SECTION 5.12

MITIGATION MEASURES

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MITIGATION MEASURES

Some stream and ditch improvement activities may inevitably cause unreasonably detrimental environmental impacts, even if best management practices are used. This section addresses practices that create or enhance wetlands and stream/ditch corridor habitat. Several of the practices contained in Section 5.1 (Common Practices for Site Assessment and Preparation) are utilized to avoid or minimize unreasonably detrimental impacts on the environment. However these latter practices are normally called for as part of construction plans and are not generally regarded as compensatory mitigation measures.

Wetland replacement usually entails enhancing the functional value of an existing, degraded wetland or creating a new wetland. Wetland replacement is relatively expensive and requires extensive planning by a qualified wetland consultant. IDNR District wildlife biologists can often help in planning, when needed. Generally, wetlands created on hydric soils in naturally low-lying areas of the landscape have a better chance of survival. Once established, created wetlands are relatively low-maintenance, requiring minimum management such as exotic plant control and prescribed burns. However, construction monitoring and aggressive management during at least the first five years of establishment are critical to creating a successful wetland.

Stream environment enhancement and the creation of check dams both involve creating aquatic habitat with in-channel structures. The primary objectives of all described structures are to improve water quality and habitat through aeration, the creation of deep water pockets, sediment removal, providing cover for fish, and substrate and food for other aquatic organisms. This is accomplished by providing conditions that create varying degrees of upstream ponding, and downstream scour action. When considering in-channel structures for stream enhancement, special care should be taken that structures do not create excessive upstream flooding or downstream erosion.

Drainage Code (IC 36-9-27) prohibits the IDNR from requiring tree planting or tree retention within the easement of a regulated drain if certain conditions are adhered to. However, tree planting or replacement when it does not create a conflict with maintenance activity may be considered in streams not considered "regulated drain" as an enhancement measure or to compensate for trees lost as a result of a drainage improvement activity.

An extensive body of literature is available on the subject of stream environment enhancement that provides details of various techniques in this category. Several of these publications are referenced in the "Forest Service Habitat Improvement Handbook". Further references and information may also be obtained from local environmental groups and agencies.

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PRACTICE 1201
WETLAND REPLACEMENT

DESCRIPTION

- Restoring or creating wetlands as an enhancement measure or to replace wetlands disturbed during construction.

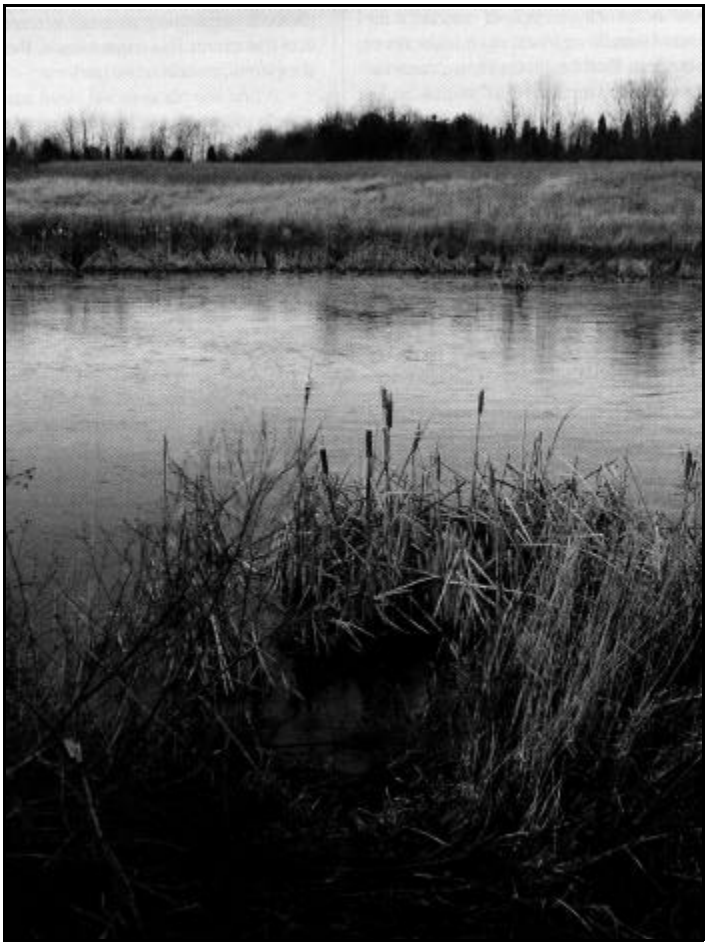

Exhibit 1201a: Wetland Replacement (Source: Land and Water Magazine)

PURPOSE

- To replace the functions and values of wetlands disturbed during development activities.
- To enhance water quality and stormwater storage capabilities of a watershed.

WHERE APPLICABLE

- Projects with wetlands impacts.
- Where wetland restoration is considered as part of a watershed management scheme.

ADVANTAGES

- Replaces ecological values lost due to impacts.
- Improves water quality, wildlife habitat, flood water retention, and ground water recharge.

CONSTRAINTS

- Expensive (However, financial assistance is usually available through contacting the IDNR Fish and Wildlife Division).
- It may not be possible to create wetlands of the same functional values as high quality, naturally occurring wetlands.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Top soil.
- Local wetland plants and seeds.

Installation

- Wetlands should be located on hydric soils.
- Excavation: The basin should be graded to 1' below the final grade unless the material found at the grade level is acceptable wetland topsoil.
- Topsoil: At least 12" of wetland topsoil is necessary for plantings. Topsoil should be finished to +0.25 to -0.20 feet of the grade lines and dimensions shown on the plans, prior to scarification. Average grades should meet the grade lines. Topsoil should be applied in a manner that minimizes compaction. Upon completion of scarifying, a 150-200 pound person should sink 1" - 2" in the material while walking.
- Wetland Seeding: The area to be seeded should be worked to a minimum depth of 3" using a disk tiller or similar equipment. The prepared surface should be relatively free of weeds, clods, stones, rivulets, gullies, crusting and caking. Seed should be planted using a rangeland, no-till drill attachment. Hydraulic seeding or hand broadcasting is not recommended other than in inaccessible areas.
- Wetland Planting: Wetland plugs, tubers, and rootstock should be installed during May and June, and within one week of seeding. One day prior to planting, the water levels should be at normal water level so that soils are saturated to 1' in the locations to be planted. Plugs should be planted 50 plants to a 10' x 10' goose grid.

Zone	Water Depth
Mesic Prairie	6" to 12" above NWL*
Sedge Meadow	NWL - to 6" above NWL
Shallow Emergent	3" below NWL to NWL
Deep Emergent	12" below NWL to 3" below NWL
Submergent	> 12" below NWL

* NWL = Normal Water Line

Exhibit 1201b: Wetland planting zones (Source: CBBEL Files)

Special Considerations

- Installing water control structures to induce drawdowns may enhance the viability of the wetland; however, water control structures are subject to vandalism and require periodic maintenance and/or adjustment.
- Wetlands require little maintenance once they are established. However, aggressive management especially during the first 5 years

is critical to their success.

MAINTENANCE

- Watering, if necessary, during plant establishment.
- Herbiciding purple loosestrife and other exotics.
- Prescribed burning and/or mowing when burning is not appropriate.
- Inlet and outlet structures should be kept free of debris.

REFERENCES

Related Practices

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

Other Sources of Information

- NRCS Engineering Field Handbook.

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PRACTICE 1202
STREAM ENVIRONMENT ENHANCEMENT

DESCRIPTION

- Instream structures designed to improve aquatic wildlife habitat.

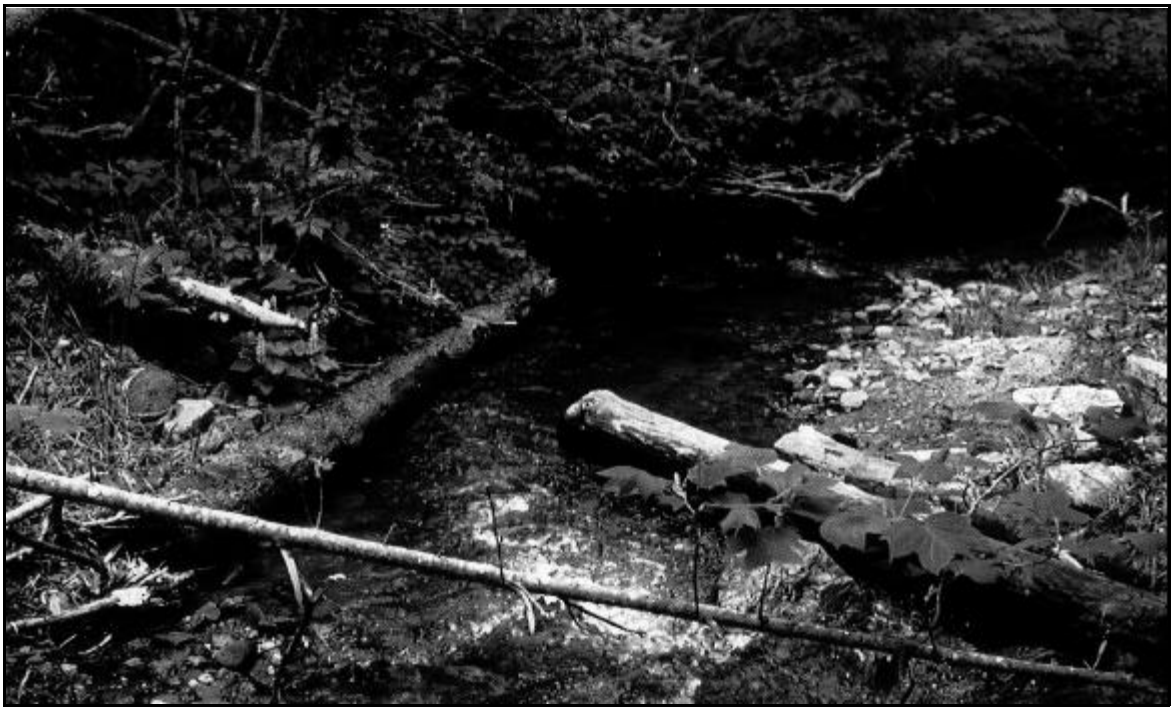

Exhibit 1202a: Stream Environment Enhancement (Source: Forest Service Habitat Improvement Handbook)

PURPOSE

- To improve wildlife habitat.

WHERE APPLICABLE

- Any stream improvement project in which one of the objectives is to improve wildlife habitat.

ADVANTAGES

- May create deeper water.
- May flush sediment thereby improving water quality.
- Provides cover for fish.
- Provides substrates and food for aquatic organisms.
- Most structures can be installed with hand tools.

CONSTRAINTS

- May be an added expense.
- May cause upstream flooding and downstream erosion if not properly installed.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Hand tools or heavy equipment, when needed..
- Natural structures (boulders, logs, stumps, etc.).
- Cable for securing some structures.
- Rebar.

Installation

- Channel Block: Log or log and crib structures installed across stream meanders and oxbows to consolidate braided channels. Channel blocks create deeper channels conducive for larger fish. Blocks should be placed at the lower end of the flood channel as well as the upper end to prevent head cutting.

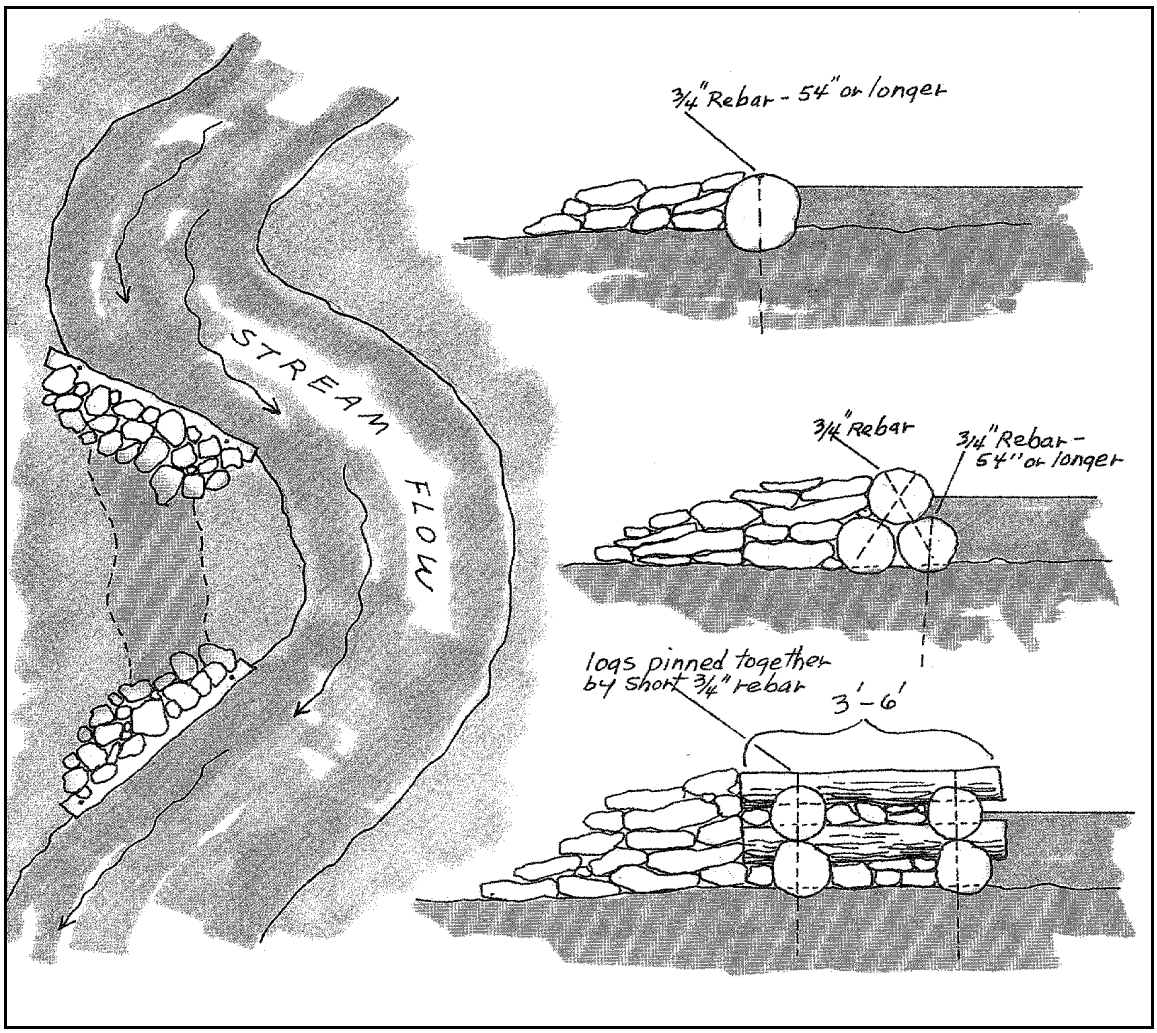

Exhibit 1202b: Channel blocks (Source: Forest Service Habitat Improvement Handbook)

- Boulder Placement: Boulders can be placed in most stream locations including riffles, runs, flats, glides, and open pools. Greatest benefits are likely to be achieved in currents > 2 ft/sec. Boulders provide overhead cover and resting pockets.

Exhibit 1202c: Boulder placement (Source: Forest Service Habitat Improvement Handbook)

- Cover Logs and Rootwads: These structures provide overhead cover where water depth may be adequate, but cover is lacking. Logs may be pinned into gravel channels with rebar. Rootwads (tree stumps with roots intact) are usually anchored to the bank so that the root mass is mostly submerged.

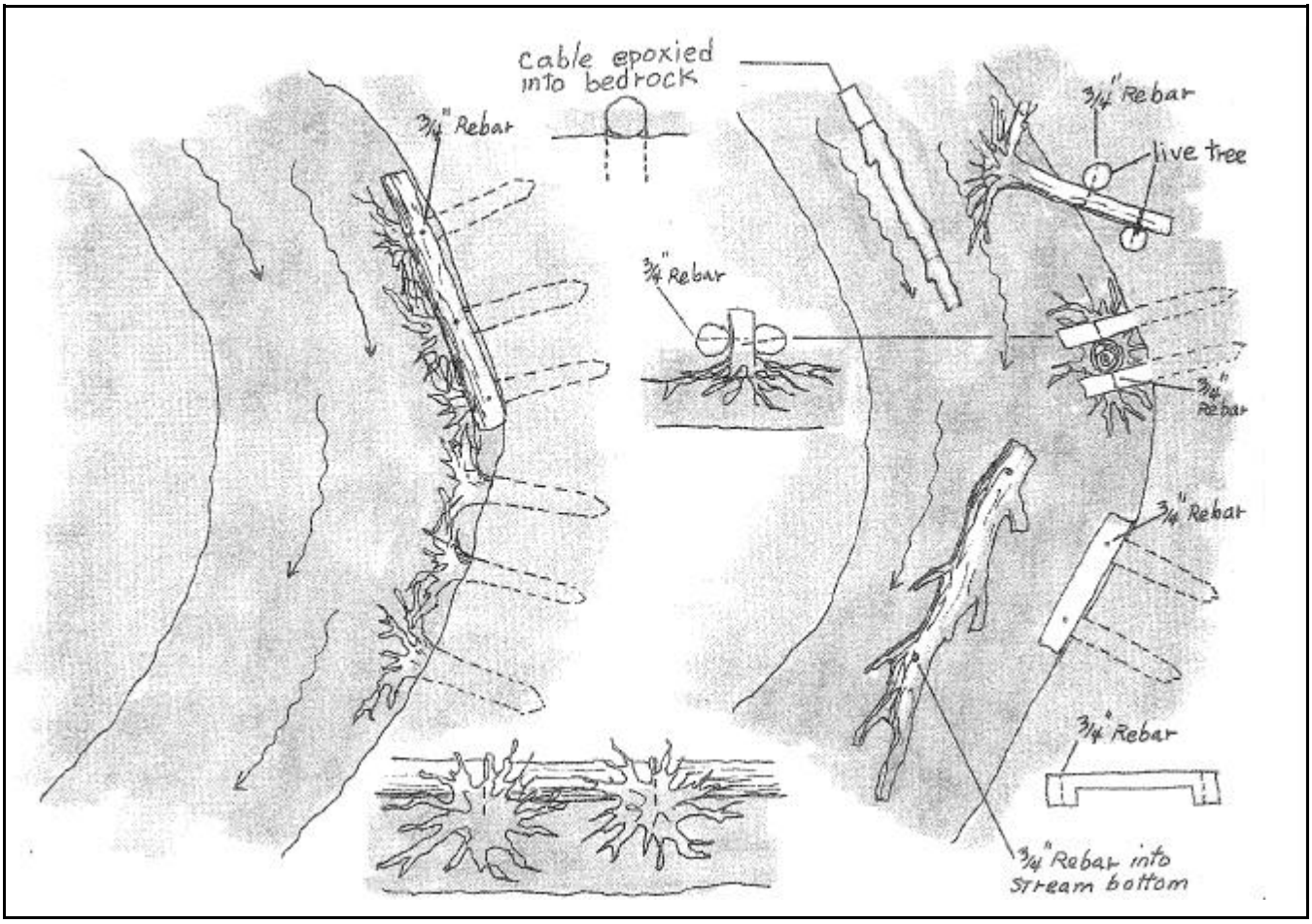

Exhibit 1202d: Cover logs and rootwads (Source: Forest Service Habitat Improvement Handbook)

- Tree Cover: Trees felled so that the tops of the trees are in the channel provide cover and structure for fish and other aquatic organisms. Trees can also be placed along the banks and serve as revetments (Practice 504). Felled trees should be sufficiently anchored to avoid creating flow-impeding obstructions downstream.

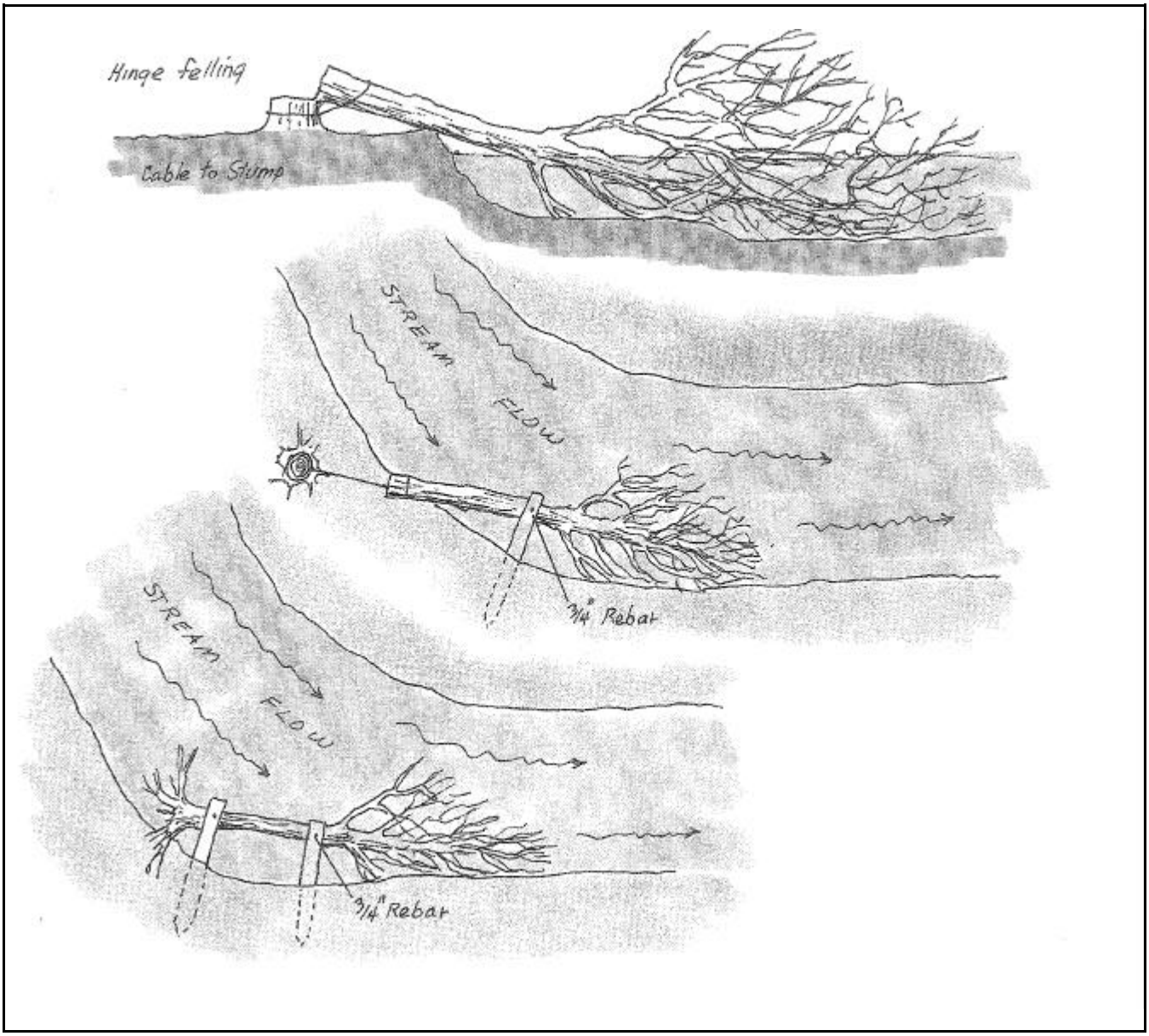

Exhibit 1202e: Tree Cover (Source: Forest Service Habitat Improvement Handbook)

- Wing Deflectors: Log and stone structures that constrict and divert water flow so that stream meanders and pools are formed by scouring and relocation of fine sediment. Wing deflectors should be placed so that water is diverted toward a stable section of the streambank. The main deflector log should be placed at a 35 degree angle from the streambank, and supported with a downstream brace log.

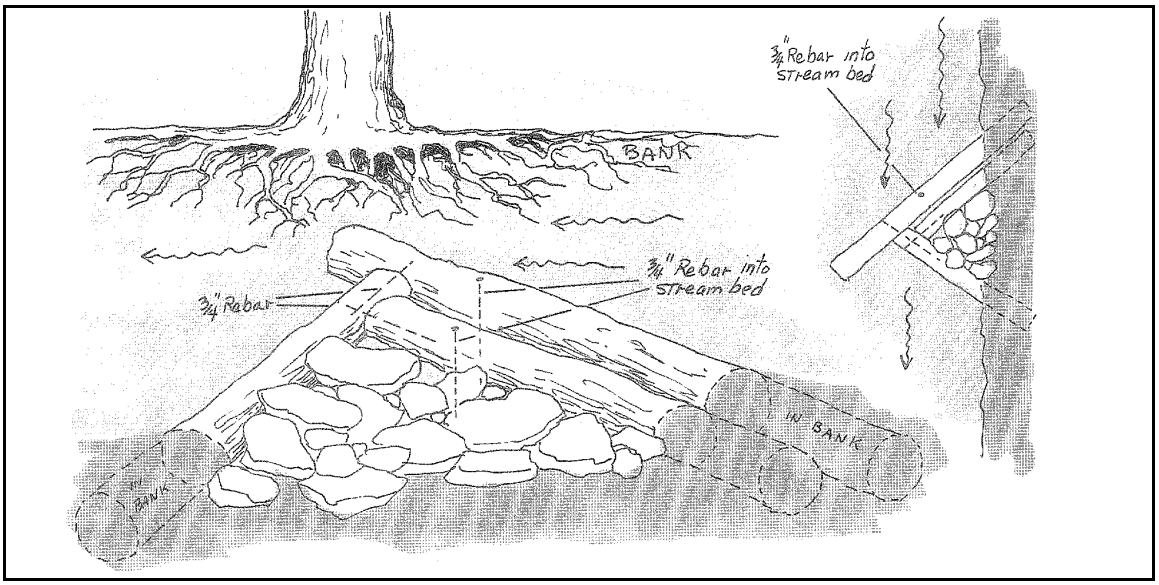

Exhibit 1202f: Single-wing deflector (Source: Forest Service Habitat Improvement Handbook)

- Rock Current Deflectors: Rock current deflectors constrict flow to create artificial pool-riffle sequences. Riprap is dumped or hand-placed as two facing triangles with their bases at each channel bank. To be effective, several sets of rock deflectors should be placed along a stream reach far enough apart, usually five to seven stream widths, to allow a pool-riffle sequence to develop. The structures should not be so high as to block flood flows.

Exhibit 1202g: Rock current deflector (Source: Ohio Stream Management Guide)

Special Considerations

- Care should be taken that in-stream structures do not cause upstream flooding or downstream erosion.
- Instream structures may not be appropriate in channels with unstable banks.
- Placing obstructions in channel may not be appropriate for single-purpose, man-made drainage ditches.
- Many of these structures may be incorporated with bioengineering techniques for eroded streambank repair (Practices 501, 502, 503 504, 505, 506, 507 , 508, 509, 510).

MAINTENANCE

- Inspect periodically, and especially after flood events.
- Repair as necessary.

REFERENCES

Related Practices

- Activity 5.5 Eroded Streambank Repair.
- Practice 1203 Log Check Dams.

Other Sources of Information

- Forest Service Habitat Improvement Handbook.
- Ohio Stream Management Guide.

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PRACTICE 1203
LOG CHECK DAMS

DESCRIPTION

- Log and/or rock structures placed across channels to create pools.

Exhibit 1203a: Log Check Dams (Source: Forest Service Habitat Improvement Handbook)

PURPOSE

- To create pool habitat for fish.
- To trap organic debris used for food by aquatic invertebrates.
- To slow water thereby reducing erosional forces.

WHERE APPLICABLE

- Steep gradient channels less than 30' wide.
- Channels with well defined banks.

ADVANTAGES

- Create deep, downstream pools through scouring.
- Create quiet water upstream of the dam.
- Dams produce more dramatic changes than other stream enhancement techniques (Practice 1202).

CONSTRAINTS

- Log Check dams are more expensive to install than other enhancement techniques.
- Log Check dams are higher maintenance than other techniques.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Logs > 10" in diameter (the larger the better).
- Rebar.

- Hogwire.

Installation

Wedge Dam

- Wedge dams are best suited in channels where there is a break in gradient with a steeper section immediately upstream.
- The two main logs in the dam should face upstream at a 45-degree angle to stream flow with the two brace logs pinned to the main logs at about a 90 degree angle. The butts of the two main logs should extend into the streambank 3'-6'. There should be a 6"-12" drop from the top of the check dam to the water. Once the logs are in place, attach the howgwire to the upperside of the log so that it extends upstream. Put a layer of gravel or flat stones on top of the wire.

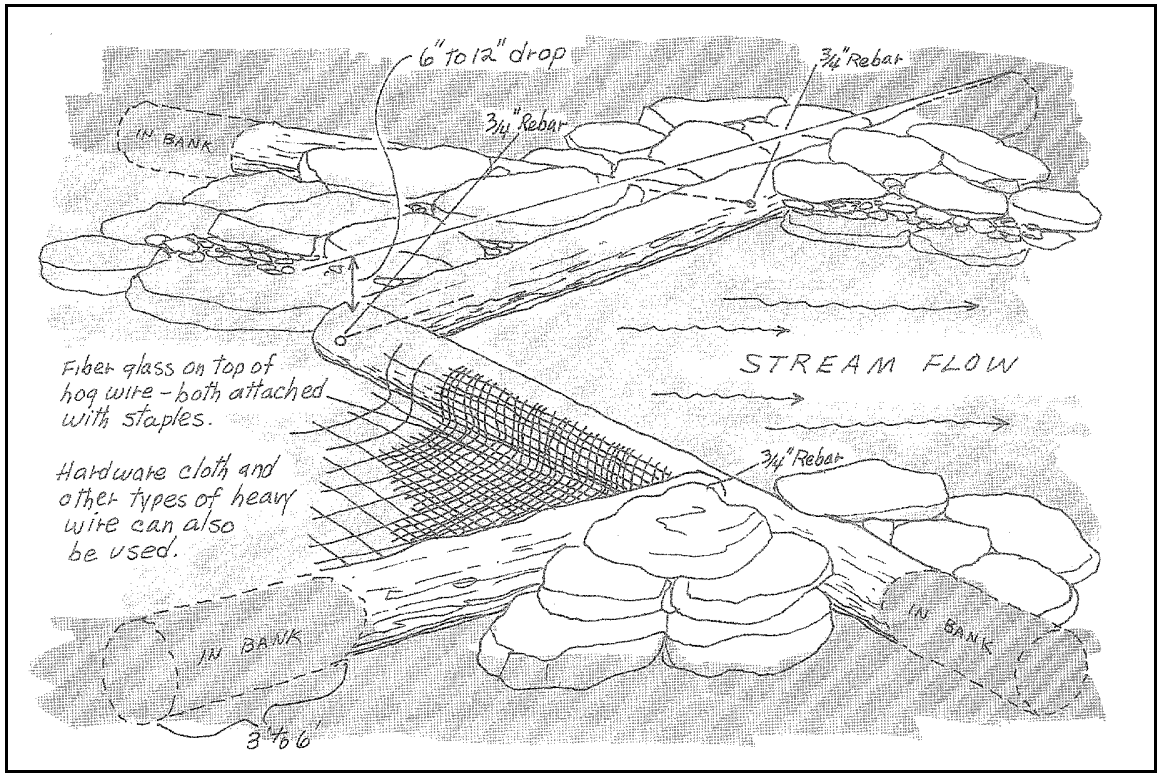

Exhibit 1203b: Wedge dam (Source: Forest Service Habitat Improvement Handbook)

K Dam

- K Dams are best suited for streams < 15' wide. Use one log (≥ 16") to span the entire length of the stream. Attach braces to the main log at about an 45 degree angle. Cut a spillway into the main log to concentrate flow to the center of the stream. Attach hardware cloth to the main log as described above.

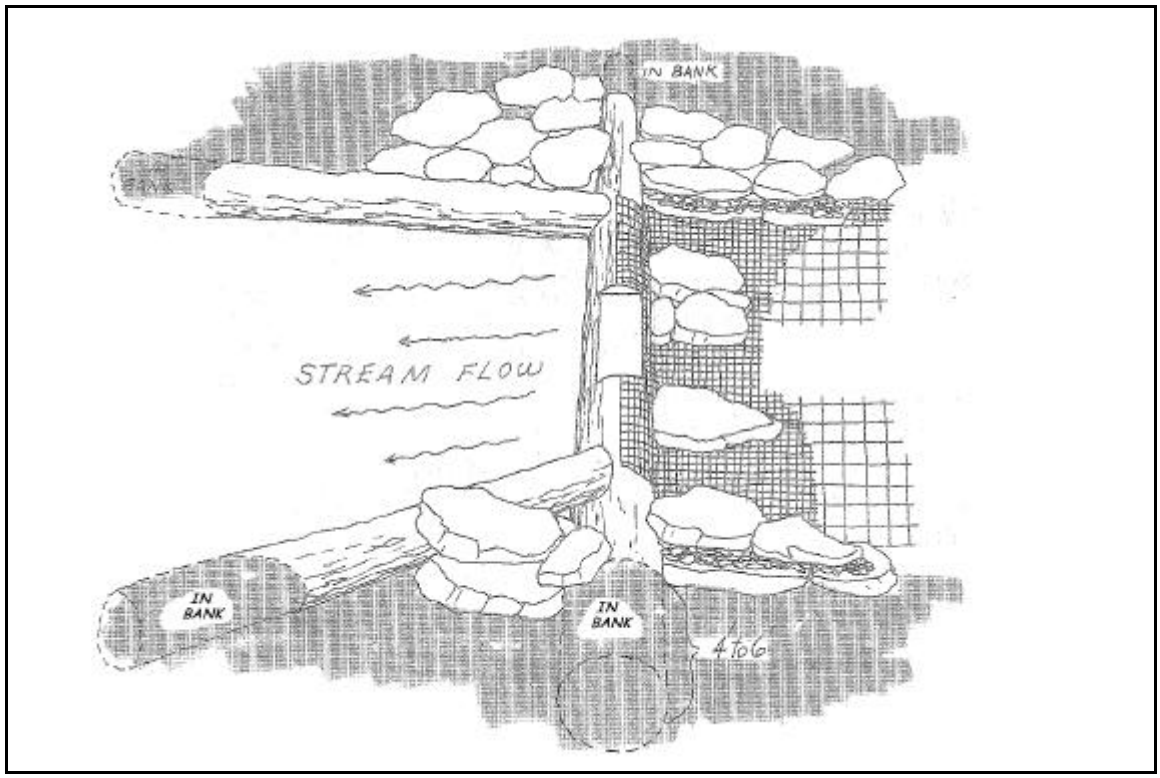

Exhibit 1203c: K-dam (Source: Forest Service Habitat Improvement Handbook)

Special Considerations

- Washing underneath check dams is the most common failure.
- Wedge dams are suitable for streams less than 30' wide. K dams should be used on streams less than 15' wide.
- K dams create larger and deeper pools than wedge dams; however, maintenance is higher with K dams.
- K dams are more difficult to install than wedge dams because greater excavation is needed to anchor the main log.

MAINTENANCE

- Monitor for under washing and repair as necessary.

REFERENCES

Related Practices

- Practice 1202 Stream Environment Enhancement.

Other Sources of Information

- Forest Service Habitat Improvement Handbook.

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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).

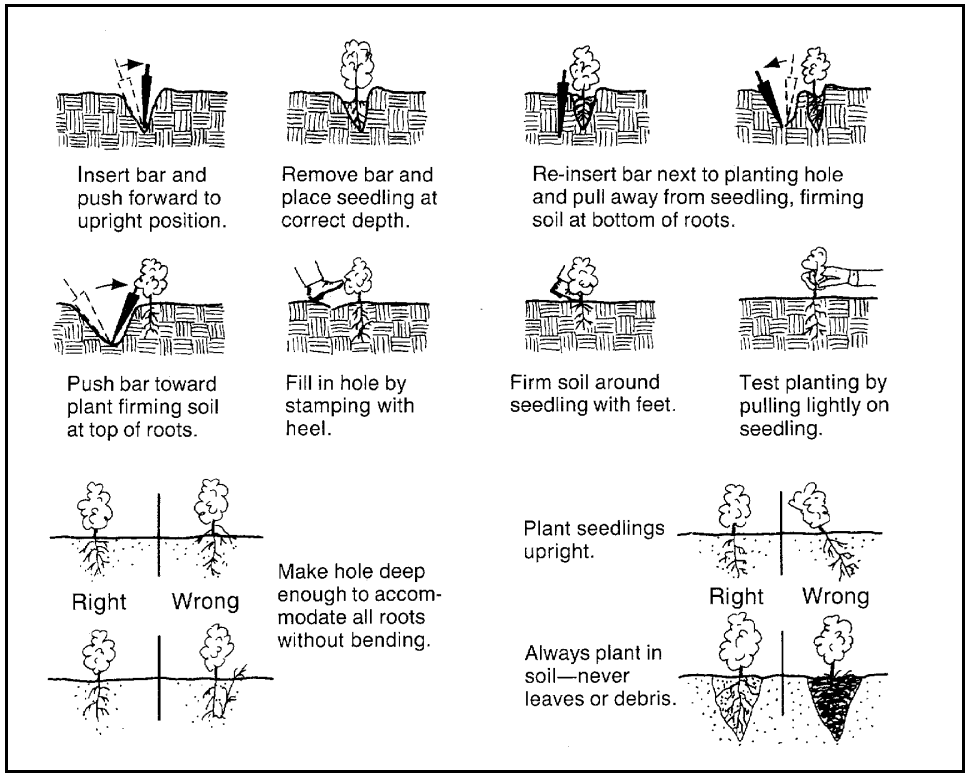

Exhibit 1204b: Planting bare-root seedlings (Source: North Carolina Erosion Control Manual)

- 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.

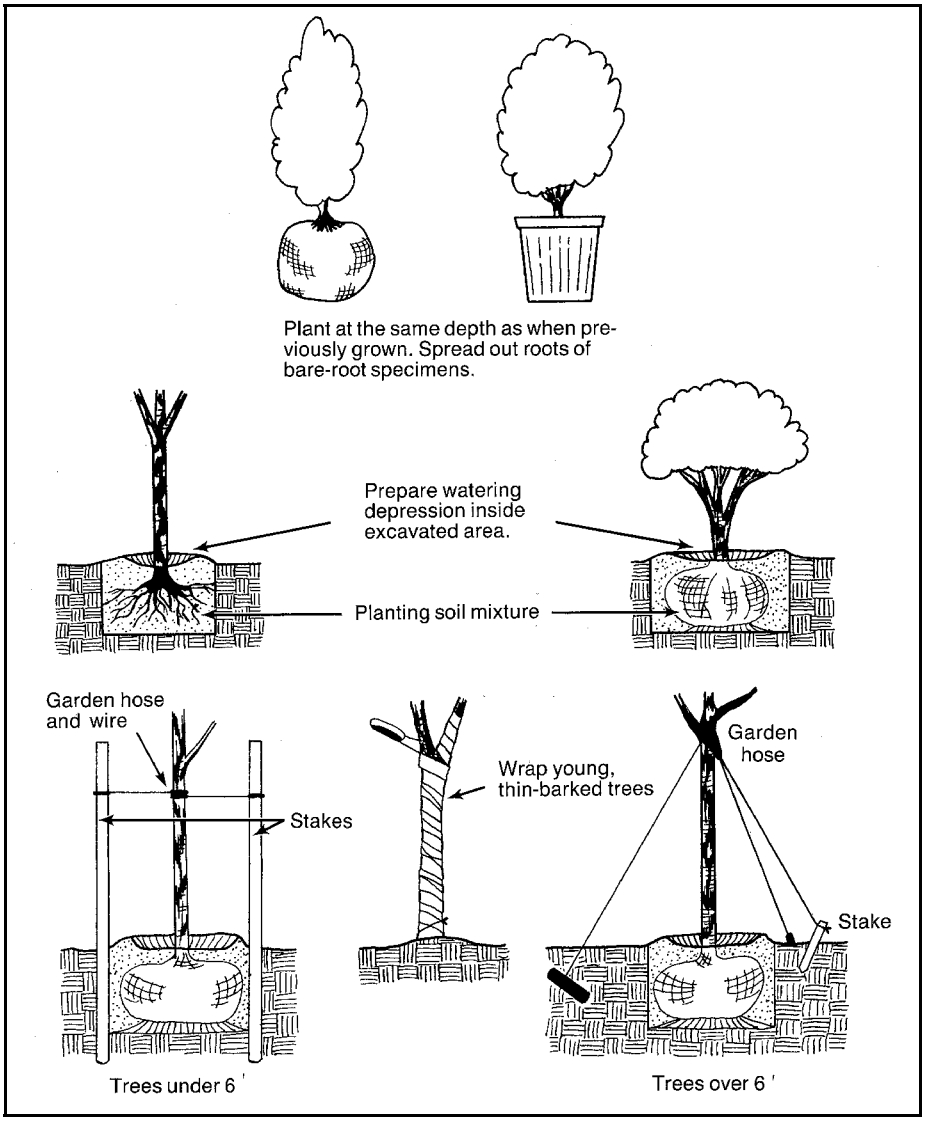

Exhibit 1204c: Planting balled and burlapped and container-grown trees (Source: North Carolina Erosion Control Manual)

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.

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