Interim Final Report to the New England and New York State Environmental Agency Commissioners: Regional Clean Water Guidelines for Turf Fertilizer Formulated for and Used on Urban Turf

October 4, 2013

A Project of:

NEIWPCC
New England Interstate Water Pollution Control Commission

The guidelines presented in this report are suggested to the New England states and New York State by the New England Interstate Water Pollution Control Commission. The guidelines do not represent policy positions of any state agency or of the U.S. Environmental Protection Agency.

Acknowledgments: NEIWPCC would like to gratefully acknowledge the time and effort contributed by the state/federal project advisory group members (cited below) and by all attendees of the project stakeholder meetings. Additionally, NEIWPCC extends special thanks to Dr. Martin Petrovic, Cornell University, and Mary Owen and Jason Lanier, University of Massachusetts Extension, for providing technical expertise through extensive reviews of earlier drafts.

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Executive Summary

In 2011, the New England environmental agency commissioners asked the New England Interstate Water Pollution Control Commission to engage turf fertilizer stakeholders in developing a regional set of turf fertilizer guidelines aimed at protecting water quality. NEIWPCC convened four stakeholder meetings between 2012 and 2013 that were attended by turf fertilizer manufacturers, lawn care professionals, sports turf managers, turf industry trade groups and professional associations, researchers, university extension specialists, municipal and private groundskeepers, state and federal environmental agencies, and watershed groups. The broad knowledge base represented by the stakeholders and the lively and open discussions at the meetings strongly informed the content of the regional guidelines presented in this report. While there certainly were differences in philosophy and opinion between industry and environmental stakeholders, there were also many areas of common ground. For example, many management practices that improve the health of turf simultaneously reduce runoff. NEIWPCC believes that the guidelines in this support are supported by the majority of stakeholders who worked on this effort. However, consensus was not possible on all topics, and areas of contention are identified and discussed in the report.

Although NEIWPCC perceived the original goal of the effort to be the development of a one-size-fits-all set of guidelines that would protect water quality while growing adequate turf in all cases, it became apparent that a catch-all approach was not practicable. One reason is that turf which is subject to intensive use, including that grown for sports use and areas subject to high foot traffic (defined as "sports turf" in Appendix A), must be managed according to its use. It was, however, possible to develop guidelines appropriate for non-performance turf (defined as "urban turf" in Appendix A), which accounts for the vast majority of turf coverage in the region. Also, turf areas of high environmental risk and sensitivity for nutrient losses merit extra precautions when using fertilizer. Periodically, alternate guidelines are recommended specifically for these areas.

The set of 33 regional guidelines presented in this report are organized around "5 R's": right formulation, right rate, right time, right place, and right supporting actions. The first four R's are broadly recognized among the agronomic community as being the factors that determine proper, environmentally safe fertilizer use. The fifth R, right supporting actions, describes practices that do not directly relate to fertilization but that impact turf's ability to retain stormwater and nutrients. The guidelines appear within a narrative report on pages 7-17 and also as a stand-alone list in Appendix B.

It is our sincere hope at NEIWPCC that state water quality programs, municipalities, and watershed groups will be able to use or adapt these regional guidelines as a basis for outreach and education efforts related to turf fertilizer. The need to better educate professional and home users on proper turf fertilizer use was a major point of discussion among stakeholders. We urge the states and EPA regions to consider investing in regional and locally targeted approaches to outreach, with a particular focus on innovative outreach tools and active training and engagement of turf fertilizer users.

Introduction

Project Background

Many of the most prominent waters in New England and New York State suffer from water quality impairments related to pollution from the nutrients phosphorus and nitrogen (U.S. Environmental Protection Agency, 2011a). Nutrient pollution is often characterized by over growth of algae and other aquatic plants, which compromises the suitability of these waters for recreation, fishing, swimming, aesthetic enjoyment, and drinking water supply. There are multiple sources of nutrient pollution to water bodies, including discharges from municipal and industrial wastewater treatment facilities, home septic systems, combined sewer overflows, atmospheric deposition resulting from the burning of fossil fuels, and runoff from agricultural and urban landscapes. The relative size of these contributions to nutrient-driven water quality problems varies by watershed. The regulatory framework provided by the Clean Water Act (CWA) has enabled EPA and state environmental protection agencies to primarily address point sources of pollution, typically identified as entities that discharge pollutants directly into water bodies via pipes or other conduits. Municipal wastewater treatment plants, industrial discharges, combined sewer overflows and municipal separate storm sewer systems (MS4s) of a certain size are all examples of point sources. Via the issuance of permits, EPA and states with delegated CWA authority can regulate and track point source discharges of nutrients and other pollutants.

In many watersheds environmental managers are finding the reduction of nutrient pollution through the regulation of point sources alone to be insufficient to restore water quality (U.S. Environmental Protection Agency, 2011b). In New England and New York, the EPA regional offices and state environmental agencies are increasingly interested in comprehensive approaches that incorporate controls on both point and non-point sources. Nonpoint source pollution is typically precipitation driven, meaning the pollution occurs when rain or melting snow washes pollutants such as sediment and nutrients from the landscape as runoff or when the pollutants leach through soil to groundwater. While the states and EPA continue to address nutrients through traditional point source regulation, they are also working to address many of the most common landscape-based sources of nutrient pollution, including outdated and poorly maintained septic systems and stormwater runoff.

Of particular note is that many states, including five in the New England/New York region, have sought to use legislation to reduce nutrient pollution resulting from the overuse and misuse of fertilizer on turfgrass (see Appendix C). Turf in lawns makes up a small but significant percentage of total land cover regionally and comprises a much larger portion of developed land. For example, in an analysis of the Piscataqua Region Watershed, the New Hampshire Department of Environmental Services found that residential lawns make up just 2.7 percent of the total watershed land cover. However, the lawns account for roughly 21 percent of total developed land cover (where “developed land” is defined as the sum of impervious surfaces and lawn areas). Turf is a major feature of all but the highest density urban landscapes, and how it is managed has a substantial impact on the overall picture of landscape-generated water pollution.

Due to inconsistencies in how states have regulated turf fertilizer through legislative efforts (see Appendix C), the New England environmental agency commissioners asked the New England Interstate Water Pollution Control Commission, a congressionally authorized interstate organization well suited to working on cross-boundary issues, to develop a uniform set of regional turf fertilizer guidelines. The request called for the guidelines to be developed though a stakeholder process, with input gathered from industry representatives, technical experts, and practitioners in the field from across the region. It was thought that a regional approach would be helpful and agreeable to both environmental managers working in watersheds crossing state boundaries and to fertilizer and turf industry companies operating in multiple states. The result of this regional, inclusive process is presented in this report in the form of a series of guidelines. The guidelines are designed to potentially alleviate the need for legislation in states that have not passed laws on turf fertilizer, to supplement laws in states that have passed legislation, and to serve as a basis for public education and outreach for any state or municipality.

Methodology

Throughout this project, NEIWPCC worked with a project advisory group composed of state and federal environmental agency representatives (see inside front cover for a list of group members). Participants primarily belonged to nonpoint source programs, with some participants also working in pollution prevention, outreach and education, and geographic program areas. The advisory group helped NEIWPCC develop an appropriate scope of work for the project, provided input on draft documents, developed stakeholder meeting agendas, provided updates on state legislative activities, conducted stakeholder outreach, and participated in multiple project meetings and stakeholder meetings.

Developing regional turf fertilizer guidelines through a stakeholder process required that NEIWPCC identify and proactively invite participation from appropriate persons and entities. The table on the following page describes categories of stakeholder who could potentially have interest in turf fertilizer, turf management and related environmental impacts, and the primary method that NEIWPCC used to engage representatives from each category. It should be noted that these categories vary widely in terms of size. While there are only a handful of university turf extension and research programs in the region and a few dozen companies that manufacture and distribute turf fertilizers, there are hundreds of sports turf managers, thousands of professional turf care companies, and millions of homeowners. NEIWPCC used existing distribution lists and networks to reach stakeholders to the extent they could be identified. This outreach was done primarily through email, with all messages encouraging recipients to share information about the effort and upcoming meetings with other potential stakeholders.

This approach to identifying and engaging stakeholders was more successful for some categories of stakeholders than others. Stakeholder meetings were attended by representatives of turf fertilizer manufacturers, professional turf care companies, turf industry associations, golf courses and other sports turf complexes, state agencies, municipalities, university extension and research programs, watershed groups/programs, and local soil and water conservation districts (see Appendix D for a complete list of participating entities). But NEIWPCC was unable to successfully solicit participation by retailers, homeowners' associations, and homeowners, due largely to the size of those stakeholder groups and difficulty in finding appropriate contacts or existing information networks.

Stakeholder Category	**Primary Method of Engagement**
Turf fertilizer manufacturers	State fertilizer registration lists, Internet queries, word of mouth
Professional turf care companies	Word of mouth through professional associations
Turf industry professional associations	Internet queries, word of mouth
Retailers selling turf fertilizer	Internet queries
Sports turf managers	Word of mouth through professional associations
State and federal environmental agencies	Existing NEIWPCC contacts
State agricultural agencies	State environmental agency connections, Internet queries
Municipalities (stormwater programs, groundskeepers, municipal officials)	Word of mouth through state distribution lists
University extensions and horticulture/plant science departments	Internet queries
Homeowners' associations	Word of mouth through professional associations
Homeowners	Word of mouth, NEIWPCC website
Watershed and water quality groups and programs	Existing state/regional outreach lists, word of mouth

NEIWPCC sought to engage stakeholders through a series of meetings, each free and open to all interested participants. The first two meetings, held in Boston on May 30 and May 31, 2012, were concentrated on issues related to the formulation and labeling of turf fertilizer products. Discussion on May 30 focused on synthetic turf fertilizer products; on May 31, focus shifted to fertilizers made from reclaimed materials. Two more meetings were held in March of 2013 - the first held in Providence, R.I. on March 12 and the second in Portsmouth, N.H. on March 26. Both were focused on fertilizer application practices.

