Sustainable Landscapes

Rain Gardens, Bioswales and Xeric Gardens

Managing Rainwater in Your Yard:
A Manual for Homeowners and Small Properties in Omaha

Steve Rodie, FASLA • Ted Hartsig, CPSS • Andy Szatko

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Little Joe Pye Weed at the UnderTheSink facility.

Meet the Authors

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Ted is a soil scientist with Olsson Associates, having more than 25 years of experience in natural resources management and restoration. Much of his program work focuses on stormwater management through the integration of natural soil and plant resources. He has extensive experience in developing, designing, and constructing stormwater management systems to minimize runoff, improve water quality, and reduce on-site costs for stormwater control in both residential and commercial applications.

Ted has authored numerous reports and articles, and coordinated and led numerous workshops regarding soils in environmental management and stormwater control.

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Table of Contents

Introduction

The demand for clean water is growing exponentially as supplies dwindle, so it has become increasingly more important for homeowners to manage and conserve rainfall on their properties.

You've seen heavy rain fall on your driveway, sidewalks, and yard. When it pools, it starts to flow downhill with increased velocity. This runoff can quickly cause flooding and erosion damage. You may also have noticed the poor quality of the runoff water which is due to the sediment, chemicals and other pollutants that are washed off bare soil areas and streets.

Have you ever wondered how you can more effectively control rainwater on your property? Sustainable landscaping emphasizes the capture and reuse of water from residential and commercial landscapes. Sustainable landscapes help manage runoff and provide beauty and value to your property. Basic design principles such as integrating well-adapted plants and working with the natural features of your yard can help enhance water quality, reduce water, chemical, and fertilizer usage, and even ease landscape management chores. Along the way, you'll probably also save money!

Prairie Crossing is a noteworthy residential subdivision in Illinois that has implemented many sustainable design principles.

1. Rain garden at the Iowa School for the Deaf.
2. The landscape at the National Park Service Headquarters Office in Omaha is a good example of an Eastern Nebraska sustainable landscape.

What are Sustainable Landscapes?

Sustainable landscapes are those that nurture and preserve themselves over time and don't require any additional amounts of water, chemical fertilizers or pesticides. In the Omaha area, sustainable landscapes include rain gardens, bioswales and xeric gardens. They are typically constructed with plants native to Eastern Nebraska or plants adapted to this region.

Rain gardens are designed to manage stormwater in urban environments. They are built as shallow depressions in yards designed to collect runoff, maximize infiltration and channel excess water slowly to the nearest outlet. In addition, they are intended to be attractive amenities that can complement the landscape of your home and the community.

Similarly, bioswales are shallow depressions, but are open-ended to direct water in a more natural manner. Bioswales can be natural extensions of rain gardens, or part of your sustainable landscape.

Gardens not intended to collect or direct rainfall are called xeric gardens, and they are designed for drier parts of a yard. They filter rainwater where it falls and help conserve our water resources.

Omaha's Unique Environment and Prairie Heritage

Omaha and other communities in this region were built on grassland prairies and upland forests formed in deep, rich soils. We experience cold winters, very warm and sometimes dry summers, and typically wet springs. Intense thunderstorms and heavy rains are common in the spring, and rainfall is common throughout the summer and autumn.

We also have unique deep wind-blown soil known as "loess." Loess soil is characterized by high silt content and is easily eroded if not protected by deep-rooted plants. When left unprotected by vegetation, exposed loess soil erodes easily, especially in developed areas, and can have a significant impact on soil resources and public safety.

A bioswale along a residential street collects and filters stormwater runoff without curb and gutters.

Extensive erosion results when large amounts of stormwater runoff no longer infiltrates soils in urbanized developed areas.

Omaha's natural environment was formed by rich prairie vegetation and soils.

The Main Objective: Disconnect Runoff Water

Regardless of what types of gardens or landscapes are created, the key objective for residential properties is to hold and filter water on-site before it gets to a street or storm sewer. Wherever possible, rainwater should be disconnected from flowing directly offsite (as happens in the photo above). Whether it flows through a rain garden or bioswale (as shown below), across healthy turf, or into a landscape bed before it leaves the site, the water quality and soil moisture in a yard will be enhanced.

Why Create Sustainable Landscapes?

In a time when environmental and water quality, protection of personal property, and costs of maintenance are so important, sustainable landscapes provide an attractive and economical approach to landscaping that also helps the community. Here are a few things to consider:

- Sustainable landscapes are a cost-effective way to manage and improve stormwater quality.
- They add value to your property with distinctive landscaping options. Sustainable landscapes help properties retain or even increase their value.
- Sustainable landscapes present a sense of place unique to Omaha's natural heritage.

What's Next?

This manual provides homeowners with important knowledge to help design and build sustainable landscapes. Along with Omaha-specific information, you will learn about site assessment, garden design, drainage and soil management, effective selection and use of plants, and the relative costs associated with sustainable landscapes.

Notes

The Landscape Environment

To design a successful sustainable garden, homeowners must have a good understanding of the features that define their landscape. Regardless of the age of your home, your yard has its own micro-climate, with physical and environmental factors to consider. These factors include basic soil type, wind characteristics, slope, drainage patterns, existing trees, and seasonal variations in sun and shade patterns. A rain garden located near your home or under a tree, for example, will have dramatically different environmental conditions than a garden located on a slope in full sun.

This chapter will address specific environmental conditions within the Omaha region and how different site characterstics can affect the design of your sustainable garden.

1. Coneflower
2. Pink Turtlehead
3. Sneezeweed

A small rain garden project in Bellevue, Nebraska.

A rain garden that blends into an existing landscape.

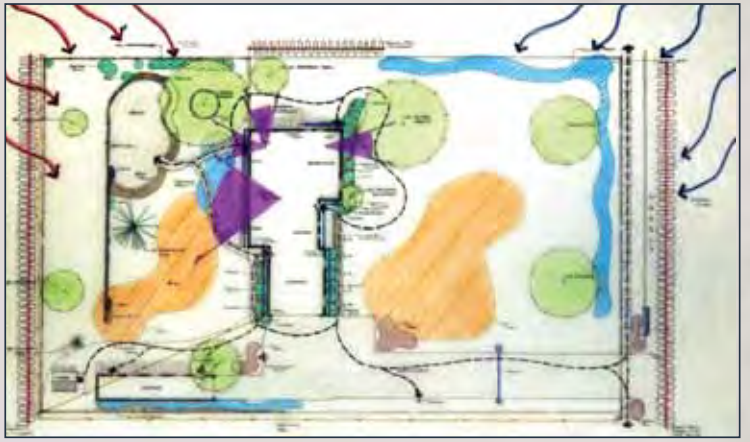
Site Characteristics and Conditions

Regardless of how simple a sustainable landscape design and installation appears, it is important to evaluate the characteristics of your yard and the surrounding yards or properties that will directly impact the landscape design. The conditions of your yard must be matched to the goals you have set for your landscape features and proposed design concepts. These conditions will help your design concepts evolve into an attractive and functioning garden.

While this manual can help with recommendations, homeowners must ultimately look at their own property for clues to successful garden design. Vegetation, topography, soil conditions, and drainage patterns can vary dramatically within a neighborhood or even a back yard. Homeowners are the best resource for knowledge of these characteristics, plus they are most aware of sun and shade locations throughout the growing season, wind direction, and the relative health of existing plants on their own property.

Suburban sprawl increases the amount of rainfall runoff that will then damage our streams and increase flooding. Photo courtesy of the NRCS.

The planning of your sustainable landscape should start with an inventory and analysis of property conditions. When assessing the condition of your property, you need to consider soil characteristics, drainage patterns, local climate, and existing vegetation. The figure below illustrates a typical analysis for a proposed design that identifies potential rain garden and bioswale locations (in blue).



A thorough site analysis of a residential property will help identify the best places to locate rain gardens, bioswales and dry landscape gardens.

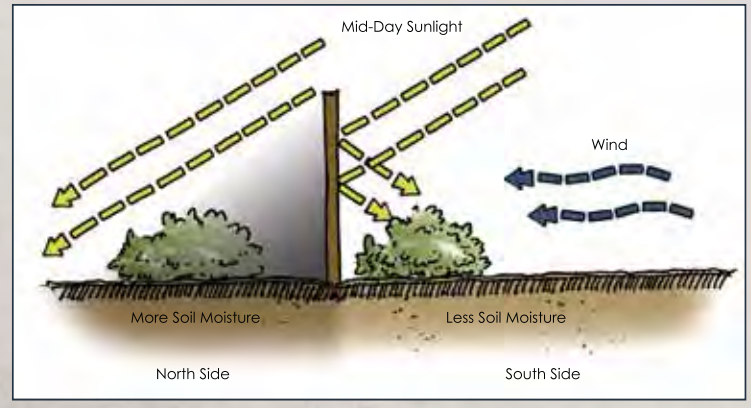
You should also consider your garden's visual appearance and maintenance within your neighborhood's overall landscape. Your neighborhood probably has a visual sense of place that dictates how formal or informal a landscape feature should appear. Rain gardens designed with curved edges, variable plant masses and tall plants will appear informal, whereas straight edges, structured plant massing and relatively shorter plants will appear more formal and manicured.

Your Yard's Microclimate

Environmental

It's important to determine the direction of prevailing winds and your garden's exposure to wind. For instance, will the garden location be open on top of a hill? Is the site nestled in a neighborhood valley with large trees? Gardens installed on the north side of a structure or fence will have less exposure and drying from wind than those open to the southeast. A landscape microclimate that has minimal air circulation will likely experience a higher level of plant diseases than an exposed location. Under these conditions, disease-resistant plants or specific cultivars will be necessary.

Sun and shade patterns on your yard affect soil moisture and the health of plants and trees. The north side of a home normally provides shaded conditions throughout the day, but in the middle of the summer when sun angles are sharpest and temperatures are highest, the shaded area near the home are significantly smaller than during the fall and spring seasons. Conditions on the south side of a building are normally hotter and drier due to full sun exposure. Shade from trees moves throughout the day, and will vary from light to filtered to dark shade depending on tree canopy shape and type of leaf.



Landscape position creates a microclimate that will dictate what plants will be successful.

Butterfly Milkweed at the Iowa School for the Deaf.

Physical

The physical and aesthetic character of a completed garden is just as important as its functional qualities. Homeowners should keep this in mind as they design, select plants, and develop long-term management specifications.

Normally, locating gardens within the root zone of existing trees is not recommended due to the potential for tree root disturbance and/or changes to soil moisture. If a garden is near a tree, however, a thorough understanding of shade and sun conditions is required to successfully match garden plants with growing conditions.

Subtle Slopes

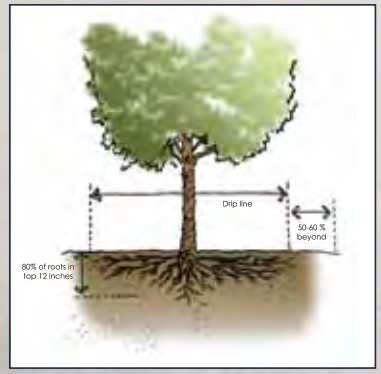
All slopes should be verified with a string, laser or builder's level to assure an accurate measurement. Slopes of 1% or 2% are very gradual, and very difficult to estimate accurately. For example, a slope directed toward a street, an adjoining property, or a structure in your yard should be measured carefully.

Topography and Slopes

The fact that water runs downhill may seem simple, but the slopes and high and low points in a landscape that dictate where water flows are not always so simple. It is important to identify the direction of water flowing across your property. Some slope is necessary to direct water into the garden and even out of the garden if it overflows. Rain gardens and bioswales are not typically recommended on slopes steeper than 12% since the cutting and filling of soil becomes more difficult on steep slopes. Sustainable landscape principles can be used, however, to reduce drainage on excessive slopes and the potential for damage by unchecked flow of water. Working with slopes is presented in detail in Chapter 3.

Existing Vegetation

If vegetation already exists on the site, and potential garden locations are adjacent to or within root zones or under canopies, each location should be assessed for compatibility with changes to soil moisture, grading of existing soils, and disturbance to roots. All healthy trees have a significant amount of root zone in the top six to 12 inches of soil for ready access to moisture and oxygen, so excavation and root disturbances within and to 50% beyond the drip line of a tree should always be avoided if possible.



Knowing the extent of plant roots (especially trees) is essential for selecting sustainable landscape locations.

Water, Soil and Plants: Working Together

Water

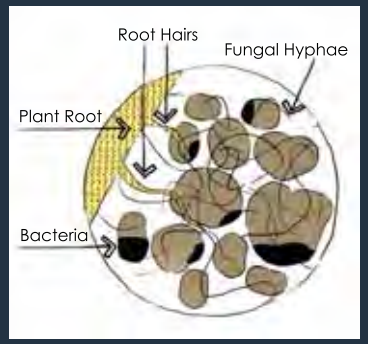
Water is the element that sustains the plant life of our gardens and can cause chronic problems if not managed properly. In the Omaha region, stormwater runoff, when left unchecked, most often flows between properties and across pavements into low-lying areas of our yards and sometimes even our houses or offices. When stormwater is collected in a rain garden, the garden helps to control water volume and velocity, and brings the water back into the soil where it can be stored for future use to sustain plants, cool the air, and flow slowly to streams to sustain their long-term flow. Here are some important facts to know about water:

- It collects rapidly across impervious or non-penetrable surfaces such as roofs, driveways, and walks, increasing in volume and erosive power. A 1,000-square-foot roof will shed over 625 gallons with a typical one inch rainfall. Most residential lots in Omaha have from 1,500 to 5,000 square feet of runoff surfaces.
- Water is a great temperature modifier, cooling air temperatures and reducing our demand for energy used by air conditioning. To cool the air, however, water must go through the soil, and then through plants.

This connection from downspout to the street sends hundreds to thousands of gallons of water directly into the storm sewer every time it rains.

Soil

Soil is the fundamental building block of successful sustainable landscapes and rain gardens. Typically, the native soils in our neighborhoods have been stripped of rich, deep topsoil, and the remaining clayey subsoil has been compacted. It is difficult for water to penetrate it effectively. Such drastically disturbed soils can be rehabilitated with strategies that involve improving its organic content, using native and/or adapted vegetation, and understanding some other elements of how soil works.



Soil Biology

The soil is a very active living organism. Soil fungi and bacteria help transport water and nutrients to plant roots, and help bind soil particles together to create rich, friable soil that rapidly absorbs water and supports plants.

Important soil facts include the following:

- Soil is more than just sand, silt, and clay. In fact, soil is a very active, living system in which billions of microbes, fungi, plant roots, and animals interact to create an environment that supports nearly all of the terrestrial life on earth. It is this organic aspect of soil that opens pores – even in clay – that allow water to infiltrate and be stored. It also absorbs and holds nutrients to support plant growth while filtering pollutants from water that seeps into the ground.

- Soils form in layers, or horizons. Loess soil is very high in silt. Over time, the silt breaks down into smaller clay particles, which moves deeper into the soil profile. The deeper subsoil is often very low in organic matter and high in clay, so it is difficult to work with. Unfortunately, this is the layer of soil that is often left after the land is developed.

- Layers of soil with differing textures can restrict water movement into and through the soil. A common mistake made in landscaping is to cover sandy, more porous soils with tighter, more clayey soils. Water will move into the clayey soil slowly and not drain into the lower sandier soil. As a result, the sandier subsoil gets little to no water, and the more clayey upper soil has a limited amount of water to support plants. Commonly, plants in these areas suffer drought stress very quickly and often die.

- In managing soil, structure is more important than texture. Soil structure is the condition of the soil, whether it is friable (easily broken, usually with large pores), platy (soil particles lay flat and stack on top of each other forming a barrier), blocky (soil "crumbs" that have angular edges), or massive (little to no structure, often becoming very hard when dry). Soil structure will often dictate more about how water moves into and through it than soil texture will.

- Tight, clayey soils are not made more porous or friable by adding sand. Clayey soils can be made more porous by mixing in organic matter – typically compost or peat moss – and allowing the mixed soil and organic matter to grow together.

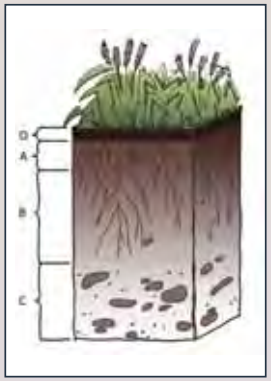
- The deep growing roots of native plants extend through soil (even clays), opening pores and expanding the biological "richness" of the soil while also accessing moisture deep in the ground.

- Soil management is critical to the success of your sustainable landscape and rain garden. By understanding the soil conditions and how you use them, you can make your garden both functional and attractive.

Typical home construction site with soil stripped of organic matter (O horizon).

A Typical Omaha Soil Profile

Omaha's soils formed in rich, deep wind-blown soils high in silt. The horizons, or layers of the soil include:



O Horizon – Made up mostly of leaf litter and decomposed organic matter, this layer is generally about two inches deep.

A Horizon – The A horizon is commonly called topsoil. Seeds germinate and plant roots grow in this dark-colored layer. It is made up of decomposed organic matter mixed with mineral particles. This layer is generally two to more than 12 inches deep.

B Horizon – This horizon is also referred to as the subsoil and it contains clay and mineral deposits, like iron and calcium carbonate, that it receives when water drips from the soil above. The B horizon is generally 20 inches or more in depth. This layer is often mistaken for topsoil in urban areas, because grading practices in large developments usually removes the O and A horizons.

C Horizon – The C horizon consists of clay and slightly broken-up bedrock. Plant roots do not penetrate into this layer; and there is very little organic material. This layer is deep in the soil profile and is generally 15 to 20 inches deep.

Rain garden at the Iowa School for the Deaf that includes Lambs Ear, Iris and Columbine.

Plants

Depending on the location and visibility of your sustainable landscape, whether it's a xeric (dry) garden, rain garden, bioswale, or a combination of them, the plants you use will determine the success of the garden.

Native plants, those that grow and reproduce naturally in a region, are the preferred plants for rain gardens due to their inherent qualities. Non-native adapted plants can also fill an important role in sustainable landscapes. Non-natives that are deep-rooted,drought tolerant and can stand short periods of flooding are well-suited for use in rain gardens.

Native Plant Facts!

Below are some important facts about native plants:

- Deep roots help the plant survive in drought and other difficult growing conditions, while creating additional pore space over time in the soil. Native plant roots can extend 15 or more feet into the soil.
- Old dying roots are replaced with new roots over time. This ongoing transition continually reinvigorates the root system while creating additional soil pore space, increasing water infiltration and storage.
- Plants native to the area are adaptable to local climate extremes in temperature, moisture and sun exposure.

Gayfeather (liatris) is an excellent example of a native plant that is deep-rooted, tolerant of wet-soils, and provides valuable habitat for butterflies and insects.

- They can provide habitat value, including food and cover for insects, birds and other wildlife.
- Once established, native plants use water efficiently and need very little fertilizer or other chemicals.
- They are not considered invasive, although this can vary dramatically for native plants that are used beyond their normal range of growth. For example, well-behaved plants on a dry site may become invasive when moved to a site with significantly more moisture.
- They help define our region and ecosystem. "Nebraska-style" landscapes, as defined by the University of Nebraska and the Nebraska Statewide Arboretum, can celebrate the diversity of prairie and river corridor vegetation and landform. More information can be found online at http://arboretum.unl.edu.

Of course, using native plants also has some limitations:

- Native plants may not be as accepted or look as attractive as more traditional landscape plants stocked at local nurseries and garden centers, because limited root/plant growth in pots, together with relatively short bloom periods, can limit their visual appeal. Native plants tend to focus much of their newly planted energy on root growth and establishment for long-term success.
- Native plants can appear weedy, especially if relatively tall species are planted in areas where they are out of scale with surrounding plants, or where plants lodge (flop over) onto adjacent plants or bed areas.
- The often more informal natural character of native plants, when compared to more traditional, trimmed/sheared landscaping, can generate a visual contrast that may not appeal to some people.
- Soils in developed landscapes are typically compacted, and often lack the organic matter of native soils. Although usually adaptable, native plants placed in non-native soils can experience limited planting success without intensive management.

Remember!

Water, soil and plants must all be carefully considered and managed when designing and building sustainable gardens. Combining this information with the climate, slope and environmental conditions helps ensure that your garden is successful.

Taking the Right Approach

Rain gardens and bioswales are just two approaches to effectively managing rainfall runoff on residential properties. Rain barrels, underground storage of runoff for irrigation and porous paving are among other valuable strategies. A holistic approach to runoff management takes into account conditions, needs and solutions for the entire site, and it will result in more environmentally sound and cost effective sustainable gardens.

This chapter discusses the benefits of using sustainable landscape design for creating xeric gardens, rain gardens and bioswales. Determining the right approach for introducing sustainable landscape design and rainwater management practices on your property is not difficult, but it takes careful planning. This means getting to know your yard and the environment that defines it.

Rain garden at the Iowa School for the Deaf.

Examine Your Property for Impervious Surfaces and Where Water Drains
Knowing where rainwater runs off from your house, paved areas and lawn will help determine where to place sustainable landscape features.

Know Your Yard

To determine how and where a sustainable landscape is most feasible, take time to get to know your yard. Observe what plants have been the most vigorous in your yard, and where they grow best with the least maintenance. What happens when it rains? Does the water sit and slowly infiltrate into the ground, or does it flow to low spots and create drainage problems? Know what the soil is like in your yard, and if plants grow better in some locations than others. Also consider whether you have to water frequently during dry times or if you use a lot of chemicals to keep the grass alive.

Make a Map of Your Property

Making a map of your property as you take inventory of the environmental features of your yard – and those of neighboring yards – will help develop a picture that clearly shows where your sustainable landscape features will perform and look the best. This chapter will help you to understand the elements of your yard and show you the right approach to make sustainable landscapes work for you. When you understand the environment of your property, you can then set goals and expectations for your landscape design.

Initial Observations

Determine what plants are growing in your yard and in your neighbors' yards. As you make these observations, note the following:

- Do established trees and shrubs dominate the landscape? This is usually the case in Omaha's older neighborhoods.
- Do the trees present a heavy canopy with substantial shade? When trees are dominant, they intercept a substantial amount of rainfall and provide an excellent means of reducing runoff and filtering pollutants from rainwater. Note the condition of the trees and the vegetation below them, and whether they should be managed differently.
- Do some trees need pruning or removal, or have some shrubs become overgrown and unmanageable? Many silver maples in Omaha are old and need to be removed. Also, willows have effective life spans of 15 to 25 years before they start to weaken or become unstable. Some trees may not be well

Established Bellevue, Nebraska home where the front drive drains straight into the home's foundation.

adapted to Omaha and may either detract from your yard's attractiveness or may actually pose a safety threat. If trees are old, overgrown or invasive, you might consider removing and replacing them. Similarly, some shrubs can be very invasive and become overgrown, spreading prolifically and requiring substantial maintenance.

- Do you have heritage trees on your property? These are trees that have been part of your property's natural landscape for many years. Their landscape value is measured in both beauty and enhanced property value. Any consideration of landscape changes, including more sustainable approaches, should take into account the value and function of these valuable trees.

Many drainage patterns and problems may be associated with neighboring yards that direct runoff into your yard.

- Your property may be in a newer area with little to no established landscaping. Look around nearby neighborhoods to see which plants and trees are thriving best. Many newer developments were likely planted with turf grass (usually blue grass and turf-type fescue) and ornamental shrubs. Trees are also typically planted, but their size and impact are easy to project.

These factors should influence your choices of how and where you will design your sustainable landscape features and your expectations for how it will look and perform.

Lay of the Land

You've noted the vegetation of your property. Now what is the lay of the land? Rolling topography will create different microclimates, as discussed in Chapter 2. It is important to know the orientation and steepness of slopes on your property before you determine where and how large your rain garden or landscape features may be. There are three terms that apply:

Slope

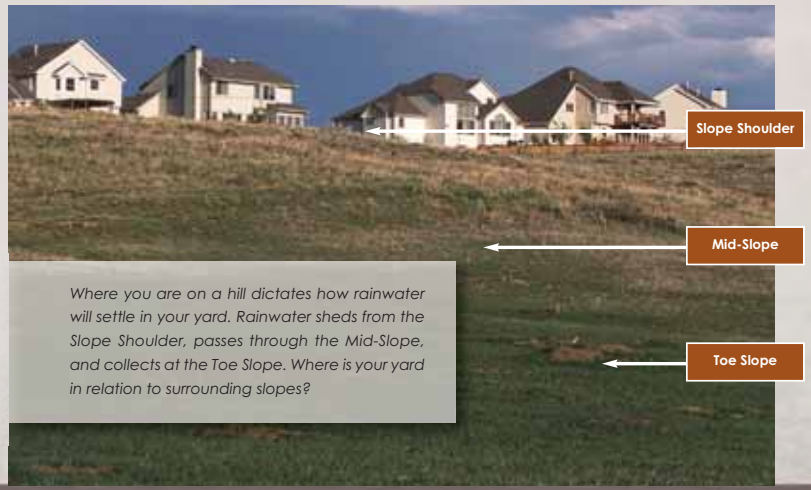
Slope is how much your property rises or falls from one point to another. Most urban or suburban lots will have one general slope, so the property is higher at one end or corner than the opposite end. On more rural or larger properties, it's not unusual to find varying slopes across the yard, perhaps with high and low points in several locations. It is important to note how slope affects rainfall runoff across your property, as it will determine not only how fast water will flow, but where it will likely concentrate, where it will go, and if it could do damage.

Aspect

Aspect is where you are located on the general slope of your surrounding environment as well as which general direction the slope is facing. You may be located on the top of the slope, where water will begin to drain; at mid-slope, where water flows across your property; or at the bottom of the slope, where the flow of water ends.

Connectivity

Connectivity is the length and width of the drainage area that leads to your property. A continuous flow of water will have no or very few interruptions. The longer the continuous flow, the greater amount of rainfall runoff will be transported to your yard or into your rain garden. If there are features in the landscape that disrupt the connectivity, such as drains, ridges, buildings, or other features, less water will be directed to your yard.



Where you are on a hill dictates how rainwater will settle in your yard. Rainwater sheds from the Slope Shoulder, passes through the Mid-Slope, and collects at the Toe Slope. Where is your yard in relation to surrounding slopes?

Knowing Your Slope

If you're in a part of Omaha in which the topography is rolling, you probably have a pretty good idea about the slope of your property, but you may not really know how severe it is. In other parts of town, your property may appear to be quite flat, and you may suspect that you have little to no slope. Even slight amounts of slope can have a significant effect on how water flows across your property. There is a simple method of determining how much slope you have in your yard, and in what direction. Using string, two poles, a string level, and a tape measure, you can easily measure the slope in your yard, as described below:

1. Tie a length of string six or 12 inches from the bottom of a straight pole set at the highest point of the slope you are measuring. Tie a loop in the far end of the string and loop it over the second pole, placed at the bottom of the slope.

