

SUSTAINABLE PLANTINGS GUIDE



CITY OF WILDWOOD, MO

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FORWARD

During the later part of the summer, 2007, a number of area property owners began to experience issues relating to the availability of potable water from their private residential wells. Adequate provision of potable water to residential properties is crucial for their use and the issue was taken with the utmost seriousness by the City. City Council was advised of the situation and immediately sought answers to questions relating to the water supply concerns and how the problem might be addressed in a responsible and expedient manner. One of the primary concerns of the City Council was the condition of the aquifer that provides potable groundwater to many of the rural residential tracts in Wildwood. Initial speculation among some of the local property owners related to increased demand for the resource by neighboring activities and newer, home sites, many of which contain much larger structures, extensive landscape irrigation systems, constructed ponds, and swimming pools. Other residents cite the recent drought conditions in eastern Missouri could also be a major factor in the spike of dry wells in the area, especially west of State Route 109. Given the complexity of this natural system of potable groundwater, the City sought professional guidance, which included contacting the Missouri Department of Natural Resources – Groundwater Section to assist with the fact finding, problem solving process. .

A representative from the State of Missouri visited the City on several occasions and provided background information about the underground water resource and the associated aquifer. The outcome of discussions with the DNR representative was that the aquifer contains an ample quantity of excellent general quality water, but is subject to a temporary drawdown during peak demand periods, which are brought on by heavy usage by similar consumers within a relatively short timeframe. This situation is typical each year, but can be exasperated by occasional drought conditions. Therefore, the resource is deemed safe and abundant, but sometimes affected by natural and human influences.

Considering the aforementioned factors, the City Council decided to take a number of measured and primarily voluntary steps toward improving conservation efforts affecting this valuable natural resource. Conservation of groundwater is being encouraged by the City Council as a means to promote the judicious use of the resource, without necessarily affecting the quality of life within these rural communities. A number of conservation steps were jointly discussed by the City Council, professionals in this field, and affected property owners. Decisions were made regarding a logical process designed to protect, preserve and extend the usage of the groundwater resource in the City of Wildwood.

This Sustainable Plantings Guide is a direct product of the previously referenced process, and is one of the principle steps in the City's conservation effort. This manual is intended to encourage and promote the use of native plantings that require minimal watering and care. The City Council has committed to requiring new developments and projects use the recommendations and requirements of this manual, but hope, more importantly, that residents and property owners will embrace the concepts and implement them on a voluntary basis. With the participation of many property owners, a reduction in groundwater consumption could be significant and have a profound and positive impact on the availability of this resource in the future.

The City Council trusts that the users of this manual will find it a useful resource for landscaping their homes and properties. It highlights plant material of all types that can complement and enhance the beautiful environment of Wildwood. Copies of this manual are available on the City's website (www.cityofwildwood.com) or can be purchased for a nominal charge at City Hall (183 Plaza Drive in Town Center). Questions about the manual and its components should be directed to the City's Department of Planning and Parks at (636) 458-0440 or via e-mail to joe@cityofwildwood.com. Remember, every drop of water is important, so please act responsibly.

EXECUTIVE SUMMARY

SUSTAINABLE PLANTINGS

**SUSTAINABLE (WATER CONSERVING)
LANDSCAPES...**

START WITH A PLAN

**ACKNOWLEDGE MICRO-CLIMATES AND THEIR
DIFFERENT REQUIREMENTS**

**GROUP PLANTS TOGETHER THAT HAVE SIMILAR
CULTURAL NEEDS**

MINIMIZE LAWN AREAS

**UTILIZE ALTERNATIVE GROUNDCOVERS IN LIEU OF
LAWN GRASSES**

**PLACE PLANTS IN THEIR APPROPRIATE
ENVIRONMENT AND PLAN FOR FUTURE GROWTH**

**USE MULCHES TO COOL PLANT ROOTS AND RETAIN
MOISTURE**

**MINIMIZE THE NEED FOR SUPPLEMENTAL
WATERING**

REQUIRE LESS MAINTENANCE

CAN BE ATTRACTIVE AS WELL AS FUNCTIONAL

INTRODUCTION

Water is essential for life on this planet. About 75 percent of the earth's surface is covered by water, yet only about one (1) percent is actually available for use to use. The remaining 74 percent is either contained in salt laden oceans and seas or frozen in polar ice caps. Because water is a limited, though renewable resource, it is necessary to protect and utilize it wisely.

For years, we've been successful at providing adequate water availability, to meet ever increasing demands, by increasing the supply. So, why bother to conserve? Increased demands on certain water sources across the nation have started to have a negative impact on the quality and quantity the supply. Underground aquifers are drying up; east coast cities are finding salt water infiltrating into their wells, even parts of Wildwood and neighboring cities are witnessing a noticeable drop in groundwater levels. The City of Wildwood is currently monitoring the situation and looking at different remedial scenarios. However, we can all do our part. We must start to consider new alternative ways of providing adequate water supply by reducing demand. We can invoke a conservation-consciousness to help turn this situation around for the benefit of our community, our nation and ultimately our entire planet.

This publication is intended to aid increased awareness of the close relationship that exists between ourselves and the natural environment that surrounds us and to encourage creative thinking toward personal conservation efforts, particularly with regard to water usage.

Better use of water in the Wildwood area might be achieved through a number of methods; exchanges between municipalities, reuse and conservation. Exchanges have benefited some water entities, however, the exchange capability is limited to periods of ample supply. Reuse of water could provide new water sources for the area, but availability and yield are uncertain due to questions regarding cost, technical feasibility, effects on public health and public acceptance. Conservation, on the other hand, is probably the most plausible method.

The ultimate goal is to eliminate unnecessary water usage, both indoors and outdoors. Indoors the task is relatively easy. There are specific measures that can be performed to reduce water consumption. The cost-benefit ratios are usually easy to determine. You install a water-saving washer at a known price and you will save a certain amount of water and money. The only problem with indoor conservation efforts is that it means that individuals and families must be aware and consciously make an effort to conserve water by not letting the water run while shaving or tooth brushing, or flushing facial tissue down the toilet, etc.

It is generally agreed that more water can be saved through appropriate management of outdoor landscape related practices than any savings that might be achieved through indoor conservation efforts. Interior demand is, for the most part, less flexible than exterior demand.

Since landscape irrigation constitutes a large portion of total water demand, techniques that help lower that demand can have a significant affect on overall water usage. The utilization of water saving methods in landscape planning, design and management can have a positive impact on the ability of water companies and/or private water sources to handle peak water usages. A John Hopkins University Study found that peak hour watering demands can be as much as 2,250 gallons per day per dwelling unit. The amount of water storage capacity required to accommodate such demands, whether in underground aquifers or in public storage facilities, could be significantly reduced by modifying our current landscape practices.

Optimally, the amount of water applied to the landscape should be just enough to offset the moisture losses resulting from the normal evaporation-transpiration (E-T) rate. The E-T rate is a function of temperature, humidity, sunlight, wind and soil conditions. The climatic conditions of an area determine the maximum amount of water that can be utilized by the landscape. However, research indicates that landscapes can be forced to have less than optimal E-T rates, by controlled watering, without causing a serious reduction in landscape quality.

The purpose of this publication is to provide the residents and property owners of Wildwood with a contemporary overview of environment, design, plants, soils and watering practices in order to achieve a beneficial reduction in water usage.

PLANNING AND DESIGN

Landscape Development Plan

The initial step in creating a design, whether developing a new landscape or redoing an existing one, should be to prepare a plan - a drawing that includes ideas, needs and desires. The plan doesn't have to be complex; a simple sketch can serve quite well. Planning on paper first will organize ideas into an orderly, well-designed outdoor environment, minimize conflicts during the construction/installation phase and reduce unnecessary and long term maintenance costs.

A typical landscape plan shows existing conditions as well as proposed elements. Existing conditions include items and features that currently occupy space or that will impact the landscape design such as; building footprints, drives, walks, patios, utilities (underground and overhead), topography, trees, shrubs, etc. This existing conditions information should be drawn to scale; i.e., 1"= 10', so that the plan is an accurate representation of the actual conditions.

Once the existing conditions are accurately portrayed on paper, concept design work can begin. Plan for everything contemplated in the near or distant future. Descriptive notations and generalized use area "bubbles" should be added to the "base" plan indicating such things as views to be maintained and/or enhanced, areas to be screened for privacy, physical features that may require special attention, specific use zones like public areas, play areas, cooking areas, pet areas, etc. and any other parameters that could possibly affect the final design.

Utilize the concept design, with the associated descriptive narrative, to create a final, detailed landscape development plan, identifying hardscape (fences, walks, decks, pools, walls, etc.) features and softscape (lawns, plant materials, mulch beds, etc.) schemes. This final plan should be as specific as possible as it will serve as the blueprint for construction and installation.

Hardscape elements generally form the backbone of the site/landscape design. Patio shapes, walk alignments, wall placements and the like, are bold, pattern forming items that combine to establish an overall design theme. Softscape features usually contribute to the design, in a support role, by softening sharp lines formed by the hardscape elements and creating interest by adding color, texture and movement.

Lawns and hard surfaced areas are usually oriented toward walking, playing and other active uses. For ease of maintenance and maximum usefulness, lawn areas should be unobstructed by individual plantings other than a tree or two that provide shade to a specific area. Trees, shrubs, flowers, fences, and walls form equally important aspects of the overall landscape design, but serve a more passive role. Plantings of shrubs and flowers are best massed together in defined beds according to their light and water usage requirements – avoid placing plant materials that prefer dry conditions in the same area as plants that require frequent watering. Generally speaking, taller plants should be placed to the rear of the garden bed with shorter plants near the front.

Landscape Components

Design for a Sustainable Landscape is a matter of knowledge and personal taste. Following is a list of typical landscape components with their associated uses as well as some advantages and disadvantages to be considered before utilizing them in the design.

1. Plant Materials

General:

- used as architectural elements to define outdoor living spaces
 - o trees as ceilings
 - o shrubs as walls
 - o ground covers as floors
 - o also utilized to direct, filter and block views
- used for engineering purposes
 - o erosion control
 - o acoustical control
 - o air purification
 - o foot traffic control
 - o glare and reflection control
- used for climate control
 - o sun protection
 - o wind reduction
 - o temperature modification
- used for aesthetic appeal
 - o visual interest
 - o sound and scent creation
- used for production of food and habitat

Trees

Summer shade from large canopy trees reduces air temperature and soil temperature, thus reducing moisture loss from evaporation and transpiration. (Air temperature may be reduced as much as 20 degrees.)

Trees grouped as a windbreak help mitigate wind velocity, thus reducing soil moisture evaporation and transpiration from other plant leaves.

Deep rooted trees remove less moisture from the soil surface. (However, deep rooted trees will not send their roots deep in soils lacking air, such as tight clays, saturated soils and hard pan layers.)

Dense trees can provide screening for undesirable sights and sounds.

Large canopy trees define overhead plan and help create outdoor rooms.

Trees can be utilized for seasonal color and textures.

Trees can function as specimens/focal points or in mass to form windbreaks, screens etc.

Evergreen trees can act as backdrops for displaying ornamental trees, shrubs and flowers having contrasting foliage and bloom color.

Trees exhibit a broad size range and scale is very important. Tree variety needs to be coordinated with location to insure adequate room for growth and mature size that is appropriate with structure and property scale.

Shrubs

Shrubs can function as specimens/focal points or in mass.

Shrubs can be used in combination with trees to form windbreaks. The wind velocity is effectively reduced for a distance of 10 times the height of the windbreak planting.

Shrubs can also add color and texture, serve as screens, attract birds, define spaces and shade soil surface.

Shrubs possess “visual weight”, for example, evergreens appear heavier than deciduous material, and thus a few evergreens in one area can help produce an asymmetrical balance with a larger group of deciduous shrubs in another area.

Groundcovers

Groundcovers can be used for erosion control.

Groundcovers can add color and texture to the “floor” plane.

Some groundcovers, such as grass, can be intensively manicured into a lawn and used in very active areas (high water requirement) or grass can be used as an inexpensive, permanent ground covering in less active areas such as naturalized meadows (low water requirement).

Groundcovers can be used in mass to form visual design features.

Groundcovers and shrub beds can be used to minimize lawn areas and reduce maintenance efforts.

Vines

Vines can be utilized as groundcover.

Vines can function as a shading element when trained over a trellis or a screen when planted adjacent to wire fences.

Vines can be used to provide seasonal color.

Flowers

Flowers can be utilized for seasonal color.

Flowers can form and/or accent focal points.

Flowers can be used in pots and hanging baskets to produce dramatic visual impact and soften hard surface areas.

Fruits/Vegetables

Vegetable gardens don't have to be rectangular. Gardens can have flowing edges, creating visual interest and forming individual spaces.

Vegetable can be integrated into planting bed and used ornamentally.

Fruit trees can serve as ornamentals or shade producers as well as providing food.

2. Structures

Fences/Walls

Fences/walls can be utilized to define space, to screen objects or views, and to reduce wind velocity.

Fences/walls can be used to provide privacy.

Fences/walls can act a support for vines/espaliers or as a backdrop for flower/shrub displays.

Fence/wall design should complement the architecture of the main or predominant site structure, i.e. texture, color, material, construction detailing, etc..

Retaining Walls

Retaining walls can be used to create planting terraces.

Retaining walls can be used to eliminate slopes to form level, more usable areas.

Retaining wall can be introduced into the landscape to provide visual interest and continuity.

Overhead Structures

Overhead structures can provide shade and/or protection from precipitation.

Overhead structures can be support for vines and hanging planters.

Overhead structures provide a sense of enclosure.

Overhead structures can act as a focal point in the landscape

Pavements/Decks

Pavements/decks can define active use areas.

Pavements/decks can reduce the amount of area to be irrigated.

Pavement/deck design should complement architecture of the main or predominant site structure..

Pavement color and texture should be considered carefully. Light and smooth finishes reflect the suns rays (cool to walk on, but can heat/light adjacent living spaces) while dark and textured finishes tend to absorb suns rays (hot to walk, retain heat and do not readily reflect light).

If pavement is to be used as a passive solar element, utilize deciduous plant materials in and around the paved areas.

Buildings

Plant material selection adjacent to buildings should take into consideration wind and sun exposure, resultant soil moisture conditions as well as reflected heat from building walls and lack of moisture and light from roof overhangs.

3. Mulches

General:

- modify winter and summer temperature extremes
- reduce water evaporation from the soil
- aid weed control
- can be organic or inorganic

Organic

Organic mulches are those derived from plants and/or former living matter such as shredded wood, wood chips, as well as straw leaves, grass clippings and other residue type materials. Organic mulches tend to improve the character of the underlying soil, adding nutrients through decomposition

Shredded Wood

Shredded wood does not compact, thus allows free movement of air and water into the soil .

Shredded wood “knits” together therefore is not easily moved by the wind.

Shredded wood clings well to steep slopes.

Shredded wood tends to weather to a grey color and has a “natural appearance”.

Shredded wood is inexpensive but must be supplemented each year.

Wood Chips

Wood chips allow water and air to readily pass through to soil below.

Wood chips do not “knit” together and are light weight thus are easily blown by the wind.

Wood chips do not hold well on steep slopes.

Wood chips grey with age.

Wood chips have a “neater” but coarser appearance than shredded wood.

Bark

Bark can come in shredded or chip form.

Bark chips come in several types and sizes, fine, medium and coarse.

Bark chips usually grey with age.

Bark chips tend to have a “neat” overall appearance.

Bark chips are expensive but do not break down as quickly as shredded wood and wood chips; therefore they do not need replenishment as often.

Residues (Straw, Hay, Leaves, Compost, Grass Clippings)

Residue mulches decompose quickly and improve soil quality.

Residue mulches are more utilitarian and do not have the aesthetic characteristics of other mulches. They are best used for intensively worked areas such as vegetable and flower gardens.

Some residue mulches, such as whole, unshredded leaves mat and actually repel water and are easily blown by the wind. It is best to shred leaves before using as a mulch.

Peat

Peat can be used as a mulch but it is difficult to “wet” and becomes hard and repels water after drying.

Peat is expensive and is blown easily by the wind.

Peat may actually introduce weed seeds.

Inorganic

Inorganic mulches are those derived from rock or man-made materials. Inorganic mulches tend to be more unnatural in appearance and add no significant nutrients to the underlying soil,

Rock

Decorative rock is an expensive but very permanent mulch material as it does not readily decompose. Therefore no additional mulch is required over time.

Rock is vastly overused and in many cases used in the “wrong locations”.

Rock mulches require some type of plastic or fabric underlayment to control weeds as the crevices between the aggregate catch wind-borne dirt and provide a rooting medium for weeds.

Cobbles can be used to create rich, bold textural relief and can be used with boulders to form “dry stream beds” or “dry ponds” to conduct and/or retain excess rain or irrigation water.

Lava

Lava is very light weight and can “float” away if used on even gentle slopes.

Lava has good insulating qualities.

Lava holds its color characteristics well, come in rust or charcoal grey.

Lava is expensive and is generally more ornamental than practical, especially for larger areas.

Plastic/Ground Fabric

Plastic/ground fabric is not normally utilized as a mulch but rather as an underlayment to other forms of mulch for weed control.

Plastic/ground fabric can be unsightly if exposed above the mulch material.

Plastic interferes with air and water exchange between soil and atmosphere.

Plastic punctures easily and becomes brittle if exposed to sunlight, thus negating its use as a weed deterrent.

4. Irrigation

Sprinkle

Sprinkle irrigation systems are the most common irrigation method. They make a good watering method if the spray drops are large. Fine sprays are more affected by wind and have a greater evaporation rate

Sprinkle system should be designed to separate differing water demand areas.

Sprinkle irrigation malfunctions are easily detected due to the fact that the water is visible during operation.

Bubbler heads are useful in some instances to flood irrigate a specific area. They have a low water evaporation rate.

Drip

Drip irrigation systems are very conservative with water.

Drip irrigation systems are more vandal prone than traditional sprinkle systems.

Clogging of drip system tubes by small particles of debris or from growth of microorganisms can be a problem. A system malfunction is not readily noticeable as with a sprinkle system.

Drip irrigation is a very good system for orchards, individual trees or small confined areas as long as the system is installed so as to be easily inspected.

5. Grading/Contouring

Berms/Slopes

Berms can be used for low screening.

Berms can be utilized to elevate plant material for more impact and/or greater screening.

Berms can be used to define spaces, reduce adjacent noises and divert winds.

Berms add interest to the landscape and can be utilized to divert and/or retain water.

Berms should be contoured to have a smooth transition into the surrounding ground plane to appear natural.

Depressions/Swales

Depressions can be used to capture and detain rainwater runoff.

Depressions/swales can be used in concert with berms to create visually appealing landscape features.

Swales and depressions need to be designed so as to not permit long term standing water, which sours the soil and causes oxygen starvation.

6. Lighting

Lighting is an important landscape component, especially in terms of functionality, aesthetics and security, but has no pertinent impact on water conservation. Therefore it has been excluded from further discussion in this publication.

7. Water (as a design feature)

Water can be used as a focal point; i.e., fountain, pool, stream. When contained in small, circulating systems, water features require a minimal amount of water to function and only need minor supplemental additions of water to replace that lost to evaporation.

Recycled water features can be used to create small micro-climates with higher humidity that allow for limited, water loving plant materials.

PLANT MATERIAL

Selection and Location

Most landscapes contain a variety of micro-climates. It is important, from a water conservation perspective, to place plants in areas that most closely match their needs for light, soil and water. For instance, plant materials that prefer sun and dry conditions will perform best in a southern or western exposure, in areas that receive water infrequently. Plants that like cooler conditions, on the other hand, will likely respond better in an eastern or northern exposure or in an area that is shaded by larger plants or structures. High water usage plants will do best in and along low-lying drainage courses and water retention areas.

Careful consideration of appropriate plant material is very important. Many of the plants commonly used in local landscape designs are either not particularly hardy to the area or require considerable care to maintain in satisfactory condition. However, there are many native and adapted plants that are very effective, distinctive and suitable for developing attractive, functional landscapes that require minimal supplemental water and nutrients.

Using native plants in a particular area of the landscape can be a design alternative. It should be noted that just being a native does not make the plant suitable for all applications nor does it mean that the plant requires less water. There are many native plants that grow naturally along water bodies and drainage ways that require ample moisture to thrive. Also, natives and adapted low-water requiring plants may need just as much water initially to establish as the water-thirsty plants, but, once established, will require much less moisture.

Manicured turf type grass should be limited to areas that require a functional lawn. Walkways, decks, or patios rather than turf might better serve heavily trafficked areas. Deeply shaded zones would do better with a shade tolerant ground cover than most turf grasses. Narrow strips, such as tree lawns (the area between the public walk and the street) are difficult, if not impossible, to irrigate without spraying water onto the adjacent street and walk. These areas might be more appropriately planted with drought tolerant

plants and watered by a drip irrigation system that will eliminate water waste. Steep slopes, where mowing is difficult, might be the place for groundcovers and/or low-water perennials. In areas where turf is appropriate, a grass type that best fits the particular situation should be selected. For example, a water-conserving, warm season grass species, that generally exhibits intolerance for heavy foot traffic during its long dormant periods, might be a good fit for a sunny front yard where most of the pedestrian circulation is confined to the sidewalk. On the other hand, high use areas where children or pets will play might be best served by a more traffic tolerant, self repairing, cool season grass, but will require considerably more water to maintain.

Landscape Style

Large expanses of green turf have persisted through the years as the “normal” planting style for most of the populated areas in this country. This is probably a carry over from the romantic English garden style of Europe, where large, highly cultivated, irrigated lawns, isolated planting beds, and clean sharp lines requiring extensive amounts of maintenance were commonplace among the upper class estates. Technological advancements in the irrigation and turf grass industries have allowed this style to remain and flourish as the accepted standard for American landscapes, including commercial and industrial complexes as well as residential developments and private dwellings.

By depending on technology, which symbolizes man’s control over nature, we have been able to develop landscapes that are largely independent of the environment in which we live. It is becoming more and more apparent that current attitudes and practices regarding the use of our natural resources need to be adjusted.

The most plausible alternative is to develop a new landscape ethic and an aesthetic appreciation for landscapes that more closely conform to the way plants grow naturally. Sustainable Landscape designs consider the appropriateness of the plantings in the character of the landscape setting. In other words, plants fit the setting both ecologically (natural water demand) as well as visually. This approach is well suited for the Wildwood area where a large portion of the area is still in a “natural” or rural condition. It is not necessary to use only native plant materials to achieve visually and ecologically suitable landscapes. There are many adapted plants from other similar climatic regions that are very compatible for the landscapes of this area.

Other alternatives to consider, such as not mixing plants with differing water demands and limiting high water demand plants to small areas where their use can be justified on either a functional or aesthetic basis, have been previously noted.

Pastures, Meadows and Prairies

Pastures

Pastures, by definition, are generally open, relatively flat fields covered primarily with herbaceous vegetation and utilized for grazing ungulate livestock as part of a farm or ranch. Pasture growth can consist of grasses, legumes, other forbs, shrubs or a mixture thereof and containing few trees.

Pasturelands in the semi-rural setting that makes up a large portion Wildwood are generally used to graze horses and/or cattle. Many of these pastures consist of established, mixed stands of cool season grasses. Tall fescue is a major cool season grass that is utilized for pastures planted in Missouri. Other cool season grasses that are adapted for and utilized in this area include Kentucky bluegrass, orchard grass, perennial ryegrass, redtop, reed canarygrass, smooth brome grass and timothy. These grasses are often grown in combination with each other and/or with forage legumes.

Forage Legumes are pod bearing plants that are noteworthy for their ability to fix atmospheric nitrogen. In other words, the plants have the ability to transmute nitrogen from the air into the soil, thus replenishing the nitrogen in the soil that is consumed by the legume itself and other plants during the growing process.

In addition, legume seed and foliage generally have a higher protein content than non-legume material, making them nutritionally desirable as food for both animal and human consumption.

Forage legumes that are well adapted to Missouri and useful in combination with pasture grasses include alfalfa, annual lespedeza (Kobe, Korean, and Marion), red clover and white or ladino clover.

Legumes, planted in combination with cool season grasses, not only improve nutritional the quality of a pasture but also serve to extend the grazing period well into the summer months when the cool season grass growth diminishes. Grass/legume pastures require little or no supplemental nitrogen fertilizer due to the previously mentioned nitrogen fixation ability of the legumes, thus reducing the cost of maintaining a pasture.

It should be noted that there are many viable selections of pasture vegetation mixes depending on the intended use of the pasture. Horses, for instance, require high quality, digestible forage as opposed to cattle or sheep that are capable of digesting high fiber feeds to a greater extent than horses. If high fiber content legumes are to be incorporated into a horse pasture mix, care must be given to the type and percentage of mix so as to minimize undesirable side affects such as excessive saliva production. Usually slobbering is not a problem when the mix contains less than 50% legumes. Horses must be adapted to pastures containing high quantities of legumes.

