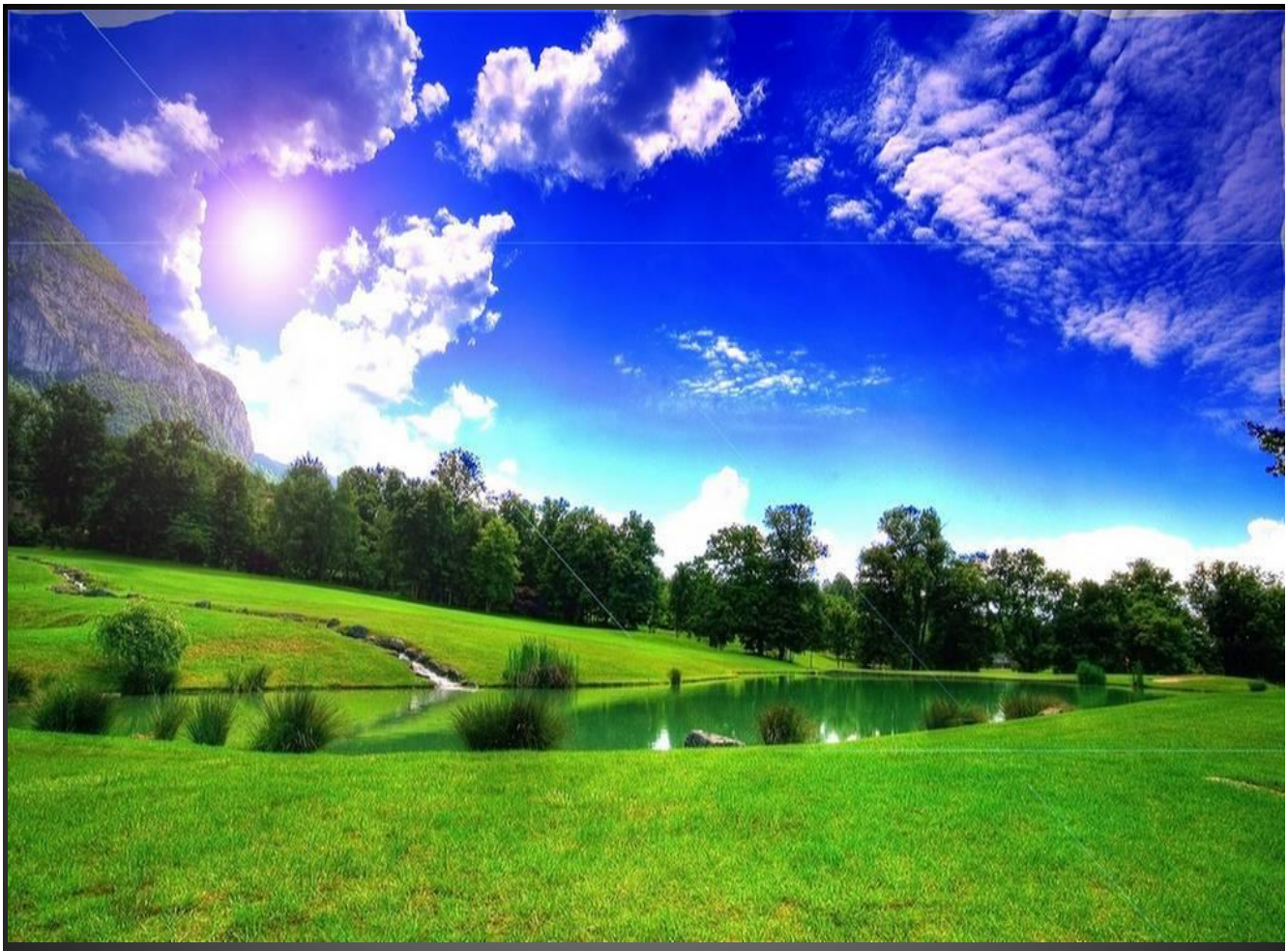

Vegetation in the Site Plan & Landscape Design

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Introduction

Reasons for planting are varied: they may be commercial (timber, biomass [fuel] or food production); the landscape may dictate the need for planting (for example for the amenity of residents, screening either visually, or for wind/noise or to enhance the landscape character); there may be nature conservation reasons for planting such as habitat creation/restoration or to connect existing habitats; it may be a reinstatement of an historic landscape pattern/design or as commemorative planting. Consider existing landscape character and its conservation through the retention of key features, for example water bodies, woodland and hedges.

Planting Layout & Design

Planting consists of many possibilities from habitat creation to ornamental gardens, woodland to avenues of trees, manicured lawns to wildflower meadows. Good planting design depends on a clear understanding of design objectives, plant characteristics, site constraints and management resources. Integration of new development with the existing landscape can best be achieved through planting that respects the local landscape character and the specific site conditions. Look at good examples of plant combinations near your site – which species are present, how they are grouped, and how they relate to site conditions for example poor drainage or local stone outcrops? With new planting, think about:

Screening:

Can the design of the new development be improved so that screening is not necessary? If not, what height screening is required (is a tall hedge sufficient, or is a tree and shrub belt necessary)? Is screening required to be continuous, intermittent, strategic, all year round and would dense screen planting look intrusive? (it may be sufficient simply to break up the outline of a large building/filter views rather than provide dense screening.)

Effect:

Will planting make a new landmark? Will it create or emphasise a vista, seize attention or add colour, texture, form and scent?

Aesthetics:

What design style is appropriate? What form or style is required, and will this be achieved by choice of plant species or by future management? How does the planting relate to the style of the proposed development and to the surrounding landscape context? Formal landscape schemes may demand plants of predictable habit, for example cloned trees of neat form for a formal avenue; whereas if the landscape objective is habitat creation and there is a natural seed bank (for example in a woodland glade) natural regeneration may be more appropriate than planting.

Wildlife interest:

Could the planting design benefit wildlife?

Principles of Landscape Design

The principles of landscape design include the elements of *unity, scale, balance, simplicity, variety, emphasis,* and *sequence* as they apply to *line, form, texture,* and *color*. These elements are interconnected.

Landscape design is a process of developing practical and pleasing outdoor living space.

Unity is the Quality of Oneness.

Unity attracts and holds attention. It organizes view into orderly groups with emphasis. Unity starts with the *story line* developed in the *family analysis*, Step 2, in the design process.

Figures 1 and 2. Unity develops from the story line. Here in Jeff de Jong's garden a story line around "sacred space gardening" creates unity with the feeling of peace and tranquility.

Line Connects and Defines the Space, Creating Outdoor Rooms

Lines are a powerful design element that define rooms and connect people to the landscape. For a professional touch, use sweeping bold lines and curves rather than small zigzags and small wavy curves. Lines develop through Step 3 in the design process, *With Lines, Delineate Softscape and Hardscape Area Creating Outdoor Room*.

Figure 3. Notice the strong use of "line" here in the Japanese Garden at Butchart Gardens, Victoria BC. The path (primary line) invites you into the garden. Secondary lines form the beds.

Figure 4. In this private garden, the "line" formed by the edge of the pond creates an amazing space as the plants reflect in the water. The line defines the space and pulls you into the landscape.

Form Includes the Three-Dimensional Mass.

Form is determined by the line, direction, and arrangement of branches and twigs. The resulting mass influences the scale. For unity, repeat the topography form in plant forms.

- **Horizontal and spreading** forms emphasis the lateral extent and breath of space. They are comfortable because it corresponds with the natural direction of eye movement.

- **Rounded** forms are most common in plant materials. They allow for easy eye movement and create a pleasant undulation that leads itself to plant groupings.

- **Vase-shaped** trees define a comfortable "people space" beneath the canopy.

- **Weeping forms** lead the eye back to the ground. What is below the weeping form often becomes a focal point.

- **Pyramidal** forms direct the eyes upward, so use sparingly. Grouping pyramidals will soften the upward influence. They will look more natural in the surroundings with foliage to the ground.

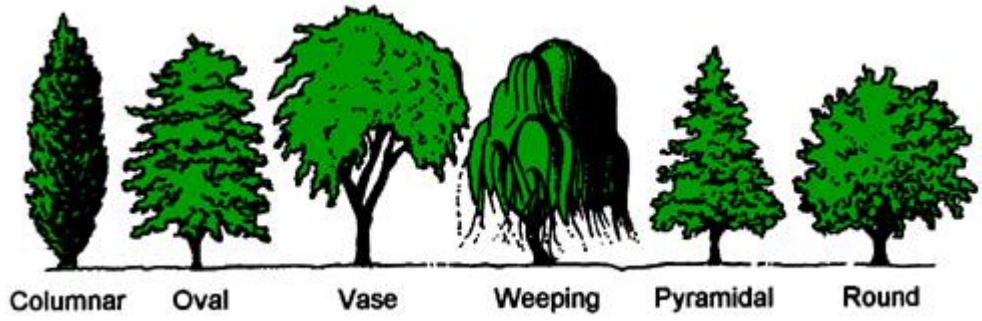


Figure 5. Plant forms.

Texture is Fine/Coarse, Heavy/Light, Thin /Dense, and Light/Shade.

Texture can be defined as the relationship between the foliage and twig size, and the mass of the plants. Close up, texture comes from the size and shape of the leaves, the size of twigs, spacing of leaves and twigs, the colors and shading, the gloss or dullness of leaves. etc. At a distance, texture comes from the entire mass effect of plants and the qualities of light and shadows.

Figure 6. Texture changes with distance. Close-up texture comes from the size and shape of leaves, twigs and branches. At a distance, texture comes from the mass and play of light.

Figure 7. Four season gardening is all about texture gardening. Without the summer color, texture becomes the primary design element.

Figure 8. Texture rules here in the Japanese Garden at Butchart Gardens, Victoria, BC. Notice how the fine texture created by the moss plays with the coarse texture of the tree trunks and lantern. In Japanese gardening, the lantern is a symbol that this is sacred space, leave your cares and worries behind.

Color Gives Greatest Appeal, and Evokes the Greatest Response.

How Does Color Speak to You?

Color is powerful in creating mood and feeling. "Color therapy" is a popular topic in our rapid paced modern world. What moods and feeling do various color create for you? What colors work for the landscape story line? What moods and feeling do you want in the garden? Is it a room for relaxation and healing or a room for action activities?

What do colors say?			
Red	**Yellow**	**Blue**	**Green**
Passion Courage Power Wealth Motivation Fame	Joy Happiness Communications Inspiration Sunshine Optimism	Imagination Calm Serenity Relaxation Compassion Reflection	Harmony Beginnings Prosperity Nature Growth Healing
Orange	**Purple**	**White**	**Pink**
Enthusiasm Joy Exuberance interaction fun Captivation	Intuition Devotion Respect Peace Spirituality Awareness Deity Royalty	Purity Innocence Faith Benevolence Honesty Grace	Love Sweetness Uplifting happiness Tenderness Enticement

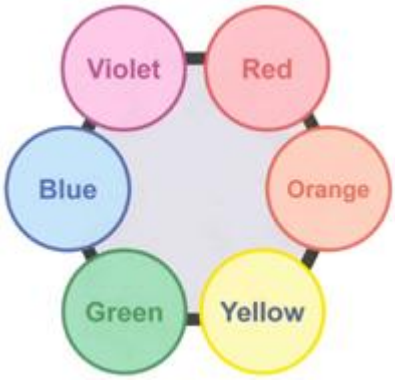


Figure 9. Color is the most powerful of the design elements. Choose colors carefully to create the mood desired in the story line.

What Color Schemes Work for the Design Theme?

Cool Colors green, blue, purple	**Warm Collars** red, yellow, orange
Less conspicuous	Conspicuous
Restful	Cheerful
Recede	Stimulating
Suggest distance	Come forward
Low scale	High Scale

Scale Evokes Emotional Connection and is Closely Related to Color.

- **Absolute scale** relates the comparative value of landscape elements to a fixed structure (house).

Figure 10. In absolute scale, the small trees on the left drawing give the feeling that the house is large. On the right drawing, the large trees give the feeling that the house is small. Both houses are the same size.

- **Relative scale** relates to comparative relative sizes or "values" of objects in the landscape. Relative scale is very emotionally charged and closely linked to color. It may create a feeling of relaxation and peacefulness or one of energy and action.

Figure 11. Relative scale compares the size or "value" of the landscape elements. Perception of tree size is based on the relative size of the person. Being emotionally charged, relative scale can create feelings of action or relaxation.

- **Low scale** is relaxing and calming. It is used in the home landscape to give a feeling of peace and relaxation. [Figure 12]

Figure 12. In this private garden in Steamboat Springs, CO, the low scale creates a relaxing, renewing atmosphere.

- **High scale** promotes action. It is used around large buildings and in large spaces to fill the space. Use of high scale in small spaces makes the space feel smaller. [Figure 13]

Figure 13. Here in the fountain area at Butchart Gardens, scale is high with the brightly colored flowers. The action feeling of high scale helps move people through.

Balance is Equilibrium on Left and Right Sides.

Gardens fall under two categories when it comes to style - formal or informal.

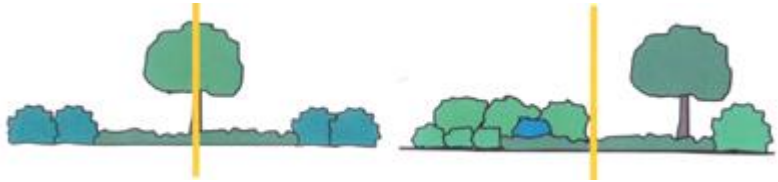


Figure 14. Formal balance (left) and informal balance (right).

- **Formal gardens** follow straight, geometric lines to determine the shape of the beds. The geometric shape selected may be copied from an architectural feature found on your home. Formal gardens rely on symmetry. One garden will match another. In a small space, the symmetry becomes the focal point. That is what the eye registers. It recognizes the pattern and takes everything in as a whole. Formal gardens date back many centuries. Palatial castles often had formal gardens. If contemplating this style do keep in mind the best way to view a formal garden is from an elevated point. Centuries old formal gardens all have verandas or balconies for viewing. Looking down you are able to appreciate the symmetry and balance. Formal style is high maintenance.

Figure 15. The stately Italian Garden at Hatley Park, Victoria, BC, is a great example of formal balance.

- **Informal gardens** are more popular. They follow the natural terrain by using curved lines. The human eye follows curves easier than straight lines. In fact, curves are more natural. There are no perfectly straight lines of great length in nature. The only illusion of a straight line is the horizon. All perfectly straight lines are man-made. Balance is created not through symmetry (as in a formal garden) but with plant material characteristics such as plant shape, color, size, and texture.

Figure 16. The Herb Garden at Government House, Victoria, BC is an excellent example of informal balance being relaxing and free flowing.

 Informal Balance.

- What is **balance**? It is visual weight. A yard bordered by a large, established windbreak on one side and nothing on the other is not balanced. The visual interest is heavily weighted towards the massive plant material. A garden with bold colors on one side and milder hues on the other creates visual imbalance. The eye takes in the garden but not as a whole - the bold colors dominate. Balance can be achieved in many ways. Most often it is achieved with plant size and plant color, but texture also can support the balance of a garden.

Simplicity and *Variety*

Simplicity and variety work together to balance each other. ***Simplicity*** is a degree of repetition rather than constant change, creating unity. ***Variety*** is diversity and contrast in form, texture, and color preventing monotony. [Figures 17 to 20]

- For simplicity, repeat some plant materials in sweeps and groupings.
- For variety, fill in with other plants.
- Avoid creating a horticultural zoo! (two of each)
- Zipper plantings (repeating the same pattern over and over again like red-white-red-white) lack simplicity and variety, rather creating monotony. [Figure 21]

Figure 17. In this simple drawing, *simplicity* is gained with the shrub row repeating the same plant materials. *Variety* is added with the tree.

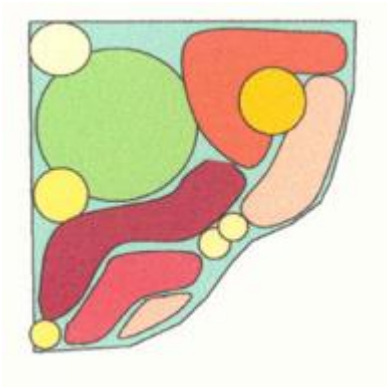


Figure 18. For simplicity, repeat some plant materials in sweeps and groupings. Fill in with other plants for variety.

Figure 19. Simplicity is created by several hundred Hosta in this large bed. Variety is created by placing some in clusters of pots. - Innis Gardens, Columbus, Ohio

Figure 20. At Abkhazi Garden, Victoria, BC, simplicity is created with the row of purple heather and the lawn (the "Yangtze River"). Variety is created with an assortment of plant materials on the rocky hillside.

Figure 21. In this park, people enjoyed taking pictures of the various flowerbeds. However, they didn't take pictures of this zipper planting (same elements repeated over and over again) finding it monotonous.

Emphasis is Dominance and Subordination of Elements.

The human mind looks for dominance and subordination in life. As we look at a landscape from any direction, we need to see dominance and subordination of various elements. If we don't find it, we withdraw from the landscape. Some gardens lack the dominant element. Others suffer with too many dominate elements screaming to be the focal point. [Figure 22-24]

Emphasis can be achieved through different sizes, bold shapes, groupings, and the unusual or unexpected. What is the focal point?

Figure 22. Emphasis is achieved with the tree being dominant and the shrub grouping being subordinate.

Figure 23. In this private garden, emphasis is added with the blooming Astelbe.

Figure 24. Ornamental grass often adds emphasis to a garden spot.

Sequence is the Change or Flow in Form, Color, Texture, and Size Giving Movement or Life.

Sequence with Texture

Change leaf size of adjacent different plants by at least one-half. Use proportionally larger numbers of fine textured plants. [Figure 25]

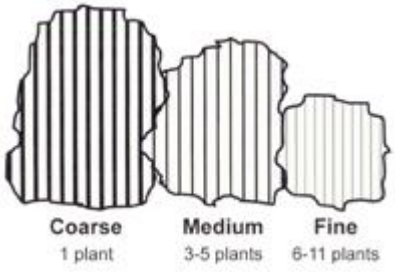


Figure 25. In texture sequence, change leaf size of adjacent different types of plants by at least one-half. Use more of the finer textured plant.

- In a flower/shrub bed, use coarser texture, larger plants in the back; sequencing to finer textured, smaller plants in the front inside-curve. [Figure 26]

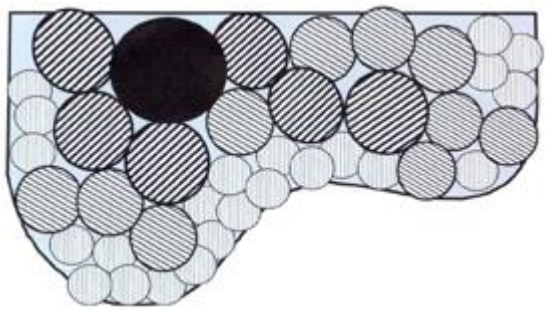


Figure 26. In texture sequence, place the fine texture plants in the inside curve and the coarse texture plants opposite. This is the way Mother Nature would do it. Look at the river. The sand bank is on the inside curve and the cliff opposite.

- Texture and distance – Texture becomes finer with distance. In a distant corner, place finer textures in the corner, sequencing to coarser textures on the arms.

Figure 27. Textures get finer with distance. Place the fine textured plants in the distant corner with coarser textured plants toward the viewer.

Sequence with Color

- There are few basic rules on how much warm and cool colors to use. However, watch that the scale does not become too commanding. More is NOT better. As a rule-of-thumb, the designs needs 90% green to set off the 10% color.

- Darkest shades and the purest intensity dominate and should be used at the focal point.

- Warm colors work best in sequence. Using cool colors in contrast is more effective than sequences.

Color Sequence

1. Decide what color(s) will be used.
2. Decide if light or dark will dominate. – The darker or more intense (pure) the color, the more it will show up and dominate the scene.
3. Calculate the number of plants of each color using this rule-of-thumb.

a. Establish the largest amount of dark/dominant color that will be used.
b. Select the next lighter shade and increase the number of plants by one-third.
c. Select the next lighter shade and increase the number of plants by one-third.
d. Continue the ratio to the lightest color. [Figure 28]

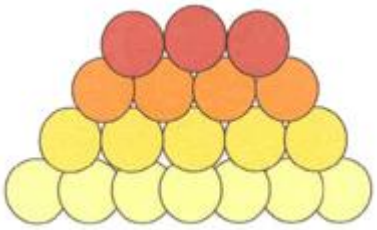


Figure 28. In color sequence, select which color will dominate (darkest or purest color) and use proportionally more of the other colors as it works out.

- Grouping for best effect – Kidney or crescent shaped groupings create a natural flowing design. [Figure 29]

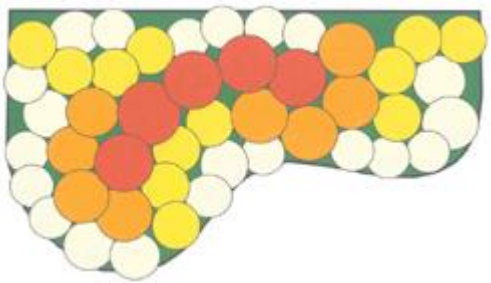


Figure 29. For a natural looking effect, place colors in interlocking kidney shapes. This is the way Mother Nature plants giving the bed the the feeling that it is alive and breathing!

Color contrasts

- Monochrome light/dark color contrasts – Use one-third one shade and two-thirds the other shade. [Figure 30]
- Complementary color contrasts – Use one-third one color and two-thirds the complementary color.

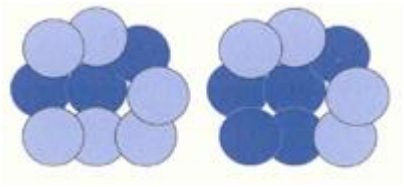


Figure 30. In color contrasts, use two-third one color (for dominance) and one-thirds of the other color (for subordination), rather than half and half.

Create effective plant combinations by paring opposites

- To create plant combinations with pizzazz, pair opposites. [Figure 31]

- Fine/Course
- Short/Tall
- Round/Upright
- Thugs/Dainty
- Small/Large
- Color contrasts

Figure 31-34. Examples of paring opposites for pizzazz!

Native plant

Native plant is a term to describe plants endemic (indigenous) to a given area in geologic time. This includes plants that have developed, occur naturally, or existed for many years in an area (e.g. trees, flowers, grasses, and other plants).

Some native plants have adapted to very limited, unusual environments or very harsh climates or exceptional soil conditions. Although some types of plants for these reasons exist only within a very limited range (endemism), others can live in diverse areas or by adaptation to different surroundings. Research has found that insects depend on native plants.

Natural landscaping, also called **native gardening**, is the use of native plants, including trees, shrubs, groundcover, and grasses which are indigenous to the geographic area of the garden.

Landscaping with native wildflowers and grasses improves the environment. Natural landscaping brings a taste of wilderness to urban, suburban, and corporate settings by attracting a variety of birds, butterflies and other animals. Once established, native plants do not need fertilizers, herbicides, pesticides or watering, thus benefiting the environment and reducing maintenance costs. Gardeners and admirers enjoy the variety of colors, shapes, and seasonal beauty of these plants.

Hummingbird going for the nectar from Zauschneria californica, the California Fuschia

Benefits

- Landscaping with native plants improves the environment.
- Native plants are hardy because they have adapted to the local conditions. Once established, native plants do not need pesticides, fertilizers, or watering. Not only is this good for the environment, it saves time and money.
- A native landscape does not need to be mowed like a conventional lawn. This reduces the demand for non-renewable resources and improves the water and air quality.

- The periodic burning (or mowing when burning is not practical) required for maintenance of a prairie landscape mimics the natural prairie cycle and is much better for the environment. Landscaping with native wildflowers and grasses helps return the area to a healthy ecosystem.