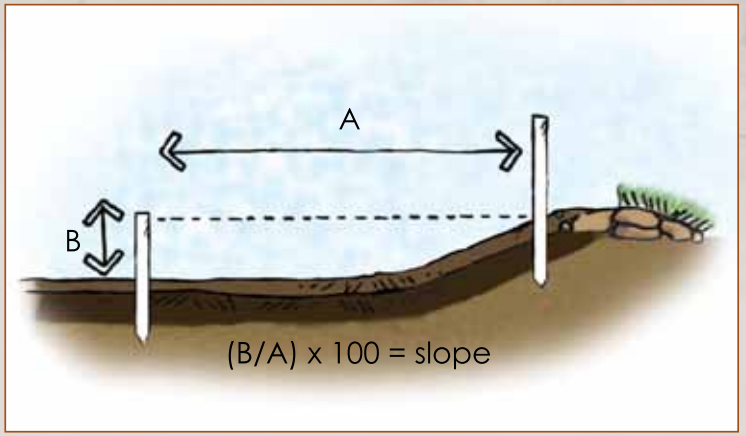
2. Pull the string taut and level. The height of the string on the second pole should be higher from the bottom than on the first pole. Use the level on the string to ensure accuracy.

3. Measure the height of the string on the second pole from the ground using the tape measure. The difference in heights of the string from the ground between the two poles will provide the amount of drop you have between the two poles.

4. Use the "Calculating Your Slope" worksheet to find your slope.

5. Keeping the first pole in place, repeat this process at multiple locations. When you compare the numbers, you can determine the direction of the slope, and where water will flow to.

6. Using the diagram of your property, map your slope measurements. Mark with arrows the direction of the slope.



Calculating Your Slope

Measure distance in inches between the two stakes. A = _____ inches

Measure the height of string above the ground at point. B = _____ inches

Calculate Percent Slope:

1. Divide B by A.

_____ (B) ÷ _____ (A) = _____ (X)

2. Multiply X by 100 to get your percent of slope.

_____ (X) x 100 = _____ % (Percent of Slope)

Large manhole and drain pipes in a backyard where rainwater was an afterthought.

An Omaha sustainable landscape that embraces rainwater into it's planning.

A rain garden that is taking runoff from the street and creating a functional and beautiful amentity for the neighborhood.

Managing Rainwater on Your Property

You've completed a pretty thorough examination of the environment affecting your yard, and how rainwater is part of that picture. You now want to consider your general approach for designing a sustainable landscape. As you determine your approach, consider the following:

- Consider a systematic approach to rainwater runoff that includes sustainable garden features, possibly multiple rain gardens and bioswales to help move excess water through your yard.
- If the slopes on your property are significant, consider bioswales, which will slow water running to rain gardens or to other drainage features.
- As you plan the rain garden, don't be concerned if you don't have a large area to work within. Anything you do will improve water quality, conserve water in your yard, and provide a very attractive garden. You may be surprised at how effective a small rain garden is in collecting and infiltrating water into the ground.
- Consider starting small, with one rain garden that collects runoff from your roof or driveway. As you gain experience and understand how the rain garden or other sustainable landscape features work, you can expand your sustainable landscape to handle more water.
- Sustainable landscapes don't have to include rain gardens. Garden areas with native plants will capture rainwater that falls directly on them and reduce the amount of runoff that would otherwise flow to other areas in your yard. Sustainable landscapes, with or without rain gardens and bioswales, are very effective in reducing runoff and enhancing Omaha's water quality. You can slow down runoff on properties with healthy tree canopies, loose soils, and deep-rooted plants; and by disconnecting all direct links from roof and surface runoff to the storm sewer.

Establishing Goals and Expectations for Your Sustainable Landscape

Chapter 4 will describe the design process for sustainable landscapes. Before the actual design begins, it is smart to set goals and expectations for the appearance and performance of the landscape. Consider the following design elements when preparing your plan:

Sustainability

Sustainable landscape design enhances the look and functionality of your landscape, maximizing environmental benefits, minimizing resource inputs and maintenance requirements, and generating long-term cost savings. Sustainable design ensures a completed landscape that will stand the test of time, mature gracefully, and require less maintenance.

Garden Form and Character

Traditionally, landscape character tends to focus on a neat, manicured appearance, but it also requires significant water, fertilizer, and chemical management. On the other hand, xeric (dry) gardens, rain gardens, and bioswales often exhibit the informal natural-style character of native plants. Gardens can be designed with formal straight-edges and planting patterns and be kept neatly trimmed, but when free-growing plants are placed next to or within a neat arrangement, they can lose their appeal.

Performance

A well-designed sustainable landscape should effectively reduce the amount of runoff from rainfall, as well as reduce chemicals and fertilizers used to maintain your landscape. These benefits enhance overall performance as well as the cost effectiveness of the landscape over time.

Successful Design

You already know why sustainable landscapes are important. You've done a lot of work to understand your yard and its landscape characteristics. You have a good working knowledge of how rainwater flows through your property, your neighborhood vegetation, and how plants, soil, and water interact. Finally, you have a strategy of what you want to accomplish with sustainable landscaping. It's time for design.

1. Rain garden in Washington County, Nebraska.
2. The Zneth (Zero Net Energy Test House) house sustainable landscape located in the Aksarben area.

Designing Sustainable Landscapes

The design of sustainable landscapes including xeric gardens, rain gardens and bioswales, greatly depends on the environmental factors of your yard as well as the goals you have set. As you begin the design of your landscape, keep in mind the three key design concepts presented at the end of the previous chapter: sustainability, garden form and performance.

In addition to xeric gardens, rain gardens, and bioswales, sustainable landscapes may include water gardens, upland butterfly gardens, and accent gardens with native and adapted flowers, grasses, shrubs and trees. Your sustainable landscape should integrate all landscape components into a common plan. In this manual, however, we will consider the design of sustainable landscapes as three separate entities: xeric gardens, which won't be receiving water and rain gardens and bioswales, both of which can receive and redirect rainfall.

A rain garden in Carter Lake, Iowa helps filter pollutants from runoff before it reaches the lake.

Landscaping on a property line between two properties can be a benefit for both homeowners.

As you prepare your design, talk to your neighbors about what you are doing. Consider the following two strategies to encourage acceptance of the natural-style garden with the neat landscape:

- Educate your neighbors about the full range of garden benefits to help them develop a deeper appreciation and acceptance. Present opportunities for neighbors to work together to plan and install gardens.

- Integrate natural-style with neat landscapes to tone down the contrast. Repeat some of the garden plants and groupings in appropriate areas or key locations to help unify the overall landscape aesthetic.

Xeric garden vegetation can be planted on areas that drain to rain gardens. Orchard Park in Omaha demonstrates how native flowers can be planted in xeric garden areas.

Designing Xeric Gardens

Xeric gardens typically require minimal amounts of soil preparation or alteration of the ground, but they must be designed to coordinate with rain gardens and bioswales you are planning for your property. Prepare your xeric garden as follows:

- **Identify suitable locations.**
- **Determine the shape and appearance of the garden.**
- **Select plants that will survive the conditions of your location.**
- **Carefully group and space the plants.**

Xeric Gardens

Also referred to as dry gardens, xeric gardens rely only on normal rainfall to survive. The plants used in xeric gardens are those well-adapted to the natural climate of Omaha, and whose roots extend far into the ground to tap deep moisture. Native or low-water perennials can be used successfully to replace tulips, roses, or other plants that require a lot of watering and maintenance.

It is not the goal of the xeric garden to capture and treat excess water, but it should function to direct rainfall or runoff into the ground. The xeric garden plays an important role in managing rainfall in your yard by reducing the amount of runoff while also conserving water by not requiring substantial watering. The best locations for xeric gardens are areas that shed water, such as high points in your landscape. These can be isolated areas, or those above or adjacent to rain gardens and bioswales.

Determine the Shape and Character of Your Xeric Garden

Sustainable xeric gardens can be equally beautiful whether they are more formal, with sharp, distinct edges, or less formal and natural-growing, allowing them to blend into landscape features.

- You can decide to match the shape of the garden to existing slopes and land shapes in your yard, such as along rounded high areas,
- Follow the curves above a natural incline that is in your yard,
- Or, you can create a more distinct shape, such as in a small area near your patio or as an accent near a fence.

Since xeric gardens do not collect runoff, their size can vary from small to large. Many attractive native and adapted plants can be planted in small areas, or can be planted to cover extensive areas of your yard.

In considering the appearance of your garden, and the plants you want to highlight, make sure the soils are deep enough to support the root structure of the plants.

The vertical structure of your garden is important. Again, depending on the topography of your garden, you will want to consider how tall plants should be, and what types of plants will make up the structure of the garden. For example, taller plants may provide a nice backdrop for shorter plants in the front or edges of the garden. Planting design principles are covered in more detail later in this chapter.

How Your Xeric Garden Impacts Other Garden Areas

Native plants established in xeric gardens will make the soil more porous and promote infiltration of water. This will reduce the amount of runoff from your yard that otherwise may have flowed to nearby gardens. It's a great idea to have xeric gardens uphill from rain gardens, but it must be understood that the amount of runoff coming from these gardens is substantially less than more conventional landscape features such as turf grass lawns.

Designing Rain Gardens

Designing a rain garden is not a complicated process, but certain steps and information must be included in order to ensure a successful garden. These steps include:

1. **Identify potential rainwater sources and how to direct them into and out of the garden.**
2. **Determine where to locate your rain garden.**
3. **Measure the areas that will collect the water.**
4. **Test your soil.**
5. **Size the garden area and depth to capture approximately one inch of rainfall.**
6. **Determine the shape and appearance of the garden.**
7. **Incorporate inlets and outlets into your rain garden.**

Water collects into the garden from the surrounding area. The deep roots of native plants help water to infiltrate deep into the soil.

Identify Potential Rainwater Sources and How to Direct Them Into and Out of the Garden

During any rainfall, take a close look at where the water is flowing and consider managing it with a rain garden. You will find that the most common sources of rainwater runoff on your property include:

- A downspout or combination of downspouts from a roof. Every house has gutters and downspouts to collect rainwater. The water draining from a roof is normally clean. It may contain some metals from roof flashing or bacteria from bird droppings, but a rain garden is capable of filtering out these pollutants.

- Runoff from your driveway, walkways, or patios and neighboring patios or driveways that flow onto your property.

This driveway slopes toward the rain garden and helps direct water into the garden.

Normally, these features drain in a specific direction. Take advantage of how your driveway or patio drains to collect runoff and return it to the ground. Rainwater running across your driveway can pick up small amounts of oil and grease, as well as some salts that will be filtered by a rain garden.

- Runoff flowing across your lawn. A lot of rain that falls directly onto your lawn does not soak in, but runs off your property. Collecting it with a rain garden keeps it flowing into the ground where it will be used by plants. Your rain garden also filters out excess fertilizers and chemicals from your lawn and keeps them from contaminating the local environment.

Why One Inch of Rainfall?

Rain gardens are typically sized to handle 90% of one-day rainfall storm totals. In Omaha, 90% of storms produce approximately one inch of rain or less. For the 10% of storms that exceed one inch, gardens are designed to safely overflow. Sizing gardens for all storms would significantly increase the size and cost of rain gardens while providing relatively minor additional benefits.

Determine Where to Locate Your Rain Garden

Finding the right location for your rain garden is a crucial step in the design process. Because you are managing water in your yard, you have to consider how and where water flows, the type of soil you have, any surrounding vegetation, and the proximity of the rain garden to your house or other structures. When identifying a suitable location to build a rain garden, consider the following:

- The rain garden should have close access to one or more obvious and measurable sources of runoff.
- Place the rain garden at least 10 feet from your house to minimize potential for foundation or basement water damage.
- Avoid building the rain garden directly beneath an existing tree to prevent conflicts with tree roots.
- Place the rain garden at least 25 feet away from septic systems to avoid septic system root problems.
- Your rain garden should be located on a gentle slope, typically less than or equal to 8%, which is a drop in ground elevation of one foot every 12 feet.
- Be a good neighbor and design your rain garden so that it does not flow onto your neighbor's property.

Before You Dig!

Be aware of rights of way, underground service lines or utilities, and/or local ordinances to avoid constructing gardens on public property or conflicting with utilities.

In Omaha, homeowners can have utilities located for free by requesting a "locate request" through the Nebraska Diggers web site or by calling the following numbers:

811 (Nationwide)
800-331-5666 (Statewide)
344-3565 (Metro Omaha)
www.ne-diggers.com

Measure the Areas That Will Collect the Water

Estimating the size of the area draining to your rain garden could be the most challenging part of your project. Using the map of your yard that you developed in Chapter 3 will help.

Measuring drainage areas is a straightforward process for roofs and paved surfaces. Simply measure the length and width of each area, and multiply to calculate the area in square feet. Don't include areas that won't drain directly to the garden. For roof areas, measurements along the foundation of the house will provide overall dimensions for a simple roof design. For complex roofs that have multiple dormers, valleys and ridges draining to multiple downspouts, a plan drawing of the house with estimated measurements may be required to calculate individual downspout outflows.

1.

2.

3.

A house with multiple dormers and rooflines can be a challenge for calculating runoff. Volumes from each portion of the roof are important to separate by downspout for accurate runoff sizing. (1. Front view. 2. Back view. 3. Diagram showing roof areas.)

Typically, lawns also yield a lot of stormwater runoff. Healthy turf grass roots can grow six to 30 inches deep in good soil, but often stay shallower due to poor soils and stress, so infiltration is typically very limited. If you have a relatively steep slope in your yard (generally more than 5%-7%), even more runoff will be generated. When estimating the amount of rainfall collected from lawn areas, assume that approximately 60%-85% will run off (the healthier the turf, the lower the runoff).

Gardens look best when they can be incorporated into existing landscape beds and features or when they repeat the shape and character of existing beds. Gardens that exist by themselves as individual landscape features tend to look less unified with the surrounding landscape. You may also consider positioning your rain garden to capture runoff from multiple downspouts or runoff sources.

When you have selected the location of your garden, the next step is to determine its size and how much water can possibly be collected. Before you do this, however, it is important to test your soil at the selected location, so you can have an understanding of what to expect when water enters your rain garden. The following guidelines will help you test your soil in preparation for sizing and designing your rain garden.

Test Your Soil

Soil texture and structure are critical to drainage and infiltration. You can test your soil to see how well it drains and if you need to, add organic matter to help with drainage. If you determine that your soil has little to no capacity to drain, find another location to build your rain garden.

Most soil in the Omaha region has a silt loam (soil composed of sand, silt and clay) to silty clay loam texture, and water will infiltrate at a rate of ¼ to ½ inch per hour. Here are three ways to test your soil so you will know what to expect from drainage in your rain garden:

- Determine the relative clay content of your soil by using the "ribbon method." Take a handful of soil from your garden and wet it to a moist, plastic condition so you can easily mold it. Gently squeeze the soil between your thumb and forefinger, forming a ribbon until it breaks off. If the ribbon is longer than 1½ or 2 inches, it has more than 30% clay.

Pressing wet soil between your thumb and fingers creates a ribbon that identifies soil texture by the length of the unbroken ribbon.

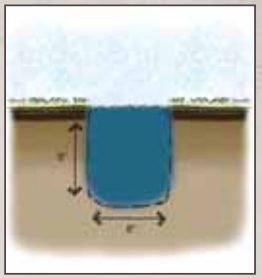
- The color of the soil below the root line of your turf grass is an indicator of the amount of organic matter in the soil. If the color is medium to dark brown, you likely have good organic content. If your soil is tan or beige, it has low organic content. Soils that contain higher amounts of clay and low organic matter will have slow infiltration.

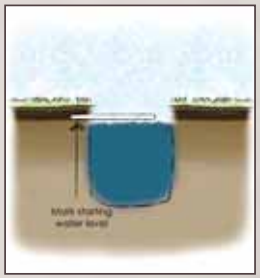
- Conduct a drainage test by digging one or two holes in your garden area. Make them about eight inches in diameter and eight inches deep, then fill to top with water. Allow the water to soak into the soil for one to two hours to penetrate the soil. Fill the hole back up with water so that the water level is about one inch from the top. Mark the starting water level with a stick or an old ruler pushed into the side of the hole. Record how far the water level drops at one-hour intervals and calculate an average infiltration rate in inches per hour. The rates may vary from minutes to hours per inch, so initially they should be checked frequently.

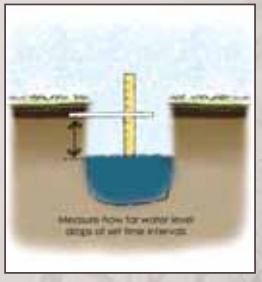
Once you have estimated the infiltration rate in inches per hour, multiply by 24 to get the rate per day to use as a design depth for the rain garden. Your maximum depth should not exceed 12 inches to maximize plant health and the ability to tolerate flooding.

The slower that water infiltrates into the soil, the shallower your rain garden should be. This prevents plants from being flooded with water. If you are planning a large garden, the infiltration rate should be tested in several areas to confirm an average and accurate rate.

Drainage Test







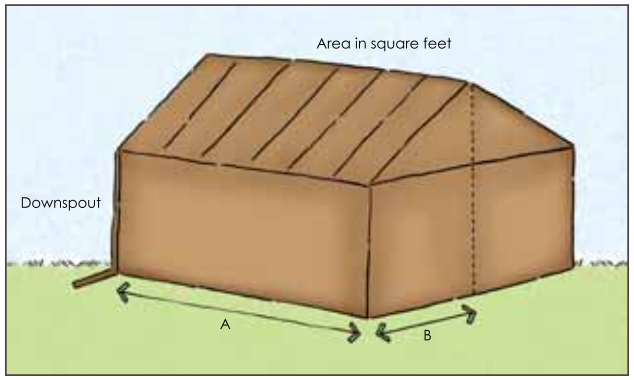
Estimating Your Drainage Area

Roof

1. Observe where downspouts are attached to gutters, and how much roof area leads to the gutter. Measure the length of the gutter. A = _____ feet
2. Measure the horizontal distance from the gutter to the roof peak (or highest point that drains to the gutter). B = _____ feet
3. Multiply A times B to get the area of roof draining to the downspout:

_____ (A) x _____ (B) = _____ square feet

4. Repeat for all downspouts that will drain to your rain garden or bioswale.



Patios and/or Driveways

1. Observe how rain runs off your patio and/or driveway. Mark areas (after they're dry) where the flow of water is directed from your patio or driveway. For example, if one-half of your driveway drains to the street, and one-half drains to your yard, measure the area that drains to your yard.
2. Calculate the area of each portion of your driveway and/or patio that drains to the portion of your yard where you will have a rain garden or bioswale.

_____ Width of Area (feet) x _____ Length of Area (feet) = _____ square feet Driveway and/or Patio Drainage Area

Estimating Your Drainage Area

Lawn

1. After you have determined the slope of your yard, and where high and low points are, mark the area that drains to the lowest point leading to your rain garden or bioswale. You can use rope or lawn paint (from your local hardware store) or even a garden hose to mark the area.
2. Measure the length and width of your lawn's drainage area leading to your rain garden. Take several measurements if necessary. Draw the area on the map of your property or yard (use the sheet provided in this chapter).
3. Assuming a simple approach, if the area is shaped like a block, calculate the area by multiplying the width times the length. If it is irregularly shaped, roughly draw it on your map, and count the squares within it.

_____ Width of Area (feet) x _____ Length of Area (feet) = _____ square feet Lawn Drainage Area

Estimating Your Runoff Amount

When you have estimated the runoff amount that will flow to your rain garden and/or bioswale, you can then determine the size that your rain garden needs to be.

A = Roof area draining to your rain garden/bioswale: _____ square feet
B = Patio/Driveway area draining to your rain garden/bioswale: _____ square feet
C = Lawn area draining to your rain garden/bioswale: _____ square feet

_____ (A) + _____ (B) + _____ (C) = _____ square feet Total Drainage

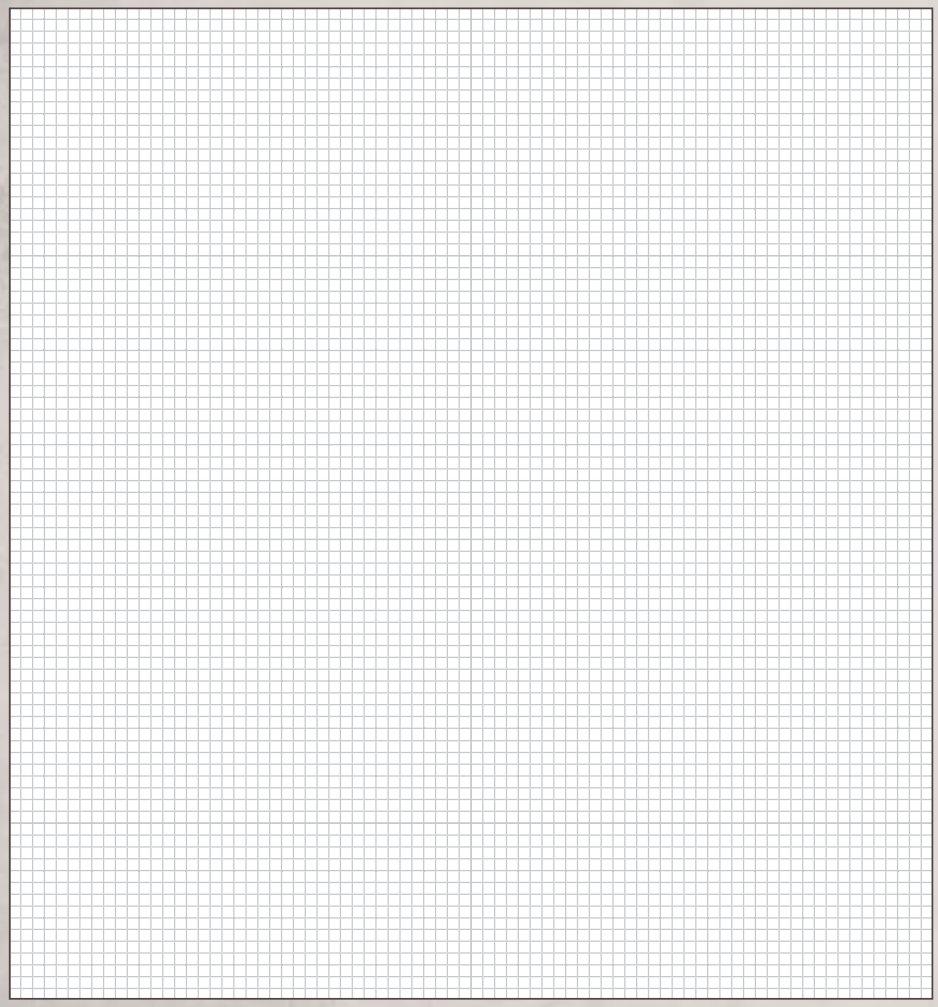
Assuming that all of our rainfall will flow to the rain garden or bioswale, and remembering that 8.3 cubic feet of runoff (from the one-inch rainfall) will flow from every 100 square feet, the volume of runoff is:

_____ Total Drainage (square feet) ÷ 100 = _____ Runoff Units

_____ Runoff Units x 8.3 Cubic Feet Per Runoff Unit = _____ cubic feet Total Runoff Volume

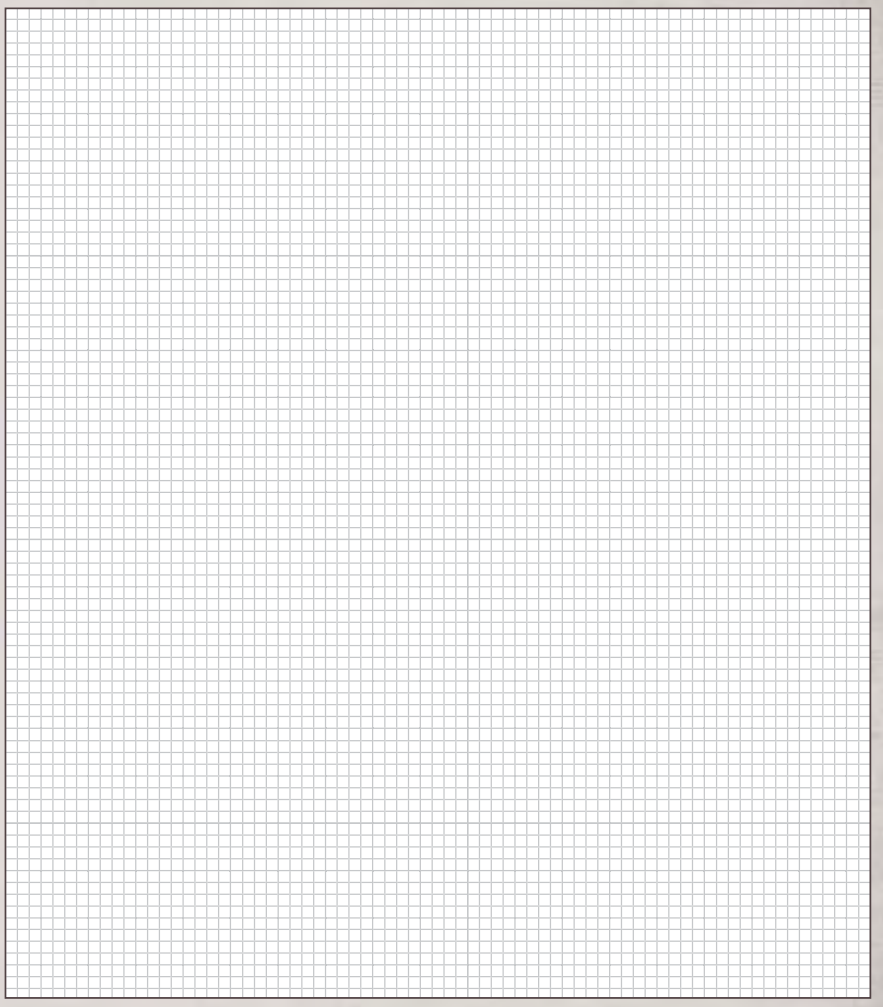
The Total Runoff Volume is the size (volume) that you will need for your rain garden or bioswale.

Yard / Property Map



1 Square = _____ foot/feet

Yard / Property Map



1 Square = _____ foot/feet

Size the Garden Area and Depth to Capture Approximately One Inch of Rainfall

Ideally, most rain gardens are sized with sufficient area and depth to capture and infiltrate the stormwater runoff from the typical one-inch storm in Omaha. Gardens with a correct depth that are undersized and have appropriate overflow capacity will still provide some stormwater management. This should be considered when a garden needs to fit in a relatively small area.

As you determine the size you want for your garden, remember:

- Your soil test will provide you with information about how deep the garden should be. The more clay in the soil, the slower water will infiltrate, and the shallower the garden should be. On more clayey soils, you probably want to limit the rain garden depth to six inches. If your soil allows more rapid infiltration of water, you could consider a depth as much as 12 inches, but do not go deeper than that.

- Try to make the bottom of the rain garden as even as possible. If depths inadvertently increase due to settling, or maybe an unlevel garden bottom, plants may be flooded for more than 24-48 hours, which can reduce plant health.

Rain garden at Immanuel Medical Center in Omaha.

Determine the Shape and Appearance of the Garden

The shape of the rain garden is dictated by its location and the property owner's preferences. Shapes with curved edges look more natural and are generally more popular than shapes with straight edges and square or angled corners. Curves also fit better with the flow of bed lines and plant groupings found in many commercial, public and residential landscapes. Garden edges adjacent to curb lines or paved surfaces will likely need to be straight. For a typical configuration, your rain garden should have:

- A ratio of length to width of approximately 2:1. Adjusting for a narrower garden may help lessen soil compaction, as there's less need for people and construction equipment to enter the garden during final preparation and planting.

- A length that is perpendicular to the downspout or other water inlet source.

- Depth that can typically vary from six to 12 inches deep depending on calculated infiltration rates and garden capacity.

