

# PLANTING GUIDE FOR GREEN INFRASTRUCTURE IN WESTERN NORTH CAROLINA



## PINEBRIDGE LIVING LEARNING CAMPUS AT THE THREE PEAKS ENRICHMENT CENTER



# GREEN INFRASTRUCTURE FOR RESILIENT LANDSCAPES & COMMUNITIES

## WHAT IS GREEN INFRASTRUCTURE?

Green infrastructure uses plants, soils, and nature itself to manage stormwater and create healthier urban environments. It is designed to capture stormwater close to where it lands to be used by plants, soaked into the ground, evaporated, or recycled for irrigation or other uses. Green infrastructure improves water quality by slowing down and filtering polluted runoff before it reaches waterways and helps to recharge groundwater and increases flow to streams, rivers, lakes, and reservoirs. Cooler-temperature runoff and shading provided by trees benefit aquatic plants and animals. Green infrastructure can be successful in a variety of settings including cold or arid climates, ultra-urban areas, in soils with slower infiltration rates, and in areas with intense rainstorms.

Green infrastructure is an adaptable and multifunctional approach to stormwater management and climate resiliency with many benefits for communities:

- Improves water quality and conserves water by reducing polluted, high velocity runoff entering waterways and by recycling and using captured rainwater.
- Strengthens the local economy by creating green jobs, reducing water treatment costs, increasing property value with green urban spaces, and reducing property damage from flooding.
- Enhances community and infrastructure resiliency by reducing local flooding and protecting floodplains, recharging groundwater supply, and reduces energy consumption needs.

Urban stormwater continues to be a persistent and growing source of water pollution across the United States. Climate change is leading to more intense weather events and dwindling water supplies.

Communities are feeling the effects of climate change now through flooding, drought, heat waves, and coastal erosion. Together these conditions are stressing the performance of the nation's water infrastructure and challenging all of us to consider new, integrated ways to manage our water resources (EPA).



# TYPES OF TREATMENT USED ON THE SITE:

1



<https://www.landtech.com/home/bioretention-post-construction-stormwater-management>

## STORMWATER TREATMENT

Stormwater is the result of precipitation and irrigation that flows overland into bodies of water. As water moves across impervious surfaces such as streets, parking lots, and driveways it pick up loose sediment, trash, oils, chemicals, fertilizers, and other pollutants which diminish water quality in rivers and oceans.

Stormwater treatment consists of structural, vegetative, or management practices used to protect and improve our surface and groundwater by treating, slowing and reducing runoff. This site uses a bioretention area, water quality swale, and extended detention basin to treat the stormwater on site.

2



Cistern with art at Maplewood Mall

## RAINWATER HARVESTING

Rainwater harvesting helps reduce stormwater runoff by collecting and storing water that runs off impervious areas, such as roofs. Rainwater that is captured can be used for irrigation purposes, and other activities where non-potable water can be used.

Cisterns are a method of capturing rainwater for future use. The cistern at Pinebridge was designed to capture water from the western half of the roof that will be re-used on site to offset and supplement cooling costs of the building.

3



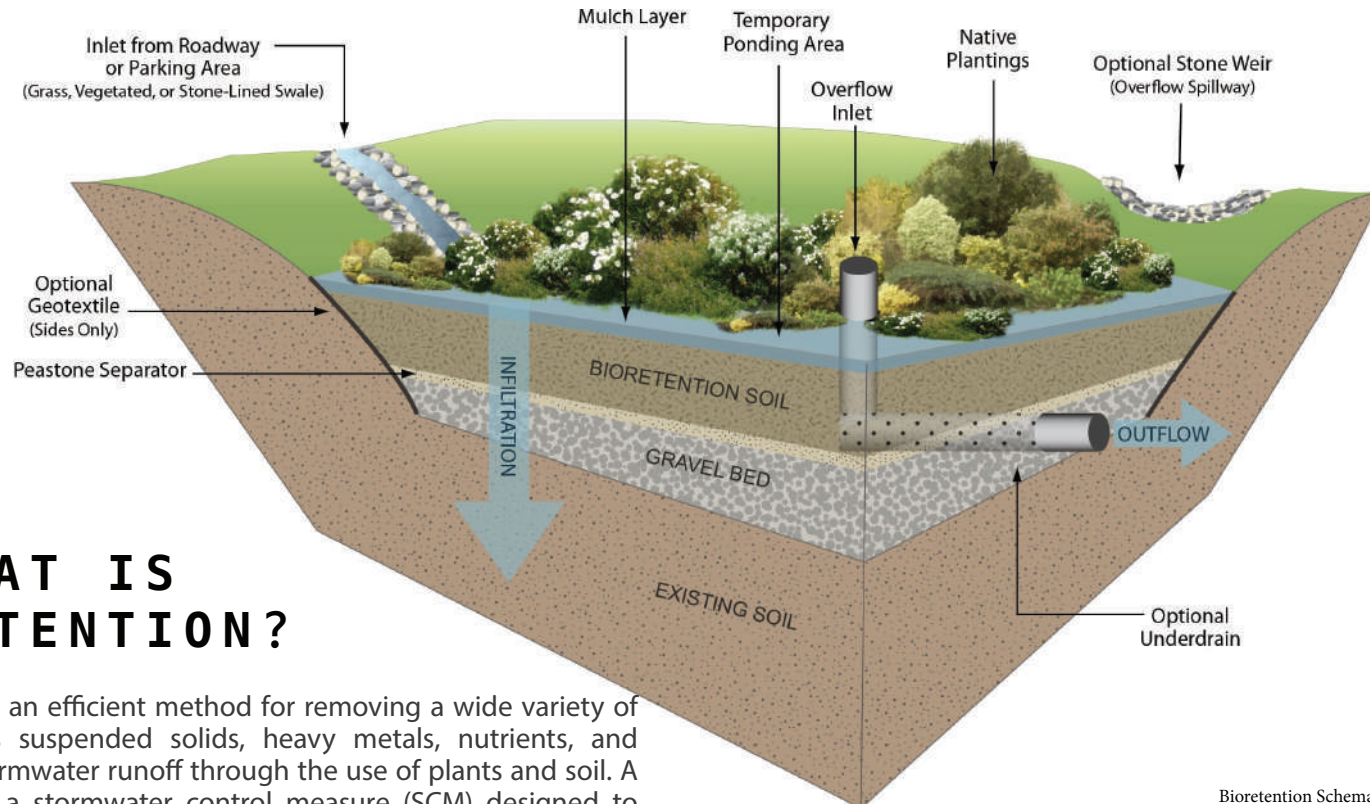
<https://hempingtonpost.com/phytoremediation-natures-peaceful-solution-to-industrial-pollution/>

## SOIL REMEDIATION

Soils in urban settings experience elevated metal concentrations, absence of top soil, erosion, drought, compaction, and a shortage of essential nutrients. While there are various methods of remediation contaminated soils, few are as effective, economical, and less environmentally disruptive as phytoremediation. Phytoremediation can be understood as the use of plants and their associated microorganisms in order to remove, degrade or isolate toxic substances from the environment.

The concept of phytotechnology, which includes vegetation for pollution remediation and prevention systems, serves as the basis for the planting list and design for Pinebridge.

# 1. STORMWATER TREATMENT - BIORETENTION



Bioretention Schematic  
<https://www.landtech.com/home/bioretention-post-construction-stormwater-management>

## WHAT IS BIORETENTION?

BIORETENTION is an efficient method for removing a wide variety of pollutants, such as suspended solids, heavy metals, nutrients, and pathogens from stormwater runoff through the use of plants and soil. A bioretention cell is a stormwater control measure (SCM) designed to capture the first flush of runoff from impermeable surfaces that contain a large portion of pollutants. It infiltrates and evaporates stormwater runoff to clean and improve water quality before the runoff enters the storm drain system.

Bioretention cells are engineered rain gardens designed to meet the hydrological conditions of the site allowing ponded water and an overflow outlet that controls the water levels and prevents flooding. They consist of a depression in the ground filled with a soil media mixture that supports various water-tolerant vegetation and allows for the filtration of runoff. Bioretention cells are typically planted with native plants that help slow the water and remove pollutants and provide landscaping and habitat enhancement. Bioretention cells are best located close to the source to minimize transport of runoff and pollutants and create a more hydrologically effective site.

### PLANT DESIGN FOR BIORETENTION

A diverse plant community is necessary to avoid susceptibility to insects and disease. A recommended minimum planting density is 400 stems/acre. Bacteria die-off occurs at the surface where stormwater is exposed to sunlight and the soil can dry out. Therefore it is best for bioretention cells to not be too densely vegetated in order to allow greater exposure to sunlight and consequent die-off of bacteria (NC Cooperative Extension, 2006).

The plants selected include herbaceous perennials and shrubs that were chosen to tolerate typical stormwater pollutant loads, variable (often very dry) soil moisture, temporary submergence, and extended wet conditions. Bioretention facilities in the Piedmont and mountains tend to become wetter over time.