Following are a couple examples of drought tolerant, cool season grass/legume pasture mixes that could be utilized for horse and/or cattle grazing:

Average Soil:	42% Kingfisher 222 Alfalfa
	16% Bariane Tall Fescue
	14% Paddock Meadow Brome
	13% Byron's Orchardgrass
	10% Mara Perennial Ryegrass
	05% Alice White Clover

Less than Ideal Soil:	42% Barolex Tall Fescue
	16% Byron's Orchardgrass
	15% Kingfisher Alfalfa
	08% BG34 Perennial Ryegrass
	07% Barafest Festulolium
	06% Alice White Clover
	06% Cyclone II Red Clover

Warm season grasses such as Switchgrass, Indiangrass, big bluestem, little bluestem, side-oats grama and Eastern gamagrass are suitable alternatives for summer pastures in this area. These grasses are discussed in greater detail in other sections of this manual. The advantage of warm season grasses over cool season grasses such as bluegrass, bromegrass and orchardgrass is their drought tolerance and their ability to produce during the midsummer when the cool season grasses tend to go dormant.

These warm season grasses start growing in late spring as air and soil temperatures increase. Greatest growth occurs from June through September. Growth slows in the autumn and ceases all together with the first killing frost.

Warm season grass pastures work well in concert with cool season grass pastures. Cool season grasses can be grazed in the early and late parts of the grazing season, with warm season grasses being grazed during the midsummer. This scheme offers a greater, more uniform supply of forage while providing rest for the cool season grasses during the summer months, thus improving their vigor and productiveness for late summer and fall grazing.

Warm season grasses can be seeded alone or as a mixture. Seeding a single grass species is sometimes preferable, as mixed species are more difficult to manage. Cool season grasses are generally

not recommended for planting with warm season grasses due to the strong competition from the cool season grasses in the spring.

Warm season grasses often establish slowly and compete poorly with weeds. Since plants grow very slowly it may require 2 to 3 years before a stand is capable of being grazed. Weed competition, during the seeding year, can be reduced by mowing to a height of 3 to 4 inches early in the season when the young grass plants are still small and will not be clipped off. Care should be given not to clip off much of the grass plants, as vigor will be greatly diminished.

It is not advisable to graze warm season grasses during the first couple of years. Grazing young, immature plants is especially harmful. Warm season grasses should not be grazed until they reach about 16-20 inches or more in height. This usually doesn't occur until about early to mid June.

Success with warm season grasses depends on recognizing that establishment, fertilization and management procedures are quite different from those normally followed for cool season grasses.

Meadows/Prairies

The terms pasture, meadow and prairie are sometimes used interchangeably. All are loosely defined as open grassy lands. Pastures, as previously described, refer to grassy fields that are primarily utilized for grazing livestock.

Meadows, on the other hand, can be defined as an ecosystem in transition from an open disturbed condition to a forested state having a variable mixture of grasses, herbaceous plants and often small trees or shrubs. Meadows bring to mind treeless, grass and wildflower laden clearings, often found within woodlands or in lowlands along streams or in high country valleys. Meadows may see periodic grazing.

In contrast, prairies often invoke images of grandeur, large expanses of open grasslands stretching for miles on end....."from the mountains, to the prairies, to the oceans white with foam,".....so to speak. Unfortunately, less than one percent now remains of the nearly 200 million acres of "prairie" that once blanketed North America from Illinois to Manitoba to Texas. Though we cannot recreate that type of prairie, we can restore a sense of its grandeur by fostering plants and animals that are native to this region. For the purposes of this manual, since meadows and prairies are similar in character, we will combine the two into a single category.

Meadows/Prairies are an important natural component of the woodland ecosystem found in Wildwood. They support a variety of wildlife and create unique transitional zones from the wooded areas that surround them, increasing the health and diversity of the overall environment. Meadows/Prairies consist of a vast number of specialized plants that interact with the soil, wildlife, and each other. The organisms form a complex and diverse relationship. Unfortunately, most of the natural meadow/prairie habitats have been eradicated over the years because their rich soils were valuable to farmers. While we cannot reclaim these natural meadow/prairie lands, we can improve some that have been degraded by overgrazing and the introduction of aggressive European weeds.

The purpose of this section is to guide property owners interested in developing or reconstructing their own small (up to 20 acres) planting of a native meadow/prairie community. When developing a new meadow/prairie, you have to be patient. Prairie plants grow extremely deep root systems that allow them to be very drought tolerant, but they require much more time to establish. In fact, during the first few growing seasons, the weeds that put their energy into above ground growth will appear to have the upper hand. But after the first few years, with proper care, prairie plants will begin to choke out non-desirable species.

Seeding a native meadow/prairie with perennial plants is not the same as using a "meadow in a can" wildflower mix that can be obtained from the local garden center or hardware store. These mixes generally contain fast growing exotics that put up an impressive display the first year but are unable to compete with adapted area weeds and as a result require reseeding each year. Some of these "wild

flowers are actually considered noxious weeds that are very aggressive and can escape into surrounding areas.

Guidelines to establishing a successful native meadow/prairie:

1. Site selection

- Choose a full sun location (at least 8 hours of sun throughout the day)
- Size – the larger the better to achieve the most plant diversity, which is a characteristic of a quality meadow/prairie (at least ¼ acre)
- Soil – any soil type will grow natives, just match plant species with soil type
- Moisture availability – any moisture amount will support natives, just match plant species with available moisture

2. Site preparation

- Eliminate weeds by proper tilling or herbicides if erosion might be an issue
- Work soil to a fine texture to assure good seed/soil contact. Be sure to leave the seed bed firm. If erosion is an possibility, seeding with a no-till drill is an option

3. Seed Selection

- Avoid non-native flowers and grasses, ie Dames Rocket, Shasta Daisy, Queen Anne's Lace, etc
- Mix should contain the following:
 - Nurse species (2 or 3 types) ie Flax, Annual Rye, oats, etc.
 - Pioneer species – to help increase stabilization of disturbed area (4 to 6 types) ie Wild Rye, Black-Eyed Susan, Bergamont, Evening Primrose, etc.
 - Early Succession forbs or grasses (6 to 10 types) ie Yellow Cone Flower, Bee Balm, Stiff Goldenrod, New England Aster, etc.
 - Site Specific Natives (20 to 30 types)

4. Seeding

- Plant by hand or use a seed drill, depends on the size of the area to be planted, smaller areas can be hand seeded but large scale plantings are more efficiently planted by using a no-till seeder that is designed specifically for planting the fluffy native seeds.
- Seed should not be planted more than ¼" deep.

5. Mulch

- Mulching is not necessary but can help hold moisture and stabilize soil, especially on smaller sites.
- Mulch should be weed free and applied lightly, as some seeds require light to germinate

6. Maintenance

- Year one – Mow every 2-3 weeks throughout growing season to a height of 4-5"
- Year two - Mow a couple of times at 6-12", if necessary
- Years three thru six – Annual burning will help the new prairie plants to become well established and control problem weeds
- As mentioned previously, native prairie plants grow their root systems first, so anything that is 6" tall the first two years is probably a weed. Therefore, mowing is critical to preventing unwanted weed species from going to seed and to permit sunlight to reach the very small native prairie plants.
- A well established meadow/prairie should be burned at 3-5 year intervals, including some fall burns. Try to burn only 1/3 of the area each year in order to preserve the insect population and winter cover for wildlife.
- Check with City for burn requirements

Following is a list of meadow and field wildflowers suitable for open, sunny locations and also a list of woodland wildflowers that are suitable for wildflower gardens in lightly shaded locations. These lists are directly from the University of Missouri Extension Service. Many of these species are listed and described in detail in other location in this manual.

Meadow wildflowers	Bloom time	Major color	Height (inches)	Soil type	Comments
Beard tongue (<i>Penstemon</i> species)	May to July	White, pink, purple	18–48	Average, well drained	Self-sows easily. Takes light shade or full sun.
Bee balm, Bergamot (<i>Monarda</i> species)	June to August	Lavender, pink, red	24–48	Average, well drained	Tolerates light shade, many soil types
Black-eyed susan (<i>Rudbeckia hirta</i>)	June to October	Golden yellow	12–24	Average, well drained	Self-sows easily. Avoid excess fertilization.
Blue false indigo (<i>Baptisia australis</i>)	May	Blue	24–48	Average, well drained	Also white and yellow species. Black seed pods.
Blue flag (<i>Iris virginica</i>)	May to July	White to deep violet	24–36	Average, wet	Very attractive. Needs moist soil.
Blue sage (<i>Salvia azurea</i>)	August, September	Azure blue	36–48	Average, well drained	Attractive, long slender flower species.
Blue star (<i>Amsonia illustris</i>)	April, May	Light blue	18–36	Moist but well drained	Shiny leaves very attractive.
Butterfly weed (<i>Asclepias tuberosa</i>)	May to September	Orange	12–36	Average dry, well drained	Perfect drainage important. Tolerates light shade.
Cardinal flower (<i>Lobelia cardinalis</i>)	July to September	Bright red	24–36	Average wet	Must be kept moist at all times. Mulch.
Compass plant (<i>Silphium laciniatum</i>)	July to October	Yellow	48–60+	Average	Vigorous; gets large.
Coreopsis (<i>Coreopsis lanceolata</i>)	May to August	Yellow	12–36	Average, well drained	Self-sows readily. Drought tolerant, soil tolerant.
Gayfeather, Blazing star (<i>Liatris species</i>)	July to October	Lavender-pink	24–48	Fertile, well drained	Good flower for cutting. Mulch for winter.
Goldenrod (<i>Solidago species</i>)	July to October	Yellow, white	12–60	Poor to average, well drained	Self-sows easily. Tolerates light shade.
Gray-head coneflower (<i>Ratibida pinnata</i>)	May to September	Yellow	36–48	Poor to average	Gray disks with drooping yellow ray floret petals.
Indian paint brush (<i>Castilleja coccinea</i>)	April to July	Red, orange	8–24	Average moist	Annual. Difficult.
Missouri coneflower, Missouri black-eyed susan (<i>Rudbeckia missouriensis</i>)	June to October	Yellow	18	Average, well-drained	Common wildflower in Ozark region of Missouri.
Missouri primrose (<i>Oenothera macrocarpa</i>)	May to July	Yellow	8–10	Average dry, well drained	Large flowers, evening bloom. Good rock garden plant.

Meadow wildflowers	Bloom time	Major color	Height (inches)	Soil type	Comments
New England aster (<i>Aster novae-angliae</i>)	July to September	Violet	36–60	Average moist	Top shoots in late spring to create lower, bushier plant
Ox-eye (<i>Heliopsis helanthisoides</i>)	July to September	Yellow	24–60	Average	May require support.
Pale-purple coneflower (<i>Echinacea pallida</i>)	May to June	Rose to magenta	24–36	Average	Tolerates poor soil.
Purple coneflower (<i>Echinacea purpurea</i>)	July to October	Reddish purple	24–36	Average, well drained	Durable, long lasting. Drainage important.
Purple poppy mallow (<i>Callirhoe involucrata</i>)	June to July	Purple	24+	Average	Likes dry, sunny locations.
Purple prairie clover (<i>Petalostemon purpurea</i>)	June to September	Rose-purple	24–36	Poor to average	Common clover. Easily grown.
Queen-of-the-prairie (<i>Filipendula rubra</i>)	June to August	Pink-red	24–72	Average, moist	Impressive but large.
Rattlesnake master, Button snakeroot (<i>Eryngium yuccifolium</i>)	July through August	Greenish white	18–48	Average, well drained	Attractive seed heads provide late summer and fall interest.
Rock pink (<i>Talinum calycinum</i>)	May to August	Red	6–12	Average, shallow	Succulent-like, tolerates poor, rocky soil.
Rose verbena (<i>Verbena canadensis</i>)	March to November	Rose, magenta	6–12	Poor to average, well drained	Self-sows. Needs full sun. Cannot compete with tall plants. Mulch.
Shooting star (<i>Dodecatheon meadia</i>)	April, May	Pink	12–18	Rich, dry and well drained	Drought tolerant. Cannot compete with large plants. Mulch.
Showy evening primrose (<i>Oenothera speciosa</i>)	May, June	Pink, white	6–12	Poor to average, well drained	Spreads easily. Mulch for winter protection.
Skullcap (<i>Scutellaria incana</i>)	June to August	Purple	24–30	Average, well drained	Seeds shaped like a cap, hence its name.
Sneezeweed (<i>Helenium autumnale</i>)	August to November	Yellow	48–72	Average moist	Rank grower. Suitable for background use.
Spiderwort (<i>Tradescantia ohioensis</i>)	April to July	Blue	12–24	Poor to average, well drained	Tolerates light shade. Cut flower stems for repeat bloom.
Sunflower (<i>Helianthus species</i>)	July to October	Yellow	48+	Average, poor	Seeds attract birds.
Sweet coneflower (<i>Rudbeckia subtomentosa</i>)	July to October	Yellow	48–72	Average, moist	Similar to black-eyed susan.
White upland aster (<i>Aster ptarmicoides</i>)	July to September	White	24–30	Average, well drained	Drainage important. Can grow in almost pure sand.
Wild pink (<i>Silene caroliniana</i>)	April to May	Rosy pink	6–8	Acid, well drained	Excellent drainage important. Suitable for rock gardens.
Yarrow (<i>Achillea species</i>)	June to September	White, pink, yellow	12–36	Average, well drained	Mulch. Tolerates light shade.
Yellow coneflower (<i>Echinacea paradoxa</i>)	June, July	Yellow	24–36	Average, well drained	An uncommon native plant suitable for gardens.

Woodland wildflowers	Bloom time	Major color	Height (Inches)	Soil type	Comments
Bellwort (<i>Uvularia grandiflora</i>)	April, May	Yellow	12–14	Moist, humus	Mulch. Attractive foliage.
Bloodroot (<i>Sanguinaria canadensis</i>)	March, April	White	6–10	Humus, dry, well drained	Sow seeds after collection. Needs sun.
Celandine poppy (<i>Stylophorum diphyllum</i>)	March to May	Yellow	10–18	Moist, humus	Needs constant moisture, mulch
Columbine (<i>Aquilegia canadensis</i>)	April, May	Red with yellow	24	Moist, rich humus	Difficult to transplant. Self-sows easily.
Dog-tooth violet (<i>Erythronium americanum</i>)	March, April	Yellow	4–10	Moist, humus	Needs spring sunlight. Four to 7 years to bloom from seeds.
Dutchman's breeches (<i>Dicentra cucullaria</i>)	April	White	4–12	Moist, humus	Needs constant moisture. Mulch.
False Solomon's seal (<i>Smilacina racemosa</i>)	April, May	White	12–36	Moist, rich humus	Arching growth. Red berries. Tall groundcover.
Fire pink (<i>Silene virginica</i>)	April, May	Brilliant red	24	Dry, sandy, well drained	Fragrant. Needs some sun. Use mulch.
Goat's beard (<i>Arunco diocus</i>)	May, June	Creamy white	48–60	Moist, rich	Male and female plants.
Golden seal (<i>Hydrastis canadensis</i>)	April, May	White	12–15	Moist, rich, well drained	Endangered plant. Red berries.
Great blue lobelia (<i>Lobelia siphilitica</i>)	August, September	Blue	12–36	Wet, rich, humus	Also for wet meadows. Mulch for winter.
Green dragon (<i>Arisaema dracontium</i>)	April, May	Greenish yellow	12–48	Wet, rich, humus	Full sun to light shade. Good near ponds.
Jack-in-the-pulpit (<i>Arisaema triphyllum</i>)	April, May	Pale green, purplish	6–24	Wet, rich, humus	Needs wet shaded site. Mulch.
Jacob's ladder (<i>Polemonium reptans</i>)	April, May	Blue-lavender	15	Moist, rich, humus	Moist woods or near ponds
Jewelweed (<i>Impatiens capensis</i>)	May to October	Orange	24–48	Moist, rich, humus	Annual plant. Can become weedy.
Mayapple (<i>Podophyllum peltatum</i>)	April, May	White	12–18	Moist, rich, humus	Forms woodland groundcover. Needs constant moisture.
Rue anemone (<i>Anemone thalictroides</i>)	April, May	White	4–6	Humus, well drained	Needs filtered light. Tolerates moist sites.
Solomon's seal (<i>Polygonatum canaliculatum</i>)	May, June	White	24–48	Rich, moist, humus	Tolerates many conditions. <i>P. biflorum</i> useful.
Tall bellflower (<i>Campanula americana</i>)	June to October	Blue	Up to 72	Rich, moist, humus	Annual. Reseeds easily. May become weedy.
Toothwort (<i>Dentaria laciniata</i>)	March, April	White to pale lavender	4–12	Rich, moist, humus	Moderate shade. Mulch. Deeply cut leaves.
Violet (<i>Viola</i> species)	March to May	Blue, white, yellow	4–10	Rich, moist, humus	Grows almost anywhere. Self-seeds easily.
Virginia bluebells (<i>Mertensia virginica</i>)	March, April	Light blue	12–20	Well drained, humus, dry	Sow seeds as soon as collected. In dry sites, mulch.
Wake robin, Trillium (<i>Trillium</i> species)	April, May	Maroon, white, yellow	8–16	Rich, humus, moist	Filtered light in spring; shade thereafter. Mulch. Give good drainage.
Wild geranium (<i>Geranium</i> species)	April, May	Lavender	10–18	Rich, moist	Takes partial sun. Mulch. Cut rhizomes for division.
Wild ginger (<i>Asarum canadense</i>)	April, May	Reddish brown	4–6	Rich, moist	Roots have aroma of ginger.
Wild sweet william (<i>Phlox divaricata</i>)	April, May	Blue, light violet	10–20	Moist, humus	Perennial. Easily grown.

Grasses

The most cost effective, efficient ground cover for weed control and foot traffic tolerance is a turf grass. Kentucky bluegrass has historically been the favored lawn grass in and around the St. Louis area because of its lush blue-green color and tight knit growth habit. It can be very low maintenance and drought tolerant provided there is proper soil preparation first. Unfortunately, adequate soil preparation is rarely performed, resulting in shallow rooting which in turn causes the need for additional watering.

The use of native and/or adapted grasses in lieu of more high water demanding varieties is one possible solution. However, most native and/or adapted grass species do not exhibit the lush green, tight knit characteristics of turf grasses that we are accustomed to seeing, and as long as the use of native grasses is considered merely a substitute for establishing a traditional lawn instead of a lawn alternative, this approach will probably be ineffective. If, however, the use of native grass is thought of as a design alternative, the opportunities to create new landscape styles are greatly expanded.

Native Grasses

Native grasses are species that are part of the area's original flora. A couple of important facts regarding native grasses need to be recognized in order to successfully establish a viable stand of grass. First, natives do not like "ideal" seedbeds. They like stubble ground with a lot of "trash" to slow the wind and retard moisture loss. Second, native prairie grasses don't establish quickly. They grow down first, developing a strong root system during the initial season of growth. When planting native grasses, don't be impatient; it may take a couple of years for development to take place above ground.

Most people are not familiar with the beauty of native grasses. Therefore they have often been overlooked as possible landscape plants. Most native prairie grasses grow in clumps, full sun and in a variety of soil types: all good characteristics for landscape use. Taller varieties can be utilized as a dramatic accent or in large meadow plantings. Shorter grasses make nice backdrops to set off perennials in flower beds or work well in smaller meadow plantings. Some species, such as Buffalograss, are low enough to be utilized in low traffic lawn areas. Following are brief descriptions of a few, more popular native grasses that might be utilized in water conserving situations:

Native Grass/Ornamental Grass/Groundcover/Perennial Legend

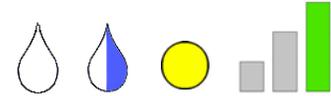
<u>Moisture</u>	<u>Light Exposure</u>	<u>Height</u>	
 Low	 Full Sun		Less than 12"
 Medium	 Sun/ Partial Shade		12" to 24"
 High	 Full Shade		24" +  Deer Resistant

Conditions: Deer Tolerant

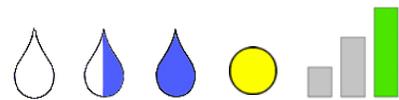
There are no plants that are 100% **deer resistant**, but many that are deer tolerant. There are plants that deer prefer over others. You will find that what deer will or will not eat varies in different parts of the country. A lot of it has to do with how hungry they are. Most deer will sample everything at least once, decide if they like it or not and return if favorable. A fence is the good deer barrier. You may go for a really tall one (7 to 8 feet), or try 2 parallel fences, (4 to 5 feet apart). Use a wire mesh fence rather than board, since deer are capable of wiggling through a 12 inch space.



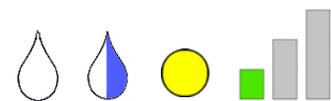
BIG BLUESTEM (*Andropogon gerardii*) is a dramatic 5-8 feet tall, clump-forming grass which grows in a wide range of soils. In mid-August, big blue produces its distinctive three-part seed heads which resemble a turkey's foot; its other name. The bluish to purplish stems turn an attractive reddish-copper color after frost. Big bluestem occasionally topples in winter.



BROOMSEDGE (*Andropogon virginicus*) and **ELLIOTT'S BROOMSEDGE (*Andropogon elliottii*)** are compact grasses growing 2 to 3 feet tall that turn orange in fall and remain standing throughout the winter. Broomsedge is commonly seen in abandoned fields. The leaves of Elliott's broomsedge around the seed heads are wider than those of broomsedge. Both prefer acid soil.

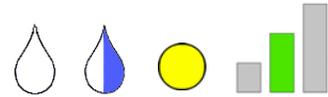


BUFFALO GRASS (*Buchloe dactyloides*) is currently enjoying a revival as a lawn grass. Researchers are developing new varieties of this short, sod-forming grass to fit a wider range of conditions. Buffalo grass is a warm-season grass that requires less maintenance than the traditional cool season lawn grasses.

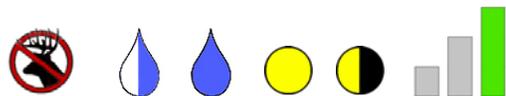




SIDEOATS GRAMA (*Bouteloua curtipendula*) and **BLUE GRAMA (*Bouteloua gracilis*)** are shorter grasses to consider for meadow plantings. Sideoats grama has attractive seed stalks with oat-like seeds that hang to one side of the stem. Blue grama seed stalks have 1 to 3 curved spikes.



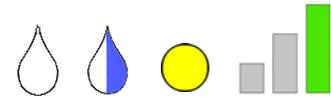
SWITCH GRASS (*Panicum virgatum*) is another of the major prairie grasses and turns golden yellow in the fall. It is the most resistant of the native grasses to ice and snow. When purchasing switch grass, choose the native rather than the more aggressive cultivated varieties such as cave-in-rock, Kanlow or Blackwell. Native switch grass grows 2 to 3 feet with large loose seed heads. Switch grass typically grows in wetter soils, but is found in all but the driest of soils.



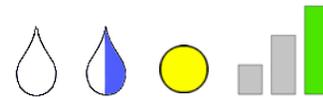


LITTLE BLUESTEM (*Schizachyrium scoparium*)

is the most widely used grass for landscaping wildflower beds and meadows, because it will not overshadow the wildflowers. The blue to green leaves and stems of the 2-4 foot grass turn the deepest russet of all the natives. This color, accented by silvery white seed heads in fall, is unforgettable.

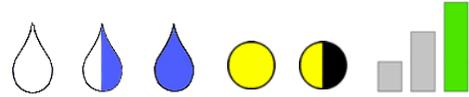


INDIAN GRASS (*Sorghastrum nutans*) is another tall prairie grass growing 5 to 7 feet. Its distinction is a large golden silky plume which follows yellow flowers in late summer. Indian grass turns golden in fall.

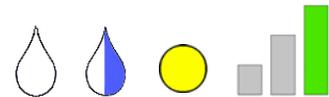




PRAIRIE CORD GRASS (*Spartina pectinata*) is the dominant grass of wet prairies and sloughs. Its gracefully arching leaves turn bright yellow in fall. Unlike other clump-forming native grasses, cord grass spreads aggressively by rhizomes and is best used to stabilize pond edges and stream sides.



PRAIRIE DROPSEED (*Sporobolus heterolepis*) with its arching fine leaves can be thought of as a miniature fountain grass. This grass is considered by many as the most handsome of the prairie grasses. The seed heads, filled with small round seeds, are on 2' to 4' long stalks. Winter color is light tan.

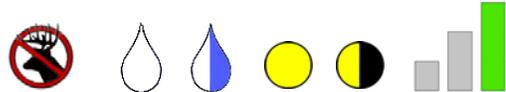


Caution should be used selecting grasses for use in the landscape. Avoid using invasive exotic grasses as reed canary grass (*Phalaris arundinacea*) Caucasian or Australian bluestem (*Bothrichloa bladhii*), Johnsongrass (*Sorgham halpense*), tall fescue (*Festuca elatior*) or quack grass (*Elymus repens*).