- A level bottom to maximize infiltration area.

- Width of no more than 15 feet on a cross slope of 8% or more. If more width is needed on a steep slope, a series of stepped gardens can be designed to fit the slope.

Incorporating Inlets and Outlets Into Your Rain Garden

Rainfall runoff can enter into your garden by direct flow into the garden, or through an inlet. It is also possible to direct water from higher areas of your yard into the rain garden with bioswales. It is important to make sure that the rain garden is protected from the force of water flowing downhill into the garden. An inlet may require some minor grading, or include aboveground swales or pipes, or underground pipes to route the water to the garden.

An example of reinforcement for the overflow of a school site rain garden. When the garden fills, it will overflow on the gravel rocks and not damage the remainder of the berm that holds the water in the garden.

On slopes, it may be necessary to create a series of rain gardens that flow into one another as the higher gardens fill with water.

If excessive flow into the rain garden occurs, an outlet should be constructed with a slightly depressed elevation to provide flow out of the garden and direct water to areas of the yard where it will be absorbed or flow safely to other drainage features.

If possible, overflow from the rain garden can be directed to a second rain garden or a water feature in the yard. In all cases, the overflow should be located on the downhill side of a garden where excess water flowing out of the garden will not damage structures, foundations or neighboring properties.

An outlet drain can help drain your garden regardless of soil infiltration. Outlet drains generally rely on one or more pipes that extend through the soil. Some pipes drain from just above the base of the rain garden and others provide overflow at the maximum depth of the accumulated water. If an outlet drain pipe is a better option, contact a landscape professional for installation.

The area of a rain garden includes both the water holding area as well as the landscaping that surrounds the garden and gives it context.

1.

2.

3.

4.

1, 2 and 3: Various examples of reinforcing the entrance to the rain gardens so that incoming water slows down and does not erode the garden. 4. An example of a soft weir outlet.

This bioswale was recently planted along a park corridor and will direct water off of parking lots to a nearby storm drain while water is infiltrated into the soil as it moves along the swale.

Designing Bioswales

Bioswales on a residential property need to be large enough to route water into and out of rain gardens. Follow these steps for proper design:

1. **Identify potential locations to direct runoff.**
2. **Determine the shape and appearance of the bioswale.**
3. **Construct your bioswale.**
4. **Select plants and place them properly.**

Bioswales

A bioswale is a long, often linear depression in the ground that allows water to move from one location to another. It has gentle side slopes where plants can be grown to slow water enough to filter pollutants and foster infiltration, while moving that water to a different location. A bioswale is sloped rather than level, and unlike a rain garden, it is designed to collect and move runoff to a particular location rather than temporarily hold water for infiltration into the soil.

Bioswales use deep-rooted native and adapted plants that enhance infiltration and slow water flow. They have less slope than traditional swales to slow water flow and increase infiltration, and regular mowing of swales to maximize water flow has been reduced or eliminated.

As a complement to a rain garden design, bioswales can be used to direct surface runoff toward a rain garden or away from buildings and activity areas. They can also be used to collect runoff from the edge of a paved surface to better focus the runoff into a rain garden. Follow these steps to enhance rain garden function and to design your bioswale.

Identify Potential Locations to Direct Runoff

These may include drainage from turf areas that have minimal infiltration, runoff from adjoining properties, and runoff from paved surface edges. Downspout runoff can also be directed away from the house and/or toward a rain garden that combines runoff from multiple downspouts.

Determine the Shape and Appearance of the Bioswale

Bioswales can vary from a small linear indentation in a turf area to a deeper garden of grasses, flowers, and other plants. A shallow turf swale can be woven into almost any setting with minimal visual impact. As a general rule, the minimum surface of a bioswale should be 1% of the total area from which it is receiving stormwater. Gradual alternating curved berms and swales in a turf area can add significant visual interest without requiring additional maintenance beyond regular mowing. Varying the width of the swale as well as curving the swale along its length can create horizontal and vertical rhythm that can help the bioswale fit in better with curved landscape themes.

Bioswale at Bass Pro Shops in Council Buffs, Iowa.

A grassy (turf) swale in a residential Omaha neighborhood.

Design Your Bioswale

Bioswales for residential and/or small property applications should move runoff from relatively limited areas, typically less than one acre with less than a 5% slope. Steps in the design of a bioswale for your yard or small property area include:

- To compute the water quality runoff volume (the volume of the bioswale), use one inch of rainfall with 100% runoff. Then use this equation:

  Runoff Area (square feet) x (1 inch ÷ 12 inches/foot) =
  Design Volume (cubic feet), the Volume of the Bioswale

- Depending on the slope of the bioswale, many designs include check dams to control and slow the velocity of water. These structures can be very attractive components of the bioswale, including rock features around which planting designs can be focused. Check dams should be no more than six to 12 inches high.

Select Plants and Place Them Properly

Plants for bioswales should be similar to those used for rain gardens, with the following exceptions:

- Since bioswales don't generally stay as wet as rain gardens, plants that are specified for use in the bottom of a rain garden may not be as adaptable as those listed for garden side usage or a combination of bottom and side locations.

- Bioswales that have large amounts of runoff are typically planted with large proportions of grasses, sedges and rushes so vegetation is somewhat flexible to the force. Smaller bioswales, including those that channel smaller amounts of water, can be planted similar to a rain garden scheme, with moisture tolerances layered relative to the bottom and sides of the bioswale, as well as drier areas on the top or adjacent to the bioswale.

Switchgrass Shenandoah

Side Oats

Little Bluestem

Blue Flag Iris in bloom.

Plants for Your Sustainable Gardens

Plant selection and placement are perhaps the most enjoyable and creative aspects of sustainable garden design. Previous design steps have provided for a functional well-placed garden location. The next step is to select appropriate plants for the location, and place or blend them to support the aesthetic qualities and maintenance considerations selected for the garden. Chapter 9 provides a list of plants that have proven to be reliable choices for planting in gardens throughout the region. The tables and plant summaries provide specific information for each plant, helping you choose plants that best correlate to garden exposure, moisture conditions and aesthetic character. Using this information will help you make appropriate plant choices for a successful sustainable garden.

Criteria for Native and Adapted Plants

The Lady Bird Johnson Wildflower Center defines a native plant species as one "that lives or grows naturally in a particular region without direct or indirect human intervention." Although most plants considered native to a particular location or habitat have been around for centuries, plants vary over time in their natural range due to changes in climate, land use and other factors. Plants native to a location or setting do not necessarily grow in all areas within the defined location. They can adapt to the conditions best suited for their long-term survival. What is most important to remember about native plants is their value to garden function and beauty, including deep rooting, climate and water adaptability, habitat value, lack of invasiveness, local sense of place, and overall enhancement of soil infiltration over time. Many adapted non-native plants also provide these functions, although the ultimate combined value of adapted plants is typically not as high as natives.

Moonshine Yarrow blooming in the early summer.

Blue Lobelia in bloom at the UnderTheSink facility.

Individual Environmental Factors of Plant Selection

Garden sites will naturally vary in soil and environmental conditions, so each site deserves specific detailed consideration for plant selection and function. The following are specific environmental factors that should be considered for selecting individual plants:

Soil Moisture

Plant species that tolerate wet soil conditions and even flooding for short periods of time should be placed at the bottom of the garden, while species that tolerate or prefer dry conditions should be placed on the berms and landscape that surround the garden. Plants that are best suited to average soil moisture conditions should be placed on garden sides.

Sun and Shade

More species require sun than shaded conditions, but some of the plants adapted to sun will also tolerate various degrees of shade. Among regionally native plants, full-sun plants (requiring six hours of direct sunlight each day), are typically prairie species, while shade tolerant plants have a woodland origin. Few species prefer full dense shade. Most require at least a couple hours of filtered, or early or late-day sun for flowering and quality vegetation. Some prairie species, especially those that remain short and grow under the tall prairie grasses, will tolerate partial shade conditions. For most plants, morning sun is preferred to afternoon sun. Shade in the afternoon can minimize heat or full-sun damage to plants that are not adapted to harsh, dry conditions.

Soil Texture and Structure

Soil texture – the percentages of clay, silt and sand – and structure will influence plant health and vigor. Many plant species have adapted to the average soil textures, such as silt loam, that are commonly found in Omaha.

Chemicals and Salt

Many gardens are used to filter runoff from paved surfaces. Salt, oil, grease, pesticides and fertilizers can all be washed into gardens. In such cases, plants that are salt tolerant should be used. (The plant information tables in Chapter 9 identify plants with moderate to high salt tolerance).

Criteria for Individual Aesthetic Factors

The most common selection criterion for sustainable garden plants tends to be for flowers, their size, color, and fragrance. Although these factors are very important for overall garden visual appeal, there are a variety of other characteristics to consider in the selection process.

Foliage Texture and Color

Flowers can be striking, but they usually last a relatively short time. Foliage texture (coarse, large leaves versus fine, small leaves) can also be an important component of plant selection. Plants with contrasting textures provide beauty and interest in a garden and colored foliage may last the entire growing season. These should be used to accent garden areas or focus views. Fall color changes, although more limited in time, are a heralded component of the fall season. Many perennials and grasses, such as geranium and little bluestem, exhibit dramatic fall color changes that rival many woody plants.

Form

Selecting plants for specific forms or shapes can have a dramatic effect on garden character. You can choose plants that are upright (Feather Reedgrass and Gayfeather), vase-shaped or arching (Butterfly Bush), or flat and layered (Low Sedges and Wild Petunia).

High texture contrasts is shown between the small and large leaves in the picture above, and in the variety of sustainable garden grasses as shown in the picture below.

The tall grasses through the middle of the garden have an upright form while the plants along the garden edges have a round or arching habit.

Longevity

When possible, select plants that have long-lasting visual appeal. Some plants have relatively long flowering periods (daylily) or follow flowering with highly ornamental fruit (dwarf false indigo). Attractive fruit, seeds or seed heads that persist all winter extend garden beauty throughout the entire winter while providing habitat value. Also, consider plants that hold their foliage well, with no early loss to diseases or environmental stresses, and retain their foliage along the full height of the plant, so they don't appear leggy or weedy. Plants with poor or lost foliage may be successfully mixed with other plants to hide bare stems as the growing season progresses.

1.

2.

3.

Seed heads (1), fall color contrasts (2) and seed pods (3) combine to create long-standing seasonal interest and habitat value.

Many sustainable garden plants provide habitat value for a wide variety of butterflies caterpillars and other beneficial insects and wildlife.

Habitat Value

Garden plants should provide habitat value for butterflies, birds, and insects that fill important roles in regional ecology. Native plants are particularly valuable in this role, but adapted plants can also be good food sources or used for cover. Hummingbirds, finches and a wide variety of butterflies are some of the key species that are attracted to a successful garden.

Garden Fit

It is crucial to select plants that fit the physical and visual parameters of the garden. One of the most important elements is plant height relative to your garden area. Plants that grow too tall for a garden will appear out of scale. Some flower species and many grasses tend to flop over when mature or when grown in moisture-rich soil. Plants that grow very wide and take up significant garden space are not appropriate for a small garden if the overall variety of plants proposed for the garden is significantly limited. For small and medium-sized gardens, limiting plants to three to four feet in height will minimize the potential weedy character associated with taller plants. In larger gardens and in gardens that have a tall backdrop (in front of a tall retaining wall, for example), taller plants may work better. In these situations, place tall plants in the middle or back of the garden, surrounding them with medium-sized plants to integrate them visually and structurally support them.

Overall Adaptability

The most successful garden plants are those with the highest level of adaptability for all conditions. As discussed previously, all plants have specific conditions that they prefer. They also have a wide range of conditions that they will tolerate successfully while continuing to flower, fruit, and remain healthy. Adaptable plants overcome changes to garden conditions over time (increased shade from growing trees, for example) and are forgiving of a design that places them in less than ideal conditions.

The massing of the plants around the edges of this garden strengthens the garden's framework, defines the edge of the garden, and helps unify the landscape.

Aesthetic Considerations for Design and Placement

Once plants are selected, aesthetic considerations for placement and arrangement of plants include:

- Plant massing
- Garden composition
- Plant heights
- Repetition
- Accent and focus
- Plant types

Plant Massing

Many garden plants look best if planted in masses. Consider the following guidelines:

- Limit the number of species of plants used in the garden. Plants that can be grouped effectively and over time will fill a garden.
- A variety of plants placed in masses will provide more interest through contrasting textures, bloom colors and times, and rhythm through varying heights and widths.
- When massing plants, always consider the size of the plants when mature, and make sure they are spaced appropriately.
- Plants that tend to root sucker or reseed naturally may be planted initially with more spacing between them since they will quickly fill the spaces to develop a massed character.

Garden Composition

Garden composition should highlight the aesthetic qualities of individual and grouped plants and should strengthen the overall design theme. Plants that have unique forms (weeping or strongly irregular, for example) are best planted individually so the form can be appreciated. Plants with an upright or rounded form can also be grouped effectively. In some cases, plant groupings exhibit textures and shapes far more interesting than if plants are installed as individuals.

The curved theme of the design is strengthened by the massing and repetition of the plants. The large masses are in scale with the building and create a strong sense of rhythm in the landscape.

Formal designs are strengthened by masses with relatively straight or strictly proportioned shapes and masses that are butted together. Informal designs are reinforced with masses that are laced together. Additionally, informal plantings are strengthened when plant masses are varied and contain curves along their length.

Plant Heights

When determining plant heights, the major viewpoints of the garden should be taken into account:

- A garden that is viewed from all directions will look and function best with the taller plants in the middle and shorter plants toward the edges. Taller plants may be placed in the center of the garden for a more symmetrical look, or if the garden is large enough, they may be placed in multiple locations to create a vertical rhythm of varying heights in the garden center.

- Gardens that are viewed from one side only should have a majority of the taller plants toward the rear of the garden, or possibly closer to the middle to create additional interest. A range of medium to short plants may then be used to fill in the middle and front of the garden. Occasionally placing a taller plant in front of shorter plants can create interest without blocking garden views.

Repetition

Repeating plants as individuals or masses, or repeating specific visual plant characteristics within a garden is a critical principle, and it helps to:

- Visually unify the garden.
- Heighten the accent potential for unique plants with less competition between variable colors and textures.
- Lower maintenance. For example, the texture and seasonal color of little bluestem tends to be subtle but can be woven throughout a garden. Several different species of gayfeather or iris might be used to vary flower colors and seasonal bloom while unifying the garden with a consistent upright form or fine leaf texture.

Accent and Focus

Every garden should combine plants that provide structure, color and interest. But not every plant needs to serve every role, and there should be a sense of accent or focus in specific garden areas. Addressing this principle will enhance the sense of garden unity while attracting viewer attention where it is intended. Although gardens that contain a majority of flowers are typically admired for their dramatic color and variety, a garden that combines just one of each species may not appear coherent and may seem too complex. Structure is also important when creating an accent or focus, and can include evergreen plants (junipers in full sun, yews in shade) or plants such as tall sedums and many grasses that maintain a garden presence through the winter months.

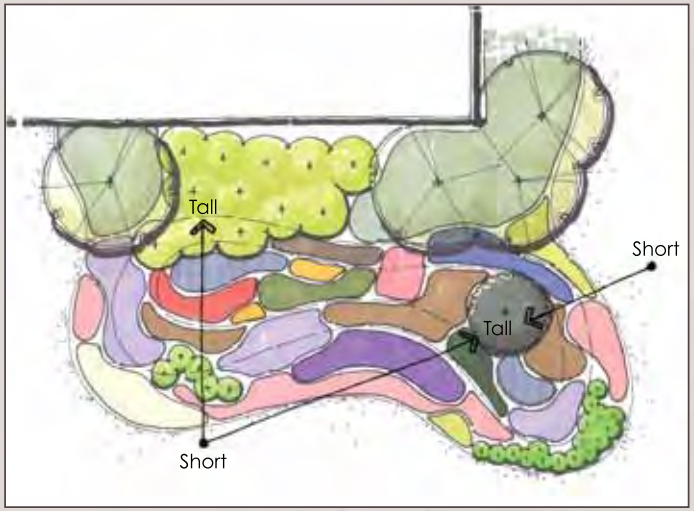
Plant Types

Small to medium-sized gardens should generally be planted with perennials and grasses. Shrubs can take up a large space in a garden, significantly reducing garden plant variety. Woody shrubs have an important role in gardens that are large enough to incorporate them. They provide year-round structure, and many provide habitat value and multi-season ornamental interest. New trees are typically not recommended for sustainable gardens. Their root systems are less conducive to developing additional soil infiltration capability, and they can dramatically change the environmental conditions for which a garden was originally designed. Plus, trees often overwhelm the scale of a garden, especially when the garden is not large or lies in a relatively small landscape space.

Garden Design Summary

This figure summarizes the rain garden design principles previously discussed. Key principles include:

- Repeating plants (as shown by similar colors)
- Placing taller plants in the background
- Massing plants into groupings (as shown by color)
- Placing masses in front of and/or behind adjoining masses
- Putting plants in areas of the garden (bottom-wet, sides-variable, outside-drier) for which they are best adapted
- Mixing flowers, grasses with shrubs or woody plants



Planting Design Suggestions

Selecting plants for your sustainable garden should be a fun, creative step. However, since there are many choices, it can sometimes be a daunting process. The following figures and lists provide some suggestions for plants that are readily available in Omaha and are generally well-suited to its climate and growing conditions. Lists for full sun, partial shade and shade conditions are shown on the following pages, as well as the information used to formulate the design and select the plants. Additional information about the plants can be found in the plant list contained in Chapter 9.

Figure 1

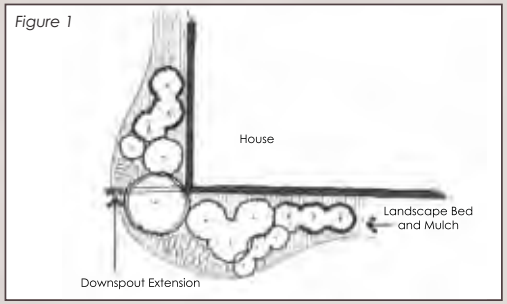


Figure 1 shows a downspout location near the corner of a house where a rain garden is being considered.

Figure 2

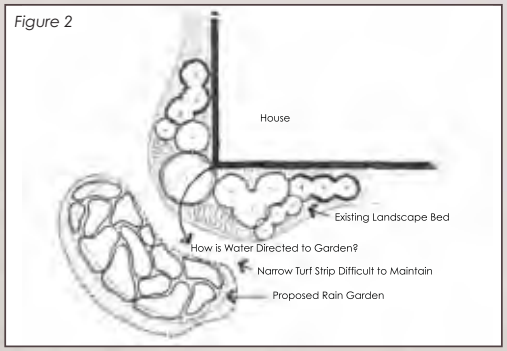


Figure 2 illustrates what often happens when a rain garden is installed but not integrated with the existing landscaping. Consider how to convey water from the landscape bed (above) to the rain garden (below).

General Assumptions:

- These diagrams show a garden located near the corner downspout of a house. Although commonly a logical location for a garden, other locations for gardens typically exist in most residential landscapes and should also be considered.
- Tallest plants in middle of garden, shorter plants around edges.
- Most important view of garden is looking toward house.
- Maximum of 4 feet plant height approximately (depending on growing conditions) to keep plants in scale with garden.
- Based on approximate scale of ⅛ inch = 1 foot, garden is 25 feet x 10 feet (250 square feet).
- Shorter plants help screen bottoms of large plants that may lack foliage.
- Repetition of at least two plants in multiple locations to unify garden.
- Several grass-like textures to unify garden.
- Select plants that bloom throughout the season.
- Many plants have high habitat value (butterflies, birds).
- Plants selected based on suggested locations in plant list (bottom, side of berm, top of berm.
- Minimum of 10 foot distance from house.
- Roof runoff directed to garden from downspout (could also route water via underground or on-ground drain pipe).
- The berm that surrounds the garden has slopes of less than or equal to 3:1 (33%).

Figure 3

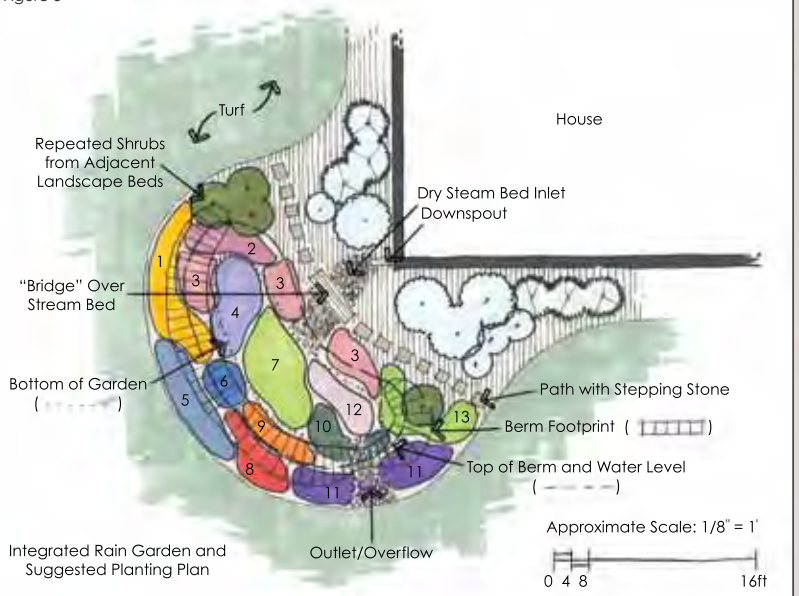


Figure 3 shows how a landscape near a house can be integrated with a proposed rain garden design. A garden that borrows or shares plants from existing or proposed landscape beds in the yard, or is physically joined with existing or proposed landscape beds, has a much stronger visual connection to the surrounding landscape. Access and maintenance can also be enhanced with beds that are linked together.

The plants recommended below are considered commonly available at Omaha garden centers and plant nurseries.

Full Sun

1. Fireworks Goldenrod
2. Purple Coneflower
3. Little Bluestem
4. Dense Blazing Star
5. Wood's Aster
6. Siberian Iris
7. Feather Reed Grass
8. Common Yarrow (use an improved cultivar)
9. Goldstrum Rudbeckia
10. Turtlehead
11. Purple Poppy Mallow
12. Little Joe Pye Weed
13. Daylily (early or ever-blooming)

Part Shade

1. Fireworks Goldenrod
2. Purple Coneflower
3. Little Bluestem
4. Swamp Milkweed
5. Wood's Aster
6. Siberian Iris
7. Feather Reed Grass
8. Butterfly Milkweed
9. Goldsturm Redbeckia
10. Turtlehead
11. Meadow Sage
12. Little Joe Pye Weed
13. Daylily (early or ever-blooming)

Shade

1. Daylily (late-booming)
2. Little Bluestem
3. Hosta
4. Annabelle Hydrangea
5. Chinese Astilbe
6. Turtlehead
7. Feather Reed Grass
8. Rose (groundcover habit)
9. Lady Fern
10. Ice Dance Sedge
11. Hosta (groundcover-type)
12. Little Joe Pye Weed
13. Daylily (early or ever-blooming)

Case Study!

Dry, sunny day in a west Omaha neighborhood.

Runoff from a thunderstorm that dropped approximately 1.86 inches of rain on the same neighborhood.

Knowing Your Site

Sometimes it is not enough to look at a home when it is pleasant and sunny outside because we can make broad assumptions that are not accurate. This property is located in a relatively new neighborhood in west Omaha and located approximately in the middle of a stretch of homes that slopes towards the west. A typical neighborhood, the homes all feature walkout basements and abutting backyards. The only runoff that these homes share in their backyards is what comes off their homes and lawns. The current homeowners did not consider what the overall drainage of the neighborhood was like, as it appeared normal to them.

In June of 2008, Omaha experienced a severe thunderstorm that dropped 1.86 inches of rainfall in a short period of time. Shortly after the downpour started, the homeowners stepped outside to discover a substantial river flowing through their backyards, eventually coming within three feet of the foundation of their homes. The flow was great enough to cause the water to white-cap on the fences along their property lines. Fortunately, there was no damage to any homes.

This storm was an eye-opener to the homeowners that something should be done to better manage stormwater on their property and protect their homes.

Their search for information led them to the concept of a rain garden as a potential solution. After consulting with an experienced contractor, they quickly learned that a rain garden alone would do little by itself to manage the sort of flows depicted in the images. The resulting solution was to regrade a portion of the backyard to move the drainage swale away from the home and create a flat, broader grassed swale to convey the water. During future phases of installation, the swale will be planted with various native grasses and flowers to create a beautiful bioswale over time.

In retrospect, the neighborhood would have benefited from a stormwater management plan that utilized its common area to create rain gardens and bioswales to protect homeowners and their property. No one homeowner in this neighborhood will be able to solve this particular issue, but these homeowners are demonstrating how embracing sustainable landscaping can manage their property issues while providing a beautiful landscape to enjoy.

The view between houses before the thunderstorm.

Runoff between houses during the thunderstorm.

The First Steps:

Creating the Foundation of Your Sustainable Landscape

Forming the Garden Shape and Size

We've emphasized the importance of the soils in establishing successful landscape features. As you start construction of the garden, take care to include the following steps:

1. Make sure the xeric, rain garden or bioswale areas are staked prior to construction. Staking should include the garden perimeter, grade changes, and weirs or drains, as well as the locations of underground utilities. Have a plan for placement and disposal of excavated soils and other debris.

2. Have the proper equipment on site, which can include a sod cutter, tiller, wheelbarrows and a skid loader. Often, the sustainable garden covers a reasonably large area, and removal of vegetation, excavating ground depressions, or contouring the grade of your property can be challenging. If

Sustainable gardens in full bloom attract a wide variety of butterflies and bees at Orchard Park in Omaha.

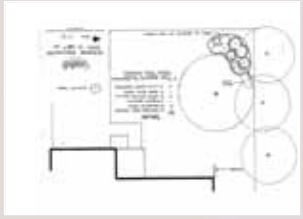
possible, identify equipment that is easy to maneuver in tight places and that doesn't exert too much force or weight onto the soil during operation. If your garden covers a large area, it may be easier to hire a clearing crew to remove vegetation and do much of your ground modification.

3 Protect existing vegetation that will not be removed for construction of the garden. Be careful around the drip line and roots of trees. Remember, healthy tree roots can extend outward from a tree up to two times as far as the canopy extends, so while it is important to protect the area immediately adjacent to the tree trunk, it is also crucial to protect the area under and outside of the canopy as well. Any excavation that must occur under a tree canopy should be carefully monitored to minimize significant damage to existing tree roots.

4 If a rain garden or bioswale is being installed as part of a new construction project, it should be the last element constructed. Soil erosion and sediment that may flow into a previously built garden on a disturbed site can clog the soil pores and cause the garden to fail.