- Diverse varieties of birds, butterflies and animals, are attracted to the native plants, thus enhancing the biodiversity of the area.

- The beauty of native wildflowers and grasses creates a sense of place, both at home and work.

- The native plants increase our connection to nature, help educate our neighbours, and provide a beautiful, peaceful place to relax.

Reduced Use of Pesticides

Since native plants have adapted to local conditions, they are more resistant to pest problems. Sometimes individuals use non-persistent pesticides, which break down into harmless components, before sowing native plant seeds to minimize competition from the weeds. Once the native plants are established, pesticides are seldom needed.

Improved Air Quality

Native landscaping practices can help improve air quality on a local regional and global level. Locally, smog (ground level ozone) and air toxics can be drastically reduced by the virtual elimination of the need for lawn maintenance equipment (lawn mowers, weed edgers, leaf blowers, etc.) which is fueled by gasoline, electricity or batteries. All of these fuel types are associated with the emissions of the following air pollutants: carbon monoxide (CO), carbon dioxide (CO_2), nitrous oxides (NO_x), sulfur dioxide (SO_2), VOCs (volatile organic compounds) and air toxics such as benzene. Gasoline lawn and garden equipment, on average, produces 5% of ozone-forming VOCs in areas with smog problems. This equipment also emits toxics and particulates.

Regionally, the NO_x and SO_2 released from lawn maintenance equipment react with water in the atmosphere to form acid rain.

Globally, native landscaping practices help to combat global warming in two ways. Carbon dioxide (CO_2) is a major greenhouse gas and by reducing the use of lawn maintenance equipment, the associated CO_2emissions are also reduced. Native plants help to reduce the amount of CO_2in the atmosphere by taking in $CO_2$and storing the carbon in the body of the plants, roots and soil. Native plants work much better than traditional mowed grass as a carbon sink due to their extensive root systems and increased ability to retain and store water.

Improved Water Quality

In conventional landscaping, pesticides are often wrongly applied at times when target insects are not vulnerable. Overuse and inappropriate use often kill beneficial insects and other wildlife. Less than 10% of all insects are harmful to plants. Pesticides have the potential to cause serious human health problems when not handled properly or applied according to the label directions. By eliminating or minimizing the use of pesticides and fertilizers, these pollutants will not run-off into streams, lake, and bays. This improves the quality of the water and the aquatic life in it. In healthy water systems. Natural controls, such as fish, frogs, and snails will help keep insect populations under control and reduce algae build-up.

Plants native to your specific region and climate will naturally adapt to the soil and require less watering, are more resistant to bugs and disease and will require less fertilizer and attention to thrive.

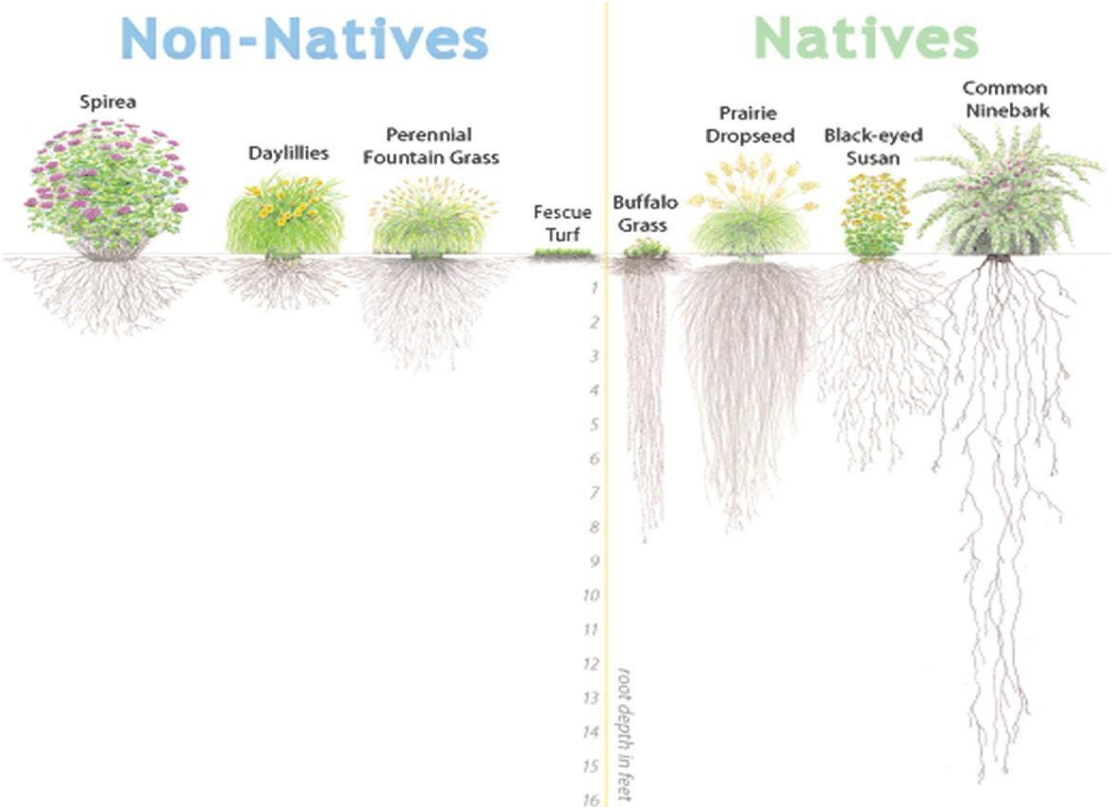
Disadvantages

- Not good for outdoor games that require a manicured turf.
- Increased wild animal intrusion.
- In certain areas, wildfires or brushfires may be of great concern.
- May look less attractive due to reduced available range of plants to choose from.
- May be hard to find native plants which produce adequate quantities of edible matter.

Non-Native plants

An **introduced**, **alien**, **exotic**, **non-indigenous**, or **non-native species**, or simply an **introduction**, is a species living outside its native distributional range, which has arrived there by human activity, either deliberate or accidental. Non-native species can have various effects on the local ecosystem.
Introduced species that have a negative effect on a local ecosystem are also known as **invasive species**.
Not all non-native species are considered invasive. Some have no negative effect and can, in fact, be beneficial as an alternative to pesticides in agriculture for example.

The term as most often used applies to introduced species (also called "non-indigenous" or "non-native") that adversely affect the habitats and bioregions they invade economically, environmentally, and/or ecologically. Such invasive species may be either plants or animals and may disrupt by dominating a region, wilderness areas, particular habitats, or wild land-urban interface land from loss of natural controls (such as predators or herbivores). This includes non-native invasive plant species labelled as **exotic pest plants** and **invasive exotics** growing in native plant communities. It has been used in this sense by government organizations as well as conservation groups such as the International Union for Conservation of Nature (IUCN).



Common invasive species traits include:

- Fast growth
- Rapid reproduction
- High dispersal ability
- Phenotypic plasticity (the ability to alter growth form to suit current conditions)
- Tolerance of a wide range of environmental conditions (Ecological competence)
- Ability to live off of a wide range of food types (generalist)
- Association with humans

- Prior successful invasions

Non-native plants are any plants that originated somewhere else in the world, that would not otherwise have been introduced to this area of California without intervention. In some cases these plants can be excellent for your landscape. In other cases, these plants may be problematic. The following are just a few of the potential advantages and disadvantages to using plants.

Benefits of Non-Native Plants

Native plants get a lot of publicity in the landscaping world. But non-native plants have their place as well. The following are some of the benefits of non-native plant species.

- **Far Greater Variety** – You have a vision. That vision may involve a specific type of plant, whether it be the color, size, shape, etc. When you're looking only at native plants you're limited by what has grown in the area. But when you consider non-native plants, you have every plant known to mankind at your disposal. While not every plant is capable of growing in the Sac soil or environment, at least you have the opportunity to choose from a huge selection.
- **Wow Factor** – Similarly, landscapes are about making your home more visually impressive, and with non-native plants you can find something that gives your landscape the "wow" factor – something that makes onlookers go "I've never seen anything like that before." Whether it's color combinations, size, shape, or something else, the "wow" factor is what makes a property stand out, and helps give it more value.
- **Resistant to Diseases** – In some cases, non-native plants may be more prone to disease or even bring disease. But they may also be more resistant to NATIVE diseases, which are often geared towards local plants. The trade-off can be nice if you live in an area that seems to have a lot of diseases attacking local plants.
- **Similar Upkeep** – Though the upkeep of native plants tend to be similar, you can often find non-native plants that require similar or less upkeep. So you're expanding your range of options without necessarily adding extra work on your part. Also, never forget the joy you may experience from growing and maintaining a non-native plant, especially in a garden.

Non-native plants are very advantageous from a landscaping perspective, and though they have their flaws they should always be something you consider.

Weaknesses of Non-Native Plants

That said, there is a reason that going native tends to be the landscaping preference. Non-native plants have several drawbacks that include:

- **More Upkeep** – Native plants have adapted for the environment. Non-native plants have not. While some plants, like cacti, can withstand almost any environment and are great imported plants, others need a lot more upkeep than Sacramento is able to provide naturally, which means more water on your part (during the drought) and more work keeping them alive.
- **More Cost** – Some non-native plants are cheaper, but most of the most interesting ones are not and need to be imported at what could be high costs. They are not always available either, so you do have to be willing to splurge for a bit more if you're going to go with a non-native plant in your landscape.
- **Invasive non-native plants** - are species which have been brought into the area that has the ability to spread causing damage to the environment, the economy, our health and the way we live. Injurious weeds are species, which have been deemed to cause a problem to farming productivity.

Vegetation in the Site Plan

Trees in Landscape

The best time to plant a tree was 20 years ago. The second-best time is now. - Chinese proverb

Trees are important in every landscape -- big or small, urban or rural, cottage or contemporary. But because trees live a lifetime or more (and often cost so much), they can be intimidating to choose and maintain. We have advice on selecting the best trees for your landscape and caring for them once they're planted. Nearly every yard has room for small trees, and they add character to the landscape. Choose from some of these varieties as a starting point. Other good garden choices include elegant, beautiful Japanese maples, which have become a hit with gardeners in the past few years; conifers; and flowering trees. Review the choices to find one that meets your landscape needs. The first year is often the most critical in a tree's life; learn essential steps to protect your new trees, particularly in winter. Once your trees are off to a good start, continue to promote their health. In addition to offering shade and structure, trees can do unique things. For example, a row of small espaliered trees can be trained into decorative patterns and serve as a living fence

Important Hints:

- When a newly planted tree dies, it's almost always for one simple reason: not enough water.
- Get rid of the grass before planting your tree, say researchers at Kansas State University.
- Choose trees with multiple trunks, such as river birch, redbud, and crape myrtle, and it will look like there are more trees in the space.
- Avoid evergreens; their shade is dank and won't be as comfortable to sit under as a deciduous tree's.
- Plant an understory species-a tree 30 feet tall or less that naturally grows beneath the big guys in the forest, and so is accustomed to less light.
- All shade is not equal. Some shady sites are dry and some moist. Be sure your tree selection tolerates the site conditions you have, Alan Haywood advises.
- **For Multi-season Interest,** You want trees with good flowers, fruit display, and bark, but also consider more subtle things such as aesthetic growth habit, wildlife appeal, and fragrance.
- Don't overlook the value of branching patterns. Deciduous trees vary a great deal in how they branch. Dense, twiggy branching isn't as pleasing to the eye as layered, open branching habits.
- Besides using trees of appropriate height, try to attract attention to the landscape below and away from the utility lines and supports, use larger trees up close to provide a visual roof that blocks the line of sight to the poles and conductors.
- Plant some fast-growing things for instant gratification, but plant slow-growing things for the long term. It increases your property values.
- Be sure the site has adequate space for the mature tree, and don't plant any tree too close to a building, walkway, or driveway.

Use of Trees

Trees have many uses in the landscape,

- **Environmental**, providing shade and shelter, absorbing pollutants and reducing wind speed.
- **Economic**, while costly to plant and maintain, a locality with plenty of trees will attract investment and higher house prices.
- **Aesthetic**, contrasting with the rigid outlines of buildings, creating an avenue, indicating the passing of the seasons.

In urban areas:

1. Street trees,
2. Trees in public open space,
3. Retail parks and,
4. Trees in private gardens form the urban forest.

In rural areas Trees:

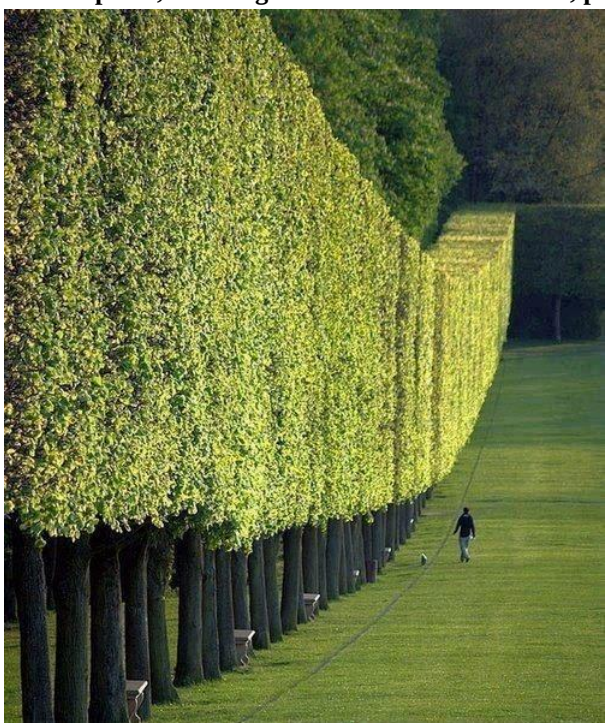
1. Define boundaries of fields,
2. Are grown as specimens in fields (parkland trees),
3. Provide shelter for cattle and,
4. Are an integral part of much of the countryside.

Following are the different uses of trees in Landscape,

- ## Functional Uses of Trees

Trees serve three broad functions in the landscape, design, environmental and engineering.

- **From a design perspective trees :**
  - **Define spaces, marking boundaries between fields, parks or gardens.**



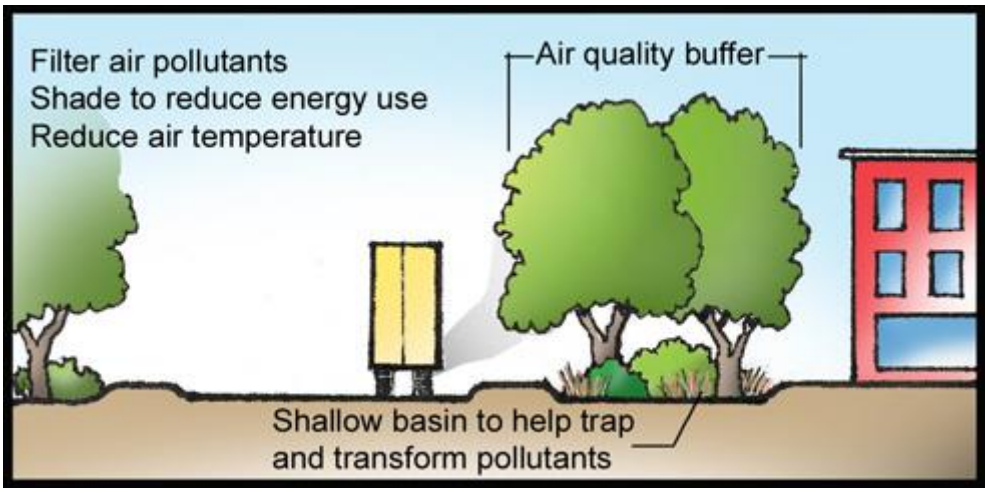
- **Provide enclosure & privacy (Privacy Screening)**

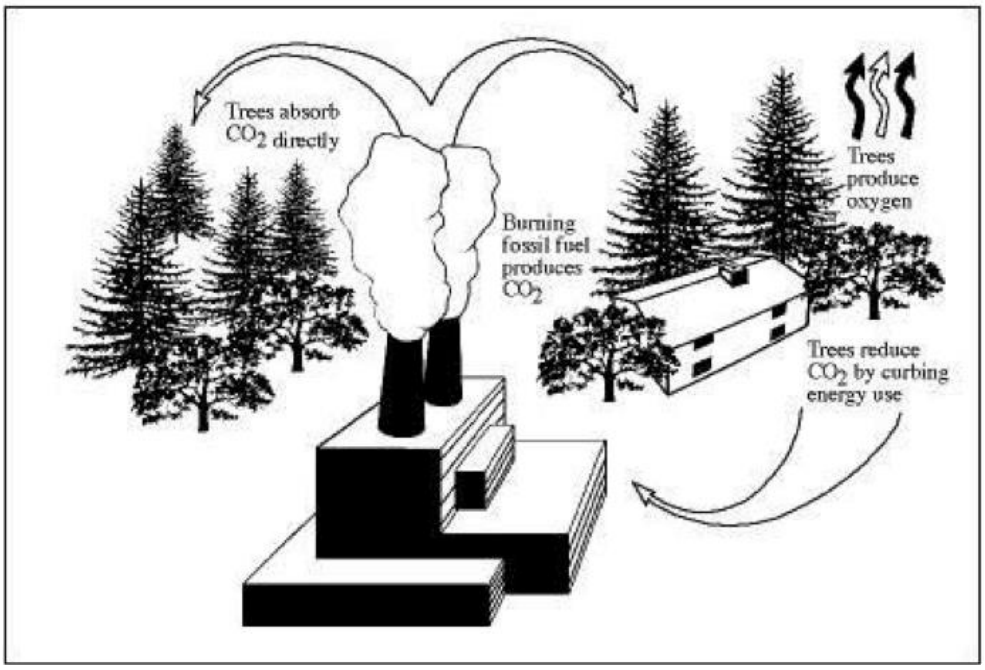
- **Camouflage and direction.**

- **Avenue planting**, form linkages between one building and another. Links an entrance with a large building or in a town or city creates a network of tree lined streets.

Avenue Planting

- **<u>From an environmental perspective trees :</u>**
  - **Reduces Pollution.**
    - Trees are nature's answer to diminishing air pollution, as well as reducing respiratory problems for the human population, according to US Forest Service scientists and collaborators behind a new study.
    - Their broad-scale estimates concluded that trees are saving more than 850 human lives a year and preventing 670,000 incidents of acute respiratory symptoms - and that's just by improving air quality less than one percent.
    - Not to mention that trees can help save $7 billion a year in health costs by reducing respiratory illness.
    - "With more than 80 percent of Americans living in urban areas, this research underscores how truly essential urban forests are to people across the nation," Michael T. Rains, Director of the Forest Service's Northern Research Station





- **Acts as Sun Barrier & Shades.**

  Searing summer sun builds up heat in unshaded areas and puts a strain on electric air conditioners and swamp coolers. Add green plants and you increase the comfort level and provide shade and evaporative cooling.

  - Results can be dramatic. Models constructed in Logan, Utah showed a 98 percent reduction in summer cooling costs by shading the entire house. In Sacramento, California, shade trees reduced attic temperatures 20 to 40 degrees - equivalent to the cooling effect of several room-sized air conditioners. In Mesa, Arizona almost $220 in annual cooling cost savings were realized from trees planted on the east and west sides of a house. Individual results will vary depending on home design and orientation, but significant energy savings are possible with proper landscaping.

  - Start by noting shade tree placement in the yard. Most summer heat gain in the home occurs in the morning and afternoon when the sun is low enough in the sky to shine directly through windows. A tree in full leaf can block 70 to 90 percent of solar radiation. Shade trees on the east side of the house prevent heat build-up in the morning, while those on the west and southwest side shield from intense afternoon rays.

  - While trees planted directly south of the house can provide additional shade and cooling, for year-round energy efficiency, it is best to leave the south side of buildings unshaded. Even after a deciduous tree loses its leaves, the remaining branches may cut out up to 60 percent of the sun's rays. Solar heating through unshaded south walls during the cold winter months more than offsets summer cooling costs.

  - Energy-efficient shade tree alternatives are roof overhangs designed to shade south windows at mid-day during the summer. They also allow light in during the winter when the sun is lower in the sky. For shading south walls through the summer only, cover the home with deciduous vines that lose their leaves in fall. Or use annual vines

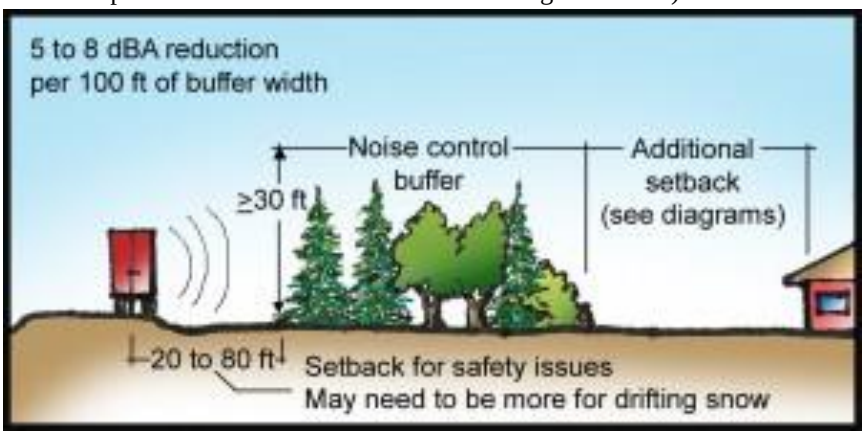
that die back to the ground. An 8° F difference between shaded and unshaded surfaces equals a 30 percent increase in insulation value for the shaded wall.

Wrong Planting large trees under utility lines often means mutilated trees. Large evergreens close to the house on the south block warming winter sunlight.

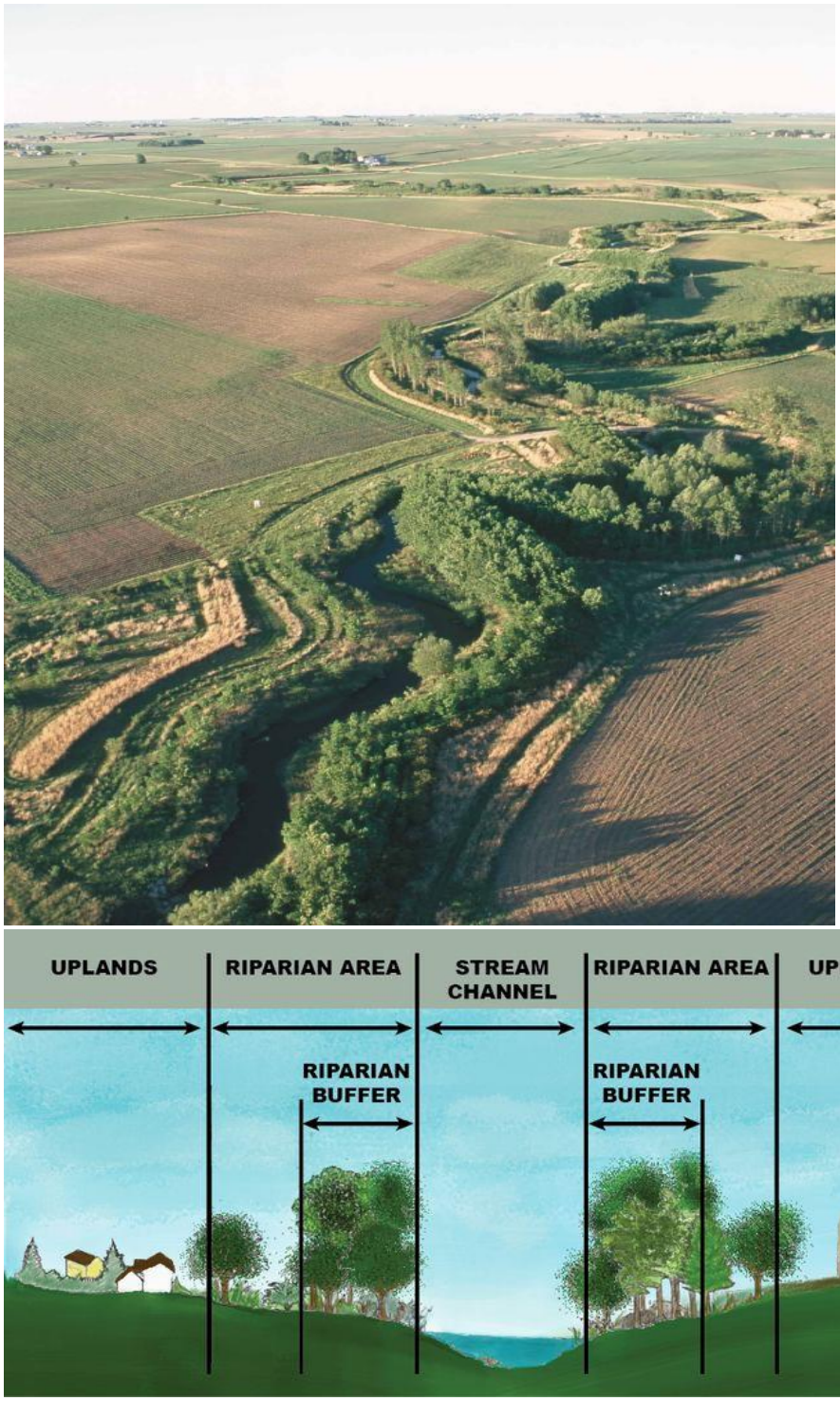
Right Short flowering trees don't clash with overhead utility lines. Large deciduous trees on the southeast, southwest, and west provide cooling shade in summer, and don't obstruct the low winter sun. An evergreen windbreak on the north blocks cold winter winds.