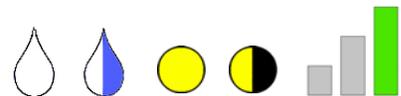
Ornamental Grass



FEATHER REED GRASS (*Calamagrotis x acutiflora* 'Karl Foerster') is one of the most versatile, attractive, and low maintenance ornamental grasses. This cool season grass appears in early spring and last until early winter. It forms an erect, narrow upright clump. Loose feathery flower appear in June. The tight green heads open to airy rosy-pink plumes that later changes to dark maroon, then bronze, and finally to golden tan over a three to four week period. This color last through the fall season.

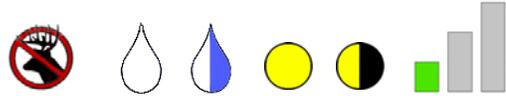


GREAT BASIN WILD RYE (*Elymus cinerius*) is also known as giant wildrye. It grows from 3 to 9 feet tall. Wildrye grows in clumps, and is usually found in dry environments.

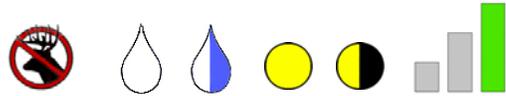




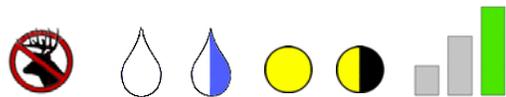
BLUE FESCUE (*Festuca glauca*) forms clumps of bluish, fine-textured grass. The plant prefers a well-drained soil and will die on clay. The color may vary so grow cultivars that will give consistently good color. Leaf color is also dependent on light exposure with best coloration developing in the sun. Blue Fescue grows best in cooler climates.



MAIDEN GRASS (*Miscanthus sin. 'Gracillimus'*) grows 5-6' x 3' wide. Graceful green leaf blades give rise to feathery copper flower plumes in late Sept. or Oct. "Gracillimus" has nice golden fall color.



FOUNTAIN GRASS (*Pennisetum alopecuroides*) produces 2- to 5-foot-tall mounds of narrow green foliage and bottle-brush-like silvery-pink to purple flowers, both of which mature to shades of brown. It is the parent of numerous cultivars with notable flowers that range from purple to gray/black. It and some of its cultivars self-sow plentifully in warm climates.



Lawn Care

There are many recommendations and techniques that can be incorporated into a lawn care program which can reduce watering requirements. Some of the more important considerations are mowing, thatching, aeration, fertilization and soil renovation.

Proper mowing is a necessity. Close cutting weakens the grass, causing shallow, weak root systems that permit weed infestation. Grass that is cut high will develop deep root systems, resulting in healthier plants, permitting greater drought resistance and preventing weed establishment. A recommended height for most lawns is two inches or more.

There are differences in opinions regarding the removal of grass clippings. Some experts recommend leaving the clippings. The problem that occurs when too much of the grass blade is removed at one time is that of thatch buildup. As a general rule, the grass blade should not be cut more than one-third of its total height (not in excess of 1" per mowing). Lawns perform better with frequent and consistent mowing, if clippings are to remain.

Some thatch buildup (1/2" or less) in the lawn is beneficial because it buffers soil temperature (reducing moisture loss) and it adds to the lawn's resilience, thereby reducing the soil compaction that can result from heavy use. However, too much thatch (more than 1/2") may prevent proper penetration of water and fertilizers. Thatch should be removed by power raking (Spring or Fall) when it accumulates to a depth greater than 1/2".

Roots need air as well as water and nutrients for proper growth. Lawns, especially those that receive heavy use, can develop compacted, air-deficient soil. Compaction can also restrict the soil's ability to absorb water. Aeration (hole punching or coring) of compacted lawns can help improve the soil's ability to absorb water, air and fertilizers and help reduce water runoff.

Lawns should be fertilized two times per year to maintain satisfactory growth and development of the turf. A poor fertilization program invites competition from water hungry weeds and reduces the healing capacity of the lawn. Over fertilization, on the other hand, will promote vigorous, water demanding growth, that will require more mowing, resulting in greater thatch buildup.

The best time to fertilize is during the cooler, wetter days of spring or fall. Experts recommend the use of a low nitrogen fertilizer that contains phosphorus and potassium. This promotes root growth while minimizing grass blade growth and increases the ability of the turf grass to survive drought stress.

Ground Covers and Perennials

The cardinal principle of preventing erosion is to have the ground as completely covered as possible with vegetation or other suitable cover such as mulch or pavement. More often than not, grass is the vegetation that provides that cover, especially in large areas. But instead of mowing and maintaining large expanses of lawn forevermore, consideration should be given to the use of ground covers and vines, especially in heavily shaded areas where grasses often struggle.

Many plants are available on the market that make suitable ground covers. They range from creeping plants, no more than a few inches high, to vigorous shrubs that grow to a height of several feet.

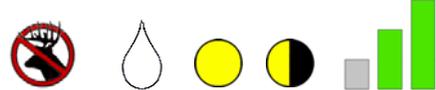
Most ground covers will require hand weeding once or twice a year as the season progresses because the different foliage and heights will spoil the neat, mat-like effect of the ground cover.

Following are brief descriptions of a few, more popular ground covers and perennials that might be utilized in water conserving situations:



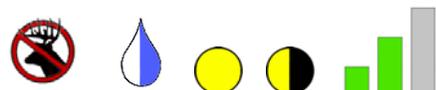
Yarrow (*Achillea filipendula*)

Yarrow is an extremely easy to grow, drought tolerant perennial that has no special needs other than ordinary, well-drained soil. Yarrow grows best in full sun and will tolerate partial shade. In the shade it tends to be a little less aggressive. Cultivars are available that range in height from 12 – 36 inches. Fern-like foliage has a strong odor. Flowers are a flat topped or round cluster and usually yellow in color with some cultivars offering pastel colors. Cultivars to look for include 'Coronation Gold', 'Gold Plate', 'Altgold' and 'Neugold'. Zones 3-8



Gray rockcress, Wall rock cress (*Arabis caucasica*)

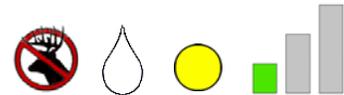
Gray rockcress is an herbaceous perennial which is low-growing and tufted mat-forming; the habit can reach 6 to 12 in. tall and spread 18 in. wide. Leaves are evergreen, colored grayish green. The flowers are white with an attractive fragrance and occur in early to mid spring. Gray rockcress performs in full sun (or partial shade in warm places) in fertile and very well drained soil. This species is moderately drought and soil tolerant and does well in lightly acidic to alkaline soil. Zones 4-10





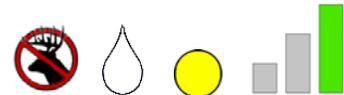
Silver Mound (*Artemisia schmidtiana*)

'Silver Mound' takes drought and cold, and aromatic oils make the leaves deer resistant. Plants form tidy, 6"+ height and 18" wide, clumps in average soil that is well-drained. A large genus of plants, most of which are grown for their silver foliage and durable dispositions. They are invaluable for their ability to set off both foliage and flowers of a wide range of hues and are, or should be, a staple of sunny borders where the dry heat they crave is common. Zones 4-9



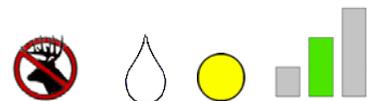
False Indigo (*Baptisia australis*)

A genus of about 35 species of North American perennials. Prominent among them is *B. australis*, which is properly revered as one of the great backbone plants available to American gardeners. It is a tall (3-4ft), rugged character whose intense blue flowers appear in June above handsome, gray-green leaves that remain an attractive feature of the garden all summer. Bloom is followed by prominent dark seedpods that complement the foliage. In full sun and well-drained soil, plants are extremely long lived. Zones 3-8



Coreopsis (*Coreopsis grandiflora*)

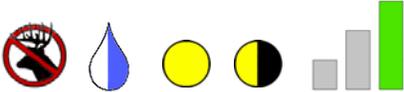
Coreopsis is a mainstay of the summer garden. It grows from 1-2 feet tall producing flowers from May through August if the spent flowers are removed regularly. Deadheading to encourage rebloom is best done so the whole flower stalk is removed and not just the flower head. Coreopsis grows very well in full sun in a well-drained soil. It is tolerant of dry soil. If grown in moist, fertile soil, Coreopsis has a tendency to open up resulting in plants that are not as attractive. Cultivars to look for include 'Early Sunrise', 'Sunray' and 'Goldfink'. Zones 4-9





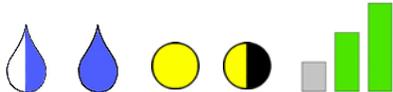
Purple Coneflower (*Echinacea purpurea*)

This is an excellent garden perennial. Echinacea is a tough plant and handles summer heat well. It performs best in average, well-drained garden soil in a full sun location growing 2-4 feet tall. It does not benefit from additional fertilizer which can make it grow taller and tend to fall over. Echinacea will tolerate light shade which enhances the color of the flowers. Echinacea starts to bloom in early summer and continues until frost. Cultivars to look for include 'Magnus', 'Alba' and 'White Lustre'. Zones 3-8



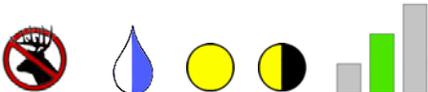
Daylily (*Hemerocallis sp.*)

Daylilies are a popular and reliable perennial that will grow in sun to light shade in a variety of soils. They do best in soils that are well drained and rich in organic matter. They also benefit from an addition of superphosphate in the spring. There are numerous cultivars available that will produce plants from 12 inches to four feet tall and offer bloom periods from late spring to late summer. Zones 3-9



Candytuft (*Iberis sempervirens*)

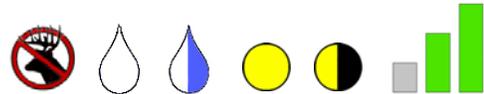
Candytuft is an herbaceous, evergreen perennial and a floriferous selection for borders, rock gardens or for use as a groundcover. Its low-growing, mounding habit complements the small, white, four-petal flowers that appear prolifically each spring. Some cultivars flower in spring and fall. It grows 12 inches tall and 24 inches wide. There are dwarf varieties available. Foliage is glossy and leaves grow to 1 inch long. Flowers will likely mask the foliage completely. In the landscape, its foliage needs winter scorch protection in colder climates. It grows in full sun or part shade, but flowers are more plentiful in full sun. It grows best in well-drained soil. Zones 3-9





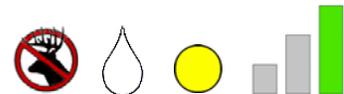
Blazing Star (*Liatris spicata*)

Liatris is an interesting perennial growing from 1-3 feet and producing spike-like flowers that have their stems wrapped in grass-like leaves. Liatris blooms in late summer and early fall. It prefers a sun to very light shade site in a well drained soil. Does not like soggy soils during the winter. When established it can tolerate some drought. Cultivars to look for include 'Kobold', 'Floristan White' and 'August Glory'. Zones 3-9



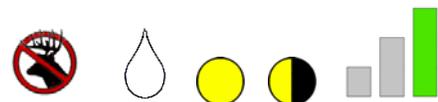
Russian Sage (*Perovskia atriplicifolia*)

A shrubby, gray-green perennial blooming in mid summer. Russian sage grows to about 3-5 feet and makes an excellent filler in the perennial border. Russian sage does best in full sun in well-drained soils. Adequate drainage needs to be provided especially during the winter. To promote good growth and flowers, Russian sage should be cut to within several inches of the soil in the spring. Zones 5-9



Black-eyed Susan (*Rudbeckia sullivantii*)

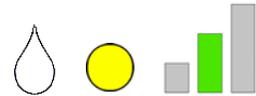
Rudbeckia offers bold splashes of reliable color from mid summer to fall. Plants are upright and grow to about 2-3 feet. They prefer full sun to very light shade in average garden soil. Plants are drought tolerant once established. *Rudbeckia sullivantii* are the true perennial types. The cultivar 'Goldstrum' is included here. *Rudbeckia hirta* is the annual type. The cultivars here include 'Marmalade', 'Rustic Colors' and 'Goldilocks'. These tend to reseed freely and act like true perennials. Zones 3-10





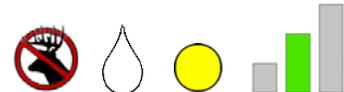
Autumn Joy Sedum (*Sedum spectabile*)

Sedums are plants that are very drought tolerant and need very little maintenance. Plants require full sun and well-drained soil. Autumn Joy grows to 24 inches and blooms late into the fall. Sedum is very adaptable to sites in the garden where soils tend to be very poor. Zones 3-10



Lamb's Ear (*Stachys byzantina*)

Lamb's ear is a low growing perennial (12-15 inches) that produces gray, velvety foliage. Flowering occurs in late spring or early summer, but flowers are not showy and so are often removed to enhance the foliage effects of the plant. Lamb's ear prefers full sun in a well-drained soil with low fertility. Excess moisture tends to rot the foliage. Lamb's ear will tolerate shade if the soil is dry. Cultivars to look for include 'Cotton Boll' and 'Silver Carpet'. Zones 4-8



Trees and Shrubs

Selecting appropriate trees and shrubs for a Sustainable Landscape requires a little more consideration than selecting plants for high and medium water use zones. Practically any plant that will survive Missouri's climate can be utilized in these latter zones. A good way to determine which plants can endure in the landscape with little or no extra water is to observe native plants. The types of plants that fair well under natural conditions may well be the best indicators of what to use in water conserving situations.

Following are brief descriptions of a few, popular evergreen trees, deciduous trees, evergreen shrubs and deciduous shrubs that might be considered. The plant material list indicated below is in no way to be considered comprehensive. There are many others, both native and introduced, that exhibit excellent water conserving characteristics.

Evergreen Tree / Deciduous Tree Legend

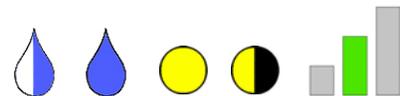
<u>Moisture</u>	<u>Light Exposure</u>	<u>Height</u>	
 Low	 Full Sun	 Less than 25'	
 Medium	 Sun/ Partial Shade	 25' to 50'	
 High	 Full Shade	 50' +	 Deer Resistant

Evergreen Trees



White Fir, Concolor Fir (*Abies concolor*)

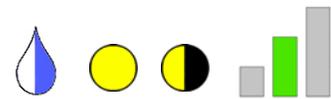
Firs grow best in climates with cool summers. The white fir is the best choice where summers are hot and droughts occur. It develops a formal conical shape for landscape use. Its appearance is similar to spruce, but the needles look softer. It is slow growing, adaptable to many conditions and somewhat pollution tolerant. White fir does not tolerate poor drainage, particularly in heavy soils. While it prefers full sun, it develops well in light shade, which may actually be beneficial to young plants in warmer sections of the state. A number of cultivars have been developed, but most are not readily available. The selection best adapted to warmer areas has blue-green needles rather than the normal gray-green. White fir is a durable evergreen that deserves more landscape use than it has had in the past. Zones: 3-8





Chinese Juniper (*Juniperus chinensis*)

Chinese juniper is a tree species, but because of the profusion of cultivars available, it may be found in many shapes and sizes. The well-known Pfitzer juniper is a Chinese juniper that is low and wide-spreading. The tree-forming varieties are upright and conical. With age they may reach 20 to 30 feet and become a single-trunked tree suited to many landscape conditions and soils. They become most dense in full sun locations. Cultivars with green foliage, as well as different intensities of bluish foliage, are available. Chinese juniper cultivars that develop into small trees include 'Hollywood,' 'Keteleeri,' 'Hetzi Column Juniper,' 'Robusta Green' and 'Wintergreen.' Chinese junipers have few major pests, but tip blight and bagworms may sometimes attack them. These are junipers for many landscape uses, but upright forms are most often used for urban sites where tall evergreen screens are wanted. Zones: 3-9



Eastern Redcedar (*Juniperus virginiana*)

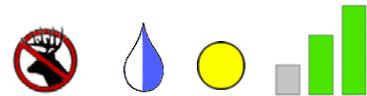
Eastern redcedar, the common evergreen growing in roadsides, fencerows and fields, is known to almost everyone. It grows well in a wide range of conditions. It is a tree for full sun although young plants may be found growing in shade. With age, trees in shade will be less dense and are more subject to disease problems. Many cultivars of redcedar have been selected and propagated for landscape use. One of the most common is 'Canaertii,' which produces a loose, upright growth with deep green color through the year. This is a female selection with bluish seeds for fall and winter color. Redcedar is fairly pest free, but twig blight and bagworms may attack them. It is a host for several rust diseases that alternate between infecting cedar and members of the rose family. Redcedars make durable screens, tall hedges or accents. This is the same cedar that produces the wood used for cedar chests and novelties. Zones: 2-9





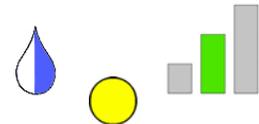
Colorado Spruce, Blue Spruce (*Picea pungens*)

Since the most popular Colorado spruce cultivars are those with bluish needles, this tree is best known as blue spruce. It can tolerate Missouri weather, soil and drought conditions better than many other spruce species. The tree develops a formal, conical shape with very stiff branches and needles. Growth is slow, but it gradually forms a 40- to 50-foot tree averaging only about one foot of growth per year. Deep soils with good drainage provide the best growth. It is most useful as a formal specimen plant. It needs full sun and a location with good air circulation, to help avoid *Cytospora* canker, which kills low branches and inner needles. Several insect pests may attack spruces. Cultivars with the most intense blue color demand the highest prices. Cones are often abundantly produced on older trees, but add little to its landscape value. Zones: 2-7



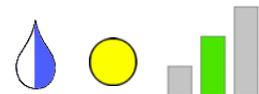
Japanese Red Pine (*Pinus densiflora*)

Japanese red pine is used as a specimen plant because of its interesting form and decorative bark. The foliage is bright bluish green to olive green. Bark on the trunk and large branches is orange-red, adding interest in all seasons. Trunks are frequently crooked or leaning, branches spread horizontally and the crown is broad and flat. The interesting growth habit and distinctive bark are the main reasons for using this tree in the landscape. This tree is usually free of any insect and disease problems and requires little maintenance. Growth is relatively slow for a pine. Some common cultivars are 'Oculus-draconis,' which has variegated needles with two yellow bands; 'Ubraculifera,' a dwarf form with many branches in a vase-shaped arrangement; and 'Pendula,' a weeping form. Zones: 5-7



Limber Pine (*Pinus flexilis*)

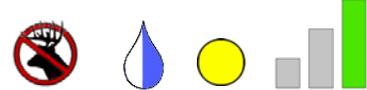
This pine often was not available for planting in the past, but now it is becoming more widely used. It is a very durable pine suitable for urban landscape use. As the name implies, the flexible branches reduce chances for breakage by high winds or heavy snows. Limber pine adapts to many soil types, even shallow soils, although it grows best in deep, well-drained soils. It should be grown in full sun, but will tolerate some shade. The general appearance is similar to white pine, but needles point forward and growth is a little more open. The most popular cultivar is 'Vanderwolf's Pyramid' that has a denser form. Limber pine does not grow as fast as white pine, but may still produce two feet of growth per year once it is well-established on a good site. Limber pine is subject to the common pests of pines, but none present serious problems. Zones: 4-7





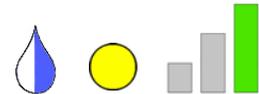
Red Pine (*Pinus resinosa*)

Red pine is extremely cold tolerant, but is less heat tolerant. The needles are long and stiffer than white pine. Branching is fairly open, but it has the overall symmetry of many pines. Dark green needles are retained for about four years before the older, inner needles drop. Although a native of the northern United States, it is still tolerant of Missouri growing conditions. It is slower growing in our climate and becomes a tree of only medium size. The bark of pines is not usually ornamental, but this pine develops bark that is orange to reddish on the upper trunk of older trees. The needle appearance of red pine might suggest Austrian pine although it is less coarse. It currently appears to be less susceptible to the tip blight that causes severe damage to Austrian pine in many locations. Zones: 2-6



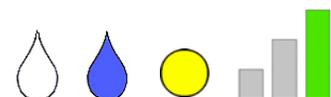
Eastern White Pine (*Pinus strobus*)

Eastern white pine becomes a large evergreen tree. Its long, soft needles give the tree a graceful look that fits into many settings. It has become more popular recently than Scotch pine because it is less susceptible to pine wilt nematode and environmental stress. White pine is a fast-growing evergreen that can provide a quick accent or screen. Although some white pines are sensitive to air pollutants and salty runoff water, it remains one of the best pines for our climate. Trees grow quite large, and should be used where there is plenty of space so pruning is not needed. Needles of white pine are held only two years, so fall needle-drop is more obvious than needle-drop of many other pines. Zones: 3-8



Japanese Black Pine (*Pinus thunbergiana*)

Japanese black pine is a popular specimen tree because of its loose, informal growth habit. It has been popular for use in Japanese garden designs. It is well adapted to many soils, and has pollution and salt tolerance that make it suitable for many urban sites. Japanese black pine is also tolerant of heat and drought. In spite of these good qualities, damage may result in our climate when rapid temperature changes occur in fall or winter. As a result, needle and twig damage are possible. Japanese black pine grows well in low-fertility soils, but needs full sun. It produces silvery-white elongated candles on the ends of its branches during the fall that give it a distinctive appearance in winter. This pine is without major pest problems, but does not have the cold tolerance of red or white pines. Zones: 5-8

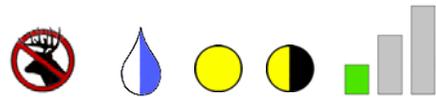


Deciduous Trees



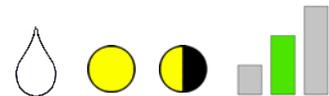
Downy Serviceberry (*Amelanchier arborea*)

Among the many species of serviceberries, downy serviceberry is the largest and most tree-like. Most others develop as large shrubs. All the serviceberries make useful small trees. Leaves are gray-green and turn yellow, red or orange in fall. Showy white flowers are produced very early in spring before the leaves. Bark on the trunk is smooth and light gray. Serviceberries tolerate light shade, but flower and fruit best in full sun. They are adapted to many soil types and environmental conditions and are fairly pollution tolerant. Fruits are dark purple with a bluish bloom, with a resemblance to blueberries. Birds are fond of them. They are edible and flavorful, but rather seedy. Cultivars exist, but are not common. 'Autumn Brilliance' is perhaps the most popular, and is grown mainly for its red-orange fall foliage. Zones: 4-9



European Hornbeam (*Carpinus betulus*)

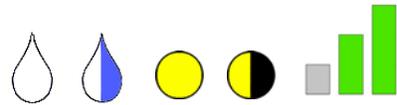
European hornbeam is a medium-sized tree that often is overlooked for use in stressful climates and urban sites. Besides being very adaptable to different soils and environmental conditions, it is essentially pest free. Leaves are dark green and develop a good yellow fall color. Although several cultivars exist, the most available and most often used is an upright growing form called 'Fastigiata'. It has a dense growth that makes it useful for a tall screen. Small trees planted close together may be used to form a tall hedge since this plant tolerates shearing. Single trees make excellent specimens with low maintenance. A close relative, the American hornbeam or musclewood, *Carpinus caroliniana*, is also a durable and well-adapted tree. It has attractive smooth gray bark and leaves that turn yellow or orange in fall. While not widely available, these trees deserve more use. Zones: 4-7





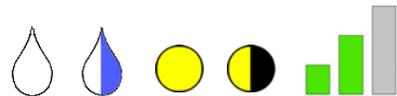
Common Hackberry (*Celtis occidentalis*)

Common hackberry is extremely tolerant of adverse conditions, but is not one of our best landscape trees. Trees become large and wide-spreading with an elm-like habit that is vase-shaped with drooping branches. The bark is grayish and corky. Red-orange fruits are produced in fall, but are not long-lasting since birds eat them quickly. Its durability makes it a worthy selection for difficult sites. It is easily transplanted and tolerates clay, rocky or sandy soils. Unlike many trees, it also tolerates persistent winds. Hackberry is attacked by a wide range of pests, but they are not serious. Two of the most disfiguring are witches' broom, which causes clusters of twiggy growth, and nipple gall that can cover leaves with large bumps. A cultivar with more compact growth and glossy green foliage is called 'Prairie Pride.' A smooth-barked hackberry, sugarberry or sugar hackberry, *Celtis laevigata*, is a good choice for planting from zone 5b southward. It is more tolerant of low, wet areas than common hackberry. 'All Seasons' sugarberry is reportedly not susceptible to witches' broom and nipple gall. Zones: 2-9



Eastern Redbud (*Cercis canadensis*)

Eastern redbud is well-known for its rosy-pink spring flowers in Missouri woodlands. It also can be found growing in the open in old fields and fencerows. It grows best in rich soils, but can tolerate poor sites if they are well-drained. Redbud is relatively pest free, although verticillium wilt sometimes shortens the life span. Foliage develops well after flowering, and the pealike pods often persist through the winter. A white variety is available that makes an outstanding specimen against an evergreen or dark background. The cultivar 'Forest Pansy' produces new foliage that is deep red-purple, but later turns green. Redbud trees are abundant seed producers. Many seedling trees may appear in some gardens to the point of being weedy. Zones: 4-9





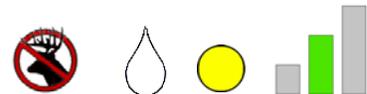
Hawthorn Washington hawthorn – (*Crataegus phaenopyrum*) Green hawthorn – (*Crataegus viridis*)

Many species of hawthorn are native to Missouri, and because of the abundance of hawthorns in the natural landscape, it has been named the official state flower. (The species deserving this recognition is downy hawthorn, *Crataegus mollis*.) Insect and disease pests can ruin the ornamental value of many hawthorns, although the trees usually survive. For landscape plantings, the Washington hawthorn and a cultivar of green hawthorn called 'Winter King' have become the most frequently used. Washington hawthorn is somewhat disease resistant but the leaves and fruits of 'Winter King' can be damaged by cedar-quince rust fungus. Lacebug is an insect that may feed on hawthorn leaves, causing serious leaf browning by mid- to late-summer.