As You Prepare Your Garden Area, Remember These Tips:

- Start from the middle of the garden and work toward the perimeter. Minimize movement of equipment within the garden area as it will compact soils, especially if they are moist or wet.
- Sustainable landscape shapes should seem natural and appear to flow into surrounding landscape forms.
- Use erosion control measures such as straw blankets, mulch and small berms to limit erosion.
- Make sure rainwater will drain in the desired direction. Over time, gardens will increase their ability to infiltrate water, but in heavy storms, there will always be runoff. Make sure water will flow where it won't hurt vegetation or structures.
- Don't block inlets or outlets by inadvertently placing soil or other material in the drainage path. A relatively small amount of blockage can cause runoff to bypass a garden, so regular maintenance checks should be performed to assure free flow into any garden or swale. Make sure that any drainage features, such as subsurface drain pipes, discharge to well-drained areas and away from buildings.
- You do not need to add fertilizer. In fact, fertilizer promotes the growth of weeds. Native or adapted plants will do very well without added fertilizer.
- Take care to follow the planned contours of the garden, smoothing rough edges to create as natural a landform as possible. Don't leave smeared or slick surfaces. Use your equipment to break up and create a rough or broken surface. If and where possible, break the soil to create a suitable seeding and rooting zone using either a power rake or rototiller.
- As the basic shape of the sustainable garden is completed, check the size, form, and depth with the plans developed for the garden, making sure all features are present, including slopes, berms and overflow areas.



Having a design for the rain garden is essential.

Outline the rain garden before starting to dig.

Excavate and form the rain garden to the designed depth, and form berms on the downhill side (left).

Prepare the soil for planting as necessary with compost or other amendments (sand-compost mix, etc.).

Install plants per your design. Remember to excavate a hole that will fit the plant roots, but not deeper.

Mulch on top of the soil protects against erosion while also reducing weed growth.

Preparing the Soil

When the basic shape of the sustainable garden has been formed and built, soil preparation for successful planting and water management may be necessary. This is particularly true if you have clayey soil with low organic matter.

New England Aster is an example of a native plant adapted to upland, drier areas for xeric gardens.

Xeric Gardens

Some people claim that native plants can grow anywhere, in any soil. While this may seem true for some plants, their natural soil environment is typically one with high organic matter and reasonably good porosity. That's why planting a xeric garden takes preparation.

If the soil is low in organic matter (looks medium brown or lighter), add compost to the soil and mix it to a depth of at least six inches. This is easiest with a rototiller. Use about one cubic yard of compost for every nine to 10 square yards of area. After you rototill the compost into the soil, it's good to go back with a spade and turn over the soil in a few locations to vary the depth of broken soil. Rake the area smooth when finished.

In the rare instance that there's shallow soil, consider the types of plants that will do best there, such as grasses, or low-growing plants. Rock features can also work well over shallow soils.

Finishing Your Xeric Garden

When installing potted plants in a xeric garden area, place two to three inches of hardwood mulch over the soil between plants to minimize erosion. If you seed the garden, use straw mulch or a straw erosion blanket to cover unprotected soil.

If a xeric garden has been located within or adjacent to a turf area, consider installing a border along the edges of the adjoining areas to physically and visually separate your xeric garden from your lawn or other landscape features. An edge can help maintain a strong contrast in color and texture and prevent garden mulch from sliding or moving into turf areas.

Rain Gardens

A good planting or seedbed is essential for the success of rain gardens. All too often, soils in newly developed neighborhoods have been stripped of their topsoil, leaving a very clayey, often dense and compacted subsoil for garden planting. Most plants won't survive well in this environment. Here are some tips to keep in mind:

- If you chose to use the existing soil, make sure it has been loosened or well tilled using either a rototiller or spade, depending on the size of the garden. Break any subsurface compaction barriers that may be present. Remember to use the excavated soil from the garden to build the berms of the garden. This will help lessen the amount of material and labor needed to build the garden.
- If you amend the soil of the rain garden with compost, add it at a rate of approximately one cubic yard per nine or 10 square yards of area (or about one cubic foot of compost per three to four square feet of area). Excavate the depth of your rain garden an extra two or three inches to account for the compost addition.
- If you have a tight, clayey soil, you may choose a special soil mix that includes equal parts of fine sand and compost to enhance infiltration the first year. The soil mix may consist of 50% fine sand and 50% compost. These components should be well mixed before placement in the rain garden.

A rain garden can bring beauty and functionality to your yard.

- Before placing the soil mix, break the surface of the native soil in place at the bottom of the garden to a depth of approximately six inches. The soil mix should then be placed in the bottom of the rain garden to a depth of six to twelve inches deep. Before you add all of the soil mix, combine about two inches of the soil mix with the top two inches of native soil to create a transition zone between soil types. This will help with drainage and root growth of the plants used for your garden. Remember to excavate the extra volume from the rain garden to account for the added soil material that will be placed.

- Regardless of how you have prepared your soil, rake it smooth and level in preparation for planting. Make sure the soil is not excessively compacted, but also not too "fluffy" or it will settle after the first rain, and your rain garden may be deeper than you planned.

- Do not add fertilizers to the soil. Native or adapted plants will do very well without fertilizers, and adding more nutrients than are necessary will encourage the growth of weeds.

Remember!

Because your soil may have a high clay content doesn't mean that it's not suitable for a rain garden. You can amend the soil to improve its drainage, and the roots of plants will open up the pores of the soil as they grow deep into the ground. You can enhance success in clay soils by starting with a relatively shallow garden and increasing the depth as the plant roots increase drainage. Also, a high clay soil planted with turf grass will produce almost as much runoff after a rainfall as impervious surfaces.

Ask For Help!

If the bioswale will channel large amounts of runoff, or if it is intended to protect structures or other property, consult with a professional engineer or landscape architect to ensure that your design is correct, and consider the services of a professional contractor to make sure it will perform as designed.

Bioswales

Preparing your soil for a bioswale is much like preparing the ground for the xeric or rain gardens. Be aware of the type of soil that you have, including variations that may occur along the length of the bioswale. Closely evaluate the topography or lay of your yard to make sure the bioswale will direct water where you want it to go, and that vegetative and/or structural features on your property won't be adversely affected.

The depth and construction of a bioswale often does not require substantial excavation or materials. Here a bioswale receives overflow from a new rain garden, and is protected by an erosion control mat until it is complete.

As You Prepare Your Soil for Construction of a Bioswale, Remember the Following:

- Stake the locations of your bioswale, including the outer edges, the midline (deepest point), and inlet and outlet locations.
- Remove all vegetation down to the bare soil. Excavate the soil to the contours specified in the design plan you developed. As with the xeric and rain gardens, be prepared to make adjustments for unanticipated debris, soil or vegetation conditions you may encounter.
- Depending on soil quality, work with the existing soil, amend it with compost as previously described, or add good quality topsoil to a depth of three to six inches. Remember to make adjustments in the depth of your excavation for any soil amendments you add that will affect the final surface elevation.
- Some bioswales include a modified channel down the middle that will be filled with the special soil mix of 50% fine sand and 50% compost to help facilitate drainage. Make sure the channel for this soil mix is prepared before other soil amendments are completed. Some bioswales also include a drainage pipe, as described for rain gardens.
- Make sure inlets and outlets are not blocked by excavated soil, vegetation, or previously unseen differences in the elevation of your yard or property.
- Don't use mulch on top of the soil in the bioswale. Depending on the rate of flow, mulch will probably float and move with the water, potentially creating flow impediments.
- Use erosion control, such as a straw erosion control blanket, to protect soil and any seed during and after the construction of the swale. The erosion control blanket will eventually degrade as the plants grow through it and mature. Make sure the blanket is tacked down with erosion blanket staples that you can purchase at your local nursery.

A bioswale can effectively capture and direct rainwater runoff to specific locations while protecting your property. Simple design practices including grasses and sedges can be used, or more colorful flowering plants can also be established in the bioswale.

Inspecting Your Work

Once the base of the sustainable landscape is completed, inspect it to make sure it meets your design requirements. Also, check to see if it matches the topography of your yard or property, that water will flow where you want it to go, and that soil has been adequately prepared for planting. When you are satisfied that it has all come together, proper placement and installation of plant material can take place.

Planting Your Garden

No matter how good the design, your garden can fail if there's not enough planning or attention given to proper plant selection, planting and initial establishment. By making appropriate choices and committing to correct techniques and procedures, healthy garden establishment can be ensured.

What to Look For When You Buy Your Plants

There are a variety of plants, but for most residential gardens, homeowners prefer to install moderate-sized container plants that will begin to fill the garden and create a show in only one season. A container size of one gallon is a popular choice, although plants in larger containers may also be available.

Little Joe Pye Weed in full bloom in the UnderTheSink rain garden.

Little Bluestem grass at a nursery.

Potted Sedum growing in one-gallon pots.

When Purchasing Plants, Here are Some Things to Look For:

- Vigorous green foliage and a dense form. A plant that appears tall and spindly relative to the size of the pot may have been pot-bound or grown in close quarters at the nursery and will lack some of the vigor found in a plant with more side stems and leaves. It may require significant cutting back of the stem growth to promote a fuller form when planted, and is likely to suffer more transplant stress when planted, especially in hot, dry, windy conditions.

- Avoid plants that are noticeably off-color, stunted or spindly due to stress or insect/disease problems.

- Plants that are blooming are not necessarily better than those that aren't, unless a specific bloom color is desired. In fact, blooming requires plant resources that may be in short supply while the plant is still in a pot and not able to expand its root system.

- Look for plants that appear well rooted. Plants that have only recently been transplanted from a small container into a larger container will not be rooted in the new potting soil, so you are basically purchasing a small plant with extra soil.

- In contrast, avoid plants that have overgrown root systems with roots growing in significant masses in undersized containers, through the pot drainage holes and into soils or mulch in holding beds. These plants may experience stress and lost roots and have difficulty becoming established in the landscape.

Choices in Sizes and Conditions

Proper selection of plants includes appropriate species determination based on site conditions, but it also includes choices of plant size and condition at time of planting. Your budget will often dictate a smaller initial plant size, but given establishment costs, maintenance commitments and anticipated visual impacts, less expensive isn't always the best choice.

Seeding

Seeding can be a cost-effective method to establish large areas, and specific seed mixes are available. Seeding has some significant limitations, which should be carefully considered. These include:

- Weeds that result from improper seedbed preparation or lack of pre-planting weed treatments.

- Difficulty in differentiating emerging garden plants from weed seedlings.

- Relatively slow establishment. Native plants typically establish their root structure over one or two years before they expand foliage and flowers or fruit.

- Relatively low initial visual appeal. Weeds often grow initially and will need to be removed.

If you are using seed, drilling is typically preferred to broadcasting in order to establish good seed-soil contact and minimize seed loss due to water or wind erosion. If broadcasting, prepare a firm seedbed with a friable surface, and place or rake the seed evenly into the soil, not more than one-half inch deep. In either case, purchase seed from a reliable source and use a mix that contains a high percentage of pure live seed. Make sure there is good soil-seed contact by rolling or lightly compacting the soil. Place approximately one inch of straw mulch or an erosion mat over the surface to protect against erosion and excess drying. Use caution with straw as weed seeds in the straw can create a significant maintenance problem. Whenever possible, specify straw from weed-free sources.

Sod

Depending on the size of the garden area, sod established from rain garden plant mixes may be a cost-effective intermediate step between less expensive seeding and relatively expensive potted plant installation. Benefits include immediate soil coverage, reduced erosion, and immediate visual effect. Limitations include fewer plant choices, slower plant establishment when compared to potted plants (depending on root systems), random fit of plants relative to growing conditions in the garden, and a generally informal plant pattern, which may appear weedy when compared to patterned plantings.

Potted plants come in a wide variety of sizes, and can typically get a quick start in the landscape if they have healthy root systems.

Potted Plants

Plugs and pots come in a variety of sizes, from deep cell plugs to more established gallon sized potted plants. Deep cell plugs are the least expensive option for live plants, and provide deeper rooting potential for seedling plants, especially those with naturally deeper root systems. This can significantly enhance early plant health and establishment.

Small plants are initially more cost effective. If healthy and well rooted, they can establish and fill in quickly. Variables for potted plant success include planting conditions, the relative growth rate and vigor of the plant, time of year, availability of supplemental irrigation, initial maintenance commitments – including weeding if necessary – and a low requirement for instant impact. If any of the conditions noted above are questionable, then larger plants should be used. Though the initial cost will be higher, the benefits of starting with larger plants will often balance out over time. Regardless of size, selected plants should be vigorous, and neither poorly rooted nor root bound. Root-bound plants may be acceptable if not overgrown in the pot. If root-bound, soil balls should be scored or broken along the edges of the root mass to encourage new rooting when planted.

Slicing through densely-rooted potted plants will help get plants off to a good start by minimizing circling roots in the planting hole.

Plant Layout and Spacing

Plant layout and spacing should correspond to specific garden conditions as well as to the approximate widths of plants listed in the plant tables (see Chapter 9). Planting density can be tightened for more immediate effect. Over planting, however, can compromise initial plant health and lead to increased disease potential. Density can also be decreased for more cost-effective planting, especially when using plants that naturally self-seed or spread through suckering roots.

Rain garden at Orchard Park was planted with plugs and gallon-sized plants.

Planting, Fertilizing and Watering

Planting

Planting sustainable garden plants follows the same procedures as those used for perennial plants in more typical landscape areas:

- After amending the soil and raking or grading to the final configuration, dig a hole deep enough to hold the root ball, so the top of the ball is at ground level or slightly lower, and at least two to three times the width of the container. Do not over dig the hole depth, as settling soil below the root ball could leave the plant too deep in the hole, which can lead to plant stress caused by lack of root oxygen and partial burial of the plant.

- Remove the pot, and break up the root ball if root bound or circling roots are evident. Use a knife, pruners or your fingers to cut the roots and redistribute them in an outward pattern to hasten healthy re-growth.

- Place the root ball in the hole, and fill lightly with soil. Add water to settle soil around root ball and minimize air pockets.

- Refill with soil. The top of the root ball should be slightly below soil surface.

- Water a second time. Then carefully apply mulch over the root ball, taking care not to bury the plant or push mulch up against plant stems.

1. *Installation of plants and mulch for a Bellevue home.*
2. *Three months after planting.*

Watering a newly-planted rain garden at Orchard Park.

Whenever possible, avoid compacting the soil when planting container plants. Methods to minimize compaction include:

- Working from garden edges.

- Keeping equipment and foot traffic on planks, plywood or other support.

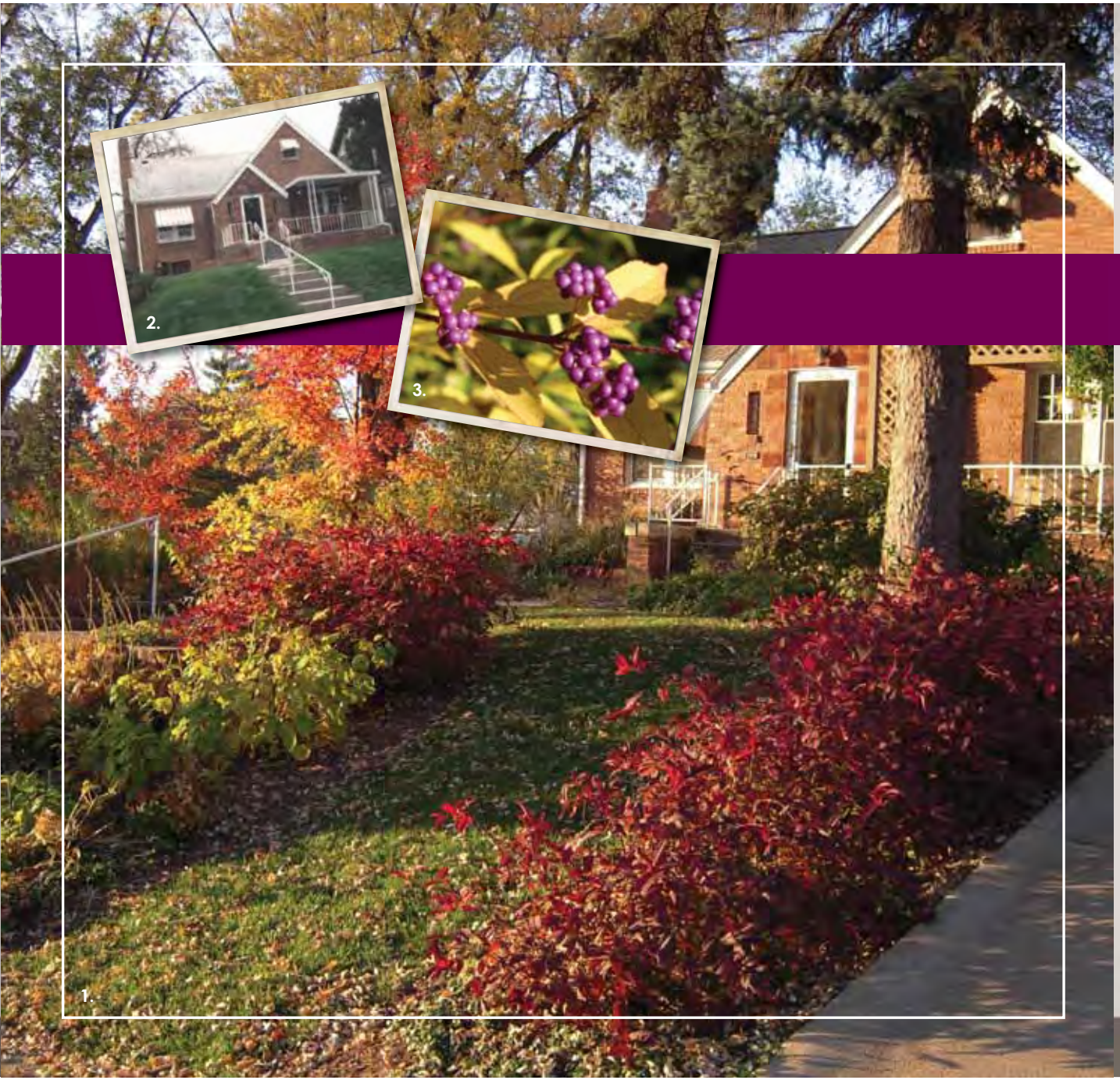
- Working on and planting into pre-laid mulch. This is typically not recommended due to the difficulty in planting small plants properly in an existing mulch layer.

Fertilizing

Fertilizing native plants is not recommended since it will likely enhance more weed growth than native plant growth. Adding commercial mycorrhizal inoculum to the soil is recommended by some plant experts, and may enhance initial plant establishment.

Initial Watering

During the planting process, all container plants brought on-site should be monitored to ensure that roots and potting soil do not dry out excessively. This is especially true for plugs and other small plants that can dry quickly when exposed to sunny, windy conditions. Initial watering during and immediately after planting is critical for successful establishment. Watering each plant after partially filling the planting hole, and a second time after the backfilling is complete, helps establish good soil-root contact and minimizes air pockets. Remember to keep roots moist, and dig holes deep and wide enough to provide adequate backfill and allow full extension of root systems.



The Cost

of Rain Gardens and Other Sustainable Landscapes

Sustainable landscapes provide outstanding amenities for the homes and neighborhoods where they are built and properly maintained. But what are the costs?

Every home landscape project is unique, with different sizes, slopes, soils, and sun exposure, making it a challenge to put an exact price tag on a garden. Generally, it is safe to assume that the cost of installing a xeric garden, rain garden, or bioswale will be comparable to a similarly constructed planting bed. It is recommended that as you design and develop your sustainable landscape features, you work with a professional to evaluate your design prior to installation. Doing so will help ensure that the garden functions properly.

The sustainable landscape (1) that replaced the more traditional landscape (2) needs less mowing, and contains a much higher habitat value and seasonal beauty.
3. Purple Beauty Berry grows well in this sustainable landscape.

There are some broad rules of thumb for developing an approximate cost for rain gardens, xeric gardens, and bioswales. The cost of the garden is related to how large and how complex the garden will be. Assuming that you'll be doing most of the construction yourself and that you'll be using live plants rather than seedings, you can figure the cost will range from $4.00 to $8.00 per square foot.

Once the dimensions of the garden have been calculated, you can develop a more accurate cost estimate for your garden and adjust your plans according to your budget. To calculate the amount of basic materials needed for the project, factor in basic cost elements like added soil, live plants, rock, and mulch. Here are other considerations to keep in mind:

- The cost of compost and soil can vary. If you buy it in bulk, you can expect to pay $14 to $20 per cubic yard. A typical 1.5 cubic foot bag at your local nursery or retail store will cost between $2.00 to $7.00 per bag. In general, purchasing in bulk is more cost effective, and it limits the amount of trash generated from bagged materials.

- The cost of using live plants depends on the size of plants you purchase. In general, gallon-sized plants are readily available and ideal for creating instant impact in the rain garden as well as having a substantial root mass to aid in establishment. One-gallon plant material will typically cost $4.00 to $12.00 per plant. You can purchase younger plants as deep cell plugs for as little as $2.00 each from a native plant nursery.

- Decorative rock and mulch can be purchased in bags or in bulk. River rock ranges in size from ¾ inch to eight inches in diameter, and is commonly used for the overflow and at the mouth of an inlet pipe. In bulk, rock costs $40.00 to $70.00 per ton. Bagged, it is $3.00 to $7.50 per bag. There are a variety of mulches available for sustainable landscapes. The most commonly used is the shredded hardwood mulch. Bulk costs are $18.00 to $25.00 per cubic yard of mulch (which will cover approximately 100 square feet to a three-inch depth). It is not recommended to use river rock or rubber mulch as a groundcover for the entire xeric or rain garden, as these materials will inhibit the establishment and growth of the plant material.

- Rental costs of tools such as a sod cutter, tiller, and a skid loader can also vary depending on the total size and time of the project, but are invaluable in the creation of the rain garden.

At a minimum, typical cost components included in the construction of a xeric garden, rain garden, or bioswale include:

Typical Cost Components

Approximate Material Amounts

Material	Amount	Coverage	Bulk Cost
Soil/Compost	1 Yard	54 Sq Ft at 6" Thick	$14 - $21
River Rock (2" - 8" size)	1 Ton	70 Sq Ft at 2" Thick	$40 - $70
Mulch, Hardwood	1 Yard	100 Sq Ft at 3" Thick	$18 - $25
Live Plants	1 Gallon	Varies	$4 - $12 per plant
Drainage Pipe (optional)			

Estimating a 150 Square Foot Garden

- **Added Soil To ½ Foot:** 150 Square Feet ÷ 54 Square Feet = 2.75 Yards
- **River Rock:** 35 Square Feet of Rock Needed ÷ 70 Square Feet = ½ Ton
- **Plants:** Depends on the design and layout

Large river rock, four to eight inches

Hardwood mulch

As rain gardens become more commonplace in Omaha, expect costs to come down. However, if your rain garden can be designed and installed as part of a comprehensive landscape project, the costs should be about the same as that of a landscape with no rain garden. By using some very general assumptions, 100 to 300 square feet with a six-inch rain garden depth and about 12 inches of added soil for example, it will cost about $8.00 to $13.00 per square foot to create your rain garden. The benefits of having a reputable landscape professional install a rain garden can include a plant material warranty, quick turnaround, and confidence in the performance of the garden.

Cost of Maintenance

Like any garden, sustainable gardens need attention and maintenance to thrive. Maintenance, as noted in Chapter 8, is highest during the first year after installation and planting. As the rain garden becomes more self-sustaining, maintenance and the associated costs are reduced. Occasionally, a visual inspection of your garden is needed to ensure that mulch is not accumulating in areas, weeds are not competing with the plants, and that water is draining out in an appropriate amount of time The inlets and overflow of your garden should also be inspected periodically for debris build-up, erosion of the soil, and displaced river rock.

All planted landscape areas such as turf grass lawns, landscape beds and garden areas, require maintenance to keep them looking good and functioning properly. A rain garden also needs maintenance but typically to a lesser degree than traditional landscapes. If you don't have a lot of time to maintain your garden, hiring someone to maintain it is always an option. Hourly rates for a professional gardener can range from $40.00 to $70.00 per hour, depending on what services they provide.

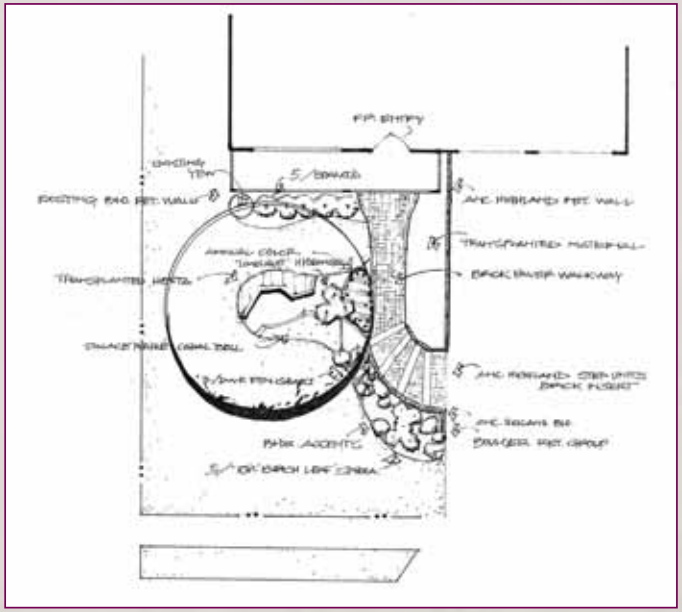
Cost Versus Performance

As with any type of construction project, the investment in the quality of care ultimately pays dividends throughout the life of your garden. Here are some things to remember:

- Look at the drainage, soils, and surrounding land use, including site vegetation, to help design your garden. Some sites have excellent soils and may not need any added soil, which can help lower costs and improve the chance of success.

- Attention to detail and care of construction are very important for the success of your garden. In particular, take care to avoid compacting soils during or after construction in the garden area. Also, a level garden bottom and proper depth will substantially affect the performance and growth of the garden.

- Maintenance is important, especially in the beginning, to keep your garden looking good and functioning properly.



An example of a professional landscape design layout.

Care and Maintenance:

Ensuring Success

Managing Expectations: Patience is Required

Sustainable landscapes provide many benefits:

- Stormwater capture and infiltration.
- An attractive and often unique landscape amenity to your home and neighborhood.
- Low maintenance after it's established.
- Cost savings from growing perennial plants, not using fertilizer, and lower watering requirements.

Lavender in full bloom used around the perimeter of a home rain garden.

However, because sustainable landscapes often contain plants that may be unfamiliar, understanding the care and maintenance for the garden and how the garden looks is different than with most gardens. As with any garden, however, its function and success will be a result of the care that is given to it. For some elements of the sustainable landscape features, especially rain gardens and bioswales, it may help to bring in a landscape professional to help evaluate the infiltration, elevations of the berm and overflow, and overall plant health. Some developing problems may not be obvious to the untrained eye.

The First Few Weeks

Dr. Stacy Hutchinson of Kansas State University once stated, "Traditional concrete stormwater structures function best the first day after construction. For plant-based stormwater systems, the first day after installation is the worst function." The physical installation of a xeric garden, rain garden, bioswale, or any other planting bed is the first part in the completion of the garden. The second part is getting it established and self-sustaining. Plants only get better as they grow and get stronger. It is those first days and weeks after they are installed that require particular care and maintenance.

Initial planting of one of the Orchard Park brioretention gardens in May.

Growth and establishment of rain garden plants at the end of August.

Mid-November, after plants were cut back.

During the first few weeks, it will be necessary to care for the sustainable landscapes much the same as any type of garden. Young plants need to be watered if there is not enough rainfall. Weeds, especially aggressive weeds, will need to be pulled. Mulch is needed to cover bare ground and to provide an attractive appearance until the plants grow and fill in. It is often necessary to remove young plants that die. Remember, invasive plants from seeds that were dormant in the soil or that are blown in will sprout and begin to grow very quickly. Being able to recognize and pull the weeds is necessary to keep the garden healthy.

