CITY OF PERRYSBURG DITCH MAINTENANCE GUIDE

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PROLOGUE

Maintaining drainage ditches is a necessary management function for most local units of government in suburban and rural areas. Though this maintenance function can involve typical mowing, sediment removal and other maintenance practices often completed by public personnel on other types of properties, the specialized nature, varying conditions, and multiple adjacent land uses along these drainage corridors require a more detailed set of considerations, protocols, optional practices, and operating procedures for ditch maintenance.

Every community and ditch corridor have unique circumstances to consider when establishing plans for ditch maintenance. The City of Perrysburg recognizes our important role in managing these drainage corridors to protect private property and the important function ditches often also serve to improve ecological functions and water quality. We recognize our role as leaders in local efforts to help improve water quality in the tributaries and mainstem of the Maumee River as well as Lake Erie by making improvements to our wastewater treatment plant operations and adopting and implementing a variety of sustainable actions, including many recommendations made in the Ohio Lake Erie Commission's "Linking Land Use and Ohio's Waters: Best Local Land Use Practices." We developed this Ditch Maintenance Guide as one tool to help ensure that our ditch maintenance practices consider the most appropriate set of maintenance plans and options while also considering the needs of our citizens and other stakeholders.

This guide discusses why we have drainage ditches; establishes protocols for annual ditch maintenance inspections to assess ditch conditions; defines routine, non-routine and redesign activities, and details the associated maintenance activities for consideration; reviews the regulatory and permitting requirements for certain maintenance activities; discusses the considerations and benefits for improved ecological and water quality conditions; and includes recommendations for involving citizens and other program stakeholders to keep them informed and engaged in maintenance plans and related local ecological or often "place-based" quality of life issues.

We encourage our citizens to understand their important role in helping to maintain open drainage channels and acknowledge drainage easements, as well as helping to improve local habitat and water quality. Many suggested practices are described in standard operating procedures included in this guide. Stewardship suggestions are also listed in a draft fact sheet prepared with this guidebook, "Taking Care of Your Backyard Waterway," that could be available for separate distribution online and at meetings and other events. We appreciate the interest and support by our stakeholders in this important endeavor and encourage continued feedback as the City of Perrysburg works hard to implement and continues to refine our ditch maintenance program.

Table of Contents

ASSESSING DITCH CONDITIONS

Background

The City of Perrysburg is committed to maintaining drainage ditches that protect roadways, minimize local flooding, and preserve water quality. As part of an infrastructure maintenance program, drainage ditches require regular inspection and cleaning. Standardized practices create efficiencies and awareness to recognize and address problem areas. The objective of this manual is to provide guidance and recommendations that can be used to perform annual inspection and routine maintenance activities that keep the public safe and waterways clean.

Introduction to Drainage Ditches

Why We Need Drainage Ditches

The primary purpose of drainage ditches is to prevent flooding and erosion by draining surface water from roadways and surrounding areas. Road drainage is key, as flooded or inadequately drained roads can be unsafe to traverse and will have a shortened lifespan. Open channels are an economical and hydraulically efficient strategy for controlling surface runoff from rain, snowmelt and discharge from sump pumps. When ditches and their vegetated buffers are properly maintained, ditches function like streams and can provide some of the same secondary benefits by improving water quality, providing habitat for terrestrial and aquatic organisms, and as privacy/screening for nearby landowners. Vegetation is critical for maintaining the stability and function of ditches. Plant growth and biological activity slows the flow of water, allowing contaminants to settle out and some of the water to infiltrate into the soil, thereby reducing sediment loads and removing some pollutants from water.

A drainage ditch is a channel that conveys water (other than irrigation-related flows) away from low-lying areas, roadways, or properties.

Why Maintain Ditches?

Regular maintenance of ditches should be used to prevent problems that compromise their function or stability. Accumulated sediments, excessive or unwanted vegetation, and erosion on slopes can reduce the storage and carrying capacity, and stability of a ditch channel, resulting in flooding and long-term damage to roadways or adjacent properties during rain events. Unmaintained drainage ditches can result in property damage, water quality impairments, and damage to infrastructure, all of which pose risks to human health and safety.

Ditch Management Plan

Drainage ditches in the City's jurisdiction should be visually inspected and documented with photographs annually. The goal of annual inspection is to identify potential maintenance issues before they become major problems. To determine whether ditches are functioning properly and remaining stable when stressed, ditches should be inspected when water has receded following unusual high-flow events or periods of seasonal high flows. Items for inspection should include:

1. **Sediment accumulations** reduce the hydraulic capacity of a ditch, jeopardizing its stability and effectiveness. Areas of excessive sediment deposition should be flagged for removal to return the ditch to its design specifications.

2. **Debris and trash** clog drainage pathways and impair habitat in drainage ditches. The extent and location of accumulated debris and trash should be noted for removal.

3. **Vegetation** is important for maintaining the stability of a ditch (i.e., minimize erosion) without impeding the flow of water. The areal coverage of vegetation on ditch slopes should be noted and invasive species, if present, should be documented. For a list of invasive plant species in Ohio, visit the Ohio Invasive Plants Council website at www.oipc.info. Trees that have a diameter at breast height (dbh) of 3 inches or greater should also be documented because protected bats might use these trees for summer roosting habitat, limiting the period for removal.

4. **Condition of roads and structures** adjacent to and crossing the ditch should be inspected for potholes, cracks, incorrect slopes, or other issues that could impact the stability of the ditch, or could be the result of a ditch malfunction. For example, dirt and gravel might wash away from the edge of a road or railway into a ditch, reducing its storage capacity. Additionally, sidewalks, railways, fences, or other structures near the ditch should be inspected for failure, cracking, and other safety or maintenance access issues.

5. **Surrounding land use** is a critical component of drainage ditch design. Changes in surrounding land use (e.g., from agricultural to urban) could have significant impacts on the flow regime, function, and stability of a drainage system.

6. **Standing water** typically indicates that a ditch is not draining as designed, and therefore not performing its primary function (Table 1). Look for areas of stagnant water and blockages that result from a damming effect. Alternatively, the slope of the ditch might have changed over time resulting in a reduction in the amount of drop over the length of the ditch.

7. **Scouring and erosion** of the ditch channel can occur when high-energy water flow is focused on a relatively small area of the ditch channel or bank. Properly functioning ditches should dissipate energy by slowing and dispersing the flow of water. Make note of areas of scour and erosion on banks and at inlets/outlets of culverts.

8. Stable **bank slopes** are necessary to maintain the capacity and continued function of drainage ditches. Collapsing slopes might indicate instability of the subgrade under a roadway. Make note of unvegetated banks, sediment deposition areas within the ditch channel, and eroding slopes. If trees are removed from bank slopes, consider leaving root systems in place to maintain soil stability.

9. Water **flow regime** should be described as:

    - Ephemeral – only flowing for a short period after a snowmelt or rain event;
    - Intermittent – flowing during the wet season but normally dry during hot summer months; or
    - Perennial – flowing continuously throughout the year.

The cross-section of a drainage ditch should be maintained at original design specifications or as subsequently improved. Drainage ditch systems rely on a stable hydraulic capacity to ensure sufficient drainage and operation. Ditch cross-sections can be inspected and changes documented over time using the Cross-Section Monitoring Form in Appendix B. Annual records of ditch cross-sections will track changing ditch shape, incision of the channel, and possibly identify the need for maintenance, such as regrading and stabilizing slopes, sediment removal, revegetation or vegetation removal, or ditch redesign or realignment.

Note that most work in perennial and intermittent streams (e.g., filling or realignment) requires a federal Clean Water Act (CWA) Section 404 permit. The Buffalo District office of the U.S. Army Corps of Engineers (USACE), or an environmental consultant familiar with this type of work, should be contacted prior to commencing work in perennial or intermittent ditches or streams in northwest Ohio. Some ditches are regulated as streams, others are not, and this determination should be made wherever there is a question. The Ohio Environmental Protection Agency (Ohio EPA) should be contacted for appropriate CWA 401 permits, especially with maintenance activities over a large area (greater than one acre).

Table 1. Quality of Drainage Determined by Dissipation Time[1]

Drainage Quality	Time for 50% Dissipation
Excellent	2 hours
Good	1 day
Fair	1 week
Poor	1 month
Very Poor	Water will not drain

See Appendix A for a Field Inspection Form and Appendix B for a Ditch Cross-Section Monitoring Form.

[1] D.E. Smith. *Local Roads Maintenance Workers' Manual*. Center for Transportation Research and Education. Iowa State University. (2006).

ROUTINE MAINTENANCE

Routine vs. Non-routine vs. Redesign

Routine maintenance generally can be accomplished by maintenance staff without analysis, engineering, or redesign. Activities might include installing seeds or plants to stabilize a slope, mowing, removing undesirable plants and trees (including, but not limited to, invasive species or unsuitably located vegetation), removing sediment buildup, or replacing a damaged or corroded culvert with another of the same size and type. The City further differentiates minor routine maintenance as that which only involves mowing, weed spraying, and/or hand-removal of sediment and debris. Major routine maintenance requires heavy equipment (other than a mower) and/or the removal of large trees (greater than 3 inches dbh) or shrubs that comprise at least 12 linear feet of quality habitat. Data necessary for completing routine maintenance activities can be recorded using the Field Inspection Form (Appendix A).

Non-routine maintenance work typically requires detailed analysis, engineering, and/or acquisition of one or more permits. Examples of non-routine activities might include replacing a culvert with one of a different type or size, repairing causes of major erosion, or modifying ditches that capture streams or wetlands. Non-routine maintenance activities might be needed to remediate ditches with long-standing problems, particularly those that were not constructed to meet the drainage demands of a growing urban area. In some cases, ditches must be redesigned or realigned to accommodate increases in water volume or velocity. Non-routine maintenance and redesign activities are beyond the scope of this handbook.

Routine Maintenance Procedures

After annual ditch inspections, City personnel should evaluate the condition of drainage ditches under City jurisdiction, and prioritize the locations and timing of maintenance activities. Activities can be outlined in advance using the Ditch Maintenance Work Order (Appendix C). Routine maintenance should be performed, as needed, by trained personnel. If possible, maintenance activities should be completed during low flow (e.g., in summer), when soil is stable enough to support heavy equipment, and the resuspension of sediment can be managed. Standard Operating Procedures (SOPs) for common routine maintenance activities, such as those listed below, are provided in Appendix E.

Removing Sediment and Debris Buildup

Over time, portions of a drainage ditch can fill in with sediment or debris, altering the flow and hydraulic capacity of the system. Sediment and debris accumulations should be cleaned out regularly to maintain the intended capacity of the ditch and to prevent serious erosion problems. Typically, sediment is carefully removed using an excavator, making sure to maintain the designed slope of the ditch and avoid damaging ditch banks with heavy equipment. In areas with minimal sediment

When performing ditch maintenance activities, beware of safety concerns, such as underground utilities and abandoned hazardous materials. Some materials require specialized handling and disposal.

accumulation, it might be most appropriate to use hand shovels instead. Large pieces of debris (e.g., trash or logs) can sometimes be removed using an excavator. Often these items will need to be removed or cut into smaller pieces by hand.

To avoid reintroducing sediment to the ditch, excavated ditch sediments should be removed from the site as soon as possible. Use sediment control structures (e.g., silt fencing) around any temporary stockpiles of the excavated material. Excavated materials should be moved to areas where they will not impact streams or wetlands, and where invasive plant species can be managed. Long-term stockpiles or upland spreading areas should be seeded where appropriate.

Mowing or Removing Undesirable Plants

Drainage ditches are generally designed to utilize vegetation as a critical component of slope stability and water filtration. Excessive vegetation that impedes water flow will require mowing or removal. Presence of invasive species also warrants mowing or selective application of herbicide. Some vegetation, particularly trees and shrubs, might need to be removed to allow heavy equipment to access the ditch bottom during other maintenance activities. Removal of vegetation should be scheduled to minimize impacts to local wildlife whenever possible. To the extent possible, mowing should occur during the period of July through October to avoid disturbing ground-nesting birds, and tree removal should occur between November and March or otherwise be coordinated with the U.S. Fish and Wildlife Service, Ohio Field Office (Ohio@fws.gov) to avoid and minimize impacts to migrating birds and protected bat species. The use of herbicides should be conducted by trained professionals and in strict accordance with manufacturer's recommendations and consider nearby land use.

Best management practices for controlling the spread of invasive plants (Appendix D):

- Schedule manual removal or herbicide applications at times when they are most likely to be effective.
- Minimize disturbance of intact soils that might harbor invasive seeds.
- Work in invasive-free zones first, to avoid spreading propagules to areas of native plant cover.
- Clean tools and equipment before moving to new work areas.
- Mow areas with invasive plants before they go to seed. Mowing will not kill all invasive species.

Stabilizing Ditch Banks

Stabilizing ditch banks helps minimize the amount of sediment entering and accumulating in the drainage system. A healthy layer of vegetation with a strong network of roots is the best form of erosion prevention. For this reason, established plants and intact soils should be disturbed as little as possible during maintenance to protect the root systems and bank stability.

Seedbed preparation is critical for quick establishment of vegetation and stabilization of ditch banks. Slopes should be graded to design specifications, and then roughened with a rake to allow good seed-soil contact. Sowing seeds on compacted soil or without proper seed incorporation into the soil can result in desiccation of the

seeds or loss during rain events. Coconut fiber matting (or similar products) can be used to protect seeds and minimize erosion during the establishment period.

Consider hydroseeding ditch slopes with a mixture of cover crops (e.g., annual ryegrass) and native plant species (e.g., ryegrass and little bluestem) during spring or fall when temperatures are cool and soil is moist. Cover crops provide a rapid cover to minimize soil erosion while native plants are established. Over time, the native plants will likely dominate the slopes, providing habitat and long-term stabilization. Root systems on native plants tend to form dense mats that extend many feet below the surface, providing a stable framework for ditch slopes. Although native seed or plugs might be costlier up front, these plants generally require less long-term maintenance and minimal or no fertilizer application.

Routine maintenance activities might be necessary at times when seeding conditions are not optimal. In those instances, secondary erosion control structures (e.g., netting or erosion control blankets) should be used to give seeds time to germinate and become established.

In situations where vegetation cannot be established or maintained, riprap revetments can be used to control ditch bank erosion. Interlocking rocks absorb energy from flowing water and protect ditch banks. In Ohio, riprap commonly includes limestone, dolomite, and quartzite rocks of various sizes. These rocks are susceptible to displacement and should be inspected periodically; displaced rocks should be replaced as necessary.

Maintaining Culverts

Properly functioning culverts that allow access to berms or roadways are a critical component of a drainage system. As in the open channel, sediment, trash and debris that restrict flow through culverts should be removed regularly. Culverts might also shift, resulting in insufficient drainage or erosion at the end of the culvert. To maintain proper drainage and minimize shifting, culverts should be installed parallel to the flow of water at the elevation and angle of the existing ditch channel. If a culvert must be replaced, the replacement should be the same material, size, length, elevation, angle, and capacity as specified in the original design. In circumstances where that is not possible, or where drainage patterns have changed, an engineering analysis should be completed and this would be considered a non-routine maintenance activity.

REGULATIONS AND PERMITTING

Overview of Regulations

Ditch regulations in Ohio are complex, and state and federal law may overlap in certain streams. Responsibilities for the proper functioning and maintenance of these important public drainage systems are spread among municipal, county, state, and sometimes federal government entities.

In Ohio water law, certain restrictions and responsibilities are placed on landowners for the maintenance of ditches on their properties. The ***Reasonable Use Rule*** states that a landowner cannot unreasonably use, alter, or divert the natural flow and water course of a ditch. Additionally, the ***Capacity of Stream Theory*** states that no landowner can increase the flow of surface water from his or her property, where such an increase exceeds the capacity of the existing watercourse downstream. An increase in flow can be either an increase in average flow or an increase in peak flows over a monitored period of time.

Before digging in any ditch, consider whether any permits may be required. Below is an overview of potentially applicable regulations and permits that may impact a ditch project. Note that the flowchart applies to ***ditches whose main function is to convey water from one place to another and does not apply to regulated streams.*** It is recommended that the USACE be contacted prior to work to determine if a given waterway is a ditch not regulated by the USACE or a regulated stream.

Some ditches are comprised partly or completely of 'captured streams' – these are natural streams that have been realigned along part of their length to serve as drainage ditches. In addition to facilitating drainage, these captured stream channels play a critical role in water cycling and aquatic habitat of urban areas. These ditches are regarded as federally jurisdictional surface waters with all the protections and qualities of other natural streams. As mentioned, federal permits would typically be required for any maintenance activities in these ditches. Restoration of the plant community and control of invasive species might be a requirement to comply with the permit.

Ohio Revised Code (ORC) Chapters 55 and 61 relate to drainage ditches. ORC Section 6131 discusses township ditches, and states that the county commissioners have sole authority and responsibility for both township and county ditches, except that townships are responsible for cleaning and maintaining township ditches.

Additionally, ORC 5589.96 authorizes a township to enter upon private property to correct a drainage problem damaging a dedicated township road, if, after five days' notice to a property owner, the property owner fails to correct the problem.

Further, ORC Chapter 715 states "Any municipal corporation may open, construct, and keep in repair, sewage disposal works, treatment plants, and sewage pumping stations, together with facilities and appurtenances necessary and proper therefor, sewers, drains, and ditches, and establish, repair, and regulate water closets and privies."

"A municipal corporation may … remove all obstructions from culverts, covered drains, or private property, laid in any natural watercourse, creek, brook, or branch, which obstruct the water naturally flowing therein, causing it to flow back or become stagnant, in a way prejudicial to the health, comfort, or convenience of any of the citizens of the neighborhood. If such culverts or drains are of insufficient capacity, the municipal corporation may make them of such capacity as reasonably to accommodate the flow of such water at all times. …In case of the failure or refusal of such owner to comply with the resolution, the work required thereby may be done at the expense of the municipal corporation, and the amount of money so expended shall be recovered from the owner before any court of competent jurisdiction."

A Note on Private Ditches

As drainage questions have progressed through the legal system, the Reasonable Use Rule is the predominant statutory doctrine used to resolve surface water drainage issues. Additionally, ORC 5589.06 states that:

"No person shall wrongfully obstruct any ditch, drain, or watercourse along, upon or across a public highway, or divert any water from adjacent lands to or upon a public highway….If the person, company, or corporation does not within five days from the receipt of written notice proceed to remove such obstruction and complete the removal within a reasonable time, the township highway superintendent, upon the order of the board of township trustees, shall remove the obstruction. The expense incurred shall be paid in the first instance out of any money levied, collected, and available for highway purposes and shall then be collected from the person, company, or corporation by civil action by the board of township trustees, and paid into the highway fund of the township."

Potential Permits

- Section 404/401 – See the checklist below. If any of the statements in the guidance checklist are not met, it is possible that the project may require a Clean Water Act Section 404 permit from the USACE. Section 404 requires USACE authorization prior to discharging dredged or fill material into the waters of the United States.
- National Pollutant Discharge Elimination System (NPDES) Construction Storm Water General Permit – This state permit is generally required for projects that disturb one or more acre of land.
- NPDES General Permit for Pesticide Application Discharges – This state permit may be required if pesticides will be used in or near a state waterbody.

Section 404/401 Permitting Guidance Checklist

Review each of the following statements to determine whether maintenance activities require permits. If any of the statements are **false**, then the project **might** require a permit from the USACE.

- ☐ The activity will not impair the flow or circulation of waters of the U.S. or reduce the reach of such waters;
- ☐ The ditch dries out between storm events and does not flow much or all the time;
- ☐ The ditch does not contain a wetland or run through a wetland;
- ☐ The activity is routine maintenance.

Regional Contact Information

U.S. Army Corps of Engineers, Buffalo District
Oak Harbor Field Office
240 Lake Street, Unit D
Oak Harbor, OH 43449
(419) 898-3491

Ohio EPA, Division of Surface Water
Northwest District Office
347 N. Dunbridge Road
Bowling Green, Ohio 43402
(419) 352-8461
(419) 373-3004

U.S. Fish & Wildlife Service
Ohio Ecological Services Field Office
4625 Morse Road, Suite 104
Columbus, OH 43230
(614) 416-8993

Wood County Soil & Water Conservation District
1616 East Wooster Street, Suite 32
Bowling Green, Ohio 43402
(419) 354-5517

When in doubt, coordinate maintenance activities with the appropriate state and federal agencies prior to starting.

POST-MAINTENANCE RESTORATION AND ECOLOGICAL IMPACTS

Ecological Value

Urban and agricultural development accompanied by drainage and flood control has largely removed natural aquatic habitat (i.e., unaltered streams and wetlands) from the landscape. In addition, highly vegetated stream riparian corridors (the vegetated buffer areas adjacent to streams) are often absent from urban areas. Modern ditches are often designed to play a role in the ecology of urban environments. Ditches and riparian corridors in urban areas may provide the connectivity between habitats for local aquatic fauna, and commercially important pollinators can thrive if these corridors are stocked with native plants.

Water Quality

Maintained ditches can improve water quality in urban areas by filtering contaminants, assimilating nutrients, and capturing sediments before they enter rivers and lakes. As buffers between roads and surface waters, ditches intercept metals and other contaminants from road runoff. Toxic compounds can be sequestered or rendered less harmful through chemical and biological processes in soil. Nutrients that are applied to lawns and agricultural fields often find their way into drainage ditches. In ditches, vegetation serves as both erosion control and filter. Plants accumulate chemicals and physically slow the flow of water, allowing sediments to fall out of suspension. These processes improve water quality downstream, and ultimately reduce the cost of water treatment in municipal facilities.

Restoration

Occasionally, vegetation on the banks of a ditch will be impacted by erosion, flooding, or ditch maintenance activities. Restoration of the ecological and water quality values of those ditches involves striking a balance between fulfilling the *primary* ditch function (drainage) and *secondary* functions (habitat and water quality). The major drivers to consider when striving for this balance are human health, safety, and roadway integrity.

In cases where vegetation can be restored, the goal should be to establish plant species that are appropriate for the system and location. The focus should be preservation of ditch function using a design and plants that will mature into a sustainable system. Restored systems can be designed to accommodate future maintenance activities, making the process cost-effective into the future.

PUBLIC INVOLVEMENT

Keeping Stakeholders Informed

Ditch maintenance activities can prompt questions and concerns from residents and interested parties. Development of a proactive community relations plan, and effective implementation of that plan, offers the opportunity for City officials to proactively share project information and plans in a comprehensive and timely manner; gain input and address concerns raised by community stakeholders; and help educate and inform ditch-side landowners, tenants, and other City residents of the opportunities to improve the ecological value of ditches and riparian corridors as well as local water quality, while maintaining the primary purpose of our important water conveyance system.

Project Contact and Information Sharing Protocols

Primary Project Contact:

City of Perrysburg
Director of Public Utilities
211 East Boundary St.
Perrysburg, OH 43551
(419) 872-8050
(419) 872-7979 fax

The City's Director of Public Utilities will be the first point of contact for most public involvement activities associated with ditch maintenance projects. The Director will respond to stakeholder requests for information; will work with the project team to address feedback; will designate other appropriate personnel to respond accordingly; and will be the primary spokesperson for any discussions with the Mayor, Administration, City Council, Council Committees, stakeholder groups, and the media. The Director will ensure that the City's standard document approval process is followed for materials prepared in support of this effort, including web site content, presentations, fact sheets, and public notices. The Director's primary support for these efforts will be the Mayor, City Administrator, Commissioner of Public Utilities, and ditch maintenance personnel.

Stakeholders

The following stakeholders will likely have an interest in ditch maintenance activities. Communication strategies should be tailored for the specific audiences and should be implemented to keep these varied audiences engaged and informed.

City Project Management and Operations Organizations

- City of Perrysburg Mayor and Administrative Personnel
- City of Perrysburg Personnel and Contractors

City Council

- City of Perrysburg Council

Citizens

- Adjacent Property Owners
- Adjacent Tenants (residents and businesses)
- City of Perrysburg Residents

Regulatory Agencies

- USACE
- Ohio EPA

Local Organizations to Assist with Education Efforts

- Wood Soil & Water Conservation District
- Black Swamp Conservancy District
- Wood County Park District
- Toledo Board of Realtors (includes former Wood County Board of Realtors)
- TMACOG Stormwater Coalition
- Wood County Engineer's Office
- Maumee Watershed Conservancy District
- Ohio State University Wood County Extension

Potential Rights, Roles, Responsibilities, and Issues of Concern Among Each Stakeholder Group

Each stakeholder group should be considered for engagement in ditch maintenance planning and implementation to address their specific roles and position in the process and to evaluate opportunities for habitat enhancement where appropriate. An understanding of the rights, roles, responsibilities, and potential issues of concern among the stakeholder groups will help establish expectations and foster effective communication and cooperation.

While it is important to consider and address the concerns of stakeholders to the extent practicable, it is possible that some concerns or requests cannot be practically or cost-effectively accommodated. Properties often contain drainage easements or rights-of-way, which are areas of land reserved for drainage maintenance activities. Objects such as sheds, fencing and trees should not be placed in the easement area and may need to be removed at the landowner's cost. Easements/rights-of-way are listed on the deed or plat, which can be found at the Perrysburg Planning and Zoning office or the Wood County Recorder's office.

Stakeholders should be aware that without proper attention to drainage systems, brush and vegetation inhibit water flow in ditches, log jams clog culverts, tree roots plug drainage tile, and new development alters drainage patterns. Updating and maintaining drainage systems minimize flooding, soil erosion and drainage tile failures for landowners and their neighbors.

City Project Management and Operations Organizations

Rights/Roles/Responsibilities:

- The Mayor and administrative staff should have access to and be aware of the existence of this guidebook and the general established protocols outlined in this document.
- If project plans are prepared, the Mayor and designated administrative staff should have access to project plans when prepared.
- Each City employee involved with ditch maintenance should read this guidebook and thoroughly understand the City's ditch maintenance and communication protocols, recommendations for consideration, and decision-making process when planning for and implementing maintenance activities.
- City administration should communicate major routine and non-routine maintenance activities with adjacent property owners and tenants as appropriate.
- City administration should communicate directly with regulatory agencies, if needed.

Potential Issues of Concern:

- Incomplete understanding of, or non-adherence to, the City's guidebook or established protocols for regulatory involvement, project communication/notification, implementation, or maintenance.
- Concerned citizens or other stakeholders that do not understand or agree with established procedures.

City Council

Rights/Roles/Responsibilities:

- Each Council member should be aware of and have access to this guidebook.
- If project plans are prepared, the elected officials should have access to the plans.
- Council members should refer citizens who have questions or concerns to the City administration for follow-up.
- City Council should be advised by the City administration of non-routine maintenance activities.

Potential Issues of Concern:

- Incomplete understanding of the City's guidebook or established protocols.
- Concerned citizens or other stakeholders that do not understand or agree with established procedures.
- Is the City administration consistently implementing the guidebook for each major routine and non-routine ditch maintenance activity?

Citizens

Rights/Roles/Responsibilities:

- City of Perrysburg residents should have access to this guidebook.
- Each adjacent property owner and tenant should have access to ditch maintenance information and be notified of major routine and non-routine ditch maintenance activities.
- Each adjacent property owner and tenant should have the opportunity to discuss questions or concerns with City administration.
- Each adjacent property owner and tenant should be aware of actions they can take to reduce ditch maintenance needs and to be ideal stewards of their property.
- Residents should refer to this guide for information to keep City rights-of-way and easements free of buildings, fences, yard waste, fill, and other obstructions.
- Original design of drainage ditches, swales, detention, retention, and flow regimes should not be modified or tampered with to ensure appropriate drainage.

Potential Issues of Concern:

- Lack of understanding of the existence of, location boundaries, or allowable practices within the drainage easement and/or rights-of-way.
- Access to timely information of major routine and non-routine ditch maintenance activities.
- Ability to discuss restoration/revegetation opportunities in accordance with this guidebook.
- Loss of privacy from removed vegetation.
- Equipment noise.
- Traffic disruption.
- Placement location of excavated sediment or woody debris (on-site vs. off-site).

Regulatory Agencies

Rights/Roles/Responsibilities:

- Regulatory agency officials should be involved early in the project planning stages to allow for a determination of whether permits may be required.
- Regulatory agency officials should communicate the likely regulatory requirements with City officials in a timely manner.
- Regulatory agency officials should expect thorough permit submittals from the City and should strive to meet anticipated timeframes for permit decisions.

Potential Issues of Concern:

- Lack of timely information sharing.
- Incorrect information regarding permitting needs.
- Extended periods for permit decisions based on incomplete applications or regulatory staffing/workload issues.

Local Organizations to Assist with Education Efforts

Rights/Roles/Responsibilities:

- Local government, education and business organizations should have access to this guide and are encouraged to share relevant information with their audiences as part of their organizations' education and outreach programs.
- Local education and business organizations should be encouraged to discuss with the City administration on how to improve residents' understanding of drainage easements and/or rights-of-way, habitat and water quality improvements, and community outreach.

Potential Issues of Concern:

- Relies on consistent messaging/information sharing among multiple parties with varying missions.

Public Notification

While no regulations require public notification of upcoming routine ditch maintenance projects, for certain projects, it is good practice to inform landowners that will be directly or indirectly impacted by a project. Landowners might have questions related to the project, such as whether their property or access will be impacted. It's important to stress the main reason for the project, and while there may be unwanted impacts despite efforts to minimize them, the purpose is to preserve the safety of nearby properties, utilities, and other structures.

To avoid unnecessary time and expense related to public notification for smaller projects that would have extremely minimal disruption to residents, it is recommended to create a tiered system to determine the need for notifications. Public notifications are recommended only for certain major routine maintenance and non-routine maintenance projects. The City defines a minor routine maintenance project as one only involving mowing, weed spraying, and/or hand-removal of sediment and debris. The City defines a major routine maintenance project as one involving heavy equipment (other than the City's standard mower) and/or the removal of large trees (greater than 3 inches dbh) or shrubs that comprise at least 12 linear feet of quality habitat, or activities as a result of redesign.

As listed below, the City anticipates public notification to take place primarily through web site postings and distributed post cards and/or door hangers/flyers. The timing of the issuance of these notifications is important. Except in instances of emergencies, it is recommended that the distribution or posting of notices take place at least three weeks in advance of the planned major routine and non-routine maintenance activities. This should allow ample time for property owners and tenants to inquire with the City about the project plans, allow time for the City to respond to feedback received, and allow time for any plan modifications, if determined to be appropriate and possible.

Informational Materials

The City of Perrysburg should prepare a variety of informational materials for posting online, distribution at meetings, and delivery to adjacent property owners and tenants.

- **Materials for Internet Postings:** The City will prepare a summary of the ditch maintenance program for placement on the City's web site and will consider posting project notifications and linking the Program Fact Sheet and Ditch Maintenance Guide. This will provide a convenient source of information for all project stakeholders.

- **PowerPoint Presentation:** The City may consider preparing a general PowerPoint presentation that can be used, or readily tailored, for stakeholder presentations. A basic presentation could be updated for project-specific purposes. Excerpts of this presentation could be shared with local organizations assisting with education efforts to incorporate into their community outreach and education presentations.

- **Program Fact Sheet**: The City will produce a fact sheet to post online and for distribution at certain meetings by the City of Perrysburg and local organizations assisting with education efforts. Upon request, the City may consider making copies for certain outreach and education activities. A draft fact sheet is located at the end of this chapter for the City's consideration, and eventually, finalization.

- **Post Cards and/or Door Hangers/Flyers**: The City will prepare postcards that can be mailed to landowners and tenants residing adjacent to the project area or door hangers/flyers that could be distributed by hand along the corridor. An example postcard is located at the end of this chapter. A door hanger or flyer can be readily prepared using text from the postcard and fact sheet.

Example Post Card

Information Notice

Planned Ditch Maintenance in *[dates or month, year]*

The City of Perrysburg is planning to complete ditch maintenance activities in your area *[from/during/in] [insert dates, timeframe, or month]*. This project is necessary to ensure that stormwater is adequately conveyed away from personal property, streets, and sidewalks to protect the health and safety of our community.

Excess surface and subsurface water must be removed through manmade ditches to prevent flooding and these drainage corridors must be maintained. Drainage on one property can significantly impact drainage on neighboring properties. For homeowners, inadequate drainage can lead to basement flooding, wood rot and ponding on their lawns.

The City makes every effort to minimize impacts to the environment and surrounding easement areas when completing these maintenance activities; however, it is possible that some trees or structures in the right-of-way could be impacted by the project. *[Insert project-specific details such as location, traffic impacts, etc.]*. If you have any questions about the project, please contact *[name]*, Director of the Department of Public Utilities, at (419) 872-8050.

Thank you for your cooperation!

TAKING CARE OF YOUR BACKYARD WATERWAY

As a landowner, the ways you manage your property can positively influence the quality of your stream or ditch. Practicing stream and ditch stewardship is simple and easy!

Establish a Buffer

Instead of mowing right up to the ditch, where possible, and when not in conflict with City ordinances, it is ideal to leave a vegetative buffer. This buffer will help encourage the growth of plants and reduce the impact of pollutants and erosion. You can plant native trees and shrubs in your yard to help establish wildlife habitat.

Place Yard Waste Where It Belongs

The placement of grass clippings, raked leaves, cut limbs, and other vegetative debris on the bank, or within the channel, contributes to flooding and poor water quality. Never put yard waste in the waterway or storm sewers. For more information on the City's yard waste program, please visit http://ci.perrysburg.oh.us/index.php/refuse-recycling/yard-waste-program.

Use Fertilizers and Pesticides Minimally

Both fertilizers and pesticides contribute to poor water quality. Avoid spreading fertilizer near the stream or ditch bank and on sidewalks and driveways, which can convey the chemicals directly into your ditch or sewer.

You Can Make a Difference to:

- ✓ Maintain your property value
- ✓ Minimize erosion and improve water quality
- ✓ Improve wildlife habitat on your property
- ✓ Protect and improve the quality of our watersheds and Lake Erie
- ✓ Make a difference in your community

Don't Mow in the Buffer Zone

—

Don't Dump Grass Clippings or Other Debris into the Ditch

—

Don't Place Buildings or Fences in the Rights-of-Way or Easements

—

You could be responsible for any changes downstream resulting from actions on your land!

FOR MORE INFORMATION

City of Perrysburg
Department of Utilities
(419) 872-8050

APPENDIX A: FIELD INSPECTION FORM

CITY OF PERRYSBURG DITCH FIELD INSPECTION FORM

INSPECTION INFORMATION

Ditch Name/Outfall ID: _____ Receiving Waterbody: _____

Closest Road(s): _____

Inspector(s): _____ Date: _____

Weather Conditions: _____Length of Stream Being Evaluated (approx. 200 ft.): _____

Precipitation in past 3 days (Circle): Yes / No If Yes, how many inches?_____

Equipment list: Camera, Measuring stick, Tablet or GPS device
* Conditions marked "Critical" should be addressed as soon as possible to prevent failure of the drainage system.

DITCH CONDITION

Sediment Accumulation

☐ Less than 2 in. (Minimal)
☐ More than 2 in. (Moderate)
☐ Clogged (Critical)

Debris and Pollution (check all that apply)

☐ None
☐ Foam
☐ Oil/Film
☐ Algae Scum
☐ Trash/Debris
☐ Logjam (Critical)
☐ Tile/Outlet Clogged or Submerged (Critical)

Vegetation on Slope

☐ Dense (> 75%)
  ☐ Invasive Species Present
  ☐ Trees > 3 in. diameter
☐ Moderate (25-75%)
  ☐ Invasive Species Present
  ☐ Trees > 3 in. diameter
☐ Sparse (< 25%) (Critical)
  ☐ Invasive Species Present
  ☐ Trees > 3 in. diameter

Scouring and Erosion

☐ No
☐ Yes, Detail: _____ (Potentially critical)

Condition of Roadway and Nearby Structures (check all that apply)

☐ Cracking
☐ Sloughing berm
☐ Flooding (Critical)
☐ Other: _____

Standing Water

☐ No
☐ Yes, Depth: _____ (Potentially critical)

Bank Slope

☐ Stable (3:1 or flatter)
☐ Moderate (3:1 to 2:1)
☐ Unstable (2:1 to 1:1) (Critical)

Surrounding Land Use

☐ Residential/Commercial
☐ Agricultural
☐ Forested/Parkland

Flow Regime

☐ Ephemeral
☐ Intermittent
☐ Perennial

Other observations: _____

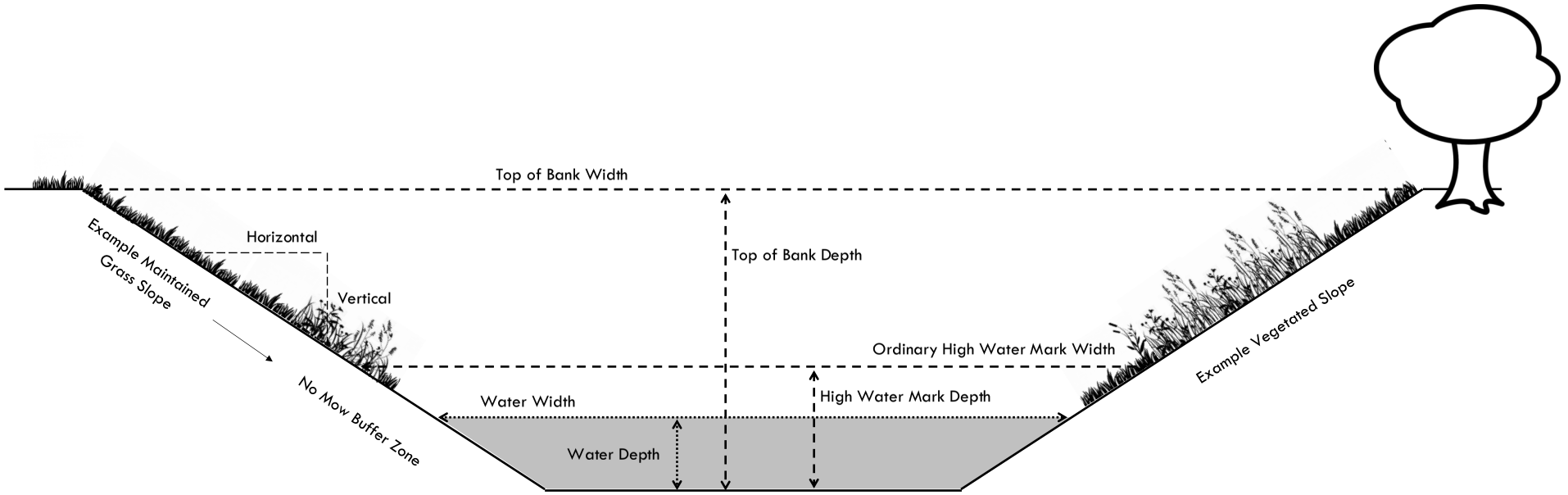
_____

APPENDIX B: DITCH CROSS-SECTION MONITORING FORM

Cross-Section Monitoring Form

Ditch Name: _____

Inspector(s): _____ Date: _____



Water Width (ft)		Water Depth (ft)	
Ordinary High Water Mark (OHWM) Width (ft)		Ordinary High Water Mark Depth (ft)	
Top of Bank Width (ft)		Top of Bank Depth (ft)	
Bank Slope (horizontal:vertical)			

The following physical characteristics should be considered when making an OHWM determination: Scour, Sediment sorting ,Deposition, Water staining, Shelving, Changes in the character of soil, Destruction of terrestrial vegetation, Natural line impressed on the bank, Presence of litter and debris, Multiple observed flow events, Bed and banks, Vegetation matted down, bent, or absent, Leaf litter disturbed or washed away, Change in Plant Community

APPENDIX C: DITCH MAINTENANCE WORK ORDER

CITY OF PERRYSBURG DITCH MAINTENANCE WORK ORDER

Ditch Name/Outfall ID: _____ Date: _____

Closest Road(s): _____

Plan Prepared by: _____

Maintenance Crew Leader: _____

PROBLEM(S) OBSERVED	MAINTENANCE NEEDED?	PROPOSED ACTION
Excessive Vegetation	YES NO	☐ Mow ☐ Remove invasive plants ☐ Trim trees/Vegetation ☐ Other: _____
Lack of Vegetation	YES NO	☐ Seed with grass ☐ Seed with native plant mix ☐ Other: _____
Debris/Log Jams/ Pollutants	YES NO	☐ Remove debris using hands or tools ☐ Remove log jams ☐ Other: _____
Sediment Accumulation	YES NO	☐ Remove sediment using heavy equipment ☐ Remove using hand shovels ☐ Other: _____
Clogged or Damaged Culvert or Tile Outlet	YES NO	☐ Repair/Clean out ☐ Replace with culvert of same size and shape ☐ Replace with culvert of another size or shape (non-routine) ☐ Other: _____
Slope/Bank Erosion	YES NO	☐ Regrade to original design specification ☐ Redesign (non-routine) ☐ Other: _____
Destabilized Bank	YES NO	☐ Add riprap ☐ Regrade or revegetate ☐ Other: _____

Comments:

_____

_____

_____

_____

_____

APPENDIX D: ODNR INVASIVE PLANT MANAGEMENT

Fighting Invasive Plants in Ohio

For more information, contact:

Ohio Department of Natural Resources
Division of Natural Areas & Preserves
2045 Morse Road, Bldg. F-1
Columbus, OH 43229-6693
(614) 265-6453
www.ohiodnr.com/dnap

The Nature Conservancy
6375 Riverside Drive
Dublin, OH 43017
(614) 717-2770
www.nature.org

Funding provided by the
Natural Areas Tax Checkoff Program
and The Nature Conservancy, Ohio Chapter

Ohio's Most Invasive Plants

This brochure describes 10 of the most invasive non-native plant species in Ohio with information about their appearance, habitat, possible controls, and native species which can be used as alternatives in garden or wildlife plantings.

What are Invasive Plants?

Of the approximately 2,300 species of plants known to occur in the wild in Ohio, about 78 percent are native or they occurred in Ohio before the time of substantial European settlement, about 1750. The other 22 percent, more than 500 species, are not native to Ohio, having been introduced from other states or countries.

Non-native plants have been introduced for erosion control, horticulture, forage crops, medicinal use, and wildlife foods as well as by accident. Most of these species never stray far from where they are introduced (gardens, urban areas, agricultural fields), yet some become very invasive and displace native plants in woodlands, wetlands, prairies, and other natural areas.

Many plants considered non-native, alien, or exotic are popular, aesthetically pleasing species. It is important to look beyond these traits – consider how these plants "act" in the landscape. Sometimes we plant invasive non-native plants for landscaping or wildlife habitat without realizing the problems they may cause when they escape into natural areas.

Without natural controls, invasive non-native plants are able to spread quickly. In some Ohio wetlands, large plots of a single invasive plant species have crowded out areas that were once filled with a wide variety of important native plants. In Ohio's woods, native spring wildflowers are quickly replaced by garlic mustard and invasive bush honeysuckle species. A diverse, healthy ecosystem is important for clean air and water, soil stability, buffer, and food and shelter for wildlife.

This brochure describes 10 of the most invasive non-native plant species in Ohio with information about their appearance, habitat, possible controls, and native species which can be used as alternatives in garden or wildlife plantings. Managing these invasive species can be challenging; be sure to obtain more detailed information before using controls, such as herbicides.

Autumn-olive
Elaeagnus umbellata

DESCRIPTION
Autumn-olive is a fast-growing shrub or small tree reaching up to 20 feet tall. Its leaves are small and oval, dark green on the upper surface and silvery below. Small coppery dots occur on stems and leaves. This shrub has light yellow, aromatic flowers and produces large quantities of small, round red fruits that are readily eaten and spread by birds.

HABITAT
Autumn-olive can survive in very poor soils because of its nitrogen-fixing root nodules. It grows in disturbed areas, roadsides, pastures, and fields throughout Ohio.

MANAGEMENT
Stems may be cut and treated with systemic herbicide. Resprouting will occur, so follow-up control is necessary. A combination of hand-pulling, digging, and herbicide treatments is usually necessary.

NATIVE ALTERNATIVES
Black haw (*Viburnum prunifolium*), dogwoods (*Cornus racemosa, C. amomum*), paw-paw (*Asimina triloba*), and spicebush (*Lindera benzoin*)

WHAT YOU CAN DO TO HELP
Be careful not to gather and transport unidentified seeds which may spread invasive plants.

Bush Honeysuckles

Lonicera maackii, L. tatarica, L. morrowii, Amur, Tatarian, Morrow honeysuckle

DESCRIPTION

These upright shrubs can grow 6-15 feet in height. Each have dark green, egg-shaped leaves. The tubular flowers are white on the Amur and the Morrow (changing to yellow with age), and pink on the Tatarian honeysuckle. Berries range from red to orange, occasionally yellow, and are eaten and dispersed by birds.

HABITAT

The bush honeysuckles inhabit abandoned fields, roadsides, woodlands, and edges of marshes. Morrow is currently a problem in northern Ohio, Amur is found mostly in southwest Ohio, and Tatarian is widespread in Ohio.

MANAGEMENT

The best control method is to cut and treat stumps with systemic herbicide. Sprouts from cut stems may be treated with a foliar application of systemic herbicide. Young shrubs are easy to pull or dig up. Be aware there is a native bush honeysuckle (*Diervilla lonicera*) in Ohio.

NATIVE ALTERNATIVES

Nine-bark (*Physocarpus opulifolius*), dogwoods (*Cornus racemosa, C. amomum*), northern arrowwood (*Viburnum dentatum*), winterberry (*Ilex verticillata*), chokeberry (*Aronia prunifolia, A. melanocarpa*), and spicebush (*Lindera benzoin*)

WHAT YOU CAN DO TO HELP

Avoid disturbance to natural areas, including clearing of native plants and dumping of yard wastes.

Buckthorns

Rhamnus frangula
Glossy (or Shining)

R. cathartica
European (or Common) buckthorn

DESCRIPTION

Buckthorns are tall shrubs or small trees that grow up to 20 feet tall. The smooth, gray to brown bark is distinctively spotted. Glossy buckthorn has shiny leaves with smooth edges. It has solitary red to purple berry-like fruits. European buckthorn has black fruits and dull green smooth leaves. Both species are abundant seed producers.

HABITAT

Glossy buckthorn usually occurs in wetlands, such as fens or bogs. European buckthorn generally occurs in a range of upland habitats, such as forests, woodland edges, fencerows, prairies, and old fields. It is not uncommon to see both species sharing the same habitat. Buckthorns are most prevalent in central and northern Ohio.

MANAGEMENT

Cutting and treating stumps or spraying foliage with a systemic herbicide is the best method of control. Buckthorns are very difficult to control due to vigorous resprouting and a large seedbank.

NATIVE ALTERNATIVES

Winterberry (*Ilex verticillata*), dogwoods (*Cornus racemosa, C. amomum*), white cedar (*Thuja occidentalis*), and Carolina buckthorn (*Rhamnus caroliniana*)

WHAT YOU CAN DO TO HELP

Plant native or non-invasive plants in your yard and garden.

Common Reed Grass

Phragmites australis

DESCRIPTION

Common reed, or Phragmites, is a grass that reaches up to 15 feet in height. The leaves are smooth, stiff and wide with coarse hollow stems. The big, plume-like flower head is grayish-purple when in fruit. It can form huge colonies and usually spreads by sprouting new shoots through underground stems (*rhizomes*).

HABITAT

Common reed grass grows in open wetland habitats and ditches. It occurs in still water areas of marshes, lake shores, riverbanks, and disturbed or polluted soils, often creating pure stands. It is possible that both native and non-native strains occur. Generally, invasive populations are non-native but it may be difficult to tell the two apart.

MANAGEMENT

Long-term management is necessary for control of this persistent plant. Cutting and treating stems with systemic herbicides is generally the most effective method. Grass-specific herbicides are recommended in areas where native plants occur.

NATIVE ALTERNATIVES

Indian grass (*Sorghastrum nutans*), big bluestem (*Andropogon gerardii*), prairie cord grass (*Spartina pectinata*), and Canada bluejoint (*Calamagrostis canadensis*)

WHAT YOU CAN DO TO HELP

Read the label! Be careful when planting seed mixes. Non-native invasive species may be in the mix.

Garlic Mustard
Alliaria petiolata

DESCRIPTION
Garlic mustard is a biennial herb; it grows as a rosette of leaves in the first year and overwinters in this form. Its lifecycle ends in the second year when it flowers and sets fruits. First-year rosettes consist of kidney-shaped, garlic-smelling leaves; the second-year plant can grow multiple stems up to 4 feet tall with triangular, sharply-toothed leaves. The small, four-petaled flowers are white and grow in clusters at the top of the stem. Garlic mustard produces large quantities of seeds which can remain viable for seven years or more.

HABITAT
This woodland plant prefers some shade but is occasionally found in full sun. It invades upland and floodplain forests, savannas, yards, streams, trails, and roadsides throughout Ohio.

MANAGEMENT
Repeated prescribed burns in oak forests may be effective. Light infestations of garlic mustard can be hand-pulled before or at flowering time. Plants should be removed from the site after pulling as the seeds may continue to mature. Systemic herbicides can be applied to the rosettes in early spring or late fall.

NATIVE ALTERNATIVES
White baneberry (*Actaea pachypoda*), columbine (*Aquilegia canadensis*), blue phlox (*Phlox divaricata*), and black cohosh (*Cimicifuga racemosa*)

WHAT YOU CAN DO TO HELP
Remove invasive plants from your property.

Japanese Honeysuckle

Lonicera japonica

DESCRIPTION

Japanese honeysuckle is a woody semi-evergreen vine with opposite, oval leaves. The flowers grow in pairs, are white to yellow, and very fragrant. Fruits, also in pairs, are purple to black berries. This vine climbs and drapes over native vegetation, forming dense patches.

HABITAT

Japanese honeysuckle thrives in disturbed habitats, such as roadsides, trails, fencerows, abandoned fields, and forest edges. Disturbances, such as logging, road building, floods, and windstorms, create an opportunity for this vine to invade native plant communities.

MANAGEMENT

Burning in combination with systemic herbicide application may be an effective control method. Herbicides can be applied to the leaves when native plants are dormant. Be aware there are native climbing honeysuckles in Ohio, such as wild honeysuckle (*Lonicera dioica*).

NATIVE ALTERNATIVES

Virginia creeper (*Parthenocissus quinquefolia*), wild honeysuckle (*Lonicera dioica*), and virgin's bower (*Clematis virginiana*)

WHAT YOU CAN DO TO HELP

Spread the word about the threats of invasive plants in Ohio and the benefits provided by native plant communities.

Japanese Knotweed

Polygonum cuspidatum

DESCRIPTION

This shrub-like herb grows up to 10 feet tall. Stems are smooth and the pointed leaves vary from broadly oval to almost triangular. Flowers are greenish-white and very small. The seeds are dispersed by wind. Once established, the plants spread by a system of underground stems reaching 60 feet.

HABITAT

Japanese knotweed can grow in a wide variety of habitats. It is found in open areas, such as roadsides, streambanks, and woodland edges. It spreads quickly and forms dense thickets.

MANAGEMENT

Knotweed is very difficult to control. Leaves may be sprayed or stems cut and treated with systemic herbicide.

NATIVE ALTERNATIVES

Northern arrowwood (*Viburnum dentatum*), black haw (*Viburnum prunifolium*), dogwoods (*Cornus racemosa, C. amomum*), and chokeberry (*Aronia prunifolia, A. melanocarpa*)

WHAT YOU CAN DO TO HELP

Familiarize yourself with the invasive plants in your area.

Multiflora Rose

Rosa multiflora

DESCRIPTION

Multiflora rose is a dense spreading shrub with widely arching canes and stiff, curved thorns. This shrub grows up to 15 feet tall with alternate, compound leaves of 7-9 oval leaflets. Multiflora rose has numerous white flowers that produce clusters of small, red fruits. The fruits (called hips) are eaten by birds and mammals which help disperse the seeds. An individual plant can produce up to 500,000 seeds per year.

HABITAT

Multiflora rose was formerly planted as a "living fence" to control livestock, stabilize soil, and create barriers for roadways. It also has been planted as a wildlife cover and food source. This rose occurs in a wide range of habitats throughout Ohio, but prefers sunny areas with well-drained soils.

MANAGEMENT

A long-term management program of mowing or cutting and treating stems with systemic herbicide several times during the growing season is recommended. Digging or hand-pulling small shrubs also may be effective.

NATIVE ALTERNATIVES

Pasture rose (*Rosa carolina*), swamp rose (*Rosa palustris*), steeple bush (*Spiraea tomentosa*), meadowsweet (*Spiraea alba*), and prairie rose (*Rosa setigera*)

WHAT YOU CAN DO TO HELP

Volunteer with your local land managing agency (parks, nature preserves, etc.).

Purple Loosestrife

Lythrum salicaria

DESCRIPTION

This popular garden flower grows 3-7 feet tall and has a dense bushy growth of one to 50 stems. Long spikes of flowers are purple to magenta, and linear-shaped leaves grow opposite along the square stems. Purple loosestrife spreads aggressively by underground stems (*rhizomes*) and can produce as much as a million seeds per plant. *Lythrum virgatum*, a popular horticultural variety, was initially thought to be unable to produce seeds. Research has shown that it can cross-pollinate with *Lythrum salicaria* and produce viable seeds of invasive loosestrife.

HABITAT

Purple loosestrife grows in a variety of wetland habitats including marshes, river banks, ditches, wet meadows, and edges of water bodies. Loosestrife can invade both natural and disturbed wetlands, replacing native vegetation with nearly pure stands of loosestrife.

MANAGEMENT

Small stands of purple loosestrife can be controlled by hand-pulling, digging, or applying systemic herbicides to the foliage. Herbicides may be used to control large populations. Biological controls using beetles and weevils are being used by some agencies in Ohio and other states.

NATIVE ALTERNATIVES

Spiked blazing-star (*Liatris spicata*), blue lobelia (*Lobelia siphilitica*), cardinal flower (*Lobelia cardinalis*), rose mallow (*Hibiscus moscheutos*), and blue flag iris (*Iris versicolor*)

WHAT YOU CAN DO TO HELP

Encourage nurseries to avoid invasive non-native plants and stock alternative native or non-invasive plant species.

Reed Canary Grass

Phalaris arundinacea

DESCRIPTION

This large, coarse grass reaches 2-5 feet tall. The hairless stems gradually taper to flat and rough leaf blades 3-10 inches long. The flowers occur in dense clusters and are green to purple, changing to beige and becoming more open over time. The plant spreads aggressively both by seed and by forming a thick system of underground stems (*rhizomes*).

HABITAT

This grass occurs in wetlands, such as marshes, wet prairies, meadows, fens, stream banks, and seasonally wet areas throughout Ohio. Reed canary grass has been planted widely for forage and erosion control. It is possible that both native and non-native strains occur together, but introduced strains are thought to be more invasive. It may be difficult to tell the two apart.

MANAGEMENT

A combination of burning or mowing with systemic herbicides is the best method of control; grass-specific herbicides applied with wick applicators are recommended in areas where native plants occur.

NATIVE ALTERNATIVES

Prairie cord grass (*Spartina pectinata*), Canada bluejoint (*Calamagrostis canadensis*), and Indian grass (*Sorghastrum nutans*)

WHAT YOU CAN DO TO HELP

Start early! Early detection and control makes eradication efforts much easier.

APPENDIX E: STANDARD OPERATING PROCEDURES FOR ROUTINE MAINTENANCE [2]

Mowing or Removing Undesirable Plants

IDH Practice 102: Tree Preservation and Protection

IDH Practice 105: Silt Fencing

IDH Practice 106: Straw Bale Filter

IDH Practice 107: Clearing and Grubbing

IDH Practice 301: Chemical Vegetation Control

IDH Practice 302: Mechanized Debrushing Using Hand-held Tools

IDH Practice 303: Mechanized Debrushing Using Heavy Machinery

IDH Practice 304: Stump Removal

Removing Sediment and Debris Buildup

IDH Practice 601: Channel Bottom Dipping

IDH Practice 602: Channel Excavation/Dredging

OSMG Guide 18: Stream Debris and Obstruction Removal

Stabilizing Ditch Banks

OSMG Guide: Riprap Revetments

OSMG Guide 08: Trees for Ditches

IDH Practice 1204: Tree Replacement

IDH Practice 1101: Mulching

IDH Practice 1102: Vegetative Stabilization and Seeding

IDH Practice 1103: Bonded Fiber Matrix

IDH Practice 1104: Erosion Control Blanket

Maintaining Culverts

IDH Practice 202: Tile Drain Repair/Replacement

[2] The SOPs included in this appendix were taken from the "Ohio Stream Management Guide" (OSMG) or "Indiana Drainage Handbook" (IDH). While most of the information is applicable to the City of Perrysburg projects, these SOPs are meant to serve as guidelines only.

PRACTICE 102
TREE PRESERVATION AND PROTECTION

DESCRIPTION

- Methods to preserve and protect desirable existing trees from damage during construction. (Note: This practice is also included in the Indiana Erosion Control Handbook.)

Exhibit 102a: Tree preservation and protection (Source: IDNR Files)

PURPOSE

- To preserve and protect trees that have present or future value for their use in erosion protection, landscape and/or aesthetic value, or for other environmental benefits.

WHERE APPLICABLE

- Applicable to nearly every project.

ADVANTAGES

- Stabilize the soil and prevent erosion.
- Reduce stormwater runoff by intercepting rainfall, promoting infiltration, and lowering the water table through transpiration.
- Provide wildlife habitat.
- Increase property values and improve site aesthetics.
- Provides stream shading and cooling.

CONSTRAINTS

- Preserving and protecting trees may impede the maneuverability of large equipment.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Standard steel posts or wood posts with a minimum cross sectional area of 3.0 sq.in.
- 40" high snow fence or 40" high plastic web fencing.

Installation

- Place barriers around protected and preserved trees to prevent the approach of equipment at the drip line of trees to be retained.
- Do not cut tree roots inside the tree drip line.
- Do not place equipment, construction materials, topsoil, or fill dirt within the limit of the drip line of the trees to be saved.
- Remove barriers during final site cleanup.

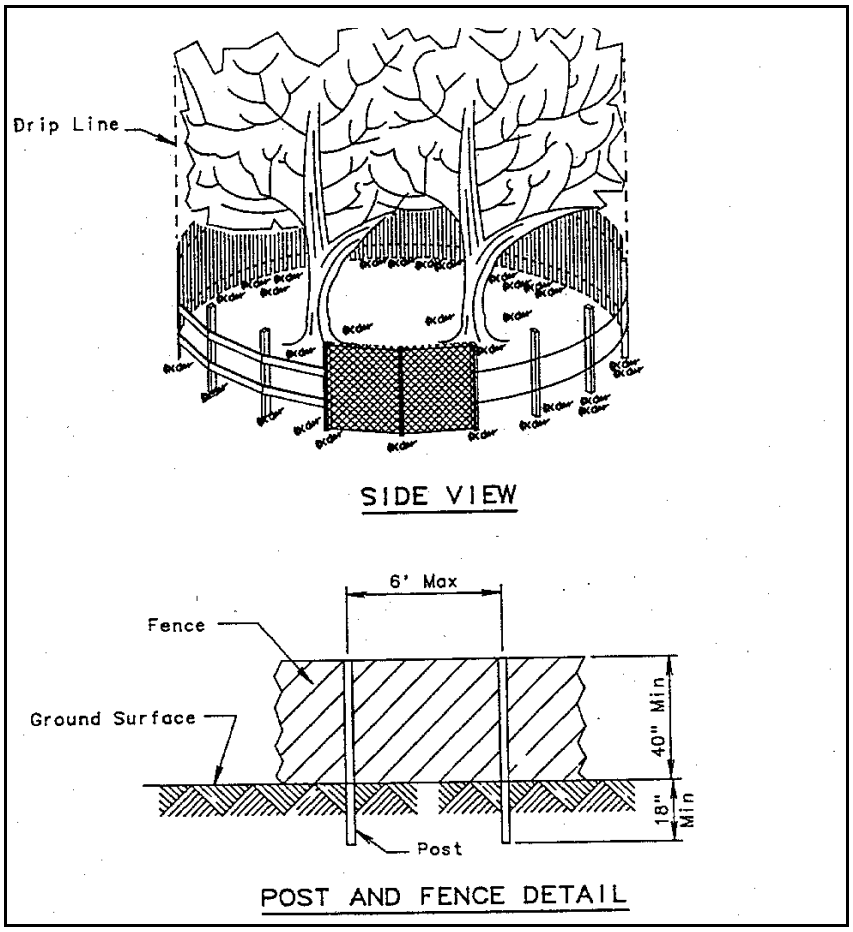


Exhibit 102b: Tree Preservation - Installation Detail (Source: NRCS Files)

Special Considerations

- Select trees to be saved prior to implementing construction activities. In general, leaving larger trees (8" or larger) will provide more shading, habitat, and food sources.
- Thinning undesirable trees ahead of time gives existing trees a chance to adjust to a more open environment.
- Prune low-hanging limbs of preserved trees that could otherwise be broken off by equipment.
- Try to leave trees in groups to avoid sun scald, frost cracks, excessive branching, and windthrow.
- In many cases, dead trees and cavities are important components of wildlife habitat. Unless the elimination of these features are essential for the project, these features may be left undisturbed.

MAINTENANCE

- Repair damaged roots by cutting off the damaged areas and painting with tree paint. Spread peat moss, wood chips or moist topsoil over exposed roots.
- Repair damage to bark by trimming around damaged areas. Taper the cut to provide drainage, and paint with tree paint.
- Cut all damaged limbs above the tree collar at the trunk or main branch. Use three separate cuts for each branch to avoid peeling bark from healthy areas of the tree.

REFERENCES

Related Practices

- Practice 1102 Vegetative Stabilization.
- Practice 1202 Stream Environment Enhancement.

Other Sources of Information

- North Carolina Erosion Control Manual.
- Indiana Erosion Control Handbook.
- NRCS Standard Specifications.

Last Print/Revision Date: October 13, 1996

PRACTICE 105
SILT FENCING

DESCRIPTION

- Temporary barrier of entrenched geotextile fabric (filter fabric) stretched across and attached to supporting posts used to intercept sediment-laden runoff from small drainage areas of disturbed soil. (Note: this practice is also included in the Indiana Erosion Control Handbook.)

Exhibit 105a: Silt Fencing (Source: North Carolina Erosion Control Manual)

PURPOSE

- Cause the deposition of transported sediment load from sheet flows leaving disturbed areas.

WHERE APPLICABLE

- Situations when sediment laden runoff from small drainage areas are a concern.

ADVANTAGES

- Silt fences capture and retain sediment on the construction site thus protecting waterways, streets and other areas outside of the construction limits from sedimentation.
- Silt fences often serve to define construction limits to equipment operators as well as bystanders.
- Silt fences are usually more effective and less expensive than a Straw Bale Filter (Practice 106).

CONSTRAINTS

- Not appropriate where the maximum drainage area exceeds 1/4 acre per 100 feet of fence. Silt fencing is further restricted by slope steepness.

Land Slope	Max. Distance Above Fence
< 2%	100'
2-5%	75'
5-10%	50'
10-20%	25'
> 20%	15'

Exhibit 105b: Maximum distance above silt fence based on land slope. (Source: Indiana Erosion Control Handbook)

- Silt fence should not be used in the flow path of defined drainageways.
- Silt fence may be a high maintenance item during earth moving activities in adjacent areas, and during the rainy season.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- 2" x 2" hardwood posts or steel posts.
- 14 gauge, 6" mesh wire fence (optional).
- Woven or non-woven geotextile fabric with specified filtering efficiency and tensile strength.

Physical Property	Woven Fabric	Non-woven Fabric
Filtering efficiency	85%	85%
Tensile strength at 20% elongation:		
Standard strength	30 lbs/l.in.	50 lbs/l.in.
Extra strength	50 lbs/l.in.	70 lbs/l.in.
Slurry flow rate	0.3 gal./min./sq.ft.	4.5 gal./min./sq.ft
Water flow rate gal./min./sq.ft.	15 gal./min./sq.ft.	220
UV resistance	70%	85%

Exhibit 105c: Properties of woven versus non-woven silt fence fabric. (Source: Indiana Erosion Control Handbook)

Installation

- Dig an 8" deep, flat-bottomed or V-shaped trench along the entire intended fence line.
- Drive wood or steel support posts at least 1' into the ground, $\leq$ 8' apart ($\leq$ 6' apart if not using support wire). Adjust spacing if necessary to ensure that posts are set at the low points along the fence.
- Fasten support wire to the up slope side of the posts, extending it 8" into the trench, or as recommended by the manufacturer.
- Run a continuous length of geotextile fabric on the up slope sides of the posts.

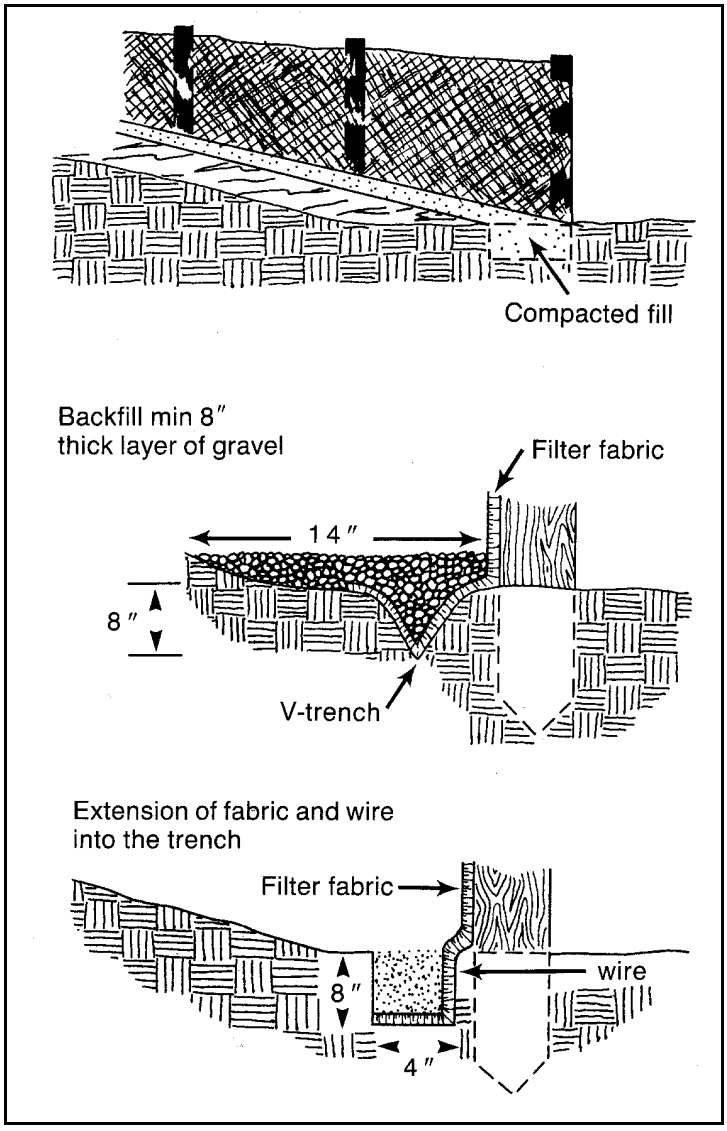


Exhibit 105d: Silt fence installation Details (Source: North Carolina Erosion Control Manual)

- If a joint is necessary, nail the overlap to the nearest post with lath.
- Place the bottom 1' of fabric in the 8" deep trench, extending the remaining 4" toward the up slope side.
- Backfill the trench with compacted earth or gravel.

Special Considerations

- Fence should be at least 10' from the toe of the slope to provide for sediment storage.
- The height of the fence should be 24"-36" above the ground surface.
- Silt fences should not be placed in areas of concentrated flows.
- Improper placement and/or installation can exacerbate and even create erosion problems.

MAINTENANCE

- Inspect fence periodically and after each storm event.
- Replace fencing as necessary.
- Remove deposited sediment when it reaches half the height of the fence at its lowest point, or if the fence begins to bulge.

REFERENCES

Related Practices

- Practice 106 Straw Bale Filter.
- Practice 1102 Vegetative Stabilization.

Other Sources of Information

- Indiana Erosion Control Handbook.
- NRCS Standard Specifications.
- North Carolina Erosion Control Manual

Last Print/Revision Date: October 13, 1996

PRACTICE 106
STRAW BALE FILTER

DESCRIPTION

- Temporary barrier consisting of a row of entrenched and anchored straw bales used to intercept sediment-laden runoff from small drainage areas of disturbed soil. (Note: This practice is also included in the Indiana Erosion Control Handbook.)

Exhibit 106a: Straw Bale Filter (Source: CBBEL Files)

PURPOSE

- Cause the deposition of transported sediment load from sheet flows leaving disturbed areas.

WHERE APPLICABLE

- Erosion would occur in the form of sheet and rill erosion.
- The maximum drainage area for overland flow does not exceed 1/4 acre per 100' of barrier.
- There is no concentration of water flowing to the barrier.
- Effectiveness is required for < 3 months.

ADVANTAGES

- Straw bale filters capture and retain sediment on the construction site thus protecting waterways, streets and other areas outside of the construction limits from sedimentation.
- Straw bale filters can serve to define construction limits to equipment operators as well as bystanders.

CONSTRAINTS

- Less resilient and usually more expensive than Silt Fencing (Practice 105).

Land Slope	Max. Distance Above Fence
< 2%	100'
2-5%	75'
5-10%	50'
10-20%	25'
> 20%	15'

Exhibit 106b: Maximum distance above straw bale filter based on land slope. (Source: Indiana Erosion Control Handbook)

- Lower filter efficiency than silt fencing.
- May be a high maintenance item during earth moving activities in adjacent areas, and during the rainy season.
- Higher flow-through rate than silt fencing.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Straw bales 14" x 18" x 36" minimum.
- Two 36" long (minimum) steel rebars or 2" x 2" hardwood stakes per bale.

Installation

- Dig a $\geq$ 4" deep flat-bottomed trench along the entire intended fence line. The trench should be wide enough to accommodate a bale width, and long enough so that the end bales extend up-slope in such a way that trapped water cannot flow around the ends of the barrier.
- Place bales in the trench on edge (bindings oriented around the sides rather than top and bottom), and abut bales tightly against each other.
- Anchor the Straw Bale Filter by driving 2 rebars or hardwood stakes through each bale until nearly flush with the top. The first stake should be driven toward the previously laid bale to force the bales together.
- Tightly wedge straw into any gaps between the bales to prevent sediment-laden water from running through the cracks.
- Backfill and compact the excavated soil against the bales to ground level on the down-slope side and to 4" above ground level on the up-slope side.

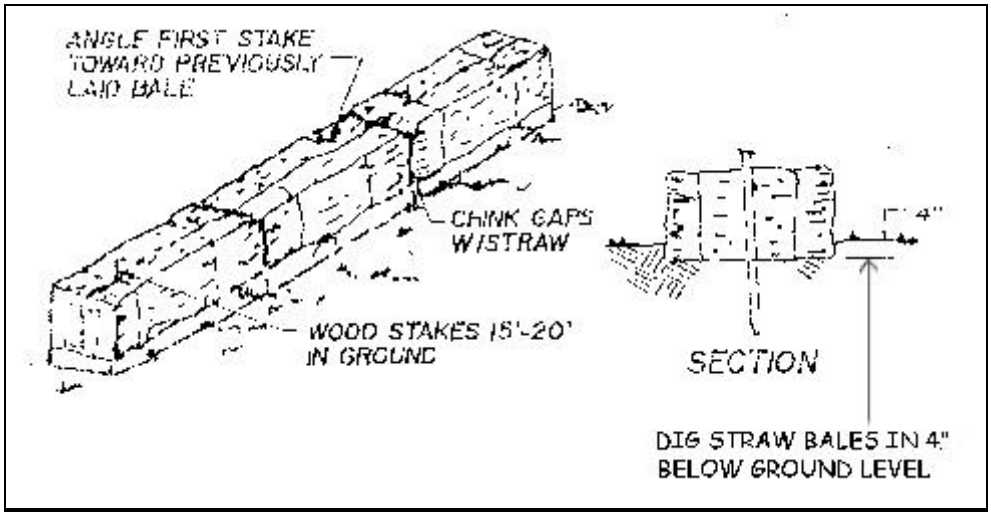


Exhibit 106c: Detail of straw bale filter installation (Source: CBBEL files)

Special Considerations

- Straw bales should not be placed in areas of concentrated flow.
- Field observations have shown that the efficacy of Straw Bale Filters is often compromised for the followings reasons:
  1. Improper use in which bales are used in waterways with high water velocities.
  2. Improper installation including no entrenchment.
  3. Inadequate maintenance.
  4. Straw bales decompose in the presence of moisture and have a very limited life span.

MAINTENANCE

- Inspect bales periodically and after each storm event.
- Replace bales as necessary.
- Remove deposited sediment when it reaches half the height of the bale filter.
- Sediment deposits remaining (after the straw bale filter is no longer required) should be dressed to the existing grade, and seeded.

REFERENCES

Related Practices

- Practice 104 Temporary Diversion.
- Practice 105 Silt Fencing.
- Practice 1102 Vegetative Stabilization.

Other Sources of Information

- Indiana Erosion Control Handbook.
- NRCS Standard Specifications.
- Illinois Urban Manual.

Last Print/Revision Date: October 13, 1996

PRACTICE 107
CLEARING AND GRUBBING

DESCRIPTION

- Removal and disposal of trees, snags, logs, stumps, shrubs, and rubbish.

Exhibit 107a: Clearing and Grubbing (Source: NRCS Files)

PURPOSE

- To prepare a site for construction activities.

WHERE APPLICABLE

- All situations in which vegetation, rubbish or debris must be removed prior to implementing construction activities.

ADVANTAGES

- Allows unimpeded access to construction site.
- Provides suitable substrate on which to work.
- Provides a safe environment in which to work.

CONSTRAINTS

- All areas cleared and/or grubbed must be stabilized with vegetation.
- All material cleared and/or grubbed must be properly disposed of.
- May require the use of heavy equipment.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Brushhog, chainsaw, stump grinder, bulldozer, etc.

Installation

- The limits of areas to be cleared and/or grubbed should be marked with stakes, flags, or other suitable methods.
- Trees to be left standing and uninjured should be designated by special marks placed about 6' high on the trunks. Preserved trees should be protected as described in Tree Preservation and Protection (Practice 102).
- Clearing: Removal and disposal of woody vegetation and other debris. Trees and woody vegetation should be cut off as near the ground surface as field conditions permit.

- Grubbing: Removal of all stumps, roots, and root clusters having a diameter of ≥ 1" to a depth of ≥ 2' below subgrade elevations for concrete structures, and ≥ 1' below the ground surface at embankment sites and other designated areas.

Special Considerations

- All materials cleared and/or grubbed should be disposed of as described in Debris Disposal (Practice 1301).
- Measures should be taken to prevent erosion and siltation during clearing and/or grubbing activities.
- All areas cleared and/or grubbed should be stabilized as soon as possible.

MAINTENANCE

- Areas cleared and/or grubbed should be monitored periodically until the site is stabilized.

REFERENCES

Related Practices

- Practice 102 Tree Preservation and Protection.
- Practice 105 Silt Fencing.
- Practice 106 Straw Bale Filter.
- Practice 1102 Vegetative Stabilization.
- Practice 1301 Debris Disposal.

Other Sources of Information

- NRCS Standard Specifications.
- Illinois DOT Specifications.

Last Print/Revision Date: October 13, 1996

PRACTICE 301
CHEMICAL VEGETATION CONTROL

DESCRIPTION

- Controlling woody vegetation by means of an herbicide.

Exhibit 301a: Chemical Vegetation Control (Source: CBBEL files)

PURPOSE	●	To control growth of woody vegetation.
WHERE APPLICABLE	●	Stream and ditch right-of-ways.
	●	Often used in conjunction with mechanical debrushing techniques (Practice 302 Debrushing Using Hand-held Tools and Practice 303 Debrushing Using Heavy Machinery).
	●	Areas where low impact, selective vegetation control is desirable.
ADVANTAGES	●	Foliar application of herbicides may be more economical than mechanical control of woody vegetation. (However, it should not be used near the water.)
	●	Herbicides used in conjunction with mechanical debrushing techniques can be used to prevent resprouting.
	●	Often used in environmentally sensitive areas to selectively eliminate undesirable species.
CONSTRAINTS	●	Herbicides can be hazardous to humans and the environment if not used properly.
	●	Product label should be strictly adhered to. In some cases label instructions prohibit use adjacent to water, and may prohibit use in certain areas where threatened/endangered species are known to exist.
	●	Applications may be done only by or under the direct supervision of a certified applicator, certified by the Office of Indiana Chemist at Purdue University.
	●	Application of herbicide may be limited by weather and season.
	●	May elicit negative public response.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Protective Clothing (minimum): shoes, long-sleeved shirt and long pants, eye protection, hat, rubber gloves.
- Foliar Application: manual or power hydraulic sprayer.
- Basal Bark Treatments: manual sprayer.
- Cut Surface Treatments: manual sprayer and or squirt bottle, tree injector.
- Herbicide.

Installation

- Foliar Spray Application: Apply to actively growing plants with fully developed foliage. Stems and leaves of target plants should be sprayed to the point of runoff.

- Injection Method: Use either a tool designed specifically for making a cut in a tree and simultaneously injecting the herbicide, or a hatchet and a squirt bottle. In both cases, tree wounds should angle downward through the bark and into the sapwood. Space cuts evenly around the trunk as recommended by the product label.

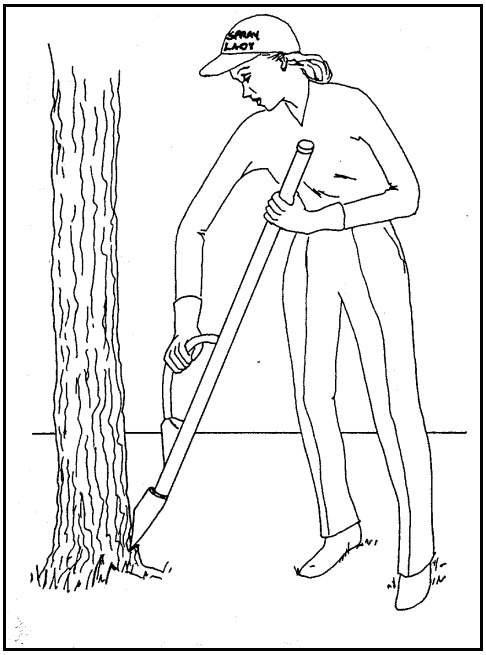


Exhibit 301b: Herbicide injection application (Source: Illinois Pesticide Manual)

- Girdling("frilling"): Make two cuts approximately 1' apart through the bark and into the sapwood, completely around the tree. Remove the bark in between and apply herbicide as recommended on the product label.

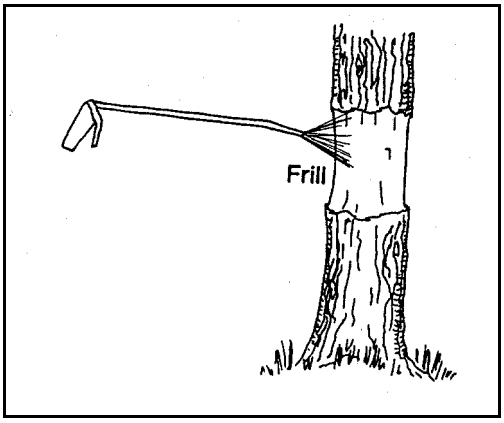


Exhibit 301c: Herbicide applied following girdling (Source: Illinois Pesticide Manual)

- Stump Treatment: Cut stumps should be treated as soon as possible after cutting, preferably less than 2 hours. Stumps should be saturated, especially in the cambial area.

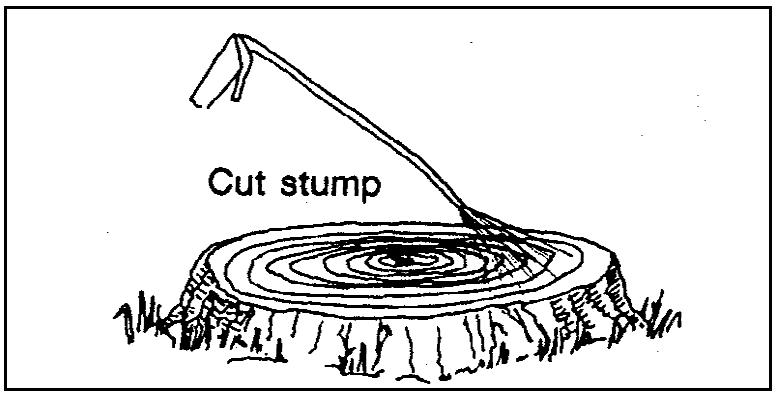


Exhibit 301d: Cut-surface application of herbicide (Source: Illinois Pesticide Manual)

Special Considerations

- Always apply herbicide in accordance with the product label.
- Take extra precautions when applying herbicide around water.
- Careless application may result in damaging non-target plants.
- Adding dyes to herbicide mixtures are useful when treating numerous cut stumps in that the applicator can keep track of stumps that have been treated, and new ones that need to be treated.
- Individual tree control may be accomplished by following methods described in the North Central Forest Experimental Station Notes (see references).

MAINTENANCE

- Repeat applications as necessary.

REFERENCES

Related Practices

- Practice 107, Clearing and Grubbing.
- Practice 302, Debrushing Using Hand-held Tools.
- Practice 303, Debrushing Using Heavy Machinery.
- Practice 304, Stump Removal.

Other Sources of Information

- Illinois Pesticide Manual.
- Illinois Vegetation Manual.
- North Central Forest Experimental Station Notes.

Last Print/Revision Date: October 13, 1996

PRACTICE 302
MECHANIZED DEBRUSHING USING HAND-HELD TOOLS

DESCRIPTION

- Removing living woody vegetation by hand-held tools.

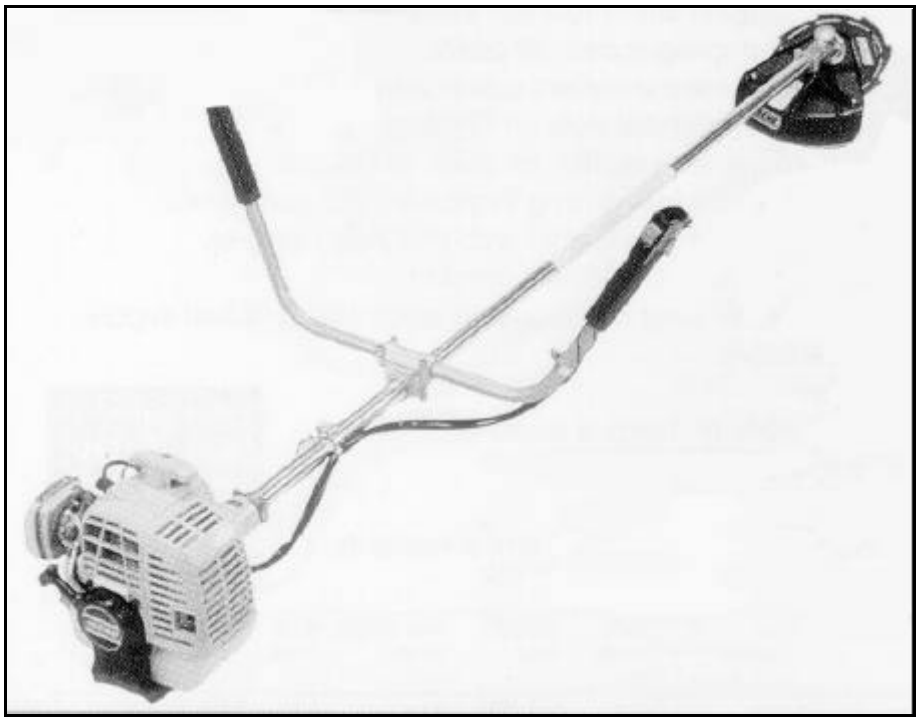


Exhibit 302a: Example of Equipment Used for Mechanized Debrushing Using Hand-held Tools (Source: CBBEL files)

PURPOSE

- To reduce or eliminate woody vegetation along stream or ditch banks and/or overbanks.

WHERE APPLICABLE

- Any drainage improvement project that specifies removing living woody vegetation.

ADVANTAGES

- Hand-held tools generally cause little to no soil displacement of banks and overbank areas.
- May be appropriate in environmentally sensitive areas.
- Lower mobilization cost than that associated with heavy machinery.
- Often requires no special training to operate hand-held tools.
- Opens up the vegetative canopy thus letting more light in for establishment of desirable plants.

CONSTRAINTS

- Time consuming.
- Labor intensive.
- Removing woody vegetation may make a bank or overbank less stable, and more prone to erosion and siltation.
- May require Vegetative Stabilization (See Practice 1102).

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Hand saws, chain saws, hand-winch, clippers, axes, machete, lopping shears, and/or weed whips.
- Herbicide.

Installation

- Cut woody vegetation above ground with appropriate implement.
- Treat stumps with an appropriate herbicide (see Practice 301 Chemical vegetation control) to prevent resprouting.

Special Considerations

- This practice does not include removing stumps or roots, or any other activity that would displace the soil.
- Cut vegetation may be removed and properly disposed of or left in place.

MAINTENANCE

- Remove resprouts as necessary.

REFERENCES

Related Practices

- Practice 107 Clearing and Grubbing.
- Practice 301 Chemical Vegetation Control.
- Practice 303 Mechanized Debrushing Using Heavy Machinery.
- Practice 304 Stump Removal.
- Practice 1102 Vegetative Stabilization.
- Practice 1301 Debris Disposal.

Other Sources of Information

- Illinois DOT Specifications.

Last Print/Revision Date: October 13, 1996

PRACTICE 303
MECHANIZED DEBRUSHING USING HEAVY MACHINERY

DESCRIPTION

- Removing living woody vegetation by means of heavy machinery.

Exhibit 303a: Mechanized Debrushing Using Heavy Machinery (Source: Allen County Surveyor's Office Files)

PURPOSE

- To reduce or eliminate woody vegetation along stream or ditch banks and/or overbanks.

WHERE APPLICABLE

- Any large drainage improvement project which requires removing living woody vegetation.

ADVANTAGES

- Use of heavy machinery may be more time efficient than hand-held tools.
- Opens up the vegetation canopy.

CONSTRAINTS

- May be more expensive than debrushing with hand-held tools (See Practice 302 Debrushing Using Hand-held Tools).
- Generally causes greater environmental impact than debrushing with hand-held tools.
- Generally less discriminating than hand-held tools making it more difficult to preserve select areas as necessary.
- Removing woody vegetation may make a bank or overbank less stable, and more prone to erosion and siltation.
- Generally believed to cause soil displacement.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Bush hogs, bulldozers equipped with shear blades, rakes, or discs, backhoes, etc.
- Herbicide.

Installation

- Cut woody vegetation above ground with appropriate implement.
- Treat stumps with an appropriate herbicide (see Practice 301 Chemical Vegetation Control) to prevent resprouting.

Special Considerations

- This practice does not include removing stumps or roots.
- Cut vegetation may be removed by or left in place.

MAINTENANCE

- Remove resprouts as necessary.

REFERENCES

Related Practices

- Practice 107 Clearing and Grubbing.
- Practice 301 Chemical Vegetation Control.
- Practice 302 Mechanized Debrushing Using Hand-held Equipment.
- Practice 304 Stump Removal
- Practice 1102 Vegetation Sterilization
- Practice 1301 Debris Disposal

Other Sources of Information

- Illinois DOT Specifications.

Last Print/Revision Date: October 13, 1996

PRACTICE 304
STUMP REMOVAL

DESCRIPTION

- Removing stumps from natural streams and man-made ditches.

Exhibit 304a: Example of Equipment Used for Stump Removal (Source: C&S Equipment Sales, Inc.)

PURPOSE	●	Prepare bank and/or channel for drainage improvement activity.
WHERE APPLICABLE	●	Any drainage improvement project that requires the removal of tree stumps.
ADVANTAGES	●	May improve access to construction site.
	●	Allows undisturbed compaction of soil, when required.
	●	Eliminates regrowth of cut trees, where appropriate.
	●	May facilitate implementation of stream stabilization practices.
CONSTRAINTS	●	Causes soil displacement.
	●	May require heavy machinery.
	●	Cavity where stump removed should be filled to grade.
	●	Site may be prone to erosion during stump-removal activities.
	●	Usually requires restabilization (See Activity 5.11 Revegetation and Site Stabilization).

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Back hoe, bush hog, bulldozers, etc.
- Clean fill.
- Vegetative Restabilization (See Practice 1102).

Installation

- Cut woody vegetation above ground with appropriate implement.
- Remove stumps with appropriate implement.

Special Considerations

- Employ appropriate siltation and erosion control practices during construction.
- Stumps should be disposed of properly (See Practice 1302 Debris Disposal).
- It is often advisable to leave stumps in place to secure the banks.

MAINTENANCE

- Periodically inspect the site for signs of erosion.

REFERENCES

Related Practices

- Practice 107 Clearing and Grubbing.
- Practice 301 Chemical Vegetation Control.
- Practice 302 Mechanized Debrushing Using Hand-held Equipment.
- Practice 303 Mechanized Debrushing Using Heavy Machinery.
- Practice 1301 Debris Disposal.

Other Sources of Information

- Illinois DOT Specifications.

Last Print/Revision Date: October 13, 1996

PRACTICE 601
CHANNEL BOTTOM DIPPING

DESCRIPTION

- Dipping, dredging and/or removing sediment from the channel bottom with a bucket from one side of the channel without disturbing the ditch banks.

Exhibit 601a: Channel Bottom Dipping (Source: NRCS files)

PURPOSE

- To lower the grade of the ditch bottom to match the upstream or downstream reaches by means of excavating or dredging the sediments accumulated at the ditch bottom over time.

WHERE APPLICABLE

- Where in-channel obstruction such as sediment or vegetative debris have eliminated a positive hydraulic grade.
- Where stream banks and adjacent overbanks are well defined and stable while in-channel alignment and condition are not conducive for effective low flow.

ADVANTAGES

- Improve low flow conveyance capacity of stream.
- Provides hydraulic benefit to low flow conditions.
- Prevents stagnation or sedimentation pools by providing positive flow conditions.
- Eliminates impact to inflow structures such as tile drains or surface flow systems.

CONSTRAINTS

- Need for extensive in-channel erosion control measures.
- May temporarily impact well established aquatic habitat.
- Has minimal hydraulic benefit for flood flow conditions.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- In-channel sediment basin.

Installation

- Install In-channel Sediment Basin (Practice 801) if necessary.

- Remove all in-channel obstructions (Practice 401 or 402).
- Excavate low flow channel below existing flow line to grades shown in design plans or specifications. Cross section geometry should, in general, be trapezoidal with positive grade. Side slopes of excavated low flow area should be cut away from edge of water so as not to compromise channel bank stability.
- Spoil material should be disposed of adjacent to excavated area unless required differently in design plans or specifications. Spoil shall be placed landward of channel bank by a distance of five feet or more (outside of the floodway) and leveled to a slope of 5:1 (1V:5H) or flatter so as not to severely impact stream system and applied erosion control measures. From the maximum height, the soil should have an 8:1 (1V:8H) back slope to field level. Grading of spoil material should coincide with adjacent stream overbank topography.
- All spoil deposition areas shall be same-day seeded or mulched immediately after final grading if not in agricultural production.

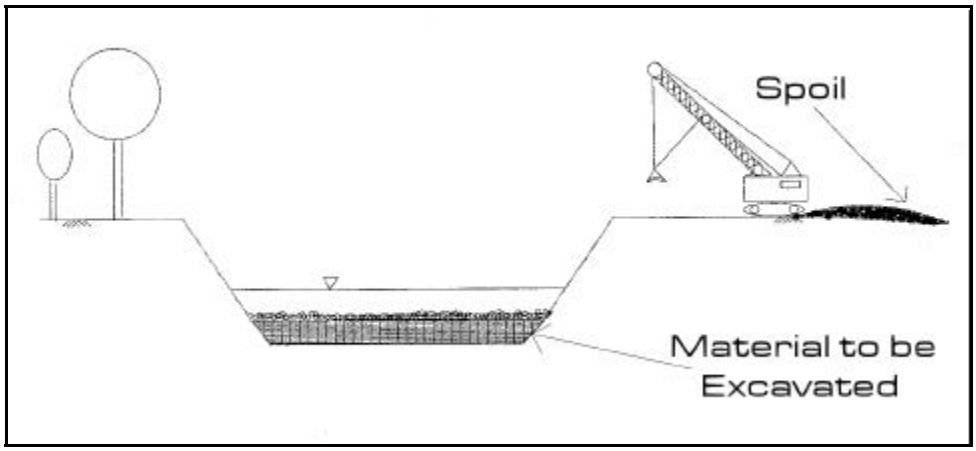


Exhibit 601b: Illustration of Bottom Dipping practice (Source: CBBEL Files)

Special Considerations

- Transitions in size or dimension of excavated area should be gradual to prevent unstable flow conditions and to avoid sedimentation problems.
- Disposal of spoil material should consider additional factors of land ownership or right-of-way, land use (particularly agricultural or crop production), environmentally sensitive areas, or related impacts due to placement of the material.
- Spoil material should not be placed in floodway or in wetlands. Additional permits are required for placement of fill in floodway or wetlands. (See Practice 1301 Debris Disposal.)
- When feasible, consider installing vegetative filter strip (Practice 804) along the work-side of the bank. Channel excavation practices create a unique opportunity to install filter strips with minimal costs.

MAINTENANCE

- Inspect excavated area after major flow events to remove collected debris, as necessary.
- Inspect excavated reach to confirm stability in channel cross section, particularly the channel banks for location of excessive erosion or

streambank failure.

- Remove sediment and debris from excavated area as necessary to maintain cross section and grade to prevent additional sedimentation or erosion.
- Reduce sediment delivery to the ditch by regrading eroded ditch banks and by installing erosion control practices in the contributing watershed.

REFERENCES

Related Practices

- Practice 401 Logjam Removal Using Hand-held Tools .
- Practice 402 Logjam Removal Using Heavy equipment.
- Practice 704 Channel Transitions (Tie-Ins).
- Practice 801 In-channel Sediment Basin .
- Practice 1001 Tile Drain Outlet Extension.
- Practice 1301 Debris Disposal.
- Practice 1303 Permanent Maintenance Access.

Other Sources of Information

- Illinois Urban Manual.
- NRCS Standard Specifications.

Last Print/Revision Date: October 13, 1996

PRACTICE 602
CHANNEL EXCAVATION/DREDGING

DESCRIPTION

- Excavating the banks (side slopes) and bottom of a channel through one-sided construction methods.

Exhibit 602a: Channel Excavation/Dredging (Source: NRCS Files)

PURPOSE

- To increase the cross section of a ditch or reshape the channel to a more stable configuration by means of channel excavation/ dredging from one side of channel.

WHERE APPLICABLE

- Where flood flow conditions warrant additional conveyance capacity in the channel area itself.
- Where channel, soil or site conditions allow for extensive excavation of material for entire stream cross section.

ADVANTAGES

- Maximizes available flow conveyance capacity of stream system.
- Provides hydraulic benefit to adjacent lands.
- Can provide a stable stream cross section for entire channel width.
- Can provide for larger in-channel and overbank habitat.

CONSTRAINTS

- May require reconstruction of all side outlets to main stream.
- May require extensive erosion control measures.
- May need extensive overbank area to perform construction.
- May negatively impact well established riparian corridor.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Vegetative stabilization material.
- Erosion control blankets or matting.

Installation

- Work should be performed from one side of channel only. When conditions allow, limiting work to north and east sides would be environmentally more beneficial as leaving trees on south and west sides provides shading to the stream. Cross section excavation should start from top of the bank of work side, continue to the ditch bottom, and then proceed to the top of the other bank.
- Install In-channel Sediment Basin (Practice 801), if necessary.
- Remove all in-channel obstructions (Practice 401 or 402).
- Remove brush and vegetative matter to be disposed of by appropriate means (Activity 5.3)
- Clear and Grub channel bank (Practice 107). Brush and debris to be disposed of by appropriate means (Practice 1301)
- Note all points of concentrated inflow to channel for special excavation/protection of these outlets.
- Excavate cross section to grades shown in design plans or specifications. Cross section geometry should in general be trapezoidal with consideration for geotechnical stability of side slopes and adjacent topography. Side slopes of excavated area should be preferably 3:1 (1V:3H) or flatter but never greater than 2:1 (1V:2H).
- Apply applicable excavated area lining as required by design plans or specifications. These linings should conform to guidelines noted for the specific requirements stated in rip-rap, vegetative, or concrete linings noted in Practices 701, 702 and 703.
- Remove piped or surface outflow structures to a point equal to the excavation limits. Re-establish outlet and applicable outfall structures while applying appropriate energy dissipators or erosion resistant linings to allow positive grade and free flow to main channel (Practices 704, 705, 1001, and 1002).
- Spoil material should be disposed of adjacent to excavated area unless required differently in design plans or specifications. Spoil shall be placed away from newly excavated bank by a distance of five feet or more (outside of the floodway) and leveled to a slope of 5:1 (1V:5H) or flatter so as not to severely impact erosion control measures and to coincide with adjacent stream overbank topography. From the maximum height, the spoil should have an 8:1 (1V:8H) slope to field level.
- All spoil deposition areas shall be same-day seeded or mulched immediately after final grading if not in agricultural production.

- All excavated areas shall be revegetated immediately after final grading using erosion control matting (Practice 1104) to the extent feasible. Same-day seeding or mulching may be considered where conditions allow rapid establishment of vegetation.

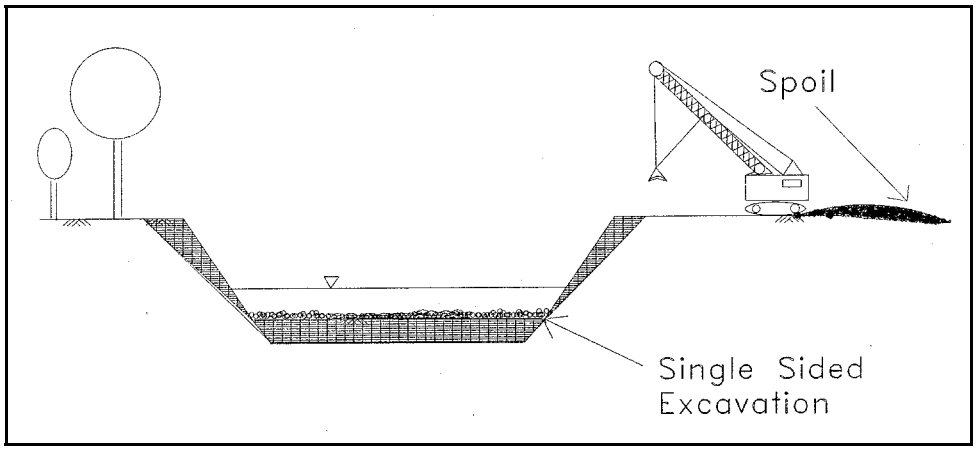


Exhibit 602b: Illustration of one-side channel excavation practice (Source: CBBEL Files)

Special Considerations

- Transitions in size or dimension of excavated area should be gradual to prevent unstable flow conditions and to avoid sedimentation problems.
- Disposal of spoil material should consider additional factors of land ownership or right-of-way, land use (particularly agricultural or crop production), environmentally sensitive areas, or related impacts due to placement of the material.
- Spoil material should not be placed in floodway or in wetlands. Additional permits are required for placement of fill in floodway or wetlands. (See Practice 1301 Debris Disposal.)
- When feasible, consider installing vegetative filter strip (Practice 804) along the work-side of the bank. Channel excavation practices create a unique opportunity to install filter strips with minimal costs.

MAINTENANCE

- Inspect excavated reach after major flow events to repair damaged areas, as necessary.
- Inspect transition areas to confirm stability in channel cross section and for points of erosion.
- Remove sediment and debris from excavated area as necessary to maintain cross section and grade to prevent additional sedimentation or erosion.

REFERENCES

Related Practices

- Practice 107 Clearing and Grubbing.
- Practice 701 Channel with Grass Lining.
- Practice 702 Channel with Riprap Lining.
- Practice 703 Channel with Concrete Lining.
- Practice 704 Channel Transitions (Tie-Ins).
- Practice 705 Grade Transitions.
- Practice 801 In-channel Sediment Basin.
- Practice 1001 Tile Drain Outlet Extension.
- Practice 1002 Riprap-Lined Apron.
- Practice 1102 Vegetative Stabilization.
- Practice 1103 Bonded Fiber Matrix.

- Practice 1104 Erosion Control Blankets and Matting.
- Practice 1301 Debris Disposal.
- Practice 1303 Permanent Maintenance Access.
- Activity 5.3 Debrushing.
- Activity 5.4 Logjam Removal and River Restoration.

Other Sources of Information

- Illinois Urban Manual.
- NRCS Standard Specifications.

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OHIO STREAM MANAGEMENT GUIDE

Stream Debris and Obstruction Removal

A Proactive Landowner's Guide to Maintaining a Free-Flowing Stream

Guide No. 18

PREFACE

Over the years, Ohio citizens have frequently contacted the Department of Natural Resources seeking assistance in the resolution of problems they have encountered related to water resources. One of the most common concerns raised by private landowners involves the situation in which trees and other debris accumulate in stream channels and obstruct streamflow through their properties. These obstructions, sometimes referred to as logjams, may become large enough to disrupt existing drainage patterns and contribute to flooding. In-stream debris often gets lodged behind bridge and culvert openings, which can cause higher flood levels and result in additional land inundation and property damage. Some streams also serve as recreational boating resources, and logjams may interfere with canoeing or other small watercraft navigation. This fact sheet poses some of the frequently raised questions regarding logjams, and provides responses from the Ohio Department of Natural Resources.

WHAT IS A LOGJAM?

A logjam is any woody vegetation, with or without other debris, which obstructs a stream channel and creates a backwater condition. Logjams occur naturally, providing beneficial stream structure and cover for fish and wildlife and allowing nutrient-rich sediment to be deposited on adjacent floodplains. However, Ohio's streams are also expected to function as efficient drainage outlets, conveying water off the land in a timely manner. Logjams may inhibit this drainage function.

DO LOGJAMS CONTRIBUTE TO FLOODING?

Yes, especially during small-scale floods. Since a logjam and the backwater pool created behind it take up volume in the stream channel or floodplain, less natural storage is available when a flood event occurs. This can elevate the level of small-scale flood events, those that occur several times a year. Such impacts can be significant to farm fields and residences in the floodplain and to particularly low-lying, flood-prone areas. A logjam can also lengthen the duration of inundation during these floods, which can have a significant impact on crops planted in floodplain fields.

The amount by which a logjam reduces the floodplain's natural storage capacity is inadequate to make a significant difference in flood elevation during large-scale flood events. Thus, removing logjams is generally not considered an effective measure to mitigate large-scale floods. Large-scale flood events can create, relocate, or enlarge logjams, though, by carrying debris from the floodplain into the stream channel and blocking bridge and culvert openings, resulting in localized impacts.

HOW DOES A LOGJAM FORM?

A logjam most commonly forms when a relatively large object, often a tree that has fallen into a stream channel, becomes wedged or blocked across the streambed. Sometimes human activities induce stream obstructions, like when trimmings from tree pruning or large appliances and other litter are dumped in a stream or left in a floodplain and subsequently are carried into the stream by high water. When an object obstructs the channel, it slows the flow and creates a pool of water behind it. As the water slows or stops behind the object, sediment suspended in the water settles out. The deposited sediment adds to the obstruction and causes additional debris to be trapped on and behind it. As more sediment and debris accumulate around and behind the obstruction, the logjam becomes larger and more tightly packed, forming a natural dam across the stream.

WHY SHOULD LOGJAMS BE REMOVED?

The formation of a logjam is a natural phenomenon and there are beneficial as well as detrimental impacts. A logjam provides structure and cover for fish and other aquatic organisms. The pool created behind the logjam provides critical aquatic habitat during low flow conditions, and the stirring and mixing oxygenates the water as it cascades over, around, and through the logjam.

A logjam may also negatively impact the stream. A tightly packed stream obstruction can act as a barrier to fish migration. Other problems caused by logjams are more insidious. A stream's energy is naturally channeled toward the route of least resistance, which is often around the obstruction. As the stream's flow is directed around an obstruction, it scours away the stream bank until a new channel is created. As the stream flows in its new channel around the logjam, it is re-directed toward the opposite bank. This begins a process, depicted in Figure 1, in which the stream's energy is directed subsequently from one bank to the other as the water flows downstream, eroding the stream banks and undercutting riparian vegetation as it creates a series of meanders. In an undeveloped watershed, where the streamside vegetation

on a newly cut channel is similar to the vegetation on the original channel, such meandering and channel relocation is not really a problem. In a developed watershed, where the streamside vegetation consists of a narrow corridor with adjacent farm fields and housing tracts, stream meandering and relocation can inflict considerable riparian property damage and also degrade the quality of the stream habitat as the limited riparian habitat is destroyed.

IS THERE A GOVERNMENT AGENCY RESPONSIBLE FOR REMOVING LOGJAMS IN ORDER TO KEEP OHIO STREAMS FREE FLOWING?

No. Governmental entities at the municipal, county, state, and federal levels have the statutory authority to undertake stream clearing and drainage improvement projects, but no governmental entity at any level has been assigned by statute the responsibility for such logjam removal activities. For more information on legal responsibilities regarding logjams see Guide 02, Who Owns Ohio Streams? The Ohio Department of Natural Resources recommends that, before an obstruction removal project is begun, there should be consultation with the applicable local, state, and federal regulatory agencies listed in Guide 06, Permit Checklist for Stream Modification Projects. The extent of permit requirements will depend on the location and design of the particular project.

Technical, educational, and other assistance may be available for obstruction removal projects. Township trustees, county engineers, soil & water conservation districts, conservancy districts, local emergency management agency and floodplain management coordinators, and staff with The Ohio State University Extension may all be possible sources of information or assistance to individuals. State agencies (e.g., the Ohio Department of Natural Resources, the Ohio Environmental Protection Agency) and federal agencies (e.g., the USDA Natural Resource Conservation Service) may also provide assistance to organized groups.

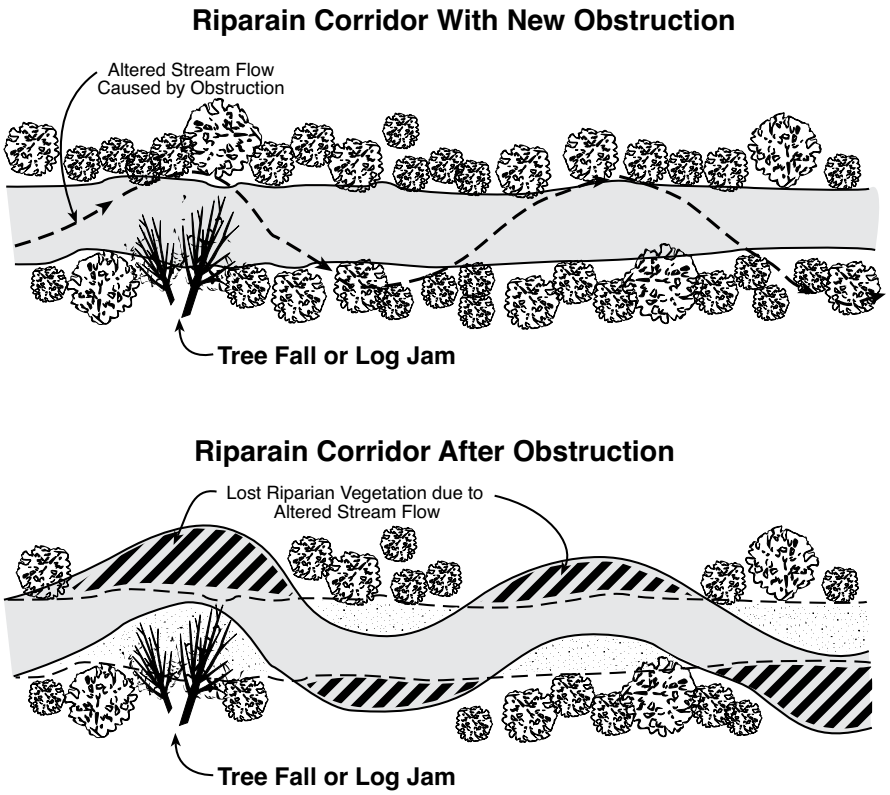

Figure 1. Effects of Obstruction on Riparian Corridor

Successful logjam removal projects have been undertaken in Ohio on many streams, some by volunteers and others using state and local appropriations and/or landowner assessments.

ARE RIPARIAN PROPERTY OWNERS REQUIRED TO REMOVE LOGJAMS FROM STREAMS ON THEIR PROPERTY?

Landowners generally are not required by statute to remove logjams from streams on their properties. Statutes do exist that grant county commissioners (Ohio Revised Code ß 6151.14) and township trustees (Ohio Revised Code ß 505.82) the authority to remove stream obstructions on private property and charge the costs of removal back to the property owner; however, these statutes are rarely used. The common law also does not specify that landowners must keep the streams flowing through their properties clear of natural obstructions. An obstruction to streamflow on one property can result in damages to upstream properties by reducing the stream's capacity for conveying runoff, contributing to flooding, or reducing the effectiveness of artificial drainage systems. Landowners have the right to pursue civil litigation for damages to their property caused by the unreasonable actions of others, but it is unclear whether a landowner's inaction in failing to remove natural stream obstructions could be successfully litigated. For more information on this subject, see Guide 02, Who Owns Ohio Streams?

While they are not required to remove logjams, landowners can contribute to the stability and overall health of their streams by proactively removing obstructions to flow. Such activities, especially on streams with limited riparian habitat, help maintain the multiple use nature of streams for fish and wildlife, drainage, recreation, and other purposes. A regular program for stream maintenance and obstruction removal may alleviate the need for a large, expensive channel restoration project later on.

HOW SHOULD IT BE DETERMINED WHAT ACTIVITIES ARE NEEDED ON A STREAM?

The easiest way to deal with log-

jams is to remove them before significant sediment and debris has been deposited. Riparian landowners should conduct routine stream inspections twice a year to identify fallen trees and other debris on their properties that need to be removed from the stream and floodplain. Special inspections should be made following large storm events, during which debris is commonly deposited. A volunteer organization could be formed to undertake annual stream walks or canoe trips of the entire stream (with landowner permission and support) to identify obstructions that need to be removed, develop a work plan of needed activities, and perhaps even assist landowners in the obstruction removal. Such a group can serve a valuable function to riparian landowners by building support throughout the watershed for a regular inspection and maintenance program.

HOW SHOULD STREAM OBSTRUCTIONS BE REMOVED AND WHAT TOOLS ARE NEED?

Fallen trees and other debris in the floodplain should be removed, buried, or secured as soon as possible. Fallen trees and other debris encountered in the stream should be removed at the earliest appropriate time. Standing trees should be left as they are. All debris should be buried, secured, or removed from the floodplain so that it won't be re-deposited during the next flood. Debris removal should be conducted only during low flow periods, which typically occur during late summer, autumn, and winter. Small debris can be removed from the channel without any tools or equipment. Larger logs and trees across the channel will need to be cut into manageable pieces and dragged out of the stream. Accumulated sediment can be raked and grubbed to remove vegetation. Large equipment should not be placed within the stream channel. Any disturbed areas along the stream channel should be seeded immediately to avoid unnecessary streambank erosion. If stream bank erosion has already occurred where a logjam has been removed, bank stabilization may be appropriate. For more information on bank stabilization methods, see Guide 07, Restoring Stream Banks With Vegetation, Guide 08, Trees for Ditches, Guide 11, Tree Kickers, Guide 12, Evergreen Revetments, Guide 13, Forested Buffer Strips, Guide 14, Live Fascines, Guide 15, Gabion Revetments, Guide 16, Rip Rap Revetments, and Guide 17, Live Cribwalls.

The following equipment is typically used for logjam removal projects: hand tools to facilitate removal of small debris; articulated log skidders with cable winches to remove larger logs; a chain saw or reciprocating saw to cut large logs and trees to manageable size; an adequate length of cable, chain, or rope to attach to the logs to facilitate their removal; a tractor, truck, or team of draft horses on the top of the stream bank to pull the logs out of the stream; and a wagon or truck on which to load the debris for subsequent removal from the floodplain.

Large logjams that are already well established need to be left for properly trained and equipped crews to remove. Specialized power equipment and explosives should never be used by anyone other then highly trained experts. The use of expensive and elaborate equipment is often not necessary when landowners take the time to perform routine maintenance and upkeep on their properties.

WHAT PRECAUTIONS SHOULD BE TAKEN BEFORE AND DURING AN OBSTRUCTION REMOVAL PROJECT?

The Ohio Department of Natural Resources recommends a consultation with the county engineer and local floodplain coordinator prior to initiation of an obstruction removal project. All tractors and other wheeled or tracked vehicles need to be kept out of the stream channel and well away from the top of the bank. Logjam removal activities should never be attempted alone, and a crew leader should be appointed to keep visual contact with everyone on the crew. The utmost caution should be taken to protect the personal safety of all workers. To avoid unnecessary damage to the streambank or riparian corridor, a single route to and from the project site should be utilized.

REFERENCES

Mecklenburg, Dan, Rainwater and Land Development—Ohio's Standards for Stormwater Management, Land Development, and Urban Stream Protection, 2nd edition, 1996, the Ohio Department of Natural Resources in cooperation with the USDA Natural Resources Conservation Service and the Ohio Environmental Protection Agency.

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For more information about the project call ODNR, Division of Soil and Water Resources at 614/265-6740. Each Guide is designed to be easily and clearly reproduced and can be bound in a notebook. Single copies are available free of charge. When distributing guides at meetings or in mailings, please use printed editions as a master for reproducing the number of copies you need, or you may print high quality originals from PDF files available on-line at: http://www.ohiodnr.gov/soilandwater/

Prepared by the Ohio Department of Natural Resources Leonard Black, Division of Soil and Water Resources, principal author. Input from staff of several ODNR divisions, and local, state and federal agencies are used in the development of the Ohio Stream Management Guides. Funding for the production of the Ohio Stream Management Guides is provided in part through a grant under Section 319 of the federal Clean Water Act.

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OHIO STREAM MANAGEMENT GUIDE

Riprap Revetments

Streambank erosion is a natural process that occurs in streams. Depending on the soil type and land use, streambank erosion can account for 40 percent or more of total soil loss in some watersheds (Farm Journal, 1992). The major factor accounting for streambank erosion is the velocity of the flowing water. Velocity is affected by the stream cross section, stream bed gradient, bank cover, depth of flow and degree of meander. Water flowing at the rate of two feet per second can move a cobblestone weighing half a pound, but an increase in velocity to ten feet per second can move a stone that weighs one hundred and fifty pounds.

There are numerous methods of controlling streambank erosion. When a streambank requires protection from high velocity flows, structural methods should be considered. Two structural methods commonly used are riprap revetments and gabion revetments. Structural methods are also used when infrastructure, such as utility lines, roads or buildings, are endangered by the eroding stream. When installing streambank erosion protection, the velocities during everyday flows as well as the velocities during large storm events should be considered in the design process.

Table 1. (From Ohio Department of Transportation, Construction & Material Specifications, 1997)

Velocity of Stream During High Flows	Size Range Largest Diameter of Rock	
2 - 6 feet/second	4" - 12"; average 6"	(ODOT Type D)
6 - 8 feet/second	6" - 18"; average 12"	(ODOT Type C)
8 - 10 feet/second	12" - 24"; average 18"	(ODOT Type B)
10 - 12 feet/second	18" - 30"; average 24"	(ODOT Type A)

RIPRAP REVETMENTS

Riprap revetments are a very effective and popular method of controlling streambank erosion. A revetment is a facing of stone or other armoring material to protect a streambank or shoreline. A riprap revetment consists of layered, various-sized rocks placed on a sloping bank (Figure 1). The most commonly used material for riprap in Ohio is broken limestone, dolomite or quartzite. The type of stone used is usually determined by what is locally available. The variance in size and the rough angular surfaces of the rock allow the revetment to absorb the impact of the flowing water instead of deflecting the flow which could cause erosion to an adjacent streambank area. The rough angular surfaces of the broken rocks also allows them to fit together to form a dense layer of protection over the eroding bank.

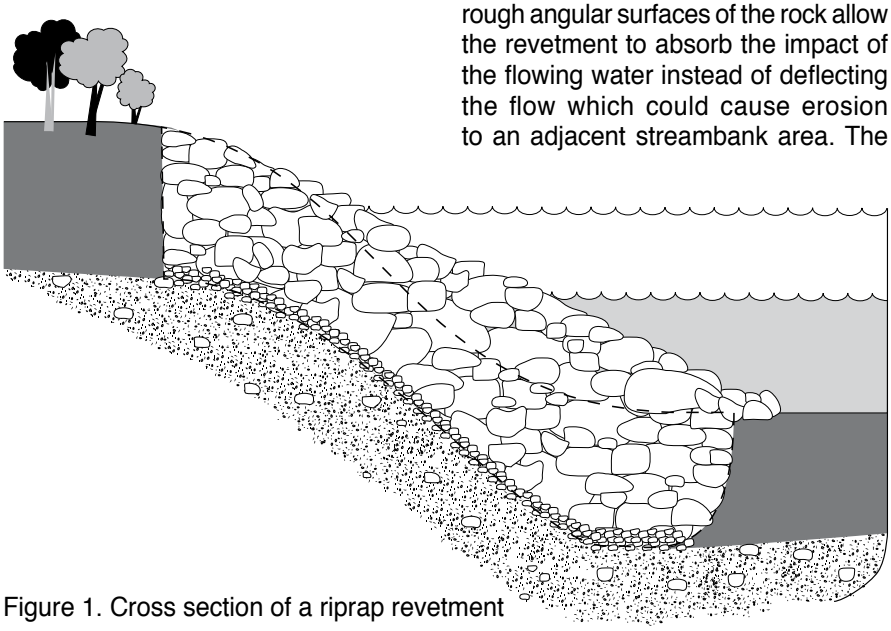


Figure 1. Cross section of a riprap revetment

STONE SIZE

The size of riprap to use for a given stream depends on the velocity of the water when the stream is at a bank full stage. Table 1 provides minimum size ranges for given stream flow velocities.

INSTALLATION PROCEDURE

1. Reshape the streambank to a maximum slope of two feet of horizontal distance for one foot of vertical rise.
2. Place a highly permeable and appropriately sized geotextile filter fabric on the prepared slope following the manufacturer's recommendations. Take care not to tear the filter fabric during installation.
3. Place a layer (six inch minimum) of gravel or small rock on the geotextile filter fabric. The underlayer stone needs to be sized appropriately so it will not wash through any gaps between the riprap stones.
4. Place the layer of riprap, 1.5 times the thickness of the largest stone, on top of the gravel. The heaviest rocks should be placed along the

bottom of the bank. Riprap should be placed into position, not dumped over the streambank edge.

5. Extend the rock layer out into the channel four to six feet or entrench the bottom row of stone into the stream bed to prevent undercutting.
6. Extend the revetment beyond the area of active erosion to prevent further erosion behind the ends of the structure.

MAINTENANCE REQUIREMENTS

A riprap revetment is susceptible to displacement and deterioration of the rock. When displacement and deterioration occur the effectiveness of the structure is greatly reduced. A riprap revetment needs to be inspected periodically and after high flow events. Any displaced or deteriorated rock should be replaced as needed.

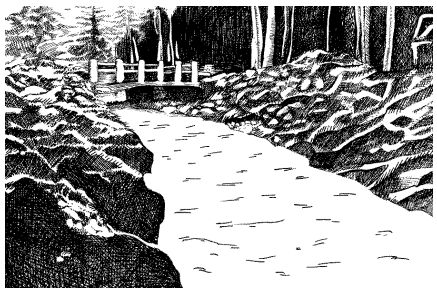
MATERIALS TO AVOID

Stones that appear to have a smooth and rounded surface should be avoided if possible. The surface of these stones does not allow the rocks to interlock which decreases resistance to movement. Broken asphalt should not be used because it has a low density and contains toxic chemicals which can leach out into the water. Items such as refrigerators, mattresses, wood and plastics should never be used because they can increase the rate of erosion and degrade the water quality of the stream. Slab concrete should only be used as an underlayer material and then only if it is broken and free of rebar.

USE OF DORMANT CUTTINGS IN RIPRAP REVETMENTS

Dormant stakes of willow (or other rapidly-rooting species) may be installed between the placed rock. The stakes must be installed perpendicular to the bank, and be long enough for the base ends to reach back-filled or undisturbed soil. Over time, dormant cuttings create a living root mat in the base soil underlying the revetment. The roots reinforce the soil particles and prevent wash out of fine materials between and under the rocks. The roots also improve drainage by removing soil moisture. The willow branches and leaves will dissipate additional energy along the streambank and may produce a more aesthetically pleasing view of the bank, as opposed to riprap alone.

As willows grow and mature, they lose their vigor and become subject to insect and disease problems. They also become brittle with age, causing them to break, fall into the stream and contribute to channel obstructions. These problems can be avoided by periodic pruning of the willows to a convenient height or down to a stump. They will re-sprout and maintain the function of the dormant cuttings.



ADVANTAGES OF RIPRAP AS AN EROSION TREATMENT

- Designed for high velocities
- Provides high degree of protection
- Relative ease of installation
- Low maintenance
- Provides immediate long-term protection

DISADVANTAGES OF RIPRAP AS AN EROSION TREATMENT

- Limited access to the site can make construction difficult
- Heavy machinery may be required to position rock
- Material costs (including transportation) may be expensive
- Often used to hold stream in an unstable configuration
- May pass erosion problems downstream

REFERENCES:

Iowa Department of Water, Air and Waste Management, 1984. How To Control Streambank Erosion

Smith, Darrell, May, 1992. “Raging Waters.” Farm Journal.

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U.S. Army Corps of Engineers, North Central Division, 1978. Help Yourself.

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Fact sheet are available on-line at: http://www.ohiodnr.gov/soilandwater/

OHIO STREAM MANAGEMENT GUIDE

Trees for Ditches

Guide No. 08

Trees along ditches? What was once seldom recommended is now considered a responsible approach to drainage management and, when done properly, very compatible with drainage objectives. Trees planted or maintained along ditches can: 1) save money, 2) meet environmental regulations, 3) improve water quality and 4) provide wildlife habitat.

SAVE MONEY

When constructing a new ditch or maintaining an existing one, clearing and grubbing costs can be reduced substantially by leaving at least one side vegetated. Leaving woody vegetation minimizes wind and water erosion' which affects crop yields and reduces the accumulation of sediment in the channel. Where one or both sides remain vegetated, shading inhibits nuisance cattail growth, thereby reducing dip-out or spraying maintenance costs. Ditch berms can grow marketable trees or firewood if selected and managed properly and provide income in later years. If land adjacent to ditches is already out of crop production and taxed at a lower rate trees are a bonus.

MEET ENVIRONMENTAL REGULATIONS

When ditch construction must meet environmental protection standards or require a Section 401 or 404 permit under the Clean Water Act, preserving or planting trees will help mitigate water quality and wildlife damages, often making permit issuance easier.

IMPROVE WATER QUALITY

Tree cover, especially on the south or west side of a ditch, shades the water, keeping water temperatures cooler which increases oxygen levels needed for fish and other aquatic life. Shading also controls nuisance algae growth, which often results in fish kills and other water quality problems. Tree leaves and leaf litter help reduce soil erosion and resulting sedimentation. Tree roots also provide some erosion control by protecting ditch banks from high velocity water.

PROVIDE WILDLIFE HABITAT

Upland and aquatic wildlife benefit from trees. Upland wildlife benefits from cover, food, access to travel lanes and greater number of species which habitat diversity supports. In-stream, leaf litter is the base of the aquatic food chain. Leaves are eaten by aquatic insects which in turn feed minnows and fish. Fallen branches provide cover for fish and smaller aquatic life. Undisturbed vegetation, like that found on one-sided construction, provides better wildlife food and cover than leaving selected trees growing among planted grass.

TREE USE

Trees are suitable for all drainage projects constructed under Ohio Drainage Law (Sections 61 31, 6133, 6135 or 6137 of the Ohio Revised Code), Conservation Works of Improvement (Section 1515 of the Ohio Revised Code), mutual group process, by developers or by individual landowners. With proper tree selection and maintenance, both drainage and environmental benefits can often be achieved.

The recommended width of woody vegetation on "berms" of natural or unmodified channels is two and one-half times the width of the ditch or fifty feet, whichever is less. However, for ditches constructed under Ohio Drainage Law, a minimum of four feet or a maximum of 25 feet width may be "constructed and maintained" and not subject to typical property taxes.

TREE SELECTION

When preserving trees along a ditch, protect those with hardwood, minimal branching, deep rooting and non-brittle characteristics. Where possible, protect trees and their adjacent vegetation from root and soil compaction from heavy equipment for a 10 foot radius around the trunk. When spreading dredged material near trees, never spread more than one inch of soil per year over the roots to avoid feeder root suffocation. The feeder roots are mostly within the tree canopy drip line. When planting trees, choose those that are suitable to the soil drainage and pH conditions. Dredged sediment and compaction from construction access may drastically alter pH and drainage conditions; soil testing may be helpful. Native trees may be a first choice for planting or preserving as listed below, but many other species may be suitable as listed in most county soil survey reports or nursery catalogs.

If future income is desired, select trees with expected high market value. If wildlife management is a goal, select a species with food and cover characteristics. The following table lists recommended trees in Ohio for use along drainage ditches. These trees can withstand periodic flooding and are less likely to cause maintenance problems. High market value trees like Black Walnut (Juglans nigra), White Oak (Quercus alba), Red Oak (Quercus rubra borealis), Sugar Maple (Acer saccharum), White Ash (Fraxinus americana), and Basswood (Tilia americana) are not listed since they are typically found on better drained soils or upland sites. The table also illustrates their suitability to different soil/climate conditions and desirable characteristics. Short lived, brittle and shallow rooted species like Willow (Salix species) are not listed, with the exception of Box Elder (Acer negundo) and Silver Maple (Acer saccharinum) which are common and less problematic trees.

Planted shrubs are fast growing and provide more immediate erosion control and habitat than planted trees. Shrubs may complement tree planting well by establishing a dense vegetative planting. Shrubs and bank erosion control species like Bankers Willow (Salix X cotteti) or

Dogwoods (Cornus species) have beneficial uses in ditch management, but are not covered in this publication.

TREE MAINTENANCE

Wooded ditch berms require maintenance. Regular inspections are needed, especially after ice storms to locate and remove damaged trees which may become water flow obstructions. When dead, leaning or other trees susceptible to breakage are removed, future maintenance costs can be reduced. While the listed species are not likely to cause problems, certain weather damages are not preventable. Trees should be kept away from subsurface drainage outlets so that roots do not plug the drainage pipes and outlets can be located for inspection and maintenance. Trees affected by insects or disease should be treated or removed before problems spread to other trees or they die, fall in and become obstructions.

When trees are managed properly they can provide income, benefit water quality and wildlife, protect crops from wind erosion and beautify the landscape. For more information on tree selection or site suitability contact your local Soil and Water Conservation District (SWCD), ODNR Divisions of Forestry or Wildlife, Ohio State University Extension, or qualified private consultant. For more information on drainage laws and standards contact your County or City Engineer, City Manager, Township Trustee or SWCD.

TreeSource—Ohio's Greenprint for the Future— is a strong new partnership between state and local government, private businesses and citizen volunteers renewing Ohio's commitment to planting and nurturing trees across the state.

For more information on TreeSource, contact the Ohio Department of Natural Resources, Division of Forestry (614) 265-6694.

Common/Scientific Name	Average Mature Height	pH Preferance	Specific Characteristics
			Highly Flood Tolerant Tress
American Sycamore Platanus occidentalis	100+	6.6-8.0	Adaptable to many soils, streambanks, bottomlands, windfirm, long-lived, fast growth, urban tolerant.
Swamp White Oak Quercus bicolor	60-70	6.0-6.5	Lowlands, stream edges, swamps, long-lived, fast growth, wildlife food, sprouts, timber, firewood.
Bur Oak Quercus macrocarpa	70-80	4.6-8.0	Adaptable to many soils, very drought resistant, deep-rooted long-lived, sprouts, wildlife food, timber, firewood.
Pin Oak Quercus palustris	70-80	5.5-6.5	Bottomlands or moist uplands, tolerant of urban stresses, moderately long-lived (100-150 years), firewood, wildlife food,sprouts, fast growth.
Bald Cypress Taxodium distichum	60-80	6.1-6.5	Highly flood tolerant, grows on flooded, poorly drained to upland soils, extensive root system, very windfirm slow-growing. longlived, sensitive to drought and heat, loses leaves in winter, not native although wideiy planted in Ohio.
Red Maple Acer rubrum	50-70	4.5-6.5	Adaptable to many soil types, some susceptibility to ice and snow damage, moderately long-lived (100-150 years), sprouts, resistant to herbicides, wildlife food, firewood, brilliant fall color
Silver Maple Acer saccharinum	60-80	4.5-6.5	Bottomlands, streambanks, alluvial floodplains, moist sites, drought resistant, branches are somewhat brittle, susceptible to ice damage, can tolerate temporary flooding, sprouts.
Box Elder Acer negundo	30-40	6.5-7.5	Adaptable to many soils, tolerant to drought and cold, short-lived (60-80 years), fibrous root system provides good erosion control, susceptible to wind/ice damage
Honey Locust Gleditsia triacanthos	70-80	6.1-7.5	Alluvial floodplains, bottomlands, drought resistant, shelter-belt series, windfirm, used to pioneer strip-mine spoils, initially fast growing, thorns.
			Moderately Flood Tolerant Tress
Shellbark Hickory Carya laciniosa	80-100	6.1-6.5	Bottomlands & alluvial floodplains, sprouts, long-lived, slow growing, some susceptibility to frost damage, wildlife food, firewood.
Green Ash Fraxinus pennsylvanica	50-70	6.1-7.5	Bottomlands, strip-mine reclamation species, windfirm, alluvial soils along streams, wildlife food, firewood, sprouts, timber
Hackberry Celt/s occ/dentalis	30-50	6.6-8.0	Bottomland, limestone outcrops or soils, drought resistant, fast growing, long-lived (150-200 years), wildlife food.
Slippery Elm Ulmus rubra	60-70	6.6-8.0	Moist, rich soils of lower slopes, streambanks, terraces, and bottomlands, moderately fast growing, fairly long-lived, sprouts. Dutch Elm disease, urban tolerant.
Black Tupelo (Gum) Nyssa sy/vatica	40-60	6.1-6.5	Adaptable to many soil types, alluvial stream bottoms, shade tolerant, wlidlife food, wildlife den tree, moderateiy long-lived.
River Birch Betula nigra	60-80	<6.5	Alluvial soils, stream bottoms, highly tolerant of acid soils, sprouts, firewood, most common in South/Central Ohio.

This Guide is one of a series of Ohio Stream Management Guides covering a variety of watershed and stream management issues and methods of addressing stream related problems. The overview Guides listed below, are intended to give the reader an understanding of the functions and values of streams. For more information about stream management programs, issues and methodologies, see Guide 05 Index of Titles or call the ODNR Division of Soil and Water Resources at 614/265-6739. All Guides are available from the Ohio Department of Natural Resources. Single copies are available free of charge and may be reproduced. Please contact:

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PRACTICE 1204
TREE REPLACEMENT

DESCRIPTION

- Planting trees as an enhancement measure or to compensate for trees lost as a result of a drainage improvement activity.

Exhibit 1204a: Tree Replacement/Planting (Source: North Carolina Erosion Control Manual)

PURPOSE

- Compensating for trees lost during a drainage improvement activity.
- To stabilize the soil, to provide food and shelter for wildlife, and to provide windbreaks or screens.

WHERE APPLICABLE

- Where tree planting or woodland corridors are called for as a part of a watershed management scheme.
- Projects with tree impacts, where trees do not interfere with regular maintenance activities. (Indiana Drainage Code prohibits the IDNR from requiring tree planting or retention within the easement of a regulated drain if certain conditions apply.)

ADVANTAGES

- Stabilize the soil and prevent erosion.
- Reduce stormwater runoff by intercepting rainfall, promoting infiltration, and lowering the water table through transpiration.
- Provide wildlife habitat.
- Provide shade.
- Increase property values and improve site aesthetics.

CONSTRAINTS

- May interfere with ditch maintenance activities.
- Is an added expense.
- Trees take years to establish.
- Until the trees become established, soil needs to be protected and stabilized in the area between immature trees by means of shrubs, vines, and other types of shade-tolerant ground covers.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Bare-root tree seedlings (small trees).
- Balled-and Burlapped or Container-Grown trees (large trees), with minimum soil ball size being 12 inches in diameter for each inch of trunk diameter..
- Ground cover species (Practice 1102).
- Mulch (Practice 1101).

Installation

Bare-root tree seedlings

- Bare-root seedlings should be handled only while dormant in late winter, early spring, or after leaf fall in autumn. Availability of stock usually limits planting to winter or spring.
- Store packages of seedlings in a shaded location out of the wind.
- If it is necessary to store moss-packed seedlings for more than two weeks, add one pint of water per package. Do not add water to clay-treated seedlings.
- Do not allow roots to dry out during planting by carrying seedlings exposed to air and sun. Keep moss-packed seedlings in a container packed with wet moss or filled with thick muddy water. Cover clay-treated seedlings with wet burlap.
- With a tree planting bar or spade, make a notch deep enough to accommodate the roots. Place the roots in the notch to the same depth as in the nursery, then firm soil around roots by pressing the notch closed (Exhibit 1204b).

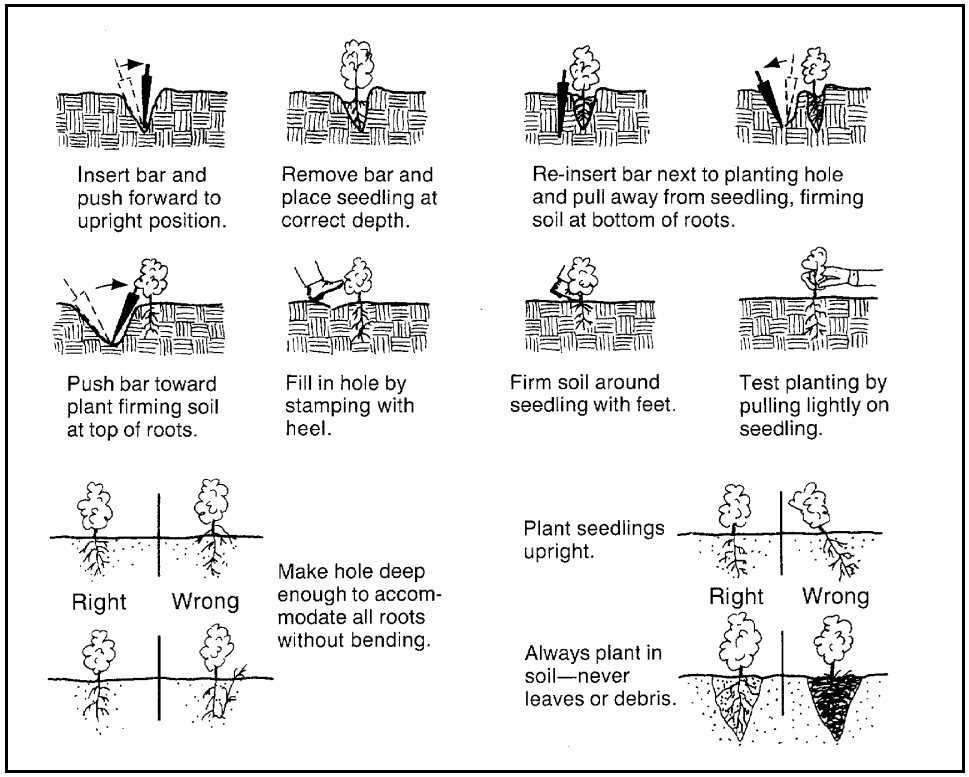

Exhibit 1204b: Planting bare-root seedlings (Source: North Carolina Erosion Control Manual)

- Water immediately and mulch the area within 2 ft of the plant.
- Several weeks after planting, broadcast a handful of 10-10-10 fertilizer around each plant, at least 1 ft from the base.
- On large sites where slopes are not prohibitive, bare-root seedlings can be efficiently planted in furrows using a tractor-drawn vegetable transplanter.

Balled-and Burlapped or Container-Grown trees

- Late fall (Nov. - Dec.) is the preferred planting time for deciduous trees and evergreens, although they may be planted year-round. Avoid summer planting.
- Keep the soil around the roots moist until planting.
- Branches should be bound with soft rope to prevent damage during transport.
- Each planting hole must be deep and wide enough to allow proper placement of the root ball. Ideally, the hole should be twice the size of the root ball. When digging the hole, keep topsoil separate from subsoil. If the subsoil is high in clay, allow extra room (one-half the height of the root ball). Backfill the hole with enough topsoil or peat moss to position the base of the tree at the same level as in the nursery (Exhibit 1204c).
- If the plant is in a container, carefully remove it, taking the soil surrounding the roots with it. This may require cutting the container. Loosen the twine and burlap at the top of balled-and-burlapped plants and check to make sure that no other wrapping is present before planting.
- Before replacing subsoil, mix it with one-third peat moss or well-rotted manure. Backfill the hole, firming the soil as it is replaced, and leave a depression around the trunk within the excavated area to hold water. Cover the base of the trunk to the same level as before it was removed.
- Water thoroughly and re-water as necessary to keep the roots moist.
- Stake small trees with vertical stakes driven into the ground, just beyond the root ball (Exhibit 1204c). Secure large trees with guy wires. Cushion wire, where it contacts the tree, with rubber hose. Wrap the trunks of young trees to protect them from sunburn and pests.

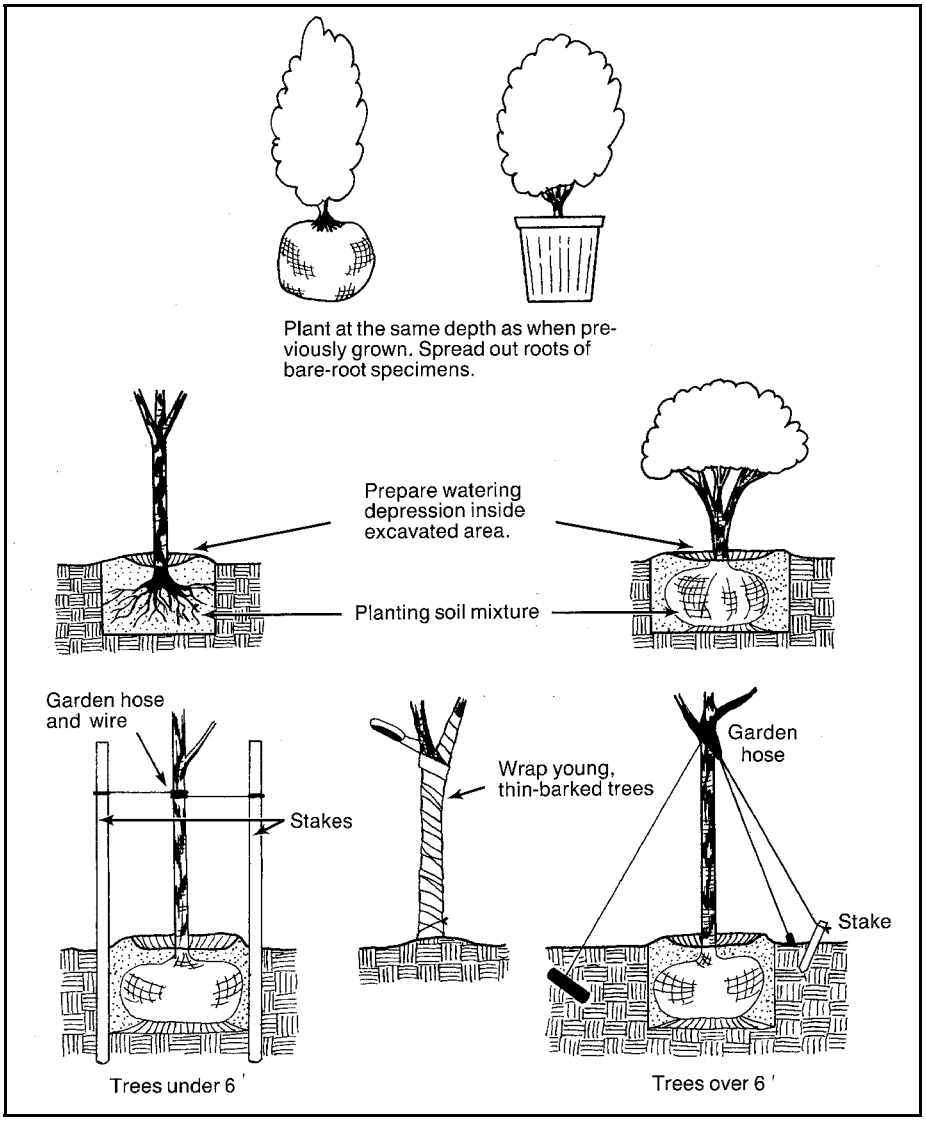

Exhibit 1204c: Planting balled and burlapped and container-grown trees (Source: North Carolina Erosion Control Manual)

Special Considerations

- Although trees are among the best soil stabilizers, years are required for the development of forest cover adequate to meet sedimentation control objectives. Efforts must first focus on establishing densely-growing species to stabilize the site and protect area between immature trees.

MAINTENANCE

- Fertilize trees in late fall or early spring (**before leaves emerge**). Using a punchbar, crowbar, or auger, make holes 18 inches deep and about 2 ft apart around the drip line of each tree. Distribute the fertilizer evenly among the holes to bring it in contact with tree roots, and close.
- Repair damaged roots by cutting off the damaged areas and painting with tree paint. Spread peat moss, wood chips or moist topsoil over exposed roots.
- Repair damage to bark by trimming around damaged areas. Taper the cut to provide drainage, and paint with tree paint.

- Cut all damaged limbs above the tree collar at the trunk or main branch. Use three separate cuts for each branch to avoid peeling bark from healthy areas of the tree.

REFERENCES

Related Practices

- Practice 102 Tree Preservation and Protection.
- Practice 1102 Vegetative Stabilization.
- Practice 1202 Stream Environment Enhancement.

Other Sources of Information

- North Carolina Erosion Control Manual.

Last Print/Revision Date: October 13, 1996

PRACTICE 1101
MULCHING

DESCRIPTION

- Application of plant residues or other suitable materials to the soil surface. (Note: this practice is also included in the Indiana Erosion Control Handbook.)

Exhibit 1101a: Mulching (Source: North Carolina Erosion Control Manual)

PURPOSE

- To prevent erosion.
- To reduce the velocity of overland water flow.
- To foster growth of vegetation by preserving soil moisture and insulating soil from extreme heat or cold.
- To reduce rain drop impact (splash erosion).

WHERE APPLICABLE

- Areas that recently have been seeded.
- Areas that require soil protection but cannot be seeded because of the time of year or other reasons.
- Areas that require mud and dust control.

ADVANTAGES

- Controls erosion in recently seeded areas.
- Conserves soil moisture thereby promoting seed germination and seedling growth.
- Reduces soil surface compaction or crusting by protecting the soil surface from raindrop impact.
- Moderates temperature and moisture extremes.

CONSTRAINTS

- Added cost to seeding.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Straw, hay, wood fiber, cellulose, or excelsior.

Installation

- Prior to Application
  1. Shape and grade as required.
  2. Remove all rocks, clods, or debris larger than 2" in diameter that will prevent contact between the mulch and soil surface.
  3. When using erosion control blankets, lime, fertilizer, and seed may be applied either before or after laying the blanket. The preferred method is to seed and add amendments before installing the blanket.

- Time of Application
  1. Immediately after seeding, or planting by conventional methods or by hydroseeding. May be applied with seeding as hydromulching.
  2. Immediately after seedbed preparation when dormant seedings are to be made by seeding over the mulch.

- Application and Anchoring
  1. Apply mulch at recommended rate.
  2. Spread uniformly by hand, hay fork, mulch blower, or hydromulcher. No more than 25% of ground surface should be visible following application.
  3. If straw or hay is used, anchor immediately (See Exhibit 1101b).

Anchoring Method	How to Apply
Mulch anchoring tool OR Farm disk (dull serrated, and set straight)	Crimp or punch straw or hay into soil 2-4". Operate machinery on the contour of slope.
Cleating with dozer tracks	Operate dozer up and down slope
Wood hydromulch fibers	Apply 0.5 ton/acre using a hydromulcher at a rate of 750 lbs/acre with a tacking agent. Do not use in areas of concentrated flow.
Asphalt emulsion	Should conform to ASTM Spec. #977. Apply at rate of 0.05 gal./sq.yd. Do not use in areas of concentrated flow.
Synthetic tackifier, binder or soil stabilizer	Apply according to manufacturers recommendations.
Biodegradable netting	Apply over mulch and staple with 6-8" wire staples. Follow manufacturers recommendations.

Exhibit 1101b: Mulch anchoring methods. (Source: Indiana Erosion Control Handbook)

- Rate
  See Exhibit 1101c.

Material	Rate	Comments
Straw or hay	1.5-2 tons/acre	Should be dry and unchopped Should be free of undesirable seeds Spread by hand or machine Must be crimped or anchored
Wood fiber cellulose	1 ton/acre	Apply with hydromulcher and use tacking agent
Long fiber wood	0.5-0.75 tons/acre	Anchor in areas subject to wind

Exhibit 1101c: Mulch Materials Rates (Source: Indiana Erosion Control Handbook)

Special Considerations

- Choice of materials should be based on the type of soil to be protected, season, and economics.
- Organic mulch materials such as straw and hay have been found to be the most effective.
- Chemical soil stabilizers and binders work best when used in conjunction with organic mulches.

MAINTENANCE

- Inspect and reapply mulch as necessary after storm events.
- Continue inspections until vegetation becomes established.

REFERENCES

Related Practices

- Practice 104 Temporary Diversion.
- Practice 105 Silt Fencing.
- Practice 106 Straw Bale Filter.
- Practice 1102 Vegetative Stabilization.

Other Sources of Information

- Indiana Erosion Control Handbook.
- Illinois Urban Manual.
- North Carolina Erosion Control Manual.

Last Print/Revision Date: October 13, 1996

PRACTICE 1102
VEGETATIVE STABILIZATION AND SEEDING

DESCRIPTION

- Stabilization and protection of streambanks with selected vegetation.

Exhibit 1102a: Vegetative Stabilization (Source: North Carolina Erosion Control Manual)

PURPOSE

- To protect streambanks from the erosive forces of flowing water and provide a natural, pleasing appearance.
- To restabilize areas disturbed during construction.
- Shade provided by woody vegetation maintains lower water temperatures and provides wildlife habitat.

WHERE APPLICABLE

- Generally applicable along streams and ditches where bankfull flow velocity does not exceed 5 ft/sec., and soils are erosion resistant.
- Vegetative techniques usually should be incorporated with structural techniques if the bankflow velocity exceeds 5 ft/sec. (See referenced sources.)

ADVANTAGES

- Often less expensive than structural techniques.
- Natural appearance.
- May create or enhance wildlife habitat.
- Self repairing in many cases.

CONSTRAINTS

- May not be applicable in high flow ditches and streams.
- Full stabilization may not be achieved until plants become established.
- Often requires limited but regular maintenance such as burning, and in some situations, herbiciding or even mowing.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Appropriate plant species selected from following Exhibit 1102b or other referenced sources. Note that not all species listed are suitable for every region or soil.
- Mulch, erosion control blankets, and/or bonded fiber matrix.

Partial Sunlight (Half Day) to Full Sunlight

Common Name	Botanic Name	Plugging Rate On Center	Seeding Rate
Banks and Slopes (Stabilizing Matrix Species)			
Big Bluestem	Andropogon gerardii	18-24"	5 lb/ac
Brown Fox Sedge	Carex vulpinoidea	18-24"	0.25 lb/ac
Canada Wild Rye	Elymus canadensis	18-24"	5 lb/ac
Streambank Rye	Elymus riparius	18-24"	1 lb/ac
Silky Wild Rye	Elymus villosus	18-24"	1 lb/ac
Virginia Wild Rye	Elymus virginicus	18-24"	3 lb/ac
Torrey's Rush	Juncus torreyi	18-24"	0.01 lb/ac
Evening Primrose	Oenothera biennis	18-24"	0.25 lb/ac
Switch Grass	Panicum virgatum	18-24"	1 lb/ac
Indian Grass	Sorghastrum nutans	18-24"	5 lb/ac
Prairie Cord Grass	Spartina pectinata	18-24"	N/A
Blue Vervain	Verbena hastata	18-24"	1 lb/ac
Toe, Lower Banks (Stabilizing Species)			
Sweet Flag	Acorus calamus	18-24"	N/A
Water Plaintain	Alisma subcordatum	18-24"	N/A
Bluejoint Grass	Calamagrostis canadensis	18-24"	N/A
Creeping Spike Rush	Eleocharis acicularis	18-24"	N/A
Blue Flag Iris	Iris virginica	18-24"	N/A
Torrey's Rush	Juncus torreyi	18-24"	N/A
Switch Grass	Panicum virgatum	18-24"	N/A
Arrowhead	Sagittaria latifolia	18-24"	N/A
Hardstem Bulrush	Scripus acutus	18-24"	N/A
Chairmaker's Rush	Scirpus americanus	18-24"	N/A
Dark Green Rush	Scirpus atrovirens	18-24"	N/A
River Bulrush	Scirpus fluviatilis	18-24"	N/A
Prairie Cord Grass	Spartina pectinata	18-24"	N/A
Blue Vervain	Verbena hastata	18-24"	N/A
Cover Crops (Hydroseeding, Hand or Machine Planted Species			
Annual Ryegrass	Lolium multiflorum	N/A	60 lb/ac
Perennial Ryegrass	Lolium perenne	N/A	24 lb/ac
Smartweed	Polygonum punctatum	N/A	5 lb/ac
Yellow Coneflower	Ratibida pinnata	18-24"	0.25 lb/ac
Black-Eyed Susan	Rudbeckia hirta	18-24"	0.25 lb/ac
Brush for live stakes, brush mattress, live fascine, branch packings, live cribwall and vegetated geogrid. (North bank may have to be planted by shade-tolerant species.)			
Buttonbush	Cephalanthus occidentalis		
Silky Dogwood	Cornus amonum		
Red-Osier Dogwood	Cornus stolonifera		

Exhibit 1102b : Plant species for Vegetative Stabilization (Source: DuPage County Streambank Stabilization Program)

Partial Sunlight (Half Day) to Full Sunlight (continued)

Common Name	Botanic Name	Plugging Rate On Center	Seeding Rate
Brush ... (continued from last page)			
White Willow	Salix alba		
Peach-Leaved Willow	Salix amygdaloides		
Pussy Willow	Salix discolor		
Sandbar Willow	Salix interior		
Black Willow	Salix nigra		
Elderberry	Sambucus canadensis		
Non-Stabilizing Decorative and Screening Plants			
Swamp Milkweed	Asclepias incarnata		
Joe-Pye Weed	Eupatorium maculatum		
Spiderwort	Tradescantia ohiensis		
Culver's Root	Veronicastrum virginicum		
Golden Alexanders	Zizia aurea		
Shrubs (Plant sparsely to prevent overshading banks)			
Eastern Ninebark	Physocarpus opulifolius		
Arrowwood Viburnum	Viburnum dentaum		
Nanneyberry Viburnum	Viburnum lentago		
Trees (Plant lightly to prevent overshading banks)			
White Ash	Fraxinus americana		
Green Ash	Fraxinus pennsylvanica		
Quaking Aspen	Populus tremuloides		
Swamp White Oak	Quercus bicolor		
White Cedar	Thuja occidentalis		
Basswood	Tilia americana		
Buffer Zone/Filter Strips			
Big Bluestem	Andropogon gerardii	N/A	5 lb/ac
New England Aster	Aster novae-angliae	N/A	2 oz/ac
Oats*	Avena sativa	N/A	25 lb/ac
Daisy*	Chrysantheumum leucanthemum	N/A	0.25 lb/ac
Chicory*	Cichorium intybus	N/A	0.1 lb/ac
Barley*	Hordeum vulgare	N/A	25 lb/ac
Annual Ryegrass*	Lolium multiflorum	N/A	25 lb/ac
Wild Bergemont	Monarda fistulosa	N/A	0.5 oz/ac
Switch Grass	Panicum virgatum	N/A	1 lb/ac
Yellow Coneflower*	Ratibida pinnata	N/A	0.25 lb/ac

Exhibit 1102b (continued): Plant species for vegetative Stabilization (Source: DuPage County Streambank Stabilization Program)

Partial Sunlight (Half Day) to Full Sunlight (continued)

Common Name	Botanic Name	Plugging Rate On Center	Seeding Rate
Buffer Zone/Filter Strips (continued)			
Black-Eyed Susan*	Rudbeckia hirta	N/A	0.25 lb/ac
Indian Grass	Sorghastrum nutans	N/A	5 lb/ac
Alsike Clover*	Trifolium hybridum	N/A	0.1 lb/ac
Red Clover*	Trifolium pratense	N/A	0.1 lb/ac
Hoary Vervain	Verbena stricta	N/A	0.5 oz/ac

* Transition species to be planted in the outer 5 feet of buffer to blend into existing landscape.

Full Shade

Bank and Slopes			
Sideflowering Aster	Aster lateriflorus	18-24"	0.25 lb/ac
Gray Sedge	Carex amphibola	18-24"	N/A
Common Wood Sedge	Carex blanda	18-24"	N/A
Fowl Manna Grass	Glyceria striata	18-24"	0.25 lb/ac
Non-Stabilizing Decorative Plants			
Jack-in-the-Pulpit	Arisaema triphyllum	10'	N/A
Green Dragon	Arisaema dracontium	10'	N/A
Turtlehead	Chelone glabra	10'	N/A
Shooting Star	Dodecatheon meadia	10'	N/A
Spotted Jewelweed	Impatiens capensis	10'	N/A
Cardinal Flower	Lobelia cardinalis	10'	N/A
Virginia Bluebells	Mertensia virginica	10'	N/A
Solomon's Seal	Polygonatum Canaliculatum	10'	N/A
Ostrich Fern	Pteretis pennsylvanica	10'	N/A
Swamp Buttercup	Ranunculus septentrionalis	10'	N/A

Not Recommended

Box Elder	Acer negundo
Garlic Mustard	Allilaria officinalis
Tartarian Honeysuckle	Loicera tatarica
Reed Canary Grass	Phalaris arundinacea
Common Buckthorn	Rhamnus cathartica
Glossy Buckthorn	Rhamnus frangula
Multiflora Rose	Rosa multiflora

Exhibit 1102b (continued): Plant species for vegetative Stabilization (Source: DuPage County Streambank Stabilization Program)

Installation

- Site Preparation
  1. Selected vegetative stabilization measure should be compatible with improvements planned or carried out by others.
  2. Protective measures should be started at a stabilized or controlled point on the stream and extended to a stabilized or controlled point downstream.
  3. The grade of the channel must be controlled, either by natural or artificial means, before any vegetative measure can be used, unless live stakes can be installed below the anticipated depth of the bottom scour.
  4. The substrate should have enough silt and clay material to maintain adequate moisture and nutrient supply, and sufficient pore space to permit root penetration. The bulk density should be 1.2-5 grams per cubic centimeter. Clay content should not exceed 35%.
  5. Soil depth appropriate for plant growth should be at least 12", except where adding soil material is not feasible because of steep grades.
  6. pH should be in a range between 5.5 and 6.5.
  7. Substrate should be free of toxins harmful to plant growth.

- Seedbed Preparation
  1. Apply fertilizer or other required amendments prior to final seedbed preparation.
  2. Prepare seedbed to a minimum depth of 3" by disking or other means. All tillage should follow the contour of the land.

- Seeding/Plugs (Exhibit 1102b)
  1. All permanent seed mixes should be installed with a rangeland drill seeder. Temporary mixes may be applied with a drill seeder, cultipacker, or a hydraulic sprayer. Hydro seeders are also good for larger areas.
  2. All seed, if possible, should be certified for viability.

- Timing
  1. Dormant seedings should take place between Dec. 1-Feb. 28 (north of U.S. 40), Dec. 10-Jan 15 (south of U.S. 40).
  2. Permanent seedings should take place between March 1 and September 30. Permanent seeding done between May 10 and August 10 may need irrigation.
  3. Temporary seeding should take place between March 1 and April 15 (oats), September 15 to October 30 (cereal rye and wheat), and March 1 to May 1 or August 1 to September 1 (perennial ryegrass).
  4. Plugs should be installed during spring.

Special Considerations

- Use of native species is always preferable to invasive introduced species such as Tall Fescue. However, the use of such species is sometimes inevitable where immediate and effective erosion control is essential. Indiana Erosion Control Handbook includes the listing of more traditional permanent seeding species applicable to many of these situations.
- All seedings should be protected with stabilization methods during the period of establishment (Practices 1101, 1103, and 1104).
- A listing of vendors who regularly carry native species noted in Exhibit 1102b may be obtained from the U.S. Fish and Wildlife Service.

MAINTENANCE

- Areas of inadequate cover after dormant seedings should be reseeded with a temporary or permanent matrix after mid- to late-April.
- Areas seeded with a permanent or temporary matrix should be fertilized as necessary. Damaged, eroded, bare, or sparsely covered areas should be repaired and reseeded.

REFERENCES

Related Practices

- Practice 1101 Mulching.
- Practice 1103 Bonded Fiber Matrix.
- Practice 1104 Erosion Control Blankets and Matting.
- Practice 1201 Wetland Replacement.
- Practice 1202 Stream Environment Enhancement.
- Practice 1204 Tree Replacement.

Other Sources of Information

- Indiana Erosion Control Handbook.
- DuPage County Streambank Stabilization Program.
- NRCS Standard Specifications.
- COE Engineering Manual.

Last Print/Revision Date: October 13, 1996

PRACTICE 1103
BONDED FIBER MATRIX

DESCRIPTION

- Continuous matrix of elongated wood strands held together by a water-resistant bonding agent.

Exhibit 1103a: Bonded Fiber Matrix (Source: Weyerhaeuser Products Brochure)

PURPOSE

- To prevent erosion and enhance germination.

WHERE APPLICABLE

- Usually on very steep slopes.
- Areas where access prohibits installation of more traditional erosion control methods.

ADVANTAGES

- Holds on near-vertical surfaces.
- Reduces labor requirements.
- Provides immediate, temporary surface stabilization.
- Provides immediate erosion and water quality benefits.
- Reduces soil crusting.
- Conserves moisture and increases seed germination and seedling growth.
- Usually incorporated with fertilizer and a seed mix.

CONSTRAINTS

- Not recommended on sandy soils.
- Not recommended for areas of high concentrated flows.
- Requires special training and a hydraulic applicator.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- 3,000-4,000 pounds of bonded fiber matrix per acre.
- Approved hydraulic applicator.

Installation

- Should be installed according to manufacturers recommendations by a certified contractor.
- Spray apply at a minimum of 3,000-4,000 pounds per acre using standard hydraulic seeding equipment. Material should be sprayed in successive layers to achieve 100% coverage of all exposed soil.

Special Considerations

- Should not be applied immediately before, during, or after rainfall.
- Material should have 24 hours to dry prior to any rain event.

MAINTENANCE

- Inspect for erosion after each storm event during vegetation establishment. Reapply as necessary.

REFERENCES

Related Practices

- Practice 1101 Mulching.
- Practice 1102 Vegetative Stabilization.
- Practice 1104 Erosion Control Blankets and Matting.

Other Sources of Information

- Weyerhaeuser Products Brochure.

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PRACTICE 1104
EROSION CONTROL BLANKET

DESCRIPTION

- Biodegradable organic or synthetic mulch incorporated into a polypropylene or similarly netting material. (Note: this practice is also included in the Indiana Erosion Control Handbook.)

Exhibit 1104a: Erosion Control Blanket (Source: CBBEL Files)

PURPOSE

- To prevent erosion.

WHERE APPLICABLE

- Usually on slopes or in areas of concentrated flow.
- Area with high potential for erosion.

ADVANTAGES

- Provides temporary surface stabilization.
- Provides immediate erosion and water quality benefits.
- Reduces soil crusting.
- Conserves moisture and increases seed germination and seedling growth.
- Applicable in areas of concentrated flow and steep slopes (where mulch alone often fails).

CONSTRAINTS

- Expensive.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Organic (straw, excelsior, coconut fiber, etc.) or synthetic mulch material incorporated into a polypropylene or similar netting. Material may be biodegradable, photodegradable, or permanent.

Installation

- Select type and weight of blanket to fit site conditions (e.g. slope, channel, flow velocity).
- Install necessary erosion control devices.
- Grade site as specified on plans.
- Add topsoil where appropriate.

- Prepare seedbed, fertilize, and seed immediately after grading.
- Lay blankets on seeded areas following manufacturers directions. Blankets should be laid so they are in continuous contact with the soil, and upslope or upstream ones should overlap the lower ones by at least 8".
- Tuck the uppermost edge of the upper blankets into a check slot (slit trench) and backfill with soil. Tamp down.
- Anchor blankets as specified by the manufacturer. This usually involves driving 6"-8" wood or metal staples into the ground in a pattern determined by site conditions. Wood staples are preferable to metal staples. Wood staples will swell and hold better.

Exhibit 1104b: Proper installation of erosion control blankets in a drainageway (Source: Indiana Erosion Control Handbook)

Special Considerations

- Maximum life varies with material.
- Poor contact between the soil and the blanket resulting from improper stapling, or not using check slots, may cause water to flow under the blanket.

MAINTENANCE

- Inspect for erosion after each storm event during vegetation establishment.
- If any areas show erosion, pull back that portion of the blanket, add soil, re-seed, and re-lay and staple the blanket.
- Check area periodically after vegetation establishment.

REFERENCES

Related Practices

- Practice 1101 Mulching.
- Practice 1102 Vegetative Stabilization.
- Practice 1105 Bonded Fiber Matrix.

Other Sources of Information

- Indiana Erosion Control Handbook.
- NRCS Standard Specifications.

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PRACTICE 202
TILE DRAIN REPAIR/REPLACEMENT

DESCRIPTION

- Maintenance, repair, and replacement of tile drains.

Exhibit 202a: Tile Drain Repair/Replacement (Source: NRCS Files)

PURPOSE

- To reestablish drain function by restoring tile segment.

WHERE APPLICABLE

- All subsurface drains.

ADVANTAGES

- Regular repairs and maintenance help avoid future costly repairs and damages.

CONSTRAINTS

- All drains should be maintained.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Varies with project.
- Properly-sized segments should match hydraulic capacity of adjoining pipes (upstream and downstream).

Installation

- Outlets should be kept free of debris. They should be protected from animals by a flap gate or a grating.
- Water surface inlets may require frequent repairs. Erosion around inlets should be repaired, and the inlet grating should be kept free of debris.
- Traps must be kept clean in order to maintain drainage capabilities. Cleanout of the trap may be less frequent as the drain ages.
- Blowouts occur when the tile is subjected to pressure flow. When the tile is subjected to pressure flow, water is forced out of the tile saturating the surrounding soil. As the flow drops, the saturated soil is sucked into the tile. To correct, replace with solid tile or correct the pressure flow problem.

- Tree roots may plug drains. To repair the line, dig it up, clean it, and re-lay it. Please note that this is only a temporary measure that may have to be repeated periodically. One way to prevent recurrence, short of killing the trees, would be to replace the part of the drain near the trees with sewer pipe.
- Drains laid under waterways may carry soil and cause holes. Drains under waterways should be inspected regularly, and the holes repaired as necessary.
- Mineral deposits can sometimes plug the perforations in drains. Indication of the presence of deposits may be seen at the outlets or at junction boxes and inspection holes. Sulphur dioxide gas injected into the upper end of the drain from tanks of compressed gas can open the drain. The gas should be held in the line for 24 hours after the air has been replaced by gas. High pressure hydraulic cleaners are also used.

Special Considerations

- Failure of drains to operate as expected may result from a variety of reasons including: insufficient capacity, drains placed too shallow, lack of auxiliary structures, insufficient drain strength, improper spacing between joints, improper bedding, poor grade and alignment, improper backfilling, and substandard materials.
- Drainage easements should be considered when installing or repairing mutual drains. These easements should be recorded at the County Recorder's Offices.

MAINTENANCE

- Periodically inspect the required area for signs of blowout at the repair site or adjacent to it.

REFERENCES

Related Practices

- Practice 201 Tile Drain Installation.
- Practice 203 Breather Pipe.
- Practice 204 Tile Drain Inlet.

Other Sources of Information

- NRCS Engineering Field Handbook.

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