In advance of both sets of meetings, NEIWPCC worked with the project advisory group to assemble draft guidelines to help focus meeting discussion; these draft guidelines were based primarily on a comprehensive review of existing state laws, available peer-reviewed research, and university extension guidance. While the advisory group found the research and drafting process useful, it is important to emphasize that group members did not enter the meetings with pre-conceived ideas about the content of the final guidelines. The drafts were a starting point for discussion, and the guidelines evolved

significantly as a result of stakeholder input at the meetings. The earlier drafts of the guidelines are available from NEIWPCC upon request.

NEIWPCC will release this interim final report for written stakeholder comment in early October, 2013. We will be particularly seeking endorsement or partial endorsement of the guidelines by industry stakeholders in recognition that guidelines are only useful to the extent that practitioners are willing to put them into action. All comments received will be compiled and made available online. NEIWPCC will develop a single written response to all comments received, which will also be posted online. NEIWPCC anticipates incorporating stakeholder comments regarding any technical deficiencies or inaccuracies into the final report and guidelines (to be released January, 2014), but does not anticipate making other substantive changes.

Scope of the Guidelines

It became apparent early in the stakeholder meeting process that important differences in view-point exist between turf professionals and environmental professionals. Most notable is the disparity between the values the two groups place on turf as a land cover. Stakeholders in the turf industry tend to view turf as being essential to community aesthetics while simultaneously being good for the environment. Those in the environmental field tend to see turf as an ecologically poor monoculture that leaks nutrients and chemicals into water. Neither view is objectively right or wrong. From an ecological perspective, turf is not the ideal land cover in all cases. Lawns lack biodiversity diverse and fail to provide adequate habitat for a range of wildlife when compared to other plant-dominated land cover types. In riparian/coastal areas, turf tends to attract nuisance waterfowl and does not provide the shade or woody organic debris than can enhance aquatic habitats. There is a preponderance of scientific study showing the value of naturalized stream banks and lakeshores.

However, scientific studies also show that when maintained properly and at high density, turf is a good ground cover in terms of preventing soil erosion and having relatively low rates of nutrient loss. In fact, healthy turf is so adept at retaining sediment and nutrients and reducing runoff volume that grassed swales, buffers, and filter strips are commonly considered best management practices for the treatment of runoff from vulnerable urban and agricultural land use areas (U.S. Environmental Protection Agency, 2012a; U.S. Environmental Protection Agency, 2012b; United States Department of Agriculture NRCS). Although there was not consensus at the stakeholder meetings about whether further land use transition to turf should be encouraged or discouraged, it is of no dispute that there is extensive turf already in New England. These guidelines, therefore, show how existing turf areas can be maintained to maximize the benefits of turf as a land cover while reducing environmental risks.

While the project was originally conceived to address fertilizer exclusively, discussions with stakeholders revealed that there are other aspects of turf care such as mowing practices, soil aeration/decompaction, and acidity correction that impact turf's ability to take up nutrients and reduce runoff. As a result, the guidelines include a section describing supporting practices not directly related to fertilizer application that can improve turf quality and reduce potential water quality impacts from nutrient loss. The report does not, however, address issues affecting the environment but not directly related to runoff volume

or nutrient loss such as irrigation/water use and pesticide use, which were determined to be outside the scope of this effort.

At the onset of the project, NEIWPCC envisioned a catch-all set of guidelines for turf care in any situation. However, through discussion with stakeholders it became evident that "performance turf" often needs more fertilizer than urban turf (also known as ornamental turf) to withstand heavy foot traffic and frequent mowing and to meet safety and playability standards. Performance turf includes golf course playing surfaces (fairways, tees, and greens), professional and recreational playing fields, and areas that typically experience high foot traffic such as university quads and public parks. It may be desirable to develop separate regional guidelines for nutrient management of performance turf. This idea was endorsed by golf industry representatives at the stakeholder meetings, who noted that many golf course superintendents have voluntarily adapted their turf care practices to reduce water pollution in response to public pressure and a desire to foster stewardship. Guidelines for performance turf should incorporate the development of comprehensive nutrient management plans that consider both use-based needs and environmental impacts, as described recently in guidance by the University of Massachusetts Extension Turf Management Program (2013).

The guidelines presented in this report are appropriate for the care of urban turf – namely residential lawns, commercial landscaped turf areas, low-traffic public areas, and even out-of-bounds and rough areas of golf courses. These uses account for the majority of turf acreage. In its draft analysis of the Piscataqua Region Watershed, New Hampshire DES found that residential lawns account for 88 percent of the total turf area observed (where "total turf area" is defined as the sum of identified lawn area and sports turf/public parks turf areas). Since landscapes differ in sensitivity to nutrient loss and potential for water quality impact, alternate guidelines are occasionally suggested for use on urban turf in particularly environmentally sensitive areas. Although states or municipalities may wish to specifically define these areas, they are envisioned to be areas immediately adjacent to impaired waters/segments, near-coastal areas of nitrogen impaired watersheds where little opportunity for attenuation exists, areas with particularly sandy soils, and land overlying single-source drinking water aquifers (see Appendix A). Such sensitive areas are well suited for applicator education and training efforts.

At the suggestion of stakeholders, the guidelines in this report have been organized around the "5 R's." The first four – right formulation, right rate, right time, right place – are the tenets espoused by turf fertilizer professionals and agronomists who advocate that if a turf manager selects the right product with the right nutrient composition, applies it at the correct rate according to soil conditions, and does it all at the right time and in the right place, there is a high likelihood that the fertilization practices will improve turf health with little chance of environmental impacts. The fifth R, right supporting practices, refers to the notion that fertilization occurs under a broader umbrella of lawn care practices that can affect turf's ability to absorb nutrients and prevent erosion losses.

Regional Clean Water Guidelines for Turf Fertilizer Formulated for and Used on Urban Turf

Regional Guidelines Part I: Right Formulation

Lawn fertilizers generally contain a combination of the essential plant nutrients nitrogen (N), available phosphate (P), and soluble potash (K) along with assorted micronutrients. Supply of these nutrients in the correct proportion encourages dense turf that is resistant to pests and disease and that performs important green infrastructure services by preventing soil erosion and improving stormwater infiltration. Determining the correct proportion of nutrients to apply in fertilizer is complicated because it depends on existing soil conditions and the species of grass being grown. Due to the similarities between the N needs of grass types common in New England, general suggestions can be made. However, the variation of soil P levels means that the decision to add P through use of fertilizer can only be sound if based on a soil test. While the burden of securing a soil test typically falls on the land owner or turf manager, the finding through stakeholder discussion for this project (and supported by multiple pieces of state legislation) is that fertilizer manufacturers have a responsibility to ensure that products with minimal environmental risk are readily available and labeled to indicate appropriate use. Fertilizer retailers should be responsible for training their sales associates to understand the different types of fertilizer and the importance of soil testing so that the associates can provide appropriate recommendations to customers.

Right Formulation – Phosphorus

Available phosphate (P) promotes the growth of a strong root system in turf, and is most needed during establishment (the first growing season). The P needs of turf decrease as turf matures. Phosphorus occurs naturally in many types of New England soil and is often present in sufficient quantity to maintain healthy mature turf without the addition of P-containing fertilizer (Fixen et al. 2010). This is especially true when excessive soil acidity is corrected through application of agricultural lime (see Regional Guideline 31, page 16). The addition of lime to acidic soil is a relatively inexpensive and easy way to release nutrients that are inert in the soil, making them available for plant use. The only reliable way to determine the soil P level and soil acidity at a given site is to conduct a soil test. Due to the severity of water quality problems caused by P pollution, even in very small amounts, many states (including the majority of New England states) have banned the sale and/or use of turf fertilizer products containing P on established lawns unless the applicator has obtained a soil test showing a P deficiency. The efficacy of turf fertilizer P-bans in improving water quality has yet to be conclusively demonstrated. However, given the extremely high costs of removing P from other waste streams and the considerable impacts to water quality in response to relatively small P inputs, it makes sense to encourage fertilization that is responsive to soil conditions and that will reduce unnecessary and avoidable environmental impacts.

> **Regional Guideline 1: Fertilizer applicators should have soil lab-tested (via a state university extension service or other professional lawn care service) before seeding a new lawn and at least once every three years following establishment.**

Regional Guideline 2: Fertilizer applicators should choose a phosphate-free fertilizer for use on established turf, unless a recent soil test (conducted within 12 months of planned application) shows an available phosphate deficiency.

Regional Guideline 3: Manufacturers of turf fertilizer intended for maintenance of established turf should formulate these products as phosphate-free fertilizers.

Regional Guideline 4: Manufacturers of turf fertilizer containing available phosphate should label these products as lawn starter or lawn repair products.