Before completion of your garden, have a plan for how you will manage its maintenance. Plan to remove invasive weeds and dead vegetation, replace plants as needed, monitor water infiltration rates, spread mulch that has been displaced, and repair inlets and outlets as necessary. As the garden matures, it may be necessary to thin vegetation to keep excessive growth in check, install new plants to change the look if desired, and cut a new bed edge around the perimeter of the rain garden bed to keep a clean edge with the turf grass.

Starting in front: Othello Ligularia, Blazing Star Liatris, and Karl Forester Grass.

Long-Term Care for Your Maturing Garden

After a couple of months, the xeric garden, rain garden, and bioswale will finally begin to look and function as they were designed. Still, many young native and adapted plants appear to grow slowly because most work on developing their root system first, making them hardy and strong. The top part of the plant may appear to be stunted, but it will grow. During the first and second season of the rain garden, remember the following:

- Be careful when weeding. It is often difficult to tell some weeds from the early flowering native plants. It may be necessary to wait until some of the weeds get larger before they are removed. Be sure to remove them before they form seed heads.

- Do not over water the plants. Native plants are used to the drier and more variable conditions of non-irrigated natural landscapes. They should not become completely dry, however. Their roots are not completely formed, and they need to continue to receive water periodically through the first year if rain doesn't come. They may also need watering in the second year if excessively dry conditions occur.

- Don't over-mulch the garden. The plants should be properly spaced with a layer of mulch placed in between the plants to allow them to grow to their full size. Add additional mulch only when necessary to replace decomposing mulch and keep the soil surface covered. Overmulching can limit the growth of existing plants, prevent new natives from growing, and fill in the rain garden with unneeded material that may lessen the garden's water-holding capacity. From a proper planting perspective it is better to plant and mulch rather than mulch and plant, unless the mulch has been previously spread to reduce soil compaction.

- Some of the native plants will go dormant in early to late fall. Some of the grasses will retain their attractive colors and stems (such as Little Bluestem, Switchgrass, and others), while others become pale brown. During the winter, these plants provide food for wildlife. If your goal is not to feed a wide variety of colorful birds, cut back the rain garden to remove excess, dead plant matter to retain a maintained look through the winter. However, it is preferable to wait until early spring to cut back.

- Wildlife may enjoy your garden as much as you do. Deer and rabbits can cause significant aboveground damage to newly installed garden plants. Voles can seriously damage root systems, especially on plants such as Gayfeather. If you live in an area where wildlife damage is common, you should select plants that aren't attractive to animals. Fences, chemicals and other barriers may also be necessary in order to help garden plants reach a level of maturity and achieve a balance between garden health and tolerable damage.

1. *Vole damage is evident in this garden (note the raised bump through the middle of the image.)*

2. *The texture and color of Little Bluestem lasts from fall to winter.*

Garden Maintenance

The following schedule is a general guide for maintenance of your sustainable landscape features.

These plugs are in their first year of growth. The bed continues to require weeding until the plants grow together, and additional watering may be required until establishment.

Short-Term: Year One

It is important to remember that native plants have not fully matured to their full aesthetic and functional value during their first year. Roots are not sufficiently developed to withstand long dry periods, so supplemental irrigation may be necessary.

- If there is little or no rain, water young plants at least two or three times weekly during the first two months. After the first two months, and especially during the summer months, water bi-weekly in the absence of rain.
- Monitor the rain garden for growth of invasive weeds. Pull invasive weeds as soon as possible. Spot apply herbicides to undesirable weeds periodically.
- Inspect the rain garden after significant rainfalls to check its condition. Redistribute mulch if it becomes displaced from the water inflow, remove trash and inspect for plants that may be stressed from extended ponding of water.
- Remove sediment that accumulates in the rain garden or at the inlets. With sediment removal, some plant and mulch maintenance will likely be necessary. Identify sediment sources (bare soil areas, pavement runoff, etc.) and consider installing a runoff filter, such as a strip of turf grass that can be periodically raked, near the garden entrance where sediment enters the garden.

Mid-Term: Years Two and Three

- Cut back dead plant material from the rain garden in early spring of each year to facilitate new plant growth. A general rule of thumb is to cut back to no lower than six inches above the ground.
- Monitor the rain garden for growth of invasive weeds. Pull invasive weeds as soon as possible. Spot apply herbicides to undesirable weeds periodically.
- Until second-year growth is established, inspect the rain garden after significant rainfalls to check the condition of the plants and mulch. Redistribute mulch if it becomes displaced from water inflow, remove debris, and inspect for plants that may be stressed from extended ponding of water.
- Inspect the rain garden's condition during the fall to assess the condition of all plants. If plants become overgrown, prune or split them as needed. Replace dead plants if necessary. Remove invasive weeds.

A good time to check on rain gardens is during or after rains when drainage and erosion problems may be easier to spot.

- Look for and remove sediment that accumulates in the garden. With sediment removal, some plant and mulch maintenance might be necessary.

Long-Term: More Than Three Years

- Cut back dead plant material from the rain garden in the early spring of each year to facilitate new plant growth. Do not cut back plant material lower than six inches above the ground.
- Monitor the rain garden for growth of invasive weeds. Pull invasive weeds as soon as possible. If possible, maintain rain garden areas through spot herbicide treatments, as needed.
- At least once a year, remove sediment from the rain garden.

Plants

In the Omaha region, a broad range of plants is suited for use in your sustainable garden. This section includes individual plant descriptions and images, as well as a series of tables that summarize plants by type and intended use in gardens.

Since plant availability will vary from year to year, no single plant list should be viewed as complete, but rather as a good starting point for creative selection and plant use in green landscape projects. For future reference, two University of Nebraska-Lincoln water web sites provide additional information to supplement this list:

- **Lawns, Landscapes and Gardens section:**
  http://water.unl.edu/landscapes

- **Property Design and Management section:**
  http://water.unl.edu/stormwater

Little Joe Pye Weed attracts bees and other insects at the UnderTheSink gardens in Omaha.

Assumptions

The following points and assumptions have been considered in list development:

- Nebraska and/or regionally native plants comprise the bulk of the list due to the inherent benefits associated with their use, including deep or variable root systems for enhanced water infiltration and drought tolerance, habitat value and diversity for local ecological communities, and overall sustainability once established.

- Adapted non-invasive, non-native plants that have proven themselves in regional green infrastructure projects are included to broaden plant diversity and availability.

- Cultivated and hybridized plants, bred for specific ornamental characteristics, growth habits and disease or drought resistance, are currently available or are in development for many plant species on the list. These plants may or may not retain the genetic diversity and specific characteristics that maximize their value in natural landscapes. However, they may provide enhanced aesthetic characteristics and disease resistance that are critical factors in a successful garden.

- Local and regional plant sources have been referenced to verify a reasonable level of plant availability. Many previously hard-to-find plants are now becoming more readily available.

- This list includes forbs, grasses, sedges, rushes, and shrubs. Homeowners should consider using a variety of plants, especially in larger gardens, to enhance seasonal diversity and garden structure. Shrubs are not recommended to replace perennial forbs and grasses in gardens because their relative size, especially in a smaller garden, can be overwhelming. Where space allows, shrubs should be used to complement forb and grass masses, frame and provide backdrops for gardens, and provide food and cover for wildlife.

- Since garden locations beyond the top of berms do not require plants adapted to flooding, you may consider other well-suited landscape plants based on the soil conditions and maintenance requirements of your garden. In order to visually unify the garden and surrounding landscape, some or all of the plants within the dry edge area should be repeated as context plantings for the surrounding landscape.

Tables

Ten tables have been developed. Table 1 lists all plants. Tables 2 through 10 include sorted lists by exposure, recommended garden location, and average plant height (from short to tall). The sorted lists are intended to shorten the time required for homeowners to cross-reference information as garden designs are developed. The tables include the following information:

Common and Scientific Names: Common names are easiest to use for public reference, but scientific names will ensure that plant selection and ordering are accurate.

Plant Commonly Available: Based on a general survey of nurseries and landscape designers in the Omaha area, plants should be relatively easy to find locally.

Regional Native Status: Listed states have been verified through the USDA Plant Database and the Flora of Nebraska, 2007. The region includes Nebraska, South Dakota, Minnesota, Iowa, Missouri, Kansas, and Colorado. The list assigns native status based on plant species, not including cultivars or hybrid cultivars.

Exposure: Full sun (minimum six to eight hours per day), part shade (includes a half day or more of shade), and filtered shade throughout the day (such as under the edge of a tree canopy), or full shade.

Soil Type: Categories include sand, loam or clay. For use as a general factor in plant selection and an indicator of potential plant adaptability on a poor site.

Tables (continued)

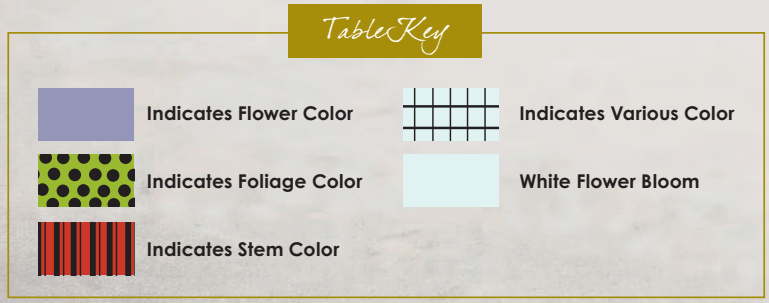
Soil Moisture: Ranges from wet to dry. For use as a general classification to match plants to conditions.

Recommended Garden Location: Correlates to soil moisture information and ability to tolerate standing water in the garden. In rain gardens, bottom plants can tolerate nine to 12 inches of water for 24 hours, side plants (sides of berms to the inside of the garden) can handle three to six inches for 24 hours, and berm plants (top and outside garden) generally have little if any flooding tolerance.

Salt Tolerance: Based on a plant's tolerance of salt, such as salt used for snow melt on streets.

Approximate Mature Height: Plants are listed by categories ranging from groundcover to more than 60 inches for perennials and grasses, and two to three feet to more than 15 feet for shrubs. Short plants should be used along garden edges and in the foreground of garden viewpoints. Medium-height plants are recommended for placement between short and tall plantings. Tall plantings should be used in the middle of the garden if viewed from all sides or at the back of a garden if viewed from one side. Tall planting can also be used to frame garden views or provide accent or focal points in the garden.

Bloom and/or Seasonal Interest: Average bloom times and approximate colors for forbs are noted by month. Grasses, sedges, and rushes are noted for their growth periods and fall and winter interest, and shrubs are noted for flower season, fall color and winter interest.



Plant Summaries and Images

Information summaries and thumbnail images are provided for some plants. The summaries include the following categories, and are intended to supplement the table information for more specific plant selection criteria:

Form: Relative shape
Foliage: Color, type and overall texture
Flowers: Color, size, shape, fragrance, average bloom season
Height/Spread: Average size

Garden Exposure/Location: Range of sun/shade conditions and designation of garden location relative to soil moisture and inundation tolerance, including bottom of garden, sides of garden, or top of berms surrounding a garden.

Comments/Cautions: Additional information based on personal experiences of the authors and contributors. Carefully consider whether to use plants that flop or may be too tall for small gardens, or tend to appear weedy, aggressive or invasive.

Alternative Species and Cultivars: Provides additional choices in plants that fill similar garden roles, expand flower colors, have special characteristics, or may be easier to locate.

Typical Rain Garden Planting Plan and Plant Lists

A rain garden planting plan was included at the end of Chapter 4 to suggest potential combinations and locations of plants for typical garden locations and conditions. The plants are commonly available in Omaha and are selected for their overall hardiness, adaptability, multi-seasonal beauty, and habitat value. This design and the accompanying plant lists provide a starting point for garden designs. In all locations, however, plant selection should be adjusted for the specific soil, exposure and size requirements of each site, and should reflect the preferences and maintenance resources of each property owner.

Herbaceous Plants

Plant Names		Native Status	Exposure			Soil Type			Soil Moisture					Location			Approximate Height								Bloom and/or Interest Season									
Common Name	Botanical Name	Species Regionally Native (by State)	Full Sun	Part-Shade	Shade	Sand	Loam	Clay	Wet	Moist	Average	Dry	Moderate to High Salt Tolerance	Bottom	Sides	Top of Berm	Groundcover	6" - 12"	12" - 24"	24" - 36"	36" - 48"	48" - 72"	6' - 10'	10' - 15'	March	April	May	June	July	August	September	October	November	Dec. - Feb.
common yarrow	Achillea millefolium	NE	x	x		x	x				x	x	x			x	x			x	x													
Paprika yarrow, Terracotta yarrow	Achillea hybrids and cultivars		x	x		x	x				x	x	x			x	x			x								VARIES						
leadplant	Amorpha canescens	NE	x			x	x	x			x	x				x	x				x													
fragrant false indigo	Amorpha nana	NE	x			x	x				x	x				x	x				x													
Arkansas amsonia	Amsonia hubrichtii		x	x			x	x		x	x	x				x	x				x													
shining bluestar	Amsonia illustris	KS, MO	x	x			x	x		x	x	x				x	x			x	x													
windflower	Anemone canadensis	NE	x	x		x	x		x	x				x	x		x			x														
American columbine	Aquilegia canadensis	NE		x	x		x			x	x		x		x	x				x								VARIES						
hybrid columbine	Aquilegia hybrids		x	x			x			x	x				x	x				x								VARIES						
spikenard	Aralia racemosa	NE		x	x		x			x	x				x							x												
pale Indian plantain	Arnoglossum atriplicifolium	NE	x	x		x	x	x	x	x				x	x						x	x												
white goat's beard	Aruncus dioicus	IA		x	x		x		x	x	x			x	x	x						x												
wild ginger	Asarum canadense	NE		x	x		x			x	x				x	x	x	x																
swamp milkweed	Asclepias incarnata	NE	x	x		x	x	x	x	x	x			x							x													
butterfly milkweed	Asclepias tuberosa	NE	x	x		x	x	x			x	x			x	x				x														
Wood's aster series	Aster dumosus 'Wood's Blue,' 'Pink,' and 'Purple'	NE	x	x			x	x		x	x	x			x	x		x												VARIES				
Chinese astilbe	Astilbe chinensis var. pumila			x	x		x			x	x		x	x	x		x		x														
lady fern	Athyrium filix-femina	NE		x	x		x		x	x	x			x	x						x													
Lady in Red lady fern	Athyrium filix-femina 'Lady in Red'			x	x		x		x	x	x			x	x						x													
blue false indigo	Baptisia australis	NE	x	x			x	x		x	x	x	x	x	x	x					x													
dwarf blue false indigo	Baptisia australis var. minor	NE	x	x			x	x	x	x	x	x	x	x	x	x				x														
boltonia	Boltonia asteroides	MO	x	x			x	x		x	x	x			x	x						x												
Snowbank boltonia	Boltonia asteroides 'Snowbank'		x	x			x	x		x	x	x			x	x						x												
Jim Crockett boltonia	Boltonia asteroides var. lasquimata 'Masbolimket'		x				x	x		x	x	x			x	x			x															
purple poppy mallow	Callirhoe involucrata	NE	x			x	x				x	x				x	x	x																
turtlehead	Chelone glabra	IA, MO	x	x	x		x	x	x	x	x			x	x					x														
Hot Lips turtlehead	Chelone lyonii 'Hot Lips'		x	x	x		x	x	x	x	x			x	x					x														
threadleaf coreopsis	Coreopsis verticillata		x	x			x			x	x				x	x			x	x														
purple prairie clover	Dalea purpurea	NE	x			x	x				x	x				x			x															
Stephanie purple prairie clover	Dalea purpurea 'Stephanie'		x			x	x				x	x				x			x															
narrow-leaf coneflower	Echinacea angustifolia	NE	x			x	x	x			x	x				x			x	x														
purple coneflower	Echinacea purpurea	IA, KS	x	x		x	x	x		x	x	x			x	x				x	x													
Phantom joe pye weed	Eupatorium 'Phantom'		x	x		x	x	x		x	x			x	x						x													
Little Joe joe pye weed	Eutrochium dubium 'Little Joe'		x	x		x	x	x		x	x			x	x						x													
sweet joe pye weed	Eutrochium purpureum	NE		x	x		x	x		x	x			x	x							x												

Herbaceous Plants cont.

Plant Names		Native Status	Exposure			Soil Type			Soil Moisture					Location				Approximate Height							Bloom and/or Interest Season										
Common Name	Botanical Name	Species Regionally Native (by State)	Full Sun	Part-Shade	Shade	Sand	Loam	Clay	Wet	Moist	Average	Dry	Moderate to High Salt Tolerance	Bottom	Sides	Top of Berm	Groundcover	6" - 12"	12" - 24"	24" - 36"	36" - 48"	48" - 72"	6' - 10'	10' - 15'	March	April	May	June	July	August	September	October	November	Dec. - Feb.
Gateway spotted joe pye weed	Eutrochium purpureum subsp. maculatum 'Gateway'	NE	x	x			x	x	x	x	x			x	x							x												
queen-of-the-prairie	Filipendula rubra	IA	x	x			x	x	x	x	x			x								x												
blanket flower	Gaillardia aristata	NE	x			x	x				x	x	x		x	x			x															
Oranges 'n Lemons blanket flower	Gaillardia aristata `Oranges 'n Lemons'		x			x	x				x	x	x		x	x			x															
blanket flower hybrids and cultivars	Gaillardia grandiflora		x			x	x	x			x		x		x	x			x															
wild geranium	Geranium maculatum	NE		x	x	x	x	x		x	x	x			x				x															
bloody cranesbill	Geranium sanguineum			x	x		x	x		x	x	x			x		x		x															
Alpenglow bloody cranesbill	Geranium sanguineum 'Alpenglow'			x	x		x	x		x	x	x			x				x															
sneezeweed	Helenium autumnale	NE	x	x			x	x	x	x	x		x	x	x						x	x												
Mardi Gras sneezeweed	Helenium 'Mardi Gras'		x	x			x	x	x	x	x			x	x					x														
Wyndley sneezeweed	Helenium 'Wyndley'		x	x			x	x	x	x	x			x	x					x														
ox-eye daisy	Heliopsis helianthoides	NE	x	x		x	x	x		x	x		x	x	x						x	x												
Summer Nights ox-eye daisy	Heliopsis helianthoides 'Summer Nights'		x	x			x	x	x	x				x	x						x	x												
daylily	Hemerocallis (various species and hybrids)		x	x	x		x	x		x	x	x	x		x	x	x		x	x							VARIES							
rose mallow, hardy hibiscus	Hibiscus moscheutos	KS, MO	x	x			x	x	x	x	x		x	x	x	x					x	x												
Disco Belle, Luna series rose mallow	Hibiscus moscheutos cultivars and hybrids		x	x			x	x	x	x	x		x	x	x	x					x	x						VARIES						
hosta	Hosta (various species and hybrids)			x	x	x	x	x		x	x	x	x		x	x		x	x	x								VARIES						
Siberian iris	Iris sibirica		x	x			x	x		x	x		x		x	x				x														
Caesar's Brother Siberian iris	Iris sibirica 'Caesar's Brother'		x	x			x	x		x	x		x		x	x				x														
blue flag iris	Iris versicolor	MN	x	x			x	x	x	x	x		x	x						x														
meadow blazing star	Liatris ligulistylis	WY, CO	x	x			x	x		x	x				x						x														
prairie blazing star	Liatris pycnostachya	NE	x			x	x	x	x	x				x	x						x														
dense blazing star	Liatris spicata	MO	x			x	x	x		x				x	x	x				x															
Kobold dense blazing star	Liatris spicata 'Kobold'		x			x	x	x		x				x	x	x			x	x															
cardinal flower	Lobelia cardinalis	NE		x	x		x	x	x	x				x						x															
great blue lobelia	Lobelia siphilitica	NE	x	x		x	x	x	x	x	x		x	x	x					x															
ostrich fern	Matteuccia struthiopteris	NE		x	x		x	x	x	x				x						x															
monkey flower	Mimulus ringens	NE	x	x		x	x	x	x	x				x	x				x	x															
bee balm	Monarda didyma	IA	x	x			x	x	x	x	x			x	x					x	x														
Jacob Kline, Raspberry Crush, others	Monarda didyma cultivars		x	x			x	x	x	x	x			x	x					x	x	x						VARIES						
wild bergamot	Monarda fistulosa	NE	x	x		x	x	x	x	x	x	x		x	x						x														
sundrops	Oenothera fruticosa	MO	x				x	x	x	x	x				x		x		x																
Missouri primrose	Oenothera macrocarpa	MO	x				x	x		x	x	x			x	x		x																	
cinnamon fern	Osmunda cinnamomea	IA		x	x		x	x	x	x	x			x							x														
smooth beardtongue, penstemon	Penstemon digitalis	NE	x	x		x	x	x		x	x	x			x	x			x																

Herbaceous Plants cont.

Plant Names		Native Status	Exposure			Soil Type			Soil Moisture					Location				Approximate Height							Bloom and/or Interest Season										
Common Name	Botanical Name	Species Regionally Native (by State)	Full Sun	Part-Shade	Shade	Sand	Loam	Clay	Wet	Moist	Average	Dry	Moderate to High Salt Tolerance	Bottom	Sides	Top of Berm	Groundcover	6" - 12"	12" - 24"	24" - 36"	36" - 48"	48" - 72"	6' - 10'	10' - 15'	March	April	May	June	July	August	September	October	November	Dec. - Feb.
prairie phlox	Phlox pilosa	NE	x	x		x	x			x	x				x	x			x															
obedient plant	Physostegia virginiana	NE	x	x			x	x		x	x				x	x				x															
Vivid, Miss Manners	Physostegia virginiana cultivars		x	x			x	x	x	x	x				x	x				x															
Solomon's seal	Polygonatum biflorum	NE		x	x		x		x	x	x	x			x		x			x															
variegated Solomon's seal	Polygonatum multiflorum 'Variegatum'			x	x		x		x	x	x	x			x	x	x		x																
Virginia mountain mint	Pycnanthemum virginianum	NE	x	x		x	x			x	x	x	x	x	x	x			x																
grayheaded prairie coneflower	Ratibida pinnata	NE	x	x		x	x	x		x	x				x						x														
Goldsturm rudbeckia	Rudbeckia fulgida var. sullivantii 'Goldsturm'	MO	x	x		x	x	x		x	x		x		x					x															
goldenglow	Rudbeckia laciniata	NE	x	x		x	x	x	x	x			x	x	x	x					x	x													
Herbstonne goldenglow	Rudbeckia laciniata 'Herbstonne'		x	x		x	x	x	x	x			x	x	x	x					x	x													
wild petunia	Ruellia humilis	NE	x			x	x	x			x	x			x	x	x	x																	
meadow sage	Salvia nemorosa	NE	x	x			x	x			x				x	x			x																
Caradonna, Purple Rain	Salvia cultivars and hybrids		x	x			x	x			x				x	x			x																
stonecrop sedum	Sedum (groundcover hybrids and cultivars)		x	x		x	x	x		x	x	x			x	x	x	x																	
showy sedum	Sedum (tall hybrids and cultivars)		x	x		x	x	x		x	x	x			x	x			x	x															
cup plant, rosinweed	Silphium integrifolium	NE	x	x		x	x	x		x	x			x	x	x						x	x												
Golden Baby, Little Lemon, Crown of Rays	Solidago spp. cultivars		x	x			x	x		x	x	x			x	x			x	x															
Riddell's goldenrod	Solidago riddellii	IA, SD	x	x		x	x	x	x	x	x				x					x															
Fireworks goldenrod	Solidago rugosa 'Fireworks'	MO	x	x			x	x	x	x	x	x			x	x					x														
showy goldenrod	Solidago speciosa	NE	x	x		x	x	x		x	x				x					x															
heath aster	Symphyotrichum ericoides	NE	x			x	x				x	x				x			x	x															
New England aster	Symphyotrichum novae-angliae	NE	x	x			x	x		x	x				x	x				x	x														
aromatic aster	Symphyotrichum oblongifolium	NE	x	x		x	x				x	x			x	x			x	x															
October Skies aromatic aster	Symphyotrichum oblongifolium 'October Skies'		x	x		x	x	x			x	x			x	x				x															
meadow rue	Thalictrum dasycarpum	NE		x	x	x	x		x	x				x	x						x	x													
prairie spiderwort	Tradescantia bracteata	NE	x				x	x		x	x				x				x																
Ohio spiderwort	Tradescantia ohioensis	NE	x	x		x	x	x		x	x			x	x				x																
Sweet Kate, Concord Grape	Tradescantia hybrids and cultivars		x	x		x	x	x		x	x			x	x				x																
blue vervain	Verbena hastata	NE	x	x			x	x	x	x	x			x	x				x																
common ironweed	Vernonia fasciculata	NE	x	x		x	x	x	x	x	x			x	x						x														
Culver's root	Veronicastrum virginicum	NE	x	x			x	x	x	x	x			x	x							x													
barren strawberry	Waldsteinia fragarioides	MN	x	x	x		x	x			x		x			x	x	x																	
heart-leaved meadow parsnip	Zizia aptera	IA, SD	x	x			x			x	x		x		x				x																

Grasses, Sedges and Rushes

Plant Names		Native Status	Exposure			Soil Type			Soil Mosture					Location				Approximate Height							Bloom and/or Interest Season									
Common Name	Botanical Name	Species Regionally Native (by State)	Full Sun	Part-Shade	Shade	Sand	Loam	Clay	Wet	Moist	Average	Dry	Moderate to High Salt Tolerance	Bottom	Sides	Top of Berm	Groundcover	6" - 12"	12" - 24"	24" - 36"	36" - 48"	48" - 72"	6' - 10'	10' - 15'	March	April	May	June	July	August	September	October	November	Dec. - Feb.
big bluestem	Andropogon gerardii	NE	x	x		x	x	x		x	x	x	x	x	x	x						x											
bushy bluestem	Andropogon glomeratus	IL	x				x	x	x	x			x	x	x							x											
sideoats grama	Bouteloua curtipendula	NE	x			x	x	x			x	x	x		x	x				x													
blue grama	Bouteloua gracilis	NE	x			x	x	x			x	x				x			x														
feather reed grass	Calamagrostis acutifora		x	x		x	x	x		x	x	x	x		x	x						x											
Karl Foerster, Overdam, Avalanche	Calamagrostis acutifora cultivars		x	x		x	x	x		x	x	x	x		x	x					x												
Korean feather reed grass	Calamagrostis brachytricha		x	x		x	x	x	x	x	x		x	x	x						x												
bluejoint grass	Calamagrostis canadensis	NE	x	x	x		x	x	x	x			x	x	x							x												
yellowfruit or large yellow fox sedge	Carex annectens	NE	x	x			x	x	x	x				x	x					x														
prairie or copper-shouldered sedge	Carex bicknellii	NE	x	x		x	x	x	x	x	x			x	x	x				x														
shortbeak or plains oval sedge	Carex brevior	NE	x	x	x	x	x	x	x	x	x	x		x	x	x			x															
longhair sedge	Carex comosa	NE	x	x			x		x	x				x					x															
fringed sedge	Carex crinita	IA	x	x	x		x		x	x	x			x						x														
Gray's sedge	Carex grayii	IA, KS	x	x	x		x	x	x	x			x	x	x					x														
bottlebrush sedge	Carex hystericina	NE	x	x			x	x	x	x				x	x					x														
Ice Dance, Old Gold	Carex morrowii cultivars			x	x		x	x	x	x	x			x	x				x														
palm sedge	Carex muskingumensis	IA, KS	x	x	x		x	x		x	x		x	x	x		x		x															
rosy sedge	Carex rosea	NE	x	x	x		x	x	x	x	x			x	x	x		x																
broom sedge	Carex scoparia	NE	x				x		x	x			x	x					x															
Sprengel's sedge	Carex sprengelii	NE	x	x			x		x	x	x			x	x	x				x														
common fox sedge	Carex stipata	NE	x	x	x		x		x	x			x	x	x					x														
tussock sedge	Carex stricta	NE	x	x			x		x	x				x	x																			
Texas sedge	Carex texensis	NE		x	x		x		x	x	x			x	x	x	x																	
brown fox sedge	Carex vulpinoidea	NE	x	x			x		x	x	x		x	x	x					x														
spikerush	Eleocharis palustris	NE	x	x			x	x	x	x				x							x													
Baltic rush	Juncus balticus	NE	x				x	x	x	x	x			x	x				x															
common rush	Juncus effusus	NE	x	x			x	x	x	x	x		x	x					x															
path rush	Juncus tenuis	NE	x	x			x	x	x	x				x	x			x																
switchgrass	Panicum virgatum	NE	x	x			x	x	x	x	x		x	x	x	x						x												
Northwind, Heavy Metal, Cheyenne	Panicum virgatum cultivars		x	x			x	x	x	x	x		x	x	x	x						x												
little bluestem	Schizachyrium scoparium	NE	x	x		x	x	x			x	x	x		x	x				x														
Blaze, Blue Heaven	Schizachyrium scoparium cultivars		x	x		x	x	x			x	x	x		x	x				x	x													
Indiangrass	Sorghastrum nutans	NE	x	x		x	x	x		x	x	x		x	x	x						x												
Sioux Blue, Indian Steel	Sorghastrum nutans cultivars		x	x		x	x	x		x	x	x		x	x							x												
prairie dropseed	Sporobolus heterolepis	NE	x	x		x	x	x			x	x			x	x			x	x														

