ROANOKE COUNTY

Purchasing Division
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Roanoke, Virginia 24018-0798
TEL: (540) 772-2061 FAX: (540) 772-2074

April 25, 2022
ADDENDUM NO. 1 TO ALL BIDDERS/OFFERRORS:

Reference – IFB 2022-070
Description: Turf Maintenance Services for RCPS
Issue Date: April 12, 2022
Proposal Due: April 28, 2022

The above Project is hereby changed as addressed below:

1. Extension of Due Date: Sealed bids are now due no later than 2:00 PM on Thursday, April 28, 2022.

2. Responses to Questions Submitted: please see the following questions submitted by potential bidders and the responses provided by RCPS as they are able.

    a. Does Roanoke County have a Nutrient Management Plan on File with the Department of Conservation and Recreation for these properties? If so, can you provide those documents to prospective bidders?

    Yes; Please see Exhibit 1 to this Addendum for a copy of the Nutrient Management Plan.

    b. You specify 1.5 pounds of Nitrogen per 1000 square feet per application X 3 applications. This exceeds the 3.5 pounds of Nitrogen allowed yearly for cool season grasses and 4.0 pounds yearly on warm season grasses, outlined by Virginia Nutrient Management Standards and Criteria.

    The specification should be 1 pound per 1000sf x 3 applications for cool season grasses, not to exceed 3.5 lbs per year and should be 1 pound per 1000sf x 3 applications for warm season grasses not to exceed 4lbs per year as outlined by the Virginia Nutrient Management Standards and Criteria.

    c. You specify a specific amount of Phosphorus per application, however Phosphorus can only be applied on soils that are Phosphorus deficient. Thus the need for accurate soil samples for each property. This affects material pricing.

    Procurement of a soil sample by the contractor shall be required for each athletic field, once per year at a minimum, to determine the recommended phosphorus application according to the Virginia Nutrient Management Standards and Criteria.

Note: A signed acknowledgment of this addendum must be received at the location indicated on the original solicitation either prior to the proposal due date or attached to your proposal.

Signature on this addendum does not substitute for your signature on the original proposal/bid document. The original proposal/bid document must be signed.

Thank you,

Kate Hoyt
Phone: (540) 283-8149
KHoyt@roanokecountyva.gov

Sign Name:	Print Name:
Name of Firm:	Date:

Addendum 1 to IFB 2022-070
Exhibit 1

192 Briarherst Drive, Amherst, Virginia 24521 ❖ 434-665-2813 (Cell) ❖ 434-946-7483 (Off.) ❖ habelrf@gmail.com

Nutrient Management planning is a large part of Virginia's strategy to clean and protect the state's waterways and to help meet the EPA's goal of restoring the ecosystem of the Chesapeake Bay. When fertilizer is used improperly, the nutrients nitrogen and phosphorus are not used by the plant and can then be carried into streams, lakes, and rivers. These nutrients then cause major ecological problems. Turfgrass covers an estimated 1.2 million acres of the Chesapeake Bay watershed in Virginia. According to Virginia's Watershed Implementation Plan (WIP), 500,000 acres must be addressed by nutrient management plans by 2025.

Urban Nutrient Management aims to limit the amount of nutrient rich runoff reaching the waters of Virginia ultimately the Chesapeake Bay from golf courses, athletic fields, homes, business complexes, etc. This is accomplished through following a site specific, agronomically and environmentally sound, Nutrient Management Plan written by a Certified Nutrient Management Planner. The goal of a Nutrient Management Plan is to manage the amount, placement, timing, and application of fertilizer, bio-solids and other nutrient rich materials all while achieving the healthiest turf or landscape area possible.

While not all of Virginia is included in the Chesapeake Bay Watershed, all of Virginia's waters can be improved by following a nutrient management plan. The Chesapeake Bay cleanup is being used as a model for future endeavors. The Albemarle Sound and Gulf of Mexico may soon be under the same restrictions as the Bay. The Roanoke, Nottaway and Meherrin Rivers all flow into North Carolina's Albemarle Sound, while the New, Holston and Clinch rivers flow to the Mississippi River and Gulf of Mexico.

These plans can be voluntary, but in several cases, they are required by law. Both golf courses and state owned lands are currently required to have plans, as well as fertilized land that is publicly owned within a Municipal Separate Storm Sewer System (MS4) permit area. These laws apply to both areas inside and outside of the Chesapeake Bay Watershed.

Thank you for choosing me to write your Nutrient Management Plan. It is my goal to provide you with the most agronomically and environmentally sound plan available. For this plan to be effective, it is important that you follow the soil test based guidelines of your plan and that you keep detailed records of your applications. While you do not have to follow the specific fertilizer analyses shown, the success of this plan hinges on not exceeding the nutrient amounts that are allowed for by the Standards and Criteria. These amounts are stressed multiple times in the discussion of Soil Test Results and Application Worksheets. In cases where plans are required by law, the limits set by the Standards and Criteria are law.

If this is a renewal plan, please be aware that the Standards and Criteria were revised in July 2014. Many guidelines have changed and old recommendations may be out of compliance with the new standards.

Together, we will do our part to protect Virginia's natural beauty and the Chesapeake Bay. Please do not hesitate to contact me if you have questions or suggestions. Your input is integral to making your Nutrient Management Plan a living and usable document.

Thank You,

Robert Habel
Owner - CNMP - VT '05

Nutrient Management Plan

Prepared For:

Dennis Epperly, Maintenance Supervisor
Roanoke County Schools
5937 Cove Road
Roanoke, VA 24019
Phone: 540-562-3700

Prepared By:

Five Oaks Agronomy Consulting
Robert Habel, CNMP
192 Briarherst Drive
Amherst, Virginia 24521
Cell: 434-665-2813 habelrf@gmail.com
Certification Code: 654

Acreage - 25 Fields, 8 Locations, 8 Soil Samples (Breakdown on Page 6)	
Total:	48.5

County:	1 – City of Roanoke 7 – County of Roanoke
Watershed:	RU09 – 8.7 Acres RU13 – 2.5 Acres RU14 – 29.5 Acres RU15 – 7.8 Acres

Plan Written: September 1, 2015

Plan Expires: September 1, 2018

Robert F. Habel

Planner Signature

Table of Contents

Sources:

Maps – Maps are produced using Google Earth or provided by client.
Photos/Logos – Obtained from client, clients website, or taken by planner.
Site information – Obtained from client or clients website.
Technical Information –

Agronomy Handbook – A&L Labs – 2001
Best Golf Course Management Practices – McCarty – 2001
Environmental Best Management Practices for Golf Courses – Virginia GCSAA – January 2012
Golf Course Management and Construction, Environmental Issues – Balogh, Walker, USGA – 1992
Soil Fertility and Fertilizers 6th Ed. – Havlin, Beaton, Tisdale, Nelson – 1999
Spectrum Analytic Agronomic Library – www.spectrumanalytic.com
Sports Turf Management in the Transition Zone – Goatley, Askew, Ervin, Mcall, VSTMA, Etc. – 2008
Turf Management for Golf Courses 2nd Ed. – Beard, USGA – 2002
Turfgrass Soil Fertility and Chemical Problems – Carrow, Waddington, Rieke – 2001
Urban Nutrient Management Handbook – VA DCR, Virginia Tech, Virginia State Uni. – May 2011
Virginia Nutrient Management Standards and Criteria – Commonwealth of Virginia – July 2014

Disclaimer: *Statements and recommendations made within this document based on published research data and experience. Recommendations are based on the soil tests included in this document and not intended for use on any other facility. Products suggested are used in methods suggest by label guidelines when available, be sure to read label before using products as labels can change. Maximum rates are provided by Virginia Department of Conservation and Recreation Standards and Criteria and are not to be exceeded even when product label suggests otherwise. No guarantee or warranty is made, expressed or implied, concerning crop performance as a result of using the contents of this document.*

Definitions:

M = 1000 FT²
 # = Pounds of product
N = Nitrogen
P = Phosphorus
K = Potassium
NMP = Nutrient Management Plan
MS4 = Municipal Separate Storm Sewer System

1. Narrative

1.1. Statement of Compliance

Roanoke County Schools are required to have and follow this Nutrient Management Plan according to the Rules and Regulations of the Code of Virginia. According to 9VAC25-890-40 MS4 General Permit, permittees are required under the "Turf and Landscape Management" section of the permit (GP Section II.B.6.c) to develop NMPs on "all lands owned or operated by the MS4 operator where nutrients are applied to a contiguous area greater than one acre." Thus, Roanoke County Schools agrees to comply with all requirements set forth in the Nutrient Management Training and Certification Regulations, 4VAC50-85-10 et seq., and to follow recommendations for turf fertilization and management as described in the Virginia Nutrient Management Standards and Criteria, Revised July 2014. This includes implementing this Department of Conservation and Recreation approved Nutrient Management Plan and maintaining fertilization records. All nutrient applications to School properties, performed by Roanoke County Schools staff or other contractors, shall comply with the provisions of this Nutrient Management Plan as of August 1, 2015. This plan is affective for three years (until August 1, 2018) or until major renovations or major changes to maintenance occurs. The planner should be alerted if this occurs or if new soil tests are taken within the three-year period, a minor revision may be needed if tests show major differences. The process of updating this plan for a new three year cycle should begin no later than 6 months prior to plan expiration (March 2018).

1.2. Plan Overview

Roanoke County Schools has 8 locations that receive fertilizer this includes 25 sports fields covering 48.5 acres. The parks and rec department utilizes several fields on school property and handles the fertilization of those fields which are covered by separate NMPs.

Green Up Lawn and Landscapes is currently contracted to fertilize these fields. Their program calls for 2.5 #/M Nitrogen and no phosphorus. A program will be written with these specs as well as a soil test specific plan for all locations.

It is important to note that according to the Code of Virginia, all fertilizer applications made to municipal properties are to be made by Certified Fertilizer Applicators. In addition, all applications made to these fields should be made in accordance with this Nutrient Management Plan and records should be kept of all applications. The records sheet provided complies with the record keeping requirements of both the Virginia Department of Conservation and Recreations (Nutrient Management) and the Virginia Department of Agriculture and Consumer Services (Certified Applicator).

1.3. Location

The Roanoke Valley is located in Southwest Virginia. The valley includes the following areas: Botetourt County, City of Roanoke, City of Salem, Craig County, Franklin County, Roanoke County, and Town of Vinton.

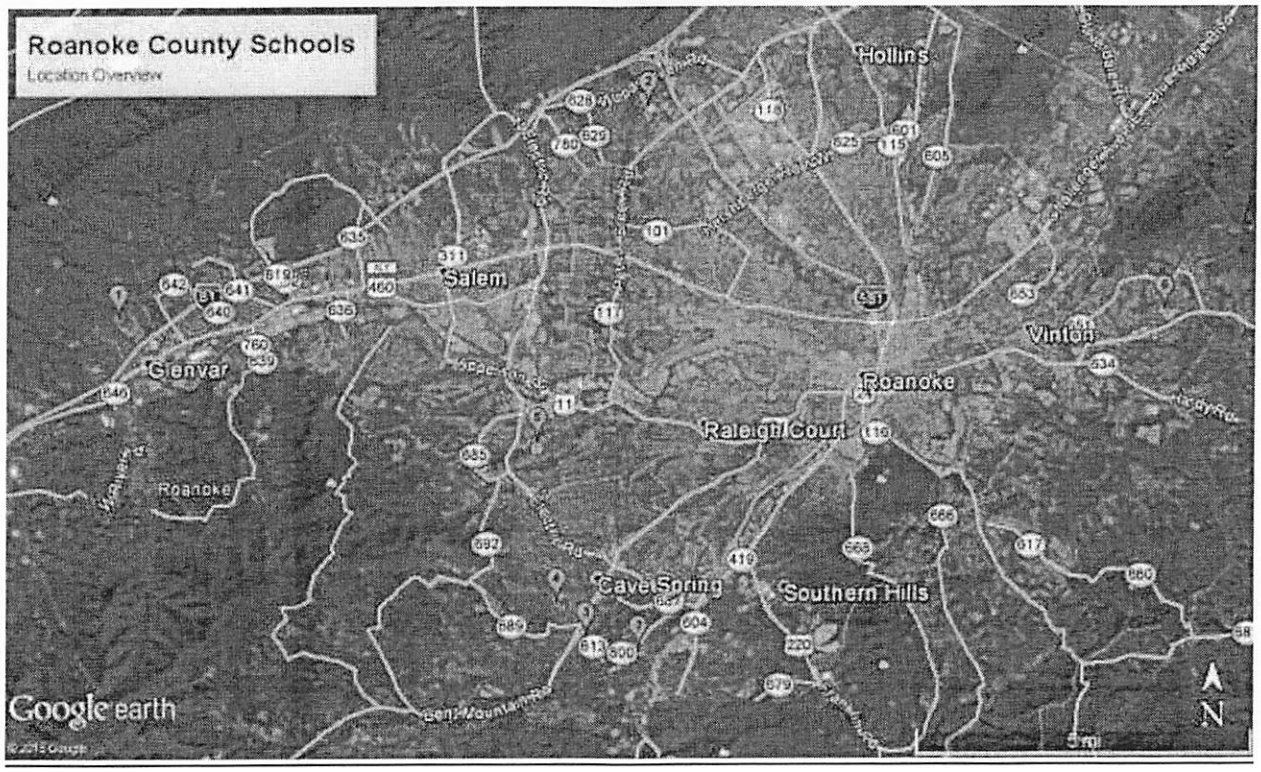
Roanoke County is located in the southernmost end of the Shenandoah Valley, between the Allegheny and Blue Ridge Mountains. It is nearly hexagonal in shape, with a land area of approximately 250 square miles. Dividing the county is a northeast-to-southwest valley. The mean width of the Roanoke Valley is between 7 and 8 miles and its elevation ranges from 900 feet above sea level on the valley floor to about 3,900 feet on Poor Mountain in the southwestern part of the county.

The Roanoke River originates in the Blue Ridge Mountains, flowing east through the middle of Roanoke County, draining into Smith Mountain Lake in Bedford County and continuing into North Carolina, ultimately reaching the Albemarle Sound. The Roanoke River Valley drainage system serves the cities of Roanoke and Salem and most of Roanoke County, with a small area in the northern part of the county drained instead by Catawba Creek, which is part of the Upper James River drainage system that drains into the Chesapeake Bay. All areas in this portion of the plan drain to the Roanoke River

The independent cities of Roanoke and Salem (incorporated as such in 1884 and 1968 respectively) are located within the boundaries of Roanoke County, but are not a part of the county. The incorporated town of Vinton is the only incorporated municipality within the county. Several locations utilized by the Parks, Recreation, and Tourism Department fall within the city/town boarders. While significant areas of the county are rural and mountainous, most residents live in the suburbs near Roanoke and Salem in the Roanoke Valley.

