BMPs TO CONSERVE WOODED AREAS AT THE LANDSCAPE LEVEL

Audience

This section is primarily aimed toward:

- local and regional units of government, and
- community and citizen organizations.

Overview

Landscape level is defined in this guidebook as the area under the jurisdiction of local or regional units of government (e.g., municipality, township, county, metropolitan council, park districts, transportation department) having authority over land development. The state of Minnesota has vested land-use planning and regulatory authority in local units of government (Minn. Stat. § 394.21 et seq. for counties and Minn. Stat. § 462.351 et seq. for municipalities and townships) to develop their own comprehensive plans.

The role of local and regional units of government usually extends to:

- planning, managing, and regulating urban growth,
- defining types of development and creating standards,
- implementing local, regional, state, and federal natural area protection regulations, and
- assessing property value and taxes.

The role of community organizations may be extended to:

- providing inputs to local comprehensive plans and development of transportation systems, and
- providing inputs in land development, price, and conservation values.

To conserve wooded areas, local and regional units of government including decision makers, planners, and community activists should work together as partners and recognize wooded areas as community assets, adopt the recommended land-use approach, and implement conservation options.

Recommended approach and conservation options

Conserving wooded areas should be an integral part of land development. Wooded areas can be conserved when urban planners adopt the following step-by-step land-use approach.

■ Define goals

Goals to conserve wooded areas across the landscape should include:

- protection and / or restoration of ecological integrity and functions,
- protection and promotion of connectivity and continuity of wooded areas across the landscape and political boundaries,

- establishment or creation of networks of forest communities as open space, and
- protection of wildlife habitat and corridors.

■ Inventory and assess resource

A landscape-level inventory should be carried out by an interdisciplinary team. The team should include a forester, arborist, soil scientist, wildlife ecologist, landscape architect, other natural resource professional, planner, engineer, archeologist, community activist, and nonprofit organization representative. A resource inventory can be based on the model used by the Minnesota County Biological Survey for assessing values and ecological functions of woodlands, or on models developed by municipalities such as the model used by the city of Maple Grove (Westwood Professional Services Inc., 1994) or the city of Cottage Grove (Bonestroo, Rosene, Anderlik & Associates, 1998). The resource inventory includes land survey, resource assessment, and production of a landscape comprehensive resource map.

◆ Conduct woodland survey and resource assessment

A woodland survey provides information needed to make appropriate land-use decisions. It consists of delineating the tree stand, identifying and classifying wooded areas by type and condition, and assessing their ecological functions as well as conservation values (ranking) within the jurisdiction and adjacent jurisdictions. Other natural resources, including wetlands, farmlands, areas occupied by rare plant and

animal species, and projected greenways areas (for the metro region) can be identified, classified, and assessed during the woodland survey. Other pertinent information, including watershed, drainage, topography, soil types, existing infrastructures, and areas of significant historical and cultural values can be identified. Aerial photography can be used to identify resources prior to doing a land survey (Figure 8). Collected data should be accessible to landowners, developers, and builders to coordinate conservation efforts.

Figure 8. Infrared aerial photography is used by natural resource professionals to see patterns of water bodies, vegetation cover, and existing infrastructure.

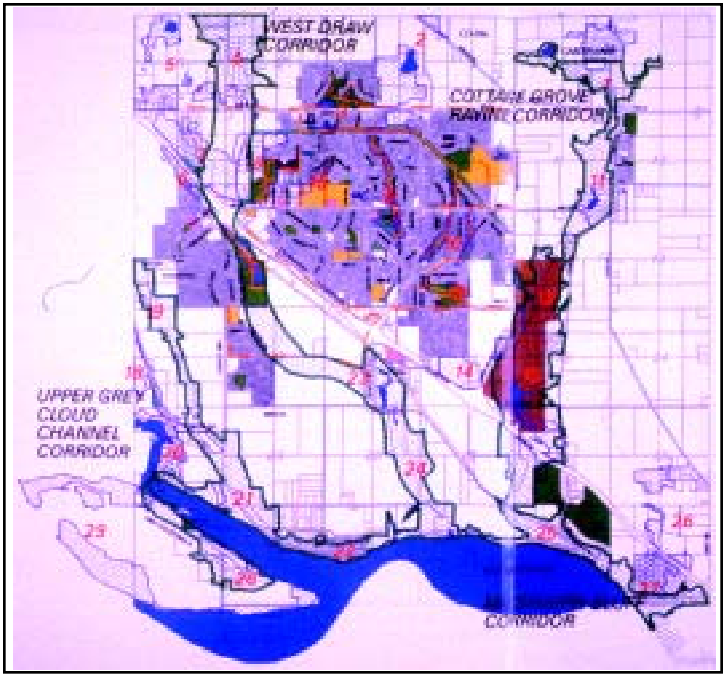
Land surveys can have significant financial cost. The Minnesota Department of Natural Resources (DNR) offers a number of financial assistance programs to communities and local and regional units of government to do resource inventory and assessment and to reach their natural resource management goals. A directory of financial assistance is available, and it provides summary-level information on DNR financial programs (see Appendix 2, page 97).

◆ Create a comprehensive landscape resource map

A comprehensive landscape resource map is a visual display of pertinent information collected during the land survey and resource assessment. The information must be accurate. Locations and types of wooded areas should be recorded on the map at the appropriate scale (Figure 9, page 22). Other examples of landscape resource maps of Burnsville, Maple Grove, and Woodbury are included in Appendix 4 (a, b, and c, page 105).

■ Create a conservation plan

A conservation plan should be based on the resource inventory and assessment data and the comprehensive landscape resource map. The process begins with identification and location of the main transportation systems, utilities, and the wooded areas to conserve.



Courtesy of City of Cottage Grove

Figure 9. A resource map such as this example of the city of Cottage Grove shows the location of important features of the landscape including tree stands, water bodies, historical sites, and existing land use.

◆ Identify and locate wooded areas

Find wooded areas within local and adjacent jurisdictions.

◆ **Identify and locate site for main transportation systems and utility infrastructure**

Transportation systems and utilities are usually connected to existing ones. Newer utility corridors can be located and designed in ways to conserve wooded areas.

◆ **Select wooded areas to conserve**

Wooded areas to conserve should include those that possess the condition and characteristics to satisfy conservation goals. The following wooded areas can be of high priority for conservation:

✴ **Larger tracts of remnant wooded areas**

The size of remnant tracts to give priority to depends on species composition (greater species diversity), species suitability to the site, health condition, and ecological functions. A county, city, or township may mandate a specified size of remnant wooded areas for protection.

✴ **Wooded areas that have the potential to be connected to others**

Continuity of wooded areas is valuable for wildlife habitat and water quality. A county, city, or township may mandate the protection of wooded areas found in flood plains, sensitive areas of watersheds, and green corridors.

✳ **Wooded areas having significant ecological functions and conservation values**

These include soil and water conservation, wildlife habitat and corridors, recreational and historical values, or social and cultural amenities.

✳ **Wooded areas occupied by rare plant and animal species**

The Minnesota County Biological Survey is conducting a statewide survey for these areas and will be an important resource for this information (see Appendix 1, page 91).

✳ **Areas with reforestation and restoration potential**

Reforestation is important to achieve connectivity and continuity of wooded areas throughout the landscape.

◆ **Identify developable areas**

Once all of these areas, including sites for main transportation systems and utility infrastructure, protected woodlands, and developable areas, have been identified, they should be recorded on the comprehensive landscape resource map and be entered in geographic information systems (GIS). They should be shared with other local and regional units of government, developers, builders, and private organizations to promote continuity and connectivity of wooded areas across the landscape for wildlife habitat, water quality, and other

ecological, social, and environmental functions and to enhance coordination and partnerships among all stakeholders. Developers and builders should participate in this process and be informed about the conservation goals and wooded areas set aside for conservation.