### BIORETENTION PLANT EXAMPLES:



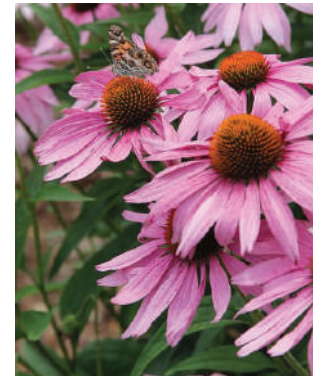
Inkberry



Northern Spicebush



Wild Bergamont

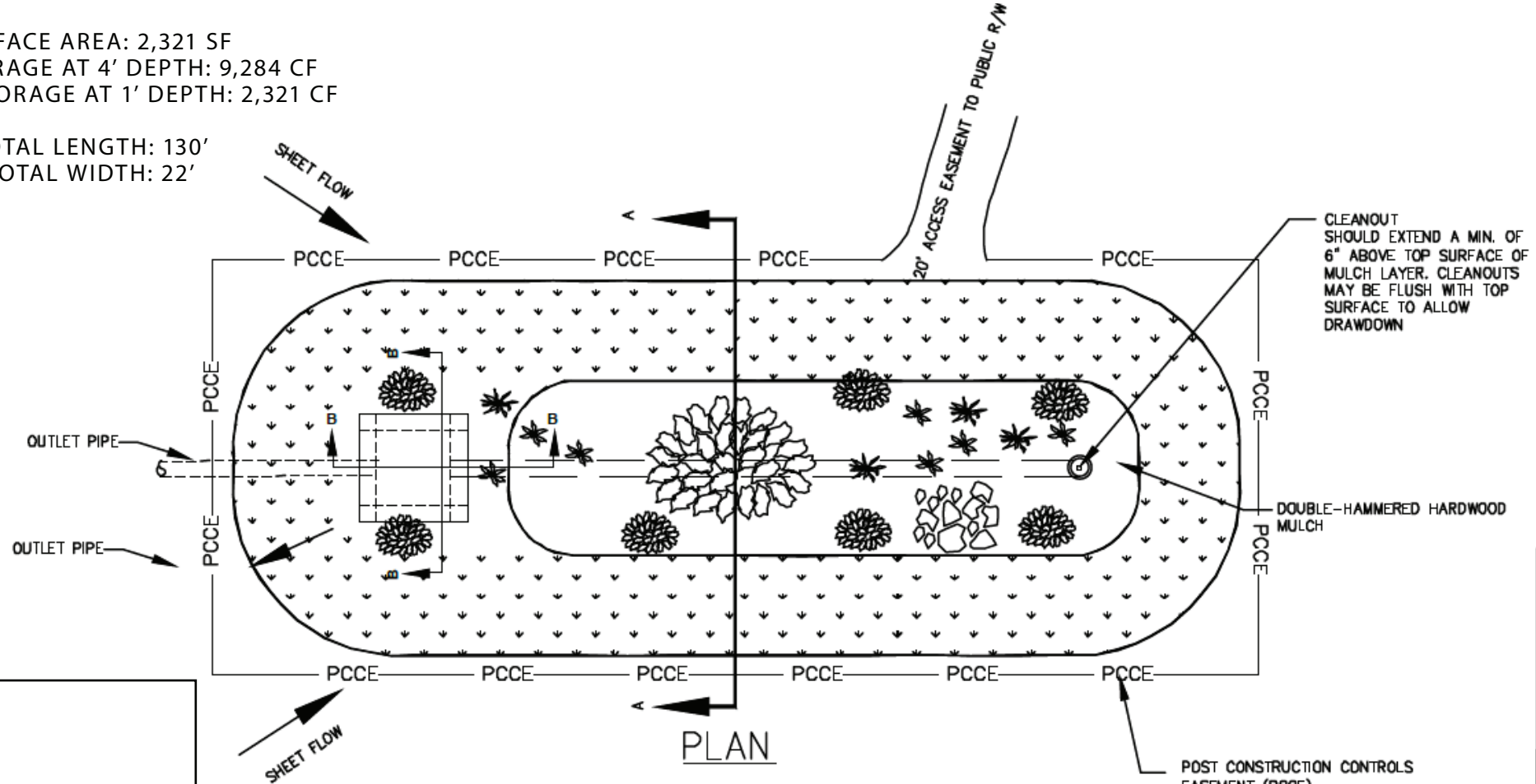


Purple Coneflower

# BIORETENTION - SITE PLAN AND PROFILE

SURFACE AREA: 2,321 SF  
TOTAL STORAGE AT 4' DEPTH: 9,284 CF  
INTERNAL STORAGE AT 1' DEPTH: 2,321 CF

TOTAL LENGTH: 130'  
TOTAL WIDTH: 22'

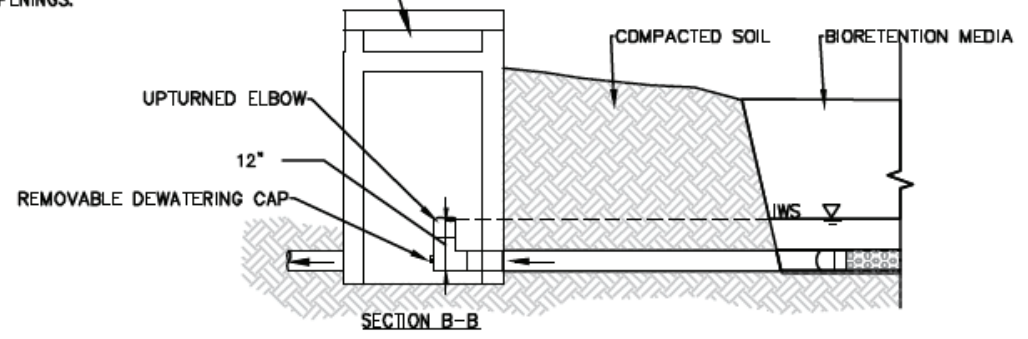


CLEANOUT SHOULD EXTEND A MIN. OF 6" ABOVE TOP SURFACE OF MULCH LAYER. CLEANOUTS MAY BE FLUSH WITH TOP SURFACE TO ALLOW DRAWDOWN

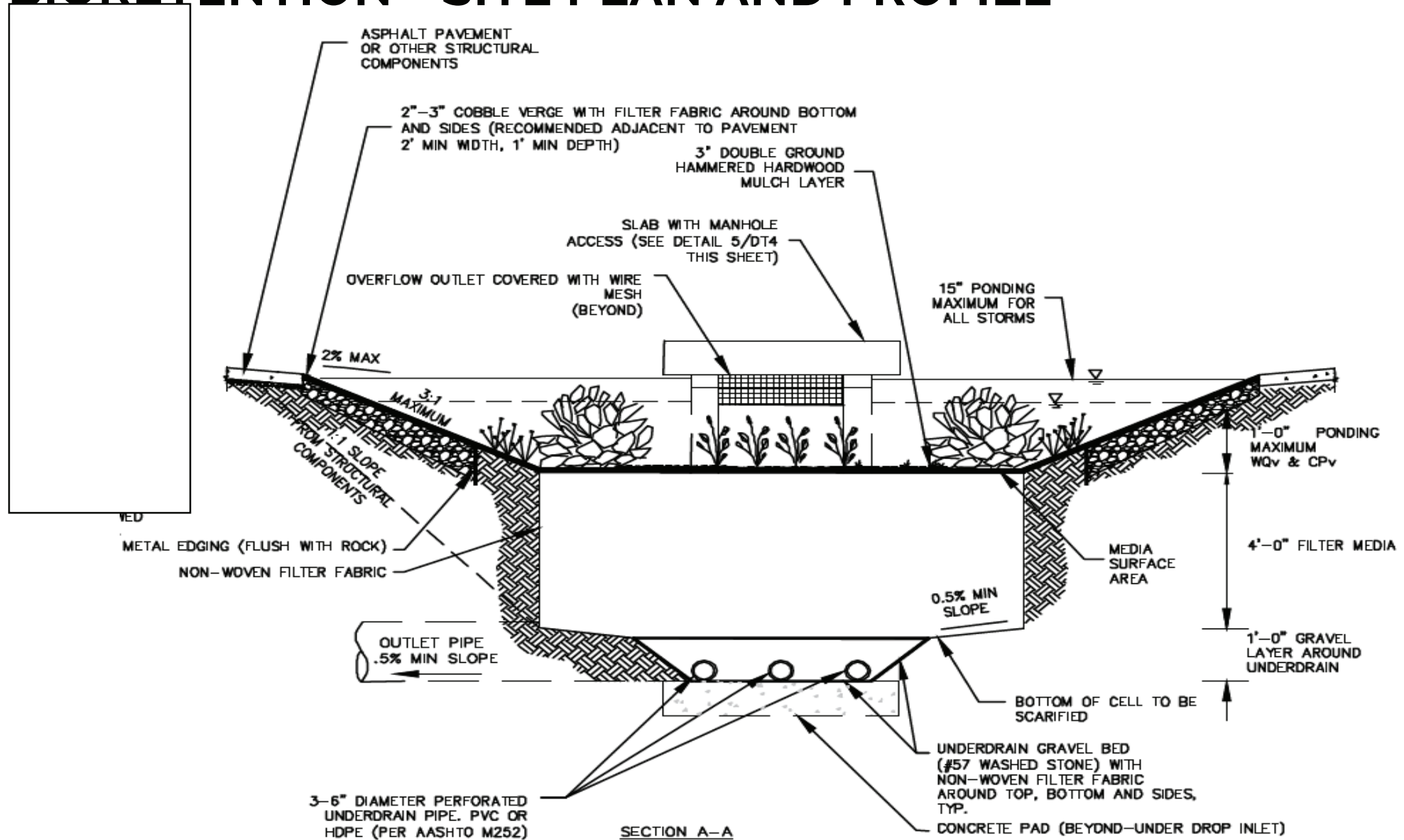
DOUBLE-HAMMERED HARDWOOD MULCH

POST CONSTRUCTION CONTROLS EASEMENT (PCCE) 10' OFFSET FROM SLOPE BREAK

WIRE SCREENING AROUND ALL OUTLET OPENINGS.