- **Acts as a Buffer.**
  Buffer Benefits

- Buffers trap sediments before they enter a stream.
  Sedimentation occurs when excess soil particles accumulate in water bodies, which can suffocate organisms and reduce sunlight needed by aquatic life. Plants in the buffer zone trap sediments in runoff and prevent them from entering the stream.
- Buffers reduce pollutants.
  Pollutants that are attached to soil particles are transported by sediment to the water. Two common pollutants, phosphorus and nitrogen, cause excessive algae growth, deteriorate water quality, and can kill fish. Phosphorus and nitrogen are the basic nutrient elements of manures or fertilizer applied to farm fields or suburban lawns. By trapping sediments, buffers trap pollutants as well.
- Buffers reduce erosion by keeping banks stable.
  The roots of trees and shrubs bind together soil particles, helping to hold the banks in place. Eroding and slumping stream banks are a source of sediment contamination in themselves. They also lead to wider, shallower and warmer channels.
- Buffers improve habitat.
  On land, buffers can serve as corridors for wildlife and homes for migratory songbirds, mink, otter, reptiles and amphibians. Trees and shrubs also help shade the creek's waters, keeping them cool enough for trout. Buffers add natural beauty to the stream setting, a benefit for all who visit or pass by.
- Buffer reduces noise.
  Noise from vehicles and others sources can reduce one's enjoyment of being outdoors. Dense, **tree buffers** can reduce noise to levels that allow normal outdoor activities to occur. For instance, a 100-foot wide planted buffer will reduce noise by 5 to 8 decibels (dBA). If one uses a barrier in the buffer such as a landform can significantly increase buffer effectiveness (10 to 15 dBA reduction per 100-foot wide buffer with 12-foot high landform).



Riparian Buffers are a Best Management Practice to protect stream water quality, reduce stream-bank erosion and provide wildlife habitat.



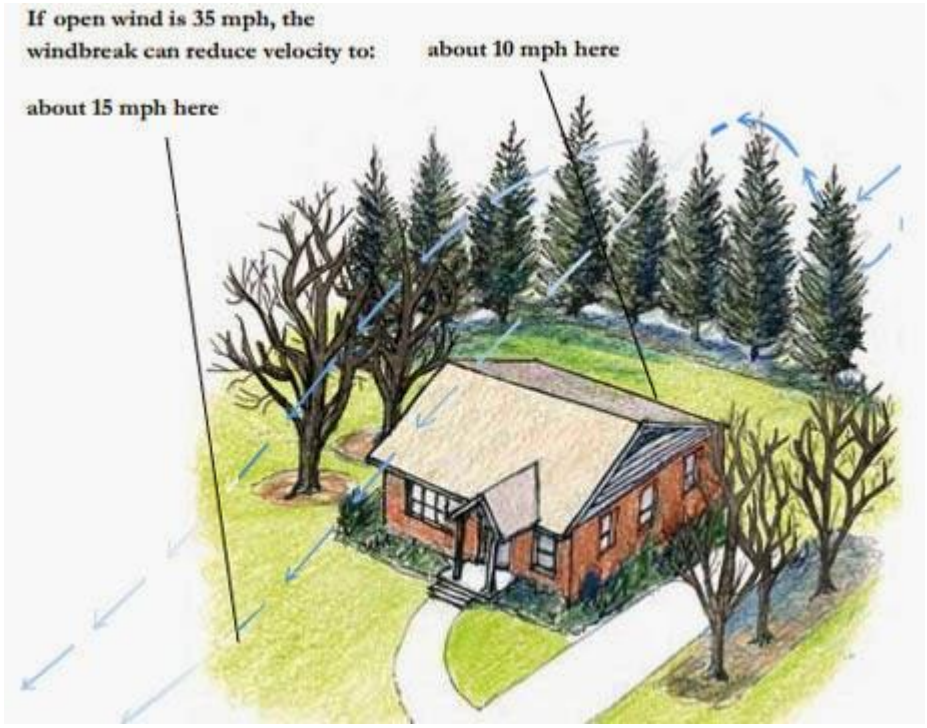
A **buffer strip** is an area of land maintained in permanent vegetation that helps to control air, soil, and water quality, along with other environmental problems, dealing primarily on land that is used in agriculture. Buffer strips trap sediment, and enhance filtration of nutrients and pesticides by slowing down runoff that could enter the local surface waters.

Key Design Considerations

• Locate buffer close to the noise source while providing an appropriate setback for accidents and drifting snow.
• Evergreen species will offer year-around noise control.
• Create a dense buffer with trees and shrubs to prevent gaps.
• Select plants appropriate for the site conditions.
• Select plants tolerant of air pollution and de-icing methods.
• Natural buffers will be less effective than planted buffers because they are usually less dense.
• Consider topography and use existing landforms as noise barriers where possible.

- **Contribute to habitat creation**

- **Acts as Wind Screens.**



- **Acts as Weather Shield.**

- **Provides required ease of sight.**

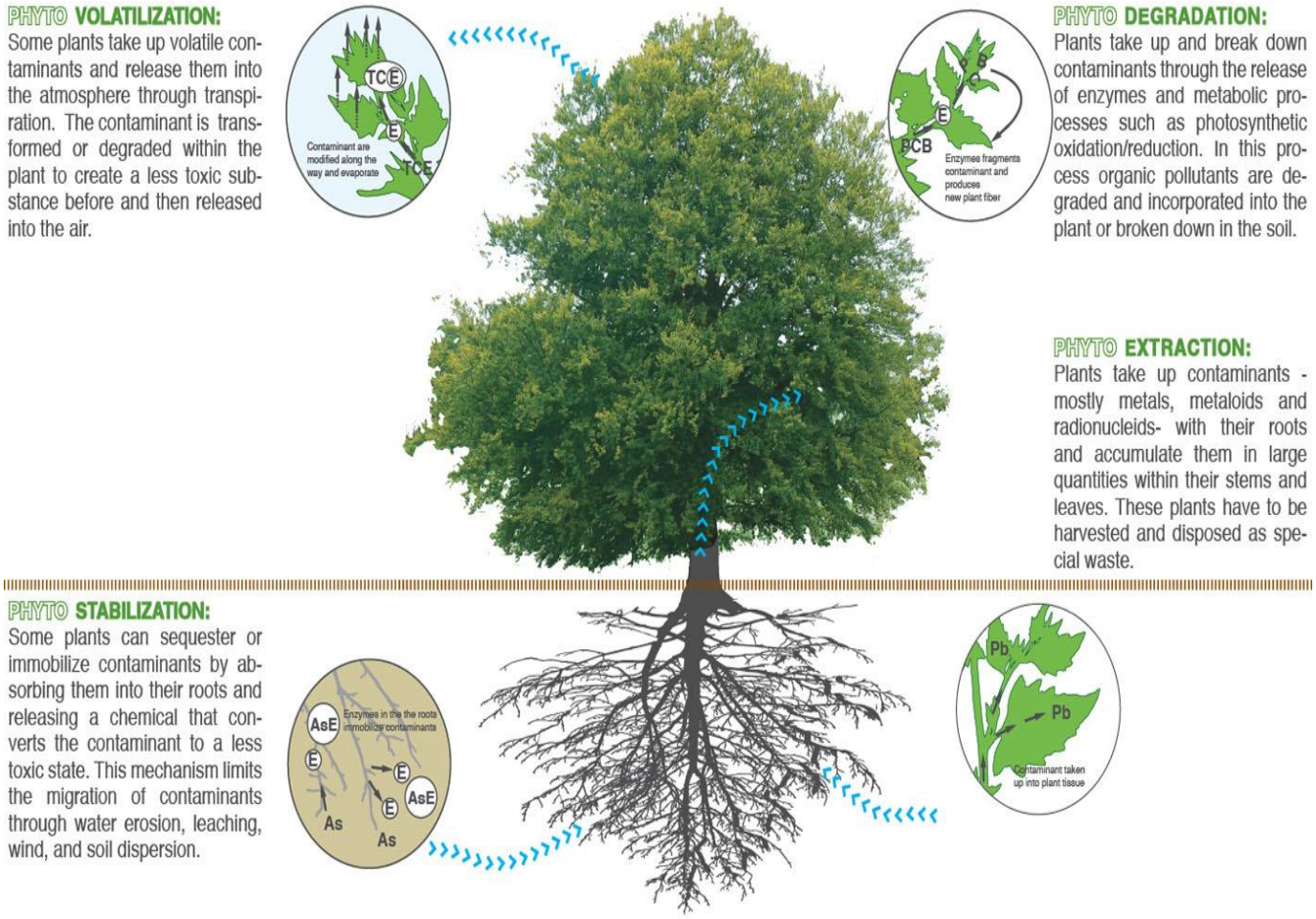
➢ From an engineering perspective trees:

- **Phytoremediation.**

  Phytoremediation is the direct use of green plants and their associated microorganisms to stabilize or reduce contamination in soils, sludges, sediments, surface water, or ground water. First tested actively at waste sites in the early 1990s.

  Phytoremediation may be applied wherever the soil or static water environment has become polluted or is suffering ongoing chronic pollution. Examples where phytoremediation has been used successfully include the restoration of abandoned metal mine workings, reducing the impact of contaminants in soils, water, or air. Contaminants such as metals, pesticides, solvents, explosives, and crude oil and its derivatives, have been mitigated in phytoremediation projects worldwide. Many plants such as mustard plants, alpine pennycress, hemp, and pigweed have proven to be successful at hyperaccumulating contaminants at toxic waste sites.

  Phytoremediation refers to the natural ability of certain plants called hyperaccumulators to bioaccumulate, degrade, or render harmless contaminants in soils, water, or air.



Advantages and limitations.

Advantages:

- The cost of the phytoremediation is lower than that of traditional processes both *in situ* and *ex situ.*
- The plants can be easily monitored.
- The possibility of the recovery and re-use of valuable metals (by companies specializing in "phyto mining").
- It is potentially the least harmful method because it uses naturally occurring organisms and preserves the environment in a more natural state.

Limitations:

- Phytoremediation is limited to the surface area and depth occupied by the roots.
- Slow growth and low biomass require a long-term commitment.
- With plant-based systems of remediation, it is not possible to completely prevent the leaching of contaminants into the groundwater (without the complete removal of the contaminated ground, which in itself does not resolve the problem of contamination).
- The survival of the plants is affected by the toxicity of the contaminated land and the general condition of the soil.
- Bio-accumulation of contaminants, especially metals, into the plants which then pass into the food chain, from primary level consumers upwards or requires the safe disposal of the affected plant material.

Various phytoremediation processes.

A range of processes mediated by plants or algae are useful in treating environmental problems:

- "Phytosequestration"-Phytochemical complexation in the root zone, reduce the fraction of the contaminant that is bioavailable. Transport protein inhibition on the root membrane-preventing contaminants from entering the plant. Vacuolar storage in the root cells -Contaminants can be sequestered into the vacuoles of root cells.
- Phytoextraction — uptake and concentration of substances from the environment into the plant biomass.
- Phytostabilization — reducing the mobility of substances in the environment, for example, by limiting the leaching of substances from the soil.
- Phytotransformation — chemical modification of environmental substances as a direct result of plant metabolism, often resulting in their inactivation, degradation (phytodegradation), or immobilization (phytostabilization).
- Phytostimulation — enhancement of soil microbial activity for the degradation of contaminants, typically by organisms that associate with roots. This process is also known as rhizosphere degradation. Phytostimulation can also involve aquatic plants supporting active populations of microbial degraders, as in the stimulation of atrazine degradation by hornwort.
- Phytovolatilization — removal of substances from soil or water with release into the air, sometimes as a result of phytotransformation to more volatile and/or less polluting substances.
- Rhizofiltration — filtering water through a mass of roots to remove toxic substances or excess nutrients. The pollutants remain absorbed in or adsorbed to the roots.

It Even Works with Radioactive Nuclear Materials!!!!

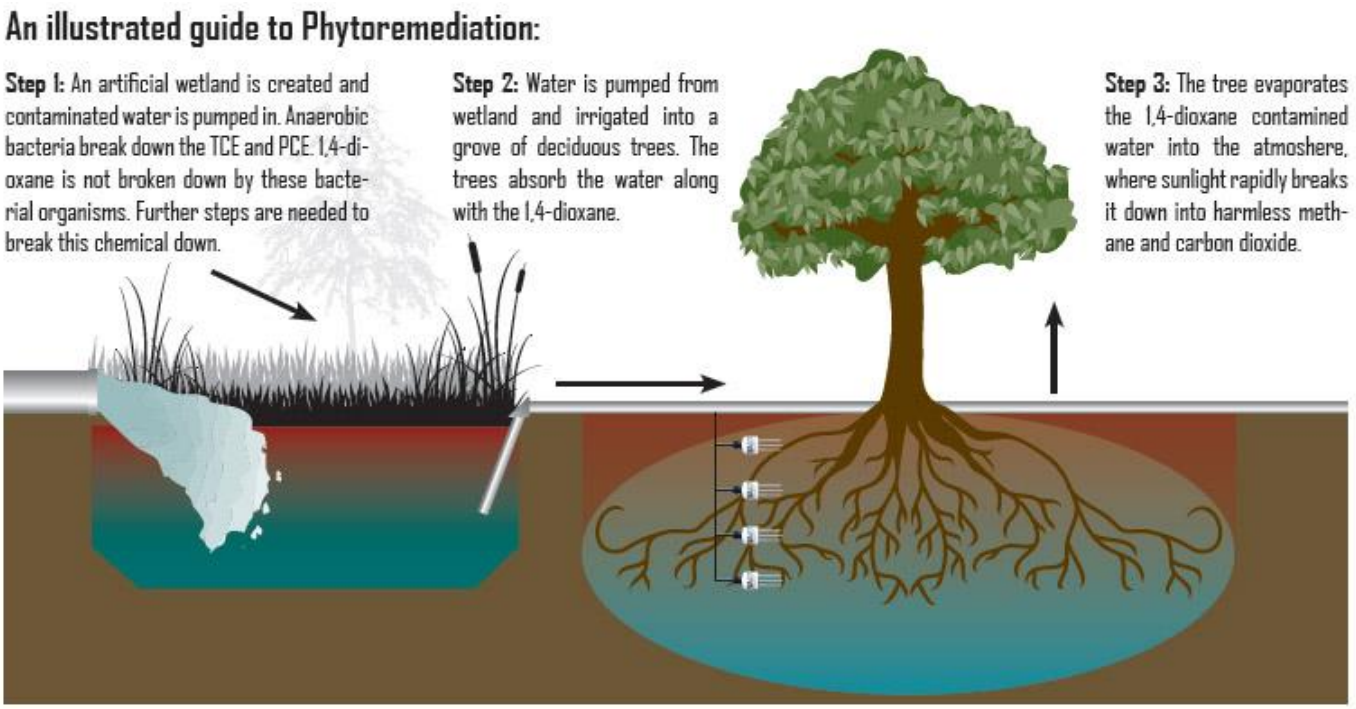
For soil contaminated with uranium, Kochian found that adding the organic acid citrate to soils greatly increases both the solubility of uranium and its bioavailability for plant uptake and translocation. Citrate does this by binding to insoluble uranium in the soil.

Leon Kochian and Deborah Lethman study electrophoresis films to identify Thlaspi caerulescens genes responsible for heavy-metal transport.

"With the citrate treatment, shoots of test plants increased their uranium concentration to over 2,000 ppm—100 times higher than the control plants," he says. This demonstrates the possibility of using citrate—an inexpensive soil amendment—to help plants reduce uranium contamination.

Recently, Kochian, with colleagues Lasat and Ebbs, identified specific agronomic practices and plant species to remediate soils contaminated with radioactive cesium or cesium-137.

"Although the cause of cesium-137 contamination—aboveground nuclear testing—has been reduced, large land areas are still polluted with radiocesium," Kochian says.



- **Bioremediation.**

  Bioremediation is the use of microbes to clean up contaminated soil and groundwater. Microbes are very small organisms, such as bacteria, that live naturally in the environment. Bioremediation stimulates the growth of certain microbes that use contaminants as a source of food and energy. Contaminants treated using bioremediation include oil and other petroleum products, solvents, and pesticides.

  How Does It Work?

  Some types of microbes eat and digest contaminants, usually changing them into small amounts of water and harmless gases like carbon dioxide and ethene. If soil and groundwater do not have enough of the right microbes, they can be added in a process called "bioaugmentation."

  For bioremediation to be effective, the right temperature, nutrients, and food also must be present. Proper conditions allow the right microbes to grow and multiply—and eat more contaminants.

  If conditions are not right, microbes grow too slowly or die, and contaminants are not cleaned up. Conditions may be improved by adding "amendments." Amendments (biostimulation) range from household items like molasses and vegetable oil, to air and chemicals that produce oxygen. Amendments are often pumped underground through wells to treat soil and groundwater in situ (in place).

  Bioremediation may be conducted *in situ* or *ex situ*. In situ processes treat soil and groundwater in place, without removal or transportation offsite. This approach may be advantageous since the costs of materials handling and some environmental impacts may be reduced. However, *in situ* processes may be limited by the ability to control or manipulate the physical and chemical environment during bioremediation. *Ex situ* processes, on the other hand, involve the removal of the contaminated media to a treatment area (EPA 2006).

  The first step of any bioremediation program is to develop a conceptual site model (CSM) to evaluate the potential for applying bioremediation at a site. The CSM takes into

account the nature and extent of contamination and site characteristics; site hydrogeology, geochemistry and oxidation-reduction conditions; biodegradation potential; contaminant fate and transport; and receptor and exposure pathways. Once a CSM is established and refined, a characterization of the existing microbial community, or the characteristics necessary for the establishment of an appropriate microbial community, can be determined. Activities undertaken prior to the implementation of a bioremediation program often involve treatability studies, examination of soil comparability and the structure and function of the microbial community to ensure that undesirable reactions with the contaminants or their degradation products are prevented. The success of a bioremediation application highly depends on characterization and monitoring completed before and during its implementation (Hazen 2010).

Advantages

There are a number of cost/efficiency advantages to bioremediation, which can be employed in areas that are inaccessible without excavation. For example, hydrocarbon spills (specifically, petrol spills) or certain chlorinated solvents may contaminate groundwater, and introducing the appropriate electron acceptor or electron donor amendment, as appropriate, may significantly reduce contaminant concentrations after a long time allowing for acclimation. This is typically much less expensive than excavation followed by disposal elsewhere, incineration or other *ex situ* treatment strategies, and reduces or eliminates the need for "pump and treat", a practice common at sites where hydrocarbons have contaminated clean groundwater.

1. Delineation of contaminated sites and soil sampling

2. Laboratory tests and isolation of microorganisms that break down pollutants

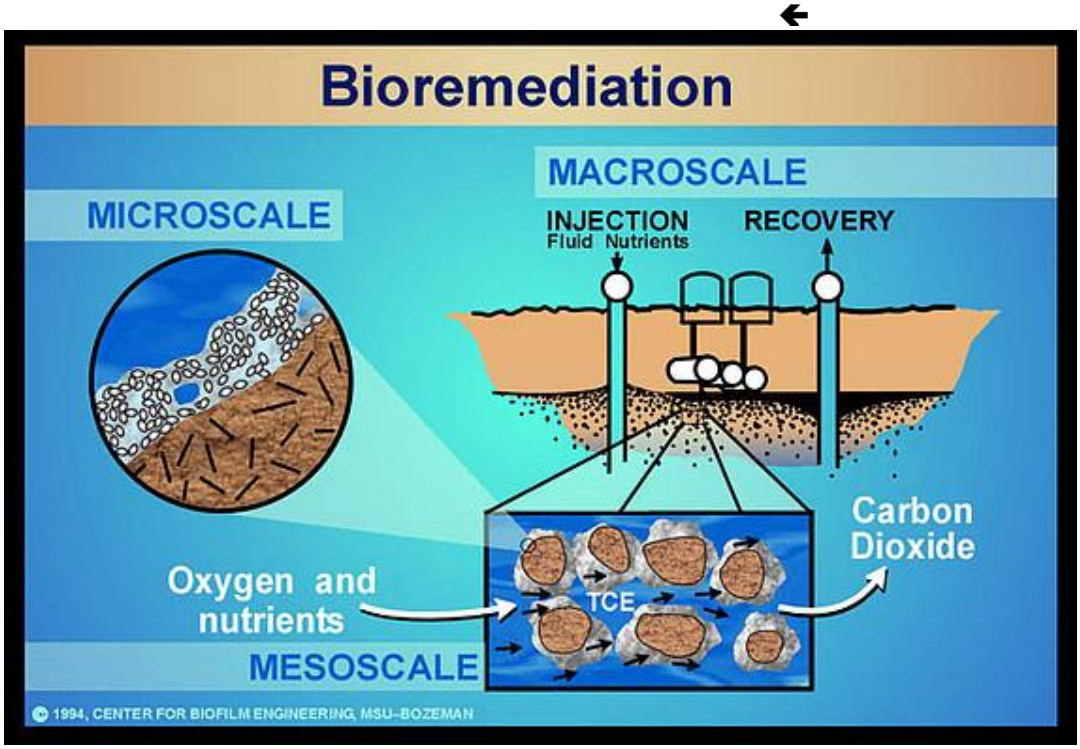
CIRCLE OF BIOREMEDIATON

6. Restoring the land to the place from which was taken (establishing the old topography)

3. Excavation of land - transfer to a place where they will be purified = *ex situ*

5. By reducing the levels of of pollutants in the soil independent institutions carried out the analysis and confirms the results

4. Construction of the projected crowd: (mechanical) mixture of soil, the addition of MICROORGANISMS and nutritive substances necessary for efficient degradation of pollutants = BIOREMEDIATION



- **Ornamental Uses of Trees**

  Ornamental trees are planted for their aesthetic features including fruit, stem, bark, habit, scent and overall form. Landscape designers utilise these trees to create added interest to designs. Ornamental trees are planted to be enjoyed by passerbys, gardeners, visitors and the public in general.

Location of Trees

The Guideline Distances

The *Dimensions Drawing* illustrates the likely locations for trees on a development with the various distances labelled with letters A, B, C etc. These letters are cross-referenced to the *Dimensions Table* which gives actual dimensions for the minimum distances in each situation. The distances are measured from the centre of the trunk and at right angles to the dwelling or garage. However measurement "C" is measured at 45º from the corner of the dwelling, and measurement "E" is taken between the centre of the trunk and the edge of the usable garden space. The distance dimensions are to be used for both existing and proposed new planting, to allow growth to maturity without conflicting with the amenity of the occupants or causing occupants to be fearful of the proximity of trees.

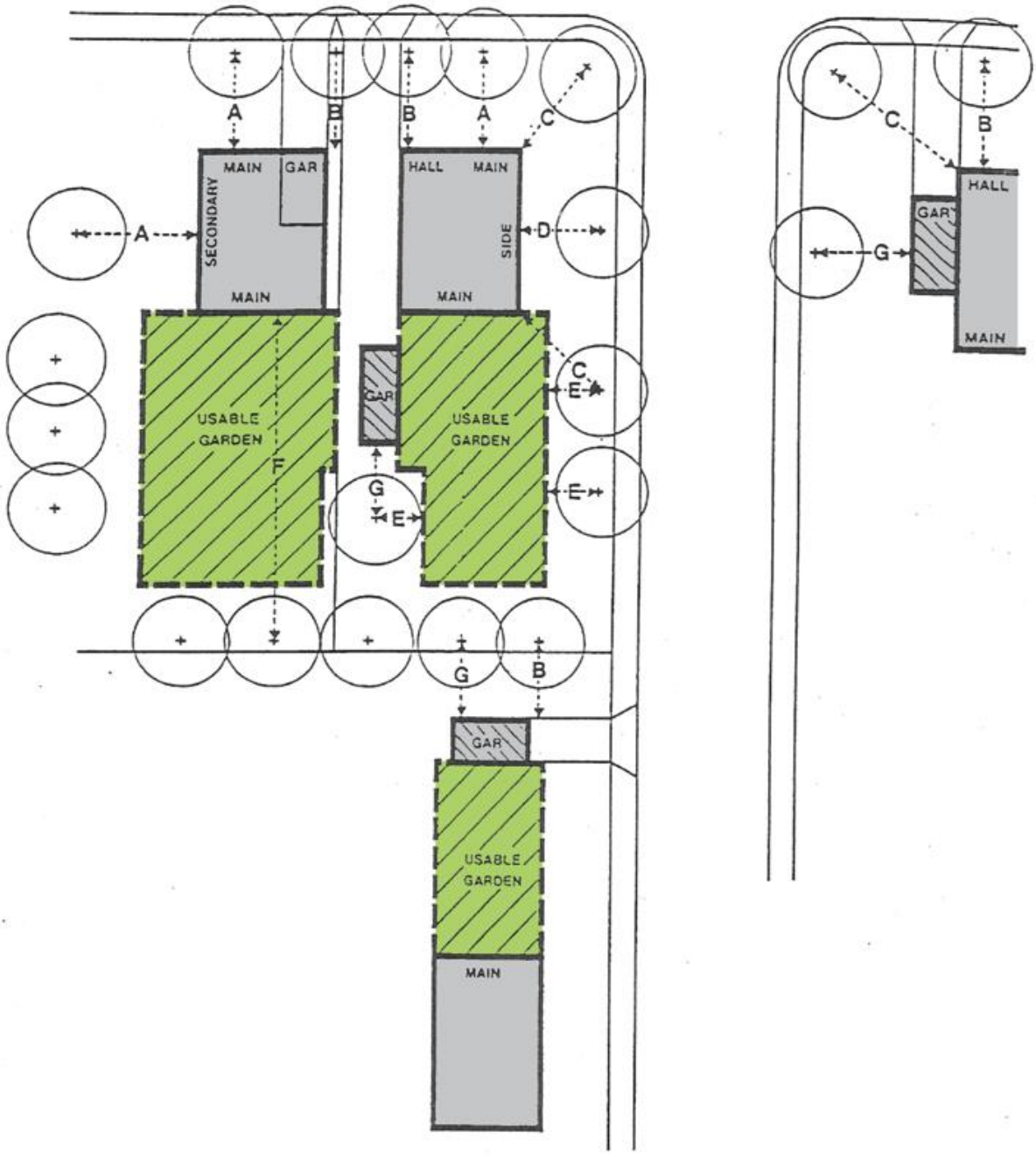
Distances vary for different species due to factors such as: the potential ultimate size; canopy shape and density (e.g. wide canopy with dense foliage); light and shade effects; extent and nature of root systems and the water demands of certain trees.

With regard to existing trees, the distances will also allow for construction to take place without causing dieback, or death of the tree (assuming due care is taken to protect the root spread and canopy during construction)

These distances are guidelines only. They may need to be increased or decreased depending on the particular situation, e.g. if trees lie to the south of a building shading may be a major issue and greater distances may be required. Variations will be subject to the agreement of the Local Planning Authority. The heights and spreads in the *Dimensions Table* are typical dimensions of trees grown in an open situation in the Leeds area.

Poor relationship: Beech trees at 4m from the front of a dwelling are overbearing and cut out light.

Better relationship: Usable gardens - beech trees on the rear boundary.



Key

A Secondary or main window (front)
B Front entrance hall or drive
C Corner
D Side
E Usable side garden
F Main usable garden
G Garage

Species - Dimensions Table

The list includes most trees suitable for planting in housing areas. There are many other cultivars too numerous to list here, some of which would be acceptable depending on location. Inclusion in the list does not imply suitability for a particular situation. The advice of a Landscape Architect should normally be sought.
Planting of poplars and willows, except for a few small or shrubby varieties, is normally inadvisable near housing due to their aggressive root systems.
Sycamore is unlikely to be chosen for new planting, but its retention is often desirable.

Poor relationship: Maple trees too close to flats necessitate continuous harsh pruning and disfigurement to reduce the canopy sizes.

Better relationship: Communal space around flats - maple trees.

Dimensions Table **Recommended Minimum Distances of Built Development to Trees** (all dimensions in metres)											
Botanical Name	**Common Name**	Height	Spread	Front: Main	Front: Hall	Corner	Side	Usable Side	Main Garden	Garage	Ultimate Size Category S = Small M= Medium L = Large VL= Very Large
Reference key as used on distances to trees plan (*Dimensions Drawing*)				**A**	**B**	**C**	**D**	**E**	**F**	**G**	
Acer campestre	Field Maple	12	8	8	8	5	6	4	14	4	S-M
Acer capillipes	Red Snake bark Maple	10	6	6	5	4	5	3	12	4	S-M
Acer cappadocicum	Cappadocian Maple	15	8	10	6	5	6	4	14	5	M-L
Acer davidii	Pere David's Maple	10	7	7	5	4	5	3	12	4	S-M
Acer ginnala	Amur Maple	6	4	5	4	3	4	3	12	3	S
Acer griseum	Paper-bark Maple	8	6	7	6	4	5	3	12	3	S
Acer hersii	Hers' Maple	10	7	7	5	4	5	3	12	4	S-M
Acer negundo	Box Elder	10	8	8	6	5	6	4	12	4	M
Acer palmatum	Japanese Maple	5	4	4	4	2	2	2	10	2	S
Acer platanoides	Norway Maple	18	10	10	8	6	7	5	16	6	L
Acer pseudoplatanus	Sycamore	20	12	12	10	8	10	6	18	8	L
Acer rubrum	Red Maple	18	10	10	8	6	7	5	16	6	L
Acer rufinerve	Grey-budded Snake Bark Maple	10	7	7	5	4	5	3	12	4	S-M
Acer saccharinum	Silver Maple	18	10	10	8	6	7	5	16	6	L
Aesculus x carnea "Briottii"	Red Horse Chestnut	14	10	9	7	6	7	5	14	5	M-L
Aesculus hippocastanum	Horse Chestnut	18	12	12	10	8	10	6	18	8	L
Ailanthus altissima	Tree of Heaven	18	10	10	8	6	7	5	16	6	L
Alnus glutinosa	Common Alder	16	8	10	6	5	6	4	14	4	M
Alnus cordata	Italian Alder	16	8	10	6	5	6	4	14	4	M
Alnus incana	Grey Alder	16	8	10	6	5	6	4	14	4	M
Amelanchier laevis	Snowy Mespilus	6	4	6	5	2	3	2	10	2	S
Araucaria araucana	Monkey Puzzle	16	5	6	5	4	6	2	12	4	M
Betula pendula/pubescens	Silver Birch	18	10	8	6	5	6	4	12	5	M
Betula jacquemontii, B. utilis	Himalayan birch	14	8	6	4	5	4		12	5	M
Carpinus betulus	Hornbeam	14	8	10	8	5	7	4	14	5	M

Vegetation in the Site Plan

Dimensions Table **Recommended Minimum Distances of Built Development to Trees** (all dimensions in metres)											
Botanical Name	**Common Name**	Height	Spread	Front: Main	Front: Hall	Corner	Side	Usable Side	Main Garden	Garage	Ultimate Size Category S = Small M= Medium L = Large VL= Very Large
Reference key as used on distances to trees plan (*Dimensions Drawing*)				**A**	**B**	**C**	**D**	**E**	**F**	**G**	
Carpinus betulus 'Fastigiata'	Fastigiate Hornbeam	14	8	8	5	4	6	2	12	4	M
Castanea sativa	Sweet Chestnut	18	12	14	12	8	10	6	18	8	L
Cedrus atlantica	Atlas Cedar	18	12	14	12	8	10	6	18	8	L
Cedrus deodara	Deodar	18	12	14	12	8	10	6	18	8	L
Chamaecyparis lawsoniana "Ellwoodii"	Lawson Cypress	8	3	6	5	3	4	1	10	3	S
Chamaecyparis l. "Fletcheri"	Lawson Cypress	8	3	6	5	3	4	1	10	3	S
Cotoneaster frigidus	Tree Cotoneaster	5	4	5	4	2	3	2	10	3	S
Crataegus crus-galli	Cockspur Thorn	6	4	5	4	2	3	2	10	3	S
Crataegus lavallei	Hybrid Cockspur Thorn	6	4	5	4	2	3	2	10	3	S
Crataegus "Paul's Scarlet"	Red Hawthorn	12	5	6	5	3	4	2	10	3	S-M
Crataegus x prunifolia	Broad-leaved Cockspur Thorn	5	5	5	4	3	3	2	10	2	S
X Cupressocyparis leylandii	Leyland Cypress	20	5	12	10	6	7	3	18	4	L
Cupressus glabra	Smooth Arizona Cypress	12	12	12	10	8	8	6	16	6	M-L
Cupressus macrocarpa	Monterey Cypress	20	10	12	10	6	8	5	18	5	L
Davidia involucrata	Dove Tree	12	8	8	6	5	7	4	12	5	M
Eucalyptus niphophila	Snow Gum	6	4	5	4	3	4	2	10	3	S
Fagus sylvatica	Beech	25	20	16	14	10	12	8	22	8	VL
Fraxinus excelsior	Ash	25	16	16	14	10	12	8	20	8	VL
Fraxinus excelsior "pendula"	Weeping Ash	8	10	10	8	5	7	3	16	4	S-M
Fraxinus oxycarpa "Raywood"	Raywood Ash	20	14	16	14	10	12	8	20	8	VL
Fraxinus ornus	Manna Ash	10	6	8	6	4	5	3	12	3	S-M
Ginkgo biloba	Maidenhair Tree	16	6	10	8	5	6	3	14	4	M-L
Ilex x altaclarensis	Highclere Holly	10	6	8	6	3	4	3	12	3	S-M
Ilex aquifolium	Common Holly	10	6	8	6	3	4	3	12	3	S-M
Juglans regia	Walnut	18	12	12	10	8	10	6	18	8	L

Vegetation in the Site Plan

Dimensions Table **Recommended Minimum Distances of Built Development to Trees** (all dimensions in metres)											
Botanical Name	**Common Name**	Height	Spread	Front: Main	Front: Hall	Corner	Side	Usable Side	Main Garden	Garage	Ultimate Size Category S = Small M= Medium L = Large VL= Very Large
Reference key as used on distances to trees plan (*Dimensions Drawing*)				**A**	**B**	**C**	**D**	**E**	**F**	**G**	
Laburnum x waterii	Voss's Laburnum	8	4	6	5	3	4	2	10	3	S
Larix decidua	Common Larch	16	6	8	6	4	5	3	16	3	M-L
Liriodendron tulipifera	Tulip Tree	16	10	12	10	6	8	5	16	5	M-L
Malus floribunda	Japanese Crab	5	6	6	5	3	4	3	10	3	S
Malus hupehensis	Hupei Crab	6	6	6	5	3	4	3	10	3	S
Malus 'John Downie'	Crab	7	5	6	5	3	4	3	10	3	S
Malus tschonoskii	Pillar Apple	10	5	8	6	4	5	3	12	3	S-M
Metasequoia glyptostroboides	Dawn Redwood	18	6	10	8	5	8	5	18	3	L
Morus nigra	Black Mulberry	5	5	6	4	3	3	2	10	3	S
Nothofagus oblique	Roble Beech	18	12	12	10	8	10	6	18	8	L
Pinus cembra	Stone Pine	16	6	8	6	4	5	3	16	4	M
Pinus nigra	Austrian Pine	20	8	10	8	5	6	4	18	4	
Pinus nigra maritima	Corsican Pine	20	6	10	8	5	6	4	18	5	
Pinus parviflora	Japanese White Pine	8	6	8	6	4	5	3	12	3	
Pinus sylvestris	Scots Pine	16	6	8	6	4	5	3	16	4	
Picea omorika	Serbian Spruce	20	3	12	10	6	6	1	18	6	L
Platanus x hispanica	London Plane	18	12	14	12	8	10	6	18	8	L
Pyrus calleryana "Chanticleer"	Ornamental pear, common pear	12	6	8	6	4	4	3	10	3	S-M
P. Communis											
Populus alba	White Poplar	18	14	12	10	6	8	5	18	5	L
Populus nigra betulifolia	Native Black Poplar	18	14	12	10	8	10	5	20	5	L
Populus nigra 'Italica'	Lombardy Poplar	20	4	14	12	6	8	6	18	6	L
Populus x 'Serotina'	Black Italian Poplar	20	18	16	14	8	10	6	20	6	VL
Populus tremula	Aspen	14	8	10	8	6	8	4	16	4	M
Prunus avium	Wild Cherry	16	12	12	10	8	10	6	18	6	M-L
Prunus cerasifera	Myrobalan Plum	6	4	6	5	3	3	2	10	3	S

Vegetation in the Site Plan

Dimensions Table **Recommended Minimum Distances of Built Development to Trees** (all dimensions in metres)											
Botanical Name	**Common Name**	Height	Spread	Front: Main	Front: Hall	Corner	Side	Usable Side	Main Garden	Garage	Ultimate Size Category S = Small M= Medium L = Large VL= Very Large
Reference key as used on distances to trees plan (*Dimensions Drawing*)				**A**	**B**	**C**	**D**	**E**	**F**	**G**	
Prunus pissardii	Purple/leaved Plum	6	4	6	5	3	3	2	10	3	S
Prunus dulcis	Almond	6	5	6	5	3	3	2	10	3	S
Prunus x hillieri "Spire"	Ornamental Cherry	8	3	6	5	3	3	2	10	3	S
Prunus lusicanica	Portugese Laurel	5	5	6	5	3	3	2	10	3	S
Prunus sargencii	Sargent's Cherry	8	6	7	5	4	5	3	12	4	S
Prunus padus	Bird Cherry	10	6	8	6	4	5	3	12	4	S-M
Prunus serrulata	Cheal's Weeping Cherry										
P S "Amanogawa"	Japanese Cherry	10	2	5	4	4	4	1	10	3	S-M
P S "Hokusai"	Japanese Cherry	6	5	6	5	3	4	2	10	4	S
P S "Kanzan"	Japanese Cherry	10	8	8	6	5	6	4	12	5	S-M
P S "Pink Perfection"	Japanese Cherry	6	5	6	5	3	4	2	10	3	S
P S "Shirofugen"	Japanese Cherry	6	6	6	5	3	4	2	10	3	S
P S "Shirotae"	Japanese Cherry	8	8	8	6	5	6	4	12	5	S-M
P S "Tai-Haku"	Japanese Cherry	10	8	8	6	6	6	4	12	6	S-M
P S "Ukon"	Japanese Cherry	8	6	8	6	5	6	3	12	4	S
Prunus subhirtella	Spring Cherry	8	5	6	5	4	5	2	10	4	S
Prunus subhirtella "Autumnalis"	Autumn Cherry	8	5	6	5	4	5	2	10	4	S
Prunus x yedoensis	Yoshino Cherry	10	8	8	6	5	6	4	12	5	S-M
Pyrus salicifolia	Weeping Pear	6	4	5	4	3	3	2	10	3	S
Quercus rubra	Red Oak	20	12	14	10	8	8	6	18	8	L
Quercus cerris	Turkey Oak	20	12	14	10	8	8	6	18	8	L
Quercus coccinea	Scarlet Oak	20	10	14	10	8	8	6	18	8	L
Quercus ilex	Holm Oak	16	10	12	10	6	8	5	14	6	M-L
Quercus petraea	Sessile Oak	20	10	14	10	8	8	6	18	8	L
Quercus robur	English Oak	20	16	16	12	10	12	8	20	10	L

Dimensions Table **Recommended Minimum Distances of Built Development to Trees** (all dimensions in metres)											
Botanical Name	**Common Name**	Height	Spread	Front: Main	Front: Hall	Corner	Side	Usable Side	Main Garden	Garage	Ultimate Size Category S = Small M= Medium L = Large VL= Very Large
Reference key as used on distances to trees plan (*Dimensions Drawing*)				**A**	**B**	**C**	**D**	**E**	**F**	**G**	
Robinia pseudoacacia	False Acacia	18	10	12	10	6	7	5	16	6	L
Salix alba	White Willow	25	16	16	14	6	10	8	22	8	VL
Salix caprea	Goat Willow	14	6	8	7	4	6	6	14	6	S-M
Salix fragilis	Crack Willow	18	14	14	12	6	8	7	18	7	L
Salix x 'Chrysocoma'	Weeping Willow	18	20	16	14	10	12	8	20	8	VL
Sorbus aria	Whitebeam	10	6	8	6	4	5	3	12	4	S-M
Sorbus aucuparia	Rowan	18	6	6	5	4	5	3	10	4	S
Sorbus "Embley" (Discolor)	Chinese Scarlet Rowan	8	6	6	5	4	5	3	10	4	S
Sorbus hupehensis	Hupeh Rowan	8	6	6	5	4	5	3	10	4	S
Sorbus x intermedia	Swedish Whitebeam	8	6	6	5	4	5	3	10	4	S
Sorbus sargentiana	Sargent's Rowan	8	6	6	5	4	5	3	10	4	S
Sorbus x churingiaca	Bastard Service tree	10	5	6	5	4	5	2	10	4	S-M
Taxus baccata	Yew	10	8	8	6	5	6	4	12	5	M-L
Tilia cordata	Small-leaved Lime	20	10	12	10	8	10	5	18	8	L
Tilia x euchlora	Caucasian Lime	16	8	10	8	5	7	4	16	5	M-L
Tilia x europaea	Common Lime	30	16	16	12	8	10	8	20	8	VL
Tilia platyphyllos	Large-leaved Lime	25	16	16	12	8	10	8	20	8	VL
Tsuga canadensis	Eastern Hemlock	20	10	12	10	8	10	5	18	8	L
Ulmus glabra	Wych Elm	18	10	12	10	6	8	3	18	7	M-L
Ulmus procera	English Elm	20	10	14	12	8	10	6	20	7	L
Ulmus wheatleyi	Wheatley Elm	18	8	10	8	4	6	3	16	6	M-L

Damages Caused By Trees:

I. Structural damage caused by subsidence.

This is generally only a problem on shrinkable clay soils. Buildings up to four storeys constructed before the 1950s are most at risk, as they frequently have foundations only 50cm (20in) deep.

II. Drain damage.

Roots may block drains, which burst as a result. This can lead to the formation of cavities where water flows into the soil. Older drains with poor seals and rigid joints are most susceptible.

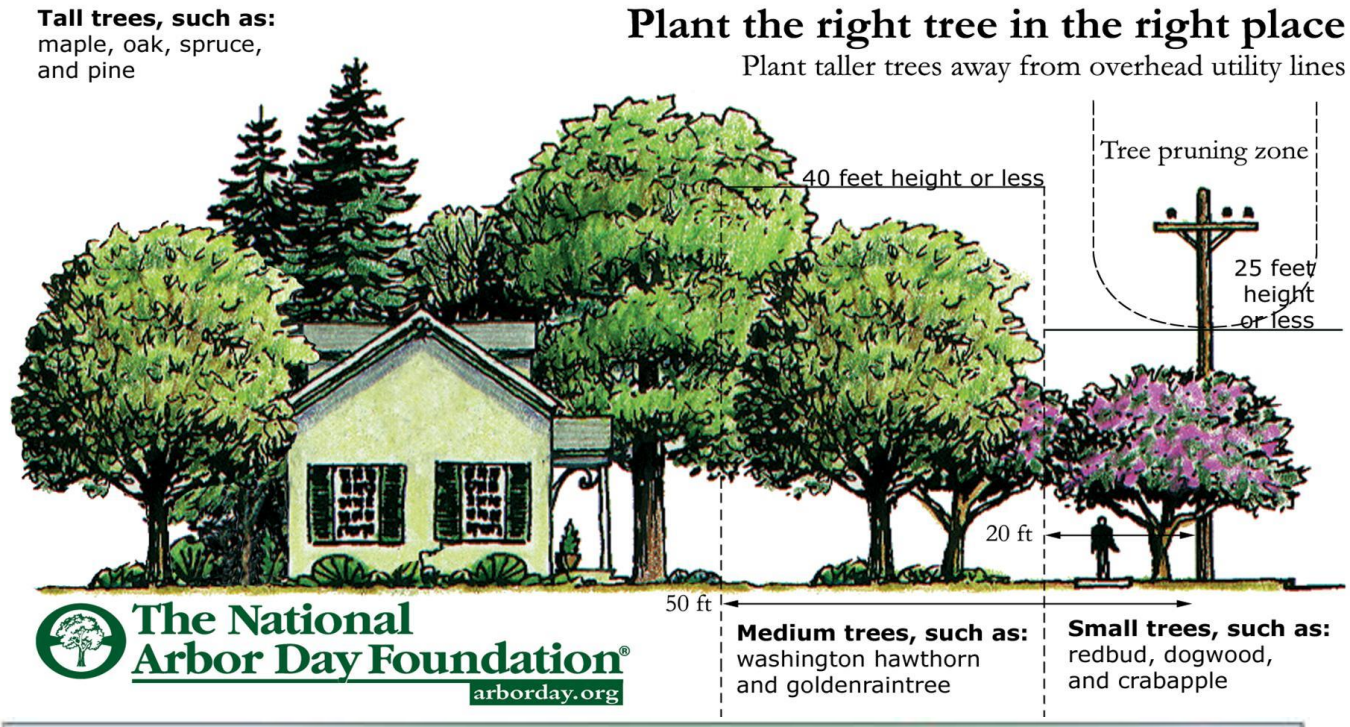
III. Physical damage.

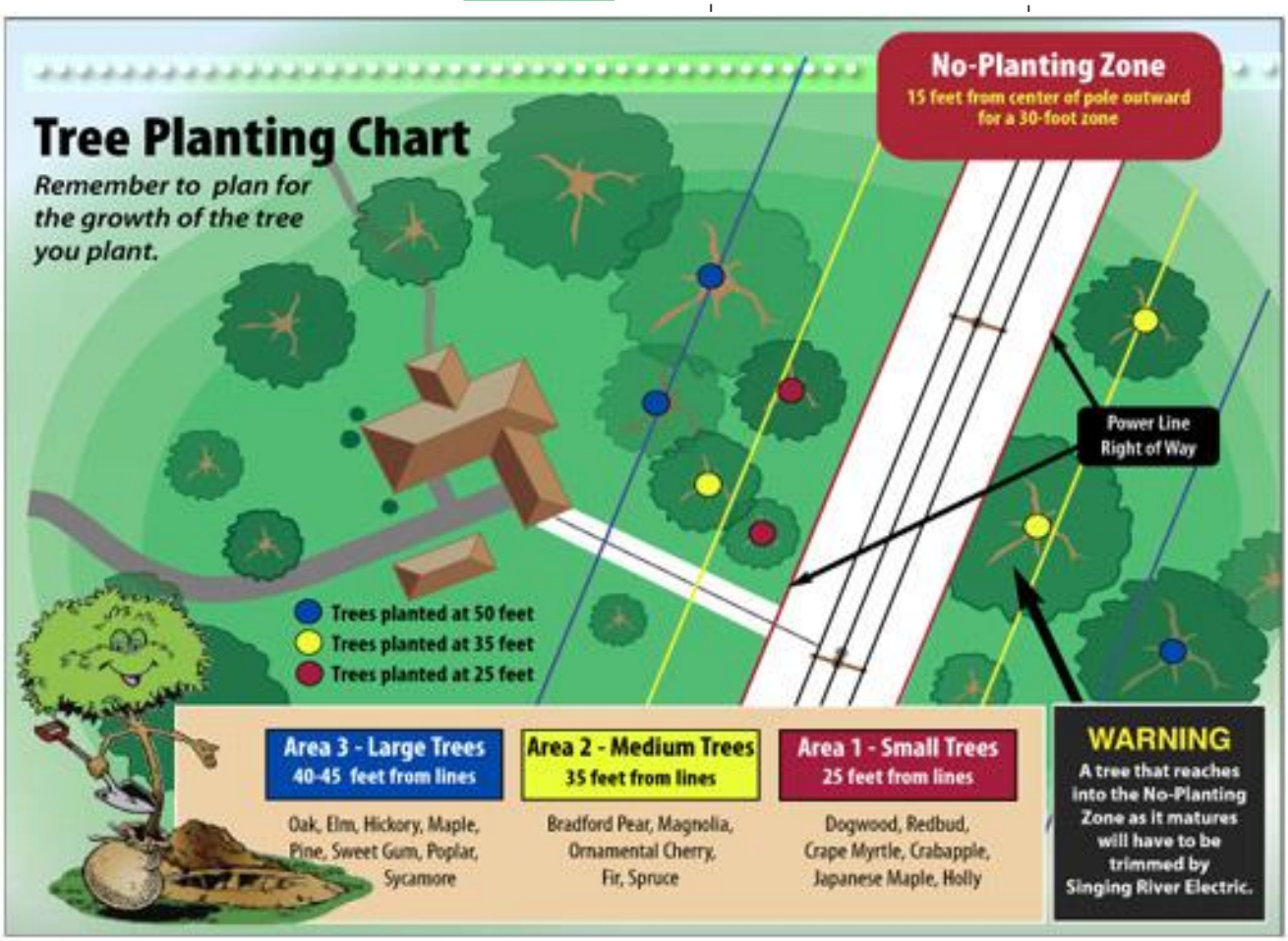
Branches can cause damage to roofs and guttering. Suckers can disturb paving, and stems can rub against walls. Buildings of more lightweight constructions, such as garages and sheds, are most at risk

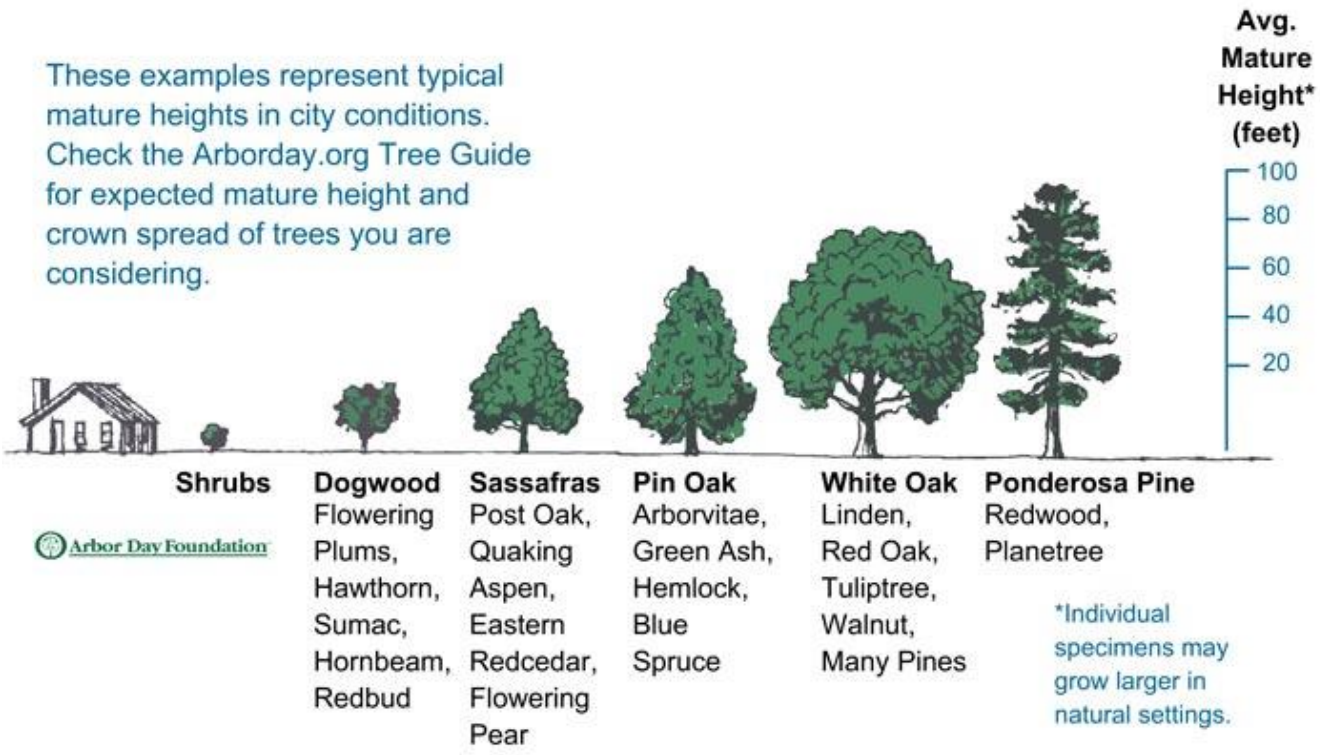
Causes:

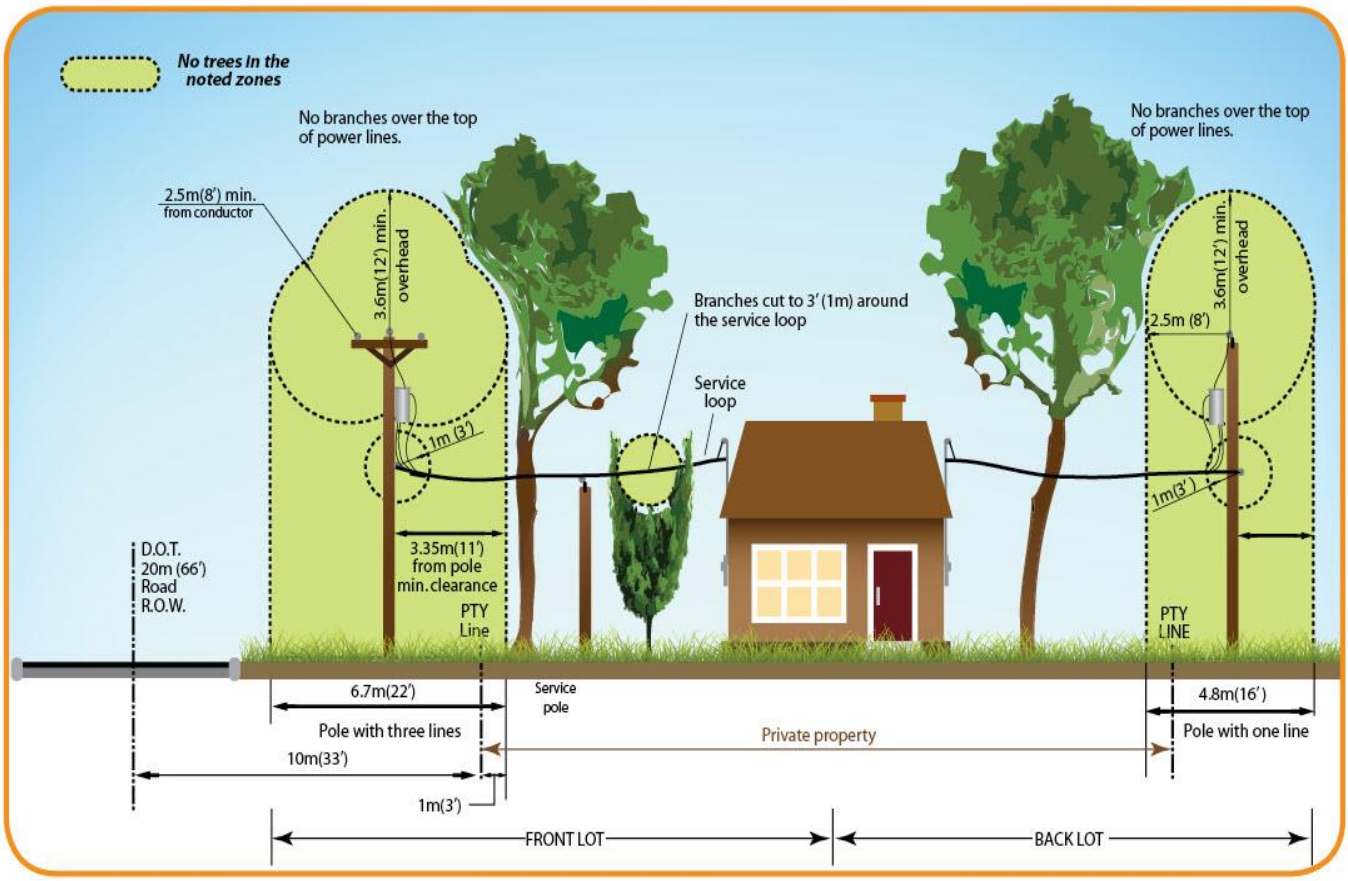
Just how can tree roots cause problems?

- During prolonged periods of drought, trees can further dry out the soil to the extent that clay soil will shrink. This can result in subsidence and structural cracking, particularly around windows and doors
- Tree roots are unlikely to directly penetrate sound footings, but can exploit any cracks or faults (perhaps caused by soil shrinkage or heave), thereby compounding the problem as they extend and expand
- Tree roots are sensitive to water, and this is what causes them to grow into drains. If the drains are watertight, then tree roots will not generally trouble them


Tall trees, such as:
maple, oak, spruce,
and pine
Plant the right tree in the right place
Plant taller trees away from overhead utility lines
Tree pruning zone
40 feet height or less
25 feet
height
or less
20 ft
50 ft
The National
Arbor Day Foundation®
arborday.org
Medium trees, such as:
washington hawthorn
and goldenraintree
Small trees, such as:
redbud, dogwood,
and crabapple


Tree Planting Chart
Remember to plan for the growth of the tree you plant.
No-Planting Zone
15 feet from center of pole outward for a 30-foot zone
Power Line
Right of Way
Trees planted at 50 feet
Trees planted at 35 feet
Trees planted at 25 feet
Area 3 - Large Trees
40-45 feet from lines
Oak, Elm, Hickory, Maple, Pine, Sweet Gum, Poplar, Sycamore
Area 2 - Medium Trees
35 feet from lines
Bradford Pear, Magnolia, Ornamental Cherry, Fir, Spruce
Area 1 - Small Trees
25 feet from lines
Dogwood, Redbud, Crape Myrtle, Crabapple, Japanese Maple, Holly
WARNING
A tree that reaches into the No-Planting Zone as it matures will have to be trimmed by Singing River Electric.


These examples represent typical mature heights in city conditions. Check the Arborday.org Tree Guide for expected mature height and crown spread of trees you are considering.
Avg. Mature Height* (feet)
100
80
60
40
20
Shrubs
Dogwood Flowering Plums, Hawthorn, Sumac, Hornbeam, Redbud
Sassafras Post Oak, Quaking Aspen, Eastern Redcedar, Flowering Pear
Pin Oak Arborvitae, Green Ash, Hemlock, Blue Spruce
White Oak Linden, Red Oak, Tuliptree, Walnut, Many Pines
Ponderosa Pine Redwood, Planetree
Arbor Day Foundation
*Individual specimens may grow larger in natural settings.


No trees in the noted zones
No branches over the top of power lines.
No branches over the top of power lines.
2.5m(8') min. from conductor
3.6m(12') min. overhead
Branches cut to 3' (1m) around the service loop
Service loop
2.5m (8')
3.6m(12') min. overhead
1m (3')
1m(3')
3.35m(11') from pole min.clearance
PTY Line
PTY LINE
D.O.T. 20m (66') Road R.O.W.
6.7m(22')
Service pole
4.8m(16')
Pole with three lines
Private property
Pole with one line
10m(33')
1m(3')
FRONT LOT
BACK LOT

Tree & Shrub Planting:

Planting new trees and shrubs is not a difficult job, but one to get right, if you want your new plants to have the best start in life. The most important considerations are root health, weather, soil conditions and aftercare.

When to do it

Planting is best done between October and April.

Container-grown plants can be planted any time of the year, but are easier to care for if planted in autumn or winter, as they need less watering than ones planted in spring or summer.

Bare-root and root-balled trees and shrubs are only available in autumn and winter. They should be planted immediately, but if this is not possible, then they can be heeled in (temporary planting in the soil to prevent the roots drying out) until planting is possible.

How to plant a tree or large shrub

Site preparation

Plants will not grow where soil contains too little air, insufficient nutrients or where soil moisture is either excessive or insufficient. Pre-planting soil preparation should aim to improve these conditions:

- Loosen the soil generally to eliminate compaction and improve drainage
- Improve background fertility by incorporating fertiliser, organic matter and lime
- Ideally, assess the need for lime with a soil pH test
- Improving the soil for a wide area (2-3m (6½-10ft) around the tree) is best practice
- If soils are waterlogged over winter consider installing drainage, or an alternative is to plant on a slight mound, about 25-30cm (10in-1ft) high and 1m (39in) in diameter. Excess moisture can kill the finer roots, which become blackened and sour smelling. Wet roots are more susceptible to disease, especially Phytophthora root rot.

Guide to planting

- Remove plants from containers or fabric wrapping (some specimen trees specify that the wrapping be left on under the terms of their guarantee, but normally fabric wrappings should be taken off)
- Tease out and spread the roots to get an idea of their spread. Dig a planting hole that is no deeper than the roots, but is up to three times the diameter of the root system
- If the sides or base of the planting hole are compacted, break the soil up with a fork before planting
- With container grown plants, the top layers of compost should be scraped away, and the point where the roots flare out should be near the soil surface
- Place the plant in the planting hole
- Insert a stake if required. Small trees do not require staking but top-heavy or larger specimens should be staked
- Refill the planting hole carefully, placing soil between and around all the roots to eliminate air pockets
- There is little evidence that adding extra fertiliser and organic matter to the planting hole helps; in fact this practice can hinder plant establishment as the organic matter decomposes and may cause the plant to sink. There is also less incentive for the roots to grow out into the surrounding soil
- Firm the soil gently, avoiding compacting the soil into a hard mass

Aftercare

Watering

Drought stress is common with newly planted trees and shrubs. Even in a cool, wet summer, the rain rarely replenishes soil moisture stores fully. The soil may be dry around the roots even when the surface appears moist.

Dry, windy conditions are especially likely to lead to water shortages. With experience, it is possible to detect the dull, lifeless foliage indicative of drought stress but by then the tree has already been damaged. Ideally anticipate water loss, and irrigate to prevent damage.

Watering aids can assist watering of newly planted trees such as irrigation tubes (biodegradable tree irrigation pipe made from potato starch is available) or watering bags such as Treegator®.

Weeding

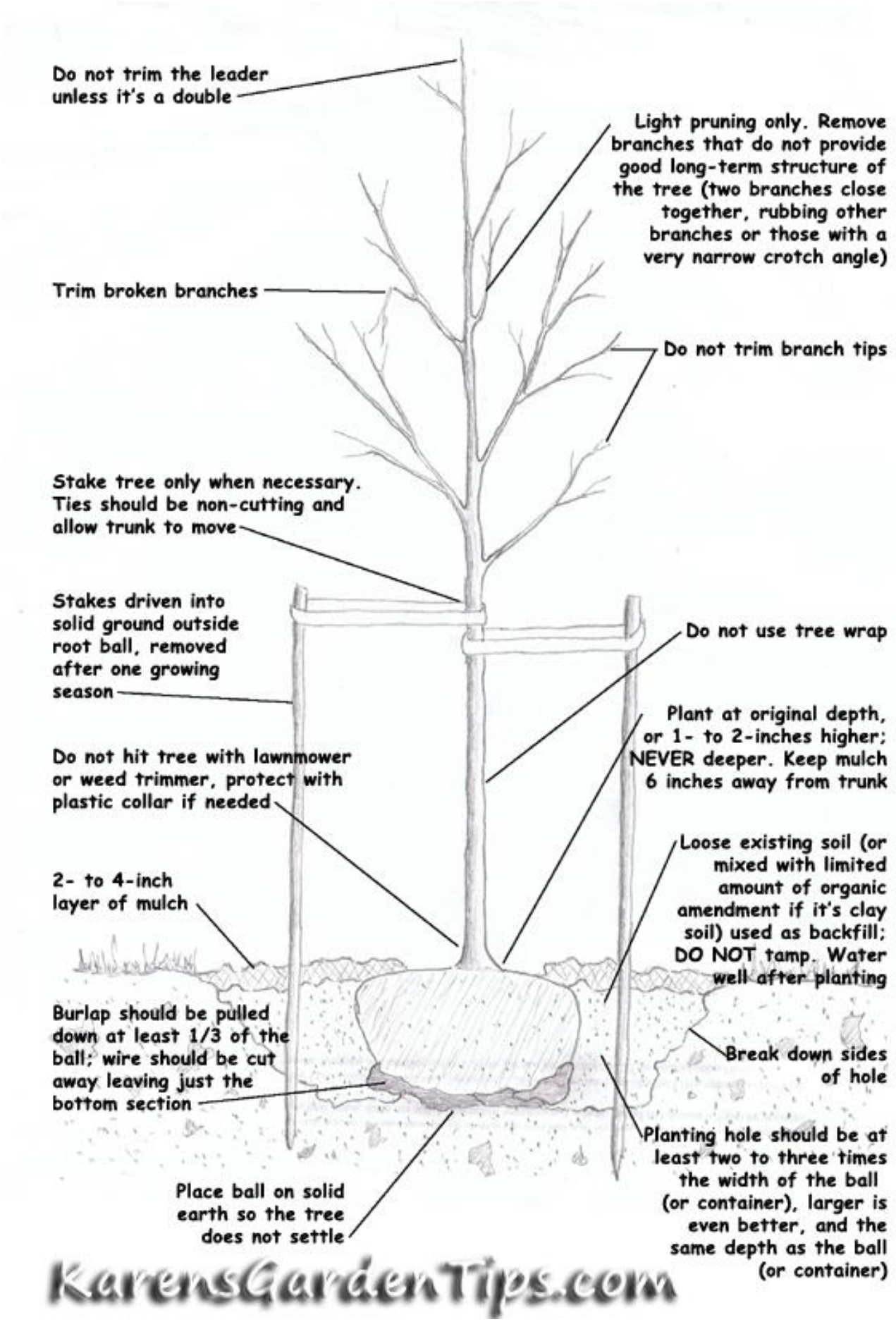
Weeds, lawns and other vegetation intercept water before it reaches the roots of newly planted trees and shrubs.

Keep a vegetation-free circle at least 1.2m (4ft) in diameter around the plant for its first three years to help avoid this problem
The circle can be kept weed free through hoeing or use of contact or systemic weedkillers
Laying mulch over this circle is also helpful, although take care to leave a collar of 10cm (4in) around the woody stems that is free of mulch, to prevent the risk of rotting the bark

Problems

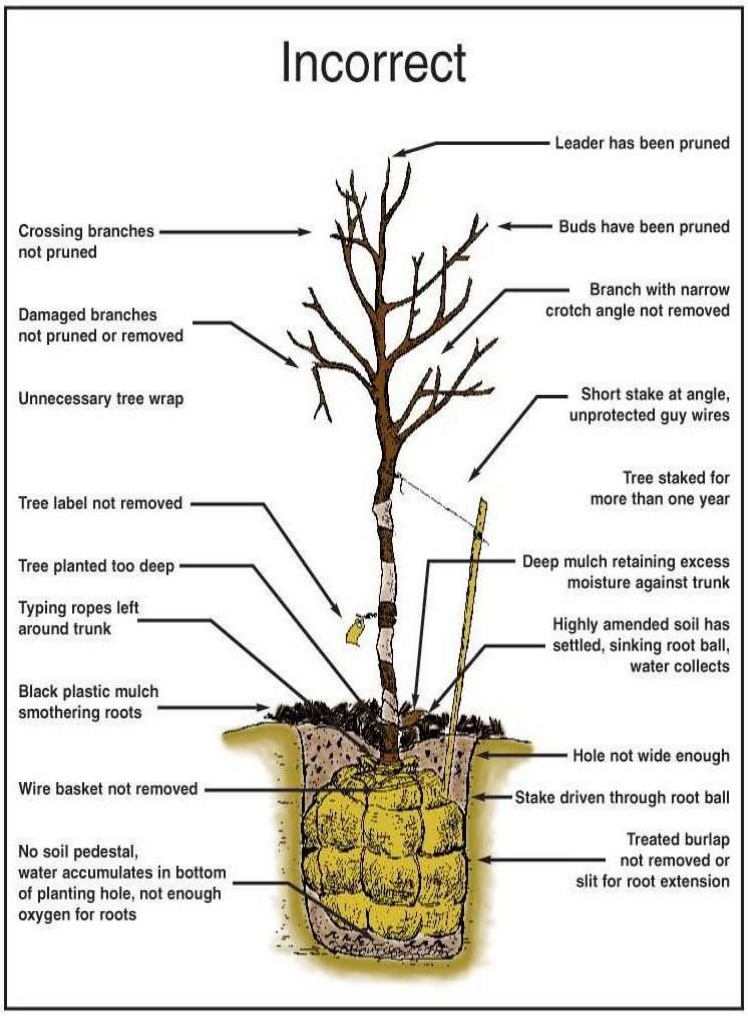
Planting too deep is a common cause of tree death. Aim to plant at the same depth that the tree was growing in the nursery. Poor establishment and brown leaves are also sometimes encountered after planting.

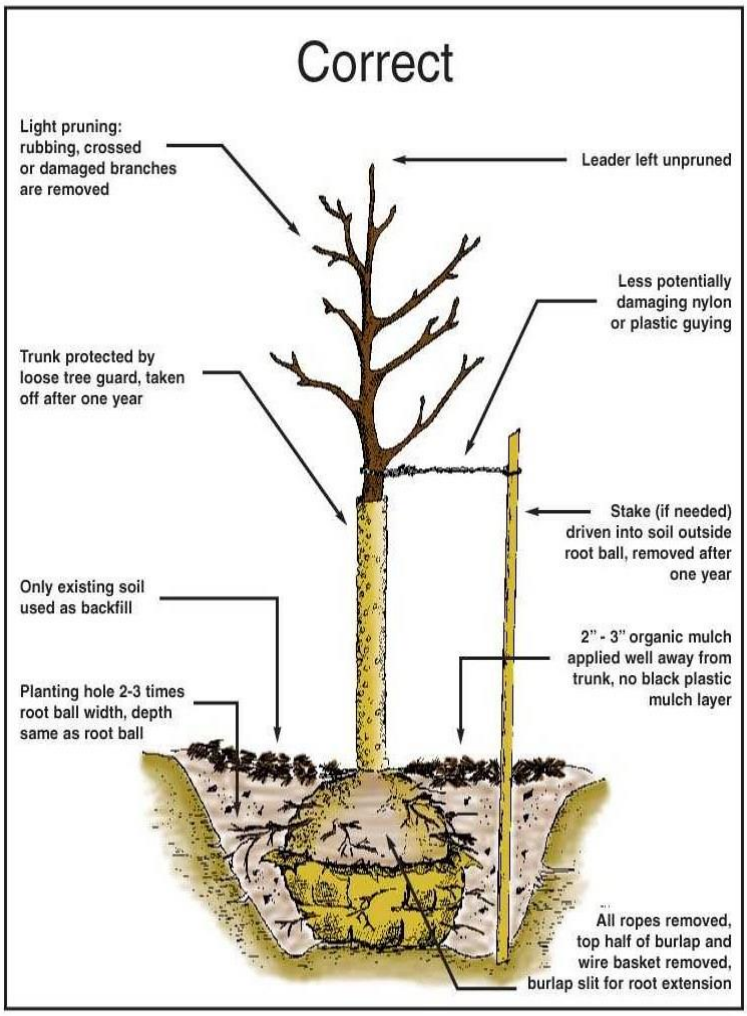
Newly planted trees often need protection from mice and voles, rabbits and deer to prevent being ring-barked.


Do not trim the leader unless it's a double
Light pruning only. Remove branches that do not provide good long-term structure of the tree (two branches close together, rubbing other branches or those with a very narrow crotch angle)
Trim broken branches
Do not trim branch tips
Stake tree only when necessary. Ties should be non-cutting and allow trunk to move
Stakes driven into solid ground outside root ball, removed after one growing season
Do not use tree wrap
Plant at original depth, or 1- to 2-inches higher; NEVER deeper. Keep mulch 6 inches away from trunk
Do not hit tree with lawnmower or weed trimmer, protect with plastic collar if needed
Loose existing soil (or mixed with limited amount of organic amendment if it's clay soil) used as backfill; DO NOT tamp. Water well after planting
2- to 4-inch layer of mulch
Burlap should be pulled down at least 1/3 of the ball; wire should be cut away leaving just the bottom section
Break down sides of hole
Planting hole should be at least two to three times the width of the ball (or container), larger is even better, and the same depth as the ball (or container)
Place ball on solid earth so the tree does not settle
KarensGardenTips.com

Tree Planting

To ensure healthy trees, start with Right Tree/Right Location.
Once you select a tree suited for your site and its microclimate, be sure to plant the tree correctly!





Urban Trees

An **urban forest** is a forest or a collection of trees that grow within a city, town or a suburb. In a wider sense it may include any kind of woody plant vegetation growing in and around human settlements. In a narrower sense (also called **forest park**) it describes areas whose ecosystems are inherited from wilderness leftovers or remnants. Care and management of urban forests is called **urban forestry**.

Urban forests play an important role in ecology of human habitats in many ways: they filter air, water, sunlight, provide shelter to animals and recreational area for people. They moderate local climate, slowing wind and storm-water, and shading homes and businesses to conserve energy. They are critical in cooling the urban heat island effect, thus potentially reducing the number of unhealthful ozone days that plague major cities in peak summer months.

Over the last decade, the activities of numerous charities and public sector organisations (e.g. Trees for Cities, The Forestry Commission and Natural England) have helped to put the creation of sustainable urban forests firmly on the agenda for politicians, policy makers, planners and landscape design professionals.
Throughout this period, ongoing scientific research has continued to provide overwhelming evidence of the numerous benefits and advantages that trees can bring to the urban environment, in terms of both their social and environmental impact.
That trees can improve the quality of life for city residents and make a positive contribution to large-scale planning and infrastructure requirements is now beyond question. In fact, the establishment of healthy urban trees is fast becoming a central component in strategies to deliver a diverse range of outcomes such as the management of urban micro-climates, the creation of Sustainable Urban Drainage Systems (SUDS) and the improvement of air quality in towns and cities. The growth of urban forests also has an important part to play in the development of carbon reduction strategies.

Top 22 Benefits of Trees

Here are 22 of the best reasons to plant and care for trees or defend a tree's standing:

Trees combat the greenhouse effect

Global warming is the result of excess greenhouse gases, created by burning fossil fuels and destroying tropical rainforests. Heat from the sun, reflected back from the earth, is trapped in this thickening layer of gases, causing global temperatures to rise. Carbon dioxide (CO2) is a major greenhouse gas. Trees absorb CO2, removing and storing the carbon while releasing the oxygen back into the air. In one year, an acre of mature trees absorbs the amount of CO2 produced when you drive your car 26,000 miles.

Trees clean the air

Trees absorb odours and pollutant gases (nitrogen oxides, ammonia, sulphur dioxide and ozone) and filter particulates out of the air by trapping them on their leaves and bark.

Trees provide oxygen

In one year an acre of mature trees can provide enough oxygen for 18 people.

Trees cool the streets and the city

Average temperatures in Los Angeles have risen 6°F in the last 50 years as tree coverage has declined and the number of heat-absorbing roads and buildings has increased.

Trees cool the city by up to 10°F, by shading our homes and streets, breaking up urban "heat islands" and releasing water vapor into the air through their leaves.

Trees conserve energy

Three trees placed strategically around a single-family home can cut summer air conditioning needs by up to 50 percent. By reducing the energy demand for cooling our houses, we reduce carbon dioxide and other pollution emissions from power plants.

Trees save water

Shade from trees slows water evaporation from thirsty lawns. Most newly planted trees need only fifteen gallons of water a week. As trees transpire, they increase atmospheric moisture.

Trees help prevent water pollution

Trees reduce runoff by breaking rainfall thus allowing the water to flow down the trunk and into the earth below the tree. This prevents storm-water from carrying pollutants to the ocean. When mulched, trees act like a sponge that filters this water naturally and uses it to recharge groundwater supplies.

Trees help prevent soil erosion

On hillsides or stream slopes, trees slow runoff and hold soil in place.

Trees shield children from ultra-violet rays

Skin cancer is the most common form of cancer in the United States. Trees reduce UV-B exposure by about 50 percent, thus providing protection to children on school campuses and playgrounds - where children spend hours outdoors.

Trees provide food

An apple tree can yield up to 15-20 bushels of fruit per year and can be planted on the tiniest urban lot. Aside from fruit for humans, trees provide food for birds and wildlife.

Trees heal

Studies have shown that patients with views of trees out their windows heal faster and with less complications. Children with ADHD show fewer symptoms when they have access to nature. Exposure to trees and nature aids concentration by reducing mental fatigue.

Trees reduce violence

Neighbourhoods and homes that are barren have shown to have a greater incidence of violence in and out of the home than their greener counterparts. Trees and landscaping help to reduce the level of fear.

Trees mark the seasons

Is it winter, spring, summer or fall? Look at the trees.

Trees create economic opportunities

Fruit harvested from community orchards can be sold, thus providing income. Small business opportunities in green waste management and landscaping arise when cities value mulching and its water-saving qualities. Vocational training for youth interested in green jobs is also a great way to develop economic opportunities from trees.

Trees are teachers and playmates

Whether as houses for children or creative and spiritual inspiration for adults, trees have provided the space for human retreat throughout the ages.

Trees bring diverse groups of people together

Tree plantings provide an opportunity for community involvement and empowerment that improves the quality of life in our neighbourhoods. All cultures, ages, and genders have an important role to play at a tree planting or tree care event.

Trees add unity

Trees as landmarks can give a neighbourhood a new identity and encourage civic pride.

Trees provide a canopy and habitat for wildlife

Sycamore and oak are among the many urban species that provide excellent urban homes for birds, bees, possums and squirrels.

Trees block things

Trees can mask concrete walls or parking lots, and unsightly views. They muffle sound from nearby streets and freeways, and create an eye-soothing canopy of green. Trees absorb dust and wind and reduce glare.

Trees provide wood

In suburban and rural areas, trees can be selectively harvested for fuel and craft wood.

Trees increase property values

The beauty of a well-planted property and its surrounding street and neighbourhood can raise property values by as much as 15 percent.

Trees increase business traffic

Studies show that the more trees and landscaping a business district has, the more business will flow in. A tree-lined street will also slow traffic – enough to allow the drivers to look at the store fronts instead of whizzing by.

Toxic Plants

Plants cannot move to escape their predators, so they must have other means of protecting themselves from herbivorous animals. Some plants have physical defences such as thorns, spines and prickles, but by far the most common protection is chemical. Over millennia, natural selection has produced a complicated and vast array of chemical compounds that deter herbivores. Tannin is a compound that emerged relatively early in the evolutionary history of plants, while more complex molecules such as polyacetylenes are found in younger groups of plants such as the Asterales. Many of the plant defence compounds arose to defend against consumption by insects, although when livestock or humans consume such plants, they may also experience negative effects, ranging from mild discomfort to death.

Deceptively attractive, some common flowers and plants not only eliminate the non-toxic plants but can kill animals and can give you headaches, cause convulsions or simply kill you, according to the "Handbook of Poisonous and Injurious Plants" (Springer, 2007).
This Causes a great change in the habitat if you are have one of these in your home or near area. Here are the World's 10 deadliest Plants:

1. Giant Pitcher Plant: *Nepenthes attenboroughii*

2. Castor Bean Plant: *Ricinus communis*

3. Western Water Hemlock: *Cicuta douglasii*

4. White snakeroot: *Eupatorium rugosum*

5. Monkshood: *Aconitum napellus*

6. Common Bladderwort: *Utricularia macrorhiza*

7. Venus flytrap: *Dionaea muscipula*

8. Angel Trumpet: *Brugmansia*

9. Oleander: *Nerium oleander*

10. Mala Mujer: *Cnidoscolus angustidens*

Tree Preservation & Maintenance

By their very nature, trees and green space provide benefits and add value to developments. The ability of trees to improve and maintain the quality of water, soil, and air and to remove pollutants from the air is well known. Trees also provide shade and help lower temperatures during hot weather. Trees enrich people's lives and beautify landscapes.

Preserving trees has positive effects on the image and attractiveness of developments and enhances developers' reputations and profits.

Preserving trees in developments increases a project's attractiveness, monetary value, and marketability by providing aesthetic and functional values.
Lots where trees are preserved can be sold more quickly and at higher prices.

Research has shown that mature trees increase the worth of a property up to 12 percent. Developers who understand these values realize that it is in their best interest to encourage the preservation of trees and green spaces.
Developers can take advantage of different opportunities when considering the preservation of trees. Individual historic, landmark, and ornamental trees are all good choices for preservation, as are native trees in groves and woodlots.
Opportunities differ from one development to another, but many of the recommendations for preserving trees remain the same.
Various people, such as arborists, engineers, architects, planners, and municipal officials, may become involved in preserving trees. Properly preserving trees in development takes time, good design, communication, and money.
However, the results are worth the effort.

Tree Protection Zone

Injuries to a tree or group of trees can be minimized by providing a tree protection zone (TPZ), a fenced area around a tree that will not be disturbed by construction work. Information from the tree report is used to determine TPZ locations. In a TPZ, the soil is protected from compaction, critical roots are not damaged by pruning, trenching, or excessive grade changes, and trunk and branches are not damaged by equipment or workers. A TPZ will ensure that a tree is protected during construction, has enough space for root and branch growth, and will receive adequate supplies of soil nutrients, air, and water.

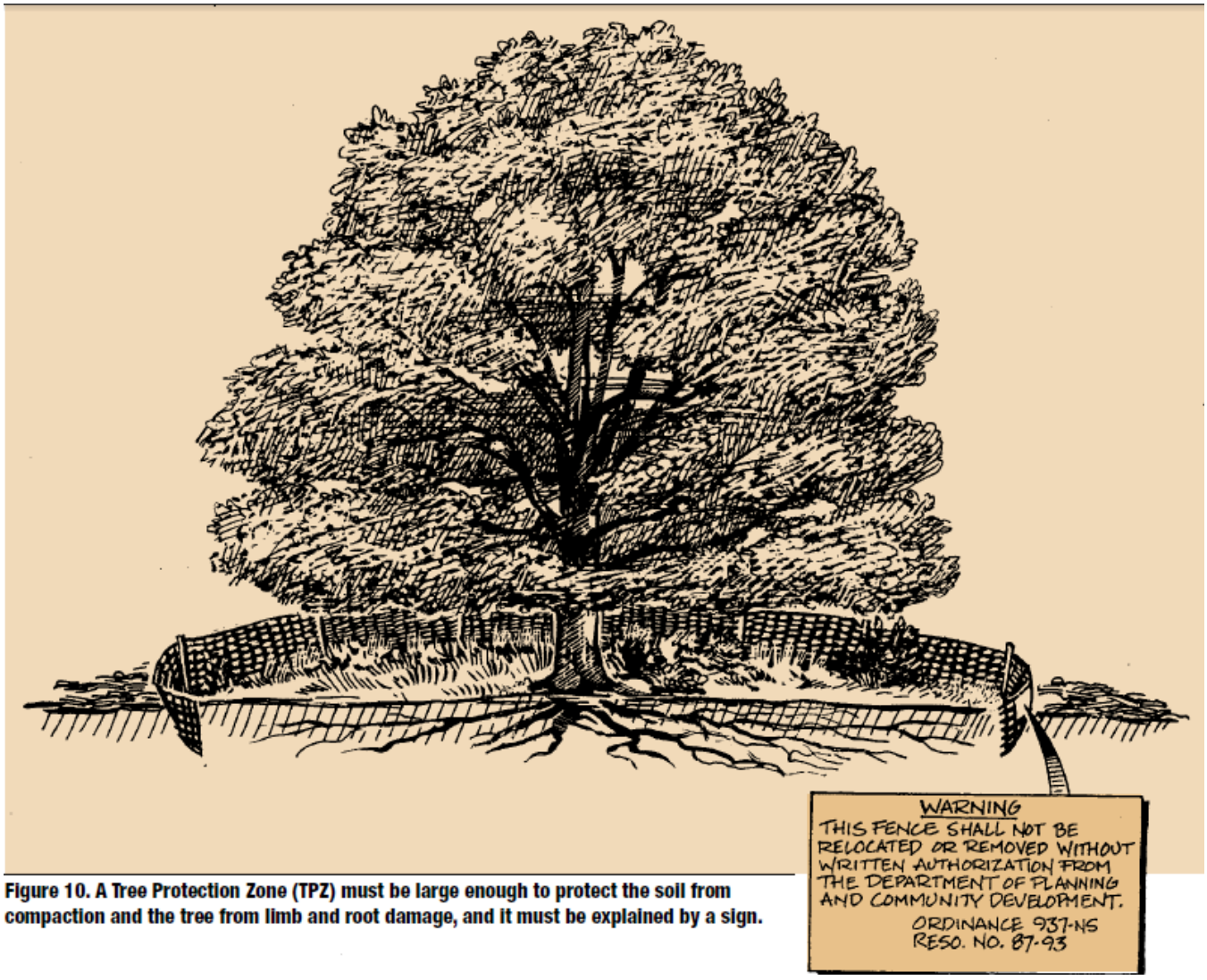


Figure 10. A Tree Protection Zone (TPZ) must be large enough to protect the soil from compaction and the tree from limb and root damage, and it must be explained by a sign.

Tree Preservation Plan

Information on tree preservation zones and the location, size, and condition of trees from the tree report is combined with information on a grading or site plan to prepare a tree preservation plan.

The tree preservation plan shows the location of development footprints, including buildings, utilities, and streets, and how trees and tree preservation zones relate to them. The tree preservation plan helps developers make decisions about which worthy trees can be preserved, which should be removed, which can be transplanted, and how trees may be encroached upon. This plan also helps developers determine how footprints, streets, and other factors can be altered to facilitate tree preservation.

A tree preservation plan identifies places where limited space needs to be carefully managed when developers are trying to accommodate both trees and construction. This type of plan leads to changes during the early stages of development that will preserve important trees and help developers avoid costly mistakes and delays. The best plans provide adequate tree protection zones that separate buildings, infrastructure, and construction activities from worthy trees.

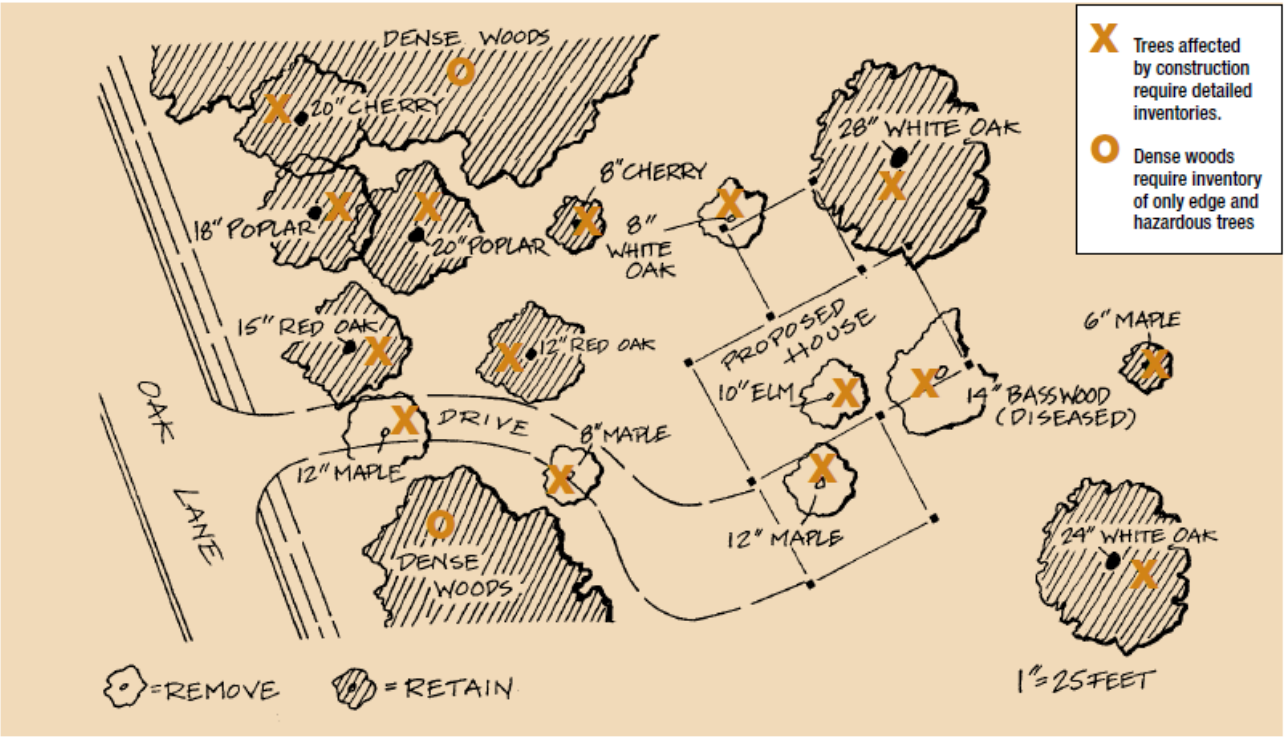


Figure 11. A simple tree preservation plan shows the location of house, driveway, and trees to be removed, encroached upon, and retained.

The following guidelines can help you develop a tree preservation plan.

- Use accurate information.
- Place utility paths on plans.
- Identify affected trees.
- Consider alternative plans to minimize construction impacts on suitable trees.
- Consider alternative construction techniques.
- Consider energy needs of buildings.
- Consider replacing or moving trees.
  Smaller trees sometimes can be replaced for less than it would cost to preserve them. Nursery plants can be placed in just the right locations and are often of equal or greater value than existing smaller trees. Usually it is more beneficial and effective to save larger trees, because larger trees can provide greater functional and aesthetic benefits and have surprisingly high monetary values in landscapes.

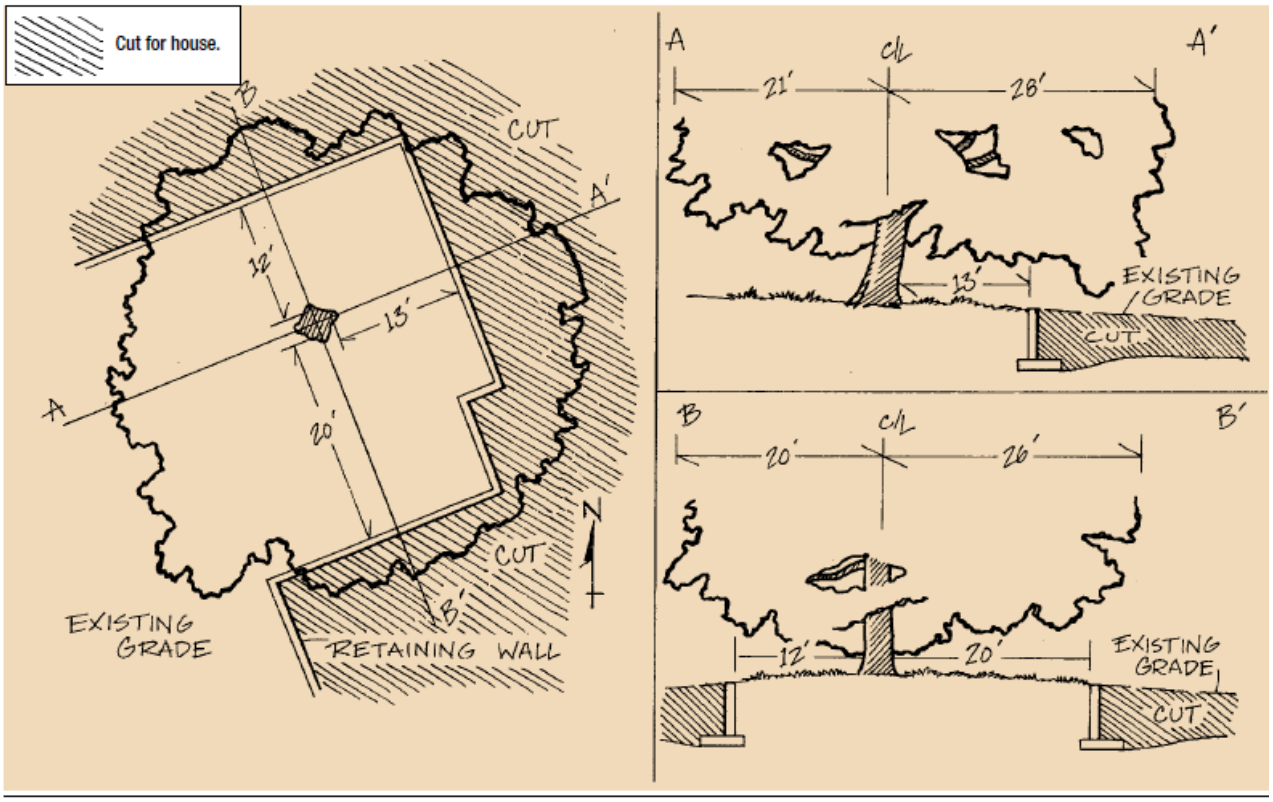


Figure 13. Information from a tree report and tree preservation plan can be used to prepare plan and elevation drawings of proposed construction impacts to trees. These drawings help developers visualize the impacts soil compaction and required limb and root pruning will have on trees.

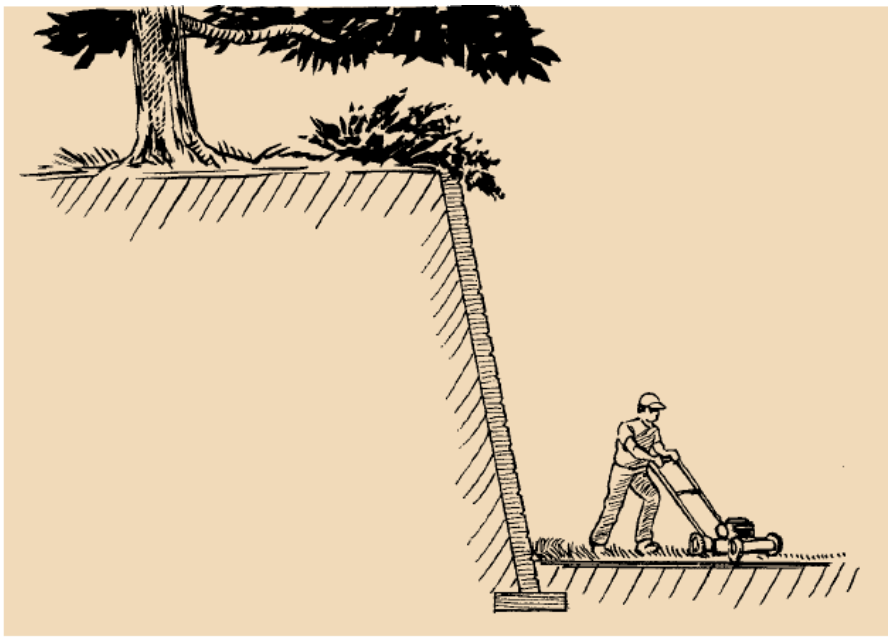


Figure 14. Crib walls can be used to limit the length of manufactured slopes, providing more room for trees and development.

Figure 15. Attractive retaining walls can be used to limit the size of fill and cut slopes, increasing the size of a tree's protection zone.

- Consider cluster development and other alternative subdivision designs.
  Developers of larger projects may wish to consider setting aside groves of trees to provide recreation, wildlife habitat, and other environmental benefits. Because of these benefits, it is often desirable to incorporate groves of trees into a development's landscape.

Construction Activities

Protecting Trees during Construction

The following recommendations should be implemented to help protect trees during the construction phase.

- **Using the tree report and tree preservation plan to evaluate trees in the field.**
  Proposed tree encroachments can be staked in the field so that needed root and canopy pruning and tree removals can be completed before construction begins.
  Staking curblines, foundations, and other elements also allows for additional evaluation of tree protection techniques, such as retaining walls, before construction begins. Lay out temporary roadways and storage areas.

- **Hurricane or other protective fencing should be placed around a TPZ to physically protect trees.**

- **Do not raise or lower the natural soil level within a TPZ.**
  Raising the grade within a TPZ by adding or "filling" soil reduces water infiltration and air exchange in the soil around the roots. Lowering the grade or "cutting" soil removes both soil and tree roots, and also damages the roots that remain.
  Filling or cutting soil within a TPZ can severely injure or kill a tree.

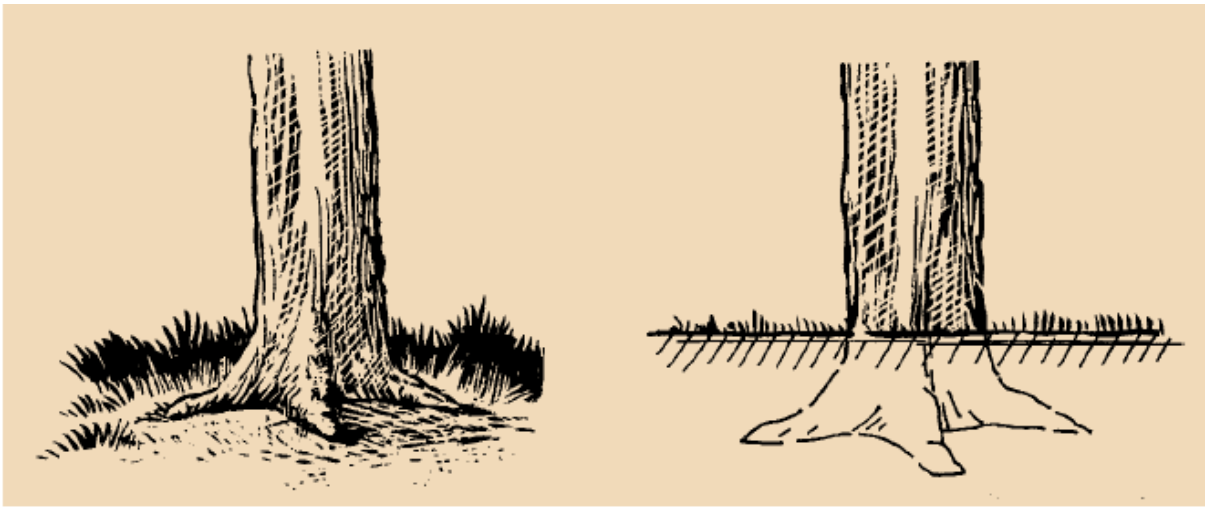


Figure 20. Do not raise the natural soil level within a TPZ. Trees that have been buried in fill can be identified by a lack of root flare.

Figure 21. Cutting or lowering the soil level near a tree severely damages tree roots, leading to a decline in health and even to death.

- **Consider impacts away from important trees.**
  Construction activities well outside the tree protection zone also can have detrimental effects on a tree's health. For example, cuts and fills can affect natural aquifers and drainage patterns. Large manufactured slopes created by cuts uphill from trees can remove their water source, or increase erosion. Compacted fills and retaining walls on the downhill side of trees can act like dams, causing water to accumulate. Positive drainage should be provided for preserved trees where needed. Effects of grading on important trees should be evaluated.

- **Do not store materials or operate equipment near or under trees.**
  Transporting, handling, and storing building materials and supplies near and under trees can compact the soil, which kills and injures tree roots. In addition to injuring tree roots, construction equipment can break limbs or wound bark.
  Equipment should not be operated in the TPZ and nothing should be stored in it, including fuel, chemicals, soil, and construction materials.

- **Do not pollute the soil within a TPZ.**
  Arrange for proper disposal of construction waste. Soils may be polluted by the on-site disposal of construction residues, petroleum products, or other chemicals.
  Lime-based products such as cement and plaster can dramatically raise the alkaline level of the soil. Many trees, such as pin oak, red maple, and sweetgum, cannot tolerate high pH or alkaline soils. Burying rocks and other debris near trees can damage and inhibit their root growth. The pollution of soils must be prevented if they are to support root growth.

- **Designate specific sites for equipment cleaning or disposal of construction debris.**
  Do not bury construction debris to avoid the cost of hauling and disposal.
  Only sites that are well away from tree preservation or planting areas should be designated for equipment cleaning and disposal of debris.

- **Use construction designs that minimize soil compaction for streets, parking lots, driveways, and patios.**
  Streets and parking lots can not support their own weight, so soil compaction is a requirement for standard asphalt or concrete construction. Self-supporting or permeable asphalt or concrete sections for streets and parking lots can be engineered and constructed around trees of high value.

- **Use aeration and other special preservation systems only when absolutely necessary.**
  If non-structural fill is to be placed and lightly compacted within a tree protection zone for a parking lot or other hard surface, an aeration system can be used to assist in the infiltration of water and air. These systems should be designed and installed by professionals.

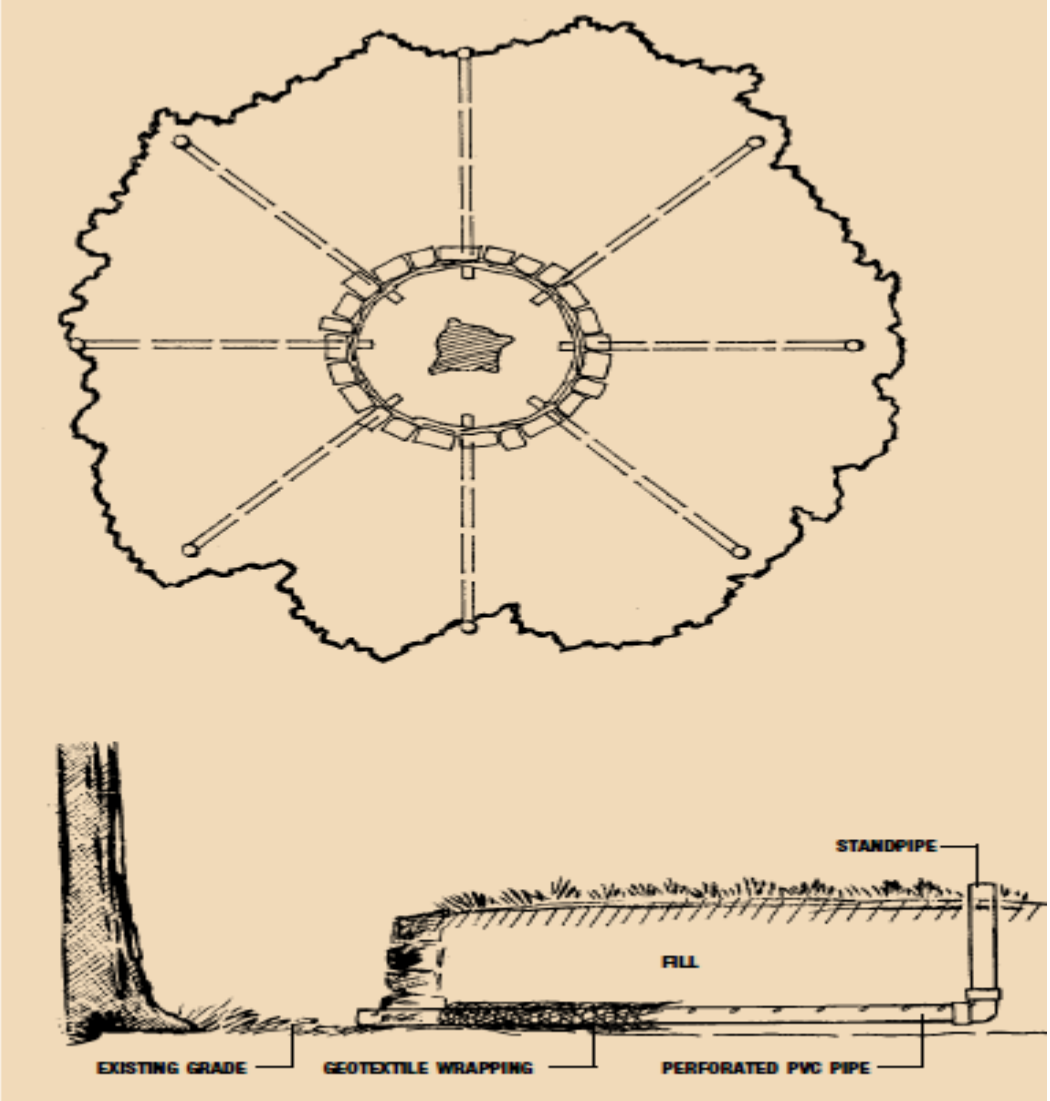


Figure 22. Aeration systems should be designed by professionals and used only when absolutely necessary. The effectiveness of aeration systems is debatable. Some of the disadvantages of 4-inch PVC pipe may be avoided by using a flexible drainage system.

- **Use geotextiles for temporary roads and storage areas.**
  Soil compaction destroys soil structure, which takes many years to develop. Soil structure directly affects the aeration, drainage, and water-holding capacity of a soil. An inexpensive and recyclable way of protecting soil structure is to use a layer of heavyweight geotextile covered with about 4 inches of wood chips. This system will support the weight of a loaded cement truck and can be used on all construction sites for temporary roadways and materials storage areas.

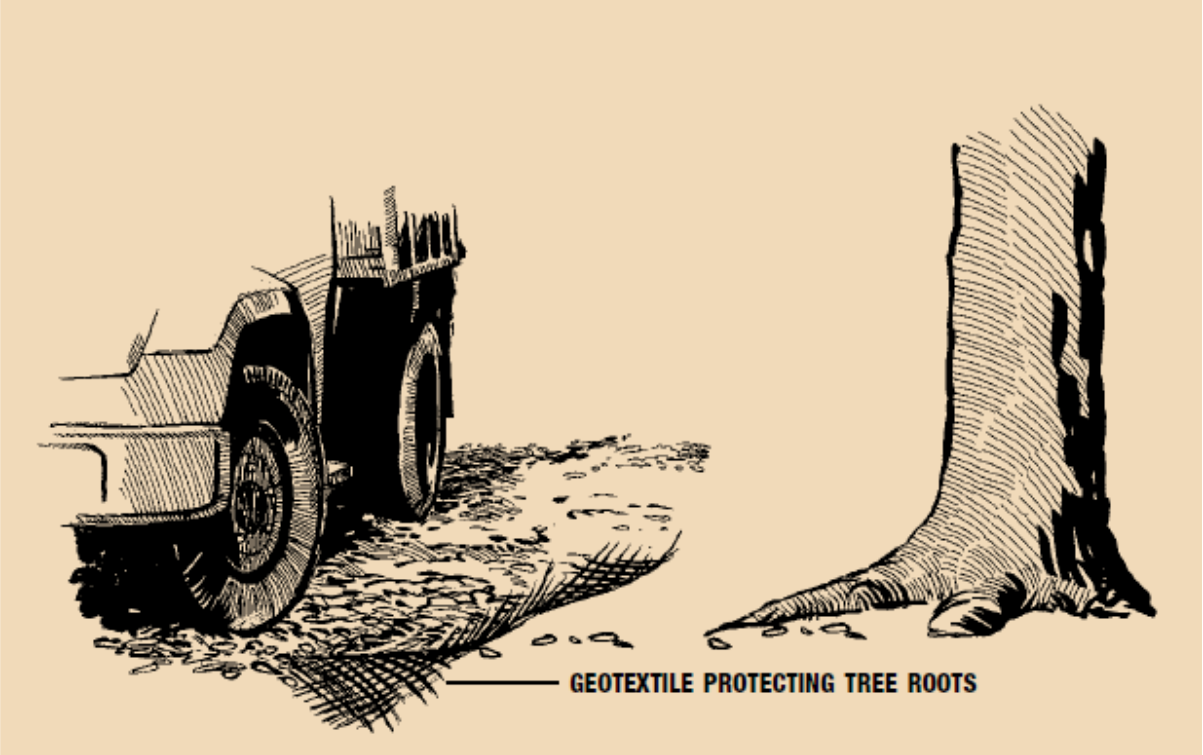


Figure 23. Two to 4 inches of mulch placed on a geotextile sheet protects soils from compaction caused by construction equipment and material storage.

- **Retain a qualified arborist to perform tree maintenance services.**
  An experienced arborist can monitor tree health before and during construction. If necessary, this specialist can then water or fertilize the trees, or provide treatment for a pest or disease problem. Although care should be taken when working around all trees, some trees are more sensitive to construction than others. For example, older and larger trees may need specialized attention, such as fertilization and irrigation, if they are disturbed by root pruning, soil compaction, or other construction activity.

- **Retain a qualified arborist to perform all required pruning.**
  Construction workers untrained in pruning or other arboricultural practices often unintentionally damage trees while trimming them. Construction workers who trim trees often leave branch stubs, tear the bark, or remove more branches than necessary. The tree preservation plan should identify which limbs must be pruned to accommodate construction.
  Required pruning and removal of limbs can be better understood by staking construction footprints. Pruning should be based on the tree preservation plan and be performed by a qualified arborist before construction begins.

Figure 24. Pruning should protect a tree's natural form. Well-pruned trees are similar in form and appearance to trees that have not been pruned.

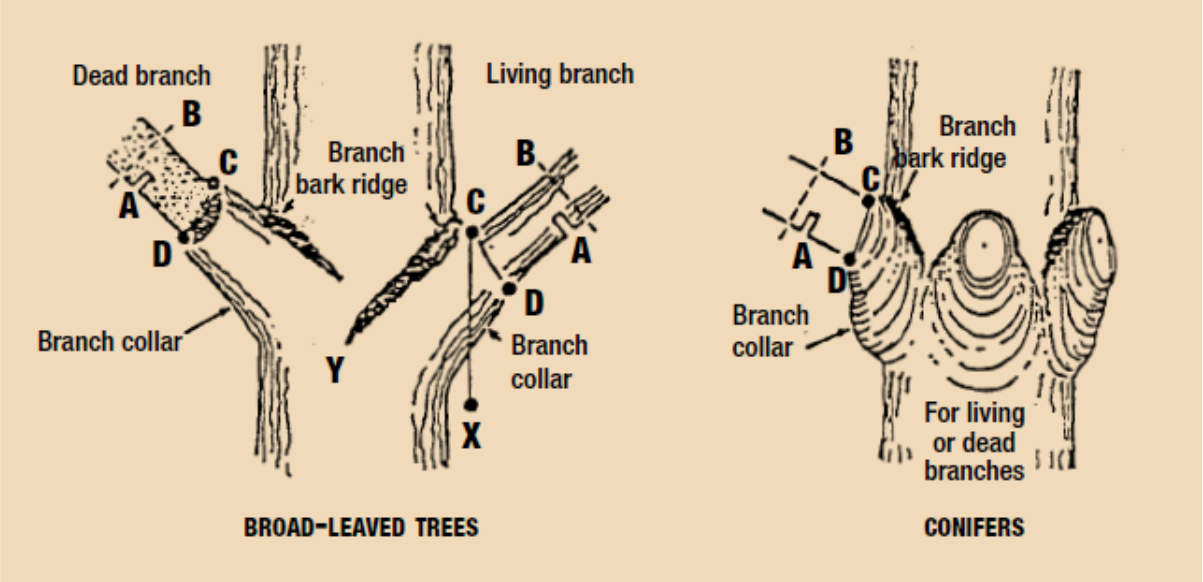


Figure 25. Natural Target Pruning properly removes a branch while protecting the branch collar, which is essential for wounds to heal. First cut A, second cut B, and third cut C-D.

- **Retain a qualified arborist to perform all required root pruning.**
  A tree's tolerance of root loss may vary greatly depending on its age, species, and health, as well as rainfall and soil quality. Some healthy young trees can survive after losing 50 percent of their roots, although their structure may be compromised. Other species are extremely sensitive to root pruning and soil compaction. Avoid disturbing more than 25 percent of the roots within the dripline for any tree and do not disturb any roots within the dripline of old, valuable, or sensitive trees. Hire an arborist to

provide supervision when exposing roots close to large, historic, or notable trees. Any root pruning should be done by, or under the direction of, a qualified arborist.

- **Consider using hand labor to expose roots in cut areas needed within or adjacent to a TPZ.** Exposing roots with a backhoe or other piece of equipment can tear roots, resulting in damage and decay. Instead, dig with hand tools to expose roots that may interfere with construction. During hot weather, wrap all roots exposed by trenching with dampened burlap if there is a delay in deciding whether the roots should be preserved. If a footing or curb is being constructed, conflicting roots should be severed cleanly with a saw.
  Newly pruned roots over 3 inches in diameter should be protected from drying by covering the cut end of the roots with a plastic bag secured by a rubber band. During hot weather, cut areas where tree roots are removed or exposed should be covered with black plastic and kept damp until it is time to complete the work.

Figure 26. When digging near trees suitable for preservation, the first cut should be made by hand labor with shovels under supervision of an arborist. Exposed roots should be neatly cut with a sharp saw. To protect them from drying out, the ends of severed roots can be covered with a plastic sandwich bag held in place by a rubber band.

Figure 27. After roots are exposed and cleanly cut, the soil around them should be watered and covered with black plastic during hot periods. Large equipment can be used for mass grading after tree roots have been protected.

- **Do not excavate utility trenches through a TPZ.**

Injuring roots kills trees. The root systems of trees can be severely injured by trenches that are dug directly through them. Relocate utility trenches or use tunnelling or boring equipment when installing underground utilities through a TPZ. Trenching with backhoes and other equipment can destroy entire root systems, while tunneling or boring under the roots has little effect.

- **Do not use a bulldozer to selectively remove trees.**
  Trees designated to be saved can be easily damaged by bulldozers during the removal of adjacent trees. When a bulldozer is used to remove a tree, the entire tree falls at once and its canopy can damage the branches and bark of adjacent trees meant to be preserved. Bulldozers also compact soils and destroy soil structure.
  Trained arborists can selectively remove trees without harming adjacent trees.

- **Use geotextiles and other alternatives for driveways and patios.**
  When constructing brick, stone or concrete driveways and patios, it often is necessary to excavate the top 12 inches of soil and then compact the subsoil using heavy equipment. Geotextiles can be used to minimize the degree of soil compaction needed under driveways and patios.

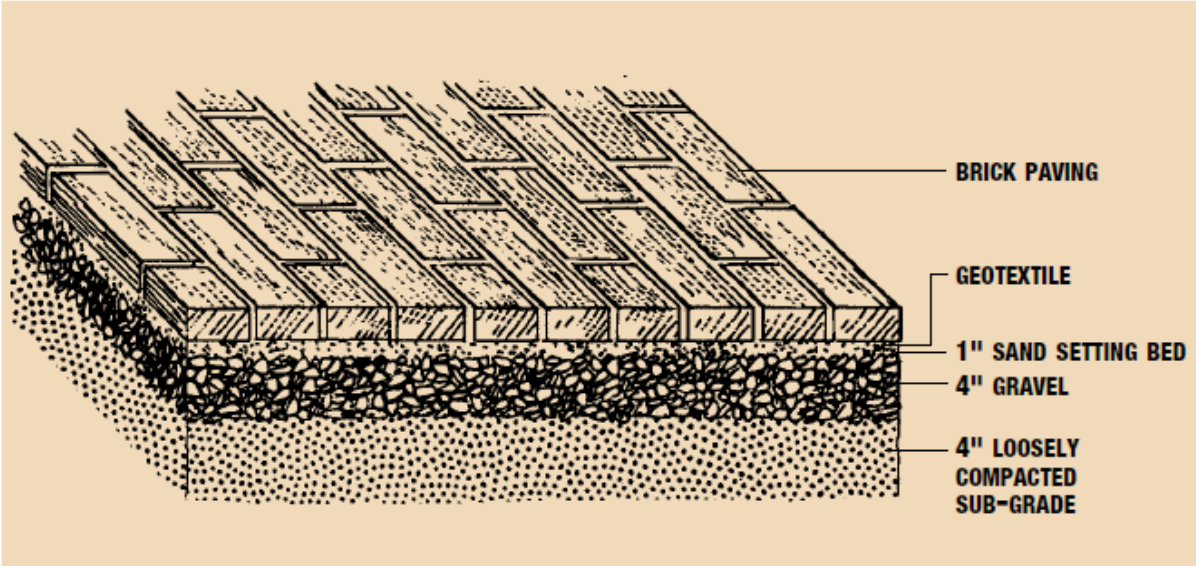


Figure 29. Brick patios and sidewalks can be designed to reduce soil compaction and root pruning.

- **Do not remove the natural leaf mulch or organic litter from beneath trees.**
  Existing litter or supplemented mulch helps improve soil structure, allows better water infiltration, protects soil and roots from erosion, moderates soil temperatures, and adds carbon and nutrients to the soil. Keep turf away from trees and install landscapes using native shrubs and other plants that will not damage trees preserved and incorporated into development.

Figure 28. Properly preserved trees will provide benefits for a lifetime.

Repairing Construction Injury

The most common causes of tree injuries are worker carelessness, grade changes, soil compaction, soil pollution, and the incorrect removal or trimming of trees.
Depending on the extent of the injuries, trees may die shortly after construction is completed or their health may slowly decline over a number of years. Several techniques can help correct injuries caused by construction activities.