■ Identify and select land protection options

Once a comprehensive landscape resource map has been developed and wooded areas to conserve have been identified, select appropriate land-protection options. Options available to local and regional units of government include:

◆ Use zoning and subdivision ordinances

Zoning and subdivision ordinances are the most common land-use tools local units of government use to control development within their jurisdictions. When drafting ordinances to promote conservation of wooded areas, consider the following:

- Gather input from developers, builders, and citizen organizations.
- Integrate conservation values in zoning codes and policies.
- Identify developable subdivisions and conservation zoning districts in the comprehensive plans.

- Determine the type of development to be allowed using information contained in the landscape-comprehensive resource map.

- Promote flexible subdivision ordinances that encourage variable lot size and configuration, street width and setbacks according to traffic, utility types and easements, and creative development plans.

- Draft local woodland and tree-protection ordinances for both public and private property.

- Provide incentives to reduce impervious surfaces. Incentives may include reduced road width, setbacks, and parking lots. Other incentives may include additional lots, tax incentives, and public recognition or awards such as the statewide builders' and developers' awards.

- Promote the use of joint utility easements and trenches for underground utilities and rights of way for overhead lines.

- Create a local natural resource advisory board to foster the participation of community organizations including citizens, nonprofit organizations, developers, builders, and contractors.

- Create conservation overlay districts in the jurisdiction using comprehensive plans and zoning ordinances, and determine urban growth boundaries.

- Provide incentives to promote or mandate implementation of conservation designs such as conservation zoning designs, open space designs, conservation subdivision designs, and cluster development designs. Washington County Planning and Administrative Services published a comprehensive guide to open space design development (see Appendix 1, page 91).

- Set up conservation standards based on sound protection options of wooded areas. For example, local and regional units of government should promote the conservation of 50 percent to 70 percent of wooded areas in residential zoning districts as natural wooded open space.

- Promote new and flexible approaches to conservation. For instance, the city of Eagan has established a park dedication policy in which as a general rule, 15 acres of land are dedicated for park, playground, and public open space for every 1,000 residents. Other communities prohibit development on wooded areas of 10 acres and larger or have adopted a one-for-one replacement per caliper inch. However, sound conservation plans should focus on species diversity of the woodlands, the health condition, and species suitability to the site. Native species that are well adapted to the local condition should be given higher conservation priority as well as species that are tolerant to site disturbances. For example, an oak sapling may be preserved instead of a mature box elder in many sites in the metro area.

- Provide a management strategy to maintain and enhance the quality of the protected wooded areas. The management strategy should have an education component for the public and include frequent assessment of the tree and forest health (insect, disease, and stress), fire hazard (Great Lakes Fire Compact, 1990), and wood utilization.

◆ Consider other conservation and protection options

A number of land protection options have been developed to assist landowner and local units of government. They include:

- conservation easements,
- land-retirement programs,
- property tax-relief programs,
- restoration cost-share programs,
- registry programs,
- transfers of land,
- deed restrictions,
- mutual covenants,
- management agreements,
- donating land,
- selling land to conservation buyers,
- land exchanges,
- transfer of development rights,

- purchase of development rights,
- outright acquisition,
- and carbon sequestration credits.

These land protection options are described in *Land Protection Options: A Handbook for Minnesota Landowners and Natural Areas: Protecting a Vital Community Asset*. Copies of these publications can be obtained free of charge to residents of Minnesota by contacting the Minnesota DNR.

Check list

- ☐ **Define goals**
- ☐ **Do resource inventory and assessment (landscape scale)**
  - ☐ Conduct woodland survey and resource assessment
  - ☐ Create a comprehensive landscape resource map
- ☐ **Create a conservation plan**
  - ☐ Identify and locate wooded areas
  - ☐ Identify and locate site for main transportation systems and utility infrastructure
  - ☐ Select wooded areas to conserve
    - ☐ Large tracts of remnant woodlands
    - ☐ Wooded areas that have the potential to be connected to others
    - ☐ Wooded areas having significant ecological functions and conservation values

- ☐ Wooded areas occupied by rare plant and animal species
- ☐ Areas with reforestation and restoration potential

☐ Identify developable areas

☐ **Identify and select land protection options**

☐ Use zoning and subdivision ordinances

- ☐ Determine type of development
  - ☐ Residential
  - ☐ Commercial
  - ☐ Institutional or other
- ☐ Determine easements, types, and design of transportation systems
- ☐ Determine easements, types, and design of utilities
- ☐ Consider woodlands and tree preservation ordinances

☐ Consider other conservation and protection options

- ☐ Conservation districts
- ☐ Conservation easements and covenants
- ☐ Transfer of development rights
- ☐ Purchase of development rights
- ☐ Land exchange
- ☐ Land retirements
- ☐ Other land-protection options

BMPs TO CONSERVE WOODED AREAS AT THE SUBDIVISION LEVEL

Audience

This section is primarily directed toward:

- local units of government,
- landowners and developers,
- builders and utility companies, and
- community and citizen organizations.

Overview

The development of a subdivision is always affected by state and federal laws, local comprehensive plans and regulations, zoning and subdivision ordinances, codes and policies, and housing market demand. All people involved in subdivision development should recognize the need and reasons to protect wooded areas and other natural areas, while complying with regulations. City planners, landowners, developers, and builders play a major role in subdivision development by planning and creating development plans in conformance with municipal, township, and county zoning and subdivision ordinances and by overseeing development. However, landowners, developers, builders, local units of government, and homeowners may have different agendas (Figure 10, page 32).

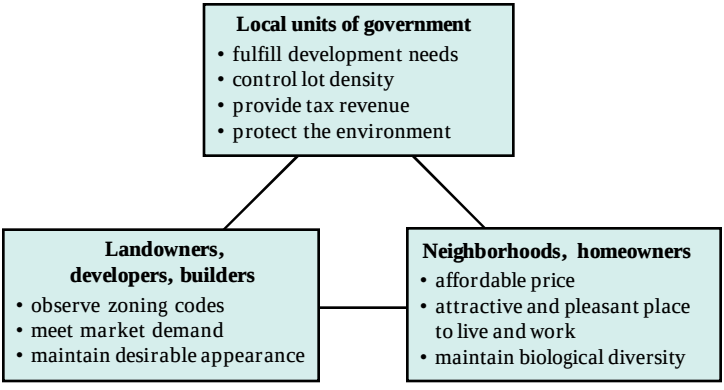


Figure 10. People involved in subdivision development may have different priorities.

Recommended practices

Protecting wooded areas and other plant communities must begin with a plan. "A planning process begins when the decision to develop the land is made and finishes when the completed development is occupied" (Watson and Neely, 1995).

■ Define goals

Defining goals is the first step to consider in land development. The goals should include:

- conservation of green corridors,
- conservation of wooded areas as natural open space or conservancy area, and
- protection of individual trees.

■ Inventory and assess resource

Resource inventory and assessment is an important step in protecting wooded areas and meeting the goals. The objective is to create a comprehensive resource map for the subdivision. This map will be the main document to use when making decisions.

A resource inventory and assessment for a subdivision can be achieved in three steps:

- evaluate existing resource information,
- conduct site review and survey trees, and
- create a comprehensive resource map for the subdivision.

◆ Evaluate existing resource information

A number of local and regional units of government collect information on the status of natural resources. This information is useful in planning at the subdivision level. Landowners and developers may take advantage of this information including topographic maps, aerial photography, and information on watersheds, wetlands, historic land uses, proposed greenways, soils, septic system suitability, areas occupied by rare plant and animal species, conservation easements, and protected wooded areas (see Appendix 1, page 91). Local zoning and tree preservation ordinances may also provide some information and guidelines.

◆ Conduct site review and survey trees

A site review and tree survey are the physical examination of the resources within the subdivision and adjacent land. They include:

- identification and location of wooded areas and other natural resources, and
- delineation of potential wooded areas to protect.

A site review and tree survey must be performed by a natural resource professional such as a forester, arborist, or landscape architect.

✶ Obtain aerial photography

Aerial photography can provide fast knowledge of existing resources and adjacent areas. Agencies that provide aerial photography (prints or services) include the Metropolitan Council, U.S. Geological Survey, or DNR (see Appendix 1, page 91).

✶ Identify and locate wooded areas and other land types

After identifying wooded areas using aerial photography, it is necessary to physically locate the wooded areas, measure them, profile trees by species and size distribution, determine cover types, and draw cover-type boundaries on the subdivision map using an appropriate scale. For definitions of specific cover

types use references such as Tester, J., 1995; Wovcha, D. S., B. C. Delaney, and G. E. Nordquist, 1995; Minnesota Department of Natural Resources, 1993.

Sampling techniques can be used to profile trees on wooded areas larger than 10 acres and a complete inventory of trees on wooded areas of less than 10 acres. When profiling trees, highlight wooded areas and trees with historical, cultural, or biological significance. Identify wooded areas that have been located or designated for protection by units of government, landowners, and/or community organizations, and record them on the subdivision map. Pay particular attention to younger stands of trees and trees that are suited to the site condition. Contact the Minnesota DNR's Division of Fish and Wildlife, Section of Ecological Services (County Biological Survey) to obtain information on the status and distribution of flora, fauna, and natural communities, and the State Historic Preservation Office to obtain other information.

Other land types, including wetlands, farmlands, and land classified as potential natural areas for rare plant and animal species, should be located, identified, and recorded on the comprehensive resource map.

✴ **Delineate potential wooded areas to protect**

The initial evaluation of natural resources should note areas of priority for protection and conservation. These areas may include:

- wooded areas protected or identified by local, state, and federal laws; policies and/or regulations, such as wetlands, and designated greenways and natural areas,

- wooded flood plains, wooded stream corridors, steep wooded slopes, and buffer zones. These areas have important ecological functions for water quality and wildlife habitat, and

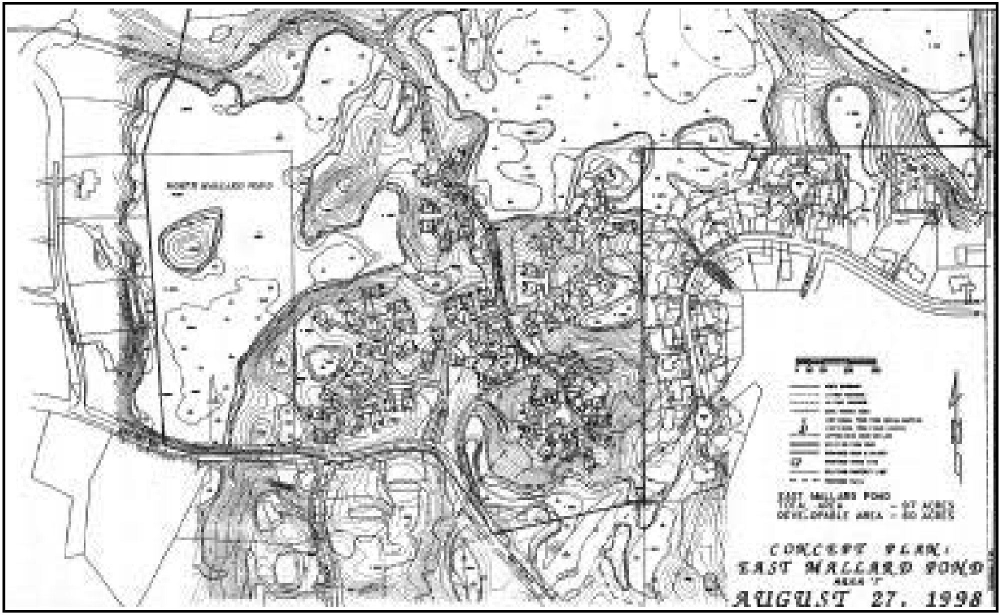
- remnant tracts of wooded areas at least one acre in size with healthy trees.

Remnant tracts of wooded areas may have aesthetic values and provide recreation for surrounding neighborhoods. They may offer ecological benefits, including carbon sequestration; screening and privacy; wildlife attraction for resting, nesting, feeding, and breeding; and energy conservation and protection against drifting snow. All of these functions may have direct impact on property values and quality of life.

A site review and tree survey may have significant financial cost. The DNR provides a number of financial assistance programs to organizations and individuals to do resource inventory and assessment and to reach their conservation and natural resource stewardship goals. Landowners and developers may be able to receive assistance for some types of projects. A directory of financial assistance is available to identify existing financial assistance programs administered by the DNR (see Appendix 2, page 97).

◆ Create a comprehensive resource map of the subdivision

The ultimate purpose of the resource assessment and inventory is to create a comprehensive resource map for the subdivision. This map constitutes the basic tool from which to make all decisions related to the development, including the type of the development design, location of permanent structures (buildings, roads, and utilities), and location of temporary facilities such as offices, parking lots, equipment maintenance space, and rights of way. Record on the map pertinent information including location of wooded areas and trees by outlining their canopy or tree line, wetlands and other type of land cover, planned unit development (roads and buildings), and preserved areas. A development map from North Oaks is a good example of a subdivision resource map (Figure 11, page 38). Another example from Robert Engstrom Companies shows a series of five comprehensive steps or maps to develop the final development plan for a subdivision. The steps or maps include site analysis, existing vegetation / woodlands, planned unit development / housing area, first development plan, and final development plan (Appendix 4 d, page 109).



Courtesy of city of North Oaks

Figure 11. A comprehensive resource map of a subdivision such as this example from North Oaks shows location of wooded areas, individual trees, water bodies, proposed developable sites, and indicates conservancy areas.

■ Create a wooded area protection plan

Develop a protection plan for wooded areas based on information provided on the subdivision comprehensive resource map. The protection plan should include:

- selection and delineation of the wooded areas to be protected, and
- selection of the protection method.

A successful protection plan to conserve wooded areas in a subdivision would set aside at least 50 percent to 70 percent of the total wooded area in form of natural open space, green corridors, or conservancy area. A number of local developers and builders have achieved these goals (e.g., development plans from North Oaks and Settler Ridge). If the subdivision is not covered with wooded areas, an alternative plan, including reforestation, may be initiated. Other techniques, including tree transplanting, can be used to save trees.

◆ Select and delineate wooded areas to protect

To achieve a successful wooded area protection plan, consider the following steps:

✳ Record location of wooded areas to be protected

Select wooded areas to be protected based on the goals and information provided on the comprehensive resource map. Record these areas on the comprehensive resource map with a distinctive pattern.

✳ **Record all areas likely to be adversely impacted during construction**

Wooded areas located on potentially sensitive sites such as wetlands and steep slopes may need additional protection. Identify and mark these areas as natural amenities to the development plan.

✳ **Record areas that can be used for reforestation and/or restoration**

These areas may be located on natural drainage or sensitive sites.

✳ **Locate and delineate developable and buildable sites**

Locate areas for development to meet subdivision density requirements, road sites, and other easements (sewer, water, communication and electrical lines, septic system, storm water, etc.). It is necessary to draw a few alternative sketches of concept plans before making a final decision. Alternative concept plans (Figure 12) may include the lot size, location, and distribution; road and transportation systems; utility systems, designs, and location; and location of areas to be graded (also see Appendix 4 d, page 109).

◆ **Submit the development plan for approval**

When submitting the final development plan, the developer and the county, city, or township planner should review the plan together.

Conservation or Open-space Development (c, d, e)

(a)

Farmstead/Subdivision

(c)

Limited Development

(b)

Conventional Development (Cookie-cutter Approach)

Mixed Residential Develop- ment

(d)

(e)

Conservation Village

Figure 12. Drawing different alternative development plans for the subdivision provides the opportunity to look at all possible options and optimize the land use and conservation effort.

■ Select a protection method

Once the development plan is approved, the developer and / or builder should select the protection method that consists of several steps:

- Determine the protected root zone.
- Mark the protected root zone.
- Identify the grading area and method.
- Create the reforestation plan and method.
- Identify trees to be transplanted.

◆ Determine the protected root zone

The protected root zone (PRZ) is defined as optimum space needed for a group of trees or an individual tree to retain good health and vigor. The larger or wider this zone is the better for the trees' health and vigor. This zone should be protected and off limits to all construction activities, including driving and parking vehicles, storing materials, and soil excavation, to minimize site disturbance and physical damage to trees during construction. It should be determined and protected before construction begins. A number of methods including the dripline, minimum area, site occupancy, and trunk diameter methods have been developed to determine the protected root zone. These methods are described in the lot-level section of this guidebook (see page 51). Each method has

its own merit to provide adequate protection area. However, the dripline method is widely recommended and used to protect mature individual trees, groups of trees, or wooded areas. The **minimum area method** can be used to protect small mature individual trees, groups of trees, or wooded areas. The minimum area method can be sed to protect small and young trees. On larger development sites, a **construction danger zone** up to 30 feet wide between the construction area and the protected root zone is necessary to minimize construction damage to trees (Figure13).

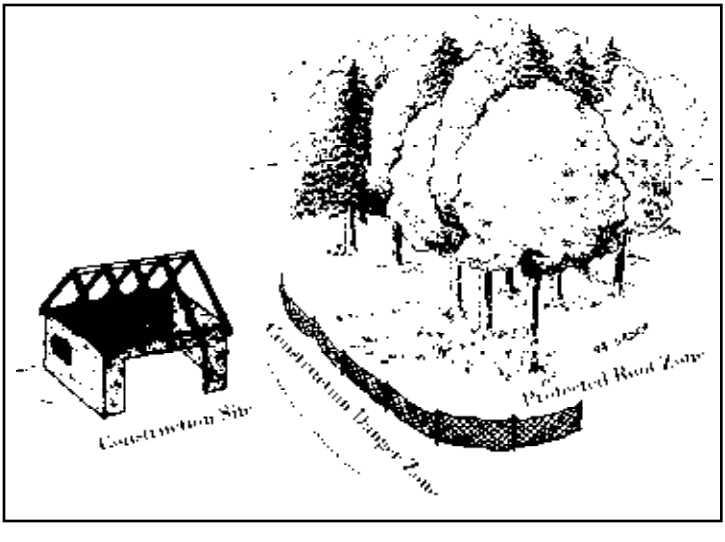


Figure 13. Determining the construction danger zone between the protective fence and the building site assists with final site and building design and selection of equipment to be used. Note that the tree protective fence is placed in front to prevent access and disturbance to the protected root zone.

◆ Mark the protected root zone

Once the protected root zone has been determined, the protection method becomes a straightforward process. It consists of marking the protected area and putting up highly visible ribbon or fencing and signs to enclose the entire area (Figure 14). This area should be off limits to all construction activities including parking vehicles, storing materials, and soil excavation.

Figure 14. Highly visible ribbon identifies protected wooded areas and trees.

If the protected areas are located on a down slope of the construction site or near wetlands, it is important to install a combination fence—a silt fence to prevent runoff and sediment, and a visual fence for enclosure (Figure 15).

Figure 15. A combination of visual fences and silt fences prevent access to the protected root zone and construction damage to trees as well as runoff.

◆ Determine the grading area and method

Before construction begins, evaluate the site to determine the area that needs grading and also the percentage of grading needed. When filling or cutting grades near the protected root zone, build the retaining walls before grading begins to prevent runoff into the protected root zone, stabilize the slope, and prevent soil erosion. Custom grading is recommended and encouraged because it impacts a smaller area and saves more trees than mass grading (see individual lot level, page 51).

◆ Define reforestation plan and method

On a site with few or no trees, a reforestation plan may be initiated with well-defined goals. Goals for reforestation may include the establishment of energy conservation trees, a living snow fence, a wildlife planting, windbreaks, or boulevard trees. A reforestation plan consists of selecting the most suitable tree species and planting design to meet the intended goals. Since the timing and design of the planting are important, the reforestation plan should be done by a natural resource professional.

◆ Record trees to be transplanted and the site

Some trees in the construction zone and on building sites can be transplanted to a different location. This conservation method can be cost effective and provide immediate functional and aesthetic benefits. However, tree transplanting is a highly specialized activity that needs to be done by a knowledgeable and experienced person. A number of tools is available to transplant trees. These tools may include a backhoe, tree spade, and crane. Understanding the biological limitations of each tree species to tolerate disturbance and the timing are critical for a successful transplantation. A systematic tree care program, including irrigation and fertilization, is necessary after transplanting. When possible, transplant trees two to four years before construction begins.

■ Monitor and evaluate the conservation plan

A successful conservation plan requires the participation and commitment of all parties involved in the development project. Before the project begins, communicate the tree conservation goals and methods to all participants, including landowners, developers, builders, contractors, and utility companies. The plan monitoring and evaluation should include education, site inspection, and financial penalties.

◆ Educate

Plan implementation should begin with education about the goals and tree protection measures. All people involved in the project should know about the tree protection goal and method. They should be informed about the protected root zone and the purpose of protective fences and signs. Contracts (including those with subcontractors) should explicitly state that any disturbance in the protected root zone (including human or machine activity, storage of material, and soil excavation) violates the contract and that specified penalties will be applied. A provision binding the contractor to the survival of protected trees up to five years from the date the construction was completed should be written into the contract.

◆ Site inspection

Monitor the program as the project proceeds. The monitoring program may include frequent visits to the site by the landowner, local unit of government, or citizen organization to check for violations of the tree protection

plan. Project managers, including the supervisor, superintendent, crew leader, or an outside consultant may be assigned this task.

◆Financial penalty

The penalty may be monetary or replacement of trees. *The Minnesota Supplement to the Guide for Plant Appraisal with Regional Tree Appraisal Factors* can be used as a guide defining the financial penalty (Minnesota Society of Arboriculture, 1996).