Table 1

Location/Acreage/Watershed Code Breakdown				
Location	**Acres**	**Irrigation**	**Grass**	**Watershed Code**
1. Glenvar High School				**RU09 8.7 Acres**
Baseball	1.8	Yes	Cool	
Football	2.2	yes	Cool	
Softball	0.8	Yes	Cool	
Soccer	2.2	Yes	Cool	
Practice Field	1.7	No	Cool	
2. Northside High School				**RU13 2.5 Acres**
Baseball	2.5	No	Cool	
3. Cave Spring Middle School				**RU14 29.5 Acres**
Practice Field	2.2	Yes	Cool	
2. Northside High School				
Football	2.2	Yes	Warm	
Practice Field	1.3	Yes	Cool	
2. Northside Middle School				
Baseball/Football	2.9	Yes	Cool	
Practice Field	2.3	Yes	Warm	
4. Hidden Valley High School				
Practice Field	2.2	Yes	Cool	
Softball	0.6	No	Cool	
Baseball	2.3	Yes	Cool	
Soccer	2	Yes	Cool	
5. Hidden Valley Middle School				
Football	1.5	Yes	Cool	
6. William Byrd High School				
Football	2.2	Yes	Cool	
Soccer/Softball	2	Yes	Cool	
Baseball	1.8	Yes	Cool	
Practice Field	4	Yes	Cool	
7. Cave Spring High School				**RU15 7.8 Acres**
Baseball	2	Yes	Cool	
Practice Fields	3.5	No	Cool	
Softball	0.6	Yes	Cool	
Soccer	1.7	Yes	Cool	
				48.5


Roanoke County Schools
Location Overview
Hollins
Salem
Vinton
Glenvar
Roanoke
Raleigh Court
Roanoke
Cave Spring
Southern Hills
Google earth
N

1.4. Nutrient Management Principals

Nutrient Management Plans focus on two primary objectives healthy plants and clean water. The *Standards and Criteria* are based upon many years of scientific research and the rates suggested are optimal for plant health within the intended usage. Low input areas, like home lawns, require some fertilizer to maintain plant vigor thus maintaining turf cover and preventing erosion. High use areas, like sports fields, require frequent fertilizer input to help maintain plant health and to aid in recovery from stress. Clean water is maintained by applying fertilizer in a responsible manner ensuring minimum movement away from the intended site.

There are four different types of elements essential for plant health. Non-mineral, Primary and Secondary elements are all considered Macronutrients. The fourth is Micronutrients. Non-mineral elements consist of carbon, hydrogen, and oxygen; these elements are obtained from air and water. The Primary nutrients are nitrogen, phosphorus, and potassium. Secondary elements are calcium, magnesium, and sulfur. Micronutrients are iron, manganese, boron, zinc copper molybdenum, chlorine, cobalt, and nickel. All of these elements are obtained from the soil and must be supplemented with fertilizer, lime or other soil amendments when a soil test shows a deficiency. In high maintenance situations, some elements are spray applied and absorbed through the leaf tissue.

Nitrogen and Phosphorus are the focus of a nutrient management plan, as these nutrients cause ecological problems. Lime is also important because having improper pH can make applied fertilizers unavailable to the plant and more likely to leach or runoff. While nitrogen and phosphorus are the focus, other nutrients are also discussed in the plan, these nutrients are beneficial to plant health, but do not cause water quality problems.

Nitrogen (N) – This element is responsible for green color, shoot growth and density, root growth, carbohydrate reserves, recuperative potential, heat, cold, drought hardiness, wear tolerance, and disease susceptibility. Nitrogen has a very complex cycle and only certain forms are available to the plant. It leaches through the soil rapidly and does not accumulate thus you cannot soil test for N. Due to these factors, nitrogen management is a large part of nutrient management. Nitrogen management includes but is not limited to using slow release materials, timing the applications in accordance with plant growth, and making multiple applications so that the element is available when it is needed by the plant.

There are multiple N rates used in this plan due to the diversity of the areas being fertilized. Please see each section and nutrient application worksheets for specifics.

Slow release products were used exclusively in this plan. If making changes, please continue to use slow release fertilizers or contact your planner for help determining the proper rates.

Phosphorus (P) – Phosphorus controls the establishment rate of newly seeded turf, plant maturation, root growth, and seed production. Like nitrogen, P also has a complex cycle. The major difference is that P readily attaches soil, it can be quantified by a soil test and only leaches when it completely saturates the soil. Phosphorus moves away from the application site when it is improperly applied to compacted soil or other impervious surfaces, when applied in excess, and since it attaches to the soil, with sediment rich runoff. Phosphorus management

is also important to nutrient management. It should only be applied when called for by a soil test, to soils that are not compacted to prevent runoff and only applied to actively growing turf with sufficient turf cover/rooting to hold the soil in place.

Maximum P rates are outlined in application worksheets. Do not exceed this number.

Potassium (K) - Potassium is responsible for root growth, heat, cold, and drought hardiness, wear tolerance, and disease susceptibility. While the *Standards and Criteria* do regulate the application of K, but in some cases, K input may exceed recommended levels, as it does not have the same detrimental effects on the health of Virginia's waters as N and P. Potassium is considered the plant nutrient most responsible for turf quality. It helps plants respond to stresses like drought, extreme heat/cold, and insect/disease pressure. The plants increased ability to respond to stress in a positive manner can help reduce the need for increased N and P fertility and reseeding caused by stress. In addition to the benefits of K, it is difficult to limit the amount of K used as most modern slow release fertilizers contain both N and K while limiting or completely removing P. Nitrogen only products are not readily available in slow release form and custom blended fertilizers are expensive.

Potassium containing fertilizers are not utilized by the fertilization contractor. Even though soil tests show that K is high, it can still be used. As discussed above, K helps the plant deal with stress. Sports fields and common areas are generally stressed be it from excessive use, compaction, improper pH, or lack of proper care due to budget and personnel restraints.

Lime - Liming is a critical management practice for maintaining soil pH at optimal levels for plant growth. Liming supplies the essential elements Calcium and/or Magnesium, reduces the solubility and potential toxicity of Aluminum and Manganese, and increases the availability of essential nutrients. Many soil elements change form because of chemical reactions in the soil due to pHs that are either too acidic or too basic. Plants may not be able to use elements in some of these forms making some elements essential to plant health unavailable. Most plants grow well in the pH range 5.8 to 6.5.

Buffer pH is used to provide an indication of the soil's total (active + reserve) acidity and ability to resist a change in pH. This buffer measurement is the major factor in determining the amount of lime to apply. The Buffer pH starts at 7 (no lime needed) and goes lower as the soil's total acidity increases and more lime is needed to raise the soil pH. As an example, a clay soil with a pH of 6.1 could have a buffer pH of 6.8 and need 1 ton/A of lime in order to maintain/increase that pH around 6.2. A sandy soil could have a much lower pH but have the same buffer pH thus, needing the same amount of lime to change the pH to 6.2. This is because sandy soils have a lower cation exchange capacity thus, less storage for reserve acid.

Attempting to change the pH in the deep rooting zone of an established turf is difficult at best. One method of getting lime somewhat deeper in established turf areas is to apply lime in conjunction with aeration. Applying lime in the fall and winter months is recommended because the freeze/thaw cycle aids in mixing lime throughout the root zone.

Lime provides the essential nutrients Calcium and Magnesium. Calcium is the main component of plant cell walls while magnesium is the atom upon which chlorophyll is built. It is important that these elements be present in the soil not only to help regulate the soils acidity but to insure plant health. When a soils pH is acidic, these elements can be added with lime. Calcitic lime should be used when calcium is deficient and magnesium is high. Dolomitic lime, which is more common, is used when the both are deficient or balanced. If pH does not need to be adjusted, calcium levels can be raised with gypsum and magnesium is raised with Epsom salts. The *Standards and Criteria* provide guidance on adjusting soil pH levels but do not include any recommendations for Ca or Mg, as they do not affect water quality.

Not all liming materials are the same, if the liming material chosen does not equate to 100% Calcium Carbonate Equivalent (CCE% should be listed on bag) see chart on page 49 to adjust the required amount of lime.

Several soil tests require lime, liming is not suggested without sampling individual fields.

Sulfur (S) - Sulfur is responsible for the plants green color, shoot growth and density, root growth, carbohydrate reserves, and disease susceptibility. Elemental sulfur applications should be avoided unless you are attempting to acidify (lower pH) the soil and should be applied at no more than 5#/M and watered in due to the turf burn potential. Unless called for by a soil test, the occasional use of sulfur containing fertilizers and micro nutrient packages should be the only S input needed to supplement the soil S content. This element is not included in the *Standards and Criteria*.

Iron (Fe) – Iron contributes to the plants green color, shoot growth and density, root growth, carbohydrate reserves, heat, cold and drought hardiness and wear tolerance. Iron is often included in fertilizer and micronutrient blends because it produces a faster greening of turf than nitrogen. According to the *Standards and Criteria,* Fe applications can be occasionally substituted for N applications because it produces greening. This is a good strategy, but Fe apps cannot replace N. While Fe is used inside the plant, the greening created by Fe is superficial and caused by the iron rusting on the plants surface. Fe should be used as an N replacement only when the plant is healthy and greening is desired without increased growth.

Micros – Other micronutrients are not mentioned by the *Standards and Criteria*. These elements are very important to plant growth, but regular input is not needed unless you are managing a sand based soil with low nutrient holding capacity. Most soils contain all the necessary micros and they will be available for the plant as long as the proper pH is maintained.

1.5. Best Management Practices for Water Quality Protection

The following list comes from the *Urban Nutrient Management Handbook* page 8-12 and details steps that can reduce the impact of nutrient management practices on water quality. A PDF of the complete handbook can be found online through ext.vt.edu, on the CD provided with the plan or a printed copy can be obtained from DCR.

- Base fertilization practices on a soil test.
- Supplement the soil test with a plant tissue test when necessary.
- Aerate compacted soil to reduce runoff and aid phosphorus and lime in entering the soil.
- Minimize fertilizer rates on slopes and sandy soils. If using quickly available sources of nitrogen on deep, sandy soils or near shallow water tables, use no more than 0.25 to 0.50 pound of nitrogen per 1,000 square feet per application.
- Establish and maintain a buffer zone of reduced- to zero-input vegetation around bodies of water. In some cases, native vegetation might be appropriate, but whatever plant material is selected, it must persist indefinitely to serve as a functional buffer zone.
- Consider using iron as a supplement to nitrogen for greening response.
- Use at least 50 percent slowly available sources of nitrogen on soils subject to leaching.
- Time applications carefully. Do not apply fertilizer before a heavy rainfall.
- Irrigate lightly (0.10 to 0.25 inch) after each application of quick-release fertilizer so it is washed off the foliage and moved into the soil. (Wait to irrigate if foliar activity is desired)
- Avoid over irrigation.
- Return grass clippings to the turf to improve nutrient cycling and reduce the amount of fertilizer needed to produce healthy plants. Use a mulching mower whenever possible and consider that a mulching mower can even be used to manage fall leaves (Goatley 2006).
- When collected, compost grass clippings rather than disposing of them in landfills.
- Use a drop (gravity) spreader near bodies of water or impenetrable areas to lessen the chance of spreading material on these surfaces.
- Perhaps the most important best management practice toward improving water quality is to simply sweep or blow fertilizers and clippings off hardscape surfaces and back into the turf.

1.6. Application Equipment Calibration

An agronomically and environmentally sound fertilizer program can be negated by improperly calibrated equipment. It is important to calibrate your equipment prior to every application. Even moving from one location to another can knock your application equipment out of adjustment so once you have your equipment calibrated for a particular product write down the setting. Use that setting to check the calibration for every site and adjust if necessary. The next time you use that product, use your records as a starting point and not a final calibration as equipment can wear over time thus changing the calibration point. For more information on how to calibrate your equipment see the *Urban Nutrient Management Handbook* Chapter 10 (ext.vt.edu) or visit your equipment manufactures website. Please remember that the number on the bag is not sufficient, every spreader and every application is different, and that the bag number only serves as a calibration starting point.

1.7. Season of Fertilization

According to the *Virginia Nutrient Management Standards and Criteria, Revised July 2014*, fertilizers must be applied in between the following dates. These are guidelines and averages, in warmer years fertilizers could be applied earlier and in cooler years fertilizers should be applied later. Fertilizers should not be applied to frozen ground or to grass that is not actively growing. For warm season grasses please wait for green up to occur. For warm season grasses that are overseeded, follow the cool season application window. If overseeding is skipped, please revert to warm season window.

	Average Frost Dates	Cool Season Applications	Warm Season Applications
Spring	April 20	March 9	April 20
Fall	October 20	November 21	September 10

Maps – *Maps showing fertilized areas were provided by Roanoke County, other satellite and topo maps created using Google Earth are to scale as shown in bottom left of each map. For all maps, unless otherwise indicated, North is oriented towards top of page. Flood maps created by Web Soil Survey.*

Nutrient Applications - *Each location addressed by this plan has its own section. Some sections cover multiple management areas. A nutrient application worksheet for each management area of that location is included as the last page(s) of that section of the plan. Application records are all located in one section together or on the disk provided. A blank worksheet is also included on the disk to help with calculations if any changes in fertilizer analysis occur. Do not hesitate to call if there are questions.*

Flooding Frequency Class Designations *– Several areas are indicated as flood prone by Web Soil Survey. Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.*

Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent.

	"None" means that flooding is not probable. The chance of flooding is nearly 0 percent in any year. Flooding occurs less than once in 500 years.
	"Very rare" means that flooding is very unlikely but possible under extremely unusual weather conditions. The chance of flooding is less than 1 percent in any year.
	"Rare" means that flooding is unlikely but possible under unusual weather conditions. The chance of flooding is 1 to 5 percent in any year.
	"Occasional" means that flooding occurs infrequently under normal weather conditions. The chance of flooding is 5 to 50 percent in any year.
	"Frequent" means that flooding is likely to occur often under normal weather conditions. The chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year.
	"Very frequent" means that flooding is likely to occur very often under normal weather conditions. The chance of flooding is more than 50 percent in all months of any year.

2. Management Areas

2.1. Cave Spring Middle School

A: Description

CSMS was originally built as Cave Spring High School in 1956. In 1966, a new high school was built and the vacated building became Cave Spring Junior High, the first junior high in Roanoke County. At the end of the 2001-2002 school year, we said good-bye to our ninth graders and became Cave Spring Middle School.

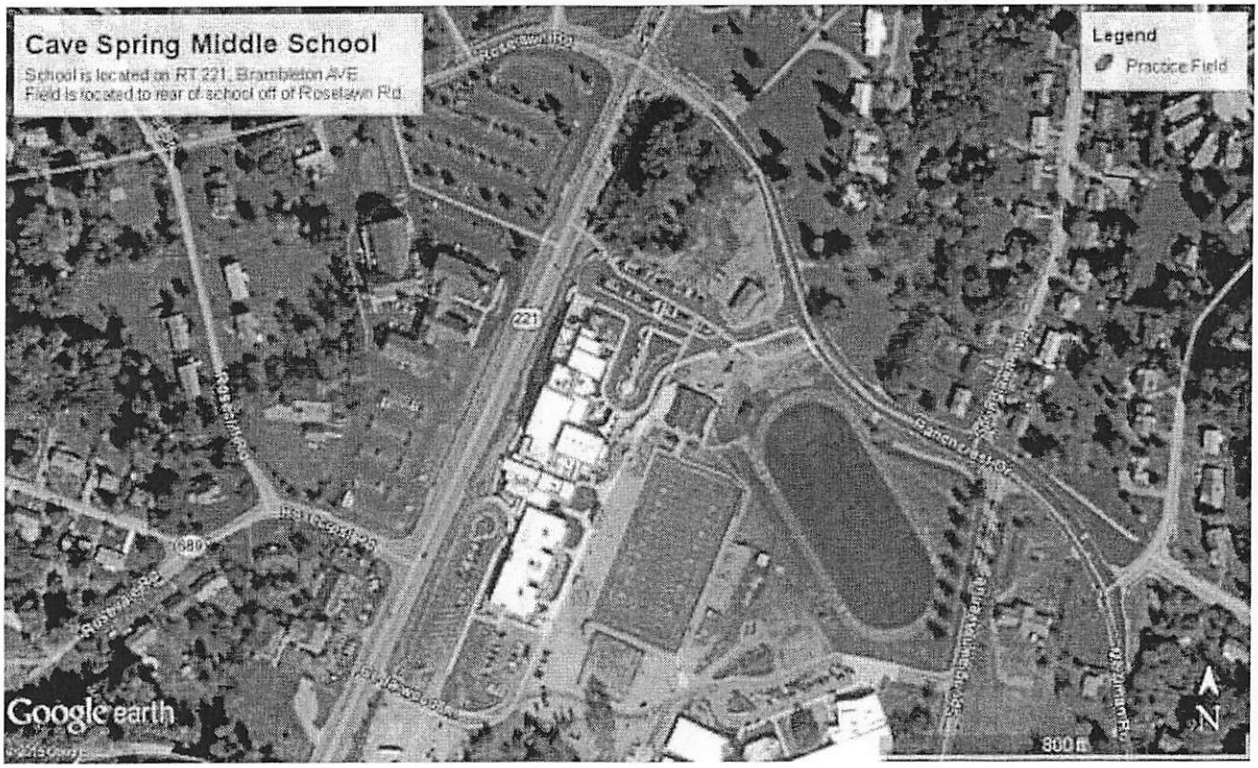
B: Location

School is located off RT 221, Brambleton AVE on Roselawn Road.

Address: 4880 Brambleton Ave, Roanoke, VA 24018
GPS Coordinates: 37.215028, -80.016029

C: Areas Managed

The field to the rear of the school surrounded by a track is 2.2 acres of cool season turf. It is irrigated.



Environmentally Sensitive –

- There are no environmentally sensitive areas near this field.
- There are many roads, sidewalks and storm water drains throughout the area. Be cautious when making fertilizer applications near these areas and always clean up any fertilizers accidently spread on pavement and sidewalks.

2.2. Cave Spring High School

A: Description

Cave Spring High School opened in 1956. In 1968, the high school was moved to its current site, while its original building became Cave Spring Junior High School, which would later become Cave Spring Middle School in 2002.

B: Location

From Route 419, Electric Road turn onto Chaparral Road, Rt 800 and follow to school.

Address: 3712 Chaparral Drive, Roanoke, VA 24018
GPS Coordinates: 37.212718, -80.001595

C: Areas Managed

There are five fields at this site.
Blue – Baseball field is 2 acres of irrigated cool season turf.
Black – Two cool season unirrigated practice fields are side-by-side totaling 3.5 acres.
Red – Cool Season irrigated soccer field, 1.7 acres.
Yellow – Cool season irrigated softball field, 0.6 acres.

Environmentally Sensitive –

- There are no environmentally sensitive areas near this field.
- There are many roads, sidewalks and storm water drains throughout the area. Be cautious when making fertilizer applications near these areas and always clean up any fertilizers accidently spread on pavement and sidewalks.

2.3. Glenvar High School

A: Description

Glenvar enjoys a rich athletic history that encompasses all types of athletics. Teams, male and female, are always competitive and at the top of the Three Rivers District. The athletes love community support provided by their community.

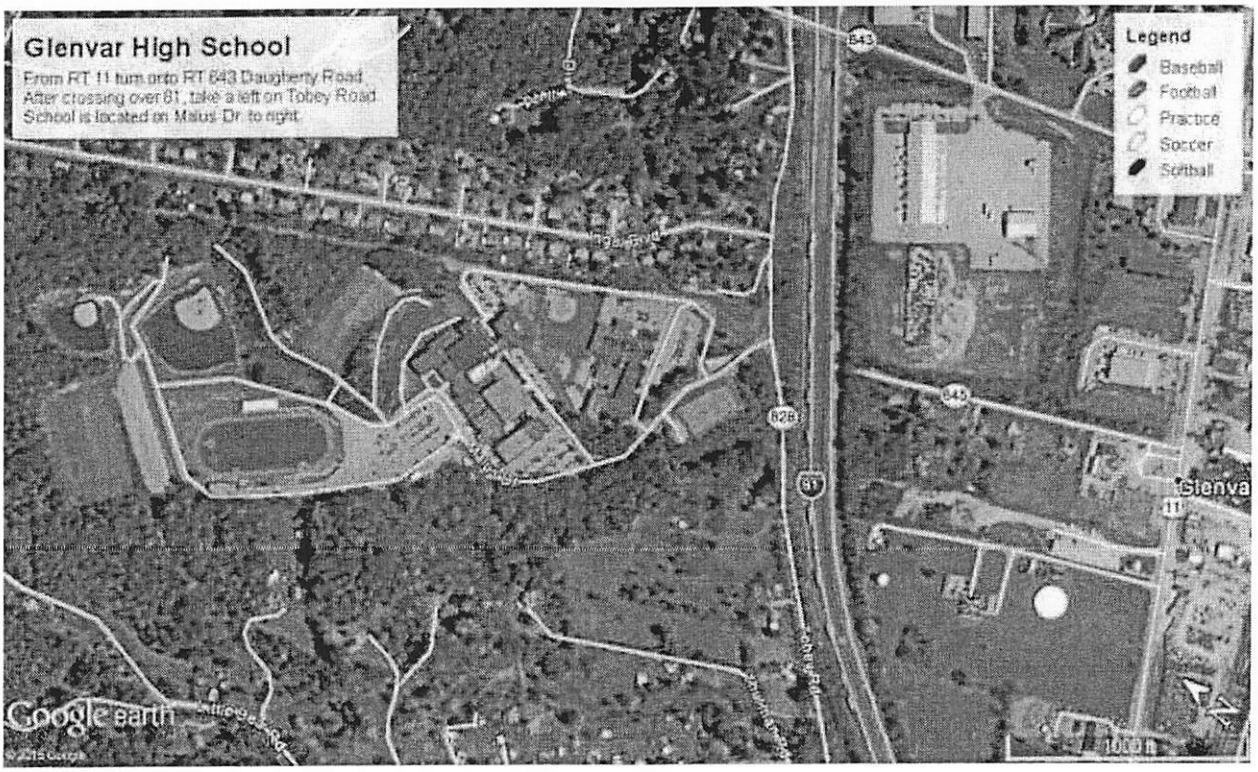
B: Location

From RT 11 turn onto RT 643 Daugherty Road. After crossing over 81, take a left on Tobey Road. School is located on Malus Dr. to right.

Address: 4549 Malus Drive, Salem, VA 24153
GPS Coordinates: 37.283462, -80.142362

C: Areas Managed

There are five fields at this site.
Blue – Baseball is 1.8 acres of cool season irrigated turf.
Red – Football is 2.2 acres of cool season irrigated turf.
Yellow – Practice is 1.7 acres of cool season unirrigated turf.
Teal – Soccer is 2.2 acres of cool season irrigated turf.
Black – Softball is 0.8 acres of cool season irrigated turf.



Environmentally Sensitive –

- There are no environmentally sensitive areas near this field.
- There are many roads, sidewalks and storm water drains throughout the area. Be cautious when making fertilizer applications near these areas and always clean up any fertilizers accidently spread on pavement and sidewalks.

2.4. Hidden Valley Middle School

A: Description

Hidden Valley Middle school is located in southwestern Roanoke County.

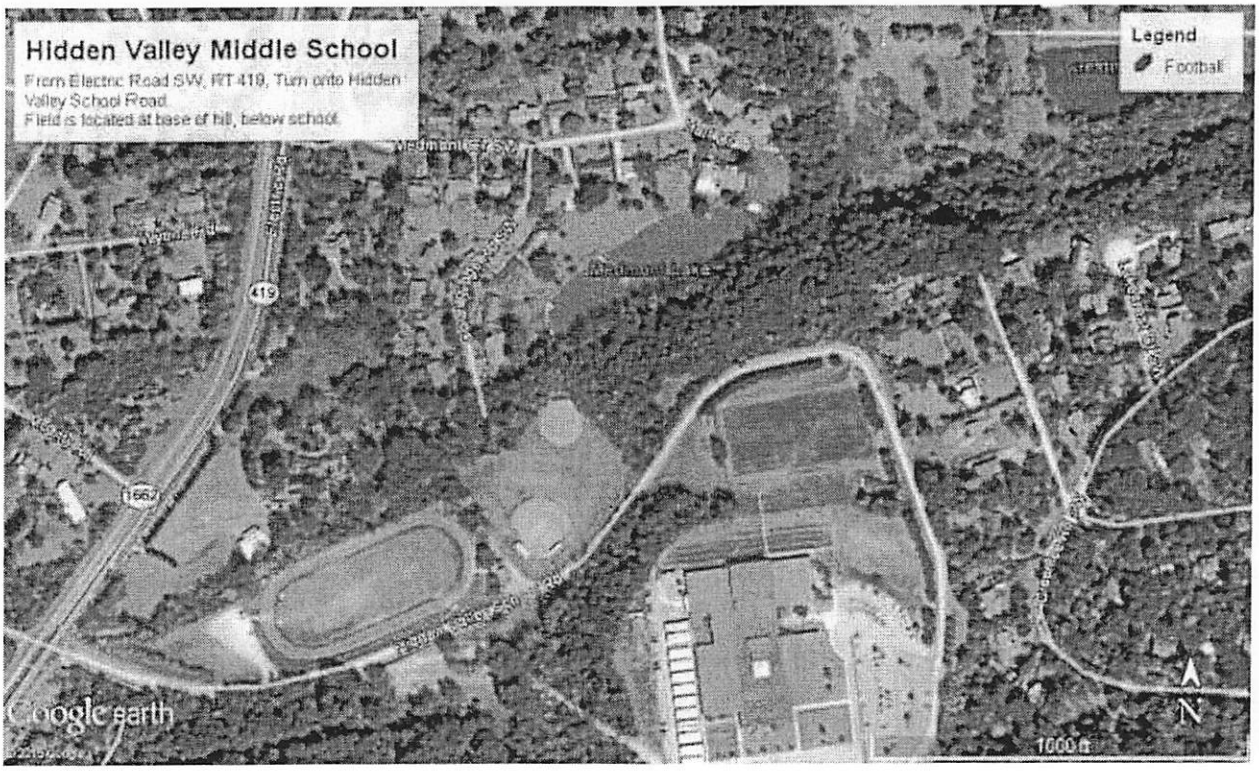
B: Location

The school is located off Electric Road on Hidden Valley School Road.

Address: Hidden Valley School Rd. Roanoke, VA 24018
GPS Coordinates: 37.256081, -80.031950

C: Areas Managed

The football field located at base of hill from school is 1.5 acres of cool season irrigated turf.



Environmentally Sensitive –

- According to Web Soil Survey, there is a "rare" chance of flooding to the west of the football field, but this should not affect this field.
- There are many roads, sidewalks and storm water drains throughout the area. Be cautious when making fertilizer applications near these areas and always clean up any fertilizers accidently spread on pavement and sidewalks.

2.5. Hidden Valley High School

A: Description

Hidden Valley High School is the newest school introduced into the Roanoke County Public School System, with its opening being in August of 2002. Hidden Valley was designed to accommodate 1100 students, be able to integrate current technology, have the infrastructure to adapt to future technology, and create a dynamic educational structure that would endure well into the future.

B: Location

From Brambleton Ave, RT 221, turn onto Pleasant Hill Dr. and then onto Titan Trail.

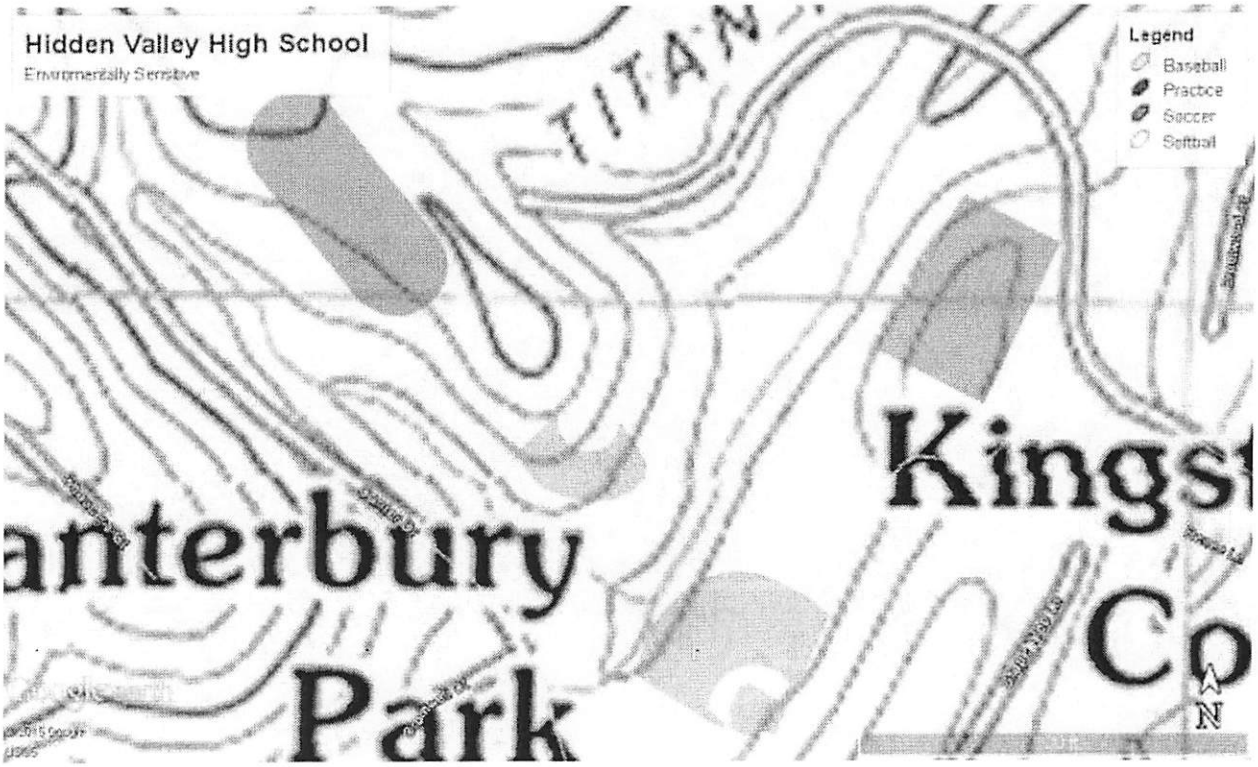
Address: 5000 Titan Trail, Roanoke, VA 24018
GPS Coordinates: 37.222274, -80.023887

C: Areas Managed

There are four fields on site.
Teal – Baseball field is 2.3 acres of cool season irrigated turf.
Blue – Practice field is 2.2 acres of cool season irrigated turf.
Red – Soccer is 2 acres of cool season irrigated turf.
Yellow – Softball is 0.6 acres of cool season unirrigated turf.

Environmentally Sensitive –

- Mud Lick Creek Flows through the sports fields area, but, according to Web Soil Survey, there is no risk of flooding. Any runoff from misapplied fertilizer will end up in this creek. Do not fertilize prior to heavy rains.
- There are many roads, sidewalks and storm water drains throughout the area. Be cautious when making fertilizer applications near these areas and always clean up any fertilizers accidently spread on pavement and sidewalks.



2.6. Northside Middle School

A: Description

Northside Middle School is located behind Northside High School.

B: Location

From Peters Creek Road turn onto Northside High School Road.

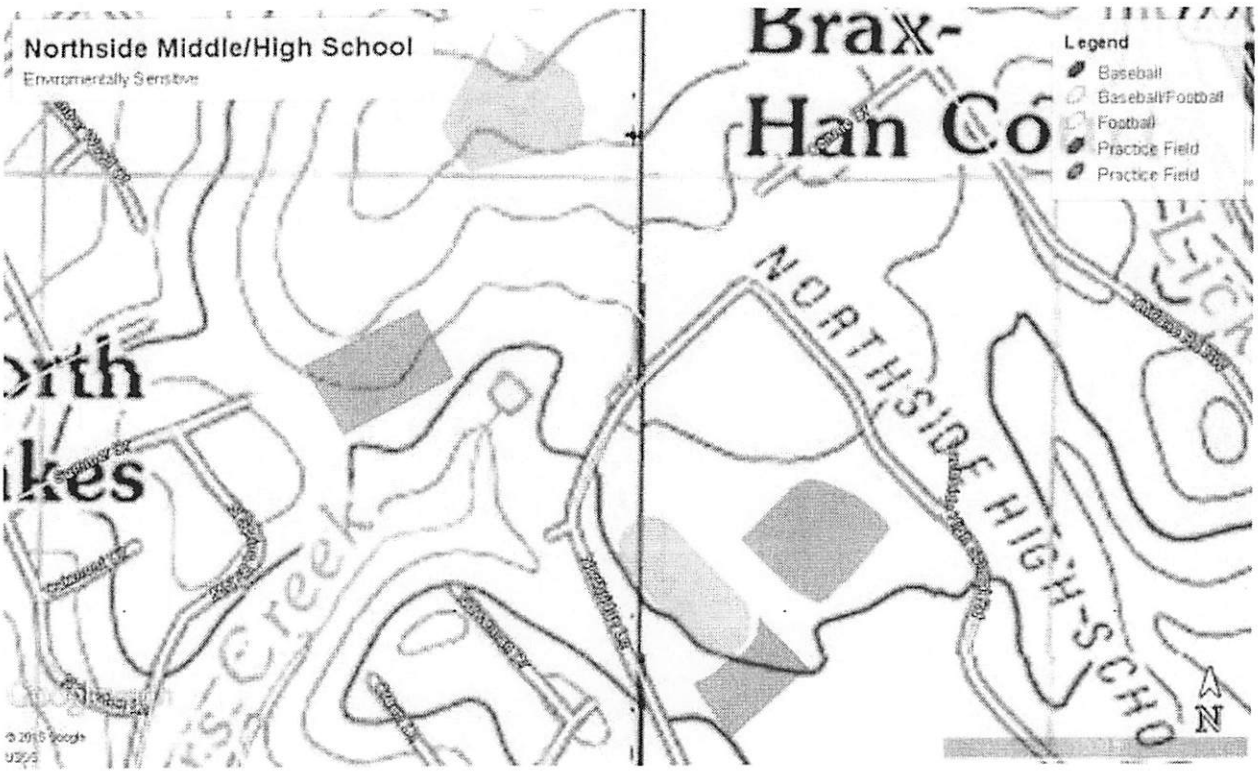
Address: 6810 Northside High School Rd, Roanoke 24019
GPS Coordinates: 37.330492, -80.000746

C: Areas Managed

There are two fields at this site.
Yellow – Baseball/Football is 2.9 acres of cool season irrigated turf.
Red – Practice field is 2.3 acres of warm season irrigated turf.

Environmentally Sensitive –

- Peters Creek originates below the practice field. Any runoff will end up in this creek. Do not fertilize prior to heavy rain.
- According to Web Soil Survey, there is no risk of flooding.
- There are many roads, sidewalks and storm water drains throughout the area. Be cautious when making fertilizer applications near these areas and always clean up any fertilizers accidently spread on pavement and sidewalks.



2.7. Northside High School

A: Description

Northside High School (NHS), located in the northern section of Roanoke County, Virginia, first opened in December 1960. Since that time, the surrounding area and the student body have changed considerably. Although still somewhat rural in some areas, this section of the county has become more commercialized and industrialized. New homes, subdivisions of single-and multi-family dwellings, and apartment complexes have also been built during this time. The extensions of I-81 and most recently Peters Creek Road have made this part of the county accessible. As the area has grown, the population has become more diverse and the socioeconomic level has risen.

The division between RU13 and RU14 runs along the ridge between the football and baseball stadiums.

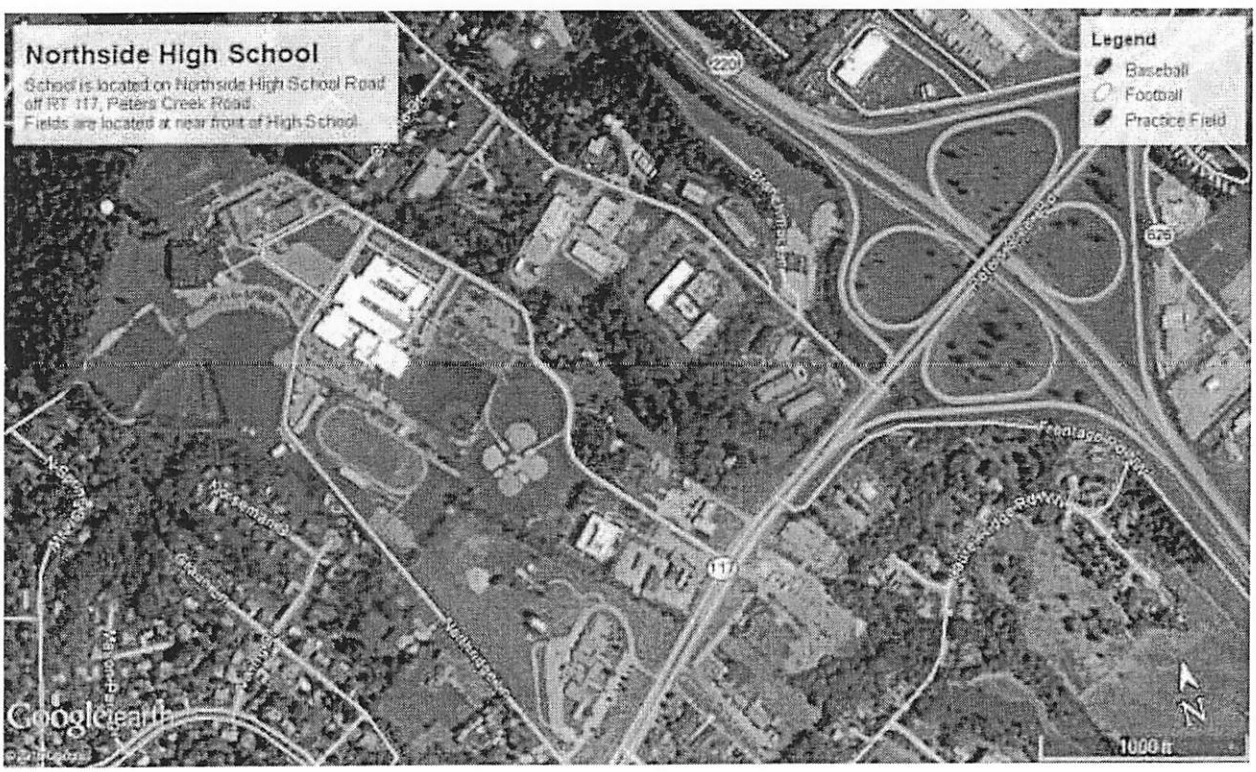
B: Location

From Peters Creek Road turn onto Northside High School Road.

Address: 6758 Northside High School Rd, Roanoke 24019
GPS Coordinates: 37.326815, -79.998579

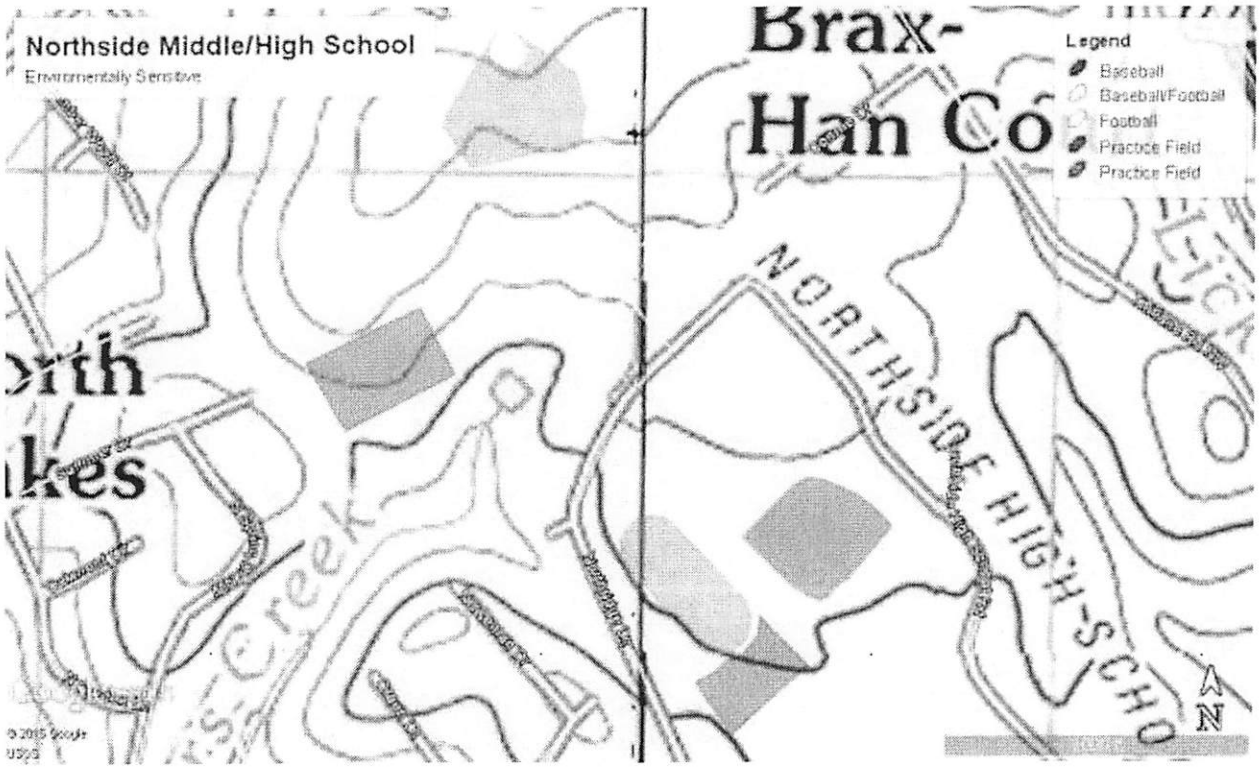
C: Areas Managed

There are three fields at this site.
Red – Baseball is 2.5 acres of cool season unirrigated turf.
Yellow – Football fields is 2.2 acres of warm season irrigated turf.
Blue – Practice field is 1.3 acres of cool season irrigated turf.



Environmentally Sensitive –

- Peters Creek originates to west of football field. Any runoff will end up in this creek. Do not fertilize prior to heavy rain.
- According to Web Soil Survey, there is no risk of flooding.
- There are many roads, sidewalks and storm water drains throughout the area. Be cautious when making fertilizer applications near these areas and always clean up any fertilizers accidently spread on pavement and sidewalks.



2.8. William Byrd High School

A: Description

William Byrd High School seeks to provide a strong and supportive learning environment for the students of the Vinton community.

B: Location

From Route 419, turn onto Starkey Road. Go to the stop sign and bear right, continuing on Starkey to its intersection with Merriman. Entrances located on Merriman and Crystal Creek Drive.

Address: 2902 Washington Ave., Vinton 24179
GPS Coordinates: 37.285126, -79.859675

C: Areas Managed

There are four fields at this site.
Teal – Baseball field is 1.8 acres of cool season irrigated turf.
Blue – Football field is 2.2 acres of cool season irrigated turf.
Red – Practice field is 4 acres of cool season irrigated turf.
Yellow – Softball/Soccer is 2 acres of cool season irrigated turf.

Environmentally Sensitive –

- Wolf Creek runs between the baseball field and the practice field. Any runoff will end up in this creek. Do not fertilize prior to heavy rain.
- According to Web Soil Survey, there is no risk of flooding.
- There are many roads, sidewalks and storm water drains throughout the area. Be cautious when making fertilizer applications near these areas and always clean up any fertilizers accidently spread on pavement and sidewalks.

3. Soil Test Summaries

Discussion of soil test results and allowable nutrient inputs. Specific applications details can be found in Nutrient Application Worksheet.

Soil samples were taken by Robert Habel on 6/10/15. A minimum of 10 random sub samples were collected, at a depth of 3-4 inches, using a soil probe and placed in plastic bags. Thatch and other organics were removed prior to boxing.

Soil tests are rated in terms of Very Low to Very High. In order to comply with Virginia Nutrient Management Standards and Criteria, Revised July 2014, no phosphorus or potassium may be applied if a soil test rates that element Very High. In economic terms, nutrients are not necessarily needed if they test above a medium rating; plant response is not guaranteed if soils already test above medium and therefore money can be saved by using a nitrogen only fertilizer. (See plant response chart page 35)

- Soil samples were taken for each location, 8 samples. Samples are listed in Alphabetical order in the first table.
- Soil test needs range from 0.75 to 2 #/M phosphorus. By averaging all soil tests together, 1 #/M phosphorus is allowed.
- Green Up Lawn and Landscapes is currently contracted to fertilize these fields. Their program calls for 2.5 #/M Nitrogen and no phosphorus. A program will be written with these specs for all locations. The fertility program they provided is not optimal for warm season turf which should be fertilized during summer when it is actively growing.
- Specialized soil test specific programs will also be written for Warm Season Irrigated and Cool Season unirrigated/irrigated turf.
- All products listed in plan will be those used by Green Up.

It is important to note that according to the Code of Virginia, all fertilizer applications made to municipal properties are to be made by Certified Fertilizer Applicators. In addition, all applications made to these fields should be made in accordance with this Nutrient Management Plan and records should be kept of all applications. The records sheet provided complies with the record keeping requirements of both the Virginia Department of Conservation and Recreations (Nutrient Management) and the Virginia Department of Agriculture and Consumer Services (Certified Applicator).

Soil Test Summary									
Customer Name:		Roanoke County Schools							
Testing Lab:		Waypoint Analytical							
Sample Date:		6/24/2015							
Analysis Date:		7/22/2015							
Planner Name		Five Oaks Agronomy Consulting							
Certification Number		654							
Managed Area ID		Soil pH	Buffer pH	Lab P_2O_5 (ppm)	VT P (ppm)	VT (H/M/L)	Lab K_2O (ppm)	VT K (ppm)	VT (H/M/L)
Location	Soil Test ID#								
Northside Middle	RCS01	5.90	6.75	21.00	6.4	M-	128.00	90.9	H-
Northside High	RCS02	5.70	6.72	30.00	10.5	M-	174.00	123.5	H
Glenvar	RCS03	6.90		71.00	29.3	H	153.00	108.6	H
Hidden Valley Middle School	RCS04	6.40		40.00	15.1	M	411.00	291.8	VH
Hidden Valley High School	RCS05	6.40		44.00	16.9	M+	247.00	175.4	VH
Cave Spring High School	RCS06	6.90		83.00	34.8	H	254.00	180.3	VH
Cave Spring Middle School	RCS07	6.40		52.00	20.6	H-	498.00	353.6	VH
William Byrd High School	RCS08	6.20		59.00	23.8	H-	307.00	218.0	VH
AVERAGE					**19.6**	**H-**		**192.77**	**VH**
DCR MAX ALLOWED INPUTS					#/M P	1		#/M K	0
Notes:									

Soil tests average high (H-) levels of phosphorus and high (VH) levels of potassium. 1 #/M of phosphorus is allowed. No potassium will be allowed.

Regulations allow for different N rates based on irrigation and grass type.

Warm Season Irrigated – Regulations allow for up to 4 lbs/M of nitrogen per year. If using 100% water-soluble nitrogen .7 lbs may be applied every 30 days. If using slow release materials, 1 lbs may be used every 30 days. Do not exceed stated per year total.

Warm Season Irrigated Overseeded – Regulations allow for up to 5 lbs/M of nitrogen per year. If using 100% water-soluble nitrogen .7 lbs may be applied every 30 days. If using slow release materials, 1 lbs may be used every 30 days. Do not exceed stated per year total.

Cool Season Irrigated – Regulations allow for up to 4.5 lbs/M of nitrogen per year. If using 100% water-soluble nitrogen .7 lbs may be applied every 30 days. If using slow release materials, .9 lbs may be used every 30 days. Do not exceed stated per year total.

Cool Season Unirrigated – Regulations allow for up to 3 lbs/M of nitrogen per year. If using 100% water-soluble nitrogen .7 lbs may be applied every 30 days. If using slow release materials, .9 lbs may be used every 30 days. Do not exceed stated per year total.

4. Nutrient Application Worksheets

The following worksheets detail specific fertilizer applications using the previously discussed soil test information. All nutrient input level recommendations come from the Department of Conservation and Recreation's Nutrient Management Standards and Criteria, this document is part of the Code of Virginia and thus is law for those required to have a Nutrient Management Plan. While applications do not have to be followed specifically, it is important to note that per month nitrogen levels shall not be exceeded and per year phosphorus levels shall not be exceeded. In some cases, potassium input may exceed recommended levels, as it does not have the same detrimental effects on the health of Virginia's waters as nitrogen and phosphorus. Potassium is considered the plant nutrient most responsible for quality. It helps plants respond to stresses like drought, extreme heat/cold, and insect/disease pressure. The plants increased ability to respond to stress in a positive manner can help reduce the need for increased N and P fertility and reseeding caused by stress.

This chart outlines which fields are cool/warm and irrigated/unirrigated.

Location/Acreage/Watershed Code Breakdown				
Location	**Acres**	**Irrigation**	**Grass**	**Watershed Code**
1. Glenvar High School				**RU09 8.7 Acres**
Baseball	1.8	Yes	Cool	
Football	2.2	yes	Cool	
Softball	0.8	Yes	Cool	
Soccer	2.2	Yes	Cool	
Practice Field	1.7	No	Cool	
2. Northside High School				**RU13 2.5 Acres**
Baseball	2.5	No	Cool	
3. Cave Spring Middle School				**RU14 29.5 Acres**
Practice Field	2.2	Yes	Cool	
2. Northside High School				
Football	2.2	Yes	Warm	
Practice Field	1.3	Yes	Cool	
2. Northside Middle School				
Baseball/Football	2.9	Yes	Cool	
Practice Field	2.3	Yes	Warm	
4. Hidden Valley High School				
Practice Field	2.2	Yes	Cool	
Softball	0.6	No	Cool	
Baseball	2.3	Yes	Cool	
Soccer	2	Yes	Cool	
5. Hidden Valley Middle School				
Football	1.5	Yes	Cool	
6. William Byrd High School				
Football	2.2	Yes	Cool	
Soccer/Softball	2	Yes	Cool	
Baseball	1.8	Yes	Cool	
Practice Field	4	Yes	Cool	
7. Cave Spring High School				**RU15 7.8 Acres**
Baseball	2	Yes	Cool	
Practice Fields	3.5	No	Cool	
Softball	0.6	Yes	Cool	
Soccer	1.7	Yes	Cool	
				48.5

NUTRIENT APPLICATION WORK SHEET												
Name:	Roanoke County Schools			Management Area:			All locations					
Prepared:	9/1/2015			Area:	2,112,660		Turf Type:	All				
Expires:	9/1/2018											
Total Yearly Nutrient Needs	Application Month/Day	Analysis N - P - K	Interval (days)	Fertilizer Description	Rate/M	lbs/app	% Slow Release N	Total/M N - P - K		Lime	Gypsum	lbs/app lime/gyp
										lbs/M		
	No applications before March 9											
Nitrogen	March	12 - 0 - 0	30	12-0-0 .58% Prodiamine	4.17	8803	0	0.5 - 0 - 0				
3												
Phosphorus	Aug/Sept	25 - 0 - 0	30	25-0-0 50% SCU	3.60	7606	50	0.9 - 0 - 0				
1												
Potassium	Oct/Nov	25 - 0 - 0	30	25-0-0 25% SCU	3.60	7606	25	0.9 - 0 - 0				
0												
	No applications after November 21											
	Lime											
						Total used:		2.3 - 0 - 0				
				Do not exceed yearly maximum allowed by Regulation:				**3 - 1 - 0**				
Notes	• This program is for all locations. Warm season fields should not be fertilized prior to April 20 or after September 10th unless they are overseeded. • Tested H- in Phosphorus and VH in Potassium • If using 100% water-soluble nitrogen .7 lbs may be applied every 30 days. If using slow release materials, .9 lb may be used every 30 days. • All fertilizer analyses are subject to change; do not exceed stated monthly Total N or yearly total P. Please contact your planner if you need help adjusting a fertilizer application to meet the requirements of this plan. • Attempt to coordinate lime apps with aerification											

NUTRIENT APPLICATION WORK SHEET													
Name:	Roanoke County Schools			Management Area:			Cool Season Irrigated Turf - See Chart						
Prepared:	9/1/2015			Area:	1,555,092		Turf Type:	Cool Season					
Expires:	9/1/2018												
Total Yearly Nutrient Needs	Application Month/Day	Analysis N - P - K	Interval (days)	Fertilizer Description	Rate/M	lbs/app	% Slow Release N	Total/M N - P - K			Lime lbs/M	Gypsum lbs/M	lbs/app lime/gyp
	No applications before March 9												
Nitrogen	March	12 - 0 - 0	30	12-0-0 .58% Prodiamine	5.00	7775	0	0.6	0	0			
4.5													
Phosphorus	June	15 - 3 - 0	30	15-3-5 40% XRT 65% Natural	4.00	6220	40	0.6	0.12	0			
1													
Potassium	August	15 - 3 - 0	30	15-3-5 40% XRT 65% Natural	4.00	6220	40	0.6	0.12	0			
0													
	September	15 - 3 - 0	30	15-3-5 40% XRT 65% Natural	6.00	9331	40	0.9	0.18	0			
	October	15 - 3 - 0	30	15-3-5 40% XRT 65% Natural	6.00	9331	40	0.9	0.18	0			
	November	15 - 3 - 0	30	15-3-5 40% XRT 65% Natural	6.00	9331	40	0.9	0.18	0			
	No applications after November 21												
	Lime												
						Total used:		4.5	0.78	0			
				Do not exceed yearly maximum allowed by Regulation:				4.5	1	0			

Notes

- Tested H- in Phosphorus and VH in Potassium
- If using 100% water-soluble nitrogen .7 lbs may be applied every 30 days. If using slow release materials, .9 lb may be used every 30 days.
- All fertilizer analyses are subject to change; do not exceed stated monthly Total N or yearly total P. Please contact your planner if you need help adjusting a fertilizer application to meet the requirements of this plan.
- Attempt to coordinate lime apps with aerification

NUTRIENT APPLICATION WORK SHEET												
Name:	Roanoke County Schools			Management Area:			Cool Season Unirrigated Turf - See Chart					
Prepared:	9/1/2015			Area:	361,548		Turf Type:	Cool Season				
Expires:	9/1/2018											
Total Yearly Nutrient Needs	Application Month/Day	Analysis N - P - K	Interval (days)	Fertilizer Description	Rate/M	lbs/app	% Slow Release N	Total/M N - P - K		Lime lbs/M	Gypsum lbs/M	lbs/app lime/gyp
	No applications before March 9											
Nitrogen	March	12 - 0 - 0	30	12-0-0 .58% Prodiamine	4.17	1506	0	0.5 - 0 - 0				
3												
Phosphorus	September	15 - 3 - 0	30	15-3-5 40% XRT 65% Natural	6.00	2169	40	0.9 - 0.18 - 0				
1												
Potassium	October	15 - 3 - 0	30	15-3-5 40% XRT 65% Natural	5.33	1928	40	0.8 - 0.16 - 0				
0												
	November	15 - 3 - 0	30	15-3-5 40% XRT 65% Natural	5.33	1928	40	0.8 - 0.16 - 0				
	No applications after November 21											
	Lime											
						Total used:		3 - 0.5 - 0				
				Do not exceed yearly maximum allowed by Regulation:				**3 - 1 - 0**				

Notes

- Tested H- in Phosphorus and VH in Potassium
- If using 100% water-soluble nitrogen .7 lbs may be applied every 30 days. If using slow release materials, .9 lb may be used every 30 days.
- All fertilizer analyses are subject to change; do not exceed stated monthly Total N or yearly total P. Please contact your planner if you need help adjusting a fertilizer application to meet the requirements of this plan.
- Attempt to coordinate lime apps with aerification

NUTRIENT APPLICATION WORK SHEET												
Name:	Roanoke County Schools			Management Area:			Warm Season Irrigated Turf - See Chart					
Prepared:	9/1/2015			Area:	196,020		Turf Type:	Warm Season				
Expires:	9/1/2018											
Total Yearly Nutrient Needs	Application Month/Day	Analysis N - P - K	Interval (days)	Fertilizer Description	Rate/M	lbs/app	% Slow Release N	Total/M N - P - K		Lime lbs/M	Gypsum lbs/M	lbs/app lime/gyp
	No applications before March 9 if overseeded, no applications before April 20 if overseeding skipped.											
Nitrogen	March	12 - 0 - 0	30	12-0-0 .58% Prodiamine	4.17	817	0	0.5 - 0 - 0				
4.5												
Phosphorus	April/May	15 - 3 - 0	30	15-3-5 40% XRT 65% Natural	3.33	653	40	0.5 - 0.1 - 0				
1												
Potassium	June	15 - 3 - 0	30	15-3-5 40% XRT 65% Natural	6.67	1307	40	1 - 0.2 - 0				
0												
	July	15 - 3 - 0	30	15-3-5 40% XRT 65% Natural	6.67	1307	40	1 - 0.2 - 0				
	August	15 - 3 - 0	30	15-3-5 40% XRT 65% Natural	6.67	1307	40	1 - 0.2 - 0				
	Oct/Nov	15 - 3 - 0	30	15-3-5 40% XRT 65% Natural	3.33	653	40	0.5 - 0.1 - 0				
	No applications after November 21st if overseeded, no applications September 10 if overseeding skipped.											
	Lime											
						Total used:		4.5 - 0.8 - 0				
				Do not exceed yearly maximum allowed by Regulation:				4.5 - 1 - 0				
Notes	• Tested H- in Phosphorus and VH in Potassium • If using 100% water-soluble nitrogen .7 lbs may be applied every 30 days. If using slow release materials, 1 lb may be used every 30 days. • All fertilizer analyses are subject to change; do not exceed stated monthly Total N or yearly total P. Please contact your planner if you need help adjusting a fertilizer application to meet the requirements of this plan. • Attempt to coordinate lime apps with aerification											

6. Reference Material

Nutrient Availability According to pH

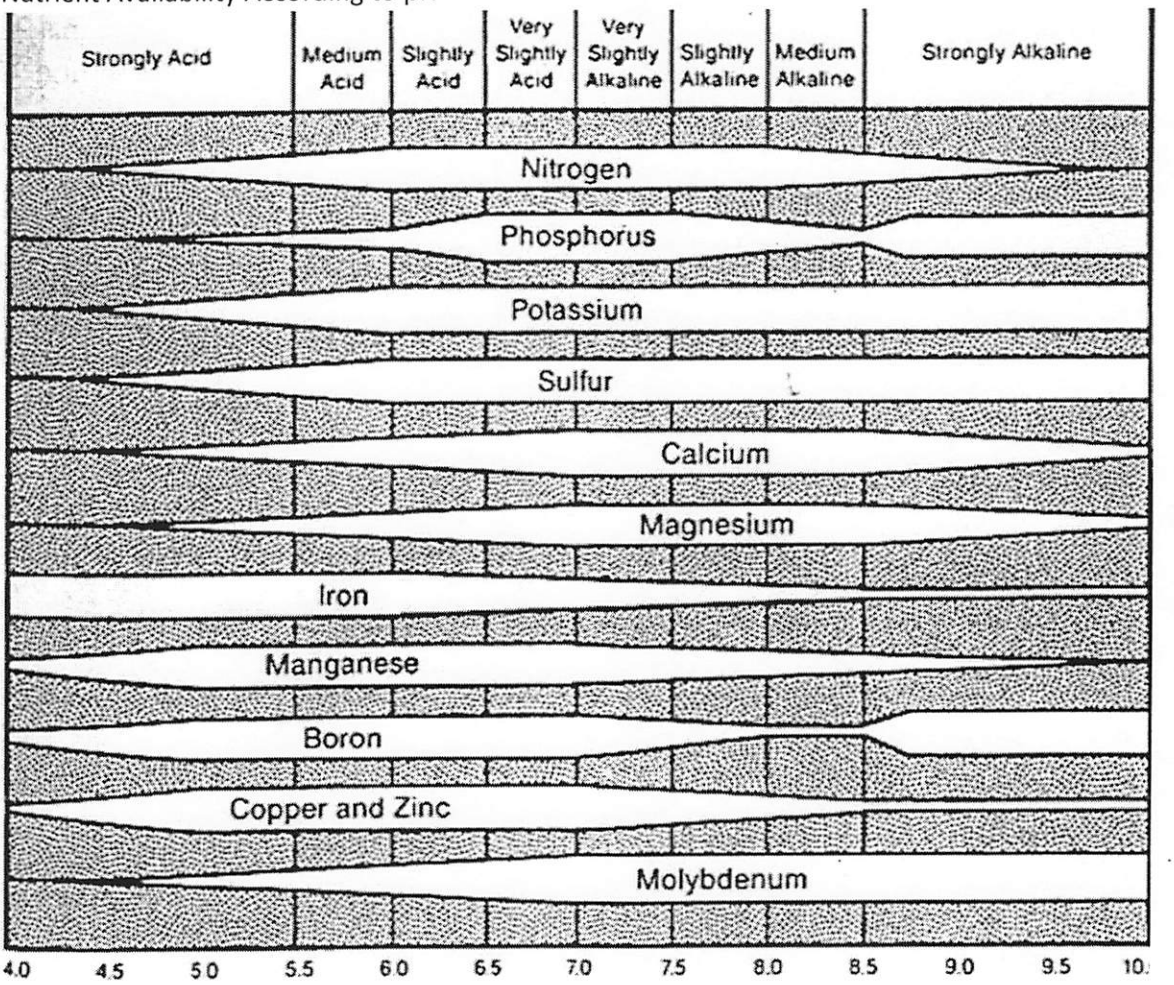


Figure 1: Nutrient Availability at pH

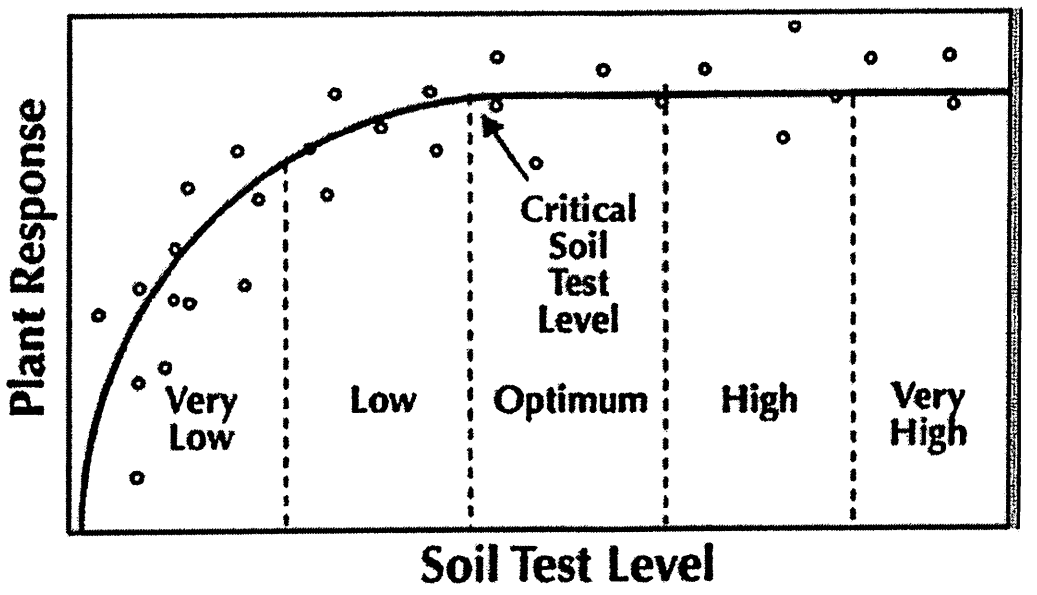


Figure 2: Plant Response Chart

Very low: A plant response is most likely if the indicated nutrient is applied. A large portion of the nutrient requirement must come from fertilization.

Low: A plant response is likely if the indicated nutrient is applied. A portion of the nutrient requirement must come from fertilization.

Medium: A plant response may or may not occur if the indicated nutrient is applied. A small portion of the nutrient requirement must come from fertilization.

High: Plant response is not expected. No additional fertilizer is needed.

Very high: Plant response is not expected. The soil can supply much more than the turf requires. Additional fertilizer should not be added to avoid nutritional problems and adverse environmental consequences.

Section VI. Turfgrass Nutrient Recommendations for Home Lawns, Office Parks, Public Lands and Other Similar Residential/Commercial Grounds

Definitions

For the purposes of this section, the following definitions, as presented by the Association of American Plant Food Control Officials (AAPFCO), apply:

"Enhanced efficiency fertilizer" describes fertilizer products with characteristics that allow increased plant nutrient availability and reduce the potential of nutrient losses to the environment when compared to an appropriate reference product.

"Slow or controlled release fertilizer" means a fertilizer containing a plant nutrient in a form which delays its availability for plant uptake and use after application, or which extends its availability to the plant significantly longer than a reference "rapidly available nutrient fertilizer" such as ammonium nitrate, urea, ammonium phosphate or potassium chloride. A slow or controlled release fertilizer must contain a minimum of 15 percent slowly available forms of nitrogen.

"Water soluble nitrogen", "WSN", or "readily available nitrogen" means: Water soluble nitrogen in either ammonical, urea, or nitrate form that does not have a controlled release, or slow response.

Recommended Season of Application For Nitrogen Fertilizers - Applies to all Turf

A nitrogen fertilization schedule weighted toward fall application is recommended and preferred for agronomic quality and persistence of cool season turfgrass; however, the acceptable window of applications is much wider than this for nutrient management. The nutrient management recommended application season for nitrogen fertilizers to cool season turfgrasses begins six weeks prior to the last spring average killing frost date and ends six weeks past the first fall average killing frost date (see Figures 6-1 & 6-2). Applications of nitrogen during the intervening late fall and winter period should be avoided due to higher potential leaching or runoff risk, but where necessary, apply no more than 0.5 pounds per 1,000 ft^2 of water soluble nitrogen within a 30-day period. Higher application rates may be used during this late fall and winter period by using materials containing slowly available sources of nitrogen, if the water soluble nitrogen contained in the fertilizer does not exceed the recommended maximum of 0.5 pounds per 1,000 ft^2 rate. Do not apply nitrogen or phosphorus fertilizers when the ground is frozen.

The acceptable nitrogen fertilizer application season for non-overseeded warm season turfgrass begins no earlier than the last spring average killing frost date and ends no later than one month prior to the first fall average killing frost date (see Figures 6-1 & 6-2).

Figure 6-1

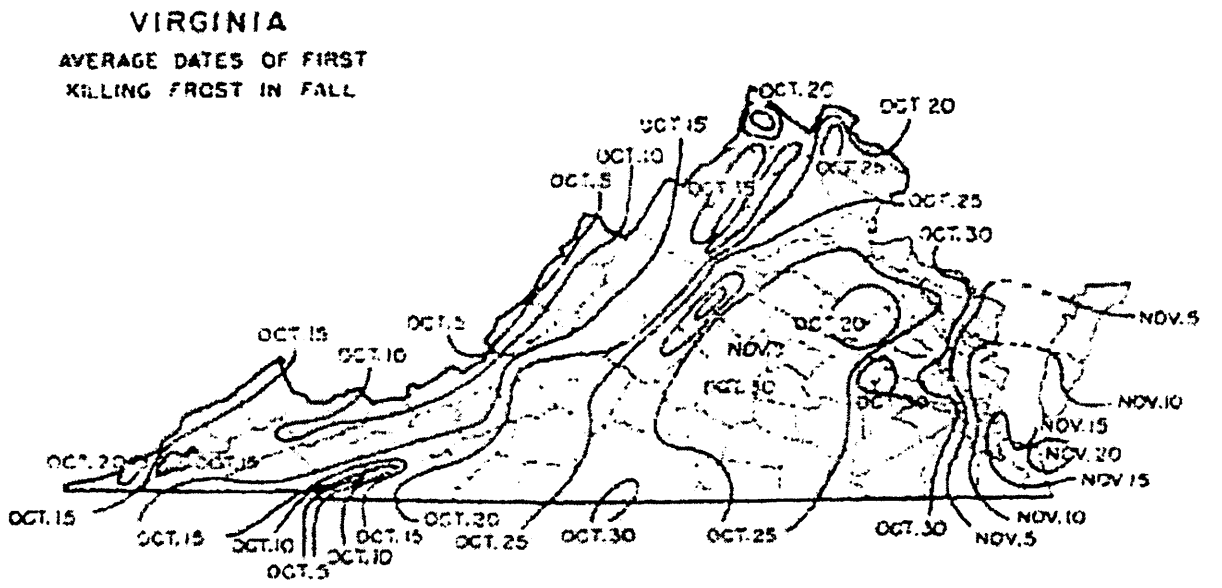
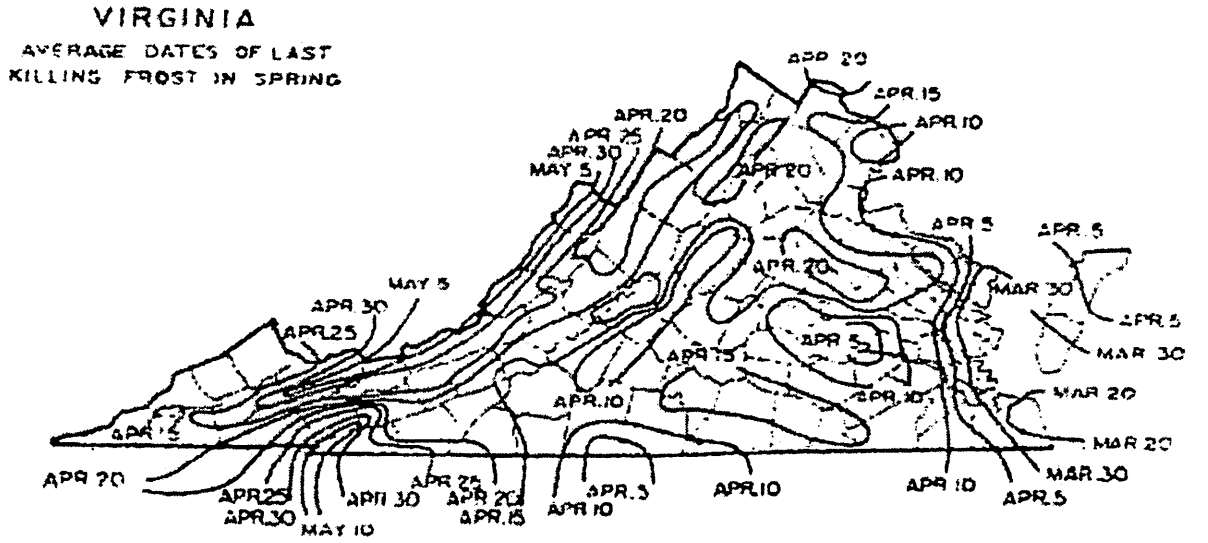


Figure 6-2



Per Application Rates

Do not apply more than 0.7 pounds of water soluble nitrogen per 1,000 ft^2 within a 30-day period. For cool season grasses, do not apply more than 0.9 pounds of total nitrogen per 1,000 ft^2 within a 30-day period. For warm season grasses, do not apply more than 1.0 pounds of total nitrogen per 1,000 ft^2 within a 30-day period. Lower per application rates of water soluble nitrogen sources or use of slowly available nitrogen sources should be ut ilized on very permeable sandy soils, shallow soils over fractured bedrock, or areas near water wells.

Annual Application Rates for Home Lawns and Commercial Turf

Up to 3.5 pounds per 1,000 ft^2 of nitrogen may be applied annually to cool season grass species or up to 4 pounds per 1,000 ft^2 may be applied annually to warm season grass species using 100 percent water soluble nitrogen sources. Lower rates of nitrogen application may be desirable on those mature stands of grasses that require less nitrogen for long-term quality. As a result, lower application rates will probably be more suited to the fine leaf fescues (hard fescue, chewings fescue, creeping red fescue, and sheep fescue) and non-overseeded zoysiagrass. Lower rates should also be used on less intensively managed areas.

Use of Slowly Available Forms of Nitrogen

For slow or controlled release fertilizer sources, or enhanced efficiency fertilizer sources, no more than 0.9 pounds of nitrogen per 1,000 ft^2 may; be applied to cool season grasses within a 30-day period and no more than 1.0 pounds of nitrogen per 1,000 ft^2 may be applied to warm season grasses within a 30-day period.