# BIORETENTION - SITE PLAN AND PROFILE



# 1. STORMWATER TREATMENT - WATER QUALITY SWALE

**WATER QUALITY SWALES**, vegetative swales, or bioswales are linear drainage features that have gently sloped sides and bottoms. They are planted with grasses which help slow the water and remove pollutants. Stormwater runoff is filtered and cleaned by grasses as it travels through the bioswale. They allow the stormwater to infiltrate the ground as the flows are slowed. The stormwater is filtered through the swale on the site before entering the drain, which will reduce sediments and other pollutants from entering the North Toe River.



Swale on Yale, Seattle

**WATER QUALITY SWALE PLANT EXAMPLES:**

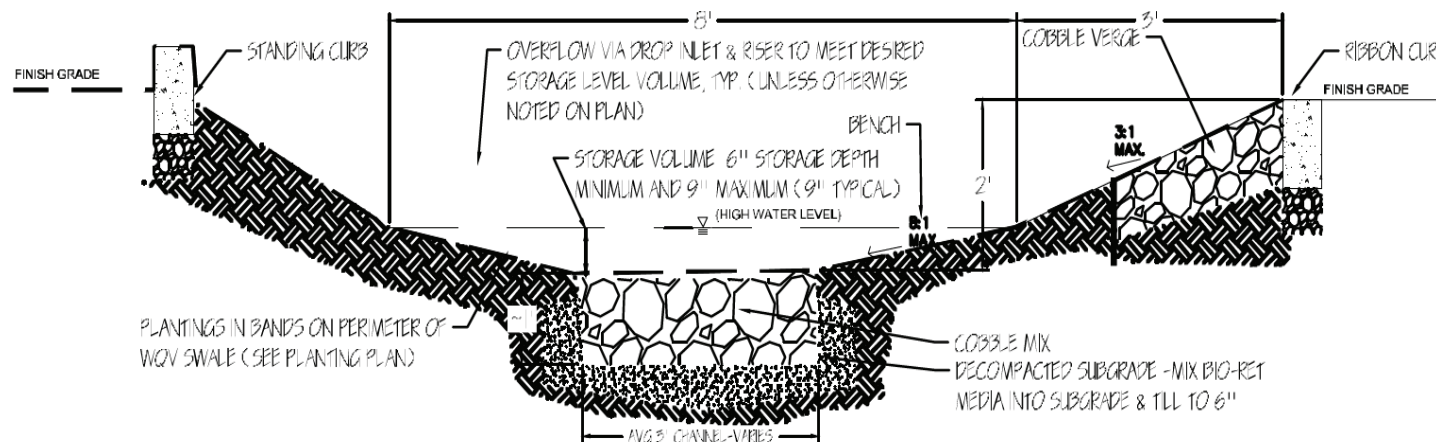


Fox Sedge



Blue Flag Iris

**WATER QUALITY SWALE SECTION:**



**WATER QUALITY** is commonly defined by its physical, chemical, biological and aesthetic (appearance and smell) characteristics. A healthy environment is one in which the water quality supports a rich and varied community of organisms and protects public health.

Water quality in a body of water influences the way in which communities use the water for activities such as drinking, swimming or commercial purposes. Water is essential to human life and to the health of the environment. As a valuable natural resource, it comprises marine, estuarine, freshwater (river and lakes) and groundwater environments.

# 1. STORMWATER TREATMENT - EXTENDED DETENTION BASIN

EXTENDED DETENTION BASINS are constructed facility that provide temporary storage of stormwater runoff and attenuation for both stormwater quality and quantity management. They are designed for complete evacuation of runoff and normally remain dry between storm events.

They improve water quality by removing suspended solids and metals, as well as trashing bacteria, oil, and grease. The extended detention basins' primary function is to reduce "peak attenuation", or to hold back the large flushes of stormwater, and release it at a slow rate.

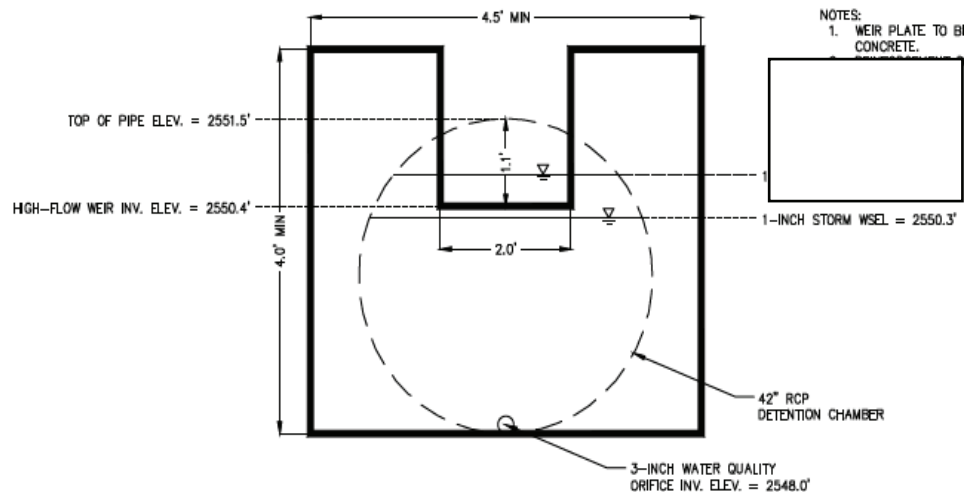
Their use on the site addresses both the stomwater runoff quality and quantity impacts of land development. This helps the reduce the velocities of water flowing from the site, protecting the North Toe River's banks from erosion.

PINEBRIDGE'S EXTENDED DETENTION BASIN, or detention chamber, was designed to collect and store runoff from the eastern half of the roof, an area consisting of 0.57-acres, the eastern emergency access lane (0.19-acres), and the northern plaza (0.50-acres). Water from the roof flows into a 15" roof drain and is carried to the detention chamber and weir plate through 80 feet of 42" Reinforced Concrete Pipe. The weir plate controls the stormwater flow into the outlet structure.

The detention system enhances water quality by providing a dewatering time of approximately 16-hours for the one (1)-inch storm event and approximately 24-hours for the 10-year storm event.

For maintenance, if the basin is holding water for an extended period of time, check the draw down orifice in the weir plate to see if it is free of debris.

DETENTION CHAMBER WEIR PLATE DETAIL:





## 2. RAINWATER HARVESTING - CISTERN

CISTERNS are commonly used structures for rainwater collection systems. They work by collecting the runoff from a structure or other impervious surface, such as a roof, in order to store it for later use.

Using harvested rainwater for purposes that don't require treated drinking water reduces the demand on municipal water supplies and increases the sustainability of drinking water supplies. A rainwater harvesting system can be used to wash cars or water gardens. Also, because a rainwater harvesting system reduces potable water bills, the system can pay for itself over time.

Rainwater harvesting systems also improve the environment by capturing nutrients and other pollutants from rooftop runoff, preventing them from contaminating surface waters. Moreover, the nutrients in rooftop runoff, such as nitrogen and phosphorus, can help plants grow when the captured water is used for irrigation.