Soil Techniques:

- **Understanding structural fills**
  Structural fills are used to key-in slopes and provide heavily compacted pads for construction. In a structural fill, all the soil is removed until a soil horizon with a certain compaction rate is found. Removed soils are then replaced upon the compacted soil while being compacted with water. It does no good to provide aeration systems or other preservation techniques or to remove fills of this nature from near trees because roots have already been severed in the fill process.
  Structural fills should be avoided within the TPZ of trees suitable for preservation.

- **Removing fill**
  Fill can kill trees quickly, or it can kill them gradually over a number of years.
  The effect fill has on trees depends on a number of factors. If construction activity has changed the grade under or near a tree, all efforts should be made to restore the area to its natural grade. Trees not surrounded by fill have a noticeable trunk flare at the soil line, while trees buried in fill have no trunk flare (see

  Figure 20, p. 16). Test holes can be dug at several points near the tree to determine how much fill has been added.

  Fill can be removed safely within one year after construction. A backhoe can be used to remove fill to within 4 inches of the original grade, but the rest should be removed by hand with shovels and rakes. Fill that has been in place for several years requires care during removal, and a qualified arborist should be consulted.

  Some trees survive the initial application of fill because their roots grow into the fill. For trees covered by fill for long periods of time, fill within 4 feet of the trunk should be removed to expose the trunk and buttress roots. If it appears that many new roots have grown and become established in the fill, the

excavation should stop and the fill should be replaced. Fill should not be removed during periods of hot, dry weather. Exposure under these conditions could shock a tree by drying out the roots as well as the soil around them.

The removal of fill can create a low spot around a tree that accumulates water.
If inadequate drainage is a problem, a French drain or other drainage system must be installed to move standing water away from the tree.

- **Repairing soil structure using vertical mulching**
  The poor structure of compacted soils can be improved by carefully drilling lines of holes in a concentric pattern beneath a tree.

Figure 30. Vertical mulching can help repair compacted soils and help trees recover from root systems damaged by compacted soils and root removal.

- **Replacing damaged soil**
  Soil that has been polluted or damaged beyond repair by pollution or heavy equipment should be removed and replaced. Damaged soil near trees should be removed with hand tools to avoid any further damage to roots. Although it may be better to use an ordinary top soil from the site or the locality, a loam-based soil that contains a balanced mixture of sand, silt, and clay also can be used.

Tree Techniques

- **Tree injury**
  Tree limbs that have been broken or torn off during construction should be pruned according to recognized standards by a qualified arborist. If a tree trunk or butt has been damaged, the wound can be treated by removing dead and injured bark from around the wound with a sharp knife. Cut the loose bark away from the wound to form a clean, smooth surface of healthy wood and bark. Take care not to damage healthy tissue and do not widen the wound any more than necessary to remove damaged bark. Tree wound dressing does not stop decay and should not be used on limb or trunk wounds.

- **Fertilizing**
  There are no general fertilizing recommendations that apply to all soils and trees. Healthy, vigorous trees usually do not need to be fertilized at all. To determine fertilizer needs, a soil test must be taken and analysed by a reputable laboratory.
  This test is needed to determine the soil's pH and basic nutrient levels.

  Major nutrients include Nitrogen, phosphorus, potassium, magnesium, and calcium. The laboratory should provide recommendations about how much of each of the basic nutrients should be applied.

- **Irrigation**
  During periods of hot weather and little rain, irrigation can be used alone or in combination with fertilizing to improve the health of a tree that has been heavily damaged by soil compaction or root removal. In the northeastern United
  States, a thorough soaking by rain every two weeks during the growing season is more than adequate to meet the needs of injured trees. Irrigation is not necessary when rainfall is adequate.

After Construction

Despite the fact that a tree or woodland is preserved and incorporated within development, some trees are likely to die each year because of the additional landscaping and construction activities of homeowner and inadequate tree care an maintenance. Various activities can injure a tree. These include grading; trenching and paving; building sidewalks driveways, pools, patios, and home additions; landscaping lawns and lots; and pruning trees incorrectly by topping.

Homeowners should provide proper car for preserved trees and should design compatible landscapes and amenities that protect the health of the trees. The following practices can help ensure that trees will remain healthy long after construction has been completed.

- **Supply homeowners with information.**
  Developers and realtors can supply home buyers with simple information about the value of their trees, how they can be protected, and experienced arborists in their area.

- **Keep competing vegetation, especially grasses, as far away from trees as possible.**
  Not only will grass compete with trees for water and nutrients, it also may produce chemicals that inhibit the growth of trees.

- **Consider alternative landscaping.**
  The areas beneath trees should be covered with mulch or planted with native ground covers. There are many species of native plants that provide a variety of sizes, colors, and forms for landscaping beneath preserved trees. A landscape can be created that not only protects trees, but also highlights native plants, conserves water, and reduces the need for fertilizers and pesticides.

- **Use mulch.**
  Mulch provides many benefits for trees. It moderates soil temperatures, reduces soil moisture loss, reduces soil compaction, improves soil structure, provides nutrients, and reduces winter drying. Mulch also keeps mowing equipment away, thus avoiding serious bark injuries.
  These benefits result in more root growth and healthier trees.
  Observe the following guidelines when applying mulch:

  1. The best mulch materials to use are composted leaves, wood chips, bark nuggets, or pine needles. Avoid plastic, stone, sawdust, finely shredded bark, and grass clippings.

  2. Mulch should be applied from the dripline to the trunk, but mulch should not be placed against the trunk. The mulch will retain too much moisture if left against the trunk, which may result in disease and decay.

  3. If it is not practical to mulch from the dripline to the trunk, minimum mulch circles should be 3 feet for small trees, 8 feet for medium trees, and 12 feet for large trees.

  4. Before applying mulch it is best to kill grass with an approved herbicide. Mulch should be applied directly to the soil surface or on top of the dead grass; plastic barriers should not be used.

  5. The mulch layer should be 2 to 4 inches deep—do not create mulch mountains.

  6. To avoid root disturbance, mulch should not be removed. Additional mulch can be added yearly to maintain a 2- to 4-inch depth.

- **Improve the aeration and drainage of compacted soils.**

Aerate compacted soil if the final landscape has already been installed, or if there are large trees on the site that have roots growing throughout the compacted area. Aeration can be done to shallow depths with standard core aerators, or to deeper depths by vertical mulching with power drills or augers.

- **Prevent additional soil compaction.**
  Build wooden decks instead of cement or stone patios. Cement or stone patios require the removal of soil and the compaction of the base. Use mulches, preferably with a geotextile base, to prevent compaction in heavily used areas or storage areas.

- **Irrigate and fertilize when needed.**
  Follow the recommendations in the construction injury section for irrigating and fertilizing trees damaged by construction.

- **Provide proper maintenance.**
  Trees are often severely damaged by topping and other improper pruning methods. Employ only qualified arborists to prune and perform other maintenance.
  Newly planted trees should be well cared for. Irrigate newly planted trees during dry periods for the first five years to increase establishment and growth.

Figure 31. Many species of native plants can provide a variety of sizes, colors, and forms to interesting landscapes. Keeping grasses away from preserved trees can increase a tree's health and appearance.

Tree Preservation Order

A Tree Preservation Order is an order made by a local planning authority in England to protect specific trees, groups of trees or woodlands in the interests of amenity. An Order prohibits the:

- cutting down
- topping
- lopping

- uprooting
- wilful damage
- wilful destruction

of trees without the local planning authority's written consent. If consent is given, it can be subject to conditions which have to be followed. In the Secretary of State's view, cutting roots is also a prohibited activity and requires the authority's consent.

The Department may make Tree Preservation Orders for the purpose of:

• Protecting trees considered to be of special value in terms of amenity, history or rarity, which may or may not be under threat.

• Ensuring the continuance of a woodland area which may be felled with Departmental consent, by securing the replanting of trees, where this is considered necessary.

To be considered for a TPO trees must be of high amenity value and in reasonable condition.
The following criteria will be used when assessing the merits of a potential TPO;

Potential Threat: Priority will be given to the protection of those trees deemed to be at immediate risk from active felling or damage from development on site. All other requests will be assessed and prioritised accordingly.

Visibility: The extent to which the trees or woodlands can be seen by the general public will inform the assessment of whether the impact on the local environment is significant.

Individual Impact: The mere fact that a tree is publicly visible will not itself be sufficient to warrant a TPO. The tree's particular importance will be assessed by reference to its size and form, its future potential as an amenity should also be assessed taking into account any special factors such as its screening value or contribution to the character or appearance of an area. In relation to a group of trees or woodland, an assessment will be made of the collective impact.

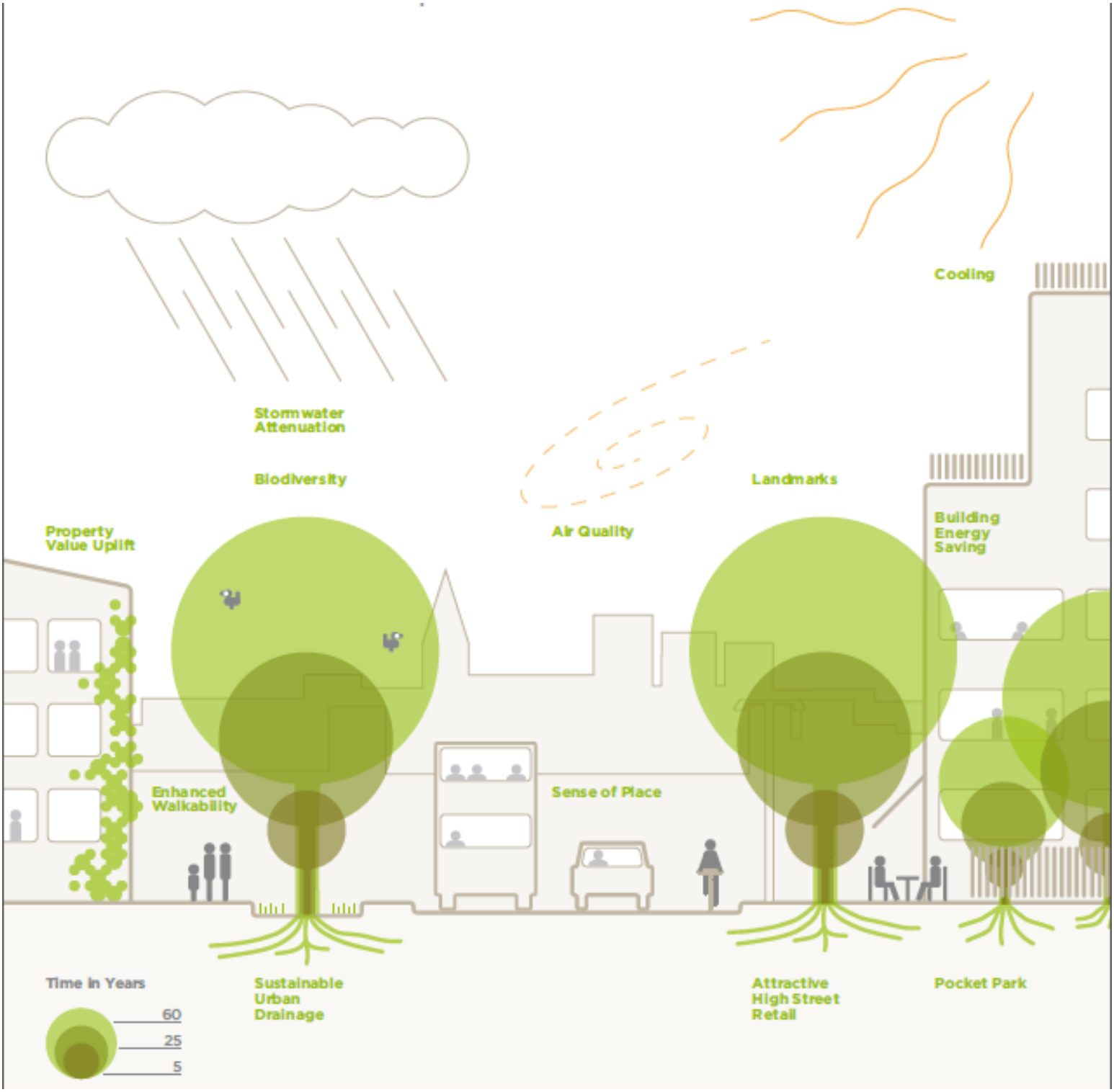
Wider Impact: The significance of the trees in their local surroundings will also be assessed, taking into account how suitable they area to their particular setting, as well as the presence of other trees in the vicinity.

Historical Importance: Certain trees because of their age, association with the setting of listed buildings or the contribution they make to the special character of a conservation area may require consideration for TPO protection.

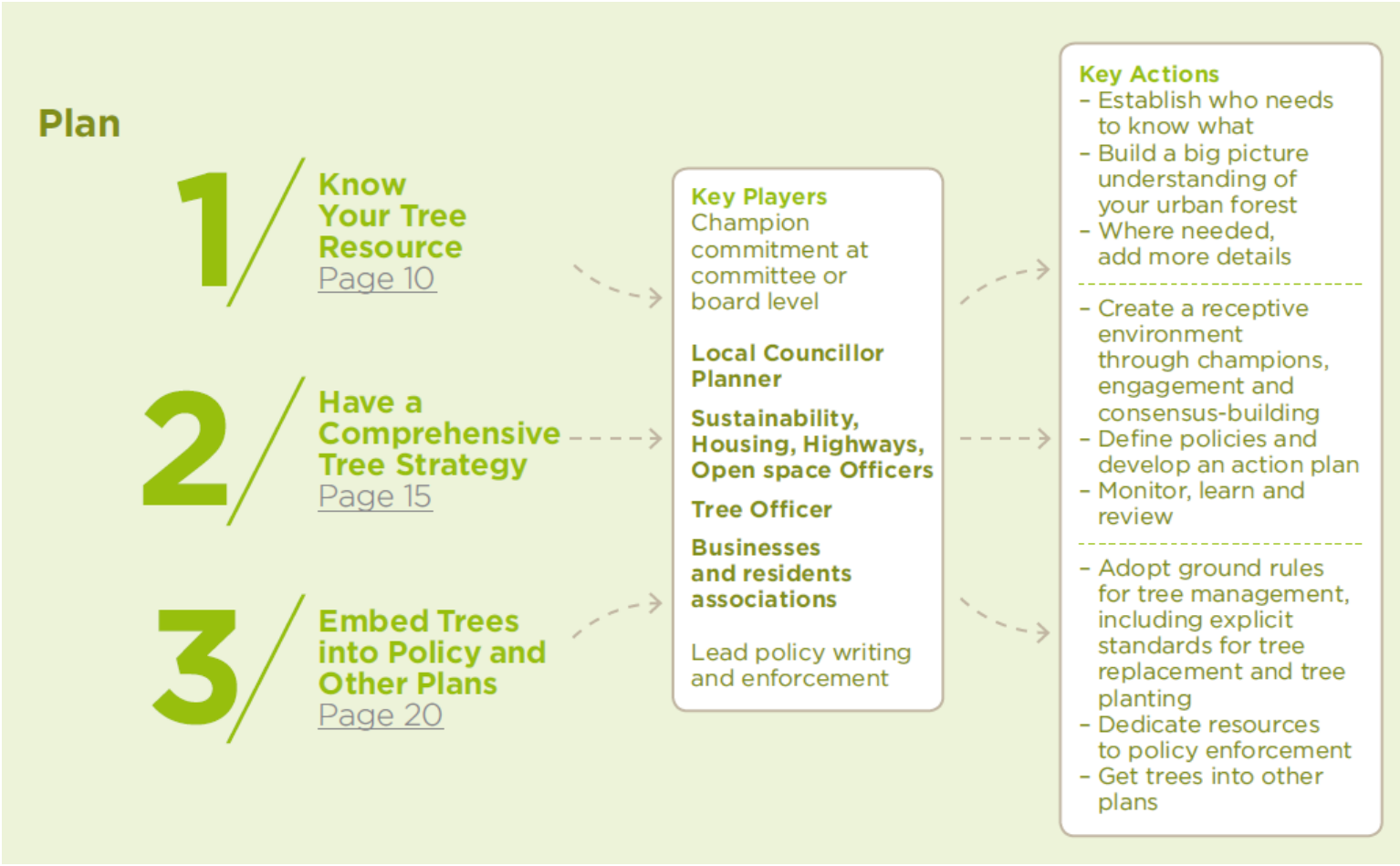
Rarity: There may be occasions where a tree(s) may be considered for TPO protection solely on the grounds of its rarity. The priority of the consideration will reflect the rarity of the species.

Protect Trees (The 12 Principles)

Trees make places work, look and feel better. As well as playing a role in climate proofing our neighbourhoods and supporting human health and environmental well-being, trees can also help to create conditions for economic success.
This guide takes a 21st century approach to urban trees, providing decision makers with the principles and references they need to fully realise this potential.



12 action-oriented principles, which can be adapted to the unique context of your own town or city to provide a roadmap for trees in a 21st century context. Each principle is fully supported by explanations of delivery mechanisms, examples of the principle in practice and links to further references.
The 12 principles in Trees in the Townscape are for everyone involved in making or influencing decisions that shape the spaces and places in which we live. It will be particularly relevant to local elected members, policy makers and community groups together with large land estate owners, such as registered social landlords. It will also be useful to those professionals who bring their technical expertise to facilitate delivery, such as engineers, architects, landscape architects or urban designers.


Plan
1
Know Your Tree Resource
Page 10
2
Have a Comprehensive Tree Strategy
Page 15
3
Embed Trees into Policy and Other Plans
Page 20
Key Players
Champion commitment at committee or board level
Local Councillor
Planner
Sustainability, Housing, Highways, Open space Officers
Tree Officer
Businesses and residents associations
Lead policy writing and enforcement
Key Actions
- Establish who needs to know what
- Build a big picture understanding of your urban forest
- Where needed, add more details
- Create a receptive environment through champions, engagement and consensus-building
- Define policies and develop an action plan
- Monitor, learn and review
- Adopt ground rules for tree management, including explicit standards for tree replacement and tree planting
- Dedicate resources to policy enforcement
- Get trees into other plans


Design
4
Make Tree-friendly Places
Page 30
5
Pick the Right Trees
Page 35
6
Seek Multiple Benefits
Page 40
Key Players
Bring forethought into briefs and proposals
Planner/ Development Control Officer
Developer/ Site Owner
Designer
Tree officer
Engineer
Utilities providers
Arboriculturist
Nurseries
Integrate green and grey infrastructure for wider returns
Key Actions
- Favour larger trees
- Survey existing trees
- Include underground matters – utilities, foundations
- Draw up a robust tree protection plan
- Consider the expected benefits and functions of the trees
- Use the context to inform the selection process
- Investigate site constraints, such as soil types and light
- Call on specialist advice
- Look at how trees can be part of the infrastructure, such as calming traffic, providing enclosures, supporting economic regeneration and public health programmes
Plant/Protect
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Procure a Healthy Tree
Page 48
8
Provide Soil, Air and Water
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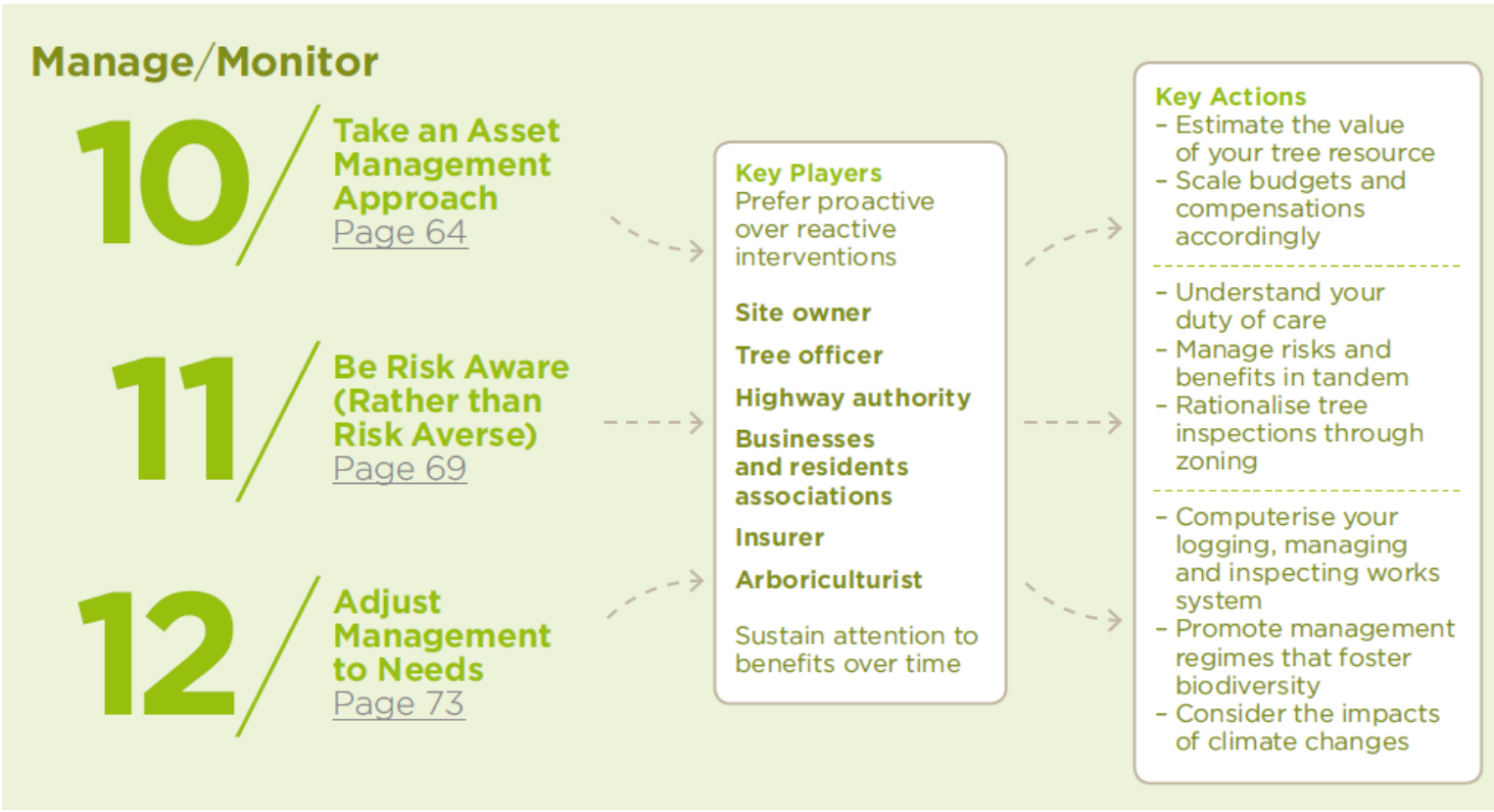
9
Create Stakeholders
Page 56
Key Players
Demand and adhere to high quality works standards
Tree officer
Site owner
Communities
Tree wardens
Contractors and sub-contractors
Tree voluntary organisations
Widen knowledge, ownership and participation
Key Actions
- Understand tree production systems and use specifications
- Conduct nursery visits
- Make soil volume an upmost priority
- Ensure sufficient watering and maintenance
- Use trained individuals to do the planting
- Explore new planting technologies
- Involve local communities and train staff
- Ensure work on or near trees meets quality standards


Manage/Monitor
10
Take an Asset Management Approach
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11
Be Risk Aware (Rather than Risk Averse)
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Adjust Management to Needs
Page 73
Key Players
Prefer proactive over reactive interventions
Site owner
Tree officer
Highway authority
Businesses and residents associations
Insurer
Arboriculturist
Sustain attention to benefits over time
Key Actions
- Estimate the value of your tree resource
- Scale budgets and compensations accordingly
- Understand your duty of care
- Manage risks and benefits in tandem
- Rationalise tree inspections through zoning
- Computerise your logging, managing and inspecting works system
- Promote management regimes that foster biodiversity
- Consider the impacts of climate changes