Shrubs and Small Trees

Plant Names		Native Status	Exposure			Soil Type			Soil Mosture					Location				Approximate Height							Bloom and/or Interest Season										
Common Name	Botanical Name	Species Regionally Native (by State)	Full Sun	Part-Shade	Shade	Sand	Loam	Clay	Wet	Moist	Average	Dry	Moderate to High Salt Tolerance	Bottom	Sides	Top of Berm	Groundcover	6" - 12"	12" - 24"	24" - 36"	36" - 48"	48" - 72"	6' - 10'	10' - 15'	March	April	May	June	July	August	September	October	November	Dec. - Feb.
red chokeberry	Aronia arbutifolia		x	x			x	x	x	x	x		x	x	x	x						x	x											
Erecta, Brilliantissima	Aronia arbutifolia cultivars		x	x			x	x	x	x	x		x	x	x	x					x	x												
black chokeberry	Aronia melanocarpa	IA	x	x			x	x		x	x	x	x	x	x	x					x	x												
Iroquois Beauty, Viking, Autumn Magic	Aronia melanocarpa cultivars		x	x			x	x		x	x	x	x	x	x	x					x	x												
buttonbush	Cephalanthus occidentalis	NE	x	x			x	x	x	x	x			x	x	x							x	x											
Sugarshack buttonbush	Cephalanthus occidentalis 'Sugarshack'		x	x			x	x	x	x	x			x	x	x						x												
redtwig dogwood, redosier dogwood	Cornus sericea	NE	x	x		x	x	x	x	x	x	x		x	x	x						x	x												
Isanti, Arctic Fire, Firedance	Cornus sericea cultivars		x	x		x	x	x	x	x	x	x		x	x	x					x	x	x												
American hazelnut	Corylus americana	NE	x	x			x	x		x	x	x			x	x									x										
northern bush honeysuckle	Diervilla lonicera	IA	x	x	x	x	x	x		x	x	x			x	x				x															
southern bush honeysuckle	Diervilla sessilifolia		x	x	x		x	x	x	x	x			x	x					x														
Butterfly, Copper	Diervilla spp. cultivars		x	x	x		x	x	x	x	x			x	x					x														
smooth hydrangea	Hydrangea arborescens	IA, KS		x	x	x	x	x		x	x		x	x	x					x														
Annabelle, White Dome	Hydrangea arborescens cultivars			x	x	x	x	x		x	x		x	x	x																			
Virginia sweetspire	Itea virginica	MO	x	x	x		x	x	x	x	x		x	x	x					x	x														
Henry, Little Henry, Merlot	Itea virginica cultivars		x	x	x		x	x	x	x	x		x	x	x					x	x														
ninebark	Physocarpus opulifolius	NE	x	x			x	x		x	x	x			x	x						x													
Diablo, Summer Wine, Coppertina	Physocarpus opulifolius cultivars		x	x			x	x		x	x	x			x	x					x	x													
shrub rose	Rosa cultivars		x	x		x	x	x		x	x	x	x		x	x				x	x						VARIES								
dwarf blue arctic willow	Salix purpurea 'Nana'	IA	x			x	x	x		x	x		x	x	x	x					x														
elderberry	Sambucus canadensis	NE	x	x		x	x	x		x	x		x	x	x	x							x												
Ural false spirea	Sorbaria sorbifolia	IA	x	x			x	x		x	x	x			x	x						x													
white meadowsweet	Spiraea alba	SD, IA	x	x			x	x		x	x		x	x	x					x															
arrowwood viburnum	Viburnum dentatum	IA	x	x			x	x	x	x	x		x	x	x	x						x	x												
Blue Muffin, Autumn Jazz	Viburnum dentatum cultivars		x	x			x	x	x	x	x		x	x	x	x						x	x												
American cranberrybush	Viburnum opulus var. americanum	NE	x	x			x	x		x	x		x		x	x							x	x											
Hahs, Wentworth, Red Wing	Vib. opulus var. americanum cultivars		x	x			x	x		x	x		x		x	x							x	x											
blackhaw viburnum	Viburnum prunifolium	IA	x	x			x	x		x	x		x		x	x								x											

Achillea millefolium
common yarrow

Full Sun · Part Shade · Top · Side · 24" Height · 36" Spread

Form: spreading mounds of low mat-like foliage; flowers on stalks above foliage

Foliage: bright green to slightly gray or dusty green; finely divided; fine texture; leaves to 12" long

Flowers: flat heads up to 4" across; millefolium white; cultivar colors range from white to pink, rose, yellow, gold, red or orange; June -Sept.

Comments and Cautions: straight species can spread aggressively by rhizomes; use cultivars and other species to lessen spreading

Additional Species and Cultivars: millefolium cultivars ('paprika,' 'summer pastels,' 'terra cotta,' and 'angelique'); hybrid cultivars ('coronation gold,''moonshine')

Amorpha canescens
leadplant

Full Sun · Top · Side · 36" Height · 36" Spread

Form: small, semi-woody to woody, irregular

Foliage: fine-textured, compound leaves with small silvery green leaflets

Flowers: racemes 2 to 4 inches long, blue to red-violet, fragrant; June-July

Comments and Cautions: cut back to within 6 inches of base in early spring to encourage full growth; extensive deep roots enhance drought adaptability

Amorpha nana
fragrant false indigo, dwarf wild indigo

Full Sun · Top · Side · 12-36" Height · 24-36" Spread

Form: compact erect shrub; semi-woody to woody

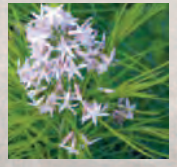
Foliage: fine-textured, compound green leaves

Flowers: dense racemes of purple pea-like flowers; fragrant; June-July

Comments and Cautions: drought-resistant; known for fragrant flowers; rabbits may cause winter damage

Amsonia hubrichtii
arkansas amsonia

Full Sun · Part Shade · Top · Side · 30" Height · 30" Spread



Form: open upright vase

Foliage: very fine, needle-like leaves; excellent yellow fall color

Flowers: light blue, star-shaped; April-May

Comments and Cautions: deep root system holds soil; spreads readily but not aggressively; cut back after flowering

Amsonia illustris
shining bluestar

Full Sun · Part Shade · Top · Side · 36" Height · 36" Spread

Form: erect to mounded

Foliage: shiny thick leathery leaves; excellent yellow fall color

Flowers: light blue, star-shaped; April to May

Comments and Cautions: deep root system holds soil; spreads readily but not aggressively; cut back after flowering

Additional Species and Cultivars: A. ciliata, A. tabernaemontana var. tabernaemontana

Anemone canadensis
windflower

Full Sun · Part Shade · Side · Bottom · 12-24" Height · 24-36" Spread

Form: spreading low foliage; flowers on stalks above foliage

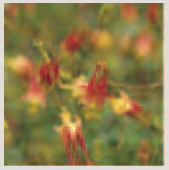
Foliage: deeply lobed basal leaves; whorled 3- to 5-parted leaves on flower stems

Flowers: white 2-inch diameter flowers; May-June

Comments and Cautions: will spread aggressively by underground rhizomes to form colonies under good growing conditions; effective groundcover

Aquilegia canadensis
American columbine

Full Sun · Part Shade · Top · Side · 24" Height · 24" Spread



Form: rounded mound of basal foliage; flower stems erect, branching

Foliage: gray-green; compound leaves; medium texture

Flowers: nodding yellow (sepals) and red (spurs) blooms; April-June

Comments and Cautions: very vigorous and easily grown but short-lived; can spread quickly by reseeding and will hybridize with other columbines; hybrids and cultivars also appropriate

Additional Species and Cultivars: A. canadensis 'Corbett;' A. caerulea Rocky Mountain columbine; 'Dragonfly' hybrids, 'Music' hybrids, 'Songbird'

Aralia racemosa
spikenard

Part Shade · Shade · Side · 48" Height · 36" Spread

Form: Large, spreading

Foliage: compound leaves, bold texture

Flowers: large white plumes in July-August followed by clusters of dark purple fruit

Comments and Cautions: slowly spreads by underground rhizomes; highly organic soil beneficial

Arnoglossum atriplicifolium
pale Indian plantain

Full Sun | Part Shade | Side | Bottom | 36-72" Height | 24-36" Spread

Form: upright

Foliage: thick, leathery, coarsely toothed basal leaves; stems and lower leaf surfaces covered with whitish bloom

Flowers: tiny, white, tubular-shaped, in flat-topped clusters; August-September

Comments and Cautions: will self-seed under good growing conditions; significant bee attractor

Additional Species and Cultivars: Cacalia suaveolens (false Indian plantain) is native to Iowa, adapted to similar garden conditions

Aruncus dioicus
white goat's beard

Full Sun | Part Shade | Top | Side | Bottom | 48" Height | 48" Spread

Form: rounded, shrub-like

Foliage: compound leaves; dark green; feathery bold texture

Flowers: small, cream-colored, in dense spikes up to 12" long

Comments and Cautions: use as backdrop or specimen plant, low moisture combined with wind and sun will cause foliage to burn

Additional Species and Cultivars: 'Child of Two Worlds;' 'Kneiffii' is a smaller cultivar

Asarum canadense
wild ginger

Part Shade | Shade | Top | Side | 6" Height | 24" Spread

Form: spreading groundcover; rhizomatous

Foliage: dull green, heart-shaped to kidney-shaped, hugging the ground; bold texture

Flowers: urn-shaped, brownish purple; under the leaves and not showy; April-May

Comments and Cautions: tolerant of dry conditions in shade once established

Asclepias incarnata
swamp milkweed

Full Sun | Part Shade | Bottom | 48" Height | 48" Spread

Form: tall, rather open habit, usually unbranched except in upper part of stems

Foliage: dark green, narrow leaves with pointed tips; medium texture; milky sap when stems are broken, but not to the same extent as common milkweed

Flowers: Rounded terminal clusters 4" to 5" across; flowers dusty pink to rose, with the "skirt" darker pink, lightly fragrant; July-August

Comments and Cautions: excellent for attracting butterflies; will self-seed

Additional Species and Cultivars: 'Cinderella,' 'Ice Ballet'

Asclepias tuberosa
butterfly milkweed

Full Sun | Full Sun | Top | Side | 18-24" Height | 18" Spread

Form: mounding upright to rounded, deep-rooted

Foliage: fine texture

Flowers: orange, flat-topped clusters followed by boat-shaped pods; June-August

Comments and Cautions: will not tolerate wet soils; excellent habitat plant with deep taproot and hardy once established; tends to emerge late in spring; susceptible to aphids; wonderful attractant for pollinators

Aster dumosus 'Wood's Blue,' 'Wood's Pink,' 'Wood's Purple'
Wood's aster series

Full Sun | Part Shade | Top | Side | 12" Height | 18" Spread

Form: compact rounded plants

Foliage: dark green; fine texture

Flowers: masses of single daisy-like flowers in blue, pink, purple; September-October

Comments and Cautions: excellent disease resistance (especially powdery mildew)

Additional Species and Cultivars: A. novae-angliae, New England Aster; 'Purple Dome,' 'Alma Potschke,' and 'September Ruby'; taller cultivars can be pinched or sheared to encourage branching and reduce height

Astilbe chinensis var. pumila
dwarf Chinese astilbe

Part Shade | Shade | Sides | Bottom | 12-15" Height | 12-15" Spread

Form: low rounded mound; spreads slowly by stolons

Foliage: compound leaves, fine-textured; deep green with russet tones on margins and undersides

Flowers: conical, fluffy pink panicles in July-August; ornamental through fall if seed heads are allowed to remain

Comments and Cautions: excellent groundcover; best astilbe for drought tolerance, but performs poorly if allowed to dry out

Additional Species and Cultivars: A. chinensis 'Visions in Pink,' 'Visions in Red'

Athyrium filix-femina
lady fern

Part Shade | Shade | Side | Bottom | 24-30" Height | 12-30" Spread

Form: mounding, vigorous; spreads very slowly by rhizomes

Foliage: deciduous; lacy lance-shaped leaves; fine-textured

Height/Spread: reaches largest size in consistently moist, shady soil

Comments and Cautions: relatively easy fern to grow, but slow to establish; tolerant of variable soil conditions; prefers high organic soils

Additional Species and Cultivars: A. filix-femina var. angustum 'Lady in Red;' smaller, more upright form with deep red stems

Baptisia australis
blue false indigo

Full Sun | Part Shade | Top | Side | Bottom | 24-48" Height | 48" Spread

Form: woody base; bushy and upright to rounded

Foliage: compound leaves, blue-green to green changing to silver-dark gray in late fall and persisting through winter; medium texture

Flowers: indigo blue, pea-like on terminal spikes, May-June; followed by showy persistent gray-black seed pods

Comments and Cautions: effective in naturalized settings; extremely deep fleshy taproot makes relocation difficult; slow to establish

Additional Species and Cultivars: Baptisia australis var. minor, smaller in all its parts to a height and spread of 24 to 36 inches

Boltonia asteroides
boltonia

Full Sun | Part Shade | Top | Sides | 48" Height | 48-60" Spread

Form: strongly upright and slightly rounded; dense mass of self-supporting stems

Foliage: narrow gray-green leaves; medium-fine texture

Flowers: white, 1-inch "daisies" cover plant late August-September; attracts butterflies

Comments and Cautions: No staking required to hold form into winter

Additional Species and Cultivars: 'Snowbank,' more compact, heavier flowering; Boltonia asteroides var. latisquama 'Jim Crockett,' compact to a height and spread of 24 inches and pale violet flowers with yellow discs from June through September

Callirhoe involucrata
purple poppy-mallow, wine cups

Full Sun | Top | 12" Height | 36" Spread

Form: sprawling groundcover

Foliage: dissected leaves on stems up to 3 feet long

Flowers: bright magenta, cup-shaped blooms with white centers; very showy; June-September

Comments and Cautions: excellent for hot dry areas; shear or mow plants to rejuvenate tired foliage; avoid disturbing taproot

Chelone glabra
turtlehead

Full Sun | Part Shade | Shade | Side | Bottom | 24-48" Height | 18" Spread

Form: dense and upright

Foliage: dark green shiny leaves, almost leathery

Flowers: terminal clusters of white tubular flowers resembling turtle heads; August-October

Comments and Cautions: attracts hummingbirds and butterflies; highly organic soil with good moisture is beneficial

Additional Species and Cultivars: C. lyonii 'Hot Lips,' smaller, more compact plant with deep pink flowers

Coreopsis verticillata
threadleaf coreopsis

Full Sun | Part Shade | Top | Side | 18-24" Height | 30" Spread

Form: upright, spreading by stolons to form large dense colonies

Foliage: threadlike, dark green; fine texture

Flowers: bright yellow notched rays and yellow disc; loose bunches; June-August

Comments and Cautions: drought tolerant and carefree once established; sandy to loamy soil promotes spread; shear after blooming

Additional Species and Cultivars: 'Zagreb,' 'Golden Showers' are tallest and strongest cultivars

Dalea purpurea
purple prairie clover

Full Sun | Top | 24" Height | 24" Spread

Form: clustered, branched stems; upright vase shape

Foliage: tiny, feathery, compound leaves; dense but fine texture

Flowers: tiny, red-violet to hot pink clustered in a hoop or donut shape; flowers open from base to tip for long season interest; June-August

Comments and Cautions: deep taproot and extremely drought tolerant; requires excellent drainage, should be located in relatively dry locations

Additional Species and Cultivars: 'Stephanie' more compact, greater flower production

Echinacea angustifolia
narrow-leaved coneflower

Full Sun | Top | 18" Height | 36" Spread

Form: narrowly upright; flower heads carried on single stems

Foliage: oblong leaves covered with stiff hairs; medium-bold texture

Flowers: pale purple to pink; small number of drooping petals surround dark cone; June-August

Comments and Cautions: upright stems show to advantage among grasses; cones provide winter bird food

Echinacea purpurea
purple coneflower

Full Sun | Part Shade | Top | Side | 24-48" Height | 24" Spread

Form: basal mound of foliage; flowers on erect individual stalks

Foliage: rough-surfaced bright to dark green leaves; variable size

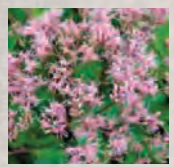
Flowers: purple-pink rays held flat around large brown-orange disk

Comments and Cautions: late season foliage may look rough but can be removed; reseeds and spreads readily; cones provide winter bird food

Additional Species and Cultivars: wide range of cultivars and hybrids with variable heights and bloom colors; orange and yellow hybrids have limited life span and hardiness

Eupatorium "Phantom"
phantom joe pye weed

Full Sun | Part Shade | Side | Bottom | Height: 24-48" | Spread: 12-24"



Form:clump-forming

Foliage: dark green leaves in whorls

Flowers: terminal, dome-shaped compound inflorescence; mid-summer to early fall; seed heads may persist into winter

Comments and Cautions: attractive to butterflies; hybrid cross between Eupatorium maculatum 'Atropurpureum' and Eupatorium rugosum

Eutrochium dubium 'Little Joe'
Little Joe pye weed

Full Sun | Part Shade | Side | Bottom | Height: 36-48" | Spread: 24-36"

Form: rounded to upright compact mound

Foliage: serrated dark green leaves whorled around stems; medium texture

Flowers: tiny mauve purple flowers in flat-topped inflorescences; August-September

Comments and Cautions: attractive to butterflies; compact form well-suited to smaller gardens; more open, less upright habit in full shade

Eutrochium purpureum
sweet joe pye weed

Part Shade | Shade | Side | Bottom | Height: 48-72" | Spread: 48"

Form: erect, mound-forming

Foliage: serrated whorled dark green leaves; bold texture

Flowers: tiny pinkish-purple flowers; vanilla-scented; in large compound inflorescences; July-September

Comments and Cautions: very attractive to butterflies; needs lots of space; good for back or center of larger gardens; can be cut back by one-third to reduce height and encourage branching

Additional Species and Cultivars: 'Little Red' more compact, 36 to 48 inches tall, better for small gardens

Eutrochium purpureum subsp. maculatum 'Gateway'
Gateway spotted joe pye weed

Full Sun | Part Shade | Side | Bottom | Height: 48-60" | Spread: 48"

Form: erect, mound-forming

Foliage: dark green whorled leaves on red stems

Flowers: tiny rose-pink flowers in 12- to 18-inch terminal inflorescences; July-September; seed heads persist into winter

Comments and Cautions: very attractive to butterflies; best for larger gardens or as a tall backdrop; tolerates more moisture than E. purpureum species (sweet joe pye weed)

Filipendula rubra
queen-of-the-prairie

Full Sun | Part Shade | Bottom | Height: 60-84" | Spread: 36"

Form: rounded, flowering stems are upright and slightly arching, seeds to form colonies

Foliage: compound, divided, deep green; medium texture

Flowers: small, pink fragrant; in large terminal plumes; May-June

Comments and Cautions: consistently moist soils keep foliage looking good; staking usually not needed

Gaillardia grandiflora
gaillardia hybrids and cultivars

Full Sun | Top | Side | Height: 12-24" | Spread: 12-24"

Form: rounded basal mounds of foliage; upright flowering stems

Foliage: gray-green leaves, lobed and covered with short hairs

Flowers: 3 to 4 inches composite flowers, rays banded with yellow, orange, red; June-September

Comments and Cautions: root rot potential in poorly drained soil; tends to be short-lived and should be allowed to reseed

Additional Species and Cultivars: G. aristata, blanket flower, is native to dry sites in the west; 'Baby Cole,' 'Bijou,' 'Fanfare,' 'Arizona Sun'

Geranium maculatum
wild geranium

Part Shade | Shade | Side | Height: 18-24" | Spread: 18"

Form: mounding

Foliage: palmately lobed leaves, dark green; medium to bold texture

Flowers: 1 inch wide, pink to purple, five-petaled; April-May

Comments and Cautions: can spread aggressively through rhizomes; useful for naturalizing

Geranium sanguineum
bloody cranesbill

Part Shade | Shade | Side | Height: 18" | Spread: 18-36"

Form: mounded, spreading

Foliage: small palmately lobed leaves, dark green turning red in fall; fine texture

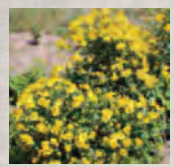
Flowers: 1 inch wide, magenta, five-petaled; May-June with some rebloom

Comments and Cautions: spreads slowly and can produce seedlings; fairly drought tolerant once established

Additional Species and Cultivars: 'New Hampshire,' 'Alpenglow'

Helenium autumnale
Helen's flower, sneezeweed

Full Sun · Part Shade · Side · Bottom · Height 36-60" · Spread 30"



Form: erect, mound-forming; stems unbranched

Foliage: dark green; medium texture

Flowers: compound, with small notched yellow rays and a round, dull, yellow raised disk; July-October

Comments and Cautions: stake or cage plants to reduce flopping; shorter, more compact hybrids and cultivars with greater bloom color variety are available; maintain consistent moisture

Additional Species and Cultivars: Most are hybrids; 'Rotgold,' 'Rubinzwerg,' 'Wyndley,' 'Mardi Gras'

Heliopsis helianthoides
ox-eye daisy

Full Sun · Part Shade · Side · Bottom · Height 36-60" · Spread 24-36"

Form: mound-forming, upright

Foliage: dark green, serrated leaves; bold texture

Flowers: daisy-like, 2 to 3 inches in diameter; yellow rays, brown centers; June-August

Comments and Cautions: species can reseed aggressively; plants require support if shade is excessive; aphids can be a problem

Additional Species and Cultivars: 'Summer Sun' and 'Summer Nights' recommended cultivars for better flower production; 'Summer Nights' has dark red-brown stems

Hemerocallis spp. (many cultivars)
daylily

Full Sun · Part Shade · Shade · Top · Side · Height 6-36" · Spread 60"

Form: low and spreading; arching mounds; groundcover

Foliage: long linear leaves; bright green; medium texture

Flowers: highly variable in bloom time and color; some fragrant; May-October; depending on selection, some are repeat bloomers

Comments and Cautions: foliage works for spreading groundcover and can be mowed to produce new leaves in midsummer; no winter interest

Additional Species and Cultivars: dozens of cultivars and hybrids available; consider length and season of bloom (choose different cultivars to extend bloom time), ability to re-bloom, fragrance, and height

Hibiscus moscheutos
rose mallow, hardy hibiscus

Full Sun · Part Shade · Top · Side · Bottom · Height 36-60" · Spread 24-36"

Form: broad and rounded; shrub-like

Foliage: lobed leaves up to 10 inches long; very bold texture

Flowers: up to 12 inches wide, overlapping petals; color range includes pinks, reds, white, yellow; July-October

Comments and Cautions: cut back only in late spring to protect crown in winter and encourage dense basal growth; flowers last only a day but are profuse; avoid windy locations

Additional Species and Cultivars: 'Disco Belle White,' 'Disco Belle Rosy Red,' 'Kopper King,' 'Luna' series, 'Plum Krazy,' 'Fireball,' 'Pink Cloud'

Hosta spp. (many cultivars)
hosta

Part Shade · Shade · Top · Side · Height 6-36" · Spread 6-60"

Form: mounded to arching; flower stems above foliage

Foliage: long petioles, smooth or wavy margins; small and pointed to very large and rounded; green, chartreuse, variegated

Flowers: bell-shaped, white to lavender, variable size on leafless stems; many fragrant; June-September depending on selection

Comments and Cautions: some cultivars may tolerate sun if adequate moisture is present; most hostas are best planted in part shade to shade

Additional Species and Cultivars: dozens of cultivars and hybrids available; choices for naturalized, spreading plantings include H. lancifolia 'Francee,' 'Ground Master'

Iris sibirica
Siberian iris

Full Sun · Part Shade · Top · Side · Height 24-36" · Spread 24-36"

Form: upright mounds

Foliage: swordlike narrow green leaves; effective yellow fall color; medium texture

Flowers: three standards and three falls held on stems above foliage; purple to blue with yellow and white cultivars; May-June

Comments and Cautions: nice foliage after bloom; less susceptible to borers and rot than tall bearded iris; divide in spring

Additional Species and Cultivars: 'Caesar's Brother,' 'Butter and Sugar'

Iris versicolor
blue flag iris

Full Sun · Part Shade · Bottom · Height 24-30" · Spread 24-30"

Form: mound-forming, arching and upright

Foliage: blue-green narrow leaves

Flowers: violet-blue with white and yellow markings; May-July

Comments and Cautions: best grown in moist soil; will slowly naturalize

Liatris ligulistylis
meadow blazing star

Full Sun · Part Shade · Side · Height 12- · Spread 12-24"

Form: upright and mound-forming

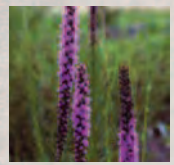
Foliage: basal tufts of narrow green leaves; medium texture

Flowers: fluffy, thistle-like, deep rose-purple flowers on columnar inflorescences; flowers open at same time within the flower head; July-September

Comments and Cautions: excellent for butterflies and birds; tends to flop and may need staking; can be difficult to establish

Liatris pycnostachya
prairie blazing star

Full Sun | Side | Bottom | Height: 36-48" | Spread: 18"



Form: mounded foliage, upright and curved flower stems

Foliage: narrow leaves, mostly at base of plant; medium texture

Flowers: fluffy, deep, rose-purple flowers crowded on dense spikes; bloom top to bottom; July-August

Comments and Cautions: tallest *Liatris* species, tends to flop and may need staking