Provided the fertilizer label guarantees that the product can be used in such a way that it will not release more than 0.7 pounds of nitrogen per 1,000 ft^2 in a 30-day period, no more than 2.5 pounds of nitrogen per 1,000 ft^2 may be applied in a single application. Additionally, total annual applications shall not exceed 80 percent of the annual nitrogen rates for cool or warm season grasses.

Phosphorus and Potassium Nutrient Needs (Established Turf)

Apply phosphorus (P_2O_5) and potassium (K_2O) fertilizers as indicated necessary by a soil test using the following guidelines:

Soil Test Level	Nutrient Needs (pounds per 1,000 ft^2)*	
	P_2O_5	K_2O
L	2-3	2-3
M	1-2	1-2
H	0.5-1	0.5-1
VH	0	0

* For the lower soil test level within a rating, use the higher side of the range and for higher soil test level within a rating use the lower side of the recommendation range. (For example the recommendation for a P_2O_5 soil test level of L- would be 3 pounds per 1,000 ft^2.)

Do not use high phosphorus ratio fertilizers such as 10-10-10 or 5-10-10, unless soil tests indicate phosphorus availability below the M+ level.

Recommendations for Establishment of Turf

These recommendations are for timely planted turfgrass, that is, the seed or vegetative material (sod, plugs, and /or sprigs), are planted at a time of the year when temperatures and moisture are adequate to maximize turfgrass establishment. These recommended establishment periods would be late summer to early fall for cool-season turfgrasses and late spring through mid-summer for warm-season turfgrasses.

Nitrogen Applications

At the time of establishment, apply no more than 0.9 pounds per 1,000 ft^2 of total nitrogen for cool season grasses or 1.0 pounds per 1,000 ft^2 of total nitrogen for warm season grasses, using a material containing slowly available forms of nitrogen, followed by one or two applications beginning 30 days after planting, not to exceed a total of 1.8 pounds per 1,000 ft^2 total for cool season grasses and 2.0 pounds per 1,000 ft^2 for warm season grasses for the establishment period. Applications of WSN cannot exceed more than 0.7 pounds per 1,000 ft^2 within a 30-day period.

Phosphorus and Potassium Recommendations for Establishment

Soil Test Level	Nutrient Needs (pounds per 1,000 ft^2) *	
	P_2O_5	K_2O
L	3-4	2-3
M	2-3	1-2
H	2-1	0.5-1
VH	0	0

* For the lower soil test level within a rating, use the higher side of the range and for higher soil test level within a rating use the lower side of the recommendation range.

Nutrient Recommendations for Golf Courses

Nitrogen Timing

The beginning and ending dates for application of nitrogen shall be determined using guidance and frost date maps contained in the Season of Application for Nitrogen section, Figures 6-1 and 6-2.

If the full rate or the highest rate of the recommendation range for a monthly application is applied in a single application, then the interval of application for nitrogen shall be at least 30 days to allow turf to utilize previous nitrogen applications. If several applications are to be made for the monthly nitrogen rate, then the timing of the applications shall be at approximately even intervals, with the rate per application to be evenly divided between each application with the total nitrogen applied not to exceed the maximum monthly rate. Use of Water Insoluble Nitrogen forms of Nitrogen is encouraged.

Nitrogen Rates

	Grass Type	Maximum WSN Rate Per Application - pounds per 1,000 ft^2	Total Annual Nitrogen Rate - pounds per 1,000 ft^2 [a]
Greens		0.7 [b]	3-6
Tees		0.7 [b]	2-5
Fairways	Cool Season	0.7 [c]	2-3
	Warm Season	0.7 [c]	3-4
Fairways – Intensive Management	Cool Season	0.5 [d]	3-4
	Warm Season	0.5 [d]	3.5-4.5
Overseeding Warm Season Fairways		.5	1.25
Roughs		0.7 [e]	1-3

Fairways-Overseeding Warm Season Fairways

- For warm season grasses, up to 0.7 pounds of nitrogen per 1,000 ft^2 in a 30-day period may be applied in the Fall after perennial ryegrass overseeding is well established. An additional nitrogen application of 0.7 pounds per 1,000 ft^2 may be made in February-March to overseeded perennial ryegrass if growth and color indicate need. Applications using WSN may not exceed 0.7 pounds per 1,000 ft^2 within a 30-day period.

- Soluble nitrogen rates of 0.25 pounds per 1,000 ft^2 or less which may be a component of a pesticide or minor element application, may be applied any time during the application windows described in Recommended Season of Application for Nitrogen Fertilizers of this section, but must be considered with the total annual nitrogen application rate.

(a)Use higher rates for intensively used turf where accelerated growth and/or rapid recovery are required, use lower rates for maintenance of lesser used areas; do not exceed total annual nitrogen levels as stated above.

(b)Greens and Tees – Per application timing must be a minimum of 30 days between applications. A rate of 0.9 pounds per 1,000 ft^2 of total nitrogen may be applied for cool season grasses or 1.0 pounds per 1,000 ft^2 of total nitrogen may be applied for warm season grasses using a material containing slowly available forms of nitrogen.

(c) Fairways-Normal Management (Non-Irrigated or Irrigated) - Per Application timing must be a minimum of 30 days between applications. Total nitrogen application rates of 0.9 pounds per 1,000 ft^2 of total nitrogen may be applied for cool season grasses or 1.0 pound per 1,000 ft^2 of total nitrogen may be applied for warm season grasses using a material containing slowly available forms of nitrogen.

(d) Fairways-Intensive Management (Irrigated)- Per Application timing must be a minimum of 15 days between applications. This option requires optimized timing of more frequent applications of nitrogen with lesser rates per application. Alternatively, a maximum application rate of 0.9 pounds per 1,000 ft^2 of total nitrogen for cool season grasses or 1.0 pounds per 1,000 ft^2 of total nitrogen for warm season grasses using a material containing slowly available forms of nitrogen may be applied with a minimum of 30 days between applications.

(e) Foliar fertilizer may be applied to warm season grasses within 30 days prior to the first killing frost in the fall, at a rate not to exceed 0.1 pounds per 1,000 ft^2 of nitrogen per application. This application must be accounted for in the total annual nitrogen rate.

Phosphorus and Potassium Recommendations for Established Golf Courses

Apply phosphorus (P_2O_5) and potassium (K_2O) fertilizers as indicated by a soil test using the following guidelines:

Soil Test Level	Nutrient Needs (pounds per 1,000 ft^2)*	
	P_2O_5	K_2O
L	2-3	2-3
M	1-2	1-2
H	0.5-1	0.5-1
VH	0	0

* For the lower soil test level within a rating, use the higher side of the range and for higher soil test level within a rating use the lower side of the recommendation range.

- For irrigated turf grown on Naturally Occurring and Modified Sand Based soils only, up to 0.5 pounds of P_2O_5 per 1,000 ft^2 may be applied, if needed, to aid in recovery of damaged turf during times of extreme use. No phosphorus applications shall be made when the soil phosphorus test level is above 65% saturation, based on the soil test phosphorus values and region as listed in Table 4-1 of Section IV.

- Avoid the general use of high phosphorus ratio fertilizers such as 10-10-10 or 5-10-10, unless soil tests indicate phosphorus availability below the M+ level.

Nitrogen Management on Athletic Fields - Cool Season Grasses

- This program is intended for those fields which are under heavy use.

- Nitrogen recommendations are based on the assumption that there is adequate soil moisture to promote good turf growth at the time of application. If no rainfall has occurred since the last application, further applications should be delayed until significant soil moisture is available.

Cool Season Grasses	Maintenance Program[a] Normal	Intensive
When to Apply[b]	Pounds per 1,000 ft² Nitrogen	
After August 15	—	0.5
September	0.7	0.7[c]
October	0.7[c]	0.7[c]
November	0.5	0.7[c]
April 15 - May 15	0.5	0.5
June 1 - June 15	—	0.5

Notes:

- Soluble nitrogen rates of 0.25 pounds per 1,000 ft² or less which may be a component of a pesticide or minor element application may be applied any time the turf is actively growing, but must be considered with the total annual nitrogen application rate.
- WSN = water soluble nitrogen; WIN = water insoluble nitrogen

(a) Intensive managed areas must be irrigated.

(b) The beginning and ending dates for application of nitrogen shall be determined using guidance and frost date maps contained in the preceding Season of Application for Nitrogen section, using Figures 6-1 and 6-2.

(c) Rates up to 0.9 pounds per 1,000 ft² of total nitrogen can be applied using a material containing slowly available forms of nitrogen, with a minimum of 30 days between applications.

(d) Make this application only if turf use warrants additional nitrogen for sustaining desirable growth and /or color.

Nitrogen Management on Athletic Fields - Warm Season Grasses

The following comments apply to both Naturally Occurring or Modified Sand based Fields and Predominantly Silt/Clay Soil Fields:

- Annual nitrogen rates for warm season grasses shall not exceed **4 pounds** in areas which have the average first killing frost on or before October 20, and shall not exceed **5 pounds** in areas which have the average first killing frost after October 20 as shown in Figure 6-1. Nitrogen rates and timings for overseeding warm season grasses are not included in these rates.
- April 15 - May 15 applications should not be made until after complete green-up of turf.
- Nitrogen applications June through August should be coordinated with anticipated rainfall if irrigation is not available.
- Use the lower end of the ranges for non-irrigated fields and the higher end of the ranges should be used on fields with irrigation.

- Nitrogen rates towards the higher end of the ranges may be applied on heavily used fields to accelerate recovery, however per application and annual rates cannot be exceeded.

Bermudagrass - Predominantly Silt/Clay Soil Fields [a]		
When to Apply[b]	Pounds per 1,000 ft² Nitrogen[a]	First Fall Killing Frost Date[b]
April 15 - May 15	0.5- 0.7[(c)]	Before Oct. 20
June	0.7	
July	0.5 – 0.7 [(c)]	
August	0.5 - 0.7 [(c)]	
Sept 1 - Sept 15	0.5 -0.7 [(c)]	After Oct. 20
If overseeded with perennial ryegrass		
Oct - Nov	0.5 [(e)]	
Feb-Mar	0.5 [(e)]	

Bermudagrass - Naturally Occurring or Modified Sand based Fields [a]		
When to Apply[b]	Pounds per 1,000 ft² Nitrogen	First Fall Killing Frost Date[b]
April 15 - May 15	0.5 -0.7[(c)]	Before Oct. 20
June1	0.7[(c)]	
July	0.7[(c)]	
August	0.7[(c)]	
Sept 1 - Sept 15	0.7[c]	After Oct. 20
If overseeded with perennial ryegrass		
Oct - Nov	0.5 [(e)]	
Feb - Mar	0.5 [(e)]	

The following notes apply to both of the Bermudagrass tables above:

(a) In the Piedmont and the Ridge and Valley areas of Virginia, the existing native soil will normally be comprised predominantly of clay and/or silt and these soils have inherently lower water infiltration and percolation rates and greater nutrient holding capacity. However, most areas of the Coastal Plain have existing native soils that are predominantly sandy textured soils and other facilities throughout the state may choose to install modified soil root zones that are predominantly sand (>50%) in order to maximize drainage and reduce compaction tendency. If subsurface drain tile surrounded by sand and/or gravel has been installed under the playing surface of any of these fields, their nitrogen programs should be managed as predominantly sand-based systems to minimize nutrient leaching.

(b) The beginning and ending dates for application of nitrogen shall be determined using guidance and frost date maps contained in the Season of Application for Nitrogen section, Figures 6-1 and 6-2.

(c) WSN must be applied as two applications not to exceed 0.35 pounds per 1,000 ft² each with a minimum of 15 days between applications. Alternatively, using a material that contains slowly available nitrogen sources, split applications of 0.5 pounds per 1,000 ft² may be applied with a minimum of 15 days between applications.

(d) If a material containing slowly available forms of nitrogen is used, rates up to 1.0 pounds of nitrogen per 1,000 ft^2 may be applied in a single application with a minimum of 30 days between applications.

(e) For overseeded warm season grasses, an additional 0.7 pounds per 1,000ft^2 of WSN may be applied in the Fall after the perennial ryegrass overseeding is well established. The WSN must be applied as two applications not to exceed 0.35 pounds per 1,000 ft^2 of nitrogen each, with a minimum of 15 days between applications. Additional WSN application of 0.5 pounds per 1,000 ft^2 may be made in February-March to overseeded perennial ryegrass if growth and color indicate need. Alternatively, split applications of 0.5 pounds of nitrogen per 1,000 ft^2 each with a minimum of 15 days between applications may be applied using a material containing slowly available nitrogen sources.

Phosphorus and Potassium Recommendations Athletic Fields
Apply phosphorus (P_2O_5) and potassium (K_2O) fertilizers as indicated by a soil test using the following guidelines:

Soil Test Level	Nutrient Needs (pounds per 1,000 ft^2)*	
	P_2O_5	K_2O
L	2-3	2-3
M	1-2	1-2
H	0.5-1	0.5-1
VH	0	0

- For the lower soil test level within a rating, use the higher side of the range and for higher soil test level within a rating use the lower side of the recommendation range.
- For irrigated turf grown on Naturally Occurring and Modified Sand Based soils only, up to 0.5 pounds of P_2O_5 per 1,000 ft^2 may be applied, if needed, to aid in recovery of damaged turf during times of extreme use. No phosphorus applications shall be made when the soil phosphorus test level is above 65% saturation, based on the soil test phosphorus values and region as listed in Table 4-1 of Section IV.
- Avoid the general use of high phosphorus ratio fertilizers such as 10-10-10 or 5-10-10, unless soil tests indicate phosphorus availability below the M+ level.

Establishment/Grow-In Recommendations for Golf Courses, Athletic Fields, and Sod Production

(These rates replace normal maintenance fertilizer applications that would have occurred during these time periods.)

Warm Season Grasses:

Predominantly Silt/Clay Soils

- Plant Date - late May -June for sprigs, plugs, sod, or seeding.
- Apply P_2O_5 and K_2O as needed based on soil test recommendations, incorporate into the top 2 inches if possible.
- At Planting - Up to 1.0 pounds of nitrogen per 1,000 ft^2 using a material containing slowly available forms of nitrogen may be applied as one application or lesser amounts applied at regular intervals, through the first 4 weeks, not to exceed a total of 1.0 pounds of nitrogen per 1,000ft^2.
- Four weeks after planting - 0.25 pounds.of WSN per 1,000 ft^2 per week for the next 4 weeks.

Naturally Occurring or Modified Sand Based Soils

- Plant Date - late May -June for sprigs, plugs, sod, or seeding.
- Apply P_2O_5 and K_2O as needed based on soil test recommendations, incorporate into the top 2 inches if possible.
- At Planting - Up to 1.0 pounds of nitrogen per 1,000 ft^2 using a material containing slowly available forms of nitrogen may be applied as one application or lesser amounts at regular intervals through the first 4 weeks, not to exceed a total of 1.0 pounds of nitrogen per 1,000 ft^2.
- Four weeks after planting - 0.25 pounds per1,000 ft^2 using a material containing slowly available forms of nitrogen per week for the next 4 weeks.