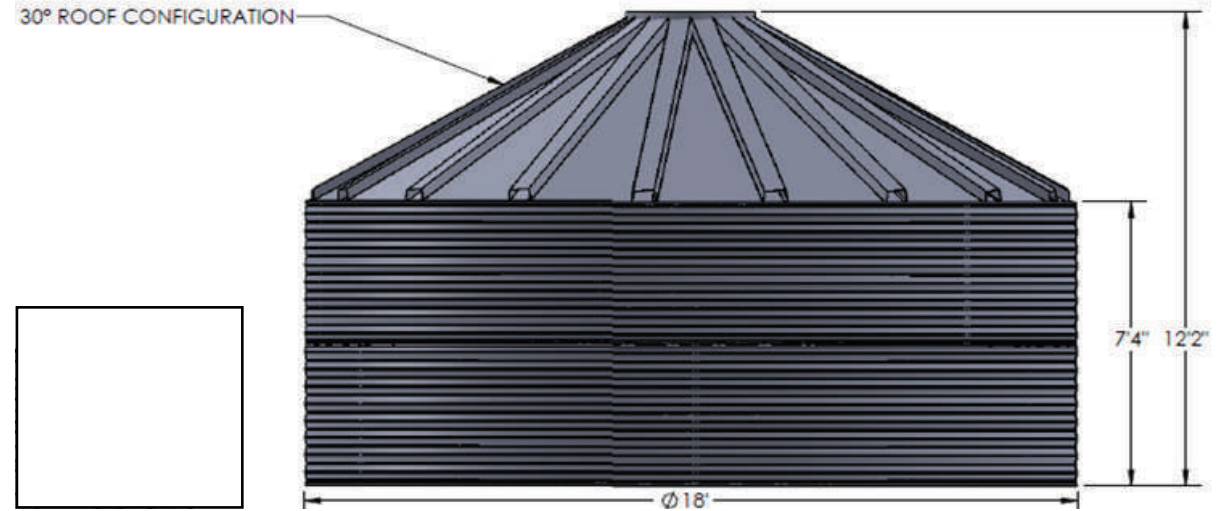
A rainwater harvesting system consists of four main components:

- The cistern stores runoff for later use.
- The gutter system collects runoff from the rooftop and directs it into the cistern.
- The overflow pipe allows excess runoff to leave the cistern in a controlled manner.
- The outlet pipe, which is connected to a pump, draws water from the bottom of the cistern for use.

### CALCULATION FOR RAINFALL COLLECTION

$$1'' \text{ of rain} \times 1 \text{ sq. ft.} = 0.623 \text{ gallons}$$

### CISTERN DESIGN:



PINEBRIDGE'S CISTERN was designed to collect and store runoff from the western half of the roof, an area consisting of 0.57-acres. This cistern aids in rooftop runoff management by working to detain and utilize the water runoff originating from roofs for the cooling system for the facility.

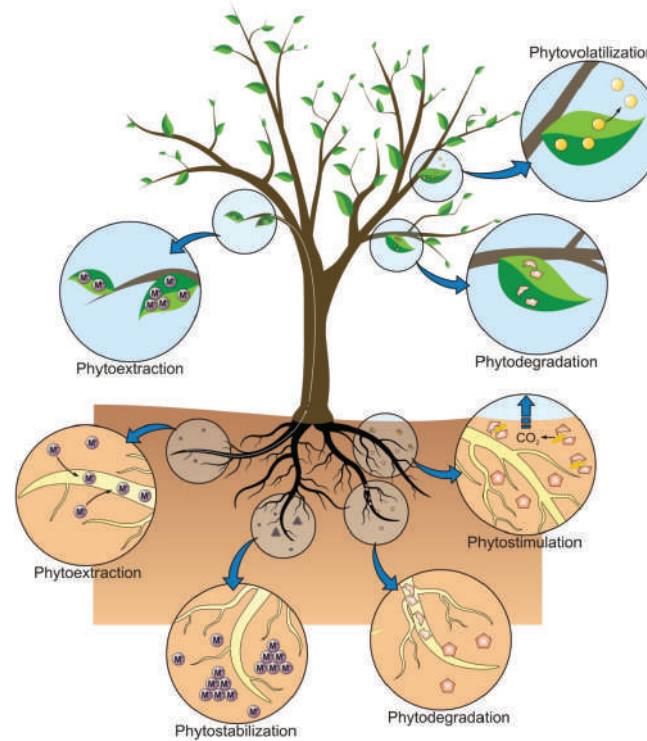
The cistern at Three Peaks was designed to capture an appropriate volume of water to be re-used onsite on a regular basis. Cistern pumps are included to increase water pressure to the mechanical system. The pumps were designed to accommodate the necessary pressure and flow for the system.

# 3. SOIL REMEDIATION - PHYTOREMEDIATION

PHYTOREMEDIATION relies on plant and soil interactions to clean, contain, or prevent contaminants and nutrients from entering water bodies. The concept of phytotechnology which includes vegetation for pollution remediation and prevention systems also serves as the basis for the planting list as well as the planting design.

The sugars from photosynthesis, oxygen and other root exudates released around the root zone (organic acids, amino acids and enzymes, etc.) both can help to transform contaminants contained in stormwater runoff but also attract microorganism to live there (Lugthenberg and Dekkers, 1999). The presence of these root exudates causes the soil to be populated with 100 to 1000 times more living organisms around plant root zones than the soil alone (Reynolds et al., 1999). The microbes create a protective barrier around the root zone and play a large part in breaking down potentially harmful substances (Kennen and Kirkwood, 2015).

Phytotechnology is very applicable to Pinebridge because these systems rely on the plant and soil interactions to clean, contain or prevent contaminants and nutrients from entering water bodies. Different plant species addressing specific pollutants have been implemented for the site.



<https://www.intechopen.com/books/environmental-risk-assessment-of-soil-contamination/phytoremediation-of-soils-contaminated-with-metals-and-metalloids-at-mining-areas-potential-of-nativ>

Phytoremediation comprise five different strategies:

1. **Phytodegradation:** organic contaminants are degraded (metabolized) or mineralized inside plant cells by specific enzymes.
2. **Phytostabilization:** contaminants are incorporated into the lignin of the cell wall of roots cells or into humus. Metals are precipitated as insoluble forms by direct action of root exudates and subsequently trapped in the soil matrix.
3. **Phytovolatilization:** relies on the ability of some plants to absorb and volatilize certain metals/metalloids. It is the conversion of metals/metalloids to less toxic and volatile forms.
4. **Phytoextraction:** involves the absorption of contaminants by roots followed by translocation and accumulation in the aerial parts. It is mainly applied to metals.
5. **Phytostimulation:** Degradation of organic pollutants through plant root exudates.

## MAJOR POLLUTANTS AND THEIR SOURCES:

Heavy Metals: Lead, copper, zinc,

Sources: Cars, trucks, industrial processes

Total Suspended Solids: Sediment, # 1 water pollution problem in NC

Hydrocarbons: Oil, gas, grease

Sources: Cars/trucks

## PHYTOREMEDIATION PLANT EXAMPLES:



Swamp Sunflower



Bushy Bluestem

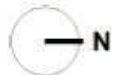
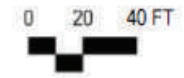


Switch Grass



Indian Steel Grass

# PINEBRIDGE SITE PLAN



# PINEBRIDGE PLANTING GUIDE KEY COMPONENTS

## PLANT STRUCTURE

Plants and root growth underground are key to proper infiltration and promotion of microbial activity the breakdown pollutants. Planting plans for the bioretention cells have focused on creating a layered system of roots that provide a variety of growth patterns from shallow and spreading to deep and spreading including plants with a fibrous and stoloniferous root system.

Just like a functioning forest with a ground layer, shrub layer, under story layer and canopy layer; the goal was to create this layering underground within the bioretention cells. This planting concept has utilized mountain plants based on plant communities that can provide this hierarchy and variety in root growth and can serve as a model for planting in the mountain regions.

“The fundamental basis for encouraging use of native plant species for stormwater facilities lies in the fact that native plants have extensive root systems which improve the ability of the soil to infiltrate water and withstand wet or erosive conditions” (Conservation Research Institute). The plan combines native plant communities and horticultural practices to create “designed plant communities” for bioretention areas.

## PLANT FUNCTION

This plan incorporates known plants for phytotechnologies, specifically those that are beneficial for removal of petroleum based products since runoff from the Mayland parking lot will be carrying hydrocarbons (grease and oil).

There is a focus on herbaceous plant species to occupy a depth of 2' in the ground layer (most herbaceous plants have a maximum root depth of 2'). Tree species with a taproot of 10' are also used in the under story and canopy layer. Soil pollutants within 10' of the soil surface is about the maximum depth where phytotechnologies are considered and soil contamination within the top 3 feet is the most effective zone for phytotechnologies (Kennen and Kirkwood, 2015).