Right Formulation – Organic and Natural Organic Fertilizers

Many manufacturers of organic, natural organic turf fertilizers, and biosolids-based products will not be able to follow Guideline 3, because their products are derived from constituents containing P that cannot be removed. While the actual percentage of P in the guaranteed analysis of organic fertilizers tends to be low (in the 1-4 percent range), the N-to-P ratio is also low compared to synthetic products. This means that when organic products are applied according to N recommendations, the amount of P applied incidentally can be considerable. Many manufacturers of organic or biosolids-based products argue that research has shown that organic fertilizers are less likely to produce P in runoff or leachate than synthetic fertilizers due to differences in P solubility. Some peer reviewed studies comparing P losses from organic matter and highly soluble fertilizers generally do support this conclusion (Tabbara, 2003; Gaudreau et al., 2002; Agyin-Birikorang et al., 2008). However, a study conducted in the Northeast demonstrated a higher percentage loss of P from organic and biosolid sources than from synthetic fertilizers and noted the likelihood of P buildup in soils repeatedly fertilized with organic P (Easton and Petrovic, 2004). While there is some evidence that it may be less environmentally risky to apply organic fertilizers to a P-rich soil than it would be to apply synthetic fertilizers containing P to the same soil, this does not mean the risk from overuse of organic P is insignificant or negligible. Many researchers and extension experts conclude that it is environmentally risky to apply P from any fertilizer source when soil tests high for P, and that the best management practice is to apply P according to soil test results (Bierman et al., 2010; Guillard, 2008; Owen and Lanier, 2013; Rutgers New Jersey Agricultural Experiment Station, 2010). Therefore, these guidelines are intended to apply to all types of turf fertilizer, including organic, natural organic, and biosolids-based products.

Right Formulation – Nitrogen

Nitrogen (N) is a key nutrient in the growth of plant foliage, and it is generally expected that all turf fertilizers will contain N. Nitrogen is also very mobile in the soil environment, making the use of a soil test impracticable as a basis for application due to the lag time between sample collection and test result delivery. Generally, the right application rate and right application timing, (discussed later in these guidelines), are the key factors in reducing potential N losses to the environment. However, much attention has been given recently to the N forms in fertilizer. Traditionally, synthetic turf fertilizers have been formulated with almost all N as water soluble N (WSN), which is immediately available for plant uptake following application. However, any WSN applied above the turf's immediate needs is vulnerable to environmental loss, either through volatilization into the atmosphere, leaching to groundwater, or

runoff. Many turf experts recommend the use of products containing a mix of WSN and slow release N (SRN) (Guillard et al., 2008; Owen and Lanier, 2013). Slow release nitrogen requires a relatively slow acting chemical or physical transformation to occur before the N becomes available for plant uptake. What is the right mixture of WSN and SRN? Some turf experts recommend that 50 percent or more of total fertilizer nitrogen (TN) be provided as SRN, particularly if fertilizer is only being used once or twice a year and in moderate amounts (Guillard, 2008; Owen and Lanier, 2013). However, the long-term efficacy of SRN to reduce N losses from turf is not known (Rutgers New Jersey Agricultural Experiment Station, 2010). Most states that have chosen to incorporate nitrogen formulation requirements into their legislation have chosen a moderate approach, as has been taken with the guideline below. Regional Guideline 21 on page 13 further details how decisions about how much SRN to use should be integrated with decisions about the frequency and timing of application.

> **Regional Guideline 5: Manufacturers of turf fertilizer should formulate all nitrogen turf fertilizers to provide at least 20 percent of total nitrogen as slow release nitrogen.**

Regional Guidelines Part II: Right Rate

The rate at which a fertilizer is applied is as important if not more important in determining water quality impacts as the formulation of that fertilizer. Turf requires the right amount of nutrition, since both underfeeding and overfeeding can be problematic for plant health. As water quality professionals well know, overloading plant systems with fertilizer frequently causes runoff and/or groundwater contamination, eventually contributing to water quality problems. Environmental practitioners often assume that less use of products on lawns is always better, but this is not necessarily supported by research. Multiple agronomic studies have shown that unfertilized turf can contribute as much nutrient loss, particularly loss of P, as over-fertilized turf due largely to erosion caused by low turf density (Bierman et al., 2010; Easton and Petrovic, 2004; Kussow, 2004). The guidelines below advise moderate fertilizer use according to soil conditions but are not intended to discourage fertilizer use completely.

Application at the right rate is primarily the responsibility of the fertilizer applicator. However, due to the high frequency with which home fertilizer users rely on the fertilizer bag label for instruction, manufacturers bear some responsibility for labeling packaging with instructions indicating an appropriate rate (Eisenhauer et al., 2009; Osmond and Hardy, 2004). The rate guidelines below describe rates in the unit of pounds per 1,000 square feet, as this is the agronomic standard used in the United States. Adoption of a set application rate requires that the applicator know the approximate square footage of the turf plot being fertilized. Training and education on turf area estimation and development of simple tools to assist in this estimation are important catalysts for improved fertilizer application.

Right Rate – Phosphorus

As described above on page 7, a soil test showing existing P levels is generally the key to both choosing an appropriate product and applying it at the right rate. A soil test, especially one procured from a university extension service, will determine the concentration of plant-available P in the soil, will state the critical or optimal level of P for the plant being grown, and will qualitatively compare the existing soil P to the optimal level for plant growth, using terms such as low, medium, optimal, high, and excessive.

For suboptimal soil P concentrations, the soil test report will usually also include a recommended application rate/schedule to fix the deficiency.

Regional Guideline 6: Turf managers seeking to grow new turf, reseed bare or thin areas, or fix an available phosphate deficiency exhibited by a soil test should follow soil test recommended application rates for phosphate.

If a soil test is not available prior to seeding a new lawn or if test results do not recommend a specific application rate — or if an area is particularly environmentally sensitive — the conservative application rate below may be followed.

Regional Guideline 7: Turf managers seeking to grow new turf, reseed bare or thin areas, or fix an available phosphate deficiency should apply no more than 1 lb of active phosphate per 1,000 square feet per year, unless a soil recent soil test (within 12 months of the planned application) specifically recommends a higher application.

Right Rate - Nitrogen

The N needs of turf vary by specific species of grass. However, because many non-professionals do not know what species of grass are in a particular lawn, it is common for recommendations for N application rates to be generalized for use in most cases. The caveat is that managers should pay attention to actual turf response between applications and adjust future applications accordingly. Recommendations written with water quality in mind usually provide a maximum application rate of both WSN (the type of N most prone to runoff and leaching) and total N. The N application rates below for areas with limited environmental sensitivity are consistent with those provided in the recent Maryland, New Jersey and New Hampshire turf fertilizer laws and will aid fertilizer manufacturers in providing compliant products and packaging (see Appendix C). Through stakeholder discussion, it emerged that it is important to the fertilizer industry that state laws and regional guidelines not limit development of improved fertilizer formulations, such as Enhanced Efficiency Fertilizers. These new formulations, not yet broadly available to the non-professional, use coating technologies and enzyme inhibitors to stabilize nitrogen in the soil for longer periods, decreasing the likelihood of leaching or runoff.

Regional Guideline 8: Fertilizer applicators using a nitrogen fertilizer, other than an Enhanced Efficiency Fertilizer, in areas of normal environmental sensitivity should apply no more than 0.7 lb of water soluble nitrogen per 1,000 square feet and no more than 0.9 lb of total nitrogen per 1,000 square feet with each application.

Regional Guideline 9: Fertilizer applicators using a nitrogen fertilizer in areas of normal environmental sensitivity should apply no more than 3.25 lbs total nitrogen per 1,000 square feet per year.

Regional Guideline 10: Manufacturers of turf fertilizer should label products containing nitrogen in such a way that Regional Guidelines 8 and 9 will be met if an applicator, using properly calibrated equipment, correctly follows the label directions.

Regional Guideline 11: Fertilizer applicators should ensure that spreader equipment is on the correct setting and is calibrated properly prior to use (see Appendix E for resources related to calibration).

Due to the extreme volatility of N in the environment and the severity of impairments in certain areas, a separate guideline for areas of high environmental sensitivity is appropriate. Many university extension guidance documents recommend a more conservative approach to turf nutrition in environmentally sensitive areas (Guillard, 2008; Maine Turf Best Management Practices Committee, 2009; Owen and Lanier, 2013). NEIWPCC envisions that state and federal environmental programs, municipalities, university extension programs, and watershed groups will share the responsibilities of informing home owners and other turf managers that they are in environmentally sensitive areas and explaining the need to pursue alternative lawn care practices. While fertilizer manufacturers should be encouraged to participate in local discussions and education efforts related to lawn care and nutrient impairments, it is not realistic to expect manufacturers to produce different fertilizers bearing different label instructions exclusively for environmentally sensitive areas.

Regional Guideline 12: Fertilizer applicators using a nitrogen fertilizer, other than an Enhanced Efficiency Fertilizer, in environmentally sensitive areas should apply no more than 0.5 lb of water soluble nitrogen per 1,000 square feet and no more than 0.7 lb of total nitrogen per 1,000 square feet with each application.

Regional Guideline 13: Fertilizer applicators using a nitrogen fertilizer in environmentally sensitive areas should apply no more than 2.0 lbs total nitrogen per 1,000 square feet per year.

Right Rate – Storage of Unused Product

Fertilizer bags are typically sized according to the area they are intended to cover, assuming the applicator follows the label instructions. Because there are only a few common bag sizes available, many applicators will have unused fertilizer left over at the end of an application and/or at the end of the season. There is a tendency, particularly among non-professional applicators, to over-apply product to use up the entire package (Eisenhauer et al., 2009). This practice should be discouraged. It is very important that applicators apply at the correct rate and store or safely dispose of unused product as it is environmentally damaging for fertilizer to be over-applied or dumped.

Regional Guideline 14: Unused turf fertilizer should be returned to its original container and stored in a safe place for future application. Weighing the bag and recording the weight prior to storage will aid in determining how much area the remaining fertilizer will cover.

Regional Guideline 15: If disposal of turf fertilizer is absolutely necessary, it should be taken to a household hazardous waste facility. Unwanted fertilizer should never be purposefully over-applied to grass; dumped in a storm drain, wetland, or water body; or emptied into a toilet or sink.

Regional Guidelines Part III: Right Time

Identifying the perfect timing of fertilizer applications is at least somewhat dependent on how much time and money a landowner is willing to invest in lawn care, making a definitive guideline infeasible. However, there are rules that apply in most situations. Turf should not be fertilized when soil is frozen (or prone to freezing), during summer dormancy (for non-irrigated lawns), and immediately before a major rain. Multiple studies have shown that turf (and fertilized land in general) is most vulnerable to nutrient loss during the winter and early spring when ground is frozen and when fertilization occurs shortly before a major rain event (Bierman et al. 2010; Soldat and Petrovic, 2008; Tabbara 2003). Many states have established cut-off dates in legislation, specifying the earliest and latest allowable date to fertilize turf in any given year. Due to regional climactic variations and variation in seasonal temperatures from year to year, the guidelines below do not include absolute cut-off dates. The responsibility to fertilize at appropriate times falls almost exclusively on the applicator. However, due to the reliance, particularly by non-professionals, on fertilizer packaging to guide application, fertilizer packaging should include warnings about inappropriate times to use the product. The specific label language recommended below covers elements of both “right time” and “right place,” and is consistent with the language required by Maryland and New Jersey laws.

Regional Guideline 16: Fertilizer applicators should never apply fertilizer to turf during the winter or when the ground is wholly or partially frozen, and should be aware of and compliant with any state-legislated cut-off dates.

Regional Guideline 17: Fertilizer applicators should never apply fertilizer during summer dormancy.

Regional Guideline 18: Fertilizer applicators should always consult a local weather forecast prior to a planned fertilizer application and should never apply fertilizer to turf when a major rain event expected within 48-hours.

Regional Guideline 19: Fertilizer applicators should not apply fertilizer immediately following a major rain event when the soil is still saturated.

Regional Guideline 20: Manufacturers of turf fertilizer intended for retail sale for application on urban turf should include the following message in a legible and conspicuous manner on at least one side of the fertilizer label: “Do not apply near water, storm drains or drainage ditches. Do not apply if heavy rain is expected. Apply this product only to your lawn, and sweep any product that lands on the driveway, sidewalk, or street back onto your lawn.”

Establishing the right times to fertilize is complicated. Turf managers can choose between various acceptable fertilization schedules based on the standard of turf expected and the availability of time and resources for lawn care. One issue noted by stakeholders is that there is a disconnect, particularly among non-professional applicators, between the most popular time to fertilize (spring) and when fertilization is most beneficial to turf (fall). Fall is also the best time to seed new or reseed existing turf due to cooler temperatures and reduced weed competition. Acceptable fertilizer timing regimes are described in the table below (adapted from Owen and Lanier, 2013), all of which should be combined with the rate recommendations for nutrient application on pages 9-12 to build an environmentally sound fertilization plan.

Regional Guideline 21: Fertilizer applicators should time applications as follows, based on the desired number of applications per year.

Number of annual applications	Best product type	Best timing*	Rationale
1	75% or more N as slow release (SRN); P only if indicated by soil test	early Sept.	Helps turf recover from summer stress, SRN will provide nutrition throughout the fall.
2 – Maintaining existing turf	50% or more N as SRN; P only if indicated by soil test	1st: early May 2nd: early Sept.	Provides nutrition during active growth/ prior to summer stress and during fall recovery, with SRN provided throughout the growing season.
2 – Establishing or reseeding turf	50% or more N as SRN; P only if indicated by soil test	1st: early Sept. 2nd: mid-Oct.	Allows for late summer seeding and provides nutrition through establishment, readying new turf for winter.
3	20%-50% N as SRN; P only if indicated by soil test	1st: mid April 2nd: late May/ early June 3rd: early Sept.	Provides nutrition immediately prior to and during active growth, and during fall recovery.
4	20%-50% N as SRN; P only if indicated by soil test	1st: mid April 2nd: late May/ early June 3rd: early Sept. 4th: mid-Oct.	Provides nutrition immediately prior to and during active growth, and during fall recovery. Late fall application potentially helps turf rebound the following spring, but should be pursued no later than the last planned mowing of the season, generally around mid-October.

*Indicated timing is based on the central New England climate. Applicators in far northern and high elevation areas (northern NH, VT, ME, NY) should consider making spring applications 1 or 2 weeks later and fall applications 1 or 2 weeks earlier than indicated. Applicators in far southern areas (coastal RI, CT, NY) should consider making spring applications 1 or 2 weeks earlier and fall applications 1 or 2 weeks later than indicated.

Regional Guidelines Part IV: Right Place

Stakeholders were readily able to reach consensus about some locations where fertilizer should never be applied: places where grass is not growing.

> **Regional Guideline 22: Fertilizer applicators should never purposefully apply fertilizer to paved surfaces such as roads, driveways, patios, or footpaths. Incidental spills should be cleaned immediately by sweeping up spilled fertilizer granules and returning them to the bag, while incidentally scattered granules should be swept from paved surfaces back onto the lawn.**

> **Regional Guideline 23: Fertilizer applicators should not apply fertilizer to bare ground unless reseeding.**

There are areas where grass does frequently grow that environmental managers consider particularly vulnerable to nutrient loss and in need of special protections. Part II of these guidelines discussed the need to be conservative with approaches to applying P (when seeding turf or when soil is tested deficient) and N in areas particularly vulnerable to nutrient loss and nutrient-based pollution. This section will examine additional precautions that are necessary when turf being fertilized is immediately adjacent to a body of water, wetland, or water conduit like a storm drain, making direct transmission of fertilizer material to the water, wetland, or conduit possible. Environmental managers and legislatures have typically favored the establishment of buffer zones around water features and infrastructure where no fertilizer should be used. Some in the turf industry argue that non-fertilization of turf buffers will result in poor turf quality immediately adjacent to water bodies, leading to erosion and sediment loss. Stakeholders also pointed out the impracticality of establishing a wide buffer around storm drains; a storm drain on the edge of a road in front of a residential property and a 25 foot buffer requirement could effectively bar the property owner from fertilizing the entire front lawn. In the development of these guidelines, it was accepted that it is possible to fertilize safely close to storm drains, impervious surfaces and other stormwater conduits without the use of a buffer zone if other precautions are used. However, in regards to application right to the water's edge, the risk of scatter directly into adjacent water bodies is unacceptably high. In many cases, such fertilization is unnecessary anyway; because many shorelines are sloped, fertilizer applied outside of the immediate shoreline area will often travel sufficiently to feed grass along the shore. Where healthy turf cannot be maintained along a shoreline without direct fertilization, land managers should seek to replace the turf with hardier native vegetation. The responsibility not to apply fertilizer in the wrong places falls primarily on the applicator, but as described in Regional Guideline 20 on page 12, fertilizer manufacturers should incorporate labeling that warns against fertilizing in inappropriate places and on immediate shorelines.

> **Regional Guideline 24: Fertilizer applicators should not spread fertilizer on turf immediately adjacent to water bodies and wetlands and should be aware of any "no fertilization" buffer zones included in state legislation.**

Regional Guideline 25: Before fertilizing, fertilizer applicators should use a tarp, drop-cloth, or similar covering to cover stormwater conveyances immediately adjacent to lawns, including storm drains, ditches and swales. Scatter that collects on the cover should be shaken or swept onto the turf.

Regional Guidelines Part V: Right Supporting Actions

Watering in dry fertilizers – The impacts of landscape irrigation on water supply are outside the scope of these guidelines, but watering in fertilizer following application is important to spur plant uptake and to encourage movement through the soil. Granulized fertilizer that is not watered in will sit on the soil surface, unavailable for plant uptake, until the next rain event. If that rain is heavy or prolonged, there is high potential for nutrient loss that impacts water quality.

Regional Guideline 26: Following fertilizer application, turf managers should water in the fertilizer using 1/2 – 1 inch of water; correct watering should dissolve the fertilizer granules but should not create run-off.

Mowing and clippings management – While mowing turf is generally necessary to maintain a good aesthetic, it is stressful for the plants, and cutting grass too short can leave it more vulnerable to weed encroachment and drought. The ideal mow height varies by grass species, but 3 inches is a good general target. Good mowing practices include mowing frequently with a sharp mower blade and never removing more than a third of the total growth at a time. When mowing is frequent and clippings are short, it is beneficial to leave the clippings on the lawn to replenish soil P, increase soil organic content, and provide a source of slow release nitrogen. Collected clippings should be treated as a fertilizer and should never be dumped in water bodies, wetlands, or storm drains. Turf managers who regularly recycle clippings should consider scaling back the fertilization rates in Part II or reducing the number of fertilizer applications to compensate for the nutrients delivered by recycled clippings. Turf managers pursuing a more thorough approach can have clippings tested for nutrient content to determine the rate of nutrient recycling achieved by leaving clippings on turf. Appendix E contains resources with more information about mowing and clippings management.

Regional Guideline 27: Turf managers should mow grass to 3 inches in length, and should leave clippings on the lawn.

Regional Guideline 28: If it is not practicable to leave clippings on the lawn, turf managers should contain them in yard bags or compost heaps. Clippings should never be allowed to collect on paved surfaces and should never be dumped in water bodies, storm drains, or wetlands.

Use of soil amendments, manure, and compost – Soil amendments, bulk compost, bulk manure, and other organic materials (such as corn gluten meal) used for weed suppression often contain nutrients (including N and P). If soil amendments and composts containing P are used on high-P soils, the potential exists for P loss and contribution to water quality problems. If amendments containing N are used in conjunction with N fertilizer, the total application of N

may surpass plant needs, increasing the likelihood of nutrient loss to the environment. It is important for turf managers to know the nutrient content of soil amendments so that they can determine whether amendments are appropriate for use and, if so, can adjust fertilizer use accordingly.

Regional Guideline 29: Turf managers wishing to use soil amendments, manure, or compost should first have the organic material tested for extractable phosphorus and nitrogen content (via a state university extension service or other professional lawn care service).

Regional Guideline 30: Turf managers should not use soil amendments, manure, or compost containing available phosphate above trace amounts unless a soil test indicates a need for additional phosphate.

pH correction – Northeastern soils, particularly those with high sand content, tend to become acidic over time, and the acidity of soils affects the availability of nutrients inherent in or added to the soil. In acidic soils, essential plant nutrients, particularly P and K, tend to be limited in their availability to plants. Correcting acidity can both reduce the perceived need for fertilizers, particularly those containing P, and can make fertilizer applications more effective. The standard soil test described in Regional Guideline 1 will report the pH of the soil (a measure of acidity) and will describe the amount of pulverized lime that should be added to bring the pH up to the ideal level for turf growth, which is approximately 6.5 pH units. Appendix E contains resources with more information about liming and pH correction.

Regional Guideline 31: Turf managers should correct excessive soil acidity indicated by a soil test by applying agricultural lime as directed by the soil test result.

Aeration – When done in conjunction with fertilization, aeration improves fertilizer uptake and provides other benefits to turf and soil. It can also lead to improved water quality; aeration reduces compaction and improves the land's infiltration rate, allowing the lawn to filter more precipitation, yielding less runoff. Aeration equipment comes in two types: core aerators, which pull out plugs of soil leaving small holes behind, and spike aerators, which create holes by displacing soil without removing plugs. Turf experts generally recommend core aeration as the more effective approach. In cases where core aeration is not feasible and the soil is very sandy, spike aeration is an acceptable alternative. Appendix E contains resources with more information about aeration.

Regional Guideline 32: Turf managers should aerate turf at least once every two years immediately prior to spring or fall fertilization.

Lawn repair – As discussed on page 9, thin and patchy turf can be as detrimental to the environment and water quality as over-fertilized turf. Turf can become thin and patchy if the soil is overly compacted; if light and water requirements are not met; or if the turf is encroached upon by weeds, damaged by over-use, harmed by road salt spread in the winter, or

mowed too short. Following the guidelines above will generally guard against many of these problems, but thin or bare patches may still develop. It is important for the environment that turf managers routinely look for thin or bare areas each fall and either reseed/overseed them or transition to some other landscape type more suited to site conditions. Managers should consider choosing a seed mix that contains turf-type tall fescues and/or fine fescues. These species require less nitrogen for healthy growth than other common species of cool season turfgrass. Managers overseeding with fescues may be able to reduce fertilizer applications over time without seeing a reduction in lawn appearance. Appendix E contains resources with more information about lawn repair and overseeding.

Regional Guideline (33): Turf managers should evaluate turf areas for sparse and bare patches annually and should reseed/overseed areas, preferably with a seed mix containing fescues, where continued turf growth is desired and practicable. If turf is not desired or will not grow due to site constraints, different landscaping should be established.

Recommendations and Conclusions

It was universally recognized by participating stakeholders that education on the practices contained in these guidelines is very important. Many stakeholders also felt there was insufficient education and outreach following the passage of recent state laws related to turf fertilizer, leading to confusion among both professional and home fertilizer users. Comprehensive enforcement of state laws presents many challenges due to the number of regulated persons and activities, making education, outreach, and training all the more important. Improving the knowledge and technical skills of home applicators, garden center customer service representatives who interact with home applicators and employees of lawn care and landscaping companies are all seen as positive steps that would decrease environmental risks from fertilizer use. There are likely opportunities for public-private partnerships on education and training efforts if environmental and industry interests can agree on a message — and the guidelines presented in this report should help in achieving such a consensus.

However, education related to turf fertilizer is particularly challenging because, as the guidelines described above demonstrate, optimal and environmentally conscious fertilizer application encompasses a whole suite of actions. It is hard to identify a short, action-based outreach message that would be effective in isolation. Social research has indicated that attitudes and behaviors related to home lawn care can be particularly hard to change (Blaine et al. 2012). There is also little evidence of positive behavior changes to date among turf fertilizer users resulting from exposure to traditional passive outreach mechanisms such as pamphlets, factsheets, and websites (Aveni et al. 2013). An expert panel convened by the Chesapeake Bay Program to evaluate options for urban nutrient management recommended applicator training and interaction-based education targeted to particularly environmentally sensitive areas as the methods of education most likely to be effective. Most states already have such training available through public university extension services, and expanding the reach of these services or providing fertilizer users with incentives to use them would help to address this issue. For example, cost-share on lab fees assessed by university extensions for soil tests may boost homeowners' willingness to obtain the tests. Some states outside of the New England and New York region have pursued another alternative: the development of professional fertilizer applicator certification programs through their recent turf fertilizer legislation. Short of this requirement, there is no training or education standard that a person must meet to professionally apply fertilizer. The New England states and New York State may wish to pursue the development of voluntary or incentive-based certification, either individually through university extension services or regionally, potentially in collaboration with NEIWPCC.

The stakeholders at our meetings discussed the potential for better outreach through the use of newer technologies such as mobile device applications, QR codes, and online video. Particularly helpful would be the development of mobile tools to help home applicators estimate lawn size, make annual fertilization plans, choose appropriate products, and apply at the right rate; users could consult these tools when buying fertilizer and while working on a lawn. It is important that any outreach on turf management be broken into small, manageable pieces and be written at a level that non-agronomists and non-environmental practitioners can understand.

Finally, the development of these regional guidelines on turf fertilizer was important for New England and New York because the guidelines can help navigate the differences between different state laws, provide direction on subjects and issues not covered by state laws, and guide action in states where no laws related to turf fertilizer and water quality currently exist. The development of voluntary guidelines allowed all involved in the process to examine lawn care with a more comprehensive approach than is realistic or advisable for legislation. For example, while it is unlikely that a state legislature would ever legally require home owners to aerate lawns or mow them to 3 inches, such practices play an important role in the overall picture of turf and potential water quality impacts. Stakeholder engagement through public meetings also allowed environmental managers and turf industry practitioners to discuss turf and the environment in an open and collaborative way. It is hoped that the states, EPA and NEIWPCC can continue to work with turf fertilizer stakeholders on regional education, outreach, and training efforts to encourage wide-spread adoption of these guidelines.

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Appendix A – Definition of Terms

Note: The Association of American Plant Food Control Officials (AAPFCO) is an interstate body primarily made up of state agricultural agency officials. One of AAPFCO's core functions is to promote the uniform regulation of fertilizer and other plant foods through the establishment of formally accepted definitions and legal standards. We have used the AAPFCO definitions of terms for these guidelines whenever possible, as requested by stakeholders.

Aeration: the creation of air-filled holes in soil, generally undertaken through use of specialized equipment.

Available Phosphate: the sum of water soluble and citric acid soluble phosphate (P_2O_5) in a fertilizer product (AAPFCO Official Fertilizer Definition P-2). The percentage of available phosphate appears as the middle number of the grade on fertilizer labels.

Biosolids: a primary organic solid material produced by wastewater treatment processes that can be beneficially recycled for its plant nutrient content and soil amending characteristics (AAPFCO Official Term T-48).

Bulk Fertilizer: Fertilizer delivered to the purchaser either in liquid or solid state in a non-packaged form to which a label cannot be attached (AAPFCO Official Term T-11). Compost, manure, and biosolids are commonly sold in bulk.

Compost: biologically stable material derived from the biological decomposition of organic matter by mixing and piling in such a way to promote aerobic and/or anaerobic decay (AAPFCO Uniform State Fertilizer Bill).

Directions for Use: instructions printed on a fertilizer label explaining how the product should be applied. Any fertilizer delivered to an end user shall include directions for use (AAPFCO Uniform State Fertilizer Bill).

Enhanced Efficiency Fertilizer: fertilizer products with characteristics that allow increased plant nutrient availability and that reduce the potential for nutrient losses to the environment (e.g. gaseous loses, leaching or runoff), when compared to an appropriate reference product (AAPFCO Official Term T-70). EEFs typically include products that are release nutrients in a slow or controlled manner or to inhibit the chemical transformation and subsequent plant availability of nutrients.

Environmentally Sensitive Areas: areas that are particularly vulnerable to fertilizer nutrient loss and/or where direct transmission of fertilizer nutrients to surface water or ground water is likely. They are generally thought to include areas in close proximity to water bodies and wetlands (especially those impaired for nutrients or of exceptional quality), wellhead protection Zones I & II, areas in close proximity to private wells, certain coastal zones, areas overlying

single-source aquifers, areas with shallow water tables, areas with exposed bedrock, and areas with very sandy soil.

Established Urban Turf: urban turf that is 12 months or greater in age (AAPFCO Official Term T-79).

Fertilizer: a substance containing one or more recognized plant nutrients, and used for its plant nutrient content (AAPFCO Uniform State Fertilizer Bill). State laws generally require that all fertilizer products be registered with the state agency of agriculture prior to distribution in that state.

Fertilizer Grade: the minimum guarantee of available plant food expressed in terms of total nitrogen, available phosphate, and soluble potash. The nutrients appearing in the grade must coincide with the guaranteed analysis statement (AAPFCO Official Term T-7). The grade should appear prominently on the fertilizer label (AAPFCO Product Label Guide). The fertilizer grade is commonly referred to as "N-P-K."

Fertilizer Label: all of the written, printed or graphic matter on the immediate container, of a statement accompanying a fertilizer (AAPFCO Uniform State Fertilizer Bill)

Guaranteed Analysis: a manufacturer's guarantee for the minimum percentage of nutrients claimed for the product (AAPFCO Uniform State Fertilizer Bill). The guaranteed analysis contains the same information as the grade but also includes nitrogen speciation and micronutrients.

Leaching: vertical movement of water (either from precipitation, snow melt, or irrigation) and associated pollutants through soil layers and eventually reaching groundwater or surface water.

Major Rain Event: a brief storm with intense rain (thunderstorms or downpours), or sustained rain of over an inch in a 24-hour period.

Natural Organic Fertilizer: fertilizer derived from either plant or animal products that contain nutrients for plant growth. It is acceptable for these materials to have been subjected to biological degradation processes under normal conditions of aging, rainfall, sun-curing, air drying, composting, rotting, enzymatic, or anaerobic/aerobic bacterial action, or any combination of these. These materials may not be mixed with synthetic materials or changed in any physical or chemical manner from their initial state except by manipulations such as drying, cooking, chopping, grinding, shredding, hydrolysis, or pelleting (AAPFCO Official Term T-13).

New Urban Turf: urban turf that is less than 12 months in age.

Organic Fertilizer: a fertilizer containing carbon and one or more chemical elements other than oxygen and hydrogen essential for plant growth (AAPFCO Official Term T-12).

Phosphate Free Fertilizer: a fertilizer product with phosphate levels below 0.5%, intended for established urban turf or lawns (AAPFCO Official Term T-76). The middle number of the grade on a phosphorus free fertilizer label will be zero.

Runoff: lateral movement of water (either from precipitation, snow melt, or irrigation) and associated pollutants across land and eventually reaching water bodies or stormwater conduits.

Slow Release Nitrogen: fertilizer nitrogen 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 highly soluble reference form of nitrogen (modified from the AAPFCO Official Term "Slow or Controlled Release Fertilizer," T-71) Slow release nitrogen may be either water insoluble, coated with sulfur compounds, polymers or other material to delay release, occluded through mixing with some inert material, or in a chemical form that is water soluble but slowly available.

Soil Acidity/pH: a measure of the hydrogen ion activity (acidity) of soil reported on the logarithmic pH scale. The pH scale runs from 1 to 14, where 1 is extremely acidic, 7 is neutral, and 14 is extremely basic.

Soil Amendment: any substance, or a mixture of substances, intended to improve the physical, chemical, biochemical or other characteristics of the soil, except fertilizers, agricultural liming materials, unmanipulated animal manures, unmanipulated vegetable manures, pesticides and other material exempted from regulation (AAPFCO Uniform Soil Amendment Bill).

Soil Test for Phosphorus: a test to measure the level of plant-available or active phosphorus in soil by using a weak acid to extract the phosphorus.

Specialty Fertilizer: a fertilizer distributed for non-farm use (AAPFCO Uniform State Fertilizer Bill). Specialty fertilizers can be synthetic, organic and/or natural organic.

Sports Turf: non-agricultural land planted exclusively for golf courses, parks and athletic fields (AAPFCO Official Term T-75).

Starter Fertilizer: a fertilizer formulated for a one-time application at planting or near that time to encourage root growth and to enhance the initial establishment (AAPFCO Official Term T-78).

Summer Dormancy: period during mid-summer most commonly observed in un-irrigated lawns when turf growth ceases. Dormancy is characterized by a loss of green color and brittle texture.

Synthetic Fertilizer: any fertilizer manufactured from one or more synthetic materials containing no animal parts, animal byproducts, manures or renderings (AAPFCO Official Term T-61).

Turf Fertilizer: a specialty fertilizer specifically formulated and distributed for use on turfgrass.

Total Nitrogen: the sum of all fertilizer nitrogen species, including water soluble nitrogen forms, slow release nitrogen forms, and water insoluble nitrogen forms. The percentage of total nitrogen appears as the left-most number of the grade on fertilizer labels.

Urban Turf: non-agricultural land planted in closely mowed, managed grasses except golf courses, parks and athletic fields (AAPFCO Official Term T-74).

Water Soluble Nitrogen: nitrogen in either ammoniacal, urea, or nitrate form that does not have slow or controlled released properties (intended to be interchangeable with AAPFCO Official Term T-82, “Readily Available Nitrogen”).

Appendix B – List of Regional Guidelines for the Formulation and Use of Turf Fertilizer on Urban Turf

Right Formulation:

Regional Guideline 1: Fertilizer applicators should have soil lab-tested (via a state university extension service or other professional lawn care service) before seeding a new lawn and at least once every three years following establishment.

Regional Guideline 2: Fertilizer applicators should choose a phosphate-free fertilizer for use on established turf, unless a recent soil test (conducted within 12 months of planned application) shows an available phosphate deficiency.

Regional Guideline 3: Manufacturers of turf fertilizer intended for maintenance of established turf should formulate these products as phosphate-free fertilizers.

Regional Guideline 4: Manufacturers of turf fertilizer containing available phosphate should label these products as lawn starter or lawn repair products.

Regional Guideline 5: Manufacturers of turf fertilizer should formulate all nitrogen turf fertilizers to provide at least 20 percent of total nitrogen as slow release nitrogen.

Right Rate:

Regional Guideline 6: Turf managers seeking to grow new turf, reseed bare or thin areas, or fix an available phosphate deficiency exhibited by a soil test should follow soil test recommended application rates for phosphate.

Regional Guideline 7: Turf managers seeking to grow new turf, reseed bare or thin areas, or fix an available phosphate deficiency should apply no more than 1 lb of active phosphate per 1,000 square feet per year, unless a soil recent soil test (within 12 months of the planned application) specifically recommends a higher application.

Regional Guideline 8: Fertilizer applicators using a nitrogen fertilizer, other than an Enhanced Efficiency Fertilizer, in areas of normal environmental sensitivity should apply no more than 0.7 lb of water soluble nitrogen per 1,000 square feet and no more than 0.9 lb of total nitrogen per 1,000 square feet with each application.

Regional Guideline 9: Fertilizer applicators using a nitrogen fertilizer in areas of normal environmental sensitivity should apply no more than 3.25 lbs total nitrogen per 1,000 square feet per year.

Regional Guideline 10: Manufacturers of turf fertilizer should label products containing nitrogen in such a way that Regional Guidelines 8 and 9 will be met if an applicator, using properly calibrated equipment, correctly follows the label directions.

Regional Guideline 11: Fertilizer applicators should ensure that spreader equipment is on the correct setting and is calibrated properly prior to use (see Appendix E for resources related to calibration).

Regional Guideline 12: Fertilizer applicators using a nitrogen fertilizer, other than an Enhanced Efficiency Fertilizer, in environmentally sensitive areas should apply no more than 0.5 lb of water soluble nitrogen per 1,000 square feet and no more than 0.7 lb of total nitrogen per 1,000 square feet with each application.

Regional Guideline 13: Fertilizer applicators using a nitrogen fertilizer in environmentally sensitive areas should apply no more than 2.0 lbs total nitrogen per 1,000 square feet per year.

Regional Guideline 14: Unused turf fertilizer should be returned to its original container and stored in a safe place for future application. Weighing the bag and recording the weight prior to storage will aid in determining how much area the remaining fertilizer will cover.

Regional Guideline 15: If disposal of turf fertilizer is absolutely necessary, it should be taken to a household hazardous waste facility. Unwanted fertilizer should never be purposefully over-applied to grass; dumped in a storm drain, wetland, or water body; or emptied into a toilet or sink.

Right Time:

Regional Guideline 16: Fertilizer applicators should never apply fertilizer to turf during the winter or when the ground is wholly or partially frozen, and should be aware of and compliant with any state-legislated cut-off dates.

Regional Guideline 17: Fertilizer applicators should never apply fertilizer during summer dormancy.

Regional Guideline 18: Fertilizer applicators should always consult a local weather forecast prior to a planned fertilizer application and should never apply fertilizer to turf when a major rain event expected within 48-hours.

Regional Guideline 19: Fertilizer applicators should not apply fertilizer immediately following a major rain event when the soil is still saturated.

Regional Guideline 20: Manufacturers of turf fertilizer intended for retail sale for application on urban turf should include the following message in a legible and conspicuous manner on at least one side of the fertilizer label: “Do not apply near water, storm drains or drainage ditches. Do not apply if heavy rain is expected. Apply this product only to your lawn, and sweep any product that lands on the driveway, sidewalk, or street back onto your lawn.”

Regional Guideline 21: Fertilizer applicators should time applications as follows, based on the desired number of applications per year.

Number of annual applications	Best product type	Best timing*	Rationale
1	75% or more N as slow release (SRN); P only if indicated by soil test	early Sept.	Helps turf recover from summer stress, SRN will provide nutrition throughout the fall.
2 – Maintaining existing turf	50% or more N as SRN; P only if indicated by soil test	1st: early May 2nd: early Sept.	Provides nutrition during active growth/ prior to summer stress and during fall recovery, with SRN provided throughout the growing season.
2 – Establishing or reseeding turf	50% or more N as SRN; P only if indicated by soil test	1st: early Sept. 2nd: mid-Oct.	Allows for late summer seeding and provides nutrition through establishment, readying new turf for winter.
3	20%-50% N as SRN; P only if indicated by soil test	1st: mid April 2nd: late May/ early June 3rd: early Sept.	Provides nutrition immediately prior to and during active growth, and during fall recovery.
4	20%-50% N as SRN; P only if indicated by soil test	1st: mid April 2nd: late May/ early June 3rd: early Sept. 4th: mid-Oct.	Provides nutrition immediately prior to and during active growth, and during fall recovery. Late fall application potentially helps turf rebound the following spring, but should be pursued no later than the last planned mowing of the season, generally around mid-October.

*Indicated timing is based on the central New England climate. Applicators in far northern and high elevation areas (northern NH, VT, ME, NY) should consider making spring applications 1 or 2 weeks later and fall applications 1 or 2 weeks earlier than indicated. Applicators in far southern areas (coastal RI, CT, NY) should consider making spring applications 1 or 2 weeks earlier and fall applications 1 or 2 weeks later than indicated.

Right Place:

Regional Guideline 22: Fertilizer applicators should never purposefully apply fertilizer to paved surfaces such as roads, driveways, patios, or footpaths. Incidental spills should be cleaned immediately by sweeping up spilled fertilizer granules and returning them to the bag, while incidentally scattered granules should be swept from paved surfaces back onto the lawn.

Regional Guideline 23: Fertilizer applicators should not apply fertilizer to bare ground unless reseeding.

Regional Guideline 24: Fertilizer applicators should not spread fertilizer on turf immediately adjacent to water bodies and wetlands and should be aware of any “no fertilization” buffer zones included in state legislation.

Regional Guideline 25: Before fertilizing, fertilizer applicators should use a tarp, drop-cloth, or similar covering to cover stormwater conveyances immediately adjacent to lawns, including storm drains, ditches and swales. Scatter that collects on the cover should be shaken or swept onto the turf.

Right Supporting Actions:

Regional Guideline 26: Following fertilizer application, turf managers should water in the fertilizer using 1/2 – 1 inch of water; correct watering should dissolve the fertilizer granules but should not create run-off.

Regional Guideline 27: Turf managers should mow grass to 3 inches in length, and should leave clippings on the lawn.

Regional Guideline 28: If it is not practicable to leave clippings on the lawn, turf managers should contain them in yard bags or compost heaps. Clippings should never be allowed to collect on paved surfaces and should never be dumped in water bodies, storm drains, or wetlands.

Regional Guideline 29: Turf managers wishing to use soil amendments, manure, or compost should first have the organic material tested for extractable phosphorus and nitrogen content (via a state university extension service or other professional lawn care service).

Regional Guideline 30: Turf managers should not use soil amendments, manure, or compost containing available phosphate above trace amounts unless a soil test indicates a need for additional phosphate.

Regional Guideline 31: Turf managers should correct excessive soil acidity indicated by a soil test by applying agricultural lime as directed by the soil test result.

Regional Guideline 32: Turf managers should aerate turf at least once every two years immediately prior to spring or fall fertilization.

Regional Guideline (33): Turf managers should evaluate turf areas for sparse and bare patches annually and should reseed/overseed areas, preferably with a seed mix containing fescues, where continued turf growth is desired and practicable. If turf is not desired or will not grow due to site constraints, different landscaping should be established.

Appendix C: Summary of Northeastern State Laws on Turf Fertilizer

State:	Connecticut	Maine	Maryland	Massachusetts	New Hampshire	New Jersey	New York	Rhode Island	Vermont
Statute	Public Act # 12-155	Maine Revised Statutes 38 § 419	Maryland Statutes, Ag § 6-201,-210,-223, -224. Ag § 8-801, -803.	Acts of 2012, Chapter 262, revising §2, 64 and adding § 65a to Ch. 128 of Mass General Statutes	NH Revised Statutes, Title 50, 483B § 1-20), NH Code of Regs, Env. 1402.14, and 2013 House Bill 393.	NJ Statutes 4: 9-15.8a, 58: 10A-61 through -69.	NY Statues AGM 10-146g, ENV 17-2101 through -2105.	State of RI General Laws, 2§7-2-1 through §7-2-20.	Vermont Statues 10 § 1266b.
P restrictions?	No product containing more than 0.67% phosphate may be applied to established, nonagricultural turf without a recent (< 2 yrs) soil test showing need for P (1/1/13).	No restriction.	No turf fertilizer > 5% P may be labeled for use on established lawn or be labeled with spreader settings unless it is specifically labeled as a starter fertilizer (4/1/11). No person may apply fertilizer containing P above trace unless establishing or repairing a lawn, or a recent soil test (< 3 years) shows a need for P. (10/1/13)	No person shall apply or authorize the application of fertilizer containing P on nonagricultural turf unless a soil test shows a need for P or unless establishing a new nonagricultural turf area. The Mass. Dept. of Ag. Resources will develop regs to implement the P requirement by 1/1/14.	No fertilizer sold at retail that is intended for use on turf shall exceed a content level of 0.67% available phosphate unless specifically labeled for establishing new lawns, for repairing a lawn, for seeding, or for use when a soil test indicates a phosphorus deficiency. (1/1/2014)	No product containing P may be applied to established, nonagricultural turf without a recent (< 3 yrs) soil test showing need for P unless turf is being repaired or sub-surface application is performed. No product containing P may be sold unless specifically labeled for turf establishment or repair or subsurface application. (1/1/12)	No product containing P > 0.67% P may be applied to established, nonagricultural turf unless a P test shows need for P. P is allowed during establishment (first growing season).	No restriction.	No person shall apply fertilizer to turf containing more than 0.67% P unless a soil test performed <18 months prior to application shows a need for P or the product is labeled as a starter product and is used to establish turf during the first growing season. (1/1/12)
Compost? (i.e. unmanipulated animal or vegetable manure)	May not be applied to established, nonagricultural turf without a recent (< 2 yrs) soil test showing need for P (1/1/13).	No restriction.	Excluded from the definition of commercial fertilizer and thus from all restrictions.	Excluded from definition of fertilizer and thus from all restrictions.	Excluded unless registered as a natural organic fertilizer.	Excluded from definition of fertilizer and thus from all restrictions.	Excluded from definition of phosphorus fertilizer and thus from all restrictions.	No restriction.	Excluded from definition of phosphorus fertilizer and thus from all restrictions.
Organics (containing P – including manipulated animal and vegetable manures)?	May not be applied to established, nonagricultural turf without a recent (< 2 yrs) soil test showing need for P (1/1/13).	No restriction.	May only be applied by pro applicators, with a max rate of 0.25 lb/1000ft^2 per application and 0.5 lb/1000ft^2 per year. May not be applied if soil test is optimal or excessive for P.	Excluded from all restrictions, provided the only manipulations performed are drying, cooking, chopping, grinding, shredding, hydrolysis and/or pelleting.	Fertilizer label instructions must be written such that application will not exceed 1lb/1000 ft^2 per application when applied according to the instructions.	Exempted from restriction on sales. May be applied at no more than 0.25 lb/1000ft^2 P per application.	Not exempted (see P restrictions above)	No restriction.	Excluded from definition of phosphorus fertilizer and thus from all restrictions.
Treated Wastewater Biosolids?	May not be applied to established, nonagricultural turf without a recent (< 2 yrs) soil test showing need for P (1/1/13).	No restriction.	May only be applied by pro applicators, with a max rate of 0.25 lb/1000ft^2 per application and 0.5 lb/1000ft^2 per year. May not be applied if soil test shows optimal or excessive P.	Excluded from definition of fertilizer and thus from all restrictions.	See organics, above.	Excluded from definition of fertilizer and thus from all restrictions.	Not exempted (see P restrictions above)	No restriction.	Excluded from definition of phosphorus fertilizer and thus from all restrictions.

State:	Connecticut	Maine	Maryland	Massachusetts	New Hampshire	New Jersey	New York	Rhode Island	Vermont
Retail Signage?	Commissioner of Agriculture "may approve" consumer information related to P in fertilizer for distribution at point of sale. No requirement.	Required (1/1/08). Signs must warn against application of fertilizer containing P to turf unless a soil test shows need for P or establishing a new lawn.	Not required, but the law requires specific language be printed on bag labels warning against improper application.	May be developed in regulation by the Mass. Dept. of Ag. Resources, but no current requirement.	None.	NJ State Experimental Ag Station "shall provide" posters for retailers to display.	Retailers selling turf fertilizer containing P > 0.67% must post signs saying that P is only to be used on new turf and when a soil test shows P is needed. (1/1/12)	None.	Retailers selling turf fertilizer containing P > 0.67% must post signs saying that P is only to be used on new turf and when a soil test shows P is needed. (1/1/12)
Retail Separation?	None.	None.	None.	May be developed in regulation by the Mass. Dept. of Ag. Resources, but no current requirement.	None.	None.	Turf fertilizer containing P >0.67% must be displayed separately from fertilizer with ≤0.67% P. (1/1/12)	None.	Turf fertilizer containing P >0.67% must be displayed separately from fertilizer with ≤0.67% P. (1/1/12)
N restrictions?	None.	None.	No more than 0.7 lb/1000ft^2 WSN and 0.9 lb/1000ft^2 TN may be applied in a single application. Label recommended application practices must reflect these limits. Annual application limits are as stated by the University of Maryland Extension (dependent on grass species and age of lawn). Between Nov.15 and Dec. 1, pro applicators may only apply WSN (no SRN) at a max rate of 0.5 lb/1000ft^2. An enhanced efficiency fertilizer may be applied at a max rate of 2.5 lb/1000ft^2 per application such that the monthly release rate is ≤ 0.7 lb/1000ft^2 TN (10/1/13)	None.	Fertilizer label instructions must be written such that application will not exceed 0.7 lb/1000ft^2 WSN and 0.9 lb/1000ft^2 TN per single application and will not exceed 3.25 lb/1000ft^2 TN per year when applied according to the instructions. Enhanced efficiency fertilizers must be labeled such that application will not exceed 2.5 lb/1000ft^2 TN per application and 3.25 lb/1000ft^2 TN per year, and such that the monthly release rate is ≤ 0.7 lb/1000ft^2 TN when applied according to the label instructions. (1/1/14)	A person who is not a professional applicator may not apply more than 0.7 lb/1000ft^2 WSN and 0.9 lb/1000ft^2 TN per application and may not apply more than 3.2 lb/1000ft^2 TN per year. A professional applicator may not apply more than 0.7 lb/1000ft^2 WSN and 1.0 lb/1000ft^2 TN per application and may not apply more than 4.25 lb/1000ft^2 TN per year. (1/1/13)	None.	None.	No person may apply nitrogen fertilizer to turf, where nitrogen fertilizer is defined as any turf fertilizer with <15% of TN as SRN (see below). (1/1/12)
SRN requirement?	None.	None.	20% of TN.	None.	See "Buffers" below.	20% of TN.	None.	Regulations define the minimum % of SRN a product must have to be labeled "slow release" and the minimum % of SRN to be labeled "organic."	15% of TN.

State:	Connecticut	Maine	Maryland	Massachusetts	New Hampshire	New Jersey	New York	Rhode Island	Vermont
Golf Courses?	Exempted.	No restriction.	Fertilizer application must be done by a certified professional applicator and according to the parts of the law that regulate activity by professional applicators. (10/1/13)	Not specifically excluded. If golf courses are encompassed by the definition of non-agricultural turf, then the P restrictions described would also apply to golf course management.	Excluded from turf law but not from buffer previsions.	Exempted.	Not exempted.	No restriction.	Generally exempted. However, golf courses must submit a nutrient management plan to VT DEC as a condition of their pesticide application permit (7/1/12).
Application Cut-off Dates?	No application between Dec. 1 and March 15	None.	No application between Nov. 15 and March 1.	None.	None.	No application between Nov. 15 and March 1.	No application between Dec. 1 and April 1.	None.	No application between Oct.15 and April 1.
Professional applicators?	Same as above.	None.	No application between December 1 and March 1.	None.	None.	No application between December 1 and March 1.	Same as above.	None.	Same as above.
Buffer Around Waterbodies?	20 feet .	None.	15 feet.	None.	For Protected Shoreland (fourth order and greater streams and rivers, ponds and lakes ≥ 10 acres, coastal waters): No application within 25 ft. Within 250 ft, any fertilizer used must be ≤ 2% P and ≥ 50% of TN as SRN.	25 feet. One "rescue treatment" per year is allowed in the 10-25 foot zone, if done by a professional applicator.	20 feet.	None.	25 feet.
Buffer if using drop spreader, rotary with deflector, or a targeted liquid spray?	15 feet.	None.	10 feet.	None.	Same as above.	10 feet.	3 feet.	None.	25 feet.
Application on impervious surfaces?	Prohibited.	Not mentioned.	Prohibited.	Not mentioned.	Not mentioned.	Prohibited.	Prohibited.	Not mentioned.	Prohibited.
Application when heavy rain is forecast?	Not mentioned.	Not mentioned.	Prohibited.	Not mentioned.	Not mentioned.	Prohibited.	Not mentioned.	Not mentioned.	Not mentioned.
State certification program for professional applicators?	None.	None.	To be established by University of Maryland in consultation with state dept. of ag. All professional applicators must either be certified or under the direct supervision of a certified person. (10/1/13)	None.	None.	Shall be established by NJ State Experimental Agriculture Station and the state department of environmental protection. All professional applicators must be certified. (1/1/12)	None.	None.	None.

State:	Connecticut	Maine	Maryland	Massachusetts	New Hampshire	New Jersey	New York	Rhode Island	Vermont
Local ordinances regulating turf fertilizer?	Prohibited.	No restriction.	Pre-empted.	Generally pre-empted, but any local ordinance broadly related to nutrient management and turf fertilizer in place prior to 7/31/2012 remains enforceable. Any local ordinance related to sewage sludge/ wastewater residuals management in place prior to 1/1/2013 remains enforceable.	Local ordinances related to the registration, sale, formulation and transportation of fertilizers are pre-empted.	Pre-empted.	Pre-empted unless local jurisdiction can demonstrate that more stringent regulations are required to protect local water quality.	No restriction.	No restriction.

Appendix D – List of Participating Stakeholders by Company/Organization

Advanced Marine Technologies
Agresource
Agrium Advanced Technologies
Barnstable County Extension
Biagro Western Sales
CSM Smith
City of East Providence
Conservation Law Foundation
Connecticut Department of Energy and Environmental Protection
Cornell University, Department of Horticulture
Cumberland County Soil and Water Conservation District
Friends of Casco Bay
Golf Course Superintendents Association of America
Golf Course Superintendents Association of New England
Great Bay Piscataqua Waterkeeper
Harrells, LLC
Helena Chemical Company
Hodgson Brook Restoration Project
Holganix
John Deere Landscapes
Koch Agronomic Services
Lake of Isles Golf Course
Lake Winnipesaukee Golf Club
Lake Winnipesaukee Watershed Association
Lamprey River Watershed Association
Lawn Care Pros, LLC
Lawn Dawg, Inc.
Lebanon Seaboard
Lowell Spinners
Massachusetts Association of Lawn Care Professionals
Massachusetts Department of Environmental Protection
Milorganite
Narragansett Bay Estuary Program
Neptune's Harvest
New Hampshire Department of Agriculture, Markets and Food
New Hampshire Department of Environmental Services
Northeast Pest Consulting

Ocean County Utility Authority
Ocean Organics Corporation
Osborne Organics
Pennington Seed
Piscataqua Region Estuaries Partnership
PJC & Company
Responsible Industry for a Sound Environment
Rhode Island Department of Environmental Management
Rhode Island Golf Course Superintendents Association
Rhode Island Nursery and Landscape Association
Rhode Island Turfgrass Foundation
Rochester Country Club
Scotts Miracle-Gro Company
SeaScape Lawn Care
Strafford County Conservation District
Stratham Conservation Committee
Tighe & Bond
Tom Irwin, Inc.
Town of Lexington
Town of Marblehead
Town of Yarmouth
Tuckahoe Turf Farms
University of Connecticut, Department of Plant Science
University of Connecticut Extension
University of Massachusetts Extension
University of New Hampshire Cooperative Extension
US Environmental Protection Agency, Region 1
US Golf Association
Valley Green
Vermont Department of Environmental Conservation
Viridis Advisors
We Care Organics

Appendix E – Resources for Further Guidance

Comprehensive:

University of Connecticut, New England Regional Nitrogen and Phosphorus Fertilizer and Associated Management Practice Recommendations

University of Massachusetts Extension, Best Management Practices for Lawn and Landscape Turf

University of New Hampshire Extension, Landscaping at the Water's Edge

Aeration:

Virginia Cooperative Extension, Aerating Your Lawn

Lawn Repair and Overseeding:

University of Connecticut Cooperative Extension, Sustainable Landscaping

University of Massachusetts Extension, Lawn Renovation and Overseeding

Mowing and Clippings Management:

Connecticut Department of Energy and Environmental Protection, BMPs for Grass Clipping Management

University of Massachusetts Extension, Lawn Mowing

Soil Acidity:

Cornell Cooperative Extension of Rockland County, Correcting Soil pH

Soil Testing:

University of Connecticut - Soil Nutrient Analysis Laboratory

University of Maine - Analytical Laboratory and Maine Soil Testing Service

University of Massachusetts Extension - Soil Sample and Plant Tissue Testing Laboratory
(serves residents of Massachusetts and Rhode Island)

University of New Hampshire Cooperative Extension - Soil Testing Service

Dairy One - Agronomy Laboratory Services (in Cooperation with Cornell Cooperative Extension)
(serves residents of New York State, New Hampshire and Vermont)

University of Vermont - Agricultural and Environmental Testing Laboratory

Spreader Calibration:

Penn State University, Calibrating Your Fertilizer Spreader