

CHAPTER 16

CONSERVATION LANDSCAPING. Best Practices for Water Quality.

Traditional landscaping in the United States has not always taken into consideration how to best meld materials and design with what is already available onsite. Often, soils are amended significantly and plants placed that require a great deal of care; regular watering, weeding and pesticide use, to maintain the manicured appearance most desired.

Because of ever increasing development and human expansion, there is a growing concern over water availability and quality and how we interact with the environment. This concern has landscaping professionals arena, as many customers are now requesting designs and plant materials that are more environmentally friendly.

Much of conservation landscaping is adapting existing design principles using conservation wise best management practices (BMPs).

The purpose of this chapter is to teach the whys & hows of creating & maintaining sustainable landscapes that can significantly alleviate the pressures traditional landscaping has placed on natural resources. The toolbox for creating conservation landscapes is full.

WHAT IS CONSERVATION LANDSCAPING?

Conservation landscaping can also be thought of as building **sustainable** landscapes. What does that mean?



The three circles in the diagram represent the three important elements of societal values - ecological, social and economic. When making decisions, these three elements must be considered, balanced and their interactions understood. Conservation landscaping decisions are made in the area of sustainability where the three circles overlap.

As a culture of sustainability grows, it becomes embedded into society and becomes part of our culture. This is the point at which people claim stewardship over environments and strive to make decisions that continue the sustainability spirit. Stewardship is a strong motivator and encourages clients to stay involved in landscape decisions.

Additional definitions of sustainable include: **“Conserving an ecological balance by avoiding depletion of natural resources”** (Oxford Dictionary) and **“the quality of not being harmful to the environment or depleting natural resources, and thereby supporting long-term ecological balance.”**(Dictionary.com)

Three basic tenants of these definitions:

1. Ecological balance.
2. Not harmful to the environment.
3. No depleting of natural resources.

Conservation landscaping means designing, installing and maintaining a landscape that is sustainable over time that functions as closely as possible to nature, reduces our environmental impact, while keeping in mind societal, cultural and economic elements and impacts.

CONSERVATION LANDSCAPING CHALLENGES.

In all human developments, significant upheaval of natural systems occurs. A new home site will have very little of the natural soil structures available, and may even contain soils or materials detrimental to native ecosystems, such as construction debris.



In an ideal world, planning would occur prior to the development stage to maintain native soils and plants, minimize compaction and conserve natural landscape features such as drainages and slopes. As this doesn't often occur, surrounding natural areas may need to be examined to obtain information about soils and native communities.

Other challenges include overcoming traditional landscaping practices that are often opposite from conservation landscaping elements and educating landscape professionals, homeowners, designers, growers and others on those conservation landscaping elements practices.

GUIDELINES FOR CONSERVATION LANDSCAPING.

According to the Chesapeake Conservation Landscaping Council (CCLC), there are eight (8) essential elements to conservation landscaping.

1. Design to benefit the environment
2. Use native plants
3. Manage Invasives
4. Provide wildlife habitat for native species
5. Promote healthy air quality and minimize air pollution
6. Conserve and clean water, improve water quality and minimize off site runoff
7. Promote healthy soils
8. Manage to conserve energy, reduce waste, eliminate or minimize the use of pesticides and fertilizers

A potential ninth guideline is to **foster environmental stewardship**. This is an understanding that the responsible management of a healthy ecosystem improves the quality of life for all generations. By teaching clients how their new healthy landscapes “work”, they will begin to see their role in maintaining these landscapes going forward, using the eight guidelines above. When you provide an “ownership” element, maintaining these areas will become a matter of personal pride and stewards will be created who will be able to help you foster the desire for others to create sustainable landscapes on their own properties.



BENEFITS OF CONSERVATION LANDSCAPING.

In line with the benefits already discussed in the eight essential elements, encouraging your clients to replace traditional lawn areas with sustainable landscape areas will:

- Reduce mowing time and harmful emissions of mowers
- Reduce or eliminate the need for synthetic fertilizers and pesticides to maintain healthy “turf”
- Eliminate unhealthy monocultures
- Reduce the need to water shallow rooted turf grasses
- Encourage quicker rainwater infiltration and less offsite runoff
- Provide wildlife habitat
- Promote healthier soils by replacing shallow rooted turf grasses with deep rooted native plants

By replacing traditional ornamentals with native plants, trees and shrubs, your client will:

- ☑ Use less fertilizer and pesticides, as natives are more acclimated and resistant to local pests and diseases
- ☑ Reduce the need to water
- ☑ Create native diverse plant communities
- ☑ Reduce invasive plant species
- ☑ Lessen the time necessary to maintain landscaped areas
- ☑ Increase the survival success rate for plantings and reduce the need to replace more finicky nonnatives
- ☑ Attract native pollinators

Installing other water quality best management practices (BMPs) onsite will:

- ☑ Increase rainwater infiltration
- ☑ Manage runoff water onsite
- ☑ Allow excess nutrients to be utilized and/or broken down by natural processes



In addition to using native plants, water quality best management practices (rain gardens, grass swales, pervious surfaces, rainwater retention & harvesting, green roofs, tree planting, and onsite waste management) are imperative for a functioning conservation landscape.

INTEGRATED PEST MANAGEMENT.

Integrated Pest Management (IPM) is a program of prevention, monitoring, and management which provides the opportunity to eliminate or drastically reduce the use of pesticides, and to minimize the toxicity of and exposure to any products which are used. IPM does this by utilizing a variety of methods and techniques, including cultural, biological and

mechanical strategies to manage pest problems. As a last resort, the least toxic pesticide may be used. This allows for the choice and use of tools that are more conducive to maintaining native communities with less potential negative impact on the environment. IPM is a holistic pest management system that focuses on **causes** of pest invasion rather than just treating the symptoms.

Traditional pest management centers on chemical application to manage pests once they are causing damage.

Through increased understanding of how native ecosystems work, we are realizing that ALL creatures native to an area serve a role in the overall design, even the ones previously viewed as pests. Nature has created a delicate balance in which each organism has a purpose, even those we may consider pests. IPM decisions are made based on the threshold of damage clients are willing to endure.

Another type of IPM deals with the management of unwanted plants. This type of IPM is referred to as Integrated Vegetation Management (IVM) and is being adopted by state departments of transportation nationwide. IVM offers management methods for invasive plants and encourages the use of natives.

Four main components of an IPM or IVM plan:

Establish Acceptable Thresholds. Just one pest does not necessarily require that action be taken. Determine the threshold that is acceptable to your client before he/she wants to engage in some sort of control.

Identify & Monitor Pest populations. A pest must be correctly identified in order to be understood and controlled. Once a pest is identified, monitor activity levels and research life cycles in order to be able to suggest control methods.

Prevent pest invasions. Understanding a pest's life cycle allows a manager to eliminate conditions that may contribute to attacks. For

example, plants too close together may have vegetation that does not receive adequate air circulation and in response vegetation rots and attracts pests. IPM solutions would be to remove excess plants or trim plants so all have adequate space.

Management. Once a pest invasion reaches the acceptable threshold level, some sort of control should be enacted. Choose first from mechanical, cultural or biological solutions. Only use chemical solutions as a last resort.

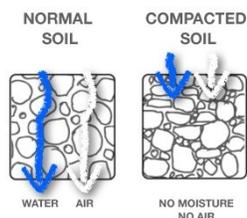
HEALTHY SOILS

Soils are a living organism. They contain millions of organisms necessary for breaking down various materials, including decaying remains of plants and animals, and pollutants, and entire microsystems exist in healthy soils.

Soils are the building block of landscaping and a basic understanding of native soils is imperative. Please refer to the Soils chapter of this manual for more information.

Conservation landscaping practices promote native soils. In urban settings, it is rare to find undisturbed native soils as soil is usually scraped off and stockpiled or hauled away. “New” soil is hauled in and spread on the site after development. Soil layers are mixed or compaction occurs during development. The overall goal of conservation landscaping regarding soils is to create, over time, soils that are similar to soils that existed naturally, on the site.

When possible, retain site topsoil. Create a stockpile site with appropriate erosion and sediment controls if site grading is to occur prior to planting.