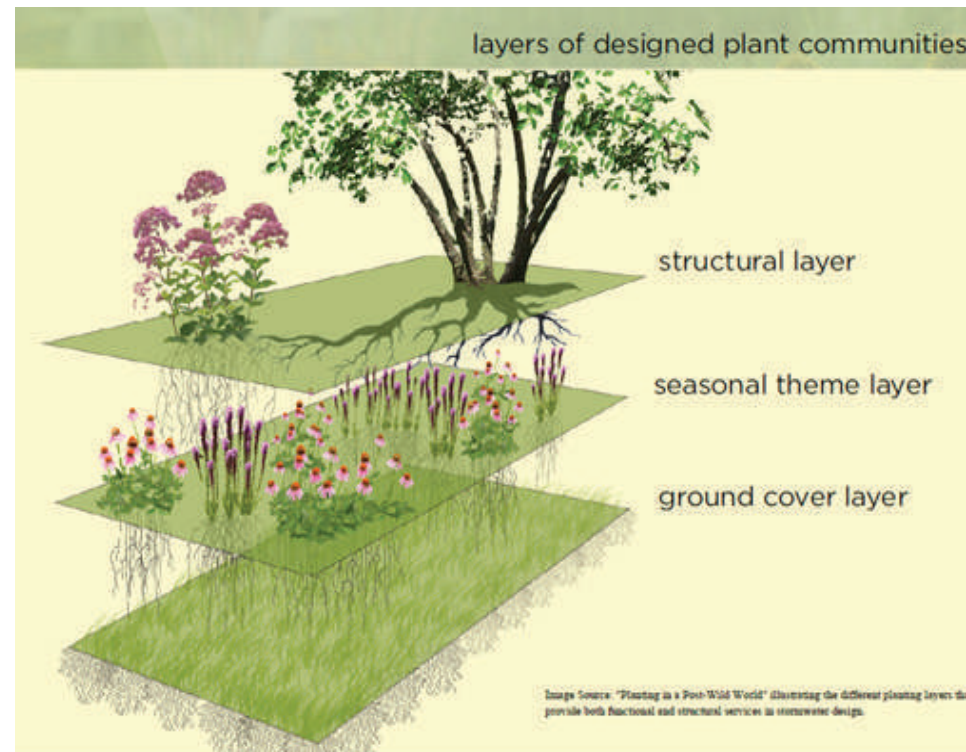


Image from Planting in a Post Wild World by Thomas Rainer and Claudia West

## PLANT DENSITY

The site was created with the appropriate density in mind. Many plantings for bioretention areas consist of a few shrubs and large areas of mulch. Other plantings feature accent plants and do not provide coverage or structure for other plants to grow or provide ground cover. The more plants and associated roots, the more pores and spaces provided for infiltration. The planting plans developed serve as a template for recommended plant density.

## SOILS

Recent research shows that the more expensive engineered soil products such as Stalite (expanded slate) do not support the growth of plant materials as well as sand, gravel and soil mixes (Smiley, S. Thomas). According to Hunt et. al. (2009) the best mix for bioretention cells is 85-88% sand, 8-12 % fines, and 3-5% organic matter. This most current soil recommendations was applied to all of the bioretention cells that are installed on the Mayland Community College Site.

# PINEBRIDGE PLANTING GUIDE

## TREES

Common Serviceberry; *Amelanchier arborea*

Fringetree; *Chionanthus Virginicus*

Tulip poplar; *Liriodendron tulipifera*

## SHRUBS

Eastern Red Cedar, Juniper 'grey owl';  
*Juniperus virginiana*

Inkberry; *Ilex glabra*

Northern Spicebush; *Lindera benzoin*  
'pubescens'

Virginia Sweetspire; *Itea virginica*

Winterberry; *Ilex verticillata*

## PERENNIALS

Aromatic Aster; *Aster oblongifolius*  
'October Skies'

Bergamot; *Monarda fistulosa*

Black Eyed Susan; *Rudbeckia fulgida* var.  
*sullivantii* 'Little Gold Star'

Blue Flag Iris; *Iris versicolor*

Bushy Bluestem; *Andropogon glomeratus*

Fox Sedge; *Carex vulpinoidea*

Indian Steel; *Sorghastrum nutans*

Little Bluestem; *Schizachyrium scoparium*  
'Blue Paradise'

Purple Coneflower; *Echinacea purpurea*  
'Kim's Knee High'

River Oats; *Chasmanthium latifolium*

## PERENNIALS

Soft Rush; *Juncus effusus*

Swamp Sunflower; *Helianthus angustifolius*

Switchgrass; *Panicum Virgatum*

## ANNUALS

Ornamental Kale; *Brassica oleracea*  
*acephala*

Sunflower; *Helianthus annuus*

# PINEBRIDGE PLANTING GUIDE

## Common Serviceberry / *Amelanchier arborea*

### MATURE SIZE

This deciduous, early-flowering, large shrub or small tree which typically grows 15-25' tall in cultivation but can reach 40' in the wild.

### DESCRIPTION

This slow-growing small tree contains drooping clusters of white flowers that bloom in early spring. The short-lived flowers are produced in clusters from woolly buds and each has five petals and many stamens. The medium green leaves turn yellow- orange to red early in the fall. The small red fruits ripen in June.

### ZONE

This species thrives in wet sites and is tolerant of pollution. It prefers moist, well-drained, acidic soil in full sun to partial shade. Grows well in the mountains, Piedmont, and inner coastal plain regions. It is hardy to zone 4.

### ROOT SYSTEM

The trees have an extensive, rhizomatous root system and can be planted on banks for erosion control.

### SITE SPECIFICS

This tree is located on the South side of the site in a Phytoremediation area.



<https://wimastergardener.org/article/serviceberry-amelanchier-spp/>



<https://plants.ces.ncsu.edu/plants/amelanchier-arborea/>

# PINEBRIDGE PLANTING GUIDE

## Fringetree / *Chionanthus virginicus*

### MATURE SIZE

This deciduous, flowering tree can grow up to 30 feet tall, but is typically smaller through most of its range.

### DESCRIPTION

The leaves are opposite with a smooth margin. The bark is scaly with dark brown ridges and red furrows. In late spring, fragrant, white flowers mature hanging from 4- to 8-inch stalks. The small tree produces a 3/4-inch, dark blue drupe that matures in late summer.

### ZONE

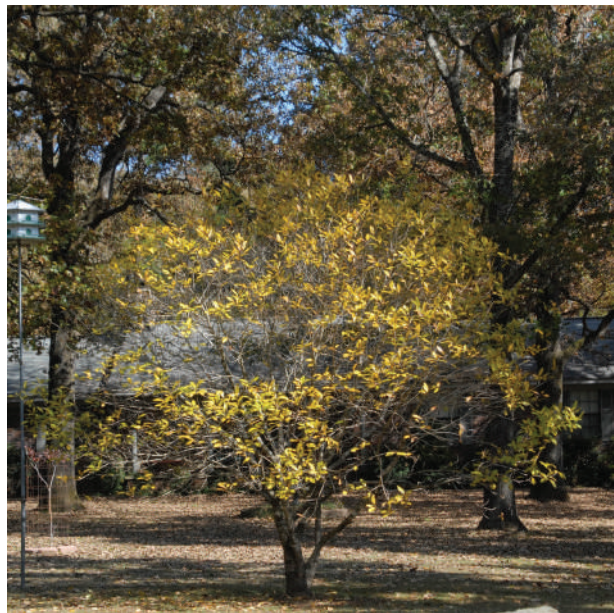
Easily grown in average, medium, well-drained soil in full sun to part shade. Prefers moist, fertile soils. Seldom needs pruning. Tolerant of air pollution and adapts well to urban settings. Intolerant of prolonged dry conditions. It is in zone 3 to 9.

### ROOT SYSTEM

The root system is woody, relatively shallow, and branching.

### SITE SPECIFICS

This tree can be found on the South side of the site in Phytoremediation areas.



<https://plants.ces.ncsu.edu/plants/chionanthus-virginicus/>

# PINEBRIDGE PLANTING GUIDE

## Tulip Poplar / *Liriodendron tulipifera*

### MATURE SIZE

A large, stately, deciduous tree of eastern North America that typically grows 70-90' (less frequently to 150') tall with a pyramidal to broad conical habit, and can spread from 35' to 50'.

### DESCRIPTION

The leaves are opposite with a smooth margin. The bark is scaly with dark brown ridges and red furrows. In late spring, fragrant, white flowers mature hanging from 4- to 8-inch stalks. The small tree produces a 3/4-inch, dark blue drupe that matures in late summer.

### ZONE

This tree prefers moist, well-drained soil, full sun, and slightly acidic soil (even though it is pH adaptable). To plant, it needs a large area. Grows in zones 4 to 9.

### ROOT SYSTEM

The root system is woody, relatively shallow, and branching.

### SITE SPECIFICS

This tree can be found on the South side of the site in Phytoremediation area.



<https://plants.ces.ncsu.edu/plants/liriodendron-tulipifera/>



# PINEBRIDGE PLANTING GUIDE

## Eastern Red Cedar, Juniper 'grey owl' / *Juniperus virginiana*

### MATURE SIZE

This small, dense, evergreen conifer with horizontal branching typically grows to 10-40' tall with a diameter of 1-2'.

### DESCRIPTION

Fruits pale-blue with whitish bloom, fleshy 'berries' (cones), 1/4 inch diameter, ripening the first season. Dark green leaves opposite, scalelike, covering older twigs closely in alternating pairs. Stem single with upright or spreading branches, bark reddishbrown, thin and shreddy, branchlets very slender.

### ZONE

The Eastern red cedar is easily grown in average, dry to moist, well-drained soils in full sun. It will tolerate a wide range of soils and growing conditions, from swamps to dry rocky glades. It can even grow on seemingly barren soils that few other plants can tolerate. It only tolerates the shade when it is extremely young. It has the best drought resistance of any conifer native to the eastern U.S. It grows throughout NC but is most common in the Piedmont. Grows in zones 2 to 9.

### ROOT SYSTEM

The root system is roots deep, widely spreading.

### SITE SPECIFICS

This conifer can be found on the Southwest side of the site.



<https://plants.ces.ncsu.edu/plants/juniperus-virginiana/>



# PINEBRIDGE PLANTING GUIDE

## Inkberry / *Ilex glabra* 'Shamrock'

### MATURE SIZE

This is a slow-growing, upright-rounded, stoloniferous, broadleaf evergreen shrub in the holly family. It typically matures to 5-10' tall, and can spread by root suckers to form colonies.