Check list

- ☐ **Define goals**
- ☐ **Inventory and assess resource (subdivision scale)**
  - ☐ Evaluate existing resource information
  - ☐ Conduct site review and survey trees
    - ☐ Obtain aerial photography
    - ☐ Identify and locate wooded areas and other land types
    - ☐ Delineate potential wooded areas to protect
  - ☐ Create a comprehensive resource map of the subdivision
- ☐ **Create a wooded area protection plan**
  - ☐ Select and delineate wooded areas to protect
    - ☐ Record location of wooded areas to be protected
    - ☐ Record all areas likely to be adversely impacted during construction
    - ☐ Record areas that can be used for reforestation and/or restoration
    - ☐ Locate and delineate developable and buildable sites
  - ☐ Submit the development plan for approval
- ☐ **Select a protection method**
  - ☐ Determine the protected root zone
  - ☐ Mark the protected root zone
  - ☐ Determine the grading area and method
  - ☐ Define reforestation plan and method

- ☐ Record trees to be transplanted and site

☐ **Monitor and evaluate the conservation plan**

- ☐ Educate
- ☐ Site inspection
- ☐ Financial penalty

ment traffic within the protected root zone. Although the tree's root injuries are difficult to see and predict, they can severely impact tree survival and growth, predisposing affected trees to disease and insect problems.

Soil compaction is most likely to occur when construction equipment is driven over an area. It can also be caused when construction materials or equipment (including workers' personal vehicles) are stored or parked near trees. Soil compaction is the main cause of tree loss following construction. It is a physical compression of soil particles caused by ground pressure and vibration from equipment and by the weight of material stored near trees. It affects root growth, water percolation, gas exchange, and nutrient uptake. Severe soil compaction occurs on the topsoil within the first 2 to 4 inches, but may affect deeper soil. Trees affected by soil compaction will suffocate, become stressed and vulnerable to insects and disease, and be likely to die within two to five years. The same fate can occur when soil fill is added within the protected root zone or drainage patterns are altered and saturated soil conditions result within the protected root zone.

Recommended practices

Proactive planning and use of appropriate approaches and tools can ensure greater protection and conservation of wooded areas and trees during construction. The following steps are necessary to achieve protection goals. They include goal definition, tree inventory and assessment,

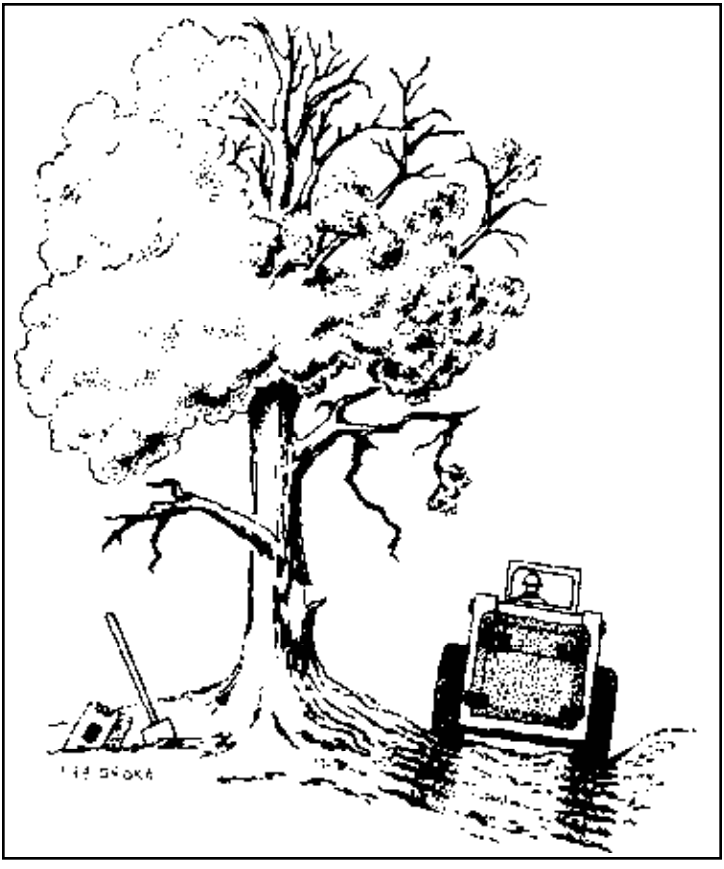


Figure 16. Using equipment near protected trees can cause severe mechanical injury to trees and compact soil in the protected root zone.

selection of building site and construction zone, creation of a protection plan, selection of a protection method, and monitoring and evaluation.

Define goals

The goals should include:

- protection of wooded areas and trees from construction damage,
- compliance with zoning regulations, conservation easements, and covenants, and
- maintenance and enhancement of community aesthetics and property values.

Inventory and assess trees

Tree inventory and resource assessment are specialized activities that should be performed by a natural resource professional (e.g., forester or arborist). The extent of the tree inventory and assessment depends on a number of factors including lot size, cover type, and stage of development activity (new development and remodeling). On lots of less than two acres, do a complete tree survey (that is, the tree count by species of all trees 2 inches in diameter and larger). Also, assess the health and growth condition. On lots of more than two acres, use either a complete or partial survey, depending on the cover type. The local tree preservation ordinance may specify the type of tree survey.

When doing a complete tree survey, measure the diameter of all trees and assess the health condition and growth characteristics of all measured trees. Trees less than 8 inches in diameter can be recorded by species, growth, and health condition. The diameter of trees larger than 8 inches is measured at 54 inches above the ground and slope side. The inventory should follow these steps:

◆ **Obtain or draw a boundary map of the lot**

Identify corners, streets, and all easements.

◆ **Record the location of all trees and wooded areas**

Record the location of all trees and wooded areas on the resource map (Figure 17, page 56). A professional surveyor may be used to more accurately locate trees close to the building site.

◆ **Do a tree survey and health assessment**

This assessment includes tree identification by species and age class and assesses health condition by growth characteristics, including trunk form (linear tree, crooked trunk, or bowing), crown form, and health condition (presence of conks, signs of stress, pests, disease, dead branches, and wilted leaves). Tree identification is needed to define the species distribution and composition on the property; to determine site suitability; to anticipate the cost of removing, replacing, and transplanting; to determine long-term

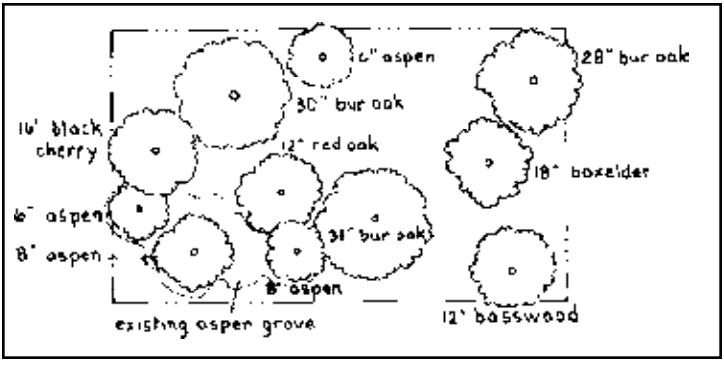


Figure 17. A resource map at individual lot level shows the location of the wooded area and individual trees, the species composition, and diameter of trees at breast height.

health and disease problems as well as silvicultural or arboricultural treatments; and if applicable, to comply with local tree preservation ordinances.

◆ **Record tree survey and health assessment information**

Write the information gathered on the resource map including the species and size. Other information such as health condition and growth characteristics can be recorded on the map or on a separate sheet.

■ Select trees or groups of trees to protect

Use the following criteria to select trees or groups of trees to protect:

- select trees or groups of trees as needed to comply with any local tree preservation ordinances,
- select trees and wooded areas found within conservation easements or covenants,
- select trees that are suitable to the site conditions (e.g., native species and trees with desirable growth characteristics),
- select trees that provide direct benefits (e.g., wildlife habitat, shade, windbreak, screening, privacy, etc.),
- select trees that are connected to other trees (e.g., groups or lines of trees) on adjoining property to achieve connectivity, and
- pay particular attention to younger trees that may have greater tolerance for site disturbance during construction.

◆ Mark trees or groups of trees to protect

Identify protected wooded areas or trees with colored ribbon (yellow or orange). If there are fewer trees to remove than to save, it may be more cost effective to mark trees to be removed. Use a standard color.

◆ Record information on the resource map

Record the location of the tree and the species name or a code on the resource map. Trees or areas to protect may be indicated with a letter P (protect) or S (save) and trees to remove may be shown with a letter

R (remove) or C (cut). Colored markers (e.g., yellow, orange, or blue) can also be used or a combination of letters and colored markers.

■ Select building site and construction zone

The homeowner, developer, builder, contractors, engineers, utility companies, and natural resource specialists should work together to select a building site and construction zone. Involving a realtor, landscape architect, and architect at the early stage of development is also important.

After reviewing all ordinances pertaining to the subdivision, including setback, conservation easements, utility and other easements, and existing covenants, select the building site, construction zone, and other areas.

◆ Select building and additions site and assess open space

The building site includes spaces for the main structure and additions and other outbuildings, driveways, garage and parking areas, and utilities (septic systems, drain fields, sewer, gas, water, well, and communication and electrical lines). The percentage of open space needs to be determined when selecting sites for building and additions sites. It should be part of the overall planning process.

◆ Select construction zone

The construction zone includes all access routes for construction equipment (trucks, tractors, utility vehicles), parking areas during construction, a material storage site, an area for cleaning and performing maintenance on equipment, and, if needed, a space for a temporary office.

◆ Identify other areas

Other areas to identify may include setbacks, utility and other easements, and areas dedicated to conservation easements, covenants, and other uses. Check with local units of government (city, township, county), homeowner associations, and nonprofit organizations (such as the Minnesota Land Trust) for other pertinent information about land-use practices on the subdivision (see Appendix 1, page 91).

For single family residential development in wooded lots, select the corner of the lot as the building site to minimize loss of trees and maximize tree protection area (Figure 18, page 60). Areas having trees of lower conservation value or poor health can be selected as building sites and construction zones.

■ Create a tree protection plan

A tree protection plan for wooded areas or individual trees at the lot level consists primarily of protecting the protected root zone. The protected root zone should be off limits to any activity. More detailed guidance may be

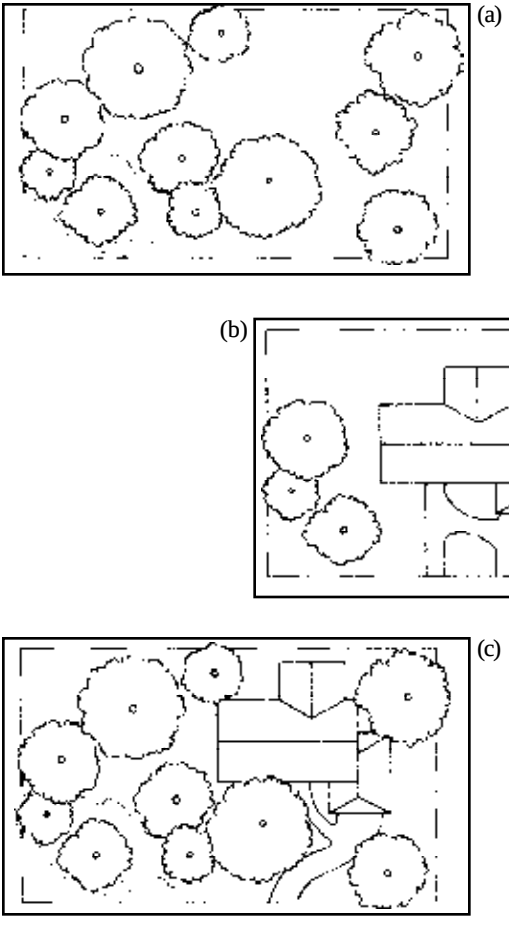


Figure 18. On a wooded lot (a), selecting the center of the lot as the building site (b) conserves less trees than selecting the corner of the lot as the building site (c), which saves more trees.

obtained from the Minnesota Extension Service publication *Protecting Trees from Construction Damage: a Homeowner's Guide* (Miller et. al., 1993). A tree protection plan follows three orderly steps:

◆ Determine and delineate the protected root zone

The protected root zone is the area near trees that should be avoided during construction. It is defined as the area directly below the branches of mature trees or the dripline (Figure 19, page 62). Since roots extend beyond this zone, the protected root zone can be extended beyond the dripline whenever possible to minimize construction damage to roots.

A number of methods have been developed to determine the protected root zone.

✳ Trunk diameter method

Measure the tree diameter in inches at breast height (54 inches above ground). Convert the measurement to feet or to a foot and half for every inch to obtain the radius of the protected root zone (Coder, 1995).

✳ Site occupancy method

Predict the tree diameter at breast height in inches for that tree at 10 years old. Multiply the number by 2.25 and convert the result into feet to obtain the radius of the protected root zone (Coder, 1995).

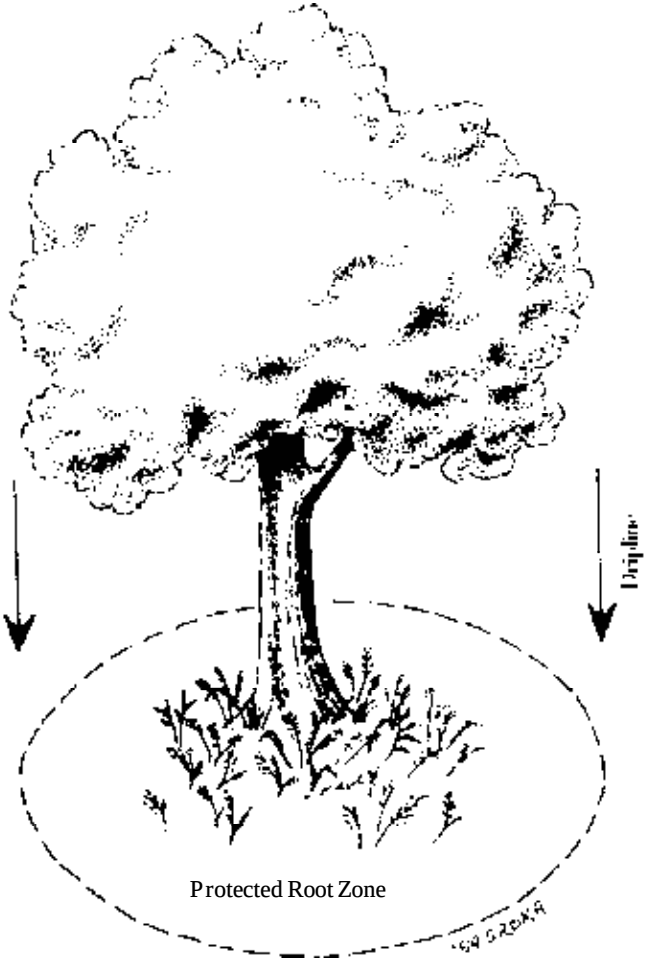


Figure 19. The protected root zone of a mature tree may be determined by projecting the dripline.

✴ **Minimum area method**

Protect an area of approximately 6 feet in radius around the trunk as the protected root zone.

✴ **Dripline method**

This is the most commonly used method. The radius of the protected root zone by the dripline method can be determined by two ways. The first consists of measuring the distance of the branch that extends horizontally farthest from the trunk and multiply by 1.5 to obtain the protected root zone radius. The second consists of projecting the tree dripline downward to the ground and delineating the area beneath the tree branches or crown as the protected root zone.

Selecting the appropriate method requires knowledge of the tree species and site condition. A forester, arborist, or other natural resource professional should make the selection. The dripline method is often preferred to protect mature trees (individuals, groups of trees, or wooded areas). However, when using the dripline method for individual trees, some adjustment should be made for trees with narrow crowns. The minimum area method can be used to protect young trees (seedlings and saplings). The dripline or minimum area methods offer only an optimum space for tree survival and growth because roots extend far beyond the dripline or the minimum area. Therefore, the larger the protected root zone, the better it is for the tree's growth and survival.

■ Select and implement tree protection method

Tree protection consists primarily of preventing physical damage to trees from driving or parking equipment, storing materials near trees, headquartering working crews near trees, and disturbing the site within the protected root zone.

◆ Protected root zone does not conflict with building site and construction zone

If enough clearance exists between the protected root zone and the building site or construction zone, simply build a fence to prevent any activity and access within the protected root zone and hang "off limits" signs on the fence to alert crews and other people visiting the site (Figure 20).

A fence prevents activities such as driving or parking equipment and storing materials such as soil from occurring within the protected root zone (Figure 21, a and b, page 66).

◆ Protected root zone overlaps with building site

If the protected root zone overlaps with the building site, decide whether to remove trees, transplant trees, change the building site or the building design, or use building materials that may cause less site impact on trees. For instance, a pervious pavement may be used to build a driveway. A pavement type requiring a thinner cross section such as concrete may be used

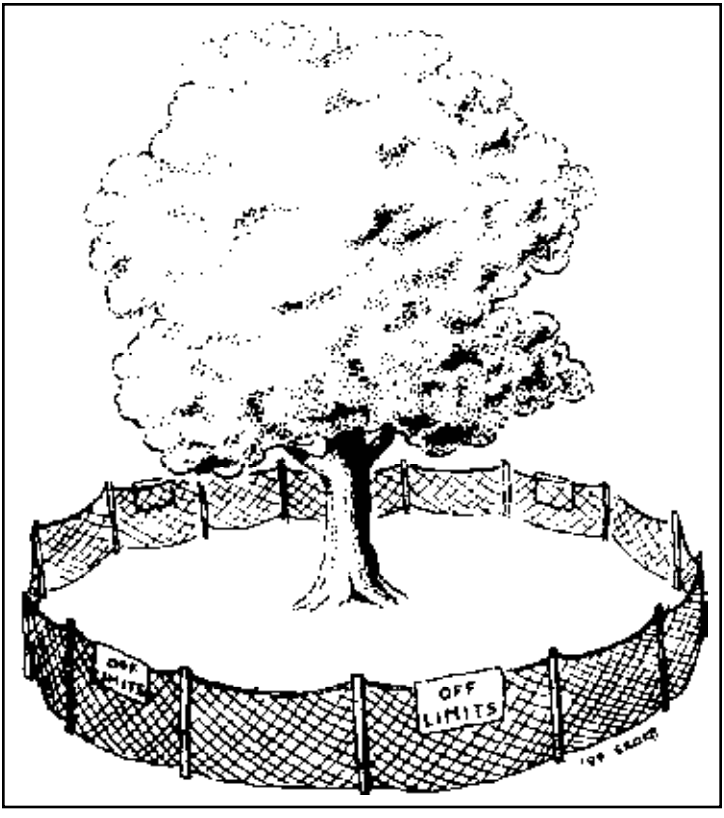


Figure 20. A highly visible fence and "off limits" signs should be placed around the protected root zone of each conserved tree to prevent any site disturbance and mechanical injury.

Figure 21. Parking equipment (a) or storing soil (b) within the protected root zone causes soil compaction and affects tree growth and survival.

instead of asphalt. Geotextile materials can be used at the bottom before pouring the concrete to reduce subbase compaction.

◆ Protected root zone overlaps with construction zone

If the protected root zone overlaps with the construction zone, a number of options can be used:

✳ Build a travel route to minimize impact on soil and root systems

A layer of wood chips may be spread or a crossing bridge installed for temporary use (Figure 22, page 68). When using wood chips for a temporary travel route, the thickness and structure of the wood-chip layer will depend on the type, size, and weight of equipment to be used. The use of mixed, particle-size wood chips spread at least 12 inches thick may be adequate. After the project is completed, the wood chips or crossing bridge must be removed and the site restored by adding ventilation holes, fertilizating, and watering.

✳ Reduce the size of the construction zone and limit the traffic

The space allocated for the construction zone can be reduced and a limited crew allowed on the site at a given time. Ground traffic for moving building materials or debris can be reduced by using a crane and pumping system instead.

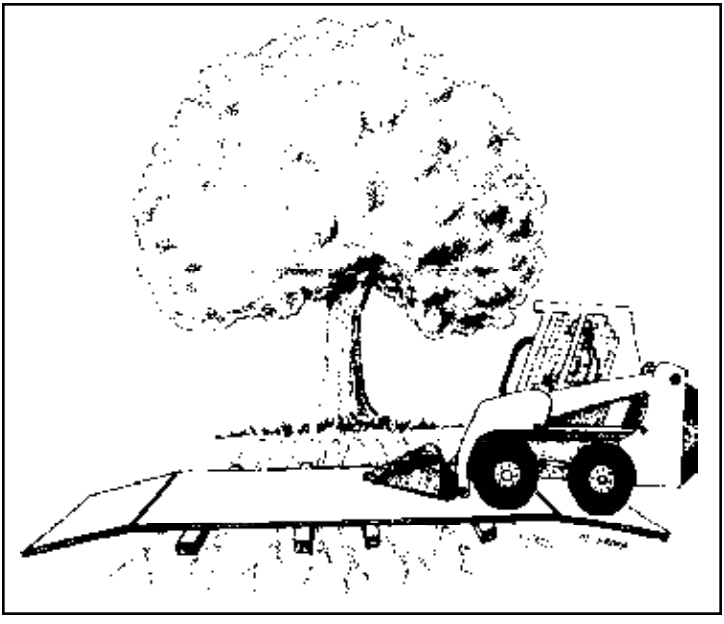


Figure 22. A temporary crossing bridge can be used near the protected root zone to minimize soil compaction and mechanical injury to the tree.

◆ **Protected root zone overlaps with utility easements**

If the protected root zone overlaps with utility easements, trees can be removed or the building design can be modified to comply with the easements. In a new development site, using a joint underground trench for utilities (gas, electricity, and cable) minimizes utility easements and site disturbance, and saves trees. Whenever cost effective and appropriate, tunneling

can be used instead of an open trench. When possible, manual or water-pressure trenching can also be used to minimize impacts on tree root systems (see utility infrastructure, page 77).

◆ Protected root zone overlaps with grading area, cut, or fill

Cutting or filling grades near the protected root zone for road construction or the building site can affect tree growth and vigor (Figure 23, page 70). Use custom grading instead of mass grading to minimize disturbances and tree damage during excavation.

✳ Reduce damage from cutting grades

Removing soil or cutting grades near the protected root zone may remove the organic soil, affect soil hydrology, deprive the tree of water and nutrients, and weaken tree resistance to wind (particularly when roots are severed). When cutting a grade near the protected root zone, prune severed woody roots immediately, water the soil around trees, and protect severed roots (with a temporary structure such as black plastic and a permanent structure thereafter) to minimize exposure to air and sun. Avoid stepper cuts exceeding 4 feet and use a step-down cut approach instead. After grading is complete, build a retaining wall, as needed, to stabilize the grade and prevent soil erosion (Figure 24, page 72).

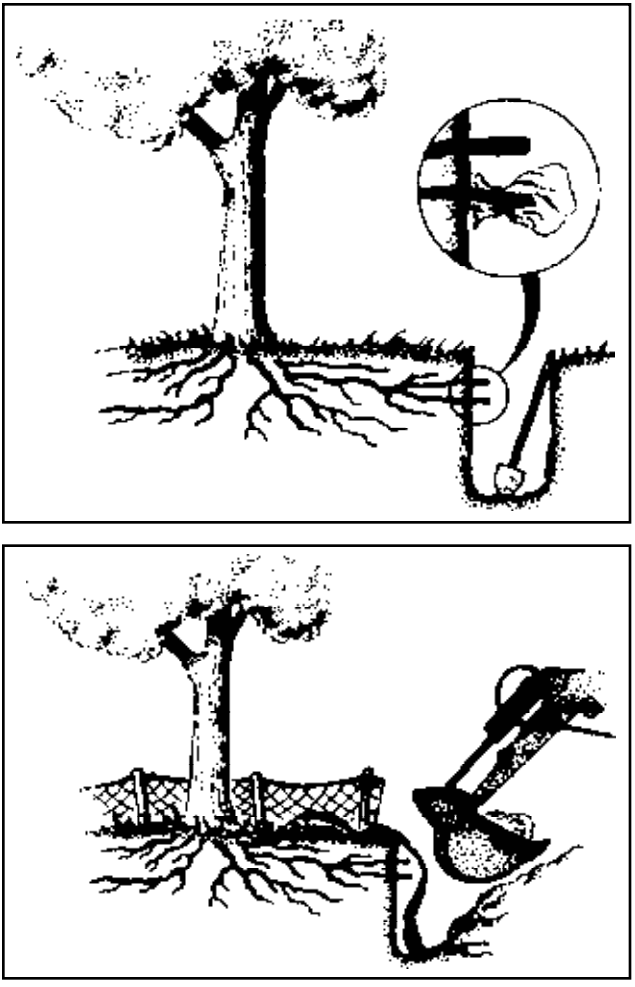


Figure 23. When roots are cut or severed during trenching or excavation, immediately protect roots with a bag (a) or tarp (b) to prevent drying.

✳ **Reduce damage from filling grades**

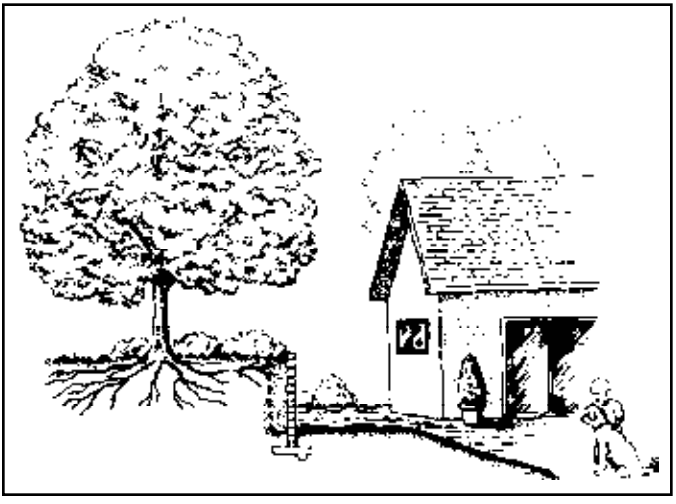
Adding soil or filling grades to level the site near the protected root zone has immediate and long-term effects on tree growth and survival. It may cause soil compaction and create anaerobic conditions. Trees may suffocate as a result. Before filling grades near the protected root zone, build retaining walls to prevent soil or filling materials from eroding over into the protected root zone (Figure 24, page 72). Retaining walls are structures built to stabilize the grade and prevent soil erosion and runoff. They can be built with a variety of materials including wood, rock, and concrete.

After grades have been cut or filled, treatments such as root and branch pruning, irrigation, and soil amendments may be necessary before installing the protected root zone fence and starting construction. These treatments can reduce impacts of construction, primarily those related to site disturbance (e.g., change in soil hydrology due to grading and microclimate). These treatments must be performed by skilled professionals. After construction is complete, site reclamation may be necessary.

■ Monitor and evaluate

Homeowners, businesses, landowners, developers, builders, and contractors should develop a monitoring and evaluation plan, indicate types of penalties, and sign a written tree protection plan before construction begins.

(a)



(b)

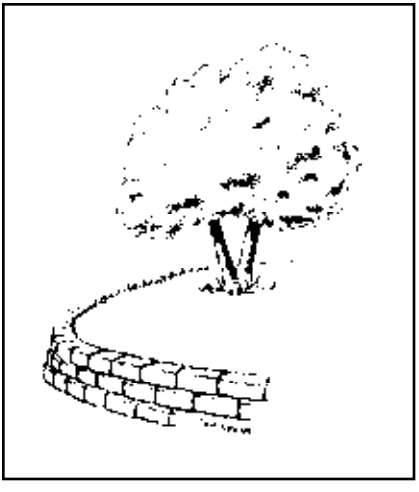


Figure 24. After cutting a grade near trees (a or b), build a retaining wall to prevent soil erosion.

The plan should specify tools and techniques that will be used to achieve protection goals. It may include frequent visits to the building site and penalties.

◆ **Visit the building site**

The homeowner or landowner should be allowed to visit the building site frequently during construction to check for any disturbance or violation of the tree protection plan.

◆ **Call for tree replacement plan**

The homeowner or landowner and the developer, builder, or contractor should agree on a tree survival and tree replacement program that should be extended between two to five years following construction.

◆ **Impose financial penalties**

Financial penalty should be agreed upon between the homeowner or landowner and the builder or contractor. Amount of financial penalty can be based on recommendations made in the *Minnesota Supplement to the Guide for Plant Appraisal with Regional Tree Appraisal Factors* (Minnesota Society of Arboriculture, 1996).

◆ **Make referrals**

The homeowner or landowner may agree to refer the builder or contractor to other homeowners for taking and protecting trees during construction.

Check list

- ☐ **Define goals**
- ☐ **Inventory and assess trees (lot scale)**
  - ☐ Obtain or draw a boundary map of the lot
  - ☐ Record the location of all trees and wooded areas
  - ☐ Do a tree survey and health assessment
  - ☐ Record tree survey and health assessment information
- ☐ **Select trees or groups of trees to protect**
  - ☐ Mark trees or groups of trees to protect
  - ☐ Record information on the resource map
- ☐ **Select building site and construction zone**
  - ☐ Select building and additions site and assess open space
  - ☐ Select construction zone
  - ☐ Identify other areas
- ☐ **Create a tree protection plan**
  - ☐ Determine and delineate the protected root zone
    - ☐ Trunk diameter method
    - ☐ Site occupancy method
    - ☐ Minimum area method
    - ☐ Dripline method
- ☐ **Select and implement tree protection method**
  - ☐ Protected root zone does not conflict with building site and construction zone

- ☐ Protected root zone overlaps with building site
- ☐ Protected root zone overlaps with construction zone
  - ☐ Build a travel route to minimize impact on soil and root systems
  - ☐ Reduce the size of the construction zone and limit the traffic
- ☐ Protected root zone overlaps with utility easements
- ☐ Protected root zone overlaps with grading area, cut, or fill
  - ☐ Reduce damage from cutting grades
  - ☐ Reduce damage from filling grades. Hang signs on the fence

☐ **Monitor and evaluate**

- ☐ Visit the building site
- ☐ Call for tree replacement plan
- ☐ Impose financial penalties
- ☐ Make referrals