In **compacted soil**, the pore spaces that naturally store air and water have been compressed causing water run off instead of infiltrate and makes it impossible for plant roots to grow. Practices to address compacted soil include:

- ☑ Cultivate and incorporate compost. Take care to avoid roots of established plants, especially trees.
- ☑ Aerate and top dress with compost. Again, avoid plant roots. Consider employing the services of an ISA certified Arborist if you will be working around trees.

Practices to prevent compacted soil include:

- ☑ Avoid working when soils are wet, especially clay soils, as soil structure damage occurs.
- ☑ Clearly designate areas for foot and vehicle traffic, construction materials delivery and storage, and worker parking if necessary. Use portable swamp/traction/construction mats or spread a thick layer of coarse mulch or gravel in these areas or where roots can't be avoided.
- ☑ Create tree protection zones around trees that are in construction zones.
- ☑ Spread mulch or plant a cover crop to minimize bare soil. Rain can compact or erode bare soils, and state and/or local regulations may require erosion controls be in place to eliminate bare soils.

From time to time, or in certain areas, you may encounter unique soil situations. In these cases, you may want to employ the services of a soils scientist to advise you in the best way to proceed.

Soils that present unique issues:

Acid Sulfate Soils. These are soils that are naturally occurring and contain iron sulfides, most commonly pyrite. When these soils are exposed to air the iron sulfides in the soil react

with oxygen and water to produce a variety of iron compounds and sulfuric acid. The initial chemical process is accelerated by soil bacteria. The resulting acid can release other substances, including heavy metals, from the soil and into the surrounding environment.



Acid Sulfate Soils can stain and degrade concrete and other surfaces

Acid sulfate soils were formed when the sea level rose and flooded the land, perhaps millions of years ago. Sulfate in the seawater mixed with land sediments containing iron oxides and organic matter. The resulting chemical reaction produced large quantities of iron sulfides in the waterlogged sediments.

Acid sulfate soils may look like rich, organic soils when first encountered, but more likely will have a grey color and a distinct rotten egg (sulfuric acid) smell.

Acid sulfate soils have a pH of less than 4.0. Nothing can be sustained in soils this acidic. A soil test must be performed to assess the pH level, and massive amounts of lime must be incorporated to raise the pH levels.

It is best to contact a specialist if you encounter these soils. Virginia Tech is a good source.

Hydric Soils. Hydric soils are permanently or seasonally saturated by water, resulting in anaerobic conditions, which means the soil

has no pore space available for air. Hydric soils are naturally found in wetlands.

Common characteristics of hydric soils:

- ☑ excessive moisture
- ☑ a "rotten egg" odor of hydrogen sulfide present within 12 inches of the surface
- ☑ a predominance of decomposed plant material
- ☑ reddish or dark-colored streaks or mottling
- ☑ a 12 inch or thicker layer of decomposing plant material on the surface
- ☑ a bluish-gray or gray color below the surface, or the major color of the soil at this depth is dark brown or black and dull.

A specialist should be consulted if you encounter hydric soils on a site.

Shallow Soils. Shallow soils occur frequently in highly or newly developed areas where contractors have removed the topsoil layer from the project site. Unfortunately, these soils will just need to be built back up with time and incorporation of good, high quality organic material.

THE ROLE OF STORMWATER



Courtesy of Frog Forest Communications

Stormwater has become a major issue because of the effects it has on water quality, namely large ecosystems such as the Chesapeake Bay. Although not all water in Virginia drains to the

Chesapeake Bay, all waters in Virginia are impacted in some way by stormwater runoff. Because of the shallow average depths of the Chesapeake, polluted runoff impacts are magnified.

COMMON STORMWATER POLLUTANTS & SOURCES.

Pollutant	Common Sources
Sediment (sand, silt & clay particles)	Bare spots in lawns & gardens, roofs, construction sites, streambank erosion, farm fields, waterwater from washing vehicles
Nutrients (nitrogen, phosphorus, etcO)	Over-application or spillage of fertilizer, pet wastes, livestock manure, grass clippings & leaves)
Chemicals	Overapplication of pesticides, spilled or leaking pesticides, solvents, de-icing salts, other household hazardous wastes
Disease Organisms (viruses, bacteria)	Pet waste, manure, garbage, sewers
Hydrocarbons	Engine exhaust, fuel & oil spills & leaks, vehicle tire wear, burning plastics
Metals	Vehicle brake & tire wear, engine exhaust, metal gutters & downspouts

ADAPTED FROM PSU PUBLICATION F264 "STORMWATER MANAGEMENT ON RESIDENTIAL LOTS"

Simply put, stormwater occurs when rain is not able to enter the ground, or **permeate**. When you think of all the development occurring in Virginia, it becomes apparent that each new parking lot or road or sidewalk reduces rainwater’s ability to infiltrate through soils and plant roots that can reduce erosion, provide cleansing and uptake of excess nutrients, and allow rainwater to reenter the groundwater system.



Stormwater is not treated through a sanitary sewer system. Many people think that stormwater must go through the same “cleansing” process as the water you use in your home. It does not. When you see a storm drain on a residential street, know

that any materials entering that storm drain go directly into some local waterway. That’s why it is so important to be aware of what is entering that system. Liquids from vehicles, general trash, sediment, pesticide residue and fertilizer nutrients can all wreak havoc on water ecosystems.

STRATEGIES FOR RUNOFF CONTROL.

BMPs should address one or more of these strategies. BMPs can address more than one tactic.

DETENTION. Detaining water in a low area where it can slowly infiltrate into the soil. (filtration basins, bioretention basins, wetlands, grass swales, rain gardens)

DIVERSION. Redirecting water flow from an area of concern. (grass swales)

SPREADING OF FLOW. Spreading potentially heavy runoff over wide, gently sloping vegetated areas to slow runoff and reduce erosion. (level spreaders)

INFILTRATION. Allowing water to percolate into the ground. (porous pavement, pervious pavers, rain gardens)

USING PLANTS. Plant roots slow and retain runoff and are able to utilize excess nutrients. (native perennials)

**THE CONSERVATION LANDSCAPE/
STORMWATER CONNECTION**

One of the major tenants of conservation design is to keep rainwater on the site onto which it falls. Through installing BMPs that decrease impervious surfaces and encourage onsite retention of water, replacing short rooted turf grasses and planting natives that have increased root depths, and protecting soils from compaction and erosion, stormwater **retention** onsite can be maximized. This means that less runoff will reach storm drains.

Impervious just means the water can’t get through. A classic impervious surface is a parking lot. Rainwater that hits a paved parking lot will run off to the lowest area. Often that is a storm sewer, and all the materials on that parking lot

enter the storm drain. By replacing an impervious surface with one that is **pervious** (the water can get through), materials are absorbed into the natural soil ecosystem and some can be broken down and utilized before entering groundwater or storm sewers.

Other impervious areas you may have on a site are sidewalks, patios, driveways and roofs.

Where between 11 and 25 percent of a local water basin is covered with impervious surfaces, streams are impacted and can be expected to experience some degradation with further development. Where over 25 percent of a local water basin is covered with impervious surfaces, streams are already degraded. Predevelopment stream form (bank blowouts and erosion) and health (plant and animal life, pH, temperature) cannot be fully maintained even when best management practices or retrofits are fully maintained. Restoration projects may improve conditions in these basins, and this information can be useful when promoting conservation landscaping.

How to Calculate Impervious Surface Percentage on a Site.

Find square footage of the following:

- House footprint
- Driveway
- All sidewalks and walkways
- A/C Pads
- Detached Garage/Sheds
- Pool Decking
- Patios, terraces and/or decks
- Include any other impervious areas within the site

Add the total square footage of the areas listed Above and then divide the sum by the total lot area of property to calculate the percentage of the site that is impervious. Remember to keep units the same, i.e. square feet to square feet.

THE ROLE OF NATIVE PLANTS

What is a Native Plant?