### DESCRIPTION

Fruits pale-blue with whitish bloom, fleshy 'berries' (cones), 1/4 inch diameter, ripening the first season. Leaves are alternate, simple, entire or finely toothed toward the tip, oblong, evergreen, leathery. Flowers are greenish-white and inconspicuous. Fruit is nearly black, shiny. The common name is in reference to the dark blue-black fruits. Inkberry can be used for erosion control, watershed protection, and phosphate mine reclamation.

### ZONE

Inkberry is shade tolerant and grows in both sunny and shaded habitats, on dry to wet sites, and on sandy to heavier peaty soils. It is fairly tolerant to droughts and extreme temperatures and very adaptable to poor soils. It is hardy in zones 4 to 9.

### ROOT SYSTEM

It has a rhizomatous root system and, if desired, can be left to form colonies and thickets.

### SITE SPECIFICS

This conifer can be found on the South side of the site in the bioretention cell.



<https://plants.ces.ncsu.edu/plants/ilex-glabra/>

# PINEBRIDGE PLANTING GUIDE

## Northern Spicebush / *Lindera benzoin* 'pubescens'

### MATURE SIZE

Spicebush is a slow-growing deciduous shrub that matures to 6- 8'.

### DESCRIPTION

The leaves are alternate with a smooth margin, and turn from light green to yellow in autumn. Leaves produce a spicy odor when crushed. The bark is brown to gray-brown and speckled with light colored lenticels. In early spring, small, yellow flowers mature in axillary clusters. It produces an edible, bright red drupe with a peppery taste and scent. The fruit matures in the fall. It is also known to attract pollinators.

### ZONE

Spicebush is a good choice for plantings in shady locations but can also grow in full sun. Moist soil is best, but it can also tolerate dry soils. Spicebush can be found throughout the coastal, mountains, and Piedmont areas in NC. It is hardy in zones 5 to 9.

### ROOT SYSTEM

The plant's woody roots are shallow and much branched.

### SITE SPECIFICS

This shrub can be found on the Southwest side of the site.



<https://plants.ces.ncsu.edu/plants/lindera-benzoin/>



# PINEBRIDGE PLANTING GUIDE

## Virginia Sweetspire / *Itea virginica*

### MATURE SIZE

Deciduous, sprawling shrub that matures to 6- 8' tall.

### DESCRIPTION

The leaves are alternate finely-toothed, glabrous, and elliptical. The branches are often green above and burgundy on the undersides. Bark is smooth and gray in young trees and turns brown and develops splits as the tree ages. In early summer, clusters of small, white 5-petaled flowers appear at the end of its branches. The shrub produces a woody capsule that matures in late summer. It has beautiful fall color. It is also known to attract pollinators.

### ZONE

It is most commonly found in wetlands, low woods, swamps, along streams throughout NC. Virginia Sweetspire prefers moist, rich, slightly acidic humusy soils in partial sun to partial shade, but tolerates a wide range of soil conditions (like neutral or alkaline soils). This plant has average fertility and it tolerant of wet or dry sites. It is a drought-tolerant shrub adapted to shady, damp areas, and works well for planting in low or wet sites. It is hardy in zones 5 to 9.

### ROOT SYSTEM

The root system is woody and develops underground runners, forming clonal offsets.

### SITE SPECIFICS

This shrub can be found on the South side of the site in the phytoremediation areas surrounding the bioretention cell and water quality swale.



<https://plants.ces.ncsu.edu/plants/itea-virginica/>

# PINEBRIDGE PLANTING GUIDE

## Winterberry / *Ilex verticillata*

### MATURE SIZE

Winterberry is a deciduous tree that may grow 10 to 15' tall, but it often occurs in the wild as a shrub.

### DESCRIPTION

The leaves are alternate with a sharply toothed margin and hairy underside. The bark is thin, smooth, and gray-brown. In spring, stalked, yellow-green flowers mature in clusters. Female specimens produce red-orange drupes that mature in the fall. The common name comes from the red berries that provide winter interest and sometimes persist into early spring. Berries have a terminal black "dot" instead of a "fly".

### ZONE

It is most commonly found in swamps, alongside streams and wet woodlands, scattered across the state. Winterberry prefers moist, good drainage, and slightly acidic soils in partial sun to partial shade. This plant has average fertility and it tolerant of wet or dry sites. It is hardy in zones 3 to 9.

### ROOT SYSTEM

This shrub has a woody, shallow, lateral root system and transplants easily.

### SITE SPECIFICS

This shrub can be found on the South side of the site in a phytoremediation area around the parking area nearest to the building.



<https://plants.ces.ncsu.edu/plants/ilex-verticillata/>



# PINEBRIDGE PLANTING GUIDE

## Aromatic Aster / *Aster oblongifolius* 'October Skies'

### MATURE SIZE

Aromatic Aster is a herbaceous perennial that typically grows 1.5 to 2' tall and a spread of 1.5 to 2'.

### DESCRIPTION

Aromatic aster is a native perennial wildflower that's name comes from the balsam-like fragrance it gives off when its rigid stems are crushed. The simple, oblong, alternate leaves are .5–3 inches long. 'October Skies' is a dwarf aster that is low to the ground and mounding. It flowers in the fall when most other plants have finished for the season, covering itself with hundreds of dark sky-blue flowers. The flowers are composite of approximately 30 purple ray flowers and yellow disk flowers. The bracts are glandular with long, green, loose or spreading tips. Fruits are flat, hairy achenes. It spreads by stolons.

### ZONE

Easily grown in average, dry to medium, well-drained soil in full sun. Does well in sandy or clay soils. Aromatic aster is very adaptable as it grows in rocky and sandy soils such as those found in prairies and bluffs as well as in moist woodland habitats. Generally tolerates poor soils, erosion, shallow-rocky soils, and drought. It is hardy in zones 4 to 7.

### ROOT SYSTEM

It has a fibrous and rhizomatous root system that forms a thick woody caudex.

### SITE SPECIFICS

This perennial can be found on the South side of the site in phytoremediation areas.



<https://plants.ces.ncsu.edu/plants/symphyotrichum-oblongifolium/>

# PINEBRIDGE PLANTING GUIDE

## Black Eyed Susan / *Rudbeckia fulgida* var. *sullivantii* 'Little Gold Star'

### MATURE SIZE

This showy daisy-like perennial grows up to 3' tall.

### DESCRIPTION

Black-eyed Susans, are some of the most popular, toughest and most beautiful perennials grown today. The cultivar 'Goldsturm' is very desirable, having compact growth and prolific flowering. Black-eyed Susans bloom in summer, but if cut back after flowering, a second, much smaller bloom may occur in late fall. It has numerous flower heads, each a little less than 3 inches across. Each flower is composed of 10 to 20 yellow-orange florets surrounding a purple-brown center, hence the name.

### ZONE

Blackeyed Susans are easy to grow, thriving in any but soggy soils. It does best in full sun but tolerates partial shade. It also bears up under hot, humid summers and, once established, will tolerate drought. Found in the coastal, mountains, piedmont regions of NC. It is hardy in zones 3 to 9.

### ROOT SYSTEM

The root system is fibrous and rhizomatous. The plant spreads by underground stems called rhizomes to form large clumps.

### SITE SPECIFICS

This perennial can be found on the South side of the site in the bioretention cell.



<https://plants.ces.ncsu.edu/plants/rudbeckia-fulgida/>

# PINEBRIDGE PLANTING GUIDE

## Blue Flag Iris / *Iris versicolor*

### MATURE SIZE

Iris versicolor, blue flag iris, grows radially reaching 2' tall.

### DESCRIPTION

Blue Flag Iris forms a mass of blue lavender to white blooms from May to July. The 4-inch blooms are formed of three upright inner standards and three distinctly marked sepals or falls. They are variably colored blue to lavender and purple with yellow splotches, white markings and striking veining on the falls. The leaves are narrow and strap-like 1 inch wide and up to 24 inches long crossing at the base to be fan-like. It's specific epithet, versicolor, is derived from this plant's ability to produce many-colored blooms while the common name, "flag", comes from an old English word (flagge) for reeds and refers to its natural preference to wetlands.

### ZONE

It prefers to grow in rich, moist soils and is happy in wet areas of pond margins, wet meadows, and marshy areas where it multiplies naturally forming clumps. It can also be grown in containers in ponds in up to 4 inches of standing water. Blue flag iris thrives in full sun and tolerates partial shade. It is hardy in zones 3 to 9.

### ROOT SYSTEM

The root mass of established colonies provides good shoreline protection. Blueflag's sword-like leaves emerge from thick horizontal root stock (corm) which are covered with fibrous roots.

### SITE SPECIFICS

This perennial can be found on the South side of the site in the bioretention cell and the water quality swale.



<https://plants.sc.gov.usda.gov/core/profile?symbol=IRVE2>



# PINEBRIDGE PLANTING GUIDE

## Bushy Bluestem / *Andropogon glomeratus*

### MATURE SIZE

Bushy Bluestem is a sturdy, warm-season, perennial grass that may grow 2 to 4 feet in height.

