

Regionally Appropriate Landscaping

Applicability

This BMP is intended for use by water system customers who wish to reduce their water supply needs and reap the biological benefits of establishing a water efficient landscape. This information should be disseminated by the water systems and the recommendations should be encouraged through the larger local water conservation and efficiency program.

Description

This category involves residential and commercial water customers who use some portion of their water expenditures for irrigation of outside vegetation. These include automated and manual above- and below-ground irrigation systems as well as “watering by hand” using a hose or container. Even though managed landscapes that include automated irrigation systems are often larger and use greater volumes of water, these best management practices are intended to be inclusive to all users of outdoor irrigation. If used efficiently, outdoor irrigation can provide desired and attractive landscapes while maintaining adequate water supplies for other uses of municipal water.

There are four general categories of BMPs for outdoor irrigation water use:

- Planning and design.
- Vegetation selection.
- Efficient irrigation system.
- Soil analysis and amendments.

These categories include many subjects and are not intended to treat one category more preferentially than another. In fact, once properly implemented, the BMPs from all categories should work in concert with one another to require minimal water use for maintaining a beautiful and functional landscape. It must be stressed that all of these BMP's require some level of continual maintenance to ensure their optimal effectiveness in regards to water efficiency. The information contained in this BMP is general in nature; therefore, it may be helpful to consult with a landscape contractor to achieve maximum water conservation benefits. However, outdoor water conservation is ultimately the responsibility of the owner of the landscape, as a professional can only advise the owner.

Planning and Design

To optimize water conservation efforts, the landscape should be planned and designed with water use in mind prior to any changes. This process should at least include the following aspects:

- Survey the land area with a transit or level. Use this information to produce a map with the elevation contours, as well as, all trees, structures, rocks and any permanent above-ground utilities.
- Use the existing contours while protecting any trees, structures or utilities from erosion.
- Use the contouring of the landscape to create “zones” where plants of similar water, sun and soil amendment needs are kept together.
- Minimal earthwork will reduce soil compaction, thereby increasing the infiltration into the soil.
- All grading activities should be conducted with the goal of reducing flow velocity and runoff. Engineering schemes such as, plunge pools, increasing channel or flow zone length through sinuosity, and widening of the flow zone should be considered to achieve this goal.
- Understand where the water is likely to flow during heavy rainfalls and use berms or vegetation such as multiple-stemmed bushes to reduce the velocity of this flow. A visit to the area during and immediately after a heavy rain is an important step to understanding the location and velocities of water flow onsite.
- Inspect the entire landscaped area regularly, especially immediately following heavy rains. Rills or small gullies can form during and immediately after these rainfall events. These should be immediately filled to avoid further soil erosion and plant losses. Once filled, alterations in the surface drainage of the landscaped area may be needed to avoid this type of erosion from reoccurring. Simple drainage barriers, such as strategically placed mulch tubes, rain gardens or simply larger, thicker grasses, could serve to reduce the concentration and velocities of water during and after a rainfall. These solutions also help avoid costly and time-intensive grading activities.
- Use turf only where needed.

Vegetation Selection

Once the design plan has been drafted with specific watering “zones,” the proper selection of desired vegetation based upon the plant climate region is critical. This was achieved on a national level by the creation of the Plant Hardiness Zone Map by the United States Department of Agriculture (USDA). The intention of the USDA’s establishment of plant hardiness zones was to provide a general idea of which plants are suitable to certain regions in an attempt to avoid unnecessary plant mortality. The introduction of the Plant Hardiness Zone Map in 1990 succinctly summarizes the original concept by stating, “All plants must be placed in an environment that meets their basic requirements (USDA, 1990).” The specific differences in plant hardiness zones are based upon the length of day, anticipated solar radiation, temperature, initial timing and frequency of frost, heat, rainfall and soil pH.

North Carolina contains several USDA Plant Hardiness Zones from Zone 5 to Zone 8. The zones range from 5b in the higher elevations of the mountains to 8b in the far outer Coastal Plain regions, with Zone 7 predominating across the state (Figure 1).