According to Virginia's Department of Conservation Natural Heritage, a native plant is a species that occurs in the region in which it evolved. Because the evolution of the plant includes responses to physical and biological processes characteristic of a region, the plant is uniquely adapted to survive the conditions of that area. This means it is more likely to be able to withstand local weather extremes, pest invasions, and interactions with other native species.



Courtesy of Frog Forest Communications

One list of nurseries that carry native plants in Virginia and surrounding states is on the Virginia Native Plant Society website:

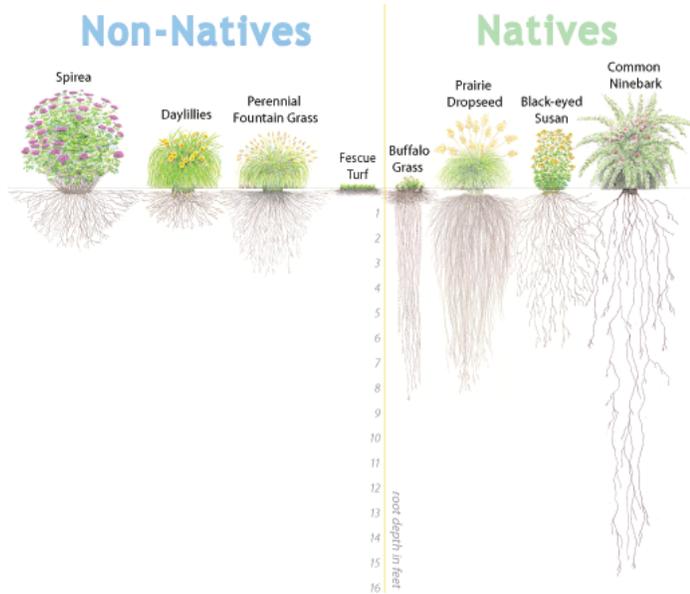
[http://vnps.org/download/plant_sales/Virginia%20Nurseries%20October%202015\(2\).pdf](http://vnps.org/download/plant_sales/Virginia%20Nurseries%20October%202015(2).pdf)

Benefits of Natives.

- Adaptability** – Native plants have become accustomed to growing and surviving even in extreme weather. For example, they will tolerate both spring floods and summer droughts.

Even though natives are adaptable to area conditions, they still may prefer specific conditions within that ecozone, such as wet soils or full sun/shade.

- Low maintenance** – Because of their adaptability and deep root systems, native plants will not require supplemental water, fertilizer, pesticide treatment or excessive care. Once established, native plants only require minimal attention.



- Drought resistance** – Because a native is adapted to utilize local resources efficiently, its root system is often many feet deeper than a plant that has ornamental value but is not native. This allows a native plant to be able to withstand drought conditions and require less watering as it can obtain water from deep in the soil. The deeper roots also serve to aerate the soil and reduce compaction and maintain natural soil structure. Deep roots also absorb more rainwater as it permeates through the soil, allowing for uptake of excess nutrients.
- Beauty** –Native plants create a beautiful landscape due to their range of sizes, heights, textures and seasonal colors. Biodiversity in choosing plants will also allow for a lengthy and diverse blooming palette.



Courtesy of Frog Forest Communications

- Time and cost efficiency** – Native landscaping is more time and cost effective than traditional non-native landscaping. Native communities will also continue to expand naturally, if allowed, with time. This may reduce the client’s cost of replacing plants or expanding garden areas.
- Biodiversity** – The many different species of native plants, each blooming or creating seeds or fruits at different periods during the growing season, create a range of food sources and habitats for wildlife. This encourages different species of animals and insects to take shelter among the plants and make the naturalized landscape their home. Natives attract and SUSTAIN wildlife populations, including pollinators.
- Air Pollution reduction** – Native plants require carbon to grow, as do other plants, so they can remove a significant amount of air pollution in large areas. Also, since there is no need to mow native plants, no pollution is generated with gas-powered lawnmowers and other lawn care equipment.
- Deter Invasive populations** - The deeper root systems also allow natives to fend off aggressive invasive plants more easily than a shallow rooted nonnative. There are native plants that can tend to become a bit invasive as well, such as Oswago, so be sure to research plants in regard to how they replicate once established. An invasive native is always better than an invasive non-native, but should be planted in an area where its tendency to overtake less aggressive natives is not a problem.

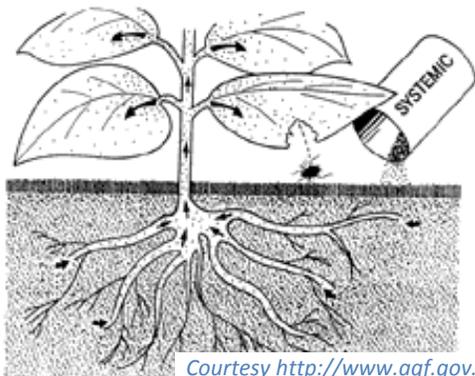
Pesticide Use on Natives.

Depending on site goals determinations need to be made regarding potential detrimental effects of purchasing natives treated with pesticides. If one goal is to attract pollinator species, it is VERY IMPORTANT that natives are obtained to which **neonicotinoid pesticides** have not been applied.

Neonicotinoids are very controversial **systemic** pesticides with a significant half-life of up to 3-4 years in some situations. Neonicotinoids affect the central nervous systems of insects and, to a lesser degree, mammals, and studies are still being conducted to determine if they are all or partially responsible for reductions in bee and other insect populations. Studies in the UK have recently provided the first evidence of a link between neonicotinoid pesticides and escalating honeybee colony losses on a landscape level. (<http://www.theguardian.com/environment/2015/auq/20/pesticides-neonicotinoids-linked-bee-decline-first-time-large-scale-field-study>)

Neonicotinoids affect the honey bees' ability to remember where flower populations and home hives are located and also can affect insect immune systems, making them much more susceptible to viruses and bacterial infections. These pesticides can also affect pollen and nectar feeding insects such as butterflies and native bees and beetles. Not all nurseries will label natives that have been treated with pesticides, so ask to be sure.

The EPA also has a schedule of review for neonicotinoid pesticides regarding potential pollinator effects. Information can be read here: <http://www.epa.gov/pollinator-protection/schedule-review-neonicotinoid-pesticides>, as well as other pollinator information, including BMPs.



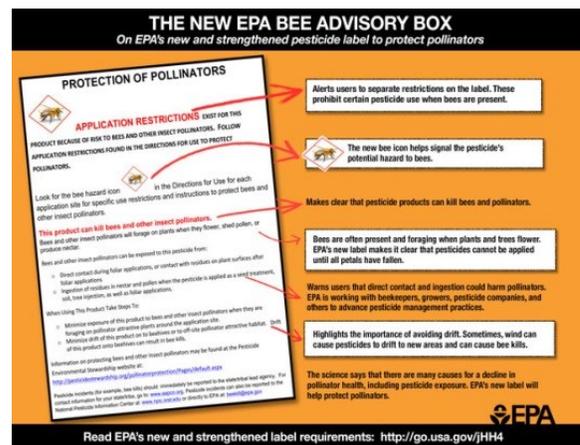
Courtesy <http://www.agf.gov.bc.ca>

A systemic is a substance that is taken up into the vascular system of the plant and kills pests when they ingest plant parts. Harmful plant

parts to pollinators include nectars and pollens and also dew that forms on leaves of treated plants.

Any pesticide that is systemic will have an effect on insect populations, by design, so make sure goals coordinate with any pesticide use. Consider educating the client about Integrated Pest Management techniques.

When you feel you must use pesticides in conservation areas, look for information on the label indicating how the pesticide will affect native insect and animal populations. EPA has developed a "BEE BOX" for inclusion on pesticides to help identify potential pesticide hazards to pollinators.



NON-NATIVE INVASIVE PLANTS

Traditional landscaping has, for generations, revolved around the lawn and ornamental plantings of materials prized for their blooms, structures, scents and uniqueness. Thomas Jefferson imported plants from all over the world to study and to grow in his gardens. Unfortunately, this was not always a healthy practice for native ecosystems. Invasives have been introduced in just this way over the years. We are still learning the detrimental impacts non-native invasives can have on native communities.