The Washington hawthorn grows upright when young, but develops a broad canopy and a rounded form with age. The tree is thorny and sometimes used as a barrier hedge by allowing or encouraging low branching. As single specimens, hawthorn trees may be shaped with single or multiple trunks. Attractive small red-orange fruits are produced in late fall and persist into the winter until severe cold turns them black or birds eat them.

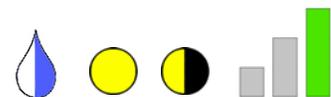
'Winter King' hawthorn develops into a broad, flat-headed tree. It derives its cultivar name because the red-orange fruits persist with good color long into winter, often until March or when waxwings or other birds eat them. Hawthorns are tolerant of urban conditions. They can grow well in many soils

and tolerate drought, wind and heat. They do not endure heavy shade or poor drainage. Zones: 4-8 (both)



White Ash (*Fraxinus americana*)

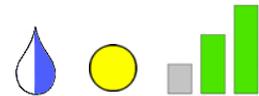
White ash has many characteristics of green ash, but trees tend to develop into an oval rather than round shape. Growth is not quite as rapid as green ash. Trees are easy to establish, and adapt to a wide range of conditions. White ash has a distinctive purple to maroon fall color. White ash varieties are selected primarily for fall color and are among the first trees to turn, lasting two to three weeks. Among the most popular cultivars are 'Autumn Purple' and 'Rosehill.' White ash is susceptible to the same pests as green ash, but ash borer is sometimes more damaging, possibly because growth is slightly slower. Ash flower gall, caused by a mite, attacks male flowers, resulting in abnormal growth. Unattractive galls persist, making the tree less ornamental. White ash is worth considering when a moderately fast growing tree is wanted. Zones: 2-9





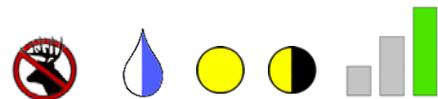
Green Ash (*Fraxinus pennsylvanica*)

Green ash grows fairly fast, developing a pyramidal shape when young, but it soon forms into a wide-spreading round-topped tree. Compound leaves give it a medium texture, but the twigs and branching pattern create a coarse effect in winter. As trees age, inner twigs often are shaded out and die. These dead twigs may drop from older trees during storms. Green ash adapts to a wide range of soils and cultural conditions. Ash borer is the most serious insect pest, which may cause branches to die, affecting the tree's ornamental value. Seeds are abundantly produced on female trees. Seedlings may become weedy. For this reason, male selections are preferred. Among the most popular male cultivars are 'Marshall's Seedless,' 'Summit' and 'Patmore'. The yellow fall color lasts a short time since green ash is among the first trees to drop its leaves in fall. Zones: 2-9



Ginkgo (*Ginkgo biloba*)

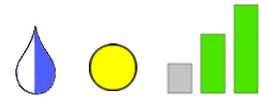
Ginkgo is an outstanding city tree because of its pollution and salt tolerance. It has open branching which allows enough sunlight to penetrate to maintain a lawn. Young trees usually have a pyramidal shape, but old trees can be very wide-spreading. It is tolerant of many soil conditions, although best growth occurs in well-drained soils with adequate moisture. Apricot-colored fruit is produced by female trees and is considered objectionable because it is messy and produces an undesirable odor. When grown from seed, there is no means of identifying a tree's sex until it begins flowering, which may require 20 years. 'Autumn Gold' is an excellent male cultivar with a pyramidal shape. Known cultivars should be used whenever fruit would be objectionable or where uniform growth form is needed. Zones: 3-9





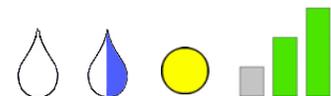
Thornless Honeylocust (*Gleditsia triacanthos var. inermis*)

Honeylocust has long been a commonly used tree for urban planting. The open, spreading crown with very small leaflets creates filtered sunlight. The light shade it produces allows a lawn to be grown beneath it. It is very tolerant of many soil conditions, and has salt tolerance for use near highways. The long, curved pods can litter the ground. Cultivars with mainly male flowers therefore essentially podless should be used. Only cultivars that are thornless are commercially available. 'Moraine' has been one of the most popular cultivars, and has no thorns or seed pods. Other cultivars include 'Imperial,' 'Shademaster' and 'Skyline'. A cultivar called 'Sunburst' with yellow foliage that gradually turns green is available, but can be severely attacked by mimosa webworm and stem cankers. Several insects and diseases may affect honeylocust trees. Therefore, the tree should be used only where control measures may be applied if necessary. Zones: 3-9



Kentucky Coffeetree (*Gymnocladus dioicus*)

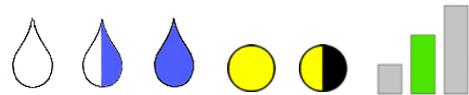
Kentucky coffeetree is a native tree well-suited to large open spaces. Branches and twigs are coarse, making it distinctive and easily identified in winter. The small leaflets give the tree a medium texture in summer. Mature trees are broad-spreading with an almost rounded form, but young trees are more upright and oval. Although it grows best in rich soil, it is adapted to many soil types and conditions. It also withstands city conditions and pollution. Female trees produce fruit that resembles extra large lima bean pods that hang on the tree through the winter. The main leaf stem of each compound leaf may be two feet long and drops from the tree after the leaflets. Kentucky coffeetree breaks dormancy late in the spring. Fall color is yellow, but not usually long lasting. Overall, the tree is durable and long-lived. Zones: 3-8





Goldenrain Tree (*Koelreuteria paniculata*)

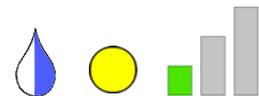
Goldenrain tree is an excellent choice for summer flowers. It grows fast to form a round-headed, wide-spreading tree. The showy large clusters of small yellow flowers are produced when few other landscape trees or shrubs are flowering. Falling flowers inspired its common name. This tree adapts to many climatic conditions, is tolerant of many soil types and endures air pollutants in urban sites. For fall and winter interest, the seed structures are large and showy. These are inflated capsules that turn from green to chartreuse, and finally to brown. Goldenrain tree is pest free and requires little care. Severe winters may cause some twig or bark damage, but trees usually recover well. This tree develops best in a sunny location although it tolerates light shade. Fall leaf color is not outstanding; usually it's dull yellow. Seeds of goldenrain tree germinate readily. It can invade surrounding areas and has the potential to become a pest. Zones: 5-9



Flowering Crabapple (*Malus species and cultivars*)

Crabapples in bloom are one of our most spectacular small, flowering trees. They are well-adapted to our soils and environmental conditions. Shapes may be columnar, weeping, oval or rounded. Sizes range from about 10 feet to 40 feet in height, but most will grow to be 15 to 20 feet tall. Flowers may be single, semi-double or double in pink, white or red. Fruits may be red or yellow, large or small, but all are attractive to birds and wildlife. Be sure to select a crabapple for planting based on all of its characteristics.

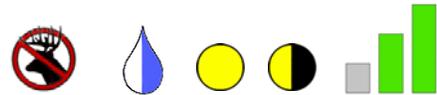
Unfortunately, several diseases attack flowering crabapples. Therefore, selection of species and cultivars regarding disease resistance is as important as ornamental value. The diseases most likely to attack them are apple scab, which causes gray spots on the leaves and summer defoliation; fire blight, which causes die-back of twigs and branches; rust, which causes orange spots on the leaves; and mildew, which causes powdery white growth on new foliage in spring. Apple scab and fire blight are the most damaging in our climate. A few of the more disease-resistant species and cultivars include `Adams,' `Prairifire,' `Snowdrift,' `Callaway,' `Donald Wyman,' `Indian Summer,' `Robinson,' `Sugar Tyme,' `Professor Sprenger,' `Liset' and *Malus floribunda*. Zones: 5-8





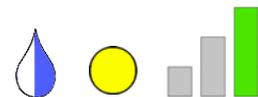
Blackgum (*Nyssa sylvatica*)

Blackgum, also known as sour gum or tupelo, is native to the southeastern third of the state. Foliage is glossy, deep green and matures to outstanding fall color from orange to deep scarlet. Flowers are not showy and the blue-black fruits in fall are ornamental for only a short time before birds and other wildlife eat them. The shape of a young tree is pyramidal, which becomes oval on older trees. Blackgum is sometimes slow to become established after transplanting, so after-planting care is important. Once established, trees require little care other than watering during drought. Although a slow-growing tree, blackgum deserves to be planted more often. Blackgum can be considered essentially pest free, since the few pests that may attack it are not serious. It tolerates urban growing conditions. Zones: 3-9



American Sycamore (*Platanus occidentalis*)

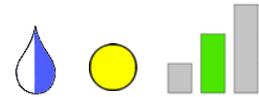
American sycamore is one of our largest native trees. For that reason it never should be planted unless it has plenty of growing space. Peeling bark reveals white, cream or gray areas along the trunk or branches. This is a tree best suited to naturalistic landscapes. It may drop leaves during the summer, as well as twigs and seed balls, causing a need for constant clean-up. Although many pests attack sycamore, only one, sycamore anthracnose, is really serious. Anthracnose causes leaves and twigs to die in spring. It is most serious in cool, wet springs and in low, wet areas. The London planetree, a hybrid between the American and Oriental sycamore is more resistant to this disease. Where the look of a planetree is desired, the London planetree is preferred to the American sycamore. 'Bloodgood,' 'Columbia' and 'Liberty' are disease resistant cultivars of London planetree. Zones: 4-9





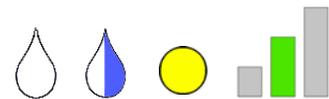
Purple-leaf Plum (*Prunus cerasifera*)

Purple-leaf plum is best known for its dark reddish foliage. Trees are easy to transplant and are tolerant of many soils and growing conditions, including heat and drought. They are not pollution or salt tolerant. Plums are subject to cankers, leaf spots, borers, tent caterpillars and a number of other problems that may make them short-lived. The small, fragrant white to pale pink flowers bloom in early spring and produce small plums that are edible. The small size of the plum gives them another common name, cherry-plum. 'Newport' and 'Thundercloud' are the most popular cultivars because of their vigor and good purple leaf color that is retained well during the summer. These trees are usually small and low branching. The purple-leaf sand cherry, *Prunus x cistena*, is a related plant also used for its purple



Callery Pear (*Pyrus calleryana*)

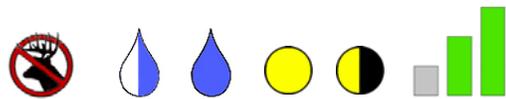
Sometimes the variety name of a tree becomes so popular that the species is known almost solely by that name. This is the case with the widely planted 'Bradford' callery pear. Other cultivars such as 'Aristocrat', 'Capital', 'Redspire,' and 'Cleveland Select' are now available. White flowers are produced abundantly in very early spring. Glossy green leaves turn wine-red in fall. The overall shape of these trees is compact and symmetrical. Callery pears are generally adaptable to a wide variety of growing conditions. The cultivar 'Bradford' gained original popularity because it is resistant to fire blight, a serious disease of pears in our area. Not all newer cultivars are as resistant, although 'Redspire' and 'Cleveland Select' have performed well. The pea-sized pear fruits are not messy in the lawn or garden. 'Bradford' tends to produce heavy limbs with narrow branch unions that may fail under an ice or wind load. Zones: 4-8





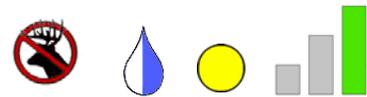
Swamp White Oak (*Quercus bicolor*)

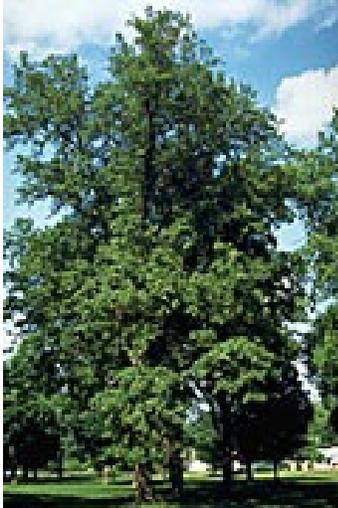
The swamp white oak is a native tree that becomes quite large and spreading. Most oaks within the white oak group are difficult to transplant, but swamp white oak is one of the least difficult. As the name implies, it is well adapted to low, moist conditions and bottomlands. In spite of this quality, this tree is able to endure drought conditions once it's well established. Leaves are dark green above and soft gray on the underside. It grows best in deep soils, but is adapted to many soil types and conditions including dense urban clay soils. Alkaline soils will cause leaf yellowing and growth problems. Fall color is a weak yellow and not outstanding. This oak, like most oaks, is subject to attack by many leaf-feeding insects, leaf galls, powdery mildew, and other diseases. Pests are not serious enough to discourage planting, but controls sometimes may be needed to maintain attractiveness. Zones: 3-8



Scarlet Oak (*Quercus coccinea*)

Although scarlet oak has been relatively uncommon for landscape planting, it is gaining popularity and is more available. It is pyramidal to oval when young and the canopy broadens with maturity. The main reason for planting this oak is its spectacular scarlet fall color. It is somewhat slower to establish than pin oak and red oak. It is tolerant of many conditions but is not as pollution tolerant as red oak. As an older tree, the branch structure becomes open as smaller branches are shaded out, sometimes giving a twiggy character to the inner trunk. Since this oak becomes quite large, it is best used in areas with plenty of space. Scarlet oak has no serious pest problems, but it is subject to many of the same pests that attack other oaks. While it grows most rapidly on deep, moist soils, it is also very tolerant of dry conditions. Zones: 4-8

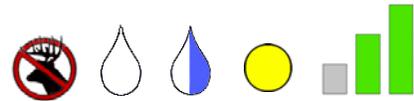




Shingle Oak (*Quercus imbricaria*)

Shingle oak is a native tree once used to make shingles, and is common in many parts of Missouri. It is less used in home landscapes and, like pin oak, it has a tendency to droop its lower branches, making it less desirable near streets or walks where clearance is needed. Foliage is dark, glossy green, but without dramatic fall color. Leaves usually turn brown late in fall and many hang on the tree through the winter. With this quality, it is a tree that can provide winter screening and windbreak. Many people object to the brown winter look for a shade tree. Winter leaf retention requires leaf clean up in spring as new growth is about to start. Shingle oak is a durable and adaptable tree that could be used more frequently for large landscapes. Twig galls will affect some trees and disfigure them.

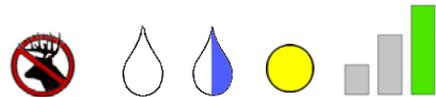
Zones: 4-8



Bur Oak (*Quercus macrocarpa*)

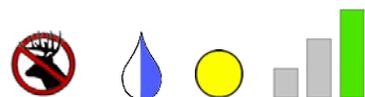
Bur oak is a native species that grows statewide on both upland and bottomland soils, although its best growth is on moist, well-drained soils. It can grow in dry soils and is more tolerant of urban conditions than most other oaks. It is slow growing and difficult to transplant. Irrigation and fertilization can speed growth of younger trees. Insect and disease problems are minor. Bur oak produces the largest acorn of any of the oaks: up to 1 1/2 inches in diameter. The large acorns are loved by wildlife but may be a nuisance in lawns. The mature size of bur oak may be too large for the average home landscape, but it makes an excellent tree for parks or other areas where it has room to grow.

Zones: 3-9



Pin Oak (*Quercus palustris*)

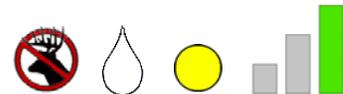
The predictable, symmetrical form and fast growth of pin oak has made it a popular tree for yard and park plantings. Young trees are pyramidal but become oval at maturity. Upper branches are upright to horizontal but lower limbs will droop. This branching pattern makes identification easy. Pin oak is easy to grow because it tolerates many soil conditions. It is intolerant of alkaline soils, which causes stunted growth with pale yellow leaves. Pin oak has few pest problems other than leaf galls and some general pests that seldom need control measures. It is not a good choice for planting near walks, driveways or streets because drooping branches will continually interfere with clearance below the tree. Even when lower branches are cut off, higher ones will begin to droop to take their place. Other oaks without this growth habit are better selections for such locations. Acorns are small enough so they do not become a major nuisance in the lawn. Fall color is reddish. Zones: 4-8





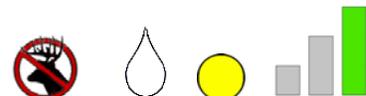
Willow Oak (*Quercus phellos*)

Willow oak has not been a common landscape tree, but continues to gain popularity. Small leaves produce a fine texture for an oak. The small acorns are not a serious litter problem. This oak is less hardy than most other species, but can be grown throughout the state. In more northern locations twig damage might be expected after very severe winters. Young trees have a pyramidal shape that is maintained for many years until it approaches maturity. It then becomes a wide-spreading tree with a rounded crown. Transplanting it is easy. In colder climates it should be planted in spring so it becomes well-established before winter cold arrives. It is suited to many soils and sites and is fairly drought tolerant. Zones: 5-9



English Oak (*Quercus robur*)

English oak has gained popularity primarily because of the more upright and columnar cultivars that are available. For a tall, narrow screen, these upright selections are more durable choices than upright poplars. The crown of the more typical English oak is pyramidal when young, but becomes rounded with age. Leaves are dark green with rounded lobes somewhat like our native white oak. English oak is easy to transplant, and adapts to many soil conditions, but must have good drainage. Fall foliage is not colorful. Brown leaves are often held through the winter. Pests are not a major problem although mildew can cover leaves in late summer and fall. Acorns are produced freely, so this oak should not be planted where branches hang over walks, driveways or streets. Several cultivars have been developed for predictable shape and mildew resistance, but they are not readily available. Zones: 4-8



Northern Red Oak (*Quercus rubra*)

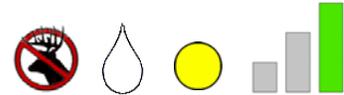
An outstanding oak for landscape use is the northern red oak. It becomes a large tree with a rounded, wide-spreading crown. As a mature tree it is among the most majestic of the oaks. Since it grows large, it needs plenty of space. Northern red oak is easy to get established and it is tolerant of urban pollution. Unlike pin oak, which is more widely planted, it is not as sensitive to soil conditions and is less likely to suffer leaf yellowing and poor growth. It is fast growing and ideal for parks, golf courses and other large areas. Leaf galls or leaf feeding insects may attack it, but most pests are not serious. All species in the red oak group are susceptible to a very destructive fungus disease called oak wilt, for which there is no cure. In fall northern red oak produces leaf colors in shades of red, scarlet and wine. Zones: 4-8





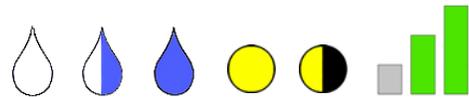
Shumard Oak (*Quercus shumardii*)

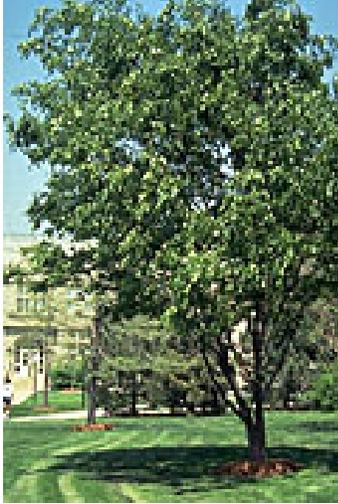
Shumard oak is one of the least common of the oaks used in landscape plantings. It becomes a large tree with similarities to pin, scarlet and red oak, and like them is most useful in large open areas. Growth when young is like pin oak, but mature structure is more like scarlet oak. The leaves are variable and might be confused with pin, red or scarlet oak. Fall color is shades of red and scarlet. It is tolerant of many soils and environmental conditions. Because of good drought tolerance, it is well-suited to the low maintenance landscape where irrigation of any type is not possible during drought periods. It has no serious pest problems, but is subject to general pests of the other oaks. Zones: 5-9



Japanese Pagodatree (*Sophora japonica*)

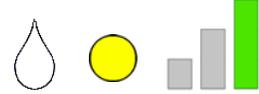
A good tree for midsummer flowers is the Japanese pagodatree. Its clusters of cream-white pealike flowers provide conspicuous color during the heat of summer. Young plants grow fast to form trees with wide-spreading crowns. Bean-like fruits are tubular and long with swollen sections for each seed. Pods may become a nuisance if trees are planted near walks or drives, but are decorative in other areas. Twigs of this tree remain green to provide winter color, but may be damaged during severe winters or rapid temperature fluctuations. Japanese pagodatree is tolerant of urban conditions, poor soils, heat and drought. The compound leaves are bright green, giving a good summer display, although without colorful fall foliage. It may be attacked by a few insects or diseases, but none serious, so it may be considered essentially pest free. Zones: 4-8





Japanese Zelkova (*Zelkova serrata*)

Since the American elm first succumbed to Dutch elm disease, there has been a search for a replacement. Zelkova is not a perfect replacement, but is a relative with a vase-shaped form resembling American elm. Leaves are dark green and held late into the fall, essentially without fall color. Zelkova's angular branching allows its use along walks, streets or other areas where low branching is undesirable. It has good pollution, wind and drought tolerance. Although it is closely related to elms, it appears to be fairly resistant to Dutch elm disease. Because many gardeners are unfamiliar with zelkova, it has been used very little, but it is gaining popularity and becoming more available. Several cultivars have been developed, but are not widely distributed. One outstanding cultivar is 'Green Vase', which features vigorous growth and bronzy-red fall foliage. Zones: 5-8



Evergreen / Deciduous Shrub Legend

<u>Moisture</u>	<u>Light Exposure</u>	<u>Height</u>	
 Low	 Full Sun	 Less than 3'	
 Medium	 Sun/ Partial Shade	 4' to 8'	
 High	 Full Shade	 8' +	 Deer Resistant

Evergreen Shrubs



Chinese Juniper (*Juniperus chinensis*)

Evergreen foliage; some cultivars have colored foliage. Full sun; moist, well-drained soil is best, but tolerates dry sites; tolerates alkaline soil. Numerous cultivars available. Check local nurseries for cultivars available in your area. The cultivars of this species are so variable in size that it is important for the consumer to verify the ultimate size of any cultivar prior to purchase. Phomopsis and Kabatina blights are common disease problems. Zones: 4-9



Common Juniper (*Juniperus communis*)

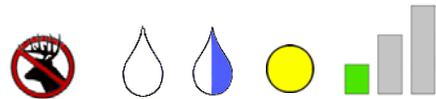
Evergreen foliage; some cultivars have colored foliage. Full sun; moist, well-drained soil is best, but tolerates dry sites; tolerates alkaline soil. As with other species of juniper, there are numerous cultivars available and they vary widely in their characteristics. Check local nurseries for cultivars available in your area. Phomopsis blight and spider mites are common problems. Zones: 2-6





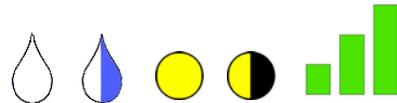
Savin Juniper (*Juniperus sabina*)

Evergreen foliage; some cultivars have colored foliage. Full sun; moist, well-drained soil is best, but tolerates dry sites; tolerates alkaline soil. Phomopsis blight is a common disease problem. As with other species of juniper, there are numerous cultivars available and they vary widely in the characteristics. **'Broadmoor'** - 2-3 feet tall, spreading to 10 feet wide, foliage is gray green, resistant to blight. **'Buffalo'** - 12 inches high, spreading to 10 feet wide, bright green foliage, hardy to zone 3. **'Skandia'** - Dense, layered habit, 1- 1 ½ feet tall, spreading to 10 feet wide; gray green foliage, blight resistant. Zones: 4-7



Mugo Pine (*Pinus mugo*)

Evergreen foliage (needles). Full sun to partial shade; prefers a moist, well-drained soil, but will tolerate dry soils; tolerant of alkaline soil. Sawflies and scale are common problems. **'Mops'** - 3 feet tall, dark green needles; **variety mugo-** about 8 feet tall; **variety pumilio-** Low growing, like a ground cover, but spreading up to 10 feet wide. Proper selection of cultivars is key to obtaining a plant that will maintain a true shrub size. Zones: 3-7

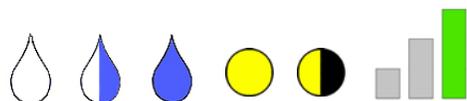


Deciduous Shrubs



Amur Maple (*Acer ginnala* or *Acer tataricum* subsp. *ginnala*)

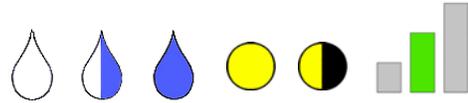
Clusters of fragrant, yellowish-white flowers in spring; fruit red on certain cultivars; autumn color is a mix of yellow and red (varies from tree to tree). Full sun or partial shade; best in moist, well-drained soils, but also tolerates dryness; tolerates neutral soil pH; salt tolerant. Often multi-stemmed; can also be pruned to produce a tree form. **'Embers'** - Exhibits bright red autumn color and red fruit. **'Flame'** - Exhibits good red autumn color and red fruit. **'Red Fruit'** - Produces bright red fruit. Zones: 3-8





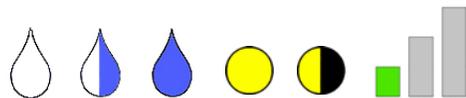
Red Chokeberry (*Aronia arbutifolia*)

Clusters of small, white flowers in mid-spring; small, round bright red fruit in late summer and autumn; autumn color is red to reddish-purple. Full sun to partial shade; tolerates both wet and dry sites; prefers acid soil. Chokeberry fruit are very astringent and will not be eaten by birds, so they are ornamental through much of winter. **'Brilliantissima'** - Flowers more abundantly; fruit is larger, glossier and more abundant; brilliant red autumn color. Zones: 4-9



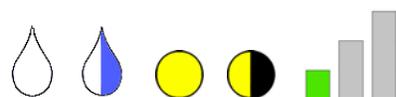
Black Chokeberry (*Aronia melanocarpa*)

Clusters of small, white flowers in mid-spring; small, round dark purple to black fruit in late summer and autumn; autumn color is red. Full sun to partial shade; tolerates both wet and dry sites; prefers acid soil. Chokeberry fruit are very astringent and will not be eaten by birds, so they are ornamental through much of winter. **'Autumn Magic'** - autumn color is a mix of red and purple. **'Morton' (Iroquois Beauty™)** - Compact (2-3 feet). Zones: 3-8



Korean Barberry (*Berberis koreana*)

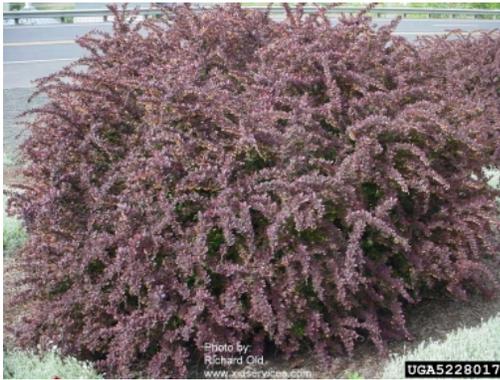
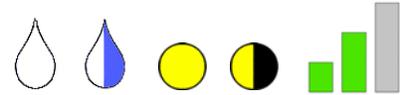
Small yellow flowers in hanging clusters in mid-spring; bright red berries in clusters in autumn; autumn color is purplish red. Full sun to partial shade; tolerates a wide range of soils except those that are overly wet. Light pruning may be needed to maintain good shape. Zones: 3-7





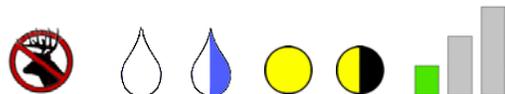
Mentor Barberry (*Berberis x mentorensis*)

Small yellow flowers in clusters in spring; autumn color is red-orange. Full sun to partial shade; tolerates a wide range of soils; avoid wet sites. Zones: 5-8



Japanese Barberry (*Berberis thunbergii*)

Small yellow flowers in clusters in spring; bright red berries in clusters in autumn and winter; autumn color is orange, scarlet and purple. Full sun; tolerates a wide range of soils except those that are overly wet. The following are cultivars of the species: **'Aurea'** - More compact (3-4 feet) with yellow foliage; **'Bogozam' (Bonanza Gold™)**- Very compact (1½ feet) with yellow leaves. The following are cultivars of *Berberis thunbergii* var. *atropurpurea* (all have foliage that is reddish or purplish); **'Concorde'**- Compact (2-3 feet); **'Crimson Pygmy'** - Very compact (1½ to 2 feet); **'Helmold Pillar'** - Narrow, upright form; **'Rose Glow'**- Young foliage is red-purple, mottled with pink. Zones: 4-8



Bluebeard (*Caryopteris x clandonensis*)

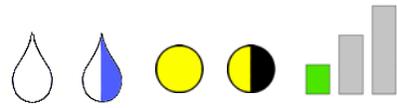
Clusters of small blue or blue-purple flowers from late summer into autumn; gray-green foliage; light brown seedheads can add mild interest in winter. Full sun to light shade, drought tolerant. In zones 4 and 5, the plant will die back to the ground like a herbaceous perennial. This does not affect flowering as flowering will occur on new growth produced each year. **'Blue Mist'** - Powder blue flowers. **'Dark Knight'** - Purple-blue flowers. **'Longwood Blue'** - 4 feet tall with blue violet flowers. Zones: 4-8





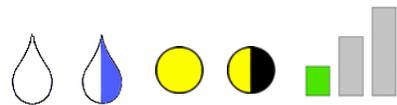
New Jersey Tea (*Ceanothus americanus*)

Clusters of small white flowers in early summer, without fragrance. Full sun to light shade; drought tolerant. Flowers are attractive to butterflies. Zones: 4-8



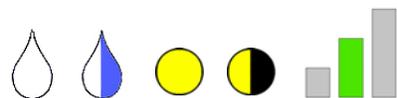
Inland Ceanothus (*Ceanothus ovatus*)

Clusters of small white flowers in early summer, without fragrance; bright red seed capsules. Full sun to light shade; drought tolerant. Flowers are attractive to butterflies. Zones: 4-8



Common Flowering Quince (*Chaenomeles speciosa*)

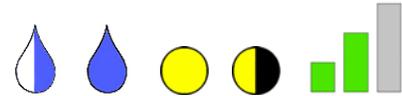
Showy, pink, red or white flowers from early to mid-spring; foliage opens red-bronze then turns dark green in summer. Full sun to partial shade; prefers slightly acid soil pH; prefers moist, well-drained soil, but tolerates dry sites. Can be attacked by leaf spots, apple scab and fireblight. This very twiggy shrub requires yearly pruning to keep it in good shape. 'Cameo' - Double, apricot flowers, height 4-5 feet. 'Jet Trail' - White flowers, height 3 feet. 'Texas Scarlet' - Abundance of red flowers; 2-3 1/3 feet tall. Zones: 4-8





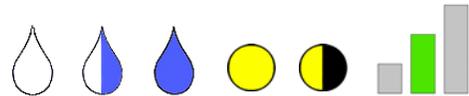
Summersweet Clethra (*Clethra alnifolia*)

Fragrant white flowers in small spikes, July and August; crisp, dark green foliage in summer; autumn color is yellow to a mild orange. Full sun to partial shade; prefers a moist to wet soil; tolerant of salt, compaction and some dryness; prefers slightly acid soil pH. Mites can be a problem in dry sites. **'Hokie Pink'** - Pink flowers on a more compact plant. **'Hummingbird'** - abundance of white flowers, yellow fall color, 2-3 feet tall. **'Pink Spires'** - 8 feet tall with pink flowers, dark green foliage and yellow fall color. **'Ruby Spice'**- Rosy pink flowers, yellow fall color, 3-6 feet tall. **'Sixteen Candles'** - White flowers, yellow fall color, 3-4 feet tall. Zones: 4-9



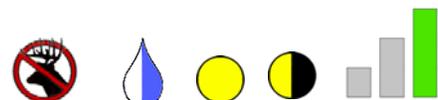
Silky Dogwood (*Cornus amomum*)

Creamy white flowers in flat topped clusters in late spring; pale to porcelain blue fruit, often blotched with white, for a short time in summer (eaten quickly by birds); autumn color is a mild purplish red. Full sun to partial shade; prefers a moist, well-drained soil, but tolerates wet and dry sites; tolerates alkaline soil. Potential for borers and scale insects, but these problems do not occur with regularity. Potential for leaf spot, twig blight, and canker, but these problems do not occur with regularity. This shrub has potential to form thickets and pruning may be needed to keep a desirable shape. Zones: 4-8



Cornelian cherry Dogwood (*Cornus mas*)

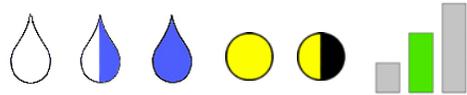
Clusters of tiny yellow flowers in early spring; oval, cherry-red fruit in summer; mottled bark. Full sun to partial shade; moist, well-drained soil; tolerates alkaline soil. This species can be used as either a large shrub or a small tree. **'Golden Glory'** - Has an upright form and flowers well. **'Redstone'** - Heavy fruit production, good for wildlife. Zones: 5-7





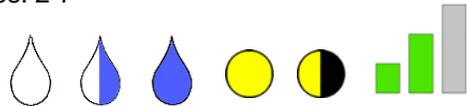
Gray Dogwood (*Cornus racemosa*)

Creamy white flowers in clusters in late spring; bluish white fruit in late summer (eaten quickly by birds); bright red fruit stalks remain after fruit is gone; autumn color is purple. Full sun to shade; prefers a moist, well-drained soil, but tolerates wet and dry sites; tolerates alkaline soil. This shrub has potential to form thickets and pruning may be needed to keep a desirable shape. Zones: 4-8



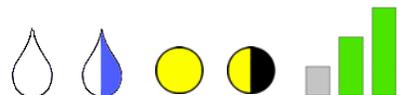
Redosier Dogwood (*Cornus sericea* or *Cornus stolonifera*)

Creamy white flowers in flat topped clusters in late spring; white to bluish-white fruit in late summer and early autumn; autumn color is purple to red; winter stems are red. Full sun; prefers a moist soil, but tolerates both wet and dry sites; tolerates alkaline soil. Stem canker is common but can be controlled with annual pruning. Yearly removal of some of the old stems at ground level will reduce the incidence of canker disease and will promote growth of new young stems which will have better winter color. **'Cardinal'** - Winter stems bright coral red. **'Flaviramea'** - Winter stems are yellow. **'Isanti'** - 5-6 feet tall; bright red winter stems. **'Kelsey'** - 2-3 feet tall, winter stems less colorful than the species. **'Silver and Gold'** - Winter stems are yellow, leaves are green with a creamy edge. Zones: 2-7



Smokebush, Smoketree (*Cotinus coggygria*)

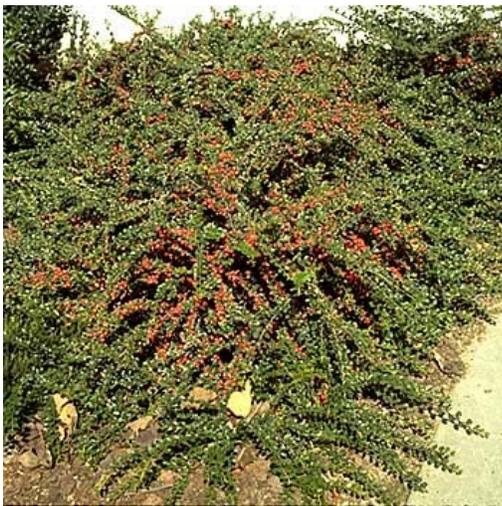
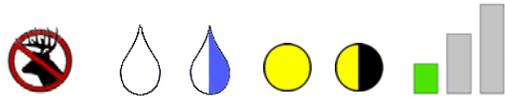
Tiny flowers held in large, loose, fuzzy clusters in early summer; fruits are small and inconspicuous, but the stalks of the fruit clusters are covered with hairs and give the plant a 'smoky' appearance; leaves are blue green (other colors available on select cultivars); autumn color is a mild yellow-orange at best. Full sun; prefers a moist, well-drained soil, but can tolerate dryness; tolerates alkaline soil. San Jose scale insect, occasional leaf spots and Verticillium wilt can occur on this species. **'Ancot' (Golden Spirit™)**- yellow leaves in summer, autumn color is orange and red. **'Nordine'** - purple foliage, autumn color is yellow to orange-yellow. **'Royal Purple'** - purple foliage, flower/fruit cluster (**'smoke'**) is also purple; autumn color is red-purple. **'Velvet Cloak'** - purple foliage, autumn color is red-purple. For cultivars with colored foliage, prune heavily to promote vigorous young stems that will produce vibrantly colored foliage. Zones: 5-7





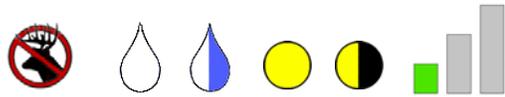
Creeping Cotoneaster (*Cotoneaster adpressus*)

Small, white flowers tipped with pink in spring; summer leaves are small but lustrous; small, bright red fruit in late summer and autumn; autumn color is red. Full sun; prefers a moist, well-drained soil, but can tolerate dryness; tolerates alkaline soil. Because of its low stature this shrub can be used as a ground cover or in rock gardens. Spider mites, scale insects, fireblight are common problems. Zones: 5-7



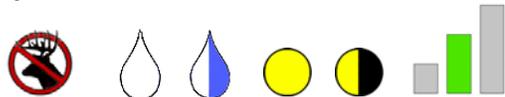
Cranberry Cotoneaster (*Cotoneaster apiculatus*)

Small, pink flowers in spring, opening about the same time as the leaves unfold; summer leaves are small but lustrous; small, bright red fruit in late summer and autumn; autumn color is reddish to purplish red. Full sun; prefers a moist, well-drained soil, but can tolerate dryness; avoid wet soils; tolerates alkaline soil; good salt tolerance. This shrub can be used as a ground cover. Spider mites, scale insects and fireblight are common problems. The low habit and stiff branches often trap autumn leaves as well as trash, so the plant may need to be cleaned up occasionally. Zones: 5-7



Spreading Cotoneaster (*Cotoneaster divaricatus*)

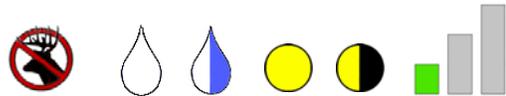
Small, pale pink flowers in spring; summer leaves are lustrous; small, bright red fruit in late summer and autumn; autumn color is red. Full sun; prefers a moist, well-drained soil, but can tolerate dryness; tolerates alkaline soil, somewhat tolerant of salt. Spider mites, scale insects, fireblight, and leaf spots are possible, although this cotoneaster is less troubled by pests than other Cotoneaster species. Zones: 5-7





Rockspray Cotoneaster (*Cotoneaster horizontalis*)

Small, pale pink flowers in spring; summer leaves are lustrous; small, bright red fruit in late summer and autumn; autumn color is reddish, although leaves may fall off green; winter branches have an interesting 'fish bone' pattern. Full sun; prefers a moist, well-drained soil, but can tolerate dryness; tolerates alkaline soil, somewhat tolerant of salt. This shrub can be used as a ground cover. Spider mites, scale insects, fireblight and leaf spots are common problems. **'Robustus'** - 3 feet tall, fruits heavily. Zones: 5-7



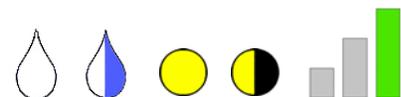
Hedge Cotoneaster (*Cotoneaster lucidus*)

Small, pale pink flowers in spring; summer leaves are lustrous; small, black fruit in late summer and autumn; autumn color is a combination of yellow, orange and red. Full sun; prefers a moist, well-drained soil, but can tolerate dryness; tolerates alkaline soil, somewhat tolerant of salt. Branches low to the ground so it can be used as a hedge or screen. Spider mites, scale insects, fireblight, leaf spots, and canker are possible problems. Zones: 3-6



Fiveleaf Aralia (*Eleutherococcus sieboldianus* or *Acanthopanax sieboldianus*)

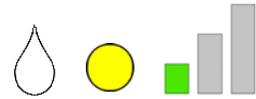
Rich dark green foliage throughout season. Full sun to shade; moist, well-drained soils; tolerates dry sites; tolerates alkaline soil. Stems bear sharp prickles at the base of each leaf. **'Variegatus'** - Green leaves with creamy white edges, 6-8 feet tall. Zones: 4-8





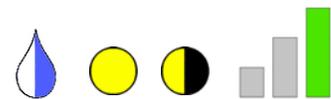
Dyer's Greenwood (*Genista tinctoria*)

Bright yellow, pea-type flowers in early summer and sporadically through late summer; green twigs in winter. Full sun; performs best in dry, infertile soils; pH adaptable. Difficult to transplant. **'Royal Gold'** - 2 feet tall with golden yellow flowers. Zones: 4-7



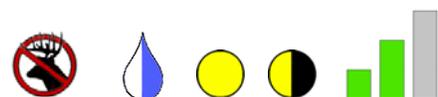
Panicle Hydrangea (*Hydrangea paniculata*)

Large pyramidal clusters of white flowers in summer; flower color changes to pinkish white in late summer and light brown in autumn. Full sun to partial shade; moist, well-drained soil is preferred. This species blooms on current year's growth. **'Grandiflora'** - Large (12-18 inch) clusters of white flowers (often sold as PeeGee hydrangea). **'Kyushu'** - Flowers heavily, even at an early age. **'Pink Diamond'** - Large clusters (12 inch) of white flowers turning to a good pink. **'Tardiva'** - Flowers late (September). **'Unique'** - Large (16 inch long) pure white flower clusters. **'Zwijenburg' ('Limelight'™)** - Lime green flowers change to white, then pink. Zones: 4-8



Shrubby St. Johnswort (*Hypericum prolificum*)

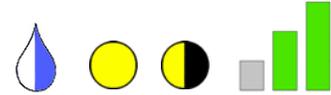
Bright yellow flowers (June-August); bluish green leaves in summer. Full sun to partial shade; tolerates both wet and dry sites; tolerates alkaline soil. Zones: 4-8





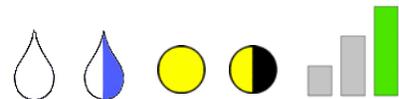
Possumhaw (*Ilex deciduas*)

Red berries on female plants in late summer, often remaining well into winter. Full sun to partial shade; tolerates both wet and dry sites; tolerates alkaline soil. 'Warren Red' - more upright form, fruits heavily, good cold hardiness. All species of Ilex have male and female flowers on separate plants. Fruit will be produced only if a male plant is available to pollinate the females. Leaves of this species will fall off in autumn. Zones: 5-9



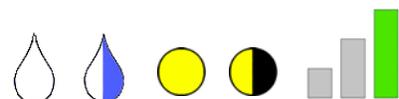
Amur Privet (*Ligustrum amurense*)

Creamy white flowers with an unpleasant scent in late spring. Full sun to partial shade; tolerates a wide range of soils, except those that are wet; tolerates alkaline soils. Tolerates heavy pruning, so is often used as a hedge. A number of insect problems are common, but not serious. These include aphids, leaf miners, scale, mealybugs and mites. A number of disease problems are common, but not serious. These include anthracnose, leaf spots, and powdery mildew. Zones: 4-7



Winter Honeysuckle (*Lonicera fragrantissima*)

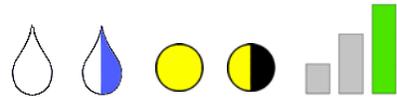
Fragrant white flowers in early spring before the leaves emerge; blue green leaves (leaves are semi-evergreen in southern states); red berries in summer. Full sun to partial shade; moist, well drained soils are best; but tolerates dry sites; tolerates alkaline soil. All honeysuckle shrubs require annual pruning to keep them in good shape and at a good size. They can tolerate very heavy pruning. Many honeysuckles are considered weedy, but Winter Honeysuckle does not present this problem. Leaf spots, powdery mildew, aphids, plant hoppers, scale are possible. These problems seldom become serious. Zones: 5-8





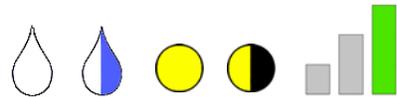
Tatarian Honeysuckle (*Lonicera tatarica*)

White or pink flowers in late spring; dark green leaves in summer; red berries in mid to late summer. Full sun to partial shade; moist, well-drained soils are best; but tolerates dry sites; tolerates alkaline soil. Leaf spots, powdery mildew, aphids, plant hoppers, scale are possible. These problems seldom become serious. Russian aphid is a serious problem on this species. 'Arnold Red'- Dark red flowers, resistant to the Russian aphid. 'Honeyrose'- Deep rosy pink flowers, resistant to the Russian aphid. This species can be weedy. Birds eat the fruit and spread them. All honeysuckle shrubs require annual pruning to keep them in good shape and at a good size. Zones: 3-8



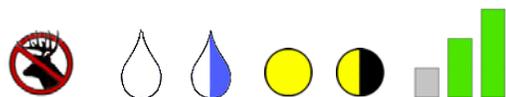
Amur Honeysuckle (*Lonicera maackii*)

Fragrant flowers, white turning to yellow, later spring to mid-summer; deep green leaves that remain green well into autumn; bright red berries in autumn. Full sun to partial shade; moist, well drained soils are best; but tolerates dry sites; tolerates alkaline soil. Aphids, plant hoppers, scale, leaf spots and powdery mildew. These problems seldom become serious. This species can be extremely weedy. Birds eat the fruit and spread them. All honeysuckle shrubs require annual pruning to keep them in good shape and at a good size. They can tolerate very heavy pruning. Zones: 3-8



Bayberry, Northern Bayberry (*Myrica pensylvanica*)

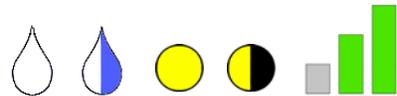
Dark green foliage, aromatic when crushed, and persisting well into autumn; clusters of gray, waxy berries on female plants; fruits persist into winter and are also aromatic. Full sun to partial shade; tolerates wet sites, dry sites, low fertility and salt; prefers slightly acid soil. Since male and female flowers are on separate plants, both are needed to produce the waxy berries (berries will be produced on female plant only). Zones: 4-6





Common Ninebark (*Physocarpus opulifolius*)

Clusters of white to off-white flowers in early summer; clusters of fruit taking on a pinkish to flesh color in mid-late summer; autumn color is a poor yellow. Full sun to partial shade; tolerates both wet and dry sites; tolerates alkaline soil. Annual pruning is needed to keep the plant in good shape. 'Dart's Gold' - Compact (4-5 feet tall), foliage yellow changing to yellow green. 'Luteus' - Foliage yellow turning to yellow green. 'Monlo' (**Diablo®**)- Reddish purple foliage, fruit turn reddish but still show up well against the foliage. 'Nanus' - 2-6 feet tall, red fruits. 'Nugget' - 6 feet tall, leaves yellow in spring, lime green in summer, yellow in autumn. 'Seward' (**Summer Wine™**)- Reddish purple foliage and a more compact plant (5 feet), pinkish white flowers. Zones: 2-6



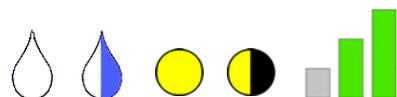
Shrubby Cinquefoil, Potentilla (*Potentilla fruticosa*)

Bright yellow flowers produced from early summer into fall; some cultivars offer white, pink or red-orange flowers; leaves are gray green in summer. Full sun; moist, well-drained soils best, but this species tolerates both wet and dry sites; very tolerant of alkaline soils. Leaf spots, mildew and mites can be a problem but are seldom serious. Numerous cultivars including: 'Abbottswood' - Blue green foliage and large white flowers, 3 feet tall. 'Coronation Triumph' - Abundant, bright yellow flowers on a 3-4 foot tall plant. 'Fargo' (**Dakota Sunspot®**) - Deep golden flowers, 2-3 feet tall. 'Gold Drop' - Yellow flowers on a dwarf shrub (2 feet). 'Goldfinger' - Dark green foliage, large yellow flowers, 3-4 feet tall. 'McKay's White' - Creamy white flowers, 2-3 feet tall. 'Pink Beauty' - Pink flowers on a dwarf shrub (2 feet). Zones: 2-6



Scarlet Firethorn (*Pyracantha coccinea*)

Clusters of small white flowers in early summer (flowers have a mildly unpleasant fragrance); shiny green leaves are semi-evergreen in zones 6 and 7 and evergreen in zones 8 and 9; bright red-orange fruits are borne in clusters from late summer into early winter. Full sun to partial shade; moist, well-drained soil is best, but will tolerate dry soil; tolerates alkaline soils. Stems are thorny. Fireblight, scab, twig blight, aphids and scale are all common problems. 'Kasan' - Hardy to zone 5, orange-red fruit, 10 feet tall, susceptible to scab. 'Lalandei' - Hardy to zone 5, orange-red fruit, 10-15 feet tall, susceptible to scab. Zones: 6-9





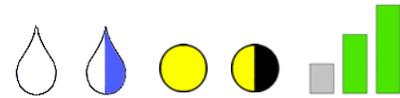
Flame Azalea (*Rhododendron calendulaceum*)

Showy flowers (color depends on cultivar selected) in late spring; flowers have no fragrance; autumn color is a very mild yellow; leaves are deciduous (shed in autumn). Partial to full shade; moist, well-drained soil is best, but will tolerate some dryness; needs acid soil. Rhododendron and azaleas both fall into the genus *Rhododendron*. Leaf spots, powdery mildew, scale, thrips and whitefly are possible problems, but occur only occasionally. Alkaline soils will lead to chlorosis (yellowing) of the leaves. Common Groups of Hybrid Rhododendrons are: **'Girard' Hybrids:** This large group of azaleas includes both deciduous and evergreen cultivars. They vary in flower color and winter hardiness.

'Knapp Hill' Hybrids: The result of crossing several species of *Rhododendron*. A large group including 'Knapp Hill', 'Exbury', 'Sloccock' and 'Ilam' Hybrids. These azaleas are deciduous. Flower color depends on the cultivar selected. Mildew can be a problem with this group.

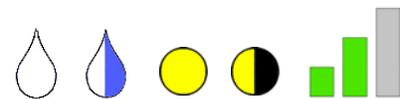
'Northern Lights' Hybrids: Developed at University of Minnesota. These hybrids were selected for excellent cold hardiness (to -30 degrees). These azaleas are deciduous. Flower color depends on cultivar selected. **'P.J.M.'**

Hybrids: A group of hybrids that are known for their compact size (3-6 feet) and their flower color (shades of lavender pink to mauve). These rhododendrons are evergreen, with the foliage taking on a purplish cast in winter. Zones: 5-7



Fragrant Sumac (*Rhus aromatica*)

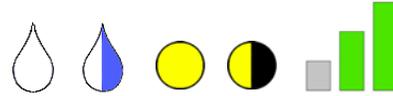
Very glossy leaves with three leaflets (trifoliate); clusters of hairy, red fruit in late summer and early autumn (on female plants only); autumn color varies from orange to scarlet and reddish purple. Full sun to partial shade; moist, well-drained soil is best, but tolerates some dryness; prefers acid soils, but tolerates alkaline soils. Male and female flowers on separate plants. Fruit will be produced only if a male plant is available to pollinate the females. 'Gro-low' - 2 feet tall, 6-8 feet wide, red fruits, orange red fall color. Zones: 4-8





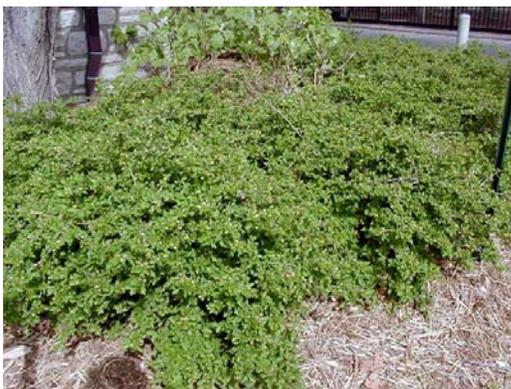
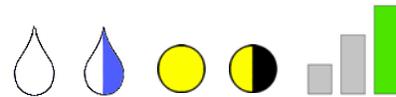
Smooth Sumac (*Rhus glabra*)

Dense, upright clusters of yellow green flowers in early to mid-summer; upright clusters of red, hairy fruit (on female plants only) in late summer, persisting into winter; autumn color is scarlet, mixed with orange and purple. Full sun; moist, well-drained soil is best, but tolerates dryness; prefers acid soils, but tolerates slightly alkaline soils. Male and female flowers on separate plants. Fruit will be produced only if a male plant is available to pollinate the females. **'Laciniata'**- Leaflets are deeply cut, bright red fruit. Zones: 3-8



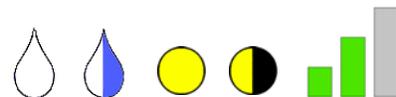
Staghorn Sumac (*Rhus typhina*)

Dense, upright clusters of yellow green flowers in early to mid-summer; upright clusters of red, hairy fruit (on female plants only) in late summer, persisting into winter; autumn color is yellow, orange and red. Full sun; moist, well-drained soil is best, but tolerates dryness; prefers acid soils, but tolerates slightly alkaline soils. **'Laciniata'**- Leaflets are deeply cut. Male and female flowers on separate plants. Fruit will be produced only if a male plant is available to pollinate the females. Zones: 4-8



Alpine Currant (*Ribes alpinum*)

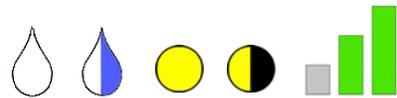
Shiny, dark green leaves in summer; female plants produce bright red fruit in mid-summer (many commercially available cultivars are male and do not produce fruit). Full sun to shade; moist, well-drained soil is best, but tolerates some dryness; tolerates alkaline soils. Male and female flowers on separate plants. Fruit will be produced only if a male plant is available to pollinate the females. Many cultivars available commercially are male. Anthracnose and leaf spots are potential problems. **'Green Mound'**- 2-3 feet tall, male (no fruit), resistant to leaf diseases. **'Spreg'(Green Jeans™)**- 3-5 feet tall, leaves remain clean throughout summer. In some parts of the country, the planting of *Ribes* species is illegal, due to the fact some species are alternate hosts for white pine blister rust. Check with local authorities before planting. Zones: 3-7





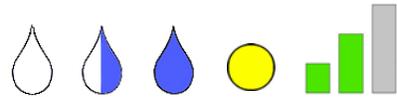
Clove Currant (*Ribes odoratum*)

Small, yellow, tubular flowers in early spring; flowers have a strong clove fragrance; autumn color is brief and mild (some yellow or a hint of red); fruits are black berries in mid-summer (on female plants only). Full sun to partial shade; moist, well-drained soil is best, but tolerates some dryness; tolerates alkaline soils. Male and female flowers on separate plants. Fruit will be produced only if a male plant is available to pollinate the females. Anthracnose and leaf spots are potential problems. In some parts of the country, the planting of *Ribes* species is illegal, due to the fact some species are alternate hosts for white pine blister rust. Check with local authorities before planting. *Ribes odoratum* is a host of this disease. Zones: 3-7



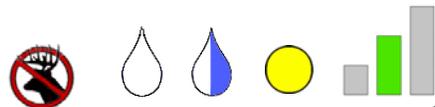
Carolina Rose (*Rosa Carolina*)

Flowers are pink, single type and fragrant, blooming in June and July; fruit are bright red rose 'hips' persisting through autumn and winter. Full sun; moist, well-drained soil is best, but tolerates both wet and dry sites; tolerates alkaline soils. Black spot and powdery mildew are occasional problems; the common insect pests of roses are also occasional problems; Japanese beetles are a damaging pest. Zones: 5-8



Rugosa Rose (*Rosa rugosa*)

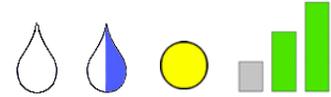
Flowers are deep pink, rose pink or white in late spring and early summer (flowers may be produced sporadically throughout summer), and they may be single or double; fragrant; summer foliage is leathery and wrinkled, giving it a distinct texture; autumn color is yellow and orange; fruits are large red-orange "hips". Full sun; moist, well-drained soil is best, but it will tolerate some dryness; prefers acid soil, but will tolerate alkaline soils. This rose is very salt tolerant. Less troubled by the common rose diseases (black spot and powdery mildew), than other roses; Japanese beetles are a damaging pest. **'Alboplena'** - Fragrant, double, white flowers, no fruit produced, highly resistant to black spot and powdery mildew. **'Frau Dagmar Hastrup'** - 3-4 feet tall, fragrant, light pink flowers, large red fruit (hips), yellow to orange autumn color, excellent resistance to black spot and powdery mildew. **'Hansa'** - Fragrant, semi-double, purplish red flowers, orange red autumn color, resistant to black spot. Zones: 3-7





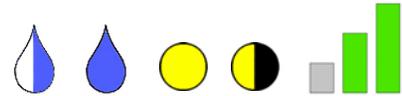
Father Hugo Rose (*Rosa xanthina forma hugonis*)

Flowers are yellow, single with a mild fragrance; the flowers bloom in spring; rose "hips" are small and dark red. Full sun; moist, well-drained soil is best, but it will tolerate some dryness; will grow in poor soils. Japanese beetles will do damage, but otherwise no common serious problems. Zones: 5-8



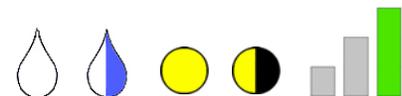
American Elderberry (*Sambucus Canadensis*)

Large flattened clusters of tiny cream-colored flowers in summer, fragrant; large clusters of small dark purple berries in late summer. Full sun to partial shade; moist, well-drained soils are best, but will tolerate some dryness as well as wet sites; tolerates alkaline soil. Occasional problems with borers, cankers and powdery mildew. Tends to sucker and may need regular pruning to keep the plant in good shape. 'Adams' - 8-10 feet tall, heavy fruit production. 'York' - Larger fruits maturing later than 'Adams', heavy fruit production. Zones: 3-8



European Elderberry (*Sambucus nigra*)

Large flattened clusters of tiny cream-colored flowers in early summer, fragrant; large clusters of small black berries in late summer. Full sun to partial shade; moist, well-drained soils are best, but will tolerate some dryness as well as wet sites; tolerates alkaline soil. Tends to sucker and may need regular pruning to keep the plant in good shape. Aphids are a common problem. Occasional problems with borers, cankers and powdery mildew. 'Albo-variegata' - White speckled foliage. 'Gerda' (Black Beauty™)- Black (dark purple) leaves, fragrant pink flowers. 'Madonna'- Leaves are a mix of green and yellow; white flowers. 'Pulverulenta'- Green leaves mottled with white. Zones: 5-7





Bumald Spirea (*Spiraea x bumalda*)

Clusters of white, light pink or dark pink flowers in early to mid-summer; foliage of some cultivars exhibit color in spring and summer; autumn color bronze to purplish. Full sun; moist, well-drained soils are best, but tolerates dry sites; tolerates neutral soil pH (highly alkaline soils may lead to chlorosis). *Spiraea japonica* is one of the parent plants of *Spiraea x bumalda*. Some of the cultivars noted may be found sold as cultivars of both species. A number of problems are common on this species including: leaf spots, powdery mildew, scale and aphids. **'Anthony Waterer'** - 3-4 feet tall, carmine pink flowers, young foliage is reddish changing to blue green, autumn color may be russet red. **'Coccinea'** - Deep, carmine red flowers. **'Fire Light'** - 2-3 feet tall, pink flowers, new foliage emerges orange and maintains some of that color in summer, autumn color is red. **'Froebelii'** - 3-3 1/2 feet tall, bright pink flowers, new growth emerges with red tones. **'Goldflame'** - From spring into summer leaves change from bronzy red to yellow to green, flowers are pink. Zones: 4-8



Japanese Spirea (*Spiraea japonica*)

Clusters of pink flowers in early summer. Full sun; moist, well drained soils are best, but tolerates dry sites; tolerates neutral soil pH (highly alkaline soils may lead to chlorosis). *Spiraea japonica* is one of the parent plants of *Spiraea x bumalda*. Some of the cultivars noted here may be found sold as cultivars of both species. A number of problems are common on this species including: leaf spots, powdery mildew, scale and aphids. **'Gold Mound'**- Golden yellow foliage most of the season, autumn color is orange red, pink flowers. **'Little Princess'** - 2 1/2 feet tall, deep pink flowers. **'Mertyann'** (**Dakota Goldcharm®**)- 12-15 inches tall, new foliage branze, turning to yellow, pink flowers. **'Neon Flash'** - 3 feet tall, new leaves emerge reddish and change to dark green, red flowers. **'Shibori'** (**'Shirobana'**) - 2-3 feet tall, white, pink and deep pink flowers all on the same plant. Zones: 4-8





Snowmound Nippon Spirea (*Spiraea nipponica* 'Snowmound')

Clusters of small white flowers in late spring; foliage is dark blue-green. Full sun; moist, well-drained soils are best, but tolerates dry sites; tolerates neutral soil pH (highly alkaline soils may lead to chlorosis). A number of problems are common on this species including: leaf spots, powdery mildew, scale and aphids. Zones: 4-7



Bridalwreath Spirea (*Spiraea prunifolia*)

Clusters of white, double flowers in mid to late spring; branches arch gracefully; autumn color is a mild orange red to yellow orange. Full sun; moist, well-drained soils are best, but tolerates dry sites. A number of problems are common on this species, but aphids tend to do the most damage. Zones: 5-8



Thunberg Spirea (*Spiraea thunbergii*)

Loose clusters of white flowers in early to mid spring; bright green, narrow leaves give the shrub a fine texture in summer; autumn color is yellow-orange, but lasts only a short time. Full sun; moist, well-drained soils are best, but tolerates dry sites; tolerates neutral soil pH (highly alkaline soils may lead to chlorosis). A number of problems are common on this species, but aphids tend to do the most damage. 'Fujino Pink' - Soft pink flowers. 'Ogon' - Yellow leaves. Zones: 5-8



Vanhoutte Spirea (*Spiraea x vanhoutte*)

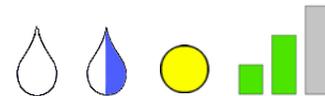
Dense, flat clusters of white flowers in late spring; blue-green foliage in summer. Full sun; moist, well-drained soils are best, but tolerates dry sites; tolerates neutral soil pH (highly alkaline soils may lead to chlorosis). A number of problems are common on this species, but aphids and powdery mildew tend to be the most common. 'Renaissance'-resistant to foliar diseases. Zones: 3-8





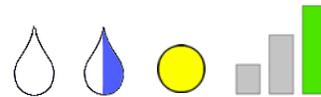
Common Snowberry (*Symphoricarpos albus*)

Small spikes of pink flowers (not very showy); fruits are white and berry-like from September through November. Full sun to partial shade; moist, well-drained soils are best, but tolerates some dryness; tolerates alkaline soil. Anthracnose, powdery mildew, rust, leaf spots and rot that discolors the fruit are common. Due to high incidence of disease and vigorous suckering, this shrub tends to require high maintenance. Zones: 3-7



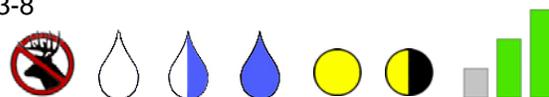
Five Stamen Tamarisk (*Tamarix ramosissima*)

Small, rosy pink flowers held in large clusters in mid-summer; small leaves give the plant a fine texture in summer. Full sun; can tolerate dry soils, salt and infertile soils; prefers acid soil but can tolerate alkaline soils as well. Regular pruning can keep this shrub in good shape and can reduce the incidence of canker diseases. Canker, powdery mildew and scale are occasional problems. **'Pink Cascade'** - Deep pink flowers. **'Rubra'** - Rosy pink flowers, may flower lightly later than the species. **'Summer Glow'** - Bright pink flowers, bluish foliage. Zones: 4-8



Arrowwood Viburnum (*Viburnum dentatum*)

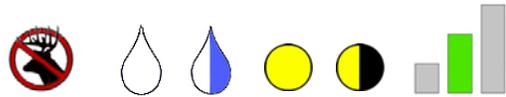
Creamy white flowers in broad, flat clusters (slightly unpleasant fragrance) in late spring; small, dark blue fruits in flat clusters in late summer (slightly showy); summer foliage is crisp and dark green; autumn color is red, but varies in intensity. Full sun to partial shade; moist, well-drained soil is best, but can tolerate wet sites and some dryness as well; prefers a slightly acid soil. One of the most trouble-free viburnums. **Christom'** (**Blue Muffin™**)- 5 to 7 feet tall, bright blue fruit, mild purple autumn color. **'Morton'** (**Northern Burgundy®**)- 10 to 12 feet tall, burgundy autumn color. **'Ralph Senior'** (**Autumn Jazz™**)- 10-12 feet tall, good orange-red autumn color. **'Synnestvedt'** (**Chicago Lustre®**)- Glossy, deep green summer leaves; autumn color is yellow. Viburnums tend to be multi-season plants with ornamental value throughout a large part of the season. Zones: 3-8





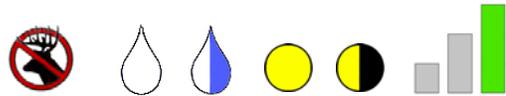
Wayfaringtree Viburnum (*Viburnum lantana*)

Small, white flowers in flat-topped clusters in late spring; fruit changes from yellow to red to black and all three colors may be present in the same fruit cluster, giving the shrub a very colorful appearance; the fruit persist through much of autumn; autumn color is purple red, but is not consistent from year to year. Full sun to partial shade; moist, well-drained soil is best, but is very tolerant of dry soils; also very tolerant of alkaline soils. One of the most trouble free viburnums. '**Emerald Triumph**'- 6-8 feet tall, dark green foliage, fruits earlier than the species. '**Mohican**'- 6-8 feet tall, fruit turn orange red and stay that color for several weeks before turning black. Viburnums tend to be multi-season plants with ornamental value throughout a large part of the season. Zones: 4-7



Blackhaw Viburnum (*Viburnum prunifolium*)

Creamy white flowers in flat-topped clusters in late spring; fruits ripen from yellow green to pink and finally blue-black by mid-autumn; autumn color is deep purple red. Full sun to partial shade; moist, well drained soil is best, but tolerates dryness; tolerant of alkaline soil. Viburnums tend to be multi-season plants with ornamental value throughout a large part of the season. Scale and borers can be occasional problems. Zones: 4-8



SOIL

Soil is the foundation of every landscape and proper soil preparation is one of the most important considerations when developing a Sustainable Landscape design. The better the soil, the greater the success.

Whether the soil is natural (original surface hasn't been disturbed by grading and/or construction activities) or modified, it may be far from ideal for growing grass, flowers, and vegetables. Much can be done to change the soil characteristics to suit individual needs. The following is a description of the "ideal soil" for plant growth.

Ideal Soil

The ideal soil has a deep rooting zone from which plant can gather water and essential nutrients. This zone is at least 36" deep. A shallow soil has limited capacity to hold enough moisture and nutrients to maintain optimal growing conditions unless irrigated. Plant will tend to grow more slowly in shallow soils.

The ideal soil is loamy in texture, that is, it contains a favorable mixture of sand, silt and clay particles. Sands take on water readily but retain little, while clays take on water very slowly but can hold on to a great deal of moisture. Unless properly amended, clay soils tend to become hard and massive when dry. In the St. Louis area, the predominant soil structure tends to exhibit more clay like characteristics. When water is applied too quickly to clay soil, the soil can't absorb it and most of it runs off. Unless properly amended, clay soils tend to become hard and massive when dry, making it difficult for plants to establish the deep root systems necessary to survive a drought.

The ideal soil has good structure. The particles of sand, silt and clay are grouped into "crumbs", permitting water to enter freely, roots to penetrate easily and deeply, and air to move in and out. The surface is moderately cloddy, not fine and dusty. The soil is firm enough to hold moisture and make close contact with roots and seeds. It allows excess water to drain through promptly but holds an adequate amount of moisture to bridge the periods between rains or waterings.

The ideal soil contains approximately 5 percent organic matter in various stages of decomposition. It also contains micro-organisms and insects that help the decomposition process. The process, in turn, releases nutrients that are utilized by plants. Since organic matter is constantly decomposing, new supplies must be added to the soil on a regular basis to maintain soil viability.

The ideal soil has an adequate and balanced supply of nutrients for plant growth. Most vegetables require high amounts of nutrients, flowers tend to require moderate levels of nutrients, while herbs and shrubs will tolerate low nutrient levels.

The ideal soil has the proper acidity for plant growth. The ideal pH range is between 6.5 (slightly acid) to 7.5 (slightly alkaline)

Fortunately there is a way to improve the characteristics of an existing soil, that is to amend it by adding lots of organic material, such as aged compost and/or manure. The ideal way to do this is to spread three to five inches of organic material over the top of the existing soil, and rototill as deeply as possible (a depth of six inches is considered sufficient.)

Once a landscape has become established it is much harder to improve the soil. Organic material can be applied to garden beds and worked in by hand. Existing lawns can be top-dressed. This involves spreading a very thin layer of compost (no more than 1/4 inch) over the lawn and letting it slowly sink to the soil level. Over the course of several years regular top-dressing will help build an organic base.

One important note: some native plants prefer soil that is low in organic matter. Before amending the soil, check with the local Extension Office to find the best soil preparation practices for specific plants.

MULCH - Soil Conservation Practices

On both urban and rural land, various conservation practices help to slow the movement of water down slopes, reducing erosion and allowing more time for water to absorb into the soil. Some of these practices are mulching, planting grasses, laying out paths, walkways and planting rows parallel to the contour of the land and constructing terraces and diversions.

Mulching is an essential component in the landscape for several reasons. Mulching minimizes evaporation. It cools plant root zones, which reduces the amount of water plants lose through transpiration. It reduces weed growth, and it helps control erosion. Mulch also adds a finished look to the shrub and flower beds.

There are two basic types of mulch - organic and inorganic. Organic mulch is wood-based, such as shredded hardwood bark, chipper chips, cedar chips, and redwood bark. Organic mulch decomposes over time and improves soil texture, but it will need to be replaced periodically. It's an ideal choice in new landscape, where plants are much smaller than their mature size. The mulch will fill in the empty spaces and slow weed growth. As the plants mature and spread, they'll cover the mulched area so you won't have to keep replacing the mulch.

Inorganic mulch is stone-based. Types of inorganic mulch include cobblestone, river rock, pea gravel and lava rock. Inorganic mulch rarely needs to be replaced, but it tends to retain and radiate heat so it's not the best choice to go along the sunny side of a house. It works best in a more formal setting where the rock will remain visible even when plants are mature.

Organic mulch should be applied directly on top of the soil in a three to four inch layer. Inorganic mulch may be applied on top of the soil or over a weed barrier fabric, and should be layered two to four inches deep. (NOTE: never apply mulch over black plastic. Plastic doesn't allow moisture or air to penetrate, and can kill useful organisms in the soil.)

IRRIGATION

Proper irrigation is another vital component of a Sustainable Landscape development. Its important to water correctly. While new plants are getting their roots well-established, a low water usage design will probably use the same amount of water as a traditional landscape, but once established, the amount of water required to maintain the plantings will be greatly reduced.

No matter how much water a landscape needs, it's important to apply the water efficiently. Efficient irrigation can be done either with a hose-end sprinkler or with an automatic sprinkler system. The keys to either method are:

Keep water close to the ground. Avoid the oscillating type of sprinkler that sends water high into the air. Stationary sprinkler heads that keep the water fairly low or sprinklers that move horizontally from side to side (like rotary heads) are less prone to evaporation. Drip, micro-sprays or bubbler emitters are the most efficient for watering flowers, shrubs and trees.

Know how much water your sprinkler puts out in a given amount of time so you can calculate how long to water for each zone. The easiest way to measure sprinkler output is to place three identical empty cans at various distances from the sprinkler within a given zone. Turn the sprinkler on for 15 minutes, and then turn it off and pour the collected water into one can. With a ruler, measure the depth of water and divide by 3 (the number of cans used). Your sprinkler delivers that much water in 15 minutes.

Design your sprinkler system (or plan your hose placement) so that a given zone or hose placement waters plants with similar watering requirements. Don't try to water low and moderate-water-requiring plants at the same time -- you'll end up either over watering some plants or under watering others.

If you have an automatic sprinkler system, change the watering times per zone at least once a month to reflect the different water requirements. Plants need more applied irrigation in the heat of the summer than in the spring or fall.

Check your system regularly for leaks, broken or misaligned heads, and make repairs promptly.

MAINTENANCE

No landscape is completely maintenance-free. Like more traditional landscapes, Sustainable Landscapes require regular maintenance, including pruning shrubs and trees, deadheading perennials, aerating, mowing and fertilizing lawns, and controlling pests.

Pruning

Regular pruning keeps plants looking good and promotes plant vigor. Also, many shrubs bloom on new wood, so pruning is necessary in order to have flowers. The best time to prune most shrubs and trees is in the winter to early spring. Prune dead or unwanted branches slightly away from the trunk, on the outer edge of the branch collar (a ring of compressed bark at the branch crotch). Leave the entire branch collar in tact, to allow new bark to form over the cut.

Deadheading

Deadheading means removing spent flowers before they mature into seed heads. Deadheading makes the garden look more attractive, helps prevent unwanted, self-sown seedlings, and encourages the plant to produce more flowers. Many plants, including valerian, catmint and salvia, will bloom repeatedly during the summer if deadheaded.

Aerating

Regular core aeration will reduce thatch buildup and loosen the soil. This promotes better root growth, and allows water and fertilizer to move into the root zone. Core aeration can be done with a core aeration machine or a manual aeration device. The plugs can be left on the lawn to disintegrate or can be added to compost piles. Core aeration is best done twice a year, in spring and late summer.

Mowing and fertilizing

Lawns should be mowed to a height of 2-3", and should be mowed frequently enough so that no more than 1/3 of the grass height is removed at any one time. Make sure the mower blades are sharp, and don't water when the grass is wet. Fertilization schedules will vary according to the type of grass involved.

Pest Control

The most effective way to control garden pests is through Integrated Pest Management (IPM). There are four steps to IPM - discovering the problem, identifying the cause, monitoring the situation, and managing the problem through a variety of techniques, including using disease-resistant plant, spraying insects with water, using sprays of BT bacteria to manage caterpillars, and using pesticides or herbicides.

EXAMPLES - SUSTAINABLE LANDSCAPES

The following pages contain various examples of practical application of Sustainable Landscape designs. Since physical conditions vary widely from site to site it is impossible to provide examples that cover every situation. The sole purpose for the inclusion of these examples is to provide an inspirational springboard for those interested in moving their existing water consuming landscape or their newly developed property toward an attractive water wise landscape.

Please note that, not all of the examples are of local origin. Since water conservation in this part of the country has not been a high priority until recently, reference to more arid regions was made due to their long experience with water shortage issues.









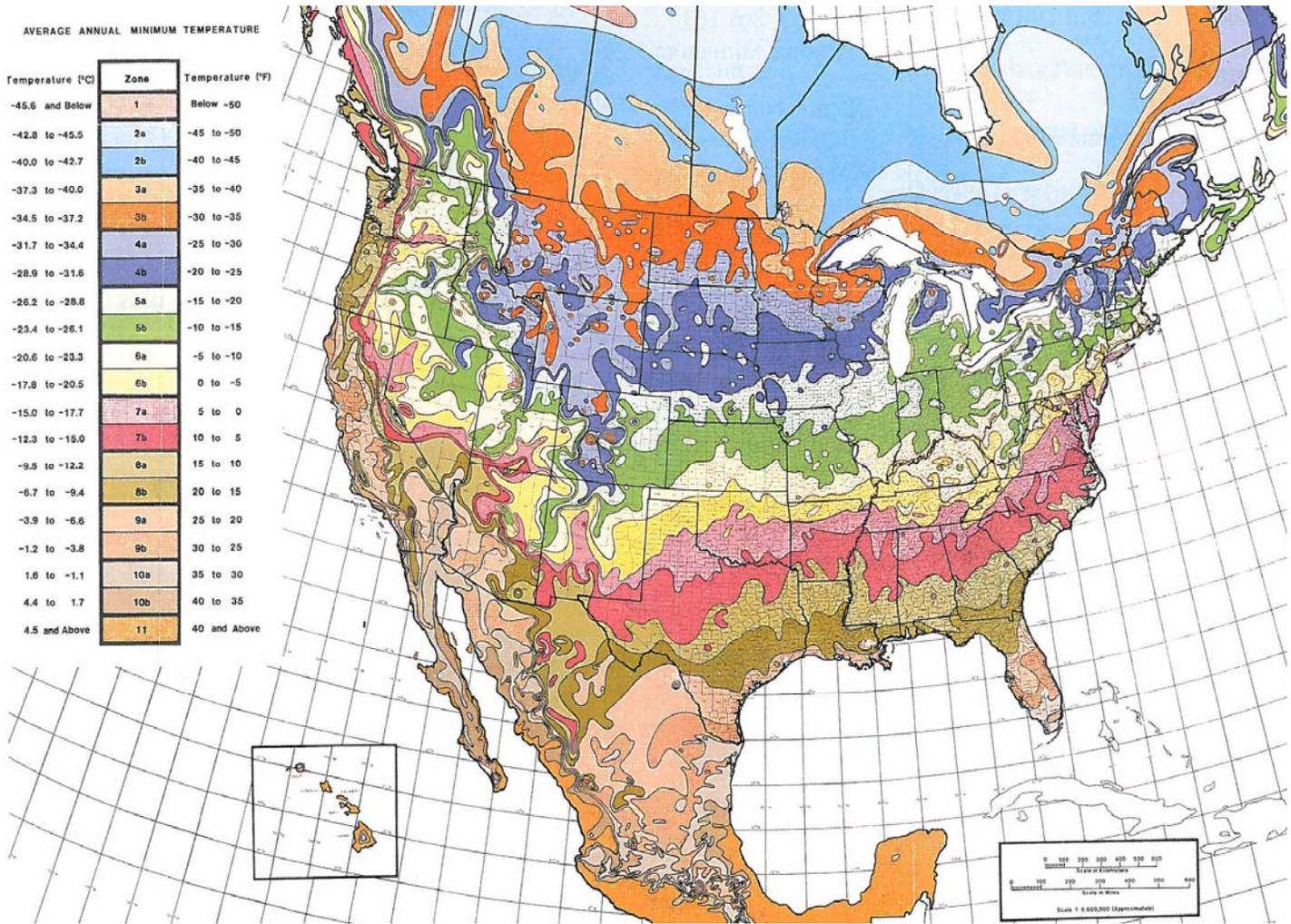








U.S. DEPARTMENT OF AGRICULTURE HARDINESS ZONE MAP



GLOSSARY*

A

Acid soil: A soil with a preponderance of hydrogen ions, and probably of aluminum in proportion to hydroxyl ions. Specifically, soil with a pH value less than 7.0. For most practical purposes, a soil with a pH value less than 6.6. The pH values obtained vary greatly with the method used; consequently, there is no unanimous agreement on what constitutes an acid soil. The term is usually applied to the surface layer or to the root zone unless specified otherwise.

Adhesion: Molecular attraction which holds the surfaces of two substances in contact, such as water and rock particles.

Aeration: 1. The process of being supplied or impregnated with air. 2. In waste treatment, the process used to foster biological and chemical purification. 3. In soils, the process by which air in the soil is replenished by air from the atmosphere. In a well-aerated soil, the soil air is similar in composition to the atmosphere above the soil. Poorly aerated soils usually contain a much higher percentage of carbon dioxide and a correspondingly lower percentage of oxygen. The rate of aeration depends largely on the volume and continuity of pores in the soil. The zone of aeration is the zone between the land surface and the water table.

Alkali: 1. Any substance capable of furnishing to its solution or other substances the hydroxyl ion (OH negative); a substance having marked basic properties in contrast to acid. The important alkali metals are sodium and potassium. 2. The term is applied less scientifically to the soluble salts, especially sulfates and chlorides of sodium, potassium, and magnesium and the carbonates of sodium and potassium, which are present in some soils of arid and semiarid regions in sufficient quantities to be detrimental to ordinary agriculture.

Alkaline soil: A soil that has a pH value greater than 7.0, particularly above 7.3, throughout most or all of the root zone, although the term is commonly applied to only the surface layer or horizon of a soil.

Annual plant: A plant that completes its life cycle and dies in one year or less.

Arboretum: A collection of plants, trees, and shrubs grown for public exhibition; for public enjoyment, recreation, education, or research.

Arid: Regions or climates that lack sufficient moisture for crop production without irrigation. The limits of precipitation vary considerably according to temperature conditions, with an upper annual limit for cool regions of 10 inches or less and for tropical regions as much as 15 to 20 inches.

Automated system (irrigation): An irrigation system using timers or self-propulsion to reduce labor requirements in the application of irrigation water.

Available nutrient: That portion of any element or compound in the soil that readily can be absorbed and assimilated by growing plants.

Available water: The portion of water in a soil that can be absorbed by plant roots; usually that water held in the soil against a soil water pressure of up to approximately 15 bars.

Available water capacity (soils): The capacity to store water available for use by plants, usually expressed in linear depths of water per unit depth of soil; the difference between the percentage of soil water at field capacity and the percentage at wilting point. This difference multiplied by the bulk density and divided by 100 gives a value in surface inches of water per inch depth of soil.

B

Berm: A shelf or flat area that breaks the continuity of a slope.

Biennial plant: A plant that requires 2 years to complete its life cycle.

Broadcast seeding: Scattering seed on the surface of the soil, in contrast to drill seeding, in which seeds are placed in rows in the soil.

Bunchgrass: A grass that does not have rhizomes or stolons and forms a bunch or tuft.

C

Canopy: The cover of leaves and branches formed by the tops or crowns of plants as viewed from above the cover.

Channel: A natural stream that conveys water; a ditch or channel excavated for the flow of water.

Clay (soils): 1. A mineral soil separate consisting of particles less than 0.002 millimeter in equivalent diameter. 2. A soil textural class. 3. (engineering) A fine-grained soil that has a high plasticity index in relation to the liquid limits.

Climate: The sum total of all atmospheric or meteorological influences, principally temperature, moisture, wind, pressure, and evaporation, which combine to characterize a region and give it individuality by influencing the nature of its land forms, soils, vegetation, and land use. See weather.

Clone: A group of organisms derived by asexual reproduction from a single parent. Such organisms are therefore of the same genetic constitution.

Coarse texture: The soil texture exhibited by sands, loamy sands, and sandy loams, except very fine sandy loam; a soil containing large quantities of these textural classes (U.S. usage). See sand, moderately coarse texture, soil texture.

Cobblestone: Rounded or sub-rounded coarse fragments from 3 to 10 inches in diameter.

Cohesion: Holding together; force holding a solid or liquid together, owing to attraction between like molecules; decreases with rise in temperature.

Compaction: 1. To unite firmly; the act or process of becoming compact. 2. In geology, the changing of loose sediment into hard, firm rock. 3. In soil engineering, the process by which the soil grains are rearranged to decrease void space and bring them into closer contact with one another, thereby increasing the weight of solid material per cubic foot.

Compost: Organic residues or a mixture of organic residues and soil that have been piled and allowed to undergo biological decomposition, until relatively stable.

Composting: A controlled process of degrading organic matter by microorganisms. Techniques include:

Mechanical: A method in which the compost is continuously and mechanically mixed and aerated.

Ventilated cell: The compost is mixed and aerated by being dropped through a vertical series of ventilated cells.

Windrow: An open-air method in which compostable material is placed in windrows, piles or ventilated bins or pits and is occasionally turned or mixed. The process may be anaerobic or aerobic.

Conifer: A tree belonging to the order *Coniferae* with cones and evergreen leaves of needle shape or "scalelike". The tree is harvested to produce wood known commercially as "softwood".

Conservation: The protection, improvement, and use of natural resources according to principles that will assure their highest economic or social benefits.

Conservation district: A public organization created under state enabling law as a special-purpose district to develop and carry out a program of soil, water, and related resource conservation, use and development within its boundaries; usually a subdivision of state government with a local governing body. Often called a soil conservation district or a soil and water conservation district.

Consistence (soil): 1. The resistance of a material to deformation or rupture. 2. The degree of cohesion or adhesion of the soil mass. Terms used for describing consistence of soil materials at various soil moisture contents and degrees of cementation are:

Wet soil: nonsticky, slightly sticky, sticky, very sticky, nonplastic, slightly plastic, plastic, and very plastic.

Moist soil: loose, very friable, friable, firm, very firm, and extremely firm.

Dry soil: loose, soft, slightly hard, hard, very hard, and extremely hard.

Cementation: weakly cemented, strongly cemented, and indurated.

Contour: 1. An imaginary line on the surface of the earth connecting points of the same elevation. 2. A line drawn on a map connecting points of the same elevation.

Contour furrows: Furrows plowed approximately on the contour on pasture and rangeland to prevent runoff and increase infiltration. Also, furrows laid out approximately on the contour for irrigation purposes.

Convection: The transfer of heat through a gas or solution because of molecular movement.

Cool-season plant: A plant that makes its major growth during the cool portion of the year, primarily in the spring but in some localities in the winter.

Cover crop: A close-growing crop grown primarily for the purpose of protecting and improving soil between periods of regular crop production or between trees and vines in orchards and vineyards.

Crop rotation: The growing of different crops in recurring succession on the same land.

Cutback irrigation: Water applied at a faster rate at the beginning of the irrigation period and then reduced or cutback to a lesser rate, usually one-half the initial rate or that amount to balance with the intake rate.

D

Deciduous plant: A plant that sheds all its leaves every year at a certain season.

Deep percolation: Water that percolates below the root zone and cannot be used by plants.

Degradation: To wear down by erosion, especially through stream action.

Depth, effective soil: The depth of soil material that plant roots can penetrate readily to obtain water and plant nutrients; the depth to a layer that differs sufficiently from the overlying material in physical or chemical properties to prevent or seriously retard the growth of roots.

Desalinization: 1. Removal of salts from saline soils, usually by leaching. 2. The conversion of salt water to sweet water. Also spelled desalination.

Dormancy: The condition of a plant or seed in which life functions are virtually at a standstill.

Drainage: 1. The removal of excess surface water or groundwater from land by means of surface or subsurface drains. 2. Soil characteristics that affect natural drainage.

Drainage, soil: As a natural condition of the soil, soil drainage refers to the frequency and duration of periods when the soil is free of saturation; for example, in well-drained soils the water is removed readily but not rapidly; in poorly drained soils the root zone is waterlogged for long periods unless artificially drained, and the roots of ordinary crop plants cannot get enough oxygen; in excessively drained soils the water is removed so completely that most crop plants suffer from lack of water. Strictly speaking, excessively drained soils are a result of excessive runoff due to steep slopes or low available waterholding capacity due to small amounts of silt and clay in the soil material.

Drill seeding: Planting seed with a drill in relatively narrow rows, generally less than a foot apart. See broadcast seeding.

Drop structure: A structure for dropping water to a lower level and dissipating its surplus energy; a fall. A drop may be vertical or inclined.

Dust mulch: A loose, finely granular or powdery condition on the surface of the soil, usually produced by shallow cultivation when the soil is dry.

E

Ecology: The study of interrelationships or organisms to one another and to their environment.

Effective precipitation: That portion of total precipitation that becomes available for plant growth. It does not include precipitation lost to deep percolation below the root zone or to surface runoff.

Elasticity of demand: The rate at which the demand for a good changes with a change in price; the slope of the demand curve.

Environment: The sum total of all the external conditions that may act upon an organism or community to influence its development or existence.

Erosion: 1. The wearing away of the land surface by running water, wind, ice or other geological agents, including such processes as gravitational creep. 2. Detachment and movement of soil or rock fragments by water, wind, ice or gravity.

Evapotranspiration: The combined loss of water from a given area and during a specific period of time, by evaporation from the soil surface and by transpiration from plants.

Evergreen: Perennial plants that are never entirely without green foliage.

Excessive precipitation: Standard U.S. Weather Bureau term for "rainfall in which the rate of fall is greater than certain adopted limits, chosen with regard to the normal precipitation (excluding snow) of a given place or area." Not the same as excess rainfall.

Excess rainfall: Direct runoff at the place where it originates.

Exotic: An organism or species that is not native to the region in which it is found.

Exposure: Direction of slope with respect to points of a compass.

F

Fallow: Allowing cropland to lie idle, either tilled or untilled, during the whole or greater portion of the growing season.

Fertility (soil): The quality of a soil that enables it to provide nutrients in adequate amounts and in proper balances for the growth of specified plants when other growth factors, such as light, moisture, temperature, and the physical condition of the soil, are favorable.

Fertilizer: Any organic or inorganic material of natural or synthetic origin that is added to a soil to supply elements essential to plant growth.

Fertilizer analysis: The percentage composition of fertilizer, expressed in terms of nitrogen, phosphoric acid, and potash. For example, a fertilizer with a 6-12-6 analysis contains 6 percent nitrogen (N), 12 percent available phosphoric acid (P_2O_5), and 6 percent watersoluble potash (K_2O). Minor elements may also be included. Recent analysis expresses the percentages in terms of the elemental fertilizer (nitrogen, phosphorus, potassium).

Fine texture: Consisting of or containing large quantities of the fine fractions, particularly silt and clay. Includes sandy clay, silty clay, and clay textural classes. See soil texture.

Firm: The consistence of a moist soil that offers distinctly noticeable resistance to crushing but can be crushed with moderate pressure between the thumb and forefinger. See consistence.

Flood irrigation: The application of irrigation water where the entire surface of the soil is covered by a sheet of water, called "controlled flooding" when water is impounded or the flow directed by border dikes, ridges or ditches.

Furrow irrigation: A partial surface flooding method of irrigation normally used with clean-tilled crops where water is applied in furrows or rows of sufficient capacity to contain the designed irrigation stream.

G

Germination: The initiation of growth by the embryo and development of a young plant from seed.

Grade: 1. The slope of a road, channel, or natural ground. 2. The finished surface of a canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared for the support of construction like paving or laying a conduit. 3. To finish the surface of a canal bed, roadbed, top of embankment, or bottom of excavation.

Grass: A member of the botanical family *Gramineae*, characterized by bladelike leaves arranged on the culm or stem in two ranks.

Greenbelt: A strip of land kept in its natural or relatively undeveloped state or in agricultural use and which serves to break up the continuous pattern of urban development, frequently planned around the periphery of urban settlements.

Greenhouse effect: The absorption of light wave energy by the earth's surface and its release as heat into the air. Thus, a passage of light occurs but the heat mass is retained like glass does in a greenhouse.

Green manure crop: Any crop grown for the purpose of being turned under while green or soon after maturity for soil improvement.

Ground cover: Grasses or other plants grown to keep soil from being blown or washed away.

Groundwater: Phreatic water or subsurface water in the zone of saturation.

Growing season: The period and/or number of days between the last freeze in the spring and the first frost in the fall for the freeze threshold temperature of the crop or other designated temperature threshold.

H

Herb: Any flowering plant except those developing persistent woody bases and stems above ground.

Housing Code: Regulations adopted by state or local government, applicable to both new and existing housing, establishing minimum standards for sanitary facilities, light and ventilation, screening, minimum size of bedrooms, maximum number of occupants in relation to total floor area, heating facilities, and other requirements considered necessary for decent, safe, and sanitary housing conditions.

Humid: Regions or climates where moisture, when distributed normally throughout the year, should not be a limiting factor in the production of most crops. The lower limit of precipitation under cool climates may be as little as 20 inches annually. In hot climates it may be as much as 60 inches. Natural vegetation is generally forest.

Humus: That more or less stable fraction of the soil organic matter remaining after the major portion or added plant and animal residues have decomposed, usually amorphous and dark colored. See soil organic matter, soil horizons.

Hydrologic cycle: The circuit of water movement from the atmosphere to the earth and return to the atmosphere through various stages or processes as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.

Hydroseeding: Dissemination of seed, hydraulically in a water medium. Mulch, lime, and fertilizer can be incorporated into the sprayed mixture.

I

Impervious soil: A soil through which water, air, or roots cannot penetrate. No soil is impervious to water and air all the time.

Irrigation: Application of water to lands for agricultural purposes. Different systems include:

Center-pivot: Automated sprinkler irrigation achieved by automatically rotating the sprinkler pipe or boom, supplying water to the sprinkler heads or nozzles, as a radius from the center of the field to be irrigated. Water is delivered to the center or pivot point of the system. The pipe is supported above the crop by towers at fixed spacings and propelled by pneumatic, mechanical, hydraulic, or electric power on wheels or skids in fixed circular paths at uniform angular speeds. Water is applied at a uniform rate by progressive increase of nozzle size from the pivot to the end of the line. The depth of water applied is determined by the rate of travel of the system. Single units are ordinarily about 1,250 to 1,300 feet long and irrigate approximately a 130-acre circular area.

Drip: A planned irrigation system where all necessary facilities have been installed for the efficient application of water directly to the root zone of plants by means of applicators (orrices, emitters, porous tubing, perforated pipe, etc.) operated under low pressure. The applicators may be placed on or below the surface of the ground.

Sprinkler: A planned irrigation system where all necessary facilities have been installed for the efficient application of water for irrigation by means of perforated pipe or nozzles operated under pressure.

Irrigation water management: The use and management of irrigation water where the quantity of water used for each irrigation is determined by the waterholding capacity of the soil and the need of the crop, and where the water is applied at a rate and in such a manner that the crop can use it efficiently and significant erosion does not occur.

L

Landscape: All the natural features, such as fields, hills, forests, and water that distinguish one part of the earth's surface from another part; usually that portion of land or territory which the eye can comprehend in a single view, including all of its natural characteristics.

Land use plan: The key element of a comprehensive plan; describes the recommended location and intensity of development for public and private land uses such as residential, commercial, industrial, recreational, and agricultural.

Leaching: The removal from the soil in solution of the more soluble materials by percolating waters.

Liquid fertilizers: A fluid in which the plant nutrients are in true solution.

Loam: A soil textural class. See soil texture.

Loamy: Intermediate in texture and properties between fine-textured and coarse-textured soils; includes all textural classes with the words "loamy" or "loam" as a part of the class name, such as clay loam or loamy sand. See soil texture.

Lysimeter: A device to measure the quantity or rate of water movement through or from a block of soil, usually undisturbed and in situ, or to collect such percolated water for quality analysis.

M

Manure: The excreta of animals, with or without the admixture of bedding or litter, in varying stages of decomposition.

Medium texture: Intermediate between fine- and coarse-textured soils, containing moderate amounts of sand, silt, and clay. Includes the following textural classes: very fine sandy loam, loam, silt loam, and silt. See soil textures.

Mellow soil: A very soft, very friable, porous soil without any tendency toward hardness or harshness.

Microclimate: 1. The climatic condition of a small area resulting from the modification of the general climatic conditions by local differences in elevation or exposure. 2. The sequence of atmospheric changes within a very small region.

Moderately coarse texture: Intermediate between coarse and medium texture and consisting predominantly of coarse particles. In soil textural classification it includes all the sandy loams except the very fine sandy loam. See coarse texture.

Moderately fine texture: Intermediate between fine and medium texture and consisting predominantly of intermediate-size (soil) particles or relatively small amounts of fine or coarse particles. In soil textural classification it includes clay loam, sandy clay loam, and silty clay loam. See fine texture.

Monoculture: Raising crops of a single species, generally even-aged.

Mulch: A natural or artificial layer of plant residue or other materials, such as sand or paper, on the soil surface.

Mulch tillage: Soil tillage that employs plant residues or other materials to cover the ground surface.

N

Native species: A species that is a part of an area's original fauna or flora.

Naturalized plant: A plant introduced from other areas which has become established in and more or less adapted to a given region by long-continued growth there.

Natural revegetation: Natural re-establishment of plants; propagation of new plants over an area by natural processes.

Neutral soil: A soil in which the surface layer, at least to normal plow depth, is neither acid nor alkaline in reaction. For most practical purposes, soil with a pH ranging from 6.6 through 7.3. See acid soil; alkaline soil; pH; reaction, soil.

Niche: A habitat that supplies the factors necessary for the existence of an organism or species.

Nonpoint pollution: Pollution whose sources cannot be pinpointed; can best be controlled by proper soil, water, and land management practices.

Normal: A mean or average value established from a series of observations for purposes of comparison, for example, normal precipitation, normal temperature, normal flow.

Nursery: A place where plants, such as trees, shrubs, vines, and grasses, are propagated for transplanting or for use as stocks for grafting; a planting of young trees or other plants, the young plants being called nursery stock or planting stock.

Nutrients: 1. Elements, or compounds, essential as raw materials for organism growth and development, such as carbon, oxygen, nitrogen, phosphorus, etc. 2. The dissolved solids and gases of the water of an area.

O

Open space: A relatively undeveloped green or wooded area provided usually within an urban development to minimize feelings of congested living.

Organic fertilizer: By-product from the processing of animals or vegetable substances that contain sufficient plant nutrients to be of value as fertilizers.

Organic gardening: A system of farming or home gardening that utilizes organic wastes and composts to the exclusion of chemical fertilizers.

Organic soil: A soil that contains a high percentage (greater than 20 or 30 percent) of organic matter throughout the solum.

Organic soil materials (as used in the Soil Classification System of the National Cooperative Soil Survey in the United States): 1. Saturated with water for prolonged periods unless artificially drained and having more than 30 percent organic matter if the mineral fraction is more than 50 percent clay, or more than 20 percent organic matter if the mineral fraction has no clay. 2. Never saturated with water for more than a few days and having more than 34 percent organic matter.

P

Park: An area dedicated to recreation use and generally characterized by its natural, historic, and landscape features. It is used for both passive and active forms of recreation and may be designed to serve the residents of a neighborhood, community, county, state, region or nation.