Additional Species and Cultivars: L. lancifolia (lanceleaf blazing star) grows 24 to 36 inches tall; adapted to wet ditches and sand-loam soil; difficult to find in trade

Liatris spicata
dense blazing star

Full Sun | Top | Side | Bottom | Height: 24-36" | Spread: 18"

Form: mounded foliage; upright flower spikes

Foliage: narrow dark green linear leaves; medium-fine texture

Flowers: small magenta flowers on stems up to 18 inches; bloom top to bottom; July-September; seed heads effective into fall

Comments and Cautions: cultivars longer-blooming and/or more compact than the species; best performing Liatris in moist soils; slow to establish

Additional Species and Cultivars: 'Floristan White,' 'Floristan Violet,' 'Kobold'

Lobelia cardinalis
cardinal flower

Part Shade | Shade | Bottom | Height: 24-36" | Spread: 24"

Form: open, upright mounds of foliage

Foliage: dark green leaves; bold texture

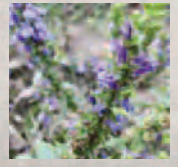
Flowers: clustered, deep red tubular flowers on vertical stems; July-September

Comments and Cautions: can be relatively short-lived; must have consistent moisture; attractive to hummingbirds and butterfies

Additional Species and Cultivars: L. 'Monet Moment;' magenta late summer-fall bloom; grows 24 to 36 inches; well-adapted to moist/dry location; hybrid lobelia generally longer lived than species

Lobelia siphilitica
great blue lobelia

Full Sun | Part Shade | Side | Bottom | Height: 24-36" | Spread: 24"



Form: rounded to upright; mound-forming

Foliage: finely toothed, light green leaves; medium texture

Flowers: showy blue tubular flowers in dense racemes; July-September

Comments and Cautions: may be short-lived under stressed conditions; must have consistent moisture

Matteuccia struthiopteris
ostrich fern

Part Shade | Shade | Bottom | Height: 36-72" | Spread: 60-96"

Form: mound-forming, upright and arching; spreads by rhizomes

Foliage: medium green, dissected, and feathery fronds; medium-fine texture

Flowers: n/a

Comments and Cautions: foliage quality declines over summer; maintain consistent moisture; goes dormant in early fall

Mimulus ringens
monkey flower

Full Sun | Part Shade | Side | Bottom | Height: 12-36" | Spread: 9-12"

Form: rhizomatous growth habit; erect square stems

Foliage: oblong sharply-toothed leaves

Flowers: in pairs, each flower to 1" long; lilac-purple, two-lipped (resemble snapdragon or face of a smiling monkey); bloom June to September

Comments and Cautions: best in part shade; used for naturalizing

Monarda didyma
bee balm

Full Sun | Part Shade | Side | Bottom | Height: 36" | Spread: inf

Form: upright, spreads by aggressive stolons to form large colonies

Foliage: bright green, toothed, and aromatic; powdery mildew can be a problem on straight species; medium-bold texture

Flowers: tubular, two-lipped flowers up to 2 inches long in dense clusters; colors include pink, purple, red, and white

Comments and Cautions: select cultivars with mildew resistance and provide good air circulation; some may spread less aggressively; attractive to hummingbirds

Additional Species and Cultivars: M. didyma 'Jacob Cline,' 'Marshall's Delight,' 'Petite Pink;''Petite Delight,' M. fistulosa, wild bergamot

Oenothera fruticosa
sundrops

Full Sun | Side | Height: 12-18" | Spread: 12-24"

Form: Upright; clustered unbranched stems

Foliage: dull green, lance-shaped leaves

Flowers: bright yellow, four-petaled flowers bloom during day; June-July

Comments and Cautions: can spread rapidly but typically not invasive; can attract birds

Oenothera macrocarpa
Missouri evening primrose

Full Sun · Top · Side · 12" Height · 12-24" Spread

Form: sprawling and spreading

Foliage: narrow silver-green leaves with ruby-red stems throughout growing season

Flowers: 3 to 5 inches across, solitary, mildly fragrant, bright yellow, open for one day; spring to late summer bloom followed by showy winged seed pods 2 to 3 inches long

Comments and Cautions: may self-seed in optimum growing conditions; has been shown to be highly adaptable in both dry and wet soils

Additional Species and Cultivars: 'Comanche Campfire'

Osmunda cinnamomea
cinnamon fern

Part Shade · Shade · Bottom · 36" Height · 36" Spread

Form: upright and arching; will form colonies

Foliage: bright green; finely divided fronds; fine texture; may turn golden in moist summers; rough and brown by August in drought conditions

Flowers: n/a

Comments and Cautions: tolerant of wide variety of soils; highly organic soil is beneficial

Penstemon digitalis
smooth beardtongue, penstemon

Full Sun · Part Shade · Top · Side · 18-30" Height · 18" Spread

Form: rosette of foliage; vertical flower stems

Foliage: thick, oblong leaves; medium texture, evergreen to semi-evergreen

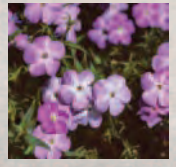
Flowers: two-lipped, white to pink, tubular; seed heads are dark brown and showy; May-June

Comments and Cautions: good drainage promotes longevity; reseeds easily

Additional Species and Cultivars: 'Husker Red,' 'Dark Towers' have deep red-purple foliage

Phlox pilosa
prairie phlox

Full Sun · Part Shade · Top · Side · 18" Height · 24" Spread



Form: weakly spreading groundcover; colonizes by underground stolons

Foliage: dark green linear leaves; fine-textured

Flowers: 1 inch wide, pale pink to lavender petals with tubular center; very fragrant; April-May, and sporadic rebloom

Comments and Cautions: higher drought-resistance than other phlox

Additional Species and Cultivars: 'Eco Happy Traveler' is more compact, stronger bloomer

Physostegia virginiana
obedient plant

Full Sun · Part Shade · Top · Side · 36-48" Height · 24-36" Spread

Form: upright habit, spreads

Foliage: sharp-toothed narrow leaves

Flowers: pinkish tubular flowers; July-September

Comments and Cautions: can be an aggressive spreader and tends to flop, especially in high fertility soils; can be cut back for denser habit

Additional Species and Cultivars: 'Miss Manners' has a clumping habit and pure white flowers; 'Vivid' has rosy-pink flowers and a compact form

Polygonatum biflorum
solomon's seal

Part Shade · Shade · Top · Side · 24-36" Height · 24" Spread

Form: unbranched arching stems, colonizes from rhizomes

Foliage: bright green leaves in flattened pattern on stems; yellow fall color; medium texture

Flowers: small, bell-shaped, white-green; hang under leaves; April-May, followed by blue-black berries

Comments and Cautions: long-lived once established; competes with tree roots

Polygonatum multiflorum 'Variegatum'
variegated Solomon's seal

Part Shade · Shade · Top · Side · 24" Height · 24" Spread

Form: unbranched arching stems, colonizes from rhizomes

Foliage: bright green leaves with white edges in flattened pattern on stems; yellow fall color; medium texture

Flowers: small, bell-shaped, white-green; hang under leaves; April-May, followed by blue-black berries

Comments and Cautions: long-lived once established; competes with tree roots

Pycnanthemum virginianum
virginia mountain mint

Full Sun · Part Shade · Top · Side · Bottom · 24-36" Height · 18" Spread

Form: erect to rounded, bushy

Foliage: narrow, tapered leaves; fine texture

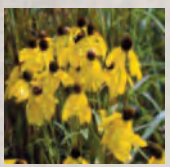
Flowers: profuse flat-topped clusters of small white flowers; July-September

Comments and Cautions: mint-like fragrance from crushed foliage and flowers; excellent for attracting pollinators; can withstand drought

Additional Species and Cultivars: P. tenuifoium

Ratibida pinnata
grayheaded prairie coneflower

Full Sun · Part Shade · Side · Height: 36-60" · Spread: 24"



Form: upright, narrow, and sparse

Foliage: pinnately divided leaves; bold texture

Flowers: bright yellow, drooping rays; gray raised disk; June-August

Comments and Cautions: best massed or combined with grasses due to sparse habit of individual plants; tallest plants may need support

Rudbeckia fulgida var. sullivantii 'Goldsturm'
goldsturm rudbeckia

Full Sun · Part Shade · Side · Height: 24-36" · Spread: 36"

Form: upright and mound-forming; spreads by rhizomes

Foliage: dark green foliage, rough-surfaced; medium-bold texture

Flowers: daisy-like with yellow-orange rays and round dark brown center discs; June-September

Comments and Cautions: foliage diseases possible if soil is too wet or air circulation is poor

Rudbeckia laciniata (R. nitida)
goldenglow, green-head coneflower

Full Sun · Part Shade · Top · Side · Bottom · Height: 36-72" · Spread: 36"

Form: rounded mounds of foliage; upright and weakly vase-shaped in bloom

Foliage: large, dull green leaves, mitten-shaped lobes; bold texture

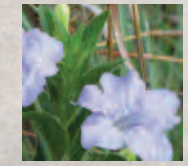
Flowers: limp yellow rays, raised green disc; July-September

Comments and Cautions: pinch back for bushier plants to reduce height; plants rarely need support; tolerates heat but not drought

Additional Species and Cultivars: 'Goldquelle,' 'Herbstonne'

Ruellia humilis
wild petunia

Full Sun · Top · Side · Height: 9" · Spread: 18"



Form: open, spreading mound; groundcover

Foliage: bright green leaves, purplish stems and petioles; medium-fine texture

Flowers: small, petunia-like, violet-blue; each lasts one day; June-August

Comments and Cautions: reseeds prolifically; deep root system; nearly maintenance-free groundcover on difficult sites; can be very aggressive

Salvia nemorosa
meadow sage

Full Sun · Part Shade · Top · Side · Height: 18-24" · Spread: 12-18"

Form: mounded foliage, upright flower stems

Foliage: dull gray-green leaves; medium texture

Flowers: spike-like racemes of violet-blue flowers; May-August if deadheaded

Comments and Cautions: long-blooming if deadheaded; wide variety of hybrids and cultivars; attractive to pollinators

Additional Species and Cultivars: 'Cardonna,' 'Marcus,' 'Purple Rain,' S. x *sylvestris* 'Mainacht'

Sedum (groundcover hybrids and cultivars)
stonecrop, sedum

Full Sun · Part Shade · Top · Upper Side · Height: 3-6" · Spread: 12-24"

Form: low, sprawling, or creeping groundcover

Foliage: small, thick succulent leaves; variable colors and sizes; fine texture

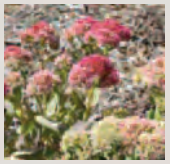
Flowers: small, star-shaped; size and shape of inflorescences varies; white, pink, yellow; late spring through late summer

Comments and Cautions: best massed and used as groundcover in drier areas

Additional Species and Cultivars: S. acre, S. sexangulare, S. kamschaticum, many others

Sedum spp. (tall hybrids and cultivars)
showy sedum

Full Sun · Part Shade · Top · Side · Height: 18- · Spread: 18-30"



Form: upright to mounded

Foliage: medium leaves; thick and succulent; bright green, blue-green, variegated, purple; medium-bold texture

Flowers: star-shaped; inflorescences vary in shape and size; colors include white, pink, red, bronze

Comments and Cautions: highly drought tolerant; may flop in too much shade or moisture

Additional Species and Cultivars: S. telephium, 'Autumn Fire,' 'Carmen,' 'Frosty Fire,' 'Abbeydore,' many others

Silphium integrifolium
cup plant, rosinweed

Full Sun · Part Shade · Top · Side · Bottom · Height: 48-72" · Spread: 24-36"

Form: upright

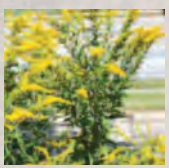
Foliage: medium green; leaves vary in size, bold texture

Flowers: yellow rays and disks resemble small sunflowers; in clusters; July-September

Comments and Cautions: tolerates drought once established; naturalizes by reseeding; resinous, gummy sap

Solidago spp. cultivars
goldenrod

Full Sun | Part Shade | Top | Side | Height: 18-24" | Spread: 18-24"



Form: upright arching stems, many have rhizomes that form colonies

Foliage: dark green, sharply toothed; medium texture

Flowers: tiny yellow flowers in curving, plume-shaped inflorescence; July-September

Comments and Cautions: select shorter, dense cultivars to reduce flopping; excellent plants for attracting pollinators

Additional Species and Cultivars: 'Golden Baby,' 'Cloth of Gold,' 'Crown of Rays,' 'Little Lemon,' 'Wichita Mountains'

Solidago riddellii
Riddell's goldenrod

Full Sun | Part Shade | Side | Height: 24-36" | Spread: 18-24"

Form: upright, will spread to form colonies

Foliage: dark green; medium texture

Flowers: tiny, bright yellow flowers in dense flat-topped inflorescences; September-October

Comments and Cautions: relatively late-blooming; unusual goldenrod; not tolerant of any dry condition

Solidago rugosa 'Fireworks'
Fireworks goldenrod

Full Sun | Part Shade | Top | Side | Height: 48" | Spread: 24"

Form: upright, will spread slowly to form colonies

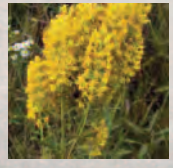
Foliage: green; medium texture

Flowers: open flat sprays of tiny bright yellow flowers like a shower of sparks; late August-October

Comments and Cautions: tolerates moist to dry soils; one of the latest to bloom; attractive to bees and butterflies

Solidago speciosa
showy goldenrod

Full Sun | Part Shade | Side | Height: 24-36" | Spread: 24-36"



Form: upright, will spread to form colonies

Foliage: green; medium texture

Flowers: tiny, bright yellow flowers in club-shaped clusters; August-October

Comments and Cautions: very showy flower; attracts bees and butterflies

Symphyotrichum ericoides
heath aster

Full Sun | Top | Height: 12-36" | Spread: 18"

Form: bushy, compact with many stems

Foliage: long narrow leaves

Flowers: daisy-like, white with yellow centers; September-October

Comments and Cautions: attractive to butterflies; mildew-resistant

Symphyotrichum novae-angliae
New England aster

Full Sun | Top | Side | Height: 36-48" | Spread: 24-36"

Form: clump-forming; upright

Foliage: rough, hairy leaves and stems

Flowers: 1.5" wide, bright purple or light lavender petal-like ray flowers surrounding a central yellow disk; blooms August-September

Comments and Cautions: may self-seed in optimum growing conditions; can flop if allowed to grown to full height; prolific late summer/early fall blooms; species susceptible to powdery mildew; recommend cultivars for shorter, more compact habit and disease resistance

Additional Species and Cultivars: 'Purple Dome'; 'Alma Potschke', Kickin Series cultivars

Symphyotrichum oblongifolium
aromatic aster

Full Sun | Part Shade | Top | Side | Height: 12-36" | Spread: 12-36"

Form: bushy, compact, rounded; spreads slowly by rhizomes to form large mounds

Foliage: small oblong leaves, blue-green to gray-green, covered with short hairs and fragrant when crushed

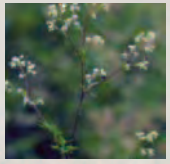
Flowers: small, daisy-like; violet-blue with yellow center; September-October

Comments and Cautions: attractive to butterflies; rarely needs attention; excellent mildew resistance

Additional Species and Cultivars: 'October Skies,' a shorter cultivar; *A. laevis* fall-blooming, violet rays with yellow centers

Thalictrum dasycarpum
meadow rue

Part Shade | Shade | Side | Bottom | Height: 36-48" | Spread: 36-48"



Form: dense, mound-forming

Foliage: fine-textured foliage, medium green

Flowers: sprays of tiny purplish-white flowers; May-July

Comments and Cautions: intolerant of hot sun and dry soils; may flop and need staking

Tradescantia bracteata
prairie spiderwort

Full Sun | Side | 12-18" Height | 18" Spread

Form: compact, mound-forming

Foliage: dark green, grass-like leaves; grooved; medium texture

Flowers: rose to purple, three petals and three sepals; each lasts one day; May-July

Comment and Cautions: foliage declines after flowering, cut back for new growth and later flowering

Additional Species and Cultivars: many T. x andersonii hybrids for rain gardens, including 'Concord Grape,' 'Purple Dome,' 'Sweet Kate,' 'Blue and Gold'

Tradescantia ohioensis
Ohio spiderwort

Full Sun | Part Shade | Side | Bottom | 24-36" Height | 18-24" Spread

Form: mounded to slightly arching

Foliage: blue-green, arching grass-like leaves; can sprawl by late summer;medium texture

Flowers: open clusters with three rounded petals and three sepals, blue to rose; each lasts one day; May-July

Comment and Cautions: can self-seed and become aggressive

Verbena hastata
blue vervain

Full Sun | Part Shade | Side | Bottom | 24-48" Height | 12-30" Spread

Form: mounded and upright; slowly forms colonies

Foliage: sharply toothed green leaves up to 6 inches long

Flowers: purplish-blue small flowers on slender spikes; July-September

Comments and Cautions: spreads slowly by rhizomes and self-seeding; attracts butterflies

Vernonia fasciculata
common ironweed

Full Sun | Part Shade | Side | Bottom | 24-48" Height | 12-24" Spread

Form: erect, fibrous stems

Foliage: smooth narrow leaves with serrated edges; medium texture

Flowers: small, fluffy, purple flowers in clustered heads; July-September

Comments and Cautions: can reseed; cut back in late spring to reduce height; attractive to butterflies

Veronicastrum virginicum
Culver's root

Full Sun | Part Shade | Side | Bottom | 48-60" Height | 24-48" Spread

Form: upright to slightly vase-shaped

Foliage: narrow whorled leaves; medium-bold texture

Flowers: tiny, white, tube-shaped flowers in slender spikes; bloom from top down; June-August

Comments and Cautions: may flop and require support; may be too large for small gardens; maintain consistent soil moisture

Waldsteinia fragarioides
barren strawberry

Full Sun | Part Shade | Shade | Top | 3-6" Height | 12" Spread

Form: mat-forming groundcover spreads by rhizomes

Foliage: small-toothed leaflets; fine texture

Flowers: small, yellow, five-petaled flowers on separate stems; April-June; fruits resemble small strawberries

Comments and Cautions: use for shade groundcover; non-native W. ternata species is more aggressive and considered invasive

Zizia aptera
meadow parsnip, heart-leaved alexanders

Full Sun | Part Shade | Side | 12-30" Height | 12-18" Spread

Form: upright, mounded

Foliage: heart-shaped basal leaves, divided stem leaves

Flowers: tiny yellow flowers in flat-topped clusters resembling carrot flowers on tall stems; May

Comments and Cautions: tends to be short-lived; foliage declines in summer

Additional Species and Cultivars: Z. aurea (golden alexander) adapted to sun and part shade; grows in small colonies; compound leaves with toothed leaflets and tiny yellow flowers; workhorse plant for some gardens

Andropogon gerardii
big bluestem

Full Sun · Part Shade · Top · Side · Bottom · Height: 96" · Spread: 36"

Form: mound-forming; upright; warm-season native prairie grass

Foliage: green to green-blue; excellent coppery, orange-red fall color

Flowers: terminal, red at emergence; inflorescence resembles turkey's foot

Comments and Cautions: can flop; best away from manicured edges; slower to establish; may self-seed

Additional Species and Cultivars: 'Pawnee,' 'Silver Sunrise' (a hybrid with distinct banding on stems)

Andropogon glomeratus
bushy bluestem

Full Sun · Side · Bottom · Height: 36-72" · Spread: 24-36"

Form: clump-forming

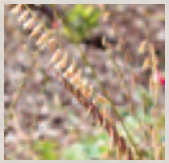
Foliage: flattened blue-green leaf blades; coppery-orange fall color persists into winter

Flowers: club-shaped flowers and bushy inflorescences; showy; September bloom

Comments and Cautions: generally intolerant of dry soils; can aggressively self-seed in optimum growing conditions

Bouteloua curtipendula
sideoats grama

Full Sun · Top · Side · Height: 36" · Spread: 18"



Form: warm-season native prairie grass; mound-forming with arching flower stems

Foliage: light green to blue-green; fine texture

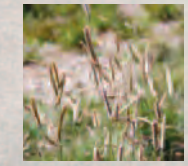
Flowers: slender arching stems hold individual spikelets in June-July; seed resembles small oats, mostly arranged on one side of stem

Comments and Cautions: very drought tolerant; seeds are fairly persistent

Additional Species and Cultivars: 'Trailway'

Bouteloua gracilis
blue grama

Full Sun · Top · Height: 12-15" · Spread: 15"



Form: warm-season native prairie bunchgrass

Foliage: slender, slightly curled leaves, blue-green color; tan fall color; fine texture

Flowers: thin wiry stems hold flowers and seeds above foliage; inflorescence resembles small comb or moustache; turning to straw in fall and fairly persistent

Comments and Cautions: will self-seed to form low maintenance turf

Additional Species and Cultivars: 'Hachita'

Calamagrostis acutiflora
feather reed grass

Full Sun · Part Shade · Top · Side · Height: 48-60" · Spread: 18-30"

Form: cool-season grass; mounds of foliage and vertical flower stems

Foliage: bright green; emerges early spring; light tan through winter; medium texture

Flowers: June; vertical inflorescence to 12 inches on long stems; tight narrow seed heads; sterile seeds; persistent into mid-winter

Comments and Cautions: upright, long-standing ornamental grass; the straight species is rarely available in the trade; divide every 3 to 4 years

Additional Species and Cultivars: 'Karl Foerster' is a commonly available hybrid; 'Overdam,' 'Avalanche' are variegated; C. brachytricha is fall-blooming and not as hardy; C. stricta (slimstem reedgrass) grows 12 to 36 inches; adapted to wet sandy soils

Calamagrostis brachytricha
Korean feather reed grass

Full Sun · Part Shade · Side · Bottom · Height: 36-48" · Spread: 24-36"

Form: clump-form, slowly spreading

Foliage: mounded, narrow stiff green leaves

Flowers: pinkish tinged plumes late summer; appear above foliage to 4'

Comments and Cautions: does well in heavy clay soils; prefers moist soil

Calamagrostis canadensis
bluejoint grass

Full Sun · Part Shade · Shade · Side · Bottom · Height: 24-60" · Spread: 24-36"

Form: clump-forming; grows from rhizomes and can form a coarse sod

Foliage: numerous slender stems

Flowers: nodding branched inflorescence; purplish turning to tan

Comments and Cautions: stands up well in winter; frequently found with sedges in natural settings; can spread aggressively; broad pH tolerance; resembles reed canary grass

Carex annectens
yellowfruit large (yellow fox) sedge

Full Sun · Part Shade · Side · Bottom · Height: 12-36" · Spread: 12-24"

Form: dense clumping

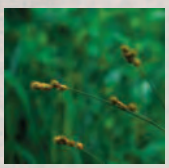
Foliage: narrow grass-like leaves to 24" long

Flowers: green/yellow/brown spikes in late spring

Comments and Cautions: best massed for foliage in moist/wet areas; effective accent; will naturalize

Carex bicknellii
prairie (copper-shouldered) sedge

Full Sun · Part Shade · Top · Side · Bottom · Height 18-36" · Spread 18-24"



Form: clump-forming; can colonize

Foliage: narrow and grass-like

Flowers: yellowish green, insignificant, April to July; on stalks up to 36" long; seed heads not showy

Comments and Cautions: relatively tolerant of variable soil moisture (dry to wet); foliage may die back during hot, dry summers; can naturalize

Carex brevior
shortbeak (plains oval) sedge

Full Sun · Part Shade · Shade · Top · Side · Bottom · Height 12-24" · Spread 15-18"

Form: short rhizomes forming tufts and clumps

Foliage: narrow and grass-like; fine-textured

Flowers: April to July; seeds are unique flat discs, tan when mature

Comments and Cautions: active growth spring and fall during cooler temperatures; adaptable to all conditions (especially dry and/or disturbed)

Carex comosa
longhair sedge

Full Sun · Part Shade · Bottom · Height 24-48" · Spread 24-48"

Form: erect, dense growth

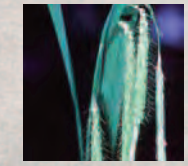
Foliage: narrow light green leaves; medium-fine texture

Flowers: insignificant; fruit a nutlet that is showy and bristly

Comments and Cautions: also known as bottlebrush sedge; may be difficult to find

Carex crinita
fringed sedge

Full Sun · Part Shade · Bottom · Height 24-48" · Spread 24-48"



Form: mound-forming

Foliage: grass-like, bright green, medium-fine texture

Flowers: insignificant; pendulous seed heads provide habitat value for birds

Garden Exposure and Location: full sun to part shade; bottom

Comments and Cautions: also known as nodding or caterpillar sedge; may be difficult to find

Carex grayii
gray's sedge

Full Sun · Part Shade · Shade · Side · Bottom · Height 24-36" · Spread 24"

Form: clump-forming

Foliage: semi-evergreen to evergreen; grass-like

Flowers: May-August; interesting showy spiked clustered seed heads; green turning brownish gray and persistent into winter

Comments and Cautions: adequate moisture required in full sun

Carex hystericina
bottlebrush (porcupine) sedge

Full Sun · Part Shade · Side · Bottom · Height 24-36" · Spread 24-36"

Form: tuft-forming; rhizomatous colonies

Foliage: narrow, grass-like

Flowers: May-July; green prickly spikelets turning brown

Comments and Cautions: almost always naturally occurs in wetlands; growth during cool seasons, dormant when hot; seed valued by wetland birds

Carex morrowii cultivars
Ice Dance, Old Gold

Part Shade · Shade · Side · Bottom · Height 10-12" · Spread 12-24"

Form: mounding and spreading slowly to form open colonies

Foliage: narrow, with a distinct V-shape; dark green with white edges; evergreen to semi-evergreen; medium-fine texture

Flowers: insignificant; May; seed heads rarely produced

Comments and Cautions: not native; needs protection from drying winds in winter and consistent moisture

Additional Species and Cultivars: Other Japanese sedge cultivars include 'Old Gold' and 'Variegata'

Carex muskingumensis
palm sedge, muskingum sedge

Full Sun · Part Shade · Shade · Side · Bottom · Height 18-24" · Spread 24"

Form: mounded, dense, clump-forming; spreads by rhizomes and seed; groundcover

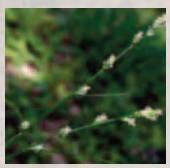
Foliage: light green, grass-like leaves; yellow after frost; medium-fine texture

Flowers: insignificant; arching tan seed heads persist through summer

Comments and Cautions: will flop in full shade; performs best with consistent moisture; not widely available commercially

Carex rosea
rosy sedge

Full Sun · Part Shade · Shade · Top · Side · Bottom · Height 6-12" · Spread 6-12"



Form: thick clumps; short rhizomes may form sod

Foliage: very fine-texture; softly-arching, grass-like leaves

Flowers: spikes of reddish flowers/seed heads in May-June

Comments and Cautions: valued for use in dry shade; adaptable to wet and dry conditions; cool-season growth

Carex scoparia
broom sedge

Full Sun · Bottom · Height 18-30" · Spread 18-30"

Form: tight bunching; vertical

Foliage: alternate narrow leaves; bright green; medium-fine texture

Flowers: insignificant; 1-inch spikelets

Comments and Cautions: also known as pointed broom sedge; not widely available commercially

Carex sprengelii
sprengel's (long-beaked) sedge

Full Sun · Part Shade · Top · Side · Bottom · Height 18-36" · Spread 18-24"