Cool Season Grasses:

Predominantly Silt/Clay Soils

- Plant Date - August - September (preferred)
- Apply P_2O_5 and K_2O as needed based on soil test recommendations, incorporate into the top 2 inches if possible.
- At Planting - up to 0.9 pounds of nitrogen per 1,000 ft^2 using a material containing slowly available forms of nitrogen may be applied; 30 days after planting, apply up to 0.5 pounds of nitrogen per 1,000 ft^2 every week for the next 4 weeks.

Naturally Occurring or Modified Sand Based Soils

- Plant Date - August -September (preferred)
- Apply P_2O_5 and K_2O as needed based on soil test recommendations, incorporate into the top 2 inches if possible.
- At Planting - up to 0.9 pounds of nitrogen per 1,000 ft^2 using a material containing slowly available forms of nitrogen may be applied.
- Apply up to 0.25 pounds of nitrogen per 1,000 ft^2 per week after germination is complete, for the next 8 weeks. If using a material that contains slowly available forms of nitrogen, up to 0.5 pounds of nitrogen per 1,000 ft^2 every two weeks may be applied after germination is complete for the next 8 weeks.

Sod Installations:

Site preparation should include a soil test, which can be done several months before the project begins in order to have time to get test results back. Phosphorus, potassium and lime applications should be based on soil test analysis to increase the likelihood of a successful installation. Shallow incorporation of material into the top 2 inches of the soil is preferred prior to sod installation, especially if lime is required.

No more than 0.7 pounds of nitrogen per 1,000 ft^2 of WSN may be applied before sod is installed. Alternatively, using a material with slowly available forms of nitrogen, 0.9 pounds of nitrogen per 1,000 ft^2 for cool season grasses or 1.0 pounds of nitrogen per 1,000 ft^2 for warm season grasses may be applied before sod is installed.

After installation apply adequate amounts of water to maintain sufficient soil moisture (i.e. to prevent visible wilt symptoms). Excessive water will limit initial root development. After roots begin to establish (as verified by lightly tugging on the sod pieces), shift irrigation strategy to a deep and infrequent program in order to encourage deep root growth. Apply approximately 1 inch of water per week (either by rainfall or irrigation), making sure that the water is being accepted by the soil profile without running off. This will insure thorough wetting of the soil profile.

After sod has completed rooting and is well established, initiate the normal nitrogen management program as described for the appropriate use shall be recommended.

Phosphorus and Potassium Recommendations for Establishment/Grow-In/Installation

Soil Test Level	Nutrient Needs (pounds per 1,000 ft^2) *	
	P_2O_5	K_2O
L	3-4	2-3
M	2-3	1-2
H	2-1	0.5-1
VH	0	0

* For the lower soil test level within a rating, use the higher side of the range and for higher soil test level within a rating use the lower side of the recommendation range.

Other Turf Management Considerations for Golf Courses, Athletic fields, and Home Lawns

Lime Recommendations

Lime should be recommended based on a soil test to maintain soil pH within an agronomic range for turfgrass.

For new seedings where lime is recommended, incorporate the lime into the topsoil for best results.

Returning Grass Clippings

Recycling of clippings on turf should be encouraged as an effective means of recycling nitrogen, phosphorus, and potassium. Proper mowing practices that ensure no more than 1/3 of the leaf blade is removed in any cutting event will enhance turf appearance and performance when clippings are returned. Return all leaf clippings from mowing events to the turf rather than discharging them onto sidewalks or streets. Rotary mulching mowers can further enhance clipping recycling by reducing the size of clippings being returned to the turfgrass canopy.

Management of Collected Clippings

If clippings are collected they should be disposed of properly. They may be composted or spread uniformly as a thin layer over other turf areas or areas where the nutrient content of the clippings can be recycled through actively growing plants. They should not be blown onto impervious surfaces or surface waters, dumped down stormwater drains, or piled outside where rainwater will leach out the nutrients creating the potential for nutrient loss to the environment.

Use of Iron

Iron applications (particularly foliar applications) may periodically be used for enhanced greening as an alternative to nitrogen. These applications are most beneficial if applied in late spring through summer for cool season grasses and in late summer/fall applications for warm-season grasses.

Impervious Surfaces

Do not apply fertilizers containing nitrogen or phosphorus to impervious surfaces (sidewalks, streets, etc.). Remove any granular materials that land on impervious surfaces by sweeping and collecting, and either put the collected material back in the bag, or spread it onto the turf and /or using a leaf blower etc. to return the fertilizer back to the turfgrass canopy.

Table 3-1
Lime Recommendations for Virginia Crops (tons/acre)
Lime Rates based on Va Tech Soil buffer pH

	Target Soil pH					
Buffer pH	5.2	5.8.	6.2	6.5	6.8	Acidity meq/100g
6.60	0.00	0.00	0.00	0.00	0.00	0.00
6.50	0.00	0.00	0.00	0.00	0.00	0.03
6.40	0.00	0.00	0.00	0.00	0.50	0.06
6.38	0.00	0.00	0.25	0.25	0.50	0.12
6.36	0.00	0.00	0.25	0.25	0.75	0.24
6.34	0.00	0.00	0.25	0.50	0.75	0.36
6.32	0.00	0.00	0.50	0.50	0.75	0.48
6.30	0.00	0.00	0.50	0.75	1.00	0.59
6.28	0.00	0.25	0.75	0.75	1.00	0.71
6.26	0.00	0.25	0.75	1.00	1.25	0.83
6.24	0.00	0.25	0.75	1.00	1.25	0.95
6.22	0.00	0.50	1.00	1.00	1.50	1.07
6.20	0.00	0.50	1.00	1.25	1.50	1.19
6.18	0.00	0.75	1.25	1.25	1.75	1.30
6.16	0.00	0.75	1.25	1.50	1.75	1.42
6.14	0.25	0.75	1.50	1.50	2.00	1.54
6.12	0.25	1.00	1.50	1.75	2.00	1.66
6.10	0.50	1.00	1.50	1.75	2.25	1.78
6.08	0.50	1.25	1.75	2.00	2.25	1.90
6.06	0.50	1.25	1.75	2.00	2.25	2.02
6.04	0.75	1.25	2.00	2.00	2.50	2.13
6.02	0.75	1.50	2.00	2.25	2.50	2.25
6.00	1.00	1.50	2.00	2.25	2.75	2.37
5.95	1.00	1.75	2.25	2.50	3.00	2.67
5.90	1.25	2.00	2.50	3.00	3.25	2.96
5.85	1.50	2.25	2.75	3.25	3.50	3.26
5.80	1.75	2.50	3.25	3.50	3.75	3.56
5.75	2.00	2.75	3.50	3.75	4.25	3.85
5.70	2.25	3.00	3.75	4.00	4.50	4.15
5.65	2.50	3.25	4.00	4.25	4.75	4.45
5.60	2.75	3.50	4.25	4.50	5.00	4.74
5.55	3.00	3.75	4.50	4.75	5.25	5.04
5.50	3.25	4.00	4.75	5.25	5.50	5.34
5.40	3.75	4.50	5.25	5.75	6.25	5.93
5.30	4.25	5.00	5.75	6.25	6.75	6.52

Lime recommendations in the table above are based on the use of a liming material equivalent in neutralizing power to 100% $CaCO_3$. For application rates of liming material that is less than 100% neutralizing power of $CaCO_3$ (pure calcium carbonate) use the table in this section, Lime Rate Adjustment for CCE.

Lime Recommendations Using Other Testing Labs

For approved labs other than Virginia Tech, use the lime recommendations given by the lab. IF there are no recommendations with the soil analysis, use the table below for A&L Agricultural, Spectrum Analytical, and Brookside Laboratories.

Table 3-2
Lime Application Rate[1] (tons/acre) to achieve desired pH based on SMP Buffer Test

	Target Soil pH				
Soil-Buffer pH	5.2	5.8	6.2	6.5	6.8
6.9	0	0.25	0.50	0.50	0.75
6.8	0.50	0.75	1.00	1.00	1.25
6.7	1.00	1.50	1.50	1.75	2.00
6.6	1.50	1.75	2.00	2.25	2.50
6.5	2.00	2.25	2.50	3.00	3.25
6.4	2.75	3.00	3.25	3.75	4.00
6.3	3.25	3.50	4.00	4.50	5.00

[1] Ag-ground lime of 90% plus total neutralizing power (TNP) or $CaCO_3$equivalent., and fineness of 40% < 100 mesh, 50% < 60 mesh, 70% < 20 mesh and 95% < 8 mesh. Adjustments in the application rate should be made for liming materials with different particle sizes, or neutralizing value.

Waters Agricultural Laboratories uses the Adams and Evans single buffer method which uses a different table for recommendations than the Mehlich or the SMP tables supplied here. In the event you would have lab reports from Waters Lab; which do not have lime recommendations, contact the lab for recommendations based on their analysis procedure.

Lime Rate Adjustment for CCE

Using the lime application rate to achieve the desired target pH based on the soil test buffer pH, use the table below to adjust that rate based on the % CCE of the liming material to be applied.

Table 3-3
Lime Application Rate Adjustment Based on % CCE of Material

	% CCE of Your Liming Material										
T/ac*	50	60	70	80	90	100	110	120	130	140	150
0.5	1.00	0.75	0.75	0.75	0.50	0.50	0.50	0.50	0.50	0.25	0.25
1.0	2.00	1.75	1.50	1.25	1.00	1.00	1.00	0.75	0.75	0.75	0.75
1.5	3.00	2.50	2.25	2.00	1.75	1.50	1.25	1.25	1.25	1.00	1.00
2.0	4.00	3.25	2.75	2.50	2.25	2.00	1.75	1.75	1.50	1.50	1.25
2.5	5.00	4.25	3.50	3.25	2.75	2.50	2.25	2.00	2.00	1.75	1.75
3.0	6.00	5.00	4.25	3.75	3.25	3.00	2.75	2.50	2.25	2.25	2.00
3.5	7.00	5.75	5.00	4.50	4.00	3.50	3.25	3.00	2.75	2.50	2.25
4.0	8.00	6.75	5.75	5.00	4.50	4.00	3.75	3.25	3.00	2.75	2.75

* Lime recommendation to adjust pH as determined from soil test analysis.

Figure 3: CEC Chart

7. Soil Test Results

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Report Number: 15-202-0522
Account Number: 04895

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SOIL ANALYSIS REPORT

Analytical Method(s):
Mehlich 3

Date Received: 07/21/2015 Date Of Analysis: 07/22/2015 Date Of Report: 07/22/2015

Sample ID / Field ID	Lab Number	Organic Matter			Phosphorus				Potassium		Magnesium		Calcium		Sodium		pH		Acidity	C.E.C
		%	Rate	ENR lbs/A	Mehlich 3 ppm	Rate	Reserve ppm	Rate	K ppm	Rate	Mg ppm	Rate	Ca ppm	Rate	Na ppm	Rate	Soil pH	Buffer Index	H meq/100g	meq/100g
RCS01	23770	5.0	H	135	21	L			128	M	239	H	1243	M			5.9	6.75	1.8	10.3
RCS02	23771	5.8	H	150	30	L			174	H	206	H	1187	M			5.7	6.72	2.1	10.1
RCS03	23772	6.2	H	150	71	H			153	H	363	H	1995	H			6.9		0.2	13.6
RCS04	23773	6.0	H	150	40	M			411	VH	397	VH	1379	M			6.4		1.1	12.4
RCS05	23774	5.7	H	147	44	M			247	VH	353	H	1483	M			6.4		1.1	12.1

Sample ID / Field ID	Percent Base Saturation					Nitrate		Sulfur		Zinc		Manganese		Iron		Copper		Boron		Soluble Salts		Chloride		Aluminum
	K %	Mg %	Ca %	Na %	H %	NO_3N ppm	Rate	S ppm	Rate	Zn ppm	Rate	Mn ppm	Rate	Fe ppm	Rate	Cu ppm	Rate	B ppm	Rate	SS ms/cm	Rate	Cl ppm	Rate	Al ppm
RCS01	3.2	19.3	60.3		17.2																			
RCS02	4.4	17.0	57.8		21.1																			
RCS03	2.9	22.2	73.3		1.4																			
RCS04	8.5	26.7	55.6		9.9																			
RCS05	5.2	24.3	61.3		8.9																			

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), ms/cm (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams). Conversions: ppm x 2 = lbs/A. Soluble Salts ms/cm x 640 = ppm.

This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: Waypoint Analytical Virginia, Inc.

By: Paurie McGroary

Paurie McGroary

Report Number: 15-202-0522
Account Number: 04885

Waypoint ANALYTICAL
"Every acre...Every year."

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Grower: ROANOKE COUNTY PUBLIC SCI

SOIL ANALYSIS REPORT

Analytical Method(s):
Mehlich 3

Date Received: 07/21/2015 Date Of Analysis: 07/22/2015 Date Of Report: 07/22/2015

Sample ID / Field ID	Lab Number	Organic Matter			Phosphorus				Potassium		Magnesium		Calcium		Sodium		pH		Acidity	C.E.C
		%	Rate	ENR lbs/A	Mehlich 3 ppm	Rate	Reserve ppm	Rate	K ppm	Rate	Mg ppm	Rate	Ca ppm	Rate	Na ppm	Rate	Soil pH	Buffer Index	H meq/100g	meq/100g
RCS06	23775	6.8	H	150	93	H			254	VH	326	H	2495	H			6.9		0.2	16.1
RCS07	23777	5.2	H	132	52	H			498	VH	368	H	1883	M			6.4		1.3	15.1
RCS08	23778	6.5	H	150	59	H			307	VH	286	H	1542	M			6.2		1.5	12.4

Sample ID / Field ID	Percent Base Saturation					Nitrate		Sulfur		Zinc		Manganese		Iron		Copper		Boron		Soluble Salts		Chloride		Aluminum
	K %	Mg %	Ca %	Na %	H %	NO_3N ppm	Rate	S ppm	Rate	Zn ppm	Rate	Mn ppm	Rate	Fe ppm	Rate	Cu ppm	Rate	B ppm	Rate	SS ms/cm	Rate	Cl ppm	Rate	Al ppm
RCS06	4.0	16.9	77.6		1.4																			
RCS07	6.5	20.3	62.4		8.9																			
RCS08	6.3	19.2	62.2		12.1																			

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), ms/cm (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams). Conversions: ppm x 2 = lbs/A, Soluble Salts ms/cm x 640 = ppm.

This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: Waypoint Analytical Virginia, Inc.

by: Pauric McGroary

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