Greens-1962
New Greens-1988
Prac. Green-2007
Tees are located at hole numbers
Type II Surface Water Management Areas
Type I Surface Water Management Areas
Groundwater Management Areas
Image © 2007 DigitalGlobe

TURF NUTRIENT MANAGEMENT PLAN CHECKLIST

For purposes of complying with DNR Technical Standard 1100 (NR 151.13(1)(b)3 and NR 151.14)

Date plan completed: _____ Initial plan or Updated plan (circle one)

Name, address, and phone number of NM planner	Business name, address, and phone for which the plan is written
	Properties for which plan is written:
Nutrient management planner's qualification ***1***-Certified sports turf manager ***2***-Certified golf course superintendent ***3***-BS degree in turf and grounds management ***4***-Equivalent experience or training	

Standard 1100 Turf Nutrient Management Requirements

	Yes	No	*Comments*
1. Narrative			
a. Is a short description of the site, its uses, and general management included?	☐	☐	
b. Different use types are designated and defined (athletic fields, fairways, etc.)?	☐	☐	
c. Dominant turf species are identified?	☐	☐	
2. Maps			
a. Is a map of the property included with the plan and use areas identified (greens, tees, athletic field, etc.)?	☐	☐	
b. Is a map of soil types included?	☐	☐	
c. Is a map of hydrologic groups included?	☐	☐	
d. Is a map of representative slopes included?	☐	☐	
e. Is a map of depth to water table included?	☐	☐	
f. Is a map of depth to bedrock included?	☐	☐	
g. Is a topographic map included?	☐	☐	
3. Soil Samples/Tests			
a. Are soil sample locations indicated on the property or soil map?	☐	☐	
b. Have soils been sampled and analyzed on areas receiving fertilizer applications?	☐	☐	
c. Have soil samples been collected in accordance with the technical standard?	☐	☐	
d. Have soil samples been analyzed at a laboratory?	☐	☐	
Which soil test was used? Bray-1 or Mehlich-3			
e. Are representative areas defined and soil types identified?	☐	☐	
4. Written Plan Components			
a. Are nutrient applications consistent with the technical standard?	☐	☐	
b. Are product types, rates, and application sites identified in the plan?	☐	☐	
c. Does the plan identify a re-establishment plan for areas of disease, winter kill, etc.?	☐	☐	
d. Are erosion control plans included for newly seeded areas and bare ground areas?	☐	☐	
5. Records: Are date, rate, product, location, and applicator being documented?	☐	☐	

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