

Technical Reclamation Memorandum
TRM # 21

Kentucky Natural Resources and Environmental Protection Cabinet
Department for Surface Mining Reclamation and Enforcement

Prepared by: Kentucky Department of Fish and Wildlife Resources and
Kentucky Department of Natural Resources, Division of Forestry and
Kentucky Department for Surface Mining Reclamation and Enforcement

Date: January 6, 1995

Subject: Plant Species, Distribution Patterns, Seeding Rates, and Planting Arrangements
for Revegetation of Mined Lands

Table of Contents

Introduction	3
General Considerations in Species Selection, Distribution Patterns and Planting Arrangements.....	3
Planting Patterns Beneficial to Wildlife	5
Appendix A - Required Tree and Shrub Species for Wildlife Habitat	8
Appendix B - Plant Species and Characteristics for Revegetation	11
Herbs	11
Trees.....	12
Shrubs	12
List of Plant Species Recommended for Revegetating Surface Coal Mined Lands in Kentucky (Tables B1.1 through B1.8).....	13
Some Characteristics of Herbaceous Plants Suitable for Revegetating Surface Coal Mined Lands for Wildlife (Tables B2.1 through B2.3)	20
Suggested Herbaceous Mixtures for Wildlife Habitat and Erosion Control (Tables B3.1A through B3.4B).	22
Some Basic Requirements of Trees Suitable for Revegetating Surface Coal Mined Lands (Tables B4.1A through B4.1B)	26
Some Basic Requirements of Shrubs Suitable for Revegetation Surface Coal Mined Lands. (Table B5.1)	27
Appendix C - Optional Selection of Tree and Shrub Species for Non-commercial (Unmanaged) Forest Land (Tables C1 through C4)	29
Appendix D - Literature Cited	32

Introduction

This document is incorporated by reference in administrative regulations 405 KAR 16:200 and 18:200 relating to revegetation of minesites. Those administrative regulations require that, except for cropland, selection of species, distribution patterns, seeding rates, and planting arrangements shall be approved case-by-case by the cabinet based upon those administrative regulations and this document. With primary emphasis on plant species that have value for wildlife, this document relates to these and other regulatory requirements mentioned below and does not attempt to address all possible aspects of revegetation.

Use of species listed in Appendix A (Tables A1 through A3), or other species recommended by the Kentucky Department of Fish and Wildlife Resources for the permit area based upon site-specific considerations, is required by Section 6(2)(b) of 405 KAR 16:200 and 18:200 for areas where trees or shrubs are planted to create wildlife habitat. This requirement applies not only where the postmining land use is fish and wildlife but also applies wherever wildlife habitat is created to enhance fish and wildlife on other postmining land uses. The administrative regulations establish minimum numbers of species that must be selected from each of the three groups: hard mast producers, conifers, shrubs and soft mast producers.

Appendix B provides several categories of information on plant species that are generally suited to reclamation of minesites and have value to wildlife. Tables B1.1 through B1.8 indicate the value of various plant species to wildlife as cover and food. Tables B1.1 through B1.8 also identify plant species that are suitable as wetland species. In response to Section 6(1)(b) of 405 KAR 16:200 and 18:200, Tables B1.6 and B1.7 further identify tree species that are considered to have good to excellent commercial value as timber. Tables B2.1 through B2.3 summarize for various herbaceous species the lower soil pH limit, whether warm or cool growth season, and whether annual or perennial in duration. Tables B3.1A through B3.4B list herbaceous mixtures for wildlife habitat and erosion control, and their recommended seeding rates and planting dates. Tables B4.1A and B4.1B summarize for certain tree species the lower soil pH limit, shade tolerance, and maximum elevation. Table B5.1 summarizes for certain shrub species the lower soil pH limit, shade tolerance, time to produce fruit or seeds, and the months when fruit or seeds are produced.

Appendix C (Tables C1 through C4) provides an optional plan for tree and shrub selection for non-commercial (unmanaged) forest land. This appendix may be completed and inserted in the permit application, thus providing the permittee flexibility to change his species selection during reclamation without obtaining a permit revision.

General Considerations in Species Selection, Distribution Patterns and Planting Arrangements

Choose an herbaceous cover that corresponds to the time of year that reclamation and seeding will occur and that will be valuable as food and cover for wildlife (Tables B3.1A through B3.4B). In some cases, different seeding mixtures will need to be applied to different areas within a permit boundary, depending on land use considerations, slope steepness, time of year, etc. Special attention must be given to steep slope areas and other areas where stability is critical.

Recommendations concerning plantings in these areas are given in the following section, **"Planting Patterns Beneficial to Wildlife."**

Plant species selection for a given land use can affect bond release. Two species that have been traditionally used for reclamation of mine lands are KY 31 fescue (*Festuca arundinaceae*) and the non-prostrate, interstate variety of sericea lespedeza (*Lespedeza cuneata*). These herbaceous species, though known for their erosion control capability, provide little or no value to wildlife and may even be detrimental, especially when left unmanaged. These species can also increase woody plant mortality through competition.