Figure 1. USDA Plant Hardiness Zones for North Carolina (USDA, 2012)



The North Carolina State University’s Department of Horticultural Science has produced many publications for shrubs and trees that provide detailed suggestions, including the hardiness zones, for which plants are appropriate to plant in North Carolina. The link for these detailed publications can be found in the references section of this BMP (NCSU, 2012c). For more detailed information, please consult your county’s cooperative extension agent or local garden center to assist in the proper selection of plants based on the plant hardiness zone, landscape placement and water needs.

Once a list of the plants has been determined, these plants should be grouped together based on water, shade and nutrient requirements. These vegetation groupings are the basis for landscape zonation as described in the planning and design section. This also provides the installer an opportunity to determine if any of the desired plants are inappropriate for the landscaped area. Consultation with a landscape contractor, arborist or county cooperative extension agent is advised for reasonable alternatives to any desired but inappropriate plants.

Turfgrass

Turfgrass is the most widely-grown ornamental crop in the southern United States. Of the 2 million acres of turfgrass grown in North Carolina, single family homes account for about 60 percent, primarily in areas serviced by a public water supply system. Other locations of turfgrass within areas serviced by a public water system include athletic fields, golf courses, parks, schools, churches and commercial buildings.

If the landscaped area being designed contains areas of turf, then an appropriate turfgrass type must be selected. There are many different types of turfgrasses known to thrive throughout North Carolina and a trip to your local agricultural supply or hardware store can be confusing if you are not fully prepared. Each species of turfgrass grown in North Carolina has positive and negative aspects. As a developer of the landscape, the individual must decide when they want or need the turf to be at its greenest and when it can be dormant.

North Carolina sits in the transition zone for cool and warm-season turfgrasses. Cool-season turf species are those with optimum growth at temperatures between 60 degrees and 75 degrees Fahrenheit, whereas warm-season turfgrasses have optimum growth between 80 degrees and 95 degrees Fahrenheit. By far, the most commonly-grown species in North Carolina is the cool-season grass tall fescue, followed by warm-season Bermudagrass. In addition to tall fescue, the cool-season grasses include creeping bentgrass, fine fescue, Kentucky bluegrass and ryegrass. The normal time for renovation of tall fescue and Kentucky bluegrass lawns in most of North Carolina is early September. High temperatures can cause cool-season grasses, such as tall fescue, to become stressed.

Warm-season grasses include bahiagrass, carpetgrass, centipedegrass, St. Augustinegrass, and zoysiagrass and bermudagrass. These grasses are generally better able to survive prolonged periods of dry conditions, but may still be severely damaged from chronic drought. Heat alone is generally not problematic with warm-season turfgrasses unless there is low soil moisture. The time to renovate warm-season grasses is normally in spring/summer.

Table 2. Characteristics of commonly grown turfgrasses in North Carolina (NCSU, 2012a).

Grass species	Adaptation					Appearance	
	Shade	Heat	Cold	Drought	Wear	Color	Texture
Bermudagrass	very poor	very good	very poor	excellent	excellent	medium	medium
Centipede	good	good	poor	good	poor	light	coarse
Tall Fescue	good	good	very good	very good	very good	medium	coarse
Kentucky Bluegrass/ Tall Fescue	good	good	very good	very good	very good	medium-dark	medium-coarse
Bahiagrass	good	good	poor	excellent	poor	medium-dark	coarse
St. Augustine grass	very good	very good	poor	good	poor	medium-dark	coarse
Zoysiagrass	good	very good	fair-good	excellent	good	medium-dark	fine-medium

North Carolina State University’s Turffiles program has established an excellent online turf selection decision aid at <http://turfselect.ncsu.edu/TurfSelection.aspx>. This internet application only requires knowledge of the general use of the landscape, shadiness of area, and county. It will generate several appropriate choices, with a table of the positives and negatives for each turf type.