### DESCRIPTION

The foliage has a reddish tint. This plant has 3/8 in. wide green leaves in summer which turns copper-orange in fall and retains color well into winter. Interesting, beard-like flowers appear in fall. The inflorescence has densely clustered, bushy bracts at top of stems. This plant prefers moist to damp sites and is not drought tolerant.

### ZONE

Broomsedge bluestem grows where average rainfall is greater than 25 inches. It is found in low roadsides, moist pinelands, brackish and freshwater marsh borders, sloughs, and wet ditches. It is native to and is found in nearly all of the eastern United States, mainly in the southern states, and extending west to California. It grows in irregularly to seasonally inundated or saturated loamy soil. Located in the coastal, mountains, piedmont regions of NC. It is hardy in zones 7 to 9.

### ROOT SYSTEM

It is a deep and fibrous rooted plant, potentially five feet, with some roots developing horizontally. These extensive roots help native grasses withstand periods of drought.

### SITE SPECIFICS

This perennial can be found on the Southwestern side of the site in the long phytoremediation area adjacent to the wall. It is also prevalent on the North side of the site in the outer phytoremediation areas.



<https://plants.ces.ncsu.edu/plants/andropogon-glomeratus/>



# PINEBRIDGE PLANTING GUIDE

## Fox Sedge / *Carex vulpinoidea*

### MATURE SIZE

Fox sedge is a native evergreen sedge that grows to 1-3' high and about as wide.

### DESCRIPTION

The leaves are light green and grow in dense rounded clumps of leaves and flowering clumps. The arching grass-like leaves are 12-14 inches long and 1/2 inch wide. Yellow/white flowers bloom in late spring/early summer (May to June). However, they are insignificant and not showy.

### ZONE

Easily grown in medium to wet soils in part shade to full sun. Occurs in seasonally wet or flooded soils in open habitats, wet meadows, marshes, and roadside ditches. This widespread sedge is found throughout North America but is most common in the eastern half. It is hardy in zone 3 to 9.

### ROOT SYSTEM

It builds soil with its short-rhizomatous and fibrous root systems that add organic matter annually as roots decompose.

### SITE SPECIFICS

It can be found on the South side of the site in the water quality swale and in the phytoremediation area next to the parking lot closest to the building.



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<http://hofmannursery.com/plants/details/carex-vulpinoidea>



# PINEBRIDGE PLANTING GUIDE

## Wild Bergamont / *Monarda fistulosa*

### MATURE SIZE

*Monarda fistulosa* is a native, clump forming perennial that can grow up to 2 to 4' tall.

### DESCRIPTION

This native perennial blooms in summer (June - September) features two-lipped, tubular flowers that appear in dense, globular, solitary, terminal heads atop square stems. Each flower head is subtended by (rests upon) a whorl of showy, pinkish, leafy bracts. The flowers are attractive to bees and butterflies. The leaves are toothed, opposite, aromatic, oblong, grayish-green.

### ZONE

Bergamont occurs in dryish soils on prairies, dry rocky woods and glade margins, unplanted fields and along roads and railroads. It prefers good drainage, moist areas, such as prairies and open woodlands. It is found in the mountains and Piedmont area of North Carolina. It is hardy in zones 3 to 9.

### ROOT SYSTEM

It has deep, strongly branched roots, and shallow rhizomes that are responsible for the vegetative spread of the plant. These rhizomes typically send up multiple leafy stems in a tight cluster, giving Wild Bergamot a bushy appearance. fibrous root system and forms a woody caudex. It also self-seeds.

### SITE SPECIFICS

This perennial can be found on the far South side of the site just outside of the water quality swale in a phytoremediation area.



<https://plants.ces.ncsu.edu/plants/monarda-fistulosa/>

# PINEBRIDGE PLANTING GUIDE

## Indian Steel Grass / *Sorghastrum nutans*

### MATURE SIZE

Indian Steel, is a warm-season bunchgrass that can grow 5 to 7' high.

### DESCRIPTION

Indian Steel makes most of its growth between June and August and remains green until the first frost. Yellow flower panicles extend above the foliage in the late summer and fall. Its leaves are deciduous and form upright clumps of slender, blue-green leaves (to 1/2" wide and 2' long). Foliage turns orange-yellow in fall and usually retains hints of color into the winter.

### ZONE

Indian Steel grows best in average, dry to medium, well-drained soils in full sun. It tolerates a wide range of soils including heavy clays and does well in poor, dry, infertile soils. However, it does not do well in full shade. Indian Steel is native to the Southeastern United States, and it's a hardy plant able to withstand drought, erosion, dry soil, shallow-rocky soil, and air pollution. It is hardy in zones 4 to 9.

### ROOT SYSTEM

It has a fibrous and short-rhizomatous root system. Its efficient fibrous root systems (which make up about two-thirds of the plant's total biomass) make Indian Steel grass especially drought-resistant. Reaching depths of 7', these root systems helped build the rich soils of tallgrass prairie over thousands of years.

### SITE SPECIFICS

This grass can be found along the outside perimeter of North side of the site.

### POLLUTANT REMOVAL

Petroleum and pesticides



<https://plants.ces.ncsu.edu/plants/sorghastrum-nutans/>

# PINEBRIDGE PLANTING GUIDE

## Little Bluestem / *Schizachyrium scoparium* 'Blue Paradise'

### MATURE SIZE

Little Bluestem is a perennial, warm-season grass that reaches 2' to 5'.

### DESCRIPTION

A native ornamental grass with attractive blue-green foliage, purplish bronze seed heads, and yellow-orange leaves. The leaves and stems frequently have a bluish cast in summer, while the fall color is a very warm copper that does not fade throughout winter. Purple-bronze racemes form above the clump of leaves and appear in August. Blooms in late summer and fall. It is attractive planted en masse and makes an excellent addition to a rain garden.

### ZONE

It performs best in average, dry to medium moisture, well-drained soil in full sun. However, it does tolerate a wide range of soil conditions including infertility and clay. Performs well in poor soils. It has drought resistance once established. It is well-adapted to southern climates as it tolerates high heat and humidity. Found throughout the coastal, mountain, and Piedmont regions of NC. It is hardy in zones 3 to 9.

### ROOT SYSTEM

It is anchored by a vigorous root system. Little Bluestem's root system is deep and fibrous, potentially 5', with some roots developing horizontally. These extensive roots help native grasses withstand periods of drought.

### SITE SPECIFICS

This grass can be found on the South side of the site in the bioretention cell and near the water quality swale.



<https://plants.ces.ncsu.edu/plants/schizachyrium-scoparium/>



<https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=f510>

# PINEBRIDGE PLANTING GUIDE

## Purple Coneflower / *Echinacea purpurea* 'Kim's Knee High'

### MATURE SIZE

Purple Coneflower is a herbaceous perennial that may grow 3 to 4' tall.

### DESCRIPTION

The leaves are alternate with a smooth margin. Pinkish purple flowers mature in early summer and continue into mid-fall. "Echinacea" is derived from the Greek word echinos which means sea-urchin or hedgehog, referring to the pointy cone found in the center of flowers in this genus.

### ZONE

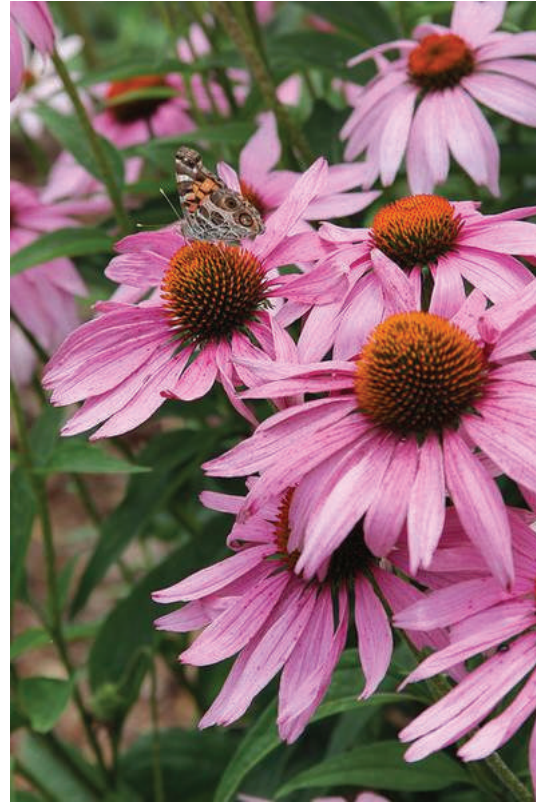
The Purple coneflower is easily grown in average, dry to medium, well-drained soil in full sun to part shade. Best in full sun. It is an adaptable plant that is tolerant of drought, heat, humidity and poor soil. Found throughout the mountains and Piedmont region of NC. It is hardy in zones 3 to 8.

### ROOT SYSTEM

It has a fibrous root system with short woody rhizomes. Plains Indians used the root to treat rattlesnake bites, bee stings, headaches, toothaches, sore throats, and distemper in horses.

### SITE SPECIFICS

This perennial can be found on the South side of the site in the bioretention cell.