Peat: Unconsolidated soil material consisting largely of undecomposed or only slightly decomposed organic matter accumulated under conditions of excessive moisture. See organic soil materials.

Peat soil: 1. An organic soil in which the organic matter is not yet decomposed or is slightly decomposed (U.S. usage). 2. An organic soil containing more than 50 percent organic matter.

Percolation: The downward movement of water through soil, especially the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of the order of 1.0 or less.

Percolation test: A measurement of the percolation of water in soil to determine the suitability of different soils for development including private sewage systems such as septic tanks and drain-fields.

Perennial plant: A plant that normally lives 3 or more years.

Permeability: Capacity for transmitting a fluid. It is measured by the rate at which a fluid of standard viscosity can move through material in a given interval of time under a given hydraulic gradient.

Permeability, soil: The quality of a soil horizon that enables water or air to move through it. The permeability of a soil may be limited by the presence of one nearly impermeable horizon even though the others are permeable.

Pest: A plant, animal, or thing that is troublesome or annoying.

Pesticide: Any chemical agent used for control of specific organisms; such as insecticides, herbicides, fungicides, etc.

pH: A numerical measure of acidity or hydrogen ion activity. Neutral is pH 7.0. All pH values below 7.0 are acid, and all above 7.0 are alkaline.

Phosphate or potash fixation (soils): The process or processes by which these two elements are converted from a soluble or exchangeable form to a much less soluble or nonexchangeable form in a soil.

Plant food: The organic compounds elaborated within the plant to nourish its cells. The term is a frequent synonym for plant nutrients, particularly in the fertilizer trade.

Plant nutrients: The elements or groups of elements taken in by a plant which are essential to its growth and used in elaboration of its food and tissues; includes nutrients obtained from fertilizer ingredients.

Plat: A plan or map showing land lines or subdivisions usually with few, if any, other features.

Poorly graded soil (engineering): A soil material consisting mainly of particles nearly the same size. Because there is little difference in size of the particles in poorly graded soil material, density usually can be increased only slightly by compaction.

Prairie: A tract of level to hilly land that has a dominance of grasses and forbs, has a scarcity of shrubs, and is treeless. The natural plant community consists of various mixtures of tall, mid, and short growing species, also known as true prairie, mixed prairie, and shortgrass prairie, respectively.

Precipitation: A general term for all forms of falling moisture, including rain, snow, hail, sleet.

Probable maximum precipitation: An estimate of the physical upper limit to the amount of precipitation that can fall over a specific area in a given time. Abbr. PMP.

Productivity: The rate at which organic matter is stored in any organism.

Pulverization: The crushing or grinding of material into small pieces.

Pure live seed: The product of the percentage of germination plus the hard seed and the percentage of pure seed, divided by 100.

R

Rainfall excess (hydraulics): The volume of rainfall that will result in runoff.

Reaction, soil: The degree of acidity or alkalinity of a soil, usually expressed as a pH value. Descriptive terms commonly associated with certain ranges in pH are extremely acid, less than 4.5; very strongly acid, 4.5-5.0; strongly acid, 5.1-5.5; medium acid, 5.6-6.0; slightly acid, 6.1-6.5; neutral, 6.6-7.3; mildly alkaline, 7.4-7.8; moderately alkaline, 7.9-8.4; strongly alkaline, 8.5-9.0; and very strongly alkaline, more than 9.0.

Reclamation: The process of reconverting disturbed lands to their former uses or other productive uses.

Reservoir: Impounded body of water or controlled lake in which water is collected or stored.

Retention: The amount of precipitation on a drainage area that does not escape as runoff. It is the difference between total precipitation and total runoff.

Return flow: That portion of the water diverted from a stream that finds its way back to the stream channel either as surface or underground flow.

Reuse: The reintroduction of a commodity into the economic stream without any change.

Riparian rights: The rights of an owner whose land abuts water. They differ from state to state and often depend on whether the water is a river, lake, or ocean. See water rights.

Riprap: Broken rock, cobbles, or boulders placed on earth surfaces, such as the face of a dam or the bank of a stream, for protection against the action of water (waves); also applied to brush or pole mattresses, or brush and stone, or other similar materials used for soil erosion control.

Root zone: The part of the soil that is penetrated or can be penetrated by plant roots.

Run: The distance of gravity flow from the point of release to the end of the area to be watered.

Runoff (hydraulics): That portion of the precipitation on a drainage area that is discharged from the area in stream channels. Types include surface runoff, groundwater runoff, or seepage.

S

Saline soil: A nonsodic soil containing sufficient soluble salts to impair its productivity but not containing excessive exchangeable sodium. This name was formerly applied to any soil containing sufficient soluble salts to interfere with plant growth, commonly greater than 3,000 parts per million.

Sample plot: An area of land, usually small, used for measuring or observing performance under existing or applied treatments. It may be temporary or permanent.

Sand: 1. A soil particle between 0.05 and 2.0 millimeters in diameter. 2. Any one of five soil separates; very coarse sand, coarse sand, medium sand, fine sand, and very fine sand. 3. A soil textural class. See soil texture.

Saturate: 1. To fill all the voids between soil particles with liquid. 2. To form the most concentrated solution possible under a given set of physical conditions in the presence of an excess of the substance.

Saturation point: 1. In soils, that point at which a soil or an aquifer will no longer absorb any amount of water without losing an equal amount. 2. In wildlife, the maximum density under which a species will normally live.

Savanna: A grassland with scattered trees, either as individuals or clumps; often a transitional type between true grassland and forest; also savannah.

Screening: The use of any vegetative planting, fencing, ornamental wall of masonry, or other architectural treatment, earthen embankment, or a combination of any of these which will effectively hide from view any undesirable areas from the main traveled way.

Sediment: Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface either above or below sea level.

Seed: The fertilized and ripened ovule of a seed plant that is capable, under suitable conditions, of independently developing into a plant similar to the one that produced it. Types of seed include:

Breeder seed: Seed or vegetative propagating material directly controlled by the originating, or in some cases the sponsoring plant breeder, institution, or firm, and which supplies the initial and recurring increase of foundation seed.

Certified seed: The progeny of foundation or registered seed that is so handled as to maintain satisfactory genetic identity and purity and that has been approved and certified by the certifying agency.

Commercial seed: A term used to designate other than recognized varieties of seed in commercial channels.

Common seed: Non-certified seed. It may be a named variety, but not grown under the certification program.

Dormant seed: An internal condition of the chemistry or stage of development of a viable seed that prevents its germination, although good growing temperatures and moisture are provided.

Firm seed: Dormant seeds, other than hard seeds, that neither germinate nor decay during the prescribed test period under the prescribed conditions. Firm ungerminated seeds may be alive or dead.

Foundation seed: Seed stocks that are so handled as to most nearly maintain specific genetic identity and purity. Production must be carefully supervised by the originating agency and approved by the certifying agency and/or the agricultural experiment station.

Hard seed: A physiological condition of seed in which some seeds do not absorb water or oxygen and germinate when a favorable environment is provided.

Registered seed: The program of foundation seed that is so handled as to maintain satisfactory genetic identity and purity and that has been approved and certified by the certifying agency. This class of seed should be of a quality suitable for production of certified seed.

Seedbed: The soil prepared by natural or artificial means to promote the germination of seed and the growth of seedlings.

Seeding, direct (forestry): A method of establishing a stand of trees artificially by sowing seed. In broadcast seeding, seed is sown over the entire area. Partial seeding may be done in strips, furrow rows, trenches, or in seed spots.

Seepage: 1. Water escaping through or emerging from the ground along an extensive line or surface as contrasted with a spring where the water emerges from a localized spot. 2. (percolation) The slow movement of gravitational water through the soil.

Self-mulching soil: A soil in which the surface layer becomes so well aggregated that it does not crust and seal under the impact of rain but instead serves as a surface mulch upon drying.

Self-pruning: The natural death and fall of branches from live trees due to causes such as light and food deficiencies, decay, insect attack, snow, and ice; also called natural pruning.

Semi-arid: A term applied to regions or climates where moisture is normally greater than under arid conditions but still definitely limits the growth of most crops. Dryland farming methods or irrigation generally are required for crop production. The upper limit of average annual precipitation in the cool semi-arid regions is as low as 15 inches, whereas in tropical regions it is as high as 45 or 50 inches. See arid.

Shrub: A woody perennial plant differing from a tree by its low stature and by generally producing several basal shoots instead of a single bole.

Silt: 1. A soil separate consisting of particles between 0.05 and 0.002 millimeter in equivalent diameter. 2. A soil textural class. See soil texture.

Silt loam: A soil textural class containing a large amount of silt and small quantities of sand and clay.

Silty clay: A soil textural class containing a relatively large amount of silt and clay and a small amount of sand. See soil texture.

Silty clay loam: A soil textural class containing a relatively large amount of silt, a lesser quantity of clay, and a still smaller quantity of sand. See soil texture.

Site (ecology): 1. An area considered for its ecological factors with reference to capacity to produce vegetation; the combination of biotic, climatic, and soil conditions of an area. 2. An area sufficiently uniform in soil, climate, and natural biotic conditions to produce a particular climax vegetation.

Slope: The degree of deviation of a surface from horizontal, measured in a numerical ratio, percent, or degrees. Expressed as a ratio or percentage, the first number is the vertical distance (rise) and the second is the horizontal distance (run), as 2:1 or 200 percent. Expressed in degrees, it is the angle of the slope from the horizontal plane with a 90° slope being vertical (maximum) and 45° being a 1:1 slope.

Sod grasses: Stoloniferous or rhizomatous grasses that form a sod or turf.

Soil: 1. The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. 2. The unconsolidated mineral matter on the surface of the earth that has been subjected to and influenced by genetic and environmental factors of parent material, climate (including moisture and temperature effects), macro- and micro-organisms, and topography, all acting over a period of time and producing a product--soil--that differs from the material from which it is derived in many physical, chemical, biological, and morphological properties and characteristics. 3. A kind of soil is the collection of soils that are alike in specified combinations of characteristics. Kinds of soil are given names in the system of soil classification. The terms "the soil" and "soil" are collective terms used for all soils, equivalent to the word "vegetation" for all plants.

Soil amendment: Any material, such as lime, gypsum, sawdust, or synthetic conditioner, that is worked into the soil to make it more amenable to plant growth.

Soil association: 1. A group of defined and named taxonomic soil units occurring together in an individual and characteristic pattern over a geographic region, comparable to plant associations in many ways. Sometimes called "natural land type." 2. A mapping unit used on reconnaissance or generalized soil maps in which two or more defined taxonomic units occurring together in a characteristic pattern are combined because the scale of the map or the purpose for which it is being made does not require delineation of the individual soils.

Soil auger: A tool for boring into the soil and withdrawing a small sample for field or laboratory observation. Soil augers may be classified as (1) those with worm-type bits, unenclosed, or (2) those with worm-type bits enclosed in a hollow cylinder.

Soil classification: The systematic arrangement of soils into groups or categories on the basis of their characteristics. Broad groupings are made on the basis of general characteristics; subdivisions on the basis of more detailed differences in specific properties. The categories of the system used in the U.S. since 1966 are discussed below:

Order: The category at the highest level of generalization in the soil classification system. The properties selected to distinguish the orders are reflections of the degree of horizon development and the kinds of horizons present.

Suborder: This category narrows the ranges in soil moisture and temperature regimes, kinds of horizons, and composition, according to which of these is most important. Moisture and/or temperature or soil properties associated with them are used to define the suborders of the orders Alfisols, Mollisols, Oxisols, Ultisols, and Vertisols. Kinds of horizons are used for the order Aridisols, composition for the orders Histosols and Spodosols, and combinations for the orders Entisols and Inceptisols.

Great group: The classes in this category contain soils that have the same kind of horizons in the same sequence and have similar moisture and temperature regimes. Exceptions to the horizon sequences are made for horizons near the surface that may get mixed or lost by erosion if plowed.

Subgroup: The great groups are subdivided into subgroups that show the central properties of the great group, intergrade subgroups that show properties of more than one great group, and other subgroups for soils with atypical properties that are not characteristic of any great group.

Family: Families are defined largely on the basis of physical and mineralogic properties of importance to plant growth.

Series: The soil series is a group of soils having horizons similar in differentiating characteristics and arrangement in the soil profile, except for texture of the surface portion, or if genetic horizons are thin or absent, a group of soils that, within defined depth limits, is uniform in all soil characteristics diagnostic for series.

Soil conditioner: Any material added to a soil for the purpose of improving its physical condition.

Soil conservation: Using the soil within the limits of its physical characteristics and protecting it from unalterable limitations of climate and topography.

Soil erosion: The detachment and movement of soil from the land surface by wind or water. See erosion.

Soil fertility: The quality of a soil that enables it to provide nutrients in adequate amounts and in proper balance for the growth of specified plants, when other growth factors, such as light, moisture, temperature, and physical condition of soil, are favorable.

Soil horizon: A layer of soil or soil material approximately parallel to the land surface and differing from adjacent genetically related layers in physical, chemical, and biological properties or characteristics, such as color, structure, texture, consistence, kinds and numbers of organisms present, degree of acidity or alkalinity, etc.

Soil improvement: The processes for, or the results of, making the soil more productive for growing plants by drainage, irrigation, addition of fertilizers and soil amendments, and other methods.

Soil management: The sum total of all tillage operations, cropping practices, fertilizer, lime, and other treatments conducted on, or applied to, a soil for the production of plants.

Soil organic matter: The organic fraction of the soil that includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population. Commonly determined as the amount of organic material contained in a soil sample passed through a 2-millimeter sieve.

Soil probe: A tool having a hollow cylinder with a cutting edge at the lower end, used for probing into the soil and withdrawing a small sample for field or laboratory observation.

Soil productivity: The capacity of a soil in its normal environment for producing a specified plant or sequence of plants under a specified system of management.

Soil profile: a vertical section of the soil from the surface through all its horizons. See soil horizons.

Soil survey: A general term for the systematic examination of soils in the field and in laboratories; their description and classification; the mapping of kinds of soil; the interpretation of soils according to their adaptability for various crops, grasses, and trees; their behavior under use or treatment for plant production or for other purposes; and their productivity under different management systems.

Soil survey field sheet: An aerial photograph on which information relating to soils and other characteristics of the land surface are delineated or portrayed.

Soil texture: The relative proportions of the various soil separates in a soil. 1. The textural classes may be modified by the addition of suitable adjectives when coarse fragments are present in substantial amounts, for example, gravelly silt loam. Sand, loamy sand, and sandy loam are further subdivided on the basis of the proportions of the various sand separates present. The limits of the various classes and subclasses are:

Sand: Soil material that contains 85 percent or more of sand. The percentage of silt plus 1.5 times the percentage of clay shall not exceed 15.

Coarse sand: 25 percent or more very coarse sand and less than 50 percent any other one grade of sand.

Sand: 25 percent or more very coarse, coarse, and medium sand and less than 50 percent fine or very fine sand.

Fine sand: 50 percent or more fine sand, or less than 25 percent very coarse, more fine sand, or less than 25 percent very coarse, fine sand.

Very fine sand: 50 percent or more very fine sand.

Loamy sand: Soil material that contains, at the upper limit, 85 to 90 percent sand, and the percentage of silt plus 1.5 times the percentage of clay is not less than 15. At the lower limit, it contains not less than 70 to 85 percent sand, and the percentage of silt plus twice the percentage of clay does not exceed 30.

Loamy coarse sand: 25 percent or more very coarse and coarse sand and less than 50 percent any other one grade of sand.

Loamy sand: 25 percent or more very coarse, coarse and medium sand and less than 50 percent fine or very fine sand.

Loamy fine sand: 50 percent or more fine sand, or less than 25 percent very coarse, coarse, and medium sand and 50 percent very fine sand.

Loamy very fine sand: 50 percent or more very fine sand.

Sandy loam: Soil material that contains either 20 percent or less clay, and the percentage of silt plus twice the percentage of clay exceeds 30, and 52 percent or more sand; or less than 7 percent clay, less than 50 percent silt, and between 43 and 52 percent sand.

Coarse sandy loam: 25 percent or more very coarse and coarse sand and less than 50 percent any other one grade of sand.

Sandy loam: 30 percent or more very coarse, coarse, and medium sand but less than 25 percent very coarse sand and less than 30 percent very fine or fine sand.

Fine sandy loam: 30 percent or more fine sand and less than 30 percent very fine sand, or between 15 and 30 percent very coarse, and medium sand.

Very fine sandy loam: 30 percent or more very fine sand, or more than 40 percent fine and very fine sand, at least half of which is very fine sand and less than 15 percent very coarse, coarse, and medium sand.

Loam: Soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Silt loam: Soil material that contains 50 percent or more silt and 12 to 27 percent clay, or 50 to 80 percent silt and less than 12 percent clay.

Silt: Soil material that contains 80 percent or more silt and less than 12 percent clay.

Sandy clay loam: Soil material that contains 20 to 35 percent clay, less than 28 percent silt, and 45 percent or more sand.

Clay loam: Soil material that contains 27 to 40 percent clay and 20 to 45 percent sand.

Silty clay loam: Soil material that contains 27 to 40 percent clay and less than 20 percent sand.

Sandy clay: Soil material that contains 35 percent or more clay and 45 percent or more sand.

Silty clay: Soil material that contains 40 percent or more clay and 40 percent or more silt.

Clay: Soil material that contains 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Sprinkler irrigation: Irrigation system in which water is applied by means of perforated pipes or nozzles operated under pressure so as to form a spray pattern.

Sprinkler pattern: The areal distribution of water applied either by perforated pipe, single sprinkler nozzle, or by the entire sprinkler lateral or laterals.

Stand: 1. An aggregation of trees or other growth occupying a specific area and sufficiently uniform in composition (species), age arrangement, and condition to be distinguishable from the forest or other growth on adjoining areas. 2. The number of plants per unit of area other than trees.

Starter fertilizer: Liquid or solid fertilizer, placed near or in contact with the seed or the roots of new transplants.

State soil conservation committee, commission, or board: The state agency established by state soil conservation district enabling legislation to assist with the administration of the provisions of the state soil conservation districts law. The official title may vary from the above as new or amended state laws are made.

Sterilization: The destruction, by chemical or physical means, of a microorganism's ability to reproduce; to render something barren.

Storm: In general, a disturbance of the atmosphere. The term may be qualified to emphasize a particular part of the meteorological disturbance, such as windstorm, sandstorm, rainstorm or thunderstorm.

Stripcropping: Growing crops in a systematic arrangement of strips or bands which serve as barriers to wind and water erosion.

Stubble: The basal portion of plants remaining after the top portion has been harvested; also, the portion of the plants, principally grasses, remaining after grazing is completed.

Stubble mulch: The stubble of crops or crop residues left essentially in place on the land as a surface cover during fallow and the growing of a succeeding crop.

Subgrade: The soil prepared and compacted to support a structure or a pavement system.

Subsoil: The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow. Although a common term, it cannot be defined accurately. It has been carried over from early days when "soil" was conceived only as the plowed soil and that under it as the "subsoil."

Summer fallow: The tillage of uncropped land during the summer in order to control weeds and store moisture in the soil for the growth of a later crop.

Surface compaction: Increasing the dry density of surface soil by applying a dynamic load.

Surface irrigation: Irrigation where the soil surface is used as a conduit, as in furrow and border irrigation as opposed to sprinkler irrigation or subirrigation.

Surface soil: The uppermost part of the soil ordinarily moved in tillage or its equivalent in uncultivated soils, ranging in depth from about 5 to 8 inches. Frequently designated as the plow layer, the Ap layer, of the Ap horizon.

Surface water: All water whose surface is exposed to the atmosphere.

Systemic pesticide: A pesticide chemical that is carried to other parts of a plant or animal after it is injected or taken up from the soil or body surface.

T

Taproot system: A plant root system dominated by a single large "taproot," normally growing straight down, from which most or all of the smaller roots spread out laterally.

Tensiometer: Instrument used for measuring the suction or negative pressure of soil water.

Terrace: 1. An embankment or combination of an embankment and channel constructed across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope. Terraces or terrace systems may be classified by their alignment, gradient, outlet and cross-section. Alignment may be parallel or non-parallel. Gradient may be level, uniformly graded, or variable graded. Grade is often incorporated to permit paralleling the terraces. Outlets may be soil infiltration only, vegetated waterways, tile outlets, or combinations thereof. Cross-section may be narrow base, broad base, bench, steep backslope, flat channel, or channel. 2. A level, usually narrow plain bordering a river, lake, or sea. Rivers sometimes are bordered by terraces at different levels.

Terrace interval: The distance, measured either vertically or horizontally, between corresponding points on two adjacent terraces.

Terrace outlet channel: Channel, usually having a vegetative cover, into which the flow from one or more terraces is discharged and conveyed from the field.

Tillage: The operation of implements through the soil to prepare seedbeds and root beds.

Tilth: The physical condition of soil as related to its ease of tillage, fitness as a seedbed, and impedance to seedling emergence and root penetration.

Topography: The relative positions and elevations of the natural or manmade features of an area that describe the configuration of its surface.

Topsoil: 1. Earthy material used as top-dressing for house lots, grounds for large buildings, gardens, road cuts, or similar areas. It has favorable characteristics for production of desired kinds of vegetation or can be made favorable. 2. The surface plow layer of a soil; also called surface soil. 3. The original or present dark-colored upper soil that ranges from a mere fraction of an inch to two or three feet thick on different kinds of soil. 4. The original or present A horizon, varying widely among different kinds of soil. Applied to soils in the field, the term has no precise meaning unless defined as to depth or productivity in relation to a specific kind of soil.

Transpiration: The photosynthetic and physiological process by which plants release water into the air in the form of water vapor.

Transplant (forestry): A seeding that has been transplanted one or more times in the nursery.

Tree: A woody perennial plant that reaches a mature height of at least 8 feet and has a well-defined stem and a definite crown shape. There is no clear-cut distinction between trees and shrubs. Some plants, such as the willows, may grow as either trees or shrubs.

U

Underplant: To plant young trees or sow seeds under an existing stand of trees.

Urban area: An area whose character is urban in nature; towns of over 2,500 are defined as urban by the U.S. Bureau of Census.

Urban runoff: Storm water from city streets and gutters that usually contains a great deal of litter and organic and bacterial wastes.

V

Vegetation: Plants in general or the sum total of plant life in an area.

Vegetation type: A plant community with distinguishable characteristics.

W

Warm-season plant: A plant that completes most of its growth during the warm portion of the year, generally late spring and summer.

Water application efficiency: Ratio of the volume of water stored in the root zone of a soil during irrigation to the volume of water applied.

Water conservation: The physical control, protection, management and use of water resources in such a way as to maintain crop, grazing, and forest lands; vegetal cover; wildlife; and wildlife habitat for maximum sustained benefits to people, agriculture, industry, commerce, and other segments of the national economy.

Water management: application of practices to obtain added benefits from precipitation, water, or water flow in any of a number of areas, such as irrigation, drainage, wildlife and recreation, water supply, watershed management, and water storage in soil for crop production. See irrigation water management.

Water penetration: The depth to which irrigation water or rain penetrates soil before the rate of downward movement becomes negligible.

Water requirement (plant physiology): In a strict sense, the ratio of the number of units of water absorbed by the plant during the growing season to the number of units of dry matter produced by the plant during that time. More generally, the amount of water lost through transpiration during the growing season, since the amount retained in the plant is very small compared to the amount evaporated from it. Water requirements vary with plants, climatic conditions, soil fertility, and soil moisture.

Water resources: The supply of groundwater and surface water in a given area.

Water rights: The legal rights to the use of water. They consist of riparian rights and those acquired by appropriation and prescription. Riparian rights are those rights to use and control water by virtue of ownership of the bank or banks. Appropriated rights are those acquired by an individual to the exclusive use of water, based strictly on priority appropriation and application of the water to beneficial use and without limitation of the place of use to riparian land. Prescribed rights are those to which legal title is acquired by long possession and use without protest of other parties.

Water rights, correlative doctrine: When a source of water does not provide enough for all users, the water is reapportioned proportionately on the basis of prior water rights held by each user.

Water table: The upper surface of groundwater or that level below which the soil is saturated with water; locus of points in soil water at which the hydraulic pressure is equal to atmospheric pressure.

Water use efficiency: Crop production per unit of water used, irrespective of water source, expressed in units of weight per unit of water depth per unit area. This concept of utilization applies to both dryland and irrigated agriculture.

Water year: The 12-month period, October 1 through September 30, designated by the calendar year in which it ends (used with streamflow data and analyses).

Weather: The state of the atmosphere at any given time with regard to precipitation, temperature, humidity, cloudiness, wind movement, and barometric pressure.

Well-graded soil (engineering): A soil consisting of particles that are well distributed over a wide range in size or diameter. Such a soil's density and bearing properties can normally be easily increased by compaction. See poorly graded soil.

Wind erosion: The detachment and transportation of soil by wind.