Form: clumping

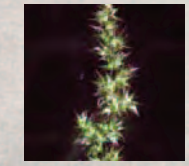
Foliage: fine, grass-like

Flowers: June-August

Comments and Cautions: native to woodlands

Carex stipata
common fox sedge

Full Sun · Part Shade · Shade · Side · Bottom · Height 24-36" · Spread 24-36"



Form: slender, open tufts or bunches

Foliage: grass-like; blades tend to arch and flop; medium-fine texture

Flowers: clusters of brown seed capsules

Comments and Cautions: also known as awlfruit or owlfruit sedge

Carex stricta
tussock sedge

Full Sun · Part Shade · Side · Bottom · Height 12-36" · Spread 12-24"

Form: rhizomatous to clump-forming

Foliage: evergreen; narrow and grass-like

Flowers: reddish-brown blooms May-June; not showy

Comments and Cautions: forms tussocks (clumps) in wet conditions; spreading into large colonies under drier conditions; good groundcover for light shade areas

Carex texensis
Texas sedge

Part Shade · Shade · Top · Side · Bottom · Height 3-6" · Spread 12-18"

Form: rhizomatous; grows in mat-like clumps

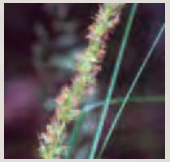
Foliage: fine-textured, grass-like; semi-evergreen

Flowers: small green spikes in May

Comments and Cautions: a good shade groundcover for naturalizing; adaptable to full sun with irrigation

Carex vulpinoidea
brown fox sedge

Full Sun · Part Shade · Side · Bottom · Height 12-24" · Spread 12-24"



Form: dense mounds or clumps

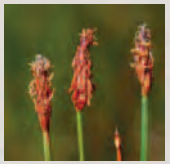
Foliage: grass-like, arching; bright green; fine texture

Flowers: golden-colored seed heads effective May-July

Comments and Cautions: may be weedy and can spread rapidly

Eleocharis palustris
spikerush

Full Sun · Part Shade · Bottom · Height 24-48" · Spread 12-24"



Form: spreads by rhizomes

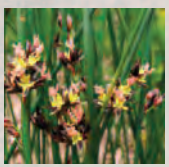
Foliage: leafless green stems grow from base of plant

Flowers: greenish-brown, inconspicuous spikelets on stems, June-September; yellow-brown seed heads

Comments and Cautions: may self-seed

Juncus balticus
baltic rush

Full Sun | Side | Bottom | Height: 24" | Spread: 18-24"



Form: rhizomatous; dense growth

Foliage: tall wiry stems; bladeless leaves at plant base

Flowers: panicles in May-July; brown capsule fruit

Comments and Cautions: typical in wet spring/dry fall conditions; highly tolerant of soil moisture conditions and drought

Juncus effusus
common rush, soft rush

Full Sun | Part Shade | Bottom | Height: 18-36" | Spread: 18-36"

Form: clump-forming and spreading by rhizomes and seed

Foliage: cylindrical, dark green stems; no actual leaves; yellow in fall before frost; fine texture

Flowers: insignificant small, greenish-brown, scaly; July-September

Comments and Cautions: can be somewhat aggressive in good growing conditions; restrict root zone to control spread

Additional Species and Cultivars: J. effusus 'Spiralis,' spiral rush, is widely available but not well-suited to large naturalized plantings

Juncus tenuis
path rush

Full Sun | Part Shade | Side | Bottom | Height: 6-18" | Spread: 6-18"

Form: mounded or tufted with arching flower stems

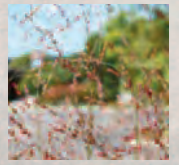
Foliage: narrow, bright green, grass-like leaves in basal tufts; turns brown with frost; fine texture

Flowers: not significant; small greenish or brownish flowers in dense spikes or heads; May-July

Comments and Cautions: may naturalize readily and become weedy; more tolerant of drought and compaction than other rushes

Panicum virgatum
switchgrass

Full Sun | Part Shade | Top | Side | Bottom | Height: 48-60" | Spread: 36-48"



Form: broad dense upright mounds; warm season native; spreads by rhizomes and seed

Foliage: bright green to blue-green; medium texture

Flowers: airy, cloudlike panicles above foliage; red, silver, white, or blue appearance; July-August; panicles persist into fall

Comments and Cautions: can reseed aggressively; consider planting after establishment of other garden plants to help limit spreading; may flop in rich soils

Additional Species and Cultivars: 'North Wind,' 'Shenandoah,' 'Rehbraun,' 'Prairie Fire,' 'Cloud Nine,' 'Dallas Blues,''Cheyenne'

Schizachyrium scoparium
little bluestem

Full Sun | Part Shade | Top | Side | Height: 24-36" | Spread: 18-36"

Form: clump-forming warm-season native grass; upright to somewhat vase-shaped

Foliage: narrow, thin blue-green to gray-green leaves; excellent orange, red, gold, or tan fall color; medium-fine texture

Flowers: reddish racemes at ends of slender peduncles; September; seed heads fluffy, white, and curled; remain through winter months

Comments and Cautions: excellent drought-tolerant plant; will flop in shade or too much moisture; cut back by half in late spring to reduce flopping; spreads by seed to form dense stands

Additional Species and Cultivars: 'Blaze,' 'The Blues,' 'Blue Heaven'

Sorghastrum nutans
Indiangrass

Full Sun | Part Shade | Top | Side | Bottom | Height: 48-84" | Spread: 48"

Form: clump-forming warm season native grass; broadly upright; blooms rise above foliage

Foliage: green, rough-textured leaves; yellow to gold fall color; medium texture

Flowers: copper-colored panicles open August-September; bright yellow pollen sacs evident; copper-tan seed heads remain through winter

Comments and Cautions: will self-seed; shorter cultivars available

Additional Species and Cultivars: 'Indian Steel,' 'Sioux Blue'

Sporobolus heterolepis
prairie dropseed

Full Sun | Part Shade | Top | Side | Height: 15-18" | Spread: 24"

Form: mounded, slightly arching, and vase-shaped; warm-season native prairie grass

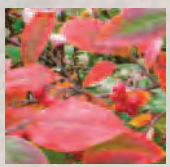
Foliage: very fine, light green leaves; fall color can be brilliant orange to tan; foliage persists through winter; fine texture

Flowers: open panicles, 2 to 5 inches long on slender stalks; vanilla-scented; August-September; delicate seed heads

Comments and Cautions: extremely drought tolerant once established; may take years to bloom

Aronia arbutifolia
red chokeberry

Full Sun | Part Shade | Top | Side | Bottom | Height: 6-10' | Spread: 3-6'



Form: vase-shaped; may sucker to form colonies

Foliage: glossy green leaves; red fall color; medium texture

Flowers: small; white to pale pink in open clusters; May

Fruit: abundant glossy bright red fruit persistent into winter; showy on some cultivars

Comments and Cautions: best fruit production in full sun; remove root suckers to control spread

Additional Species and Cultivars: 'Elegantissima' more compact than species, with better fall color and larger, more numerous fruit; 'Erecta' has an upright habit

Aronia melanocarpa
black chokeberry

Full Sun | Part Shade | Top | Side | Bottom | Height: 5-6' | Spread: 4-5'

Form: rounded; may sucker to form colonies in good growing conditions

Foliage: glossy green leaves; red fall color; medium texture

Flowers: small; white to pale pink in open clusters; May

Fruit: blackish-blue, berry-like fruit persistent into winter; showy on some cultivars; edible

Comments and Cautions: best fruit production in full sun

Additional Species and Cultivars: 'Morton' (Iroquois Beauty) and 'Autumn Magic' are compact selections; 'Viking' and 'Nero' have showy large fruit; var. elata is larger by several feet

Cephalanthus occidentalis
buttonbush

Full Sun | Part Shade | Top | Side | Bottom | Height: 5-10' | Spread: 4-8'

Form: open and rounded

Foliage: large glossy green leaves; bold texture

Flowers: tiny white flowers packed into 1-inch round flower heads; fragrant; June-July

Fruit: rounded, stalked balls, persistent through winter

Comments and Cautions: attracts bees and butterflies

Additional Species and Cultivars: 'Sputnik' is a compact form, 'Sugarshack' (compact, 4 to 6' ht.)

Cornus sericea
redtwig dogwood

Full Sun | Part Shade | Top | Side | Bottom | Height: 6-10' | Spread: 6-10'

Form: upright, multi-stemmed, and spreading or suckering; stoloniferous red stems provide winter interest

Foliage: smooth green leaves with distinct veins; reddish-purple to yellow fall color; medium texture

Flowers: small white flowers in flat-topped clusters; May-June and intermittently through summer

Fruit: whitish to purple drupe fruit clusters in late summer, taken readily by birds

Comments and Cautions: bird habitat value; multi-season interest; best stem color produced on new stems; cultivars are smaller, more dense, or variegated; some disease and insect issues

Additional Species and Cultivars: 'Isanti,' 4 to 6 feet and finer texture; 'Allemans,' compact and dense; 'Cardinal,' large with brilliant red winter twigs; 'Farrow' (Arctic Fire), 3 to 4 feet, 'Firedance' (compact, 3 to 4' ht.)

Corylus americana
American hazelnut

Full Sun | Part Shade | Top | Side | Height: 10-12' | Spread: 8-10'

Form: rounded; suckering to form spreading colonies

Foliage: medium to large, toothed, dark green leaves; good fall color potential; bold texture

Flowers: showy male catkins, tiny female flowers in April

Fruit: nut in papery husk; late summer into fall

Comments and Cautions: high habitat value; tough and interesting plant

Diervilla lonicera
northern bush honeysuckle

Full Sun | Part Shade | Shade | Side | Bottom | Height: 3' | Spread: 3'

Form: mounded; suckering to form loose colonies

Foliage: dark green leaves; yellow to red fall color; medium texture

Flowers: small, bell-shaped, fragrant flowers, yellow changing to orange; June-August

Fruit: brown, not showy

Comments and Cautions: can be relatively short-lived but rejuvenates by suckering

Additional Species and Cultivars: 'Copper' grows to 3' x 3'; D. sessilifolia 'Butterfly,' Butterfly southern bush honeysuckle, profuse yellow flowers, grows to 3'-6' height and width.

Hydrangea arborescens
smooth hydrangea

Part Shade | Shade | Side | Bottom | Height: 6-8' | Spread: 6-8'

Form: rounded; erect, usually unbranched stems that sucker to form colonies

Foliage: large, dull green leaves with pointed tips; bold texture

Flowers: symmetrical rounded heads 4 to 6 inches across; buds are chartreuse, opening to small white fertile flowers and persisting through winter; June-September

Fruit: none

Comments and Cautions: species has been all but replaced by showy cultivars but reversion often occurs; cut close to ground each spring for best flowering and foliage

Additional Species and Cultivars: 'Annabelle,' with round heads 8 to 12 inches across; 3 to 5 feet by 5 feet or more; 'Dardom' (White Dome) with showy sterile flowers sprinkled into domes of fertile flowers; 3 to 5 feet; 'Invincibelle Spirit,' deep pink

Itea virginica
Virginia sweetspire

Full Sun | Part Shade | Shade | Side | Bottom | Height: 3' | Spread: 5'

Form: arching, somewhat rounded; suckering roots form loose colonies

Foliage: dark green leathery leaves; dark red fall color lasts into November; medium texture

Flowers: drooping, elongated clusters of tiny, white, fragrant flowers; June-July

Fruit: not showy

Comments and Cautions: will naturalize in ideal conditions; may be chlorotic in alkaline soils; cultivars have better flowering and fall color than species

Additional Species and Cultivars: 'Henry's Garnet,' 'Merlot;' 'Sprich' (Little Henry) is a dwarf

Physocarpus opulifolius
ninebark

Full Sun | Part Shade | Top | Side | Height: 5-8' | Spread: 4-6'

Form: rounded to vase-shaped, and broadly spreading with exfoliating bark; species has rather coarse appearance

Foliage: dull green leaves with large marginal teeth; medium texture

Flowers: small white to pink flowers in flat clusters; May-June

Fruit: reddish seed capsule clusters late summer into fall

Comments and Cautions: very hardy and deep-rooted; can be rejuvenated by cutting to ground

Additional Species and Cultivars: 'Monlo' (Diablo), 'Summer Wine,' 'Copper Glow,' and 'Coppertina' all

Rosa cultivars
shrub rose

Full Sun | Part Shade | Top | Side | Height: 2-5' | Spread: 2-5'

Form: highly variable, groundcover to large rounded or arching shrub

Foliage: compound leaves, shiny, leathery, or rough; potential for fall color

Flowers: highly variable in structure, color, bloom season, and fragrance

Fruit: variable fruit (hips) size, color, and persistence

Comments and Cautions: select disease-resistant hardy cultivars; not tolerant of poor drainage

Salix purpurea 'Nana'
dwarf purpleosier willow

Full Sun | Side | Bottom | Height: 3-6' | Spread: 3-6'

Form: compact, rounded; fine-textured, dense, pale purple to silver winter twigs

Foliage: narrow blue-green leaves; fine texture

Flowers: showy grayish-white catkins in early spring before foliage; April-May

Fruit: not showy

Comments and Cautions: susceptible to many disease and insect problems, especially if drought-stressed; works well in a naturalistic setting; not long-lived

Sambucus canadensis
elderberry

Full Sun | Part Shade | Top | Side | Bottom | Height: 5-10' | Spread: 5-10'

Form: rounded and suckering to form large colonies; coarse plant with thick, mostly unbranched, weak stems

Foliage: bright green compound leaves; bold texture

Flowers: small, fragrant, white flowers in large flat clusters; June-July

Fruit: small, edible, purple berry-like fruit in large clusters; late summer through fall

Comments and Cautions: high habitat value (flowers, fruit); produces better flowers and fruit in full sun; spreads by seed

Additional Species and Cultivars: 'Laciniata,' cut foliage and smaller habit; 'Aurea,' gold foliage

Sorbaria sorbifolia
Ural false spirea, sorbaria

Full Sun | Part Shade | Top | Side | Height: 4-6' | Spread: 6'

Form: upright, semi-woody or suffrutescent; suckering rapidly or form indefinite colonies

Foliage: compound, doubly serrate, almost fernlike bright green leaves; medium texture

Flowers: small white flowers in 10-inch long pointed panicles; June-July and sporadically throughout summer

Fruit: not effective

Comments and Cautions: extremely effective for erosion control; showy during growing season; cut to ground in early spring

Additional Species and Cultivars: 'Sem' is a dwarf selection that grows with less suckering

Spiraea alba
white meadowsweet

Full Sun | Part Shade | Side | Bottom | Height: 4' | Spread: 4'

Form: upright, numerous unbranched stems; mounded overall form

Foliage: narrow-toothed green leaves; medium-fine texture

Flowers: cone-shaped terminal clusters of tiny white flowers; June-August

Fruit: small pod-shaped follicles; late summer into fall

Comments and Cautions: more adaptable to wet soil than other spireas; do not allow to dry out

Viburnum dentatum
Arrowwood viburnum

Full Sun | Part Shade | Top | Side | Bottom | Height: 5-8' | Spread: 5-8'

Form: upright, rounded to vase-shaped, multi-stemmed; may sucker weakly

Foliage: shiny green leaves, distinctly toothed; good fall color potential

Flowers: flat-topped clusters of small white flowers; no fragrance; May-June

Fruit: blue-black, berry-like fruit clusters late summer; rapidly taken by birds

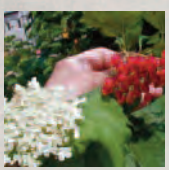
Comments and Cautions: use cultivars for best fruiting, size, and fall color

Additional Species and Cultivars: 'Autumn Jazz,' fall color, good fruit set; 'Blue Muffin,' compact habit, dense fruit; many others

Viburnum opulus var. americanum (V. trilobum)

American cranberrybush

Full Sun | Part Shade | Top | Side | Height: 8-12' | Spread: 8-12'



Form: upright, rounded, spreading; may sucker or root from prostrate stems

Foliage: lobed green leaves; red to yellow fall color; medium texture

Flowers: showy flat-topped flower structures composed of tiny white fertile flowers surrounded by large sterile flowers; May-June

Fruit: clusters of edible red drupe fruit; very showy in late summer through fall

Comments and Cautions: generally fewer problems than with European cranberrybush (*V. opulus*); cultivars valuable for compact growth and prolific fruiting

Additional Species and Cultivars: 'Wentworth,' 'Hahs,' 'JN Select' (Red Wing)

Viburnum prunifolium

blackhaw viburnum

Full Sun | Part Shade | Top | Side | Height: 12-15' | Spread: 6-12'

Form: upright, multi-stemmed shrub or small tree

Foliage: glossy dark green leaves; reddish purple fall color

Flowers: small white flowers in flat-topped clusters, non-fragrant; May-June

Fruit: showy, edible, blue-black, berry-like fruit; persists fall into winter

Comments and Cautions: may sucker in ideal conditions; excellent plant for larger gardens

Additional Species and Cultivars: 'Summer Magic,' foliage emerges with bronze edge; *V. rufidulum*, rusty blackhaw or southern blackhaw

Photo Citations

Achillea millefolium ..... Steven N. Rodie
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  Andy Szatko (City of Omaha's Stormwater Program)

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  Ion Exchange, Harper's Ferry, IA (www.ionxchange.com)

  Prairie Restorations, Inc., Princeton, MN (www.prairieresto.com)

  Taylor Creek Restoration Nurseries, Brodhead, WI (www.appliedeco.com/tcrn)

  Kaw River Restoration Nurseries, Lawrence, KS (www.appliedeco.com/krrn)

  Shooting Star Native Seeds, Spring Grove, MN (www.shootingstarnativeseed.com)

  Stock Seed, Murdock, NE (www.stockseed.com)

  Papio Valley Nursery, Papillion, NE (www.papiovalley.com)

- **Wildlife Damage/Prevention Information:**

  Voles: http://icwdm.org/wildlife/voles.asp

  Deer: http://www.icwdm.org/wildlife/deer.asp

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  Missouri Botanical Garden (www.mobot.org)
  Lady Bird Johnson Wildflower Center (http://www.wildflower.org/)

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Glossary

Adaptive Management – Changes in the management approach of a program or practice (such as gardening) that is necessary because of changes in goals, performance, or the environment.

Berm – A mound or bank of earth used to create a barrier.

Bioswale – A shallow, typically linear depression that is open on both ends and allows water to flow from one location to another. Bioswales are designed and built to filter, treat, and partially infiltrate stormwater.

Clay – Heavy, thick soil which absorbs water slowly and then retains it for a long time.

Cultivar – A cultivated species or variety of plant that has been developed for desired qualities such as flower color or size, dwarf form, hardiness, etc.

Drain Sleeve – A sleeve of loosely woven, elastic material that fits over a perforated drain pipe and prevents it from clogging.

Drip Line – The area underneath the entire branch network of a tree which is approximately equal to the critical root zone.

Forb – An herbaceous flowering plant that is not a grass, sedge or rush.

Friable – Soil that is easily crumbled.

Geotextile – A fabric that is stapled or otherwise attached to the ground to prevent the erosion of the underlying soil.

Grade – The slope of a landscape area or surface, expressed as either a ratio of horizontal run over vertical rise, or a percentage indicating a vertical rise of one unit over a run of 100 units. (Examples: a three-foot run with a one-foot rise is a 3:1 slope; a two-foot rise over a run of 100 feet is a 2% slope.)

Glossary

Grade Control – A structure built in a swale or stream to slow the flow of water and reduce the influence of steep grades.

Grasses – Plants with jointed stems, sheath-like leaves, and seed-like grains.

Herbaceous Plant – A non-woody plant.

Horizon – Layers of soil with differing qualities such as texture, color, organic matter content, and structure.

Impervious – Unable to let water pass through.

Infiltration – The process by which water on the ground surface enters the soil.

Infiltration Rate – The speed by which water enters and passes through soil, generally measured in inches per hour.

Lacing – The overlapping of different types of plant groupings (in front of and behind one another depending on heights) with other groups in order to help create a sense of visual structure and order in a landscape garden.

Level Spreader – A strip of rock designed to intercept a stream of water and spread the flow across a wider area of ground.

Loam – A soil that has roughly equal components of sand, silt, and clay, and is very easy to manage and grow plants in. Variations of loam include silt loam, which has higher silt content, sandy loam which has higher amounts of sand, and clay loam which has higher clay content.

Lodge – In describing plants, the flopping over of a plant caused by wind/weather, top-heavy growth, or weak roots.

Loess – Deep soils high in silt content that were deposited from winds thousands of years ago.

Glossary

Glossary

Mulch – A covering placed on a ground surface to prevent erosion and weeds and to provide insulation and decomposable organic matter.

Organic Matter – Matter that has come from once-living organisms, is the product of decay,
or is composed of organic compounds (examples include decayed leaves, rotten fruit, manure, etc.)

Peds – A soil structure quality in which the soil has rounded crumbs that fall apart easily. Usually found in soils with good organic matter.

Perennial – A plant that grows back from its original stem or roots year after year.

Pervious – Able to let water pass through.

Ponding Depth – The maximum depth of standing water above the soil surface in a rain garden.

Porous – Full of pores and easy to infiltrate.

Rain Garden – A shallow depression planted with native or regionally-adapted plants, and constructed to absorb rainwater runoff from surrounding areas – typically roofs, driveways, and lawns. Rain garden plants have deep roots that open pores into the soil and help filter pollutants from runoff, and require little to no extra water or fertilizers to stay healthy.

Rushes – Grass-like plants with rounded stalks or hollow stem-like leaves and small non-showy flowers that typically prefer growing in moist conditions.

Saturation – The point at which soil can hold no more moisture.

Sedges – Grass-like plants with small non-showy flowers and three-sided triangular stems that typically prefer moist growing conditions.

Glossary

Soil Compaction – The increase in soil density and decrease in soil porosity and infiltration rate that result when weight is applied to the soil surface.

Sustainable Landscape – A landscape that maximizes ecological function, habitat value, and aesthetic beauty throughout all four seasons while reducing or preventing pollution and conserving natural and economic resources.

Swale – A shallow ditch or depression in the ground that has gentle side-slopes and a gentle slope along its length so that water moves along its length.

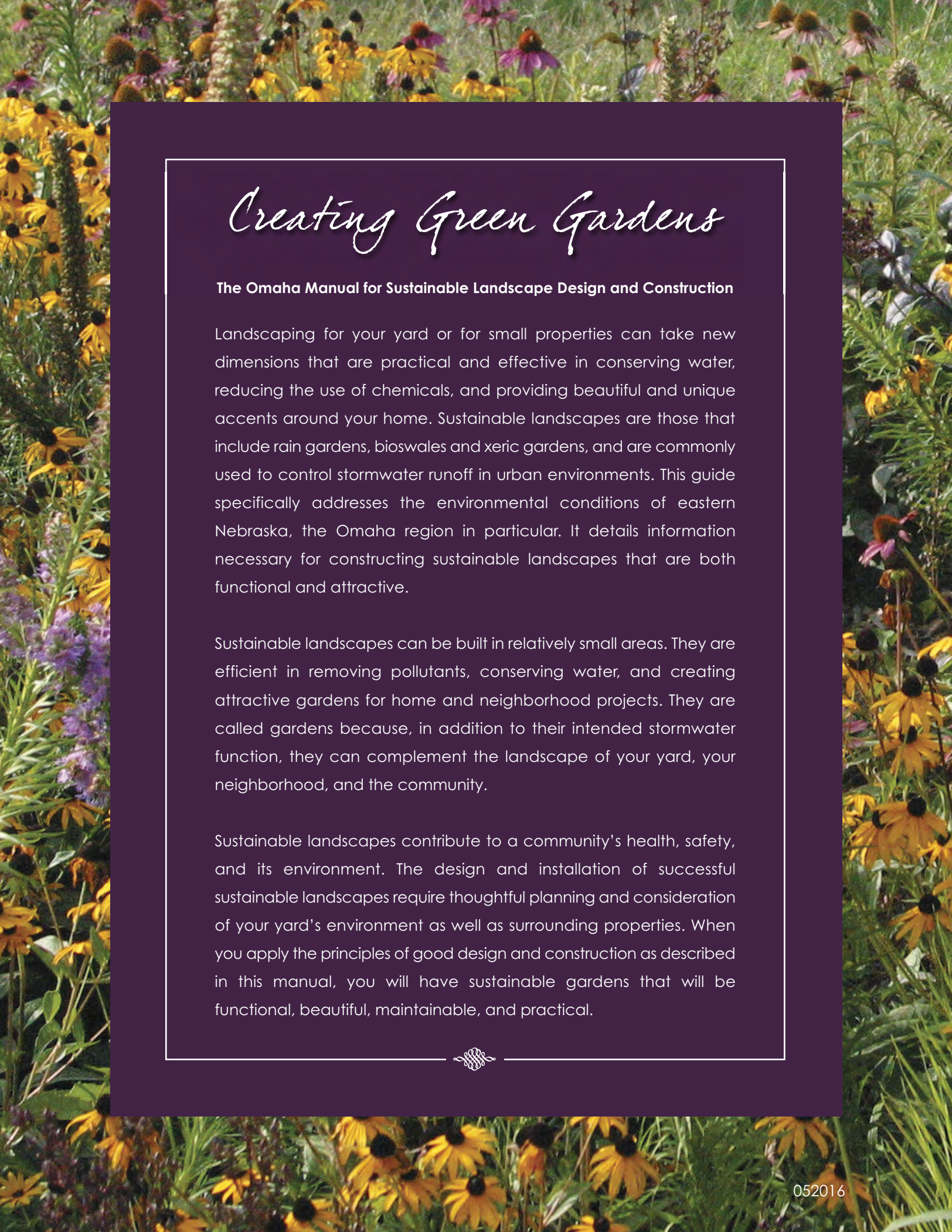
Vole – Any of various small rodents that typically have a stout body, rather blunt nose, and short ears. They inhabit and dig damaging tunnels beneath the surface of both moist and dry landscapes.

Water Table – The zone of soil and rock saturated with ground water.

Weir – A structure built to control overflow of water from a pond or stream, or other water-holding structure.

Xeric – An area adapted to a dry environment. In Omaha, this would mean an area that does not receive more water than is received by normal rainfall.

Purple Beauty Berry in full bloom.



Creating Green Gardens

The Omaha Manual for Sustainable Landscape Design and Construction

Landscaping for your yard or for small properties can take new dimensions that are practical and effective in conserving water, reducing the use of chemicals, and providing beautiful and unique accents around your home. Sustainable landscapes are those that include rain gardens, bioswales and xeric gardens, and are commonly used to control stormwater runoff in urban environments. This guide specifically addresses the environmental conditions of eastern Nebraska, the Omaha region in particular. It details information necessary for constructing sustainable landscapes that are both functional and attractive.

Sustainable landscapes can be built in relatively small areas. They are efficient in removing pollutants, conserving water, and creating attractive gardens for home and neighborhood projects. They are called gardens because, in addition to their intended stormwater function, they can complement the landscape of your yard, your neighborhood, and the community.

Sustainable landscapes contribute to a community's health, safety, and its environment. The design and installation of successful sustainable landscapes require thoughtful planning and consideration of your yard's environment as well as surrounding properties. When you apply the principles of good design and construction as described in this manual, you will have sustainable gardens that will be functional, beautiful, maintainable, and practical.

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