<https://plants.ces.ncsu.edu/plants/echinacea-purpurea/>



# PINEBRIDGE PLANTING GUIDE

## River Oats / *Chasmanthium latifolium*

### MATURE SIZE

The plant can reach up to 4' in height, but is most often shorter.

### DESCRIPTION

River Oats is a native rhizomatous clump-forming upright grass with a distinctive seed head resembling oats, known as drooping panicles. The leaf blades are broadly lanceolate (up to 1-inch wide at base) giving it the common name broad-leafed chasmanthium. Seed heads are borne in open panicles up to 10-inches long. The drooping panicles are initially green turning straw colored as seed ripen.

### ZONE

It is easily grown in moist to wet well-drained soils in part sun to part shade. It is fairly tolerant of shade and may spread aggressively by rhizomes and seeds. Throughout its range, River oats is found in moderate or greater shade. Its adaptation varies from moist to well drained sites. This species is considered a facultative wet site species growing on deep moist well drained sites. It is hardy in zones 5 to 9.

### ROOT SYSTEM

River oats hold soil with their vigorous fibrous roots and expand into colonies from underground rhizomes.

### SITE SPECIFICS

This perennial can be found on the South side of the site in the bioretention cell.



Chasmanthium latifolium  
<https://plants.ces.ncsu.edu/plants/chasmanthium-latifolium/>



# PINEBRIDGE PLANTING GUIDE

## Swamp Sunflower / *Helianthus angustifolius*

### MATURE SIZE

The swamp sunflower is a native perennial that grows up to 8' tall.

### DESCRIPTION

It has showy yellow daisy-like flowers from mid to late summer into fall. A profusion of 2-3 inch flowers with 10-20 yellow narrow pointed rays surrounds a purplish-brown disk with hairy bracts. The plant produces small yellow flowers from late August until frost. The leaves are narrow, willowy, scratchy, simple, hairy and pointed at the tip. The leaves have three linear veins. The stem is green and has a slight purple tint and is hairy. The upper leaf surfaces have broad spiny hairs that are directed toward the tip and soft white hairs cover the underside. It is federally listed as an endangered species.

### ZONE

Swamp sunflower prefers moist to occasionally wet acidic sandy to clay loams in full sun. It can be grown on drier soils if adequate moisture is provided. It will tolerate part shade but flowers better in full sun. It is believed that this species once occurred in natural forest openings or grasslands. The sunflower is found throughout North Carolina in coastal, mountains, and Piedmont regions. It is hardy in zones 5-9.

### ROOT SYSTEM

It has fibrous roots with short rhizomes.

### SITE SPECIFICS

This perennial can be found throughout both sides of the site in the phytoremediation areas.



<https://plants.ces.ncsu.edu/plants/helianthus-angustifolius/>





# PINEBRIDGE PLANTING GUIDE

## Soft Rush / *Juncus effusus*

### MATURE SIZE

The Soft rush is a perennial that grows 2 to 4' tall.

### DESCRIPTION

The Soft rush, is a grass-like, rhizomatous, wetland perennial that features smooth, upright, cylindrical, unjointed, spire-like green stems (leaves are absent) which grow in spreading basal clumps.

### ZONE

Easily grown in moist to wet soils in full sun to part shade. Best in full sun. Performs well in standing water to 4" deep, but will also grow well in garden soils as long as the soils are in fact kept consistently moist. It is often found growing in ditches, bogs, swamps, marshes, wet pastures, and along the margins of lakes and rivers. It is hardy in zones 4 to 9.

### ROOT SYSTEM

The rhizomatous nature, nitrogen fixation capabilities, dense root system, and phenotypic plasticity to flooding and drought stress provide high soil and slope stabilization capabilities, particularly in areas with flooded soils or fluctuating hydrology.

### SITE SPECIFICS

This perennial can be found throughout both sides of the site in the phytoremediation cell and bioretention cell.



<https://plants.ces.ncsu.edu/plants/juncus-effusus/>



© Ted Rodner

# PINEBRIDGE PLANTING GUIDE

## Switchgrass / *Panicum Virgatum*

### MATURE SIZE

Switchgrass is a perennial grass that grows 3 to 4' and occasionally 7'.

### DESCRIPTION

Bluish cast in summer; reddish fall color; fast-spreading by rhizomes; vigorous. Foliage clump is topped by finely-textured, pink-tinged, branched flower and seed panicles that hover over the foliage. Open panicles of dark red to purple are apparent in late summer and fall; This plant is highly resistant to deer grazing and is slightly salt tolerant.

### ZONE

Prefers partial to full sun. Moderately deep to deep, somewhat dry to poorly drained, sandy to clay loam soils are best. It is a valuable soil stabilization plant on strip-mine spoils, sand dunes, dikes, and other critical areas. Found throughout the coastal, mountain, and Piedmont regions of NC. It is hardy in zones 5 to 9.

### ROOT SYSTEM

The root system is deep, fibrous, and rhizomatous; it can penetrate up to 10 ft.

### SITE SPECIFICS

This perennial can be found throughout both sides of the site in the phytoremediation areas.



<https://plants.ces.ncsu.edu/plants/panicum-virgatum/>



# PINEBRIDGE PLANTING GUIDE

## Ornamental Kale / *Brassica oleracea acephala* 'chidori red'

### MATURE SIZE

Ornamental Kale is a cool weather annual that grows 1 to 1.5' tall.

### DESCRIPTION

Kale, is a vegetable that is grown for harvest of its edible leaves. Although very similar to cabbage, kale is distinguished by having loose, upright, wavy-edged leaves that do not form a head (acephala from Greek means headless). Leaves are typically light green to blue green, but ornamental kales (grown primarily for ornamental foliage) come in leaf colors ranging from purple to red to pink to white.

### ZONE

Easily grown in organically rich, consistently moist, well-drained loams in full sun. Kale is a cool weather vegetable that is best grown in the cool temperatures of fall. Found throughout the coastal, mountain, and Piedmont regions of NC. It is hardy in zones 2 to 11.

### ROOT SYSTEM

The root system is shallow and fibrous.

### SITE SPECIFICS

This annual can be found on the South side of the site in the phytoremediation areas.

### POLLUTANT REMOVAL

Lead (Pb) and other heavy metals



<https://plants.ces.ncsu.edu/plants/brassica-oleracea-acephala-group/>



# PINEBRIDGE PLANTING GUIDE

## Sunflower / *Helianthus annuus*

### MATURE SIZE

Common sunflower is a widely branching, stout annual that grows 1.5 to 10' tall.

### DESCRIPTION

The sunflower's leaves are alternate but may be opposite lower on the stalk. Each cordate leaf is irregularly toothed. The terminal flowers heads are large and showy, up to 5 in. across. A tall, coarse leafy plant with a hairy stem commonly branched in the upper half and bearing several or many flower heads, the central maroon disk surrounded by many bright yellow rays.

### ZONE

Sunflowers are best grown in full sun with good drainage soil. Found throughout the coastal, mountain, and Piedmont regions of NC. It is hardy in zones 2 to 11.

### ROOT SYSTEM

The root system is shallow and fibrous. Sunflowers have a single tap-root and smaller, hairy secondary roots. Sunflower roots usually grow 1 to 3 feet deep.

### SITE SPECIFICS

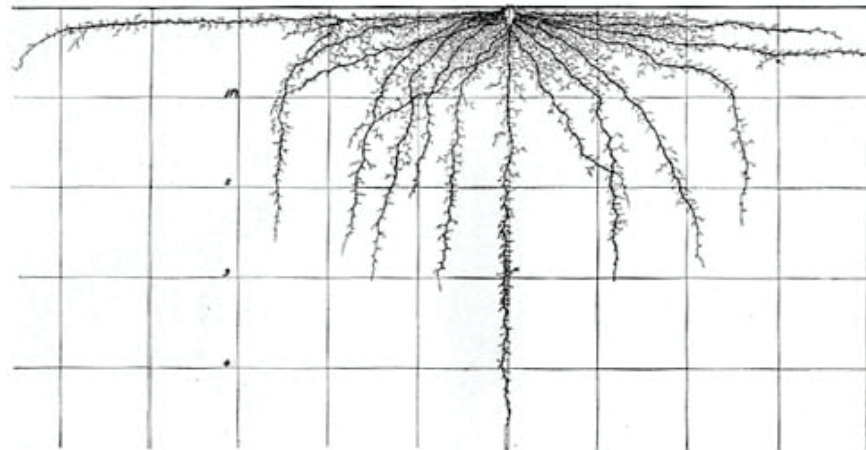
This annual can be found on both the North and South sides of the site in phytoremediation areas and the phytoremediation cell.

### POLLUTANT REMOVAL

Lead (Pb), Zinc (Zn), Cadmium (Cd), Copper (Cu), Manganese (Mn), Cesium (Cs), Strontium (Sr), and Polycyclic aromatic hydrocarbons (PAHs)



<https://plants.ces.ncsu.edu/plants/helianthus-annuus/>



Root system of a 2.5-months-old sunflower.  
<https://soilandhealth.org/>

# PINEBRIDGE SITE JULY 2020