Non-native invasive plants are everywhere. Common examples are kudzu, multiflora rose, butterfly bush, mile-a-minute vine, Japanese

knotweed, Canada thistle, autumn olive and English Ivy.



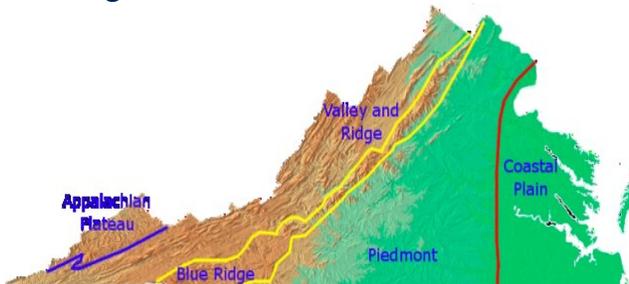
Kudzu, a non-native invasive will overtake everything in its path, trees, other plants & manmade structures
 Courtesy of Frog Forest Communications

All of these plants have been “naturalized” in the United States and are doing so well that they are able to take over and destroy native plant populations, including trees, and create areas of monoculture that do not usually attract or sustain wildlife species.

Because these species are not native, they may also be unpalatable to native wildlife, allowing them to spread unchecked.

Many non-native invasives are very difficult to control once allowed to establish in an area. Educate clients on how to identify non-native invasives and what best management practices to follow once identified.

Knowing what is Native where



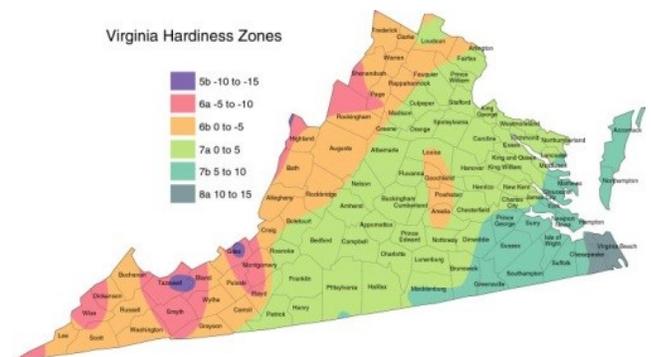
Source: USGS Open-File Report 99-11

Virginia encompasses various physiographic and hardiness regions. Keep these in mind when designing native communities. For example, a

coastal native plant community would not do well in the Blue Ridge Mountains.

There are five (5) physiographic regions in Virginia: Appalachian Plateau, Valley and Ridge, Blue Ridge, Piedmont and Coastal Plain. For use in this chapter, condense those to Coastal, Piedmont and Mountain. Mountain encompasses Appalachian Plateau, Valley and Ridge and Blue Ridge. Refer to guides in the “Native Plant References” section at the end of this chapter for information on what will work in the project area.

Also keep the USDA Hardiness zone of areas in mind when choosing natives that will flourish on a site. Virginia has areas in 6 subzones as indicated in the map below. Each of these subzones will have different frost dates, and low and high temperature averages. Native plant species are adapted to specific hardiness zones just as non-native species are and will not flourish in areas too hot or too cold.



Importance of Biodiversity

As in any natural system, biodiversity is much healthier than a monoculture or a system with only a few different species because diseases specific to one type of plant will not cause total destruction of a community. Various types of plants also serve different needs of insects and other animals. The butterfly life cycle, for example, requires different plants for egg laying, larval feeding and adult nectar collection. So when planning areas within a site, research the uses of natives in relation to the client’s goals. A pollinator garden would require

different natives than a garden in which goals are to attract songbirds or provide habitat for gamebirds.

The greater the diversity provided, the greater the benefit to native wildlife.

DESIGNING a SUSTAINABLE LANDSCAPE

Designing a conservation landscape should follow the same basic procedures as designing any other landscape.

The way the site is assessed and the questions a client is asked will be a bit different.

PLANNING & ASSESSMENT

GOALS

The first step is to learn and review the goals of the client. Be ready to incorporate these goals and to educate the client on eventual design choices. Using conservation landscaping may require the presentation of solutions that are not traditionally considered and may not be initially understood.

Once the client's goals have been identified, conduct a needs assessment by interviewing the client and surveying the property. Remember to keep in mind existing and future needs. Guide the client in the goal of creating areas that mimic natural cycles such as nitrogen, area hydrology and carbon use and sequestration. This just means that the aim is to recreate what nature provides naturally.

Questions for the client can include:

How will the site be used? Consider current and future uses. Do you need to incorporate play areas? Water features? Wind or sight screens? Hardscaping? Attract specific wildlife? What type of landscaping is preferred? Formal? Naturalized? Symmetrical? More free flowing?

Are there specific features your client would like to preserve? Rock outcroppings? Ponds? Trees? Encourage the preservation of large, mature native trees and other natural species.

Identify human activity patterns that may impact your design. Where do people walk? Are there pathways that have been created through the site? Are there children and/or pets that need specific outdoor play areas? Where do cars and vehicles need to go? Where are the entry/exit points?



Does the site contain impervious areas - sidewalks, driveways, ditches, parking areas, patios? Remember that roofs are impervious as well. Could these areas be replaced with pervious BMPs to encourage maximum infiltration of rainwater? Or could other BMPs be created around or near the impervious areas to assure that water is infiltrating as closely to the place it fell as possible?



UNDERSTANDING THE SITE

Understanding the site is imperative to a successful conservation landscape. Knowing the client's goals and coordinating those with a clear understanding of the site will create a long term native scape that will be sustainable, beautiful and healthy.

A final design should maximize ease of care, once established. With this in mind, develop large contiguous areas, not islands that will require more maintenance.



Identify problem areas, such as places where water may currently stand, areas with erosion issues and shortcuts where soils may be severely compacted. Other problem areas may be caused by poor soils due to removal of topsoil during construction.

Assess the site for species that can be preserved and incorporated into the conservation design. If a native plant species is already doing well on a site, take advantage of that. Decide the best way to feature, protect and enhance naturalized areas that already exist.

Note soils throughout the site and take appropriate soil tests. Also note sun/exposure situations in relation to the native species you may want to incorporate. Take notice of plant communities/species that seem to do well together. Mimic those relationships in your design.

If wildlife habitat is a goal, **Food, Water, Cover** and **Space** for each species you wish to attract is needed. If the wildlife is not currently on the site, assess which of the four basic needs is missing and why. Can it be provided? If not, advise the client of the assessment. Space can be provided by connecting sites to other contiguous areas where that wildlife may already live. By creating wildlife corridors in this way, natural movement areas can be provided and reductions in the occurrences of wildlife using public roads to get from place to place may occur. By providing corridors, wildlife may be deterred from taking up residence in homes and outbuildings, as natural habitat will be more attractive and available.

If a nuisance population of a particular species is suspected, you may want to choose “resistant” plant species or consult with area animal control or Game Commission agencies.



Courtesy of Frog Forest Communications

Also assess the site for possible threatened and/or endangered plant or animal species. The Natural Heritage Division of the Virginia Department of Conservation & Recreation (DCR) has a list of threatened, rare and endangered plants, animals on their website:

http://www.dcr.virginia.gov/natural_heritage/in_foservices.shtml.

The most important thing to consider when planting a conservation landscape is to think **LONG TERM**. Consider that the landscape being designed should function as an ecological system on its own, once established. This may mean it looks a bit meager for the first year or so as natives establish strong root systems. Explain this to clients so he/she is not surprised with a less than mature site at first.

Remember the overall goal is to design a site that maintains or creates ecological balance, does not deplete natural resources, and is not harmful to the environment. Take natural cycles into consideration, such as carbon, water and nutrients.

WATER ON THE SITE

A thorough assessment of water features pertaining to each site should be conducted. This should include knowing in what watershed the property is located, how water flows over a site,

knowing how much water enters a site from other adjoining properties and identifying any open water features. All of this will help to develop the most effective strategies for controlling stormwater and maintaining and/or increasing water quality.

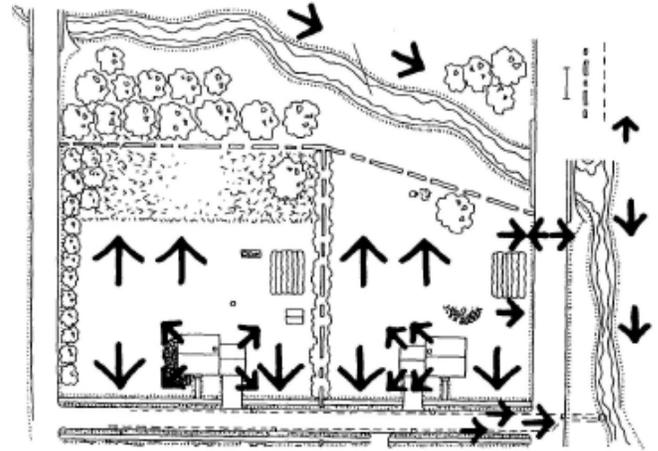
Topographic maps can be helpful in determining the water flow that affects a site. Also be aware of any regulations - local, state or federal – that may determine what can or cannot be done on a site. Virginia’s stormwater regulations are currently administered by the Department of Environmental Quality (DEQ). There are other water protection enactments, such as the Chesapeake Bay Preservation Act, that may apply. Refer to the section on regulations at the end of this chapter for assistance.

It may also be beneficial to contact agencies such as the local Conservation District or locality planning departments to inquire about local water issues and possible programs to assist in design and species selection. A list of Virginia’s Conservation Districts can be obtained by visiting <http://vaswcd.org/districts-by-countycity>.

CONCEPTUAL DESIGN

A base map of an existing site will be the first step in creating a conceptual design. Create a map with existing site conditions and improvements such as:

- legal boundaries
- existing buildings and structures such as fences, pools, walls
- Areas where access is gained to site (driveways, paths, sidewalks, parking areas/lots)
- All impervious surfaces and materials
- Utility lines, including underground utilities
- Soil composition
- Light exposures (shade, sun, direction of light)
- Water flow within, over and off the site



Arrows can be used to show water flow on/off a site

By using a topographic map or an aerial map showing elevations, you will be able to ascertain water flow to & from your site.

Once base conditions have been identified, create a quick graphic overlay to convey design ideas to clients in a format that allows for a visual illustration and feedback. With this overlay, clients can see how the design best addresses his/her goals while still maintaining the integrity of any existing conservation areas, addressing applicable ordinances and regulations, and connecting natural areas on the site to natural areas on adjoining sites, thus creating conservation corridors.

This overlay will be important in educating clients on the true value and purpose of conservation landscaping and the possible compromising of goals to achieve true sustainability.

Explain the increased benefits of conservation landscaping at this point. Educate the client that conservation landscaping will require less maintenance once established, creates ecological balance, health and social benefits and cost reductions in such things as plant replacement, pesticides and less lawn maintenance equipment.

Also be sure to explain to the client how the site will look upon install as well as other stages,

such as one year from construction and at maturity.

Making sure clients understand why design elements are being proposed. This will help with the final design and may illicit suggestions from clients based on their understanding of the local natural landscapes.

FINAL DESIGN

Once the conceptual design is approved by the client, a final design can be developed. This will include specific plant lists, natural features to be highlighted, and uses indicated for each area. It will also site BMPs in relation to water flow. The final design should also show possible future expansion areas and linkages to other nearby properties with similar features.



This tree was planted in the wrong place

In preparing the final plan, remember to apply the **“Right Plant, Right Place”** strategy. By identifying soils, slopes, light exposures, utilities, water availability and proximity of plants to structures and other features on a concept map, it becomes possible to quickly identify what types of plants will work where.

TIPS FOR SUCCESS

- ☑ **Adequate plant spacing.** Make sure plants are spaced adequately so they have room to grow to their natural size.

Crowding plants leads to disease and pests.

- ☑ **Design using layers.** Nature grows in layers. Forests have an understory layer filled with ground covers & shade loving plants that keep moisture in the soils. The middle forest layer is made up of shrubs and small woody trees that adapt to light conditions at this level. The final layer is large trees. Consider mimicking designs on this natural structure for well-functioning landscapes.
- ☑ **Consider the contribution of each plant to the overall site design and function.** For example, if windbreaks are part of the plan, incorporate evergreens. On hills where erosion is an issue, low growing, deeply rooted plants should be a staple. When attracting birds is a goal, you will incorporate plants with berries and seeds.
- ☑ **Consider blooming cycles.** Natives are available so that blooming can occur from spring to fall. Don't forget to provide materials that create winter interest, as well. Many native grasses can supply winter interest.
- ☑ **Consider using large areas of the same plant to create dramatic shows.** A large area of blooming asters is more stunning than one or two plants. This tip shouldn't extend to trees.
- ☑ **Encourage use of reclaimed/recycled materials.** Keep in mind that treated lumber contains toxins that may leach into the soils and water.

DEALING WITH LAWNS

Although it is preferable to replace lawns with other plantings and BMPs, there will usually be a desire to have a lawn space of some sort. To convert this lawn area to a conservation landscape space, advise the client of the following:

- ☑ Raise mower blades so they are cutting at a height of about 3". Leaving grass higher helps to choke out weeds and

eliminates the need for associated herbicides.

- ☑ Leave clippings on lawn. As they decompose, clippings will return nutrients back into the turf and feed important soil microbes. Clippings left on lawns DO NOT cause thatch, as is commonly believed. Heavy fertilization and frequent watering increases and causes thatch, and then only in cool season grasses.
- ☑ Convince clients that watering is not necessary. If the lawn is well established, a period of dormancy will not hurt it. The grass may turn brown and be unsightly for a time, but a refreshing rain will green it right up.

BMPs TO CONSIDER

As conservation landscaping gains in popularity, more and more types of practices become available. Several of the most popular and easiest to install are described here. Keep abreast of new technologies and options by reviewing information in the references suggested at the end of this chapter.

The more familiar you are with various BMP options, the more creative you can be in designing the site, solving problems and meeting goals.

Not all practices will be applicable to all sites. Keep goals and outcomes in mind, and remember how the water flows over any particular site.

RAIN GARDENS

A rain garden is a slightly sunken area, planted with natives, that is designed to retain rainwater for no more than 24 hours as it infiltrates through the soil and plant roots. Rain gardens are a popular best practice and can range from simple, small, easy to install areas to large areas using manufactured soils, amendments and additional drainage materials. They can be any size and are easily customizable to a particular

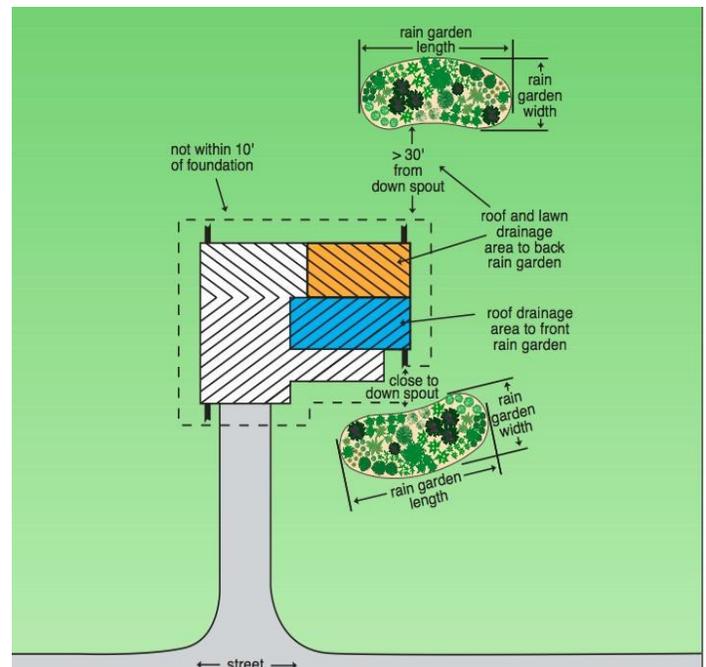
site. A plus for these gardens is that they can aesthetically appear as “typical” landscape beds, with some maintenance.



This rain garden treats street runoff.

Source: EPA

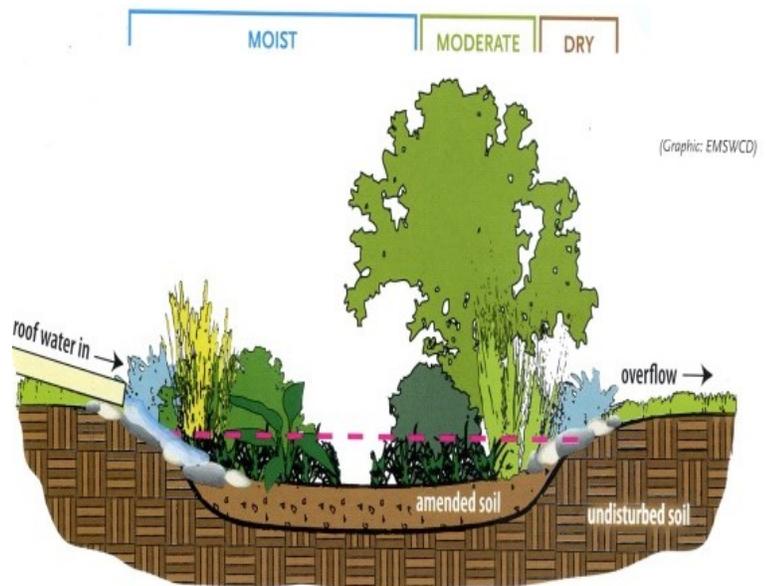
The goal of a rain garden is to capture water and retain it so it can slowly infiltrate and excess nutrients can be absorbed by plants within the BMP. It should be located in an area where rainwater runoff naturally flows and can be easily collected. A popular place for raingardens is where the downspout exits.



Things to consider when siting a rain garden:

- ☑ Know where underground utilities are.

- ☑ Do not place the garden where water currently stands. Standing water indicates the soil is not able to absorb water.
- ☑ Locate the garden at least 10-15 feet from the house to avoid moisture and pest problems.
- ☑ Placing a rain garden under a tree is not advisable as damage to roots will occur upon install.
- ☑ Slight slopes are ok, but avoid steep slopes.
- ☑ Site the garden where overflow from heavy rainfall can be handled.



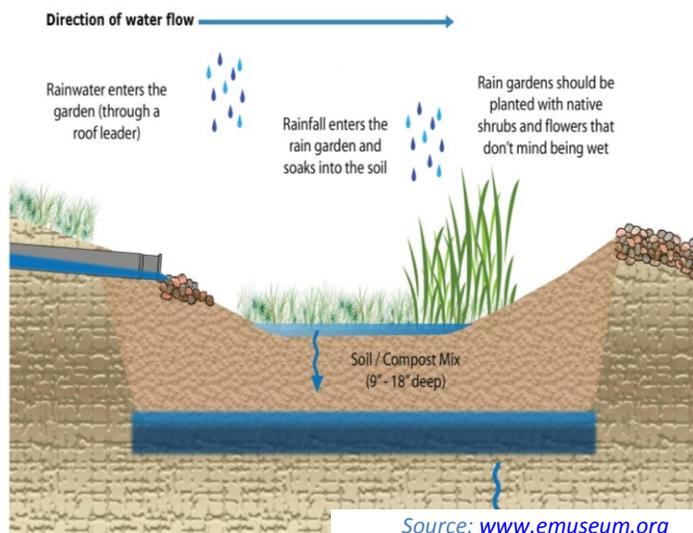
To create a rain garden, start by **determining the drainage area** that the garden will be expected to handle. A general rule for sizing a garden is to make sure it can easily handle 30% of the drainage area.

The area you choose must be able to drain naturally if amendments are not to be added. This basically requires a **perk test** be done in the area you choose. Test holes should drain completely in 24 hours or less. If the test holes do not drain, re-site the garden.

slightly amended with natural composts to speed drainage and avoid drowning plants.

The **bottom of the rain garden should be level** regardless of how deep. A series of gardens can be connected if needed to create additional area for runoff treatment. Connections can be made with other BMPs such as bioswales.

When **planting** a rain garden, three wetness zones should be expected. The lowest part of the garden will hold water the longest, so plants here will need to be able to tolerate standing water for short periods of time. Plants chosen for the middle zone of a garden should be able to handle wet and dry soil conditions and plants along the edges of the garden should be OK with drier soil conditions.



Mulch the garden with natural materials to protect the soils. Do not use large chips, as they will tend to float during heavy rainfalls.

BIOSWALES

Bioswales achieve the same goals as rain gardens by slowing and filtering stormwater, but can also be designed to manage an amount of runoff from a large impervious area, such as a parking lot or roadway.

The **depth of a raingarden** is usually determined in relation to the type of soil. A heavy clay soil will drain more slowly than a loamy or sandy soil so may have to be

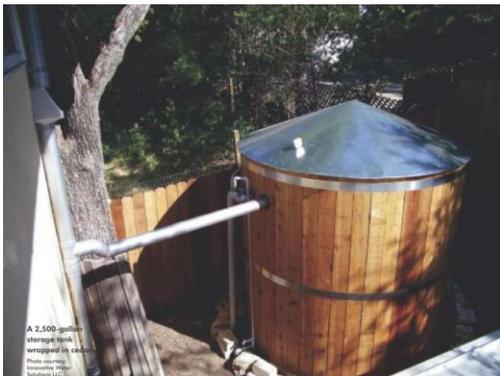


Heavily vegetated bioswale drains an office park & major roadway. Source: US Department of Agriculture

They consist of a swaled drainage course with gently sloped sides and are filled with vegetation, compost and/or riprap. The water's flow path, along with the wide and shallow ditch, is designed to maximize the time water spends in the swale, which aids the trapping of pollutants and silt. Depending upon the geometry of land available, a bioswale may have a meandering or almost straight channel alignment. Swales can be used to link other BMPs on your site. Like rain gardens, they are vegetated with native plants that can withstand both wet conditions and drought.

RAIN BARRELS

Rain barrels offer a means of collecting rainwater for use at a later time. Rain barrel systems can be sized depending on the needs of your site. A single rain barrel can be placed at a downspout, or multiple barrels and/or tanks can be connected in order to collect a greater amount of water. A system such as this is said to be a rainwater harvesting system.



A 2,500-gallon storage tank wrapped in cedar. Photo courtesy: Environmental Water Solutions, LLC.

There are two means of rainwater reuse, Active and Passive. Active reuse is storing the rainwater for various non-potable uses such as watering plants, washing cars, decks and patios and even flushing toilets. Passive reuse is leaving the valve on the rain barrel system open a bit or hooking a soaker hose to the valve so gravity can slowly release the stored water. With either use, it is important to know that the long term storage of rainwater should be avoided.

Stored rainwater cannot be used for drinking unless it is purified as specified by local, state and federal regulations.



Source: Clemson.edu

Rain barrels can be purchased as kits from many water quality organizations, or can be easily built. The important points to remember are to size the system for the needs of the client, make sure the top of the barrels is screened to keep out debris, and it may help to place a brick at the bottom of each barrel to keep it from being blown around on windy days when it is empty.

IMPERVIOUS SURFACE REMOVAL

This technique is the removal of current areas of impervious surface area. Remember that if an area is impervious, water cannot get through. Common impervious areas are parking areas, driveways, sidewalks, patios and roofs.



Depending on the percentage of impervious surfaces on a site, this may be a significant way to keep water onsite and allow infiltration.

Be careful to keep soil compaction to a minimum while removing these surfaces. Also research options for where the materials removed must be taken as waste or to be recycled.

Once the impervious areas are removed, replace the area with another conservation BMP. If the area is to be used as it was before the impervious surface was removed, suggest pervious materials to clients.

If it is no longer necessary for its original use, place another water quality BMP in that area to encourage infiltration.

PERVIOUS MATERIALS/PERMEABLE HARDSCAPES



Pervious and permeable just means that water can get through.

There are many ways to create pervious surfaces.

Take a look at the photos for ideas.



ONSITE WASTE MANAGEMENT

Onsite waste management may not be widely thought of as a BMP, but it is. Onsite waste management keeps materials like leaves and brush and vegetable & fruit waste out of landfills. Any materials that can be kept out of landfills, composted and reused on the site contribute to the overall water quality of an area. And that's all that needs to be done for this BMP. Educate clients on what is a compostable material and what isn't.

A simple chart such as this one can serve to educate clients and could be used as a marketing tool if combined with a business name and conservation landscaping options.

COMPOSTABLE	NO!
Grass clippings without pesticides	Anything with pesticides
Fruit & vegetable waste	Human & Pet Manure (carnivores)
Livestock manure without antibiotics	Meat scraps
Leaves	Bones
Egg shells	Grease
Coffee/tea grounds	Diseased plants
Paper Towels	Magazines/Glossies
Newspapers	Plastics

In order for compost to “work”, layers of green and brown materials must be alternated.

Compost bins come in many shapes and sizes. They are sold in kits, or easily made from new or recycled materials.



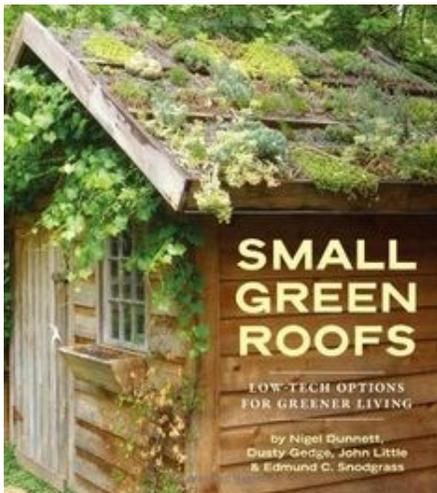
Depending on the materials and attention given to maintaining the pile, compost could be ready to use in a few months and will supply clients with an ongoing source of nutrients to replace synthetic fertilizers.

Using materials composted onsite assures that soil amendments are conservation friendly.

GREEN ROOFS

Roofs are an impervious surface often overlooked. On a homesite, a roof may not seem to be much of a stormwater runoff problem, but think of commercial sites such as large box stores. Oftentimes, the roof of a large box store or a parking garage can encompass an acre or more. That's a lot of runoff!

Although residential green roofs are often out of the budget abilities of most homeowners as they require fortifying the underlying structure and acquiring building permits and engineers to design, there may be areas where experimentation with this BMP can be done on a small scale just to show the client how it works. Sheds are a favorite site to try.

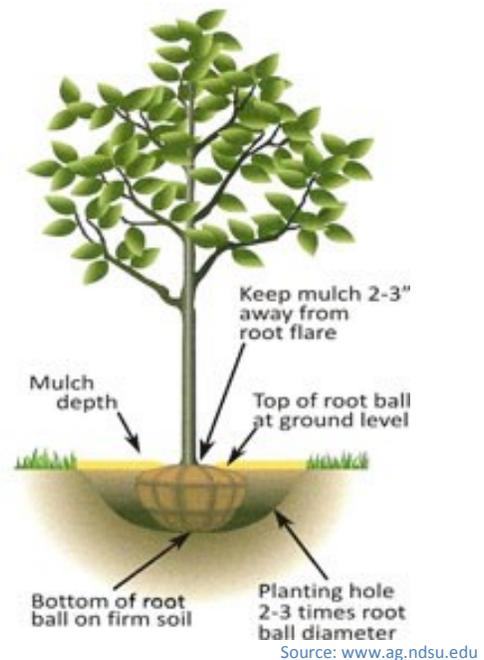


A green roof contains planting media and vegetation that act as filters for the rainwater that falls on the roof. Runoff is reduced, and the runoff that remains is filtered of some of the toxins and excess nutrients that would otherwise go directly into stormwater systems.

TREE PLANTING

Remember that anything that allows the slowing of rainwater can be considered a BMP. Tree canopy diffuses the rain before it hits the ground and greatly reduces the impact of rain on the earth's surface.

Recommend native trees to clients, and when possible, incorporate tree plantings into landscape beds to reduce trunk damage from equipment.



It is always a good idea when dealing with trees, to work with a certified arborist. A list of certified arborists can be found by searching the Mid Atlantic Chapter of the International Society of Arborists page:

<http://www.goodtreecare.com/>.

INSPECTION, MONITORING & MAINTENANCE

BMPS, no matter how simple, must be inspected frequently to assure they are working properly. Most small scale BMPs are fairly simple to inspect and maintain.

The best time to inspect a water quality BMP for functionality is after a rain event. In cases where no rain has fallen for quite a while, inspections should occur at least every 2 weeks. Inspections

can be as simple as to make sure the mulch cover is adequate in a rain garden, and plants look healthy and disease free.



If a rain garden looks like this a week after a rain event, something is wrong. Instruct clients to call if this happens.

Inspecting a rain barrel system should include checking the screen for accumulated debris, making sure the downspout is connected properly and that the spigot is working.

Pervious surfaces can be checked by applying water with a hose to check infiltration rates and abilities.

Regardless of the size of the site or the BMPs, a customized maintenance plan should be devised. This should be part of the service provided to customers once installation is done. Depending on a client's goals, the plan can span any length of time. A popular length for a plan is one year. That allows the client to see what needs to be done in each season. Or, if the BMPs installed require more frequent, regular inspection and monitoring, perhaps a monthly plan would be best.

Include things like how and when to inspect each BMP, what to look for if a BMP is not functioning as it should, what to do if the client finds a problem. Most things should be able to be taken care of by a client who has knowledge of how his/her new landscapes work.

WORKING WITH CLIENTS & THE COMMUNITY

Throughout this chapter much has been discussed about educating clients. This is an important piece of any conservation or landscaping project.

Without education and understanding, the client may not maintain the BMPs properly or appreciate their functions. If BMPs are not working as designed, clients may encounter serious water drainage and pest issues.

Some of the things clients should be able to understand:

- ☑ What regulations may limit what can be done onsite, or drive conservation landscaping to be installed
- ☑ What types of stormwater their site produces and where it goes
- ☑ How their new conservation landscapes reduce stormwater runoff and increase water quality
- ☑ What types of wildlife their new landscape might attract
- ☑ Differences to expect in appearances of plants from those that may have been treated with pesticides for disease and pests
- ☑ How varying mowing practices can help in keeping stormwater from running off site or creating erosion onsite
- ☑ How their new landscape interacts with those around it
- ☑ Opportunities for expansion of conservation landscaping
- ☑ Opportunities for tax and/or nutrient credits, if they exist

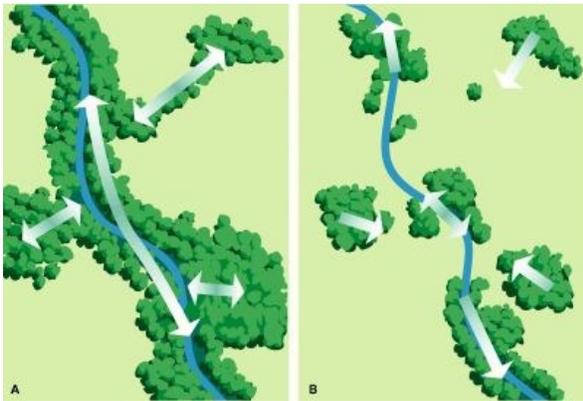


Educated clients will be able to discuss what has been installed for them with neighbors, friends and family and may refer your services to new clients.

MARKETING IDEAS FOR COMMUNITY CONSERVATION LANDSCAPING/ INTERCONNECTEDNESS

The real power in conservation landscaping is in linking together areas in which it is being used.

Linking areas creates wildlife corridors that allow animals to roam through natural habitat without interfering with developed human sites.



Source: vnrc.org

Consider approaching neighbors of current clients, local park authorities, churches, businesses, state and local facility managers, farmers, and others who may own land that could benefit from conservation landscaping. Explain how sustainable landscapes can be created for them. A bit of marketing to these audiences may yield more work in similar areas.

Within a typical park or urban locality setting, there are numerous opportunities:

- ☑ If pathways are paved (impervious), suggest swales alongside, or diversions to rain gardens
- ☑ Gutters from buildings should run into retention areas, such as rain gardens
- ☑ See if staffs can be worked with to create an education area sponsored by your business to explain and

demonstrate conservation landscaping techniques

- ☑ Suggest rainwater harvesting systems to provide water for ballfields and in-place ornamentals
- ☑ Offer to institute and manage an IPM/IVM program for the area
- ☑ Becoming certified as an Urban Nutrient Management Planner (VA DCR certification) will afford opportunities to create nutrient management plans within these areas, a much needed service that dovetails nicely, and in some areas is required, with conservation landscaping. Information on this certification program can be found here: <http://www.dcr.virginia.gov/soil-and-water/urban-nutmgt>

Businesses and localities in some areas may be eligible for conservation, tax and/or nutrient credits if they install water quality BMPs. Being familiar with these benefits will make promoting conservation landscaping even easier.

ESSENTIAL REFERENCES



These are the ones you MUST be familiar with for certification.

Regulations

This page contains links for Virginia's water quality regulations, including erosion & sediment control, stormwater & Chesapeake Bay Preservation Act.

<http://www.deq.virginia.gov/Programs/Water/Laws,Regulations,Guidance.aspx>

Information on the Division of Chesapeake Bay Local Assistance SITE PLAN SUBMISSION GUIDELINES can be found here. Note the sections pertaining to landscaping and BMP selection. Not all sites in Virginia will be subject to the Chesapeake Bay Preservation Act, but these guidelines offer great ideas for all of Virginia.

<http://www.deq.virginia.gov/Portals/0/DEQ/Water/ChesapeakeBay/siteplansubguide.pdf>

Best Management Practices (BMPs)

Information contained on the Virginia Stormwater BMP Clearinghouse site assists in implementation of appropriate BMPs to meet the requirements of the Virginia Stormwater General Permit, EPA has developed a National Menu of Stormwater Practices divided into six categories. Each of these categories of BMPs is linked to a separate web page on this site that provides BMP standards and specifications, or to resources outside of this web site that describe in more detail and provide useful reference material pertaining to the applicable practices.

<http://www.vwrrc.vt.edu/swc/StandardsSpecs.html>

This document contains GREAT information on how to build a raingarden, and has sample garden plans. It also shows the raingarden stages after several years of planting and offers a troubleshooting guide for non-functioning raingardens. It also offers great information on other BMPs and has an extensive reference section for native plant information. Please note one difference in this manual from the Virginia standards, and that is that this manual offers "conservation landscaping" as a BMP. This chapter teaches you that "conservation landscaping" is the encompassing of ALL practices used to reduce stormwater runoff and increase water quality.

http://chesapeakestormwater.net/wp-content/uploads/dlm_uploads/2013/04/Homeowner-Guide.pdf

From this link, you can download the "Conservation Landscaping Guidelines" document from the Chesapeake Conservation Landscaping Council. Here you will find more information on applying the eight (8) essential guidelines discussed in this chapter.

<http://www.chesapeakelandscape.org/2013/11/eight-essential-elements-of-conservation-landscaping-now-in-print/>

SUPPLEMENTAL READING

The more you understand conservation landscaping principles, the more options you'll be able to provide your client and the more creative you can get in achieving goals... use these references to learn more deeply about the identified subjects.

Best Management Practices (BMPs)

This technical bulletin from the Chesapeake Stormwater Network has great information on how to inspect and maintain bioretention BMPs. It also has a great section on how these BMPs work. <http://chesapeakestormwater.net/wp-content/uploads/downloads/2013/10/FINAL-VERSION-BIORETENTION-ILLUSTRATED-102113.pdf>

This Better Site Design Manual will help you to understand how BMPs work in reducing stormwater and in increasing water quality. The manual is a bit technical, but still offers good background information.

<http://www.deq.virginia.gov/Portals/0/DEQ/Water/Publications/SiteDesignBrochure.pdf>

Montgomery County, Maryland is the leader in adopting regulations and BMPs for use in residential and other settings. This link gives you a great deal of information on various BMPs. Again, note that conservation landscaping is a BMP here and this chapter teaches you that conservation landscaping is the encompassing of ALL practices used.

<http://www.montgomerycountymd.gov/dep/water/rainscapes.html>

There is some great information here on when BMPs need maintenance.

<https://www.novaregion.org/DocumentCenter/Home/View/1675>

Virginia Conservation Assistance Program offers assistance to homeowners and information on BMPs.

http://www.tjswcd.org/docs/urban/VCAP_Manual_July_2015.pdf

This reference offers information on why stormwater is a problem and outlines BMPs used in the NoVA area.

<https://www.novaregion.org/DocumentCenter/Home/View/1676>

The Urban Nutrient Management Handbook is chocked full of information on soils, stormwater, BMPs and fertilization and nutrient issues. If you'd like to learn more in these areas, consider taking the DCR Urban Nutrient Management Certification course.

<http://www.hort.vt.edu/Documents/FoxUrbNutMgmt.pdf>

US EPA has a multitude of resource material on stormwater. This is a bulletin explaining conservation design and landscaping in relation

to discharge permitting laws and has an extensive resources list.

http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/upload/region3_factsheet_lid_esd.pdf

General Conservation Landscaping Information

Virginia DCR Urban Nutrient Management page offers information on Virginia's Watershed Implementation Plan, nutrient management planning and general information on how to increase water quality. It also has information on the steps to becoming a certified nutrient planner.

http://www.dcr.virginia.gov/soil_and_water/urban-nutmgt.shtml

Landscapes for Life, a program of the US Botanic Garden, offers a multitude of information on conservation landscaping.

<http://landscapeforlife.org/>

They also teach a course based on their "Sustainable Sites Initiative" and the manuals and PowerPoint presentations can be downloaded here. A great site for easily understood background information!

<http://landscapeforlife.org/resources/>

Virginia Native Plants

Virginia DCR Natural Heritage program. Note the brochures on the right side of the page. These are excellent resources for native plants by region!

http://www.dcr.virginia.gov/natural_heritage/nativeplants.shtml

Virginia Native Plant Society

<http://vnps.org/>

Piedmont Environmental Council offers a list of plant links. The links to the Department of Forestry lists will give you information on natives beyond perennials, to include trees and shrubs.

<http://www.pecva.org/our-mission/wildlife-habitat/154-native-plants-pollinators/477-native-plant-lists>

This resource offers good information on choosing natives for pollinators in the western regions of Virginia.

<http://pollinator.org/PDFs/CentralAppalachian.rx4.pdf>

Northern Virginia Native Plants information.

<http://www.fairfaxcounty.gov/nvswcd/newsletter/nativeplants.htm>

<http://www.novaregion.org/DocumentCenter/View/10615>

This is a great database that allows you to put in your own specifics, such as choosing a shrub that is low growing, native to Orange County, spreads slowly and likes partial sun. A great site!

<http://www.albemarle.org/nativeplants/>

Integrated Pest Management (IPM)

EPA Integrated Pest Management information and fact sheets.

<http://www.epa.gov/pesticides/factsheets/ipm.htm>

The National Pesticide Information Center offers fact sheets and general information.

<http://npic.orst.edu/pest/ipm.html>

Virginia's Office of Pesticide Safety offers IPM basics and some identification guides.

http://www.vapesticidesafety.com/integrated_pest_management.shtml

Integrated Vegetation Management (IVM)

EPA Fact Sheet.

http://www.epa.gov/pestwise/htmlpublications/ivm_fact_sheet.html

Penn State University IVM Information.

<http://extension.psu.edu/natural-resources/forests/vegetation-management/ivm-principles>

Invasive species

Laws & Regulations pertaining to Invasive Species.

http://www.dcr.virginia.gov/natural_heritage/vaisc/laws.htm

Virginia's Department of Conservation & Recreation maintains the state's invasive species list and has a working group of professionals who deal with invasive species issues.

http://www.dcr.virginia.gov/natural_heritage/vaisc/index.htm

The USDA National Invasive Species Information Center has information on invasives nationwide and offers profiles of invasives for identification purposes.

<http://www.invasivespeciesinfo.gov/plants/main.shtml>