There are many factors that affect turfgrass survivability and water needs in drought conditions including species type, turf age, rooting depth, soil type, shade, maintenance, traffic and heat. Water efficiency should be a goal during all climate conditions; however, during drought conditions turf should be watered and irrigated only to keep the grasses alive. Due to the great deal of water needed to establish new turfgrasses, it is highly recommended that turf areas have at least minimum maintenance, as the water needed to maintain turf is less than the quantity needed to start again. A rule of thumb, when the watering regime goal is merely the survival of the turf, then irrigation of half an inch of water every two to four weeks is appropriate. This minimal water usage will keep the turf crowns hydrated, and allow the turfgrass to go semi-dormant to dormant. The color of the grasses may turn a dull brown. However, this may not occur in species such as tall fescue and bermudagrass. If the color changes do occur, the color and vigor will readily return once drought conditions have attenuated or reduced in severity. Keeping vehicle and foot traffic off the turf when it is under severe drought stress will further increase the survivability of the turf.

Use of herbicides and fertilizers are known to bind water molecules; therefore, avoid their usage when under drought conditions. However, under normal climate conditions, application herbicide treatments will serve to reduce competition for water resources by undesired/weed species. Similarly, the use of insecticides should

be restricted during drought conditions. However, their use under normal conditions will serve to control many insect, nematode or disease issues; thereby, avoiding the costly water use needed during reseeding. Keep in mind that judicious use is critical as some products can be toxic to certain turf species; therefore, it is critical to follow the manufacturer's suggested dosing.

During normal conditions in the summer months, turf generally needs approximately one-inch of water per week. This water can be provided from both irrigation and rainfall; therefore, it is important to install a rain gauge near the irrigated area and keep track of the amount of precipitation collected. Due to the somewhat spotty nature of rain events, this is likely to differ from the nearest reported/published rain gauge data. The Turf Irrigation Water Management Model, which can be found at <http://turf-ims.ncsu.edu/>, can be used to calculate and track irrigation use. It utilizes North Carolina State Climate Office weather data in concert with general soil type data, turfgrass type and irrigation discharge rate to provide monthly irrigation needs. The irrigation section of this BMP document provides detailed information about proper irrigation practices.

To further increase water efficiency of the turfgrass, the mowing height should be maintained at the higher end of the recommended scale for that specific turf species. Please visit, <http://www.turffiles.ncsu.edu/Turfgrasses>, for the recommended mowing heights of the specific species. Other mechanical maintenance practices, such as aeration, should be conducted at the appropriate times of the year for the specific turf type on the landscape. For cool-season grasses, these practices should occur in the fall when the ground is moist and the turf is typically subjected to little water stress. However, for warm-season grasses any mechanical activities should occur in the early summer to avoid turf damage.

Turfgrass that turns bluish-gray in the heat of the day may be in immediate need of water to prevent mortality. This situation may require exceeding the recommended watering regime, especially during an extremely hot and dry period. Be aware that the bluish-gray color may be a diurnal discoloration that will recover at night. Therefore, it is recommended that regular watering continue for at least one full day following observation of the discoloration before exceeding the normal watering regime. If the landscaped area is located in an area with local water restrictions, hand-watering of those areas that show visual signs of heat and moisture stress may be needed until the next allowable sprinkler irrigation opportunity (NCSU, 2012a).

Efficient Irrigation

Once the landscaped area has been properly planned and zoned and the locations of the large trees have been approximated, the type of irrigation system should be determined. There are two choices, below-ground permanent systems and above-ground temporary systems. For larger land areas with more extensive landscaping, the below-ground permanent systems are often preferred. However, many configurations are possible including maintaining both permanent and temporary

irrigation systems in the same planned landscape. This approach allows for more flexibility for landscape alterations and potentially greater water conservation and efficiency. For more information about conservation programs and efficiency ordinances local municipalities can initiate, please refer to the BMP entitled *Retrofitting Irrigation Systems*.