Regardless of the postmining land use, sowing the above species in seed mixtures that will allow them to become dominants or co-dominants, or use of other highly competitive species or species mixtures that overly inhibit plant succession or impair establishment of vegetative diversity or the achievement of the postmining land use, should be limited to areas where needed to control severe erosion, such as in ephemeral drains, in diversion ditches, and on impoundment embankments. However, some such species may be appropriate for pastureland and cropland, provided that there is an adequate management plan. Where KY fescue is used, a low endophyte variety (less than five (5) percent infected seed) should be seeded except where used for severe erosion areas as set forth above.

The natural occurrence of such species after reclamation will be acceptable if it was demonstrated in the permit application that such species were common within the permit area prior to mining and if the premining soil medium (rather than a topsoil substitute) was used as the vegetative growth medium and provided that the occurrence of the species does not interfere with achievement of the approved postmining land use.

Of particular significance to wildlife is the establishment of woody species. Whenever practicable, plant strips of shrubs and/or trees around the entire perimeter of the site at a stocking density required under 405 KAR 16:200 and 18:200. These strips should be at least 50 feet wide. Tables B1.6 through B1.8 list tree and shrub species recommended for mine reclamation. Preference should be given to mast or seed producing species.

Some sites may have several postmining land uses. If such is the case, whenever practicable, completely surround each different land use unit with a shrub and/or tree strip as discussed above.

Contour mines and underground mines developed in upland forests that disturb less than 20 acres may actually enhance wildlife habitat without planting canopy producing species. Establishment of a variety of shrubs in strips or clumps and herbaceous vegetation that provide food and cover for wildlife may sufficiently enhance the area by increasing "edge" and creating interspersions. By the same token, sites with little forest land adjacent to the permit boundary can be greatly enhanced if a large percent of the mined area is planted with trees.

Unless contrary to the postmining land use, a strip of wet site trees or shrubs should be planted along the shoreline of planned permanent impoundments; however, trees and shrubs must not be planted on embankments or near the toe of an embankment. Breaks will need to be provided along this vegetative strip to allow access by wildlife, and any barriers that may prevent wildlife passage to the pond will need to be removed.

When woody plants are to be stocked within the permit area, the permittee will need to incorporate management techniques to ensure the highest possible survival rate at the time of bond release. Even under good conditions, a high percentage of new seedlings can be lost through natural mortality (drought, disease, animal damage, etc.).

Soil degradation, which is attendant to almost any type of land disturbance, can impair seedling survival. Therefore, it will be advantageous to seed or plant a higher number of plants than the desired density to help ensure successful stocking. It may be beneficial to rip areas to be planted in trees to a depth of 50 to 80 cm if soil compaction is a problem (Torbert et al., 1986).

Ground cover can greatly affect woody plant survival. Competition between woody plants and herbaceous species will occur if the ground cover is too thick or too high. Therefore, it is advantageous to stock woody plants as soon as possible, before ground cover has had time to become well established. Spot application of herbicides may also be necessary to curb this competition in areas where woody plants are grown. Furthermore, the use of some species should be restricted around tree and shrub plantings because of their competitive nature. See Table B3.4B for a recommended ground cover seeding mixture for areas to be stocked with trees or shrubs.

For compatibility with plant and wildlife species in the vicinity of the permit area, consideration should be given to use of native plant species for revegetation, where practicable.

Planting Patterns Beneficial to Wildlife

The arrangement of vegetation plantings on a postmining site is critical to its future productivity for wildlife. High quality wildlife habitat can be created by providing an interspersed variety of habitat types, such as a mosaic of shrubby areas, woodlands, and grass/legume areas that furnish an abundance of "edges" between vegetation types. Also crucial to this concept is plant species diversity within a given habitat. Generally, plantings that provide a mixture of plant species supplying either food or cover, or both, will be most beneficial. In short, the principal keys to potential wildlife productivity on a site are plant species selection and habitat diversity.

Revegetated mine sites can be improved for wildlife with alternating plantings of herbs, trees, and/or shrubs rather than solid plantings. For example, where re-mining of previously mined areas leaves a highwall, bench, and downslope, a basic planting could be as follows: plant two or three rows of conifers and one or two rows of hardwoods in front of the highwall, which would eventually screen the highwall; plant the bench with alternating strips or blocks of herbaceous species and shrubs; plant the edge of the bench adjacent to the downslope with a few rows of conifers; and plant the downslope with herbs and woody plants. Again, strip plantings on the downslope are more desirable (Rafaill and Vogel, 1978).

Steep slopes should be planted in alternating woody strips and herbaceous cover species that will provide quick erosion control. Steep backfill areas and highwalls may inhibit the movement of some wildlife. It is recommended that access points be provided along any highwalls left by remaining operations to allow wildlife to travel freely between newly revegetated areas and undisturbed areas.

Strip plantings of grass/legume mixtures 100 - 150 feet wide alternating with strips of shrubs and/or trees 30 - 50 feet wide is a useful pattern on expansive sites. For smaller areas, the widths of vegetative strips can be proportionally decreased. On cuts less than 100 feet wide, a narrow row of woody vegetation or randomly spaced clumps of woody species may create sufficient diversity. Open areas seeded to grass/legume mixtures must be at least one-half acre in size. Such openings can be created by seeding old roadways.

