ODNR, DIVISION OF MINERAL RESOURCES MANAGEMENT

GUIDELINES

SUBJECT: Guide to Reforestation on Ohio Surface Mine Lands

EFFECTIVE: April 4, 2016

PURPOSE: To aid the mining industry in establishing trees and shrubs on Ohio reclaimed surface mine lands.

(This guidance document replaces Policy/Procedure Directive Regulatory 88-5, Policy/Procedure Directive Inspection and Enforcement 94-1, Policy/Procedure Directive Regulatory 95-2 and Policy/Procedure Directive Regulatory 95-1 and the Mined Land Technical Reforestation Guidance & Recommendations)

Introduction

There are many situations during mined land reclamation where trees and shrubs are desired or required. These guidelines are intended as practical and proven methods for successful tree/shrub reclamation and bond release.

History

The mining laws and rules have always allowed or required tree planting during reclamation. Many plantings have been successful but in some cases tree/shrub planting has been challenging on reclamation ground for a variety of reasons. Some of the predominant reasons appear to be compaction, competition, moisture, and timing. Several directives have addressed tree/shrub planting in the past. This guideline is intended to consolidate these documents into one comprehensive reference tool.

This guideline is organized to describe general tree/shrub planting methods which apply to all land uses and for specific land uses. The *Reclamation Tree/Shrub Species Spreadsheet* and *Reclamation Herbaceous Cover for Tree/Shrub Planting Spreadsheet* that is part of this document is available in electronic format which allows the user to sort by land use for the appropriate species.

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Grading and Topsoil Methods

Salvage all topsoil and subsoil available from the tree/shrub planting area or other adjacent areas. For optimal tree/shrub survival it is recommended to include at least 3-4 feet of the A, B and C soil horizons. The soil should be direct hauled to the tree/shrub planting areas when possible. When salvaging soil, everything on and in the soil should be saved including all organic material, vegetation, stumps, roots, limbs, brush, and logs. This helps reduce compaction and preserve seeds and organic matter. Spoil and topsoil should be handled to minimize compaction using truck dump piles, dozer pushup methods, low ground pressure dozers and equipment. Keeping compaction to a minimum is one of the most important factors for a successful tree/shrub planting operation.

- Salvage all topsoil and available subsoil material. It is recommended 3-4 feet of subsoil material. Refer to Appalachian Regional Reforestation Initiative (ARRI) FRA No.3;
- Direct haul topsoil with vegetation when possible to reduce compaction and preserve seeds;
- Organic material, roots, stumps, limbs and brush should be left in the re-soiling material;
- Use dump piles where practical. Dump piles should be placed in a staggered configuration to reduce soil and water runoff, with one to two passes with a Low Ground Pressure (LGP) dozer. Dump piles should not be used in stream buffer zone areas unless they are graded to allow runoff to enter the stream. When using dump piles permission must be obtained from the landowner.
- Spoil and topsoil should be handled to minimize compaction (dumped, LGP dozer, dozer pushup method);
- Depending on land use, a rough final surface may be beneficial to reduce compaction and retain soil moisture;
- Grading should allow for a flood plain if possible (Riparian/Wetland Areas)

Soil/Seedbed Preparation

Following soil spreading, the soil should be loosened by ripping, plowing, and/or disking where possible or practicable. Ripping should be at least 3 feet deep and using a checkerboard pattern is preferable. Tillage work should be done following the contour to reduce erosion and using low ground pressure equipment to reduce compaction when possible. Depending on the land use, a rough final surface may be beneficial to control erosion and retain moisture. Soil should be prepared in the fall for next year's tree/shrub planting when possible. The soil should be handled in dry conditions to reduce compaction and to give the ground time to absorb moisture during the winter. Cover crops shall be planted in the fall to protect the soil over winter. Trees and shrubs should be planted as early as possible in the spring.

- Soil should be loosened by ripping, plowing and/or disking where possible or practicable;
- Ripping should be at least 3 feet deep, checkerboard pattern is preferable;
- Tillage work should be done on the contour to reduce erosion;
- Soil should be prepared in the fall for next spring planting when possible;
- A cover crop shall be planted in the fall to protect soil over winter.

Planting Methods & Timing

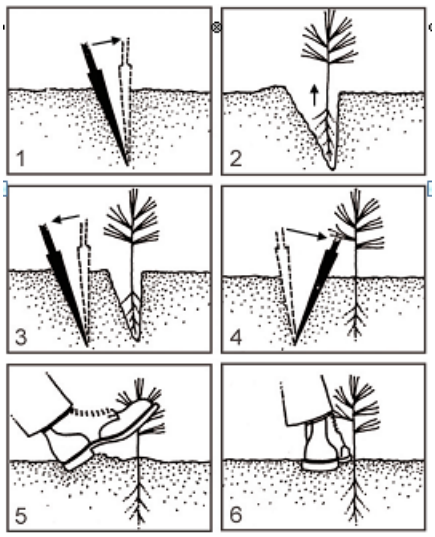
The permittee must assign a qualified individual from their company or the tree planting company who has participated in the Division of Mineral Resources Management (DMRM) tree planting workshop or equivalent to monitor the planting and verify that the following handling and planting practices are followed. Trees and shrubs should be planted as early as possible in the spring. Hand planting or machine planting is acceptable but hand planting is usually preferred because it is critical that trees/shrubs are planted as soon as soil conditions allow. February, March and April are recommended for tree/shrub seedling planting. No tree/shrub seedling planting should be done after April 30th. Tree/shrub seeds may be planted if the appropriate timing and methods are used. When soil is prepared for tree/shrub planting, herbaceous tree/shrub-compatible ground cover should be planted to control erosion. If the cover becomes well established it may be advantageous to use herbicides on the areas in the spring to reduce the herbaceous competition before planting trees. Applying herbicides in strips where trees/shrubs will be planted may be a good method to control erosion and reduce competition. Some experimentation is being conducted with planting trees/shrubs in the fall but these species must be dormant at the time of planting. Tree/shrub availability and timing may be an issue for a successful fall planting. Fall planting is not recommended.

- Light seeding of non-competitive grasses, legumes and cover crop should be planted following soil preparation;
- Tree and shrub seedlings should be hand or machine planted in February, March and April when soil conditions allow;
- No tree/shrub seedlings should be planted after April 30th;

- Fall tree/shrub planting is not recommended on reclamation land;
- If direct seeding, tree/shrub seeds can be planted using appropriate timing and methods. Be advised that this method has shown little or no success on reclaimed mined land because of the competition from herbaceous species. Refer to the *Reclamation Tree/Shrub Species Spreadsheet* and the document *Direct Seeding of Fine Hardwood Tree Species*.
- Planting rates are prescribed in the permit.
- Herbicides may be beneficial to reduce competition in tree/shrub planting areas where vegetation is well established.
- Tree/shrub tubes are not recommended unless a strict maintenance schedule is adhered to.
- In some streambanks and riparian areas, another option is using cuttings and posts (typically willow and cottonwood) that will help establish woody cover. For more information refer to the *Ohio Stream Management Guide No. 07: Restoring Streambanks with Vegetation*.
- Survival and growth of trees on mined areas has been enhanced by inoculating the seedlings with Pitholithus tinctorius (P.*t.). P.t. is an ecto-mycorrhizal fungus that is tolerant of high temperatures and acid conditions. Planting P.t. stock on acidic areas or "hot spots" is an effective way of establishing tree cover on such sites. Species which are best adapted for P.t. inoculating are conifers such as white pine, Virginia pine and selected hardwoods such as northern red oak.*

RECOMMENDED HAND PLANTING METHOD

1. Insert dibble at angle shown and push forward to upright position.
2. Place seedling in hole, pull up to nursery depth, and straighten roots.
3. Insert dibble 2 inches from seedling and pull handle toward planter.
4. Push handle toward seedling (3 & 4 → packs soil at bottom and top).
5. Fill in second hole by stomping with heel.
6. Pack soil around seedling with feet.



Species

Species selection is very important when dealing with mine reclamation areas. Mined soils and site conditions can be much different than native pre-mining soils and conditions. Some of the considerations when selecting species are soil pH, direction of exposure from sun and weather, availability of moisture, and landowner's desired land use. Reclaimed mine soils usually dry out quickly and can become compacted easily by large earth moving equipment. Reducing compaction and saving the top few inches of soil containing tree/shrub seeds thus allowing volunteer pioneer species to establish may be one of the best ways to start the successional process. Planting species with proven success on mined lands will also help start the process. Some species although desirable may not be as easy to start from the beginning of the reclamation process. Choosing the correct species for each situation and post mining land use on the reclamation site will prove beneficial to the end product. For example, the use of willow and sycamore along stream corridors for quick growth and shade for the stream may be very beneficial but the same species may not be beneficial anywhere else on the site. Refer to the *Reclamation Tree/Shrub Species Spreadsheet* for land uses and recommended tree species.

- Healthy 2 year old stock is recommended;
- List of Herbaceous Species (low competition for woody vegetation) See *Reclamation Herbaceous Cover for Tree/Shrub Planting Spreadsheet*;
- List of Tree/Shrub Species (species that work, species that include good bat habitat) See *Reclamation Tree/Shrub Species Spreadsheet*;
- Planting plan should be detailed in the permit.
- See *pH Map of Ohio's Coal Regions* *(*Adapted from OARCD Research Bulletin #1158 by M.M. Larson)

Proper Tree/Shrub Handling

Proper handling and storage of tree seedlings is an important aspect of a successful tree/shrub planting. It's recommended to pick the trees/shrubs up at the nursery to make sure you can control the environment for the seedlings. When trees/shrubs arrive they should be kept in a cool dry location and protected from freezing, direct sunlight or drying out. The seedlings should be planted as soon as possible when soil and weather conditions allow. A very important aspect of planting is to keep the roots moist through the whole process. The use of a hydrating gel is highly recommended. Proper planting techniques and attention to detail for each seedling will help insure success.

- Proper handling and storage of seedlings
    - Limit level of stress upon arrival;
    - Placing tree/shrub bags in a regulated cold storage (33 degrees to 40 degrees F with humidity above 80%) until planting;
        - If cold storage not available, keep seedling bags cool and moist
    - Protect from freezing;
    - Do not place in direct sunlight;

  - Do not store for more than 10 days
- When preparing for planting
  - Cover tree/shrub bags with light reflecting tarps so they are not exposed to light and wind;
  - Place wet mulch in the planting bag or dip roots in a hydrating gel to provide extra protection;
  - If planting a mixture of species, separate and mix the species in the shade
- Planting tree seedlings
  - Best planting days are overcast with temperatures below 50 degrees F when the soil is moist but not frozen;
  - Use appropriate planting tool(s); the hoedad, KBC planting bar, sharpshooter spade, and dibble bar;
  - Dig a bigger hole for seedlings with bigger roots; do not bend or break to fit in the hole;
  - Plant tree seedling in a vertical position and pack soil firmly around the roots so that all air pockets are removed
  - No more than one seedling, stake or post can be placed in a single hole. The hole shall be closed tightly: a firm tug shall not loosen or remove the seedling, stake or post from the hole.
  - Roots cannot be exposed once a seedling is planted. This would require seedlings to be planted deep enough to cover the entire root system and that the holes are completely sealed.
  - Roots must remain straight when the seedling is placed in the hole. This would require the hole to be deep enough for the entire root system to fit without being bent or doubled.
  - Seedlings must be planted so that no more than one-half inch on the stem above the root collar is beneath the soil.
- Post planting care and assessment
  - Conduct a survival assessment during second growing season before leaf fall

Stocking/Planting Rates

The table below shows the spacing and planting rates for trees for post mining land uses typically encountered on Ohio mine sites. Most land uses require 600 trees/shrubs per acre for a Phase II release so an 8X8 spacing (681 stems/acre) is recommended with proper planting techniques to improve success. The inspector should be notified and the *Verification of Proper Planting of Tree Seedlings/Posts* form submitted for confirmation of planting as soon as possible following tree planting.

	Fish & Wildlife	Undeveloped	Forest	Recreation	Bat	Wetland	Riparian
Spacing	8 X 8	8 X 8	8 X 8	8 X 8	8 X 8	8 X 8	8 X 8
Stems per acre (Phase II requirement)	681 (Minimum 600 stems per ac.)	Herbaceous cover only required for Phase II	681 (Minimum 600 stems per ac.)	681 (Minimum 600 stems per ac.)	681 (Minimum 600 stems per ac.)	681 (Minimum 600 stems per ac.)	681 (Minimum 600 stems per ac.)
Surviving stems per acre (Phase III requirement)	250	681 (Minimum 600 stems per ac.) Must be planted but no survival requirement	450	250	300	Must meet land use requirements	Must meet land use requirements
Number of species planted	No more than 25% of any one species	No more than 25% of any one species	75% must be commercial timber species	No more than 25% of any one species	6 total 4 exfoliating	No more than 25% of any one species	No more than 25% of any one species

Maintenance

Maintenance of tree/shrub planting areas may be and normally is required to insure successful reclamation and bond releases. Tree/shrub shelters may be beneficial but need regular attention to insure that they are working properly. This may include re-staking and adjustments every year. Herbicides may be useful to help reduce competition from competitive grasses. Re-planting additional seedlings if needed to accomplish the required stocking rates is a common practice and will not normally re-start the maintenance period. Other maintenance such as mowing between rows, deer repellant, fencing, fertilizing, and watering may be beneficial in some situations.

- If using tree/shrub shelters, regular maintenance must be implemented including re-staking and shelter adjustment/alignment;
- If grass competition becomes too heavy, herbicide treatment may be required. Herbicides should be used in areas where grasses are established in order to increase tree/shrub survival.
- Replant seedlings if needed to achieve regulatory compliance.
- Mowing between rows to reduce herbaceous cover if needed

- Deer repellant if needed

Ground Cover (herbaceous cover)

Following soil placement and seedbed preparation on the proposed tree planting area, soil should be lightly seeded with the recommended tree-compatible herbaceous species. Soil should always be seeded following placement or disturbance.

Considerations for tree/shrub–compatible ground cover for reforestation and erosion control.

Analyze on site conditions

- Soil test to determine chemical properties of the soil
- Choose appropriate ground cover that fits soil conditions- see *pH Map of Ohio Coal Regions*
- Adjust soil pH to the 5.5-to-6.5 range- see pH column in the *Reclamation Tree/Shrub Species Spreadsheet* and *Reclamation Herbaceous Cover for Tree/Shrub Planting Spreadsheet*
- Apply fertilizer per soil test recommendations

Tree-compatible ground cover (Fish & Wildlife, Undeveloped, Recreation, Forest and Bat Enhancement)

- Perennial Grasses (pick at least two) (orchard grass should not be planted with trees/shrubs)
- Annual Grass
- Legumes (pick at least two)

Tree-compatible ground cover (Riparian and Wetland)

- Pick at least four but more is preferable

The *Planting Report* form with an attached planting list should be submitted to the inspector following planting for verification.

The Forest Reclamation Advisory (FRA) is intended to present methods for establishing ground cover vegetation to control erosion without hindering survival and growth of planted trees/shrubs or volunteer species. Minimizing herbaceous ground cover competition is important to giving trees a good start. With reduced ground cover, the area should be closely monitored for erosion and repairs completed by hand when needed. Care should be taken to protect the trees/shrubs and minimize compaction. Minor erosion is acceptable in tree planting areas when the sediment does not leave the site.

It is important to realize that success is determined by achieving the post mining land use, controlling erosion and preventing off-site sedimentation. Each reclamation site

will present different challenges and will need to be analyzed for the best approach. Reviewing OAC 1501:13-9-15, Revegetation, and conferring with the regulatory authority is very important during the reclamation process.

Reference: *The Appalachian Regional Reforestation Initiative (ARRI) FRA No.6*

Extra Enhancements

- Strictly avoid disturbing sections of buffer zones and existing trees/shrubs where possible.
- Use willow posts as a follow-up planting method in saturated zones when needed.
- Use water bars along streams to reduce erosion if needed.
- Encourage volunteer trees/shrubs by planting less groundcover and saving and redistributing the top few inches of topsoil. This layer has a large amount of native seed present.
- Use grass strips/buffers to reduce erosion.
- Leave seed trees where possible to encourage volunteer seedlings. Volunteer stems of acceptable tree/shrub species may also be counted for bond release purposes.

Fish and Wildlife Habitat

- Minimum of 600 trees/shrubs planted per affected acre (or stems when direct seeded) for Phase II release
- Minimum of 250 trees/shrubs surviving per affected acre of which 80% have been in place for at least 3 years for Phase Ill release. (2 years for remining reduced maintenance areas)
- Ground cover for release: Phase II- 30%, Phase III- 70%, ground cover for release purposes includes the herbaceous vegetation and the tree/shrub canopies.
- Conifer seedlings should be planted in blocks for wildlife cover, not to exceed two acres in size and should not comprise more than 50% of the total seedlings needed for the permit.
- *Verification of Proper Planting of Tree Seedlings/Posts* form must be submitted to the inspector following planting.
- The Division must approve requests for reduced stocking levels of tree and shrub plantings (compressed plantings, open areas, brush piles, permanent impoundments, wetlands, access roads, or other wildlife enhancement features) on wildlife land use areas.

Undeveloped

- Minimum of 600 seedlings per acre (or stems when direct seeded) must be planted for Phase III release.

- 30% to 50% of the affected area must be planted with trees and shrubs if permitted as undeveloped or if an Application to Revise a Permit (ARP) is approved changing the land use to undeveloped prior to herbaceous cover being planted.
- 10% to 30% of the affected area must be planted with trees and shrubs if herbaceous cover is planted under pasture land or grazing land prior to an ARP changing it to undeveloped.
- Tree and shrub plantings should be on slopes steeper than 20 degrees and along drainages and around permanent sources of water.
- Conifer seedlings should be planted in blocks for wildlife cover, not to exceed two acres in size and should not comprise more than 50% of the total seedlings needed for the permit.
- *Verification of Proper Planting of Tree Seedlings/Posts* form must be submitted to the inspector following planting.
- Undeveloped tree planting areas will be eligible for Phase Ill release upon expiration of the period of extended responsibility, verification of proper tree planting in accordance with the approved planting plan at a rate of 600 trees/shrubs per acre on each acre on which trees/shrubs are to be planted and ground cover is at least 70% in the last year of responsibility. Ground cover for release purposes includes the herbaceous vegetation and the tree/shrub canopies.

Forest

- Minimum of 600 trees/shrubs per acre planted for Phase II
- Minimum of 450 trees per acre surviving of which 75% are commercial trees and 80% have been planted for 3 years (2 years for remining reduced maintenance areas) for Phase Ill
- For commercial species see *Reclamation Tree/Shrub Species spreadsheet*

OAC 1501:13-9-15 (L)(1)(a) requires a minimum of 600 trees and shrubs per affected acre (or stems when direct seeded) be planted for Phase II bond release. This can be accomplished through direct seeding-or by the planting of bare root or containerized seedlings. Seedlings can be planted by hand or machine, and should be planted at approximately an 8 foot by 8 foot spacing to meet this stocking requirement.

As stated in OAC 1501:13-9-15 (L)(2)(a), the Phase III bond release requirement is the survival of at least 450 tree and/or shrubs per affected acre, of which 75% are commercial tree species and 80% have been in place for at least 3 years (2 years on remining areas) on each acre on which trees/shrubs are to be planted.

Recreation

- Minimum of 600 trees/shrubs planted per affected acre (or stems when direct seeded) for Phase II release.

- Minimum of 250 trees/shrubs surviving per affected acre of which 80% have been in place for at least 3 years for Phase Ill release. (2 years for remining reduced maintenance areas)
- Ground cover for release in tree planning areas: Phase II- 30%, Phase III- 70%, ground cover for release purposes includes the herbaceous vegetation and the tree/shrub canopies.

Riparian

Where avoidance is not possible, the permittee must restore the riparian vegetation. The Buffer Zone Variance Request (BZVR) should detail the species to be planted, methods to be employed, and the area to be planted. The riparian planting plan must include at least four species and no more than 25 percent of any individual species may be included in the planting mixture. See *Ohio Stream Management Guide No. 07: Restoring Streambanks with Vegetation*.

Woody species plantings must be in rows spaced 8 feet apart with an 8 foot spacing between seedlings/cuttings which would equate to 681 stems per acre. In general, for areas where all or substantial amounts of existing riparian vegetation will be removed, a minimum width along affected portions of the stream must be planted. The minimum riparian planting width is a distance of two and one half times the channel bottom width or 50 feet on each side of the stream, whichever is greater.

In order to increase the survival and growth of the riparian planting, it is recommended that resoiled areas to be planted with riparian vegetation be lightly compacted or ripped. To meet stream and habitat restoration criteria, success standards on riparian plantings may be required by other agencies.

Riparian vegetation must be properly planted and the Verification of Proper Planting of Tree Seedlings/Posts form must be submitted to the inspector prior to a Phase II release.

Vegetation does not need to be re-established in areas that did not contain riparian vegetation pre-mining (i.e. roads, structures, land uses of cropland, industrial, commercial, etc.)

Wetland

- 600 trees planted per acre for Phase II

  In order to increase the survival and growth of the wetland planting, it is recommended that resoiled areas to be planted with riparian vegetation be lightly compacted or ripped. To meet stream and habitat restoration criteria, success standards on riparian plantings may be required by other agencies.

Wetland vegetation must be properly planted and the Verification of Proper Planting of Tree Seedlings/Posts form must be submitted to the inspector prior to a Phase II release.

Bat Enhancement

- 600 trees per acre planted for Phase II (except for undeveloped land use)
- Undeveloped land use 600 trees per acre planted prior to Phase III release
- When maintenance period expires 300 trees/shrubs per acre surviving for Phase III release (2 year maintenance period for remining areas)

Reforestation planting plans must include a minimum of six different tree species. Species selection should be determined by site-specific characteristics (soil moisture, sun exposure, etc.) and seedling availability. Trees must be planted at a minimum density of 600 stems per acre (8 x 8 foot spacing). A minimum of four species identified as Exfoliating Bark Species must be planted and equal at least 40 percent of the minimum stems per acre required for final bond release. The applicant may select the remaining 60 percent of the minimum stems per acre from any of the tree categories listed in the species list. Each of the selected tree species should be planted at approximately equal rates. Tree survival at the time of final bond release must meet the minimum state-specific program requirement for the corresponding land use, and cannot be less than 300 stems per acre (even if the Post Mining Land Use (PMLU) requires less; i.e., undeveloped land). Low compaction grading techniques, such as those encouraged by the Forestry Reclamation Approach (FRA), are recommended to increase the survival rate of planted trees/shrubs. The applicant must demonstrate in the Protection and Enhancement Plan how they plan to minimize compaction to encourage tree growth and survival (e.g., FRA, soil ripping).

Pollinators

DMRM recommends the use of plants that provide habitat for pollinators. It is estimated that animal pollinators are needed for the reproduction of 90% of flowering plants and one third of human food crops. Each of us depends on these industrious pollinators in a practical way to provide us with the wide range of foods we eat. In addition, pollinators are part of the intricate web that supports the biological diversity in natural ecosystems that helps sustain our quality of life. Abundant and healthy populations of pollinators can improve fruit set and quality, and increase fruit size. In farming situations this increases production per acre. In the wild, biodiversity increases and wildlife food sources increase. It is imperative that we take immediate steps to help pollinator populations thrive. The beauty of the situation is that by supporting pollinators' need for habitat, we support our own needs for food and support diversity in the natural world. For more information on pollinators see the attached document *Selecting Plants for Pollinators*.

Pastureland/Grazingland

DMRM encourages the planting of trees/shrubs to enhance the primary post mining land uses of pasture and grazing land. To facilitate the addition of tree plantings to proposed and existing mining permits, DMRM has adopted the policy that any operator who wishes to include trees in the planting plan for pasture and grazing land may do so by indicating the location and number of trees to be planted in the application or through an ARP. A letter from the property owner agreeing to the tree planting should also be submitted to DMRM. The only measure of compliance will be verification that the correct number of trees is planted per the approved plan. Following tree/shrub planting, a verification form should be submitted to the inspector.

- In an application or ARP, indicate the location and number of trees to be planted.
- Provide a letter or correspondence from the land owner consenting to the tree/shrub planting.
- Submit *Verification of Proper Planting of Tree Seedlings/Posts* form to the inspector following planting.
- There are no tree survival requirements for bond releases on Pastureland or Grazingland.

Remining

- Remining areas have the same requirements as the post mining land uses except the extended period of responsibility is 2 years instead of 5 for a Phase III bond release.
- OAC 1501:13-9-15(O) indicates where survival rates are required, 80% of the trees/shrubs need to be in place for 2 years instead of 3 for final bond release. This survival rate is applicable to tree/shrub plantings on all post mining land uses.

Planting Report

At the time the application is submitted, the mine operator shall indicate the proposed species and quantities to be planted or direct seeded. This list shall be attached to the *Planting Report* form and be included in the permit file. The Planting Report should be submitted to the DMRM inspector following seeding or planting for verification.

Within thirty days of the completion of the tree/shrub planting the *Verification of Proper Planting of Tree Seedlings/Posts* form must be completed and submitted to the inspector.

References/Resources

Appalachian Regional Reforestation Initiative (ARRI) FRA No.3: "Low Compaction Grading to Enhance Reforestation Success on Coal Surface Mines." R. Sweigard et al, July 2007

Appalachian Regional Reforestation Initiative (ARRI) FRA No.6: "Tree-Compatible Ground Covers for Reforestation and Erosion Control." J. Burger et all, July 2009

Direct Seeding of Fine Hardwood Tree Species, Lenny D. Farlee, Proceedings of the Seventh Walnut Council Research Symposium

ODNR Division of Mineral Resources Management

Ohio Stream Management Guide No. 07: Restoring Streambanks with Vegetation

pH Map of Ohio Coal Regions - Adapted from Research Bulletin #1158 by M.M. Larson, 1984, Ohio Agricultural Research and Development Center

Planting Report

Reclamation Herbaceous Cover for Tree/Shrub Planting Spreadsheet

Reclamation Tree/Shrub Species Spreadsheet

Selecting Plants for Pollinators

Verification of Proper Planting of Tree Seedlings/Posts

Appalachian Regional Reforestation Initiative (ARRI)