It should be noted that according to North Carolina general statute 89G-3, section 65.8.(a) and (b), no person shall engage in the practice of irrigation construction or contracting, use the designation 'irrigation contractor', or advertise using any title or description that implies licensure as an irrigation contractor unless the person is licensed as an irrigation contractor. All irrigation construction or contracting performed by an individual, partnership, association, corporation, firm, or other group shall be under the direct supervision of an individual licensed by the North Carolina Irrigation Contractors' Licensing Board.

For the below-ground permanent systems, pipe layout is vital. The piping should be laid out so that larger rooting trees are avoided and the nozzles are spaced such that there is little spray overlap. Irrigation water is not needed directly at the base of trees once they are established. Impermeable surfaces such as sidewalks, driveways and roads should never be irrigated. Use of water efficient nozzles, which are regularly maintained, is important to achieve water conservation goals. Leaks around the nozzles or within the below-ground piping can result in significant water loss, reduced water pressure through the system and mortality from oversaturation and erosion from a softening of the subsoil.

Permanent systems are typically constructed as automated systems. If the irrigation system is automated, rain and/or soil moisture sensors need to be installed and actively functioning. A well-functioning sensor will avoid both unnecessary water usage during times when no irrigation is needed and over-watering when some irrigation is needed. It is important to note that these devices must be accurately calibrated based upon the specific conditions at the landscaped area. Sensors should be calibrated at the initial installation and then periodically per manufacturers guidelines.

Temporary, above-ground irrigation systems include hand watering, manual irrigation and temporary sprinklers. These methods are thought to reduce water consumption. However, water reduction is on a case-by-case basis and hand watering does not always conserve water. Misuse of water can easily occur with a sprinkler attached to a hose by over-watering or watering surfaces with no plants. To avoid this situation, it is recommended to measure the irrigation radius of the sprinklers used and plan for where they will be placed.

A measure of the water volume discharged from sprinkler or nozzle heads should be conducted for permanent and temporary irrigation systems. To calculate the length of time required to irrigate one-inch of water on the landscape area, first distribute a few empty "catch" cans across the irrigated area. Note the exact time when irrigation

begins. Standard, small tuna cans are useful since they are typically one-inch tall. The irrigation cycle should end once the catch can is full. The ending time should be noted. This provides the user with an approximate length of time required to provide the turf with enough water to thrive for another week. It also serves as an assessment of the distribution evenness of the sprinkler heads.

Regardless of the irrigation system type, turf areas are generally wide and broad. Therefore, sprinkler irrigation is typically a better choice. However, drip irrigation is an appropriate alternative for shrubbery, gardens or during the grow-in period for trees. Drip irrigation uses less water than the traditional sprinkler because it places water directly into the soil and reduces the amount of water lost to runoff and evaporation.

In addition, manual hand-watering with a hose or bucket should be a tool everyone uses in landscaped areas. Some plants require more water than others and dry zones can be present, as rainfall is not equal everywhere even across a single lawn. If small areas of water stress are observed either in turf (i.e. blue-greenish blade color) or larger plants (i.e. brittle stems and early leaf drop), water should be provided directly to these plants to avoid loss, as establishing new plants will often require significantly more water than what's needed to save the existing plant. For more valuable landscaping vegetation, water injection and syringing is a tool that can be used to provide water directly to the roots. People should consult a landscape professional if they choose this method.

It is recommended that irrigation occur two to three times a week, keeping in mind that generally only one-inch of water total is needed for the entire week, including that received from precipitation. Irrigation frequency will often vary with climatic and environmental factors, such as seasonal shifts, temperature and rainfall. Significant alterations on water usage can be expected when any of these factors depart from normal conditions.

To avoid direct and immediate losses of irrigated water from evapotranspiration (ET), watering activities should be conducted between 10 p.m. and 8 a.m. Nighttime is generally less windy, cooler and more humid, resulting in less evaporation and more efficient application of water. It is advised that the watering be conducted late at night rather than early morning to avoid times of high water demand. Contrary to popular belief, studies have shown that irrigating during this period does not stimulate disease development. For more information, go to <http://www.turffiles.ncsu.edu/PDFFiles/000851/ag661.pdf>.

Measuring the depth of the root zone is important when determining the frequency and duration of irrigation. Landscapes with deep, well-established root zones may require less-frequent irrigation in the summer, even during peak ET demands. For younger landscapes, more frequent irrigation will likely be needed in the spring, when the roots are becoming established. Shallow rooting depth and warmer,

windier days result in higher ET rates. Understanding the changing needs of the landscaped area is important for water conservation and the health of the plants.

Irrigation frequency should also be adjusted depending on existing environmental factors such as compacted soils or soils with a shallow hardpan or clay lens. To avoid runoff on these soils, irrigate only a small portion of the needed water, wait until all the water has percolated into the soil, and continue to apply small portions of water. If kept near field capacity, and not allowed to dry, this process will assist in reducing the compaction of the soil. Field capacity is the amount of water remaining in a previously saturated soil after free drainage has ceased. On well-aerated soils with low to moderate traffic, minor water stress on the turf can serve to benefit the turfgrasses, as this will tend to increase the rooting depth. It is recommended that once wilting is observed on a few blades, wait another 24 hours, then water the area again to ensure water infiltrates deep into the soil column.

Table 2. Estimated monthly irrigation totals for turfgrasses in the Raleigh area (NCSU, 2012a).

Month	Mean Temperature(°F)	Average Rainfall	ETP ^a	Gross Irrigation Requirement ^b	Net Irrigation Requirement ^c
				(inches)	
Jan	40.2	3.63	0.59	-	-
Feb	42.9	3.44	0.77	-	-
March	49.9	3.79	1.68	-	-
April	59.3	2.88	3.27	1.83	2.29
May	67.2	3.64	5.20	3.38	4.23
June	74.6	3.54	6.88	5.11	6.39
July	78.4	4.51	7.60	5.35	6.68
Aug	77.1	4.33	6.73	4.57	5.71
Sept	70.8	3.70	4.86	3.01	3.76
Oct	60.0	2.94	2.85	1.38	1.73
Nov	50.6	2.90	1.29	-	-
Dec	42.4	3.01	0.65	-	-
Total	-	42.14	42.37	24.63	30.79

^a ETP is potential evapotranspiration or the reference water use based on climatic information calculated using a modified Blaney-Criddle method.
^b Gross irrigation requirement is determined by subtracting the effective rainfall from the ETP. Effective rainfall is assumed to be 50 percent of the average monthly rainfall.
^c The net amount of water required by the turfgrasses is quantified by the following equation:
$$\text{Irrigation Requirement} = \frac{\text{GIR}}{\text{DU}}$$
Where GIR is the gross irrigation requirement and DU is the uniformity of distribution of the irrigation system, which may be assumed to be 80 percent.

Soil Analysis and Amendments

In North Carolina, most soils are acidic and somewhat low in nutrients; therefore, optimal plant growth and yield often require the addition of amendments. Plants with nutrient deficiencies or ion toxicities will show symptoms of water stress. This is because essential nutrients such as Phosphorus (P), Potassium (K), and Nitrogen

(N) are necessary for the plant to transmit water from the soil into the roots and up into the above-ground portions of the plant. At the same time, ion toxicities, such as Aluminum (Al), Iron (Fe), or Sodium (Na) will restrict the uptake of water from the soil. Proper soil pH is also critical to avoid plant water uptake issues. In highly acidic soil conditions plant roots will be constrained in the uptake of water. For most areas throughout North Carolina, the recommended soil pH range is between 5.5 and 6.5.

Soil testing is the best way to determine the types and quantities of the soil amendments needed based on existing field conditions. Over-fertilization or over-liming should be avoided, as it could result in increased shoot growth at the expense of root development. A soil analysis should be completed prior to any planting. Ensuring the turf and larger plants have the proper amount of fertilizer applied early in the season will assist in making more efficient use of the available nutrients. This will result in increased efficiency of water uptake throughout the growing season. In North Carolina, the Department of Agriculture and Consumer Services (NCDA&CS) provides a free assessment of soil samples sent by North Carolina residents. This report details the existing levels of essential macronutrients, as well as important micronutrients present. The report also provides recommendations for quantities of soil amendments to be applied. These recommendations are based on the specific use of the landscaped area, which in this case would be a managed lawn.

It is important to follow the instructions provided by the State Department of Agriculture and Consumer Services for proper collection of samples, including sample depth and composite sampling. When, where and how the sample is taken all affect sample quality and the resulting nutrient/amendment recommendations. Each sample must accurately reflect the variability and conditions in the landscaped area, and typically soil from a single location cannot do this. Samples should be taken at the depths of the rooting zone for the plants planned for that location. Therefore, in planned turf areas the sample does not need to exceed 6 inches. However, in areas where larger plants are planned, the sample depths should be between 6 inches and 12 inches. The samples taken at different depths should not be combined together into a single composite sample. Rather, composite samples should be soil samples of the same depth at different locations. Each sample should be a composite of between 15 and 20 locations, thoroughly mixed, and the area represented by each sample should be relatively uniform. Avoid areas where soil conditions would be expected to be markedly different from those in the rest of the landscaped area (i.e. wet spots, severely eroded areas, old building sites, fence rows, spoil banks, burn row areas, old woodpiles or fire sites. These peculiar areas should have their own separate sample(s). The sample turn-around time varies throughout the year with the winter months generally taking longer than the summer months due to the increased agricultural needs (NCDA&CS, 2008). An example of a soil analysis report as well as an explanation of soil test results are included as Appendices 1 and 2 at the end of this BMP.

Mulching

Mulching around trees and shrubs in a landscaped area, excluding the lawn, provides temperature protection and moisture retention for the plants as well as creating an attractive landscape. Some of the primary water efficiency benefits mulches provide include:

- Soil moisture retention, which is then taken up by the plants.
- Reduction of moisture lost to the atmosphere from the soil by evaporation (i.e. 10 percent to 25 percent reduction in soil moisture loss from evaporation).
- Soil protection from compaction from traffic, as well as from precipitation striking the soil. Compaction reduces the total pore space in the soil available to hold water.
- Reduction of runoff, which results in holding more water on-site.
- Reduction of topsoil erosion. Topsoil often contains more water for plants and more nutrients than the deeper, underlying soil.
- Insulation of the soil below from heat loss in the winter and evenings. Resistance of rapid warming in the summer and mid-day. This consistent environment reduces the amount of water lost to evaporation.
- Impedes the growth of weeds and other undesirable plants, which compete for limited water resources. A 2-inch-to-4-inch layer (after settling) is adequate to prevent most weed seeds from germinating.

The mulched area should include as much of the root zone as possible. For plant beds, the entire area should be covered with mulch. For individual plants, such as trees, the mulched area should extend at least three feet from the base of the plant. It is advisable to pull the mulch between 1 inch and 2 inches from the base of plants to prevent bark decay. Mulch can be applied year-round. However, the best time to mulch is late spring after the soil has warmed. Early spring application will delay soil warming and possibly plant growth. It is not necessary to remove the mulch when you fertilize. Apply the fertilizer on the mulch. Nutrients will move with the water to the roots below.

Mulch depth depends on two factors: the moisture holding capacity of the underlying soil and the type of mulch material used. Sandy soils dry out quickly and often benefit from a slightly deeper mulch layer of between 3 inches and 4 inches. However, excessive application of mulch can result in a situation in which roots are growing in the mulch and not in the soil. Over-mulched plants are easily damaged when herbicides and fertilizers are applied and during periods of drought stress. Mulching an area that is poorly drained can further reduce the drainage resulting in an area permanently saturated, which the selected plants would not be able to tolerate (NCSU, 2012b).

Table 3. Mulching estimates to adequately cover a landscaped area with a loamy surface (top 6 inches) soil (NCSU, 2012b).

Inches of Material	Organic Material Needed to Cover 100 Square Feet
6	2 cubic yards
4	35 cubic feet
3	1 cubic yard
2	18 cubic feet
1	9 cubic feet
1/2	4 cubic feet

There are essentially two distinct categories of mulching products, organic mulches and inorganic mulches. Organic mulch lacks significant manufacturing in its production. As such, organic mulch contains only plant materials. Inorganic mulches often also contain plant material, but may also include many different types of materials integrated during the manufacturing process. Each has its own advantages and disadvantages, and its selection should be based upon landscape setting, anticipated use, maintenance requirements and budget.

Organic Mulch Materials

Many organic materials can be used as mulch. The material should be weed-free, non-matting, easy to apply, and readily available. Fine particle organic mulch will form a more complete soil cover than a coarse, loose material. Coarse mulch material will need to be applied in thicker layers in order to achieve the desired benefits. Organic mulches decompose with time, releasing small amounts of nutrients and organic matter to the soil. The layer of mulch should be renewed as needed to maintain a 2-inch-to-4-inch depth. On previously mulched areas, apply a 1-inch layer of new material every few years.

Some of the best organic materials include pine bark nuggets, shredded hardwood, pine straw and compost. Pine straw is aesthetically pleasing and will remain in place better than most other materials. However, pine straw can be a fire danger during drought conditions. Pine bark nuggets are longer lasting, but can be washed with a heavy rain. Note that pine bark mulch is primarily used as a soil conditioner and that pine bark nuggets are used as mulch. Bark used as mulch should contain less than 10 percent wood fiber. Reapplication time should be a consideration; pine straw will need to be reapplied each year while pine bark may not need to be reapplied for several years.

Other organic materials sometimes used for mulch include: wheat straw, shredded newspaper, peanut hulls, wood chips, sawdust and partially decomposed leaves. Most of these materials are less expensive than pine straw or pine bark but have some significant limitations. Any fresh, light-colored, unweathered organic mulch such as wheat straw, peanut hulls and wood chips will tie up nitrogen during the early stages of decomposition. Properly composted wood chips can be used as a long-lasting mulch that weathers to a silver-gray color. Unfortunately, most wood chip material is sold as a fresh material rather than as a composted or aged material. The chips decompose slowly, but as they decompose, microorganisms use nutrients from the soil that might otherwise be available for plant growth. If sawdust is used, it should be well-aged. Otherwise it will be difficult for water to move into the soil. Uncomposted sawdust is low in nitrogen and will rob nitrogen from the soil as it decomposes.

Yard waste, such as grass clippings, leaves and small twigs can be used as mulch in moderation. The back side of the shrub border or natural area is an ideal place to dispose of small pruning clippings. Ideally, these materials should be shredded or composted before applying; however, small amounts can be applied to existing mulch. Non-shredded leaves and grass clippings can form a thick mat that makes water penetration nearly impossible.

Organic material that has been stockpiled (in large piles) often goes through anaerobic (low oxygen, high moisture) decomposition and becomes acidic, with a pH of approximately 3. This can present a toxicity problem for the plants unless adequate liming material is provided. Properly composted organic material should have a pH of between 6.0 and 7.2. Anaerobic decomposition is often a problem with uncomposted materials such as leaves, grass clippings, wood chips or sawdust due to its toxic byproducts including methane and alcohol production. A good way of determining if the mulch underwent anaerobic decomposition is the strong smell of vinegar, ammonia or sulfur emanating from the mulch when turned. Damage usually occurs within 24 hours after application of the mulch and will manifest as marginal leaf chlorosis, leaf scorch, defoliation and/or plant death. Materials such as shredded newspaper, sawdust and yard waste may contain chemical contaminants that can harm plant growth.

Inorganic Mulch Materials

Though organic mulch provides good soil water benefits, geotextiles and landscape fabrics can be used to provide similar results. These materials are especially useful on areas with significant slopes and are used extensively on newly constructed road rights-of-way and other recent grading projects. They allow for normal water and oxygen exchange and prevent the growth of most weeds, while allowing desired grasses to grow through. The material should be applied on bare soil before or immediately after planting and held tightly in place by biodegradable staples or other similar devices. Good growth results have been shown when using a combination of landscape fabric covered with an organic material. However, a thin layer of soil can

develop atop the fabric, since these materials provide a semi-permeable covering. This thin layer of soil can be a haven for weeds, which can use the water before it is transmitted past the fabric and into the soil. In this situation, using a coarse-textured mulch, such as pine bark nuggets, will delay the development of this layer.

For comments or questions regarding the Regionally Appropriate Landscaping BMP, please contact the water efficiency specialist of the Water Supply Planning Branch at 919-707-9005.

References

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- NCSU, 2012c. http://cals.ncsu.edu/hort_sci/extension/HorticulturePublicationsTurfandGroundsCare.php.
- Dr. Charles Peacock, NCSU Turf Management Department and Dr. Anthony Lebude, NCSU Horticulture Department, Personal Communication.

Appendices

Appendix 1. Example of a NCDA&CS soil analysis report.

NCDA&CS Agronomic Division Phone: (919)733-2655 Web site: www.ncagr.gov/agronomi/														Report No: 09536								
														Grower: _____ Copies To: _____								
<h1>Soil Test Report</h1>																						
SERVING N.C. RESIDENTS FOR OVER 60 YEARS																						
Received: 10/10/2011				Completed: 10/18/2011				Links to Helpful Information				Wake County										
Agronomist Comments _____																						
Field Information		Applied Lime			Recommendations																	
Sample No.	Last Crop	Mo	Yr	T/A	Crop or Year	Lime	N	P ₂ O ₅	K ₂ O	Mg	S	Cu	Zn	B	Mn	See Note						
FRONT					1st Crop: Lawn	0	(1.0 lbs Nitrogen or EQUIV PER 1000 SQ FT)			0							↓					
					2nd Crop: Lawn	0	(1.0 lbs Nitrogen or EQUIV PER 1000 SQ FT)			0							↓					
Test Results																						
Soil Class	HMP%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	Mn-I	Mn-Al(1)	Mn-Al(2)	Zn-I	Zn-Al	Cu-I	S-I	SS-I	NO ₃ -N	NH ₄ -N	Na	
MIN	0.66	0.93	10.2	84.0	1.6	5.9	166	106	56.0	23.0	151			132	132	45	30					0.1
Field Information		Applied Lime			Recommendations																	
Sample No.	Last Crop	Mo	Yr	T/A	Crop or Year	Lime	N	P ₂ O ₅	K ₂ O	Mg	S	Cu	Zn	B	Mn	See Note						
BACK					1st Crop: Lawn	30M	(1.0 lbs Nitrogen or EQUIV PER 1000 SQ FT)			0							↓					
					2nd Crop: Lawn	0	(1.0 lbs Nitrogen or EQUIV PER 1000 SQ FT)			0							↓					
Test Results																						
Soil Class	HMP%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	Mn-I	Mn-Al(1)	Mn-Al(2)	Zn-I	Zn-Al	Cu-I	S-I	SS-I	NO ₃ -N	NH ₄ -N	Na	
MIN	0.27	0.93	8.8	83.0	1.5	5.6	124	92	54.0	24.0	130			267	267	63	60					0.1
Field Information		Applied Lime			Recommendations																	
Sample No.	Last Crop	Mo	Yr	T/A	Crop or Year	Lime	N	P ₂ O ₅	K ₂ O	Mg	S	Cu	Zn	B	Mn	See Note						
HOSTA					1st Crop: Garden, Flower	0	(7.0 lbs 15-0-14 or EQUIV PER 1000 SQ FT)			0							↓					
					2nd Crop: Garden, Flower	0	(7.0 lbs 15-0-14 or EQUIV PER 1000 SQ FT)			0							↓					
Test Results																						
Soil Class	HMP%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	Mn-I	Mn-Al(1)	Mn-Al(2)	Zn-I	Zn-Al	Cu-I	S-I	SS-I	NO ₃ -N	NH ₄ -N	Na	
MIN	0.60	1.01	9.4	85.0	1.4	5.9	86	48	66.0	16.0	192			175	175	83	26					0.1

Appendix 2. Explanation of Soil Test Results.