For single cut contour mining, habitat diversity can be achieved by using bands of different types of vegetation. Diversity can be attained by utilizing plants with differing physical and biological characteristics such as growth forms, foliage retention, and fruit retaining dates. In the case of multiple seam contour operations, a different revegetation plan can be implemented on each contour to diversify the site.

Similar planting patterns can also be incorporated into specific postmining land uses to enhance wildlife habitat. Where extensive areas are to be revegetated for pasture or hay, diversity can be increased by planting strips of shrubs such as amur privet, autumn olive, or bicolor lespedeza, or native shrubs such as dogwood, wild plum, or viburnum. These plantings can also serve as woodland/field borders at the edge of pastures or cropland.

Shrubs can be useful as hedges and natural fences, extending within future crop fields or along crop field and pasture boundaries. These hedges and fences usually consist of one or two rows of shrubs laid out on the contour. Two or three rows of pines planted along one side of a single row of autumn olive, rugosa rose, or native shrubs such as bayberry, can provide an effective windbreak for pastures or cropland and important nesting, escape, and winter cover for wildlife. One to ten rows of trees and shrubs planted at right angles to the direction of the prevailing winds will also serve as windbreaks and cover for wildlife. Scattered clump plantings of trees and shrubs in an open field may also provide needed food and cover.

Random planting patterns may create gaps in cover that some wildlife species are unwilling to cross. Therefore, properly placed travel corridors will further enhance wildlife habitat on a postmining site. These can be developed in large areas of open habitat by establishing one row of a dense growing shrub, such as bristly locust, or two rows of thinner shrubs, such as autumn olive, bicolor lespedeza, or native shrubs such as wild plum or dogwood. These row plantings provide travel corridors for many ground dwelling birds and mammals. Particularly important are travel corridors to and from water sources, which encourage animals to use the water features.

Christmas tree plantations can be established in a manner that will also benefit wildlife. Proper planning and management will provide harvesting on a continuous rotating basis. In this way part of the understory remains unshaded where vegetational variety can be developed. A double row (six feet apart) or single row of shrubs bordering a conifer plantation will further improve the wildlife value of the area.

Mixed forest stands are more beneficial to wildlife than single species plantings. Planting blocks of conifers within mixed hardwood plantations increases the diversity of food and cover available for wildlife. Hardwood stands may be separated from coniferous rows by grass/legume strips to provide more "edge." Hardwood timber lots will also be more desirable to wildlife if provided with a double or single shrub row border about 40 feet from the edge of the woods. Unless established strictly for commercial purposes, coniferous plantings should include at least 20 percent hardwoods. In selecting hardwoods, preference should be given to mast and fruit producing species.

Food plots can also be planted to benefit wildlife but cannot serve as substitutes for permanent food-bearing plants. A food plot is a patch of plants set aside for wildlife consumption. These plots should be at least one-eighth acre in size. Generally, one-eighth to one-half acre plots with one patch per 100 acres is sufficient. Long, narrow food patches adjacent to cover are best.

Plant communities change with time, through vegetative succession. For example, trees and shrubs gradually begin to invade pastures that have not been managed in recent years. The same is true with mined land. Areas planted as grasslands should slowly evolve into young forests if abandoned after bond release. If the landowner or operator desires to counteract this natural process, then maintenance procedures may be necessary. Cutting, disking, or controlled burning may be necessary to prevent open areas from becoming overgrown. Recommendations for the best habitat maintenance procedures may be obtained from biologists, foresters or associated professionals.

As discussed earlier, pond areas are very beneficial to wildlife. Unless contrary to the postmining land use (e.g., ponds retained strictly for livestock), pond borders will need to be planted with wet site tree and shrub species, as previously mentioned. The creation of artificial wetlands will also enhance wildlife usage of an area. Wet site species and a recommended seeding mixture for such areas are listed in Tables B1.1 through B1.8, B3.4A and B3.4B, respectively.

Appendix A - Required Tree and Shrub Species for Wildlife Habitat

Use of species listed in this appendix, or other species recommended by the Kentucky Department of Fish and Wildlife Resources for the permit area based upon site-specific considerations, is required by Section 6(2)(b) of 405 KAR 16:200 and 18:200 for areas where trees or shrubs are planted to create wildlife habitat. This requirement applies not only where the postmining land use is fish and wildlife but also applies wherever wildlife habitat is created to enhance fish and wildlife on other postmining land uses.

Table A1 - Hard Mast Producers

Common Name	Species Name
Mockernut hickory	<i>Carya alba</i>
Bitternut hickory	<i>Carya cordiformis</i>
Pignut hickory	<i>Carya glabra</i>
Native Pecan	<i>Carya illinoensis</i>
Shellbark hickory	<i>Carya laciniata</i>
Shagbark hickory	<i>Carya ovata</i>
Black Walnut	<i>Juglans nigra</i>
Sawtooth oak	<i>Quercus acutissima</i>
White oak	<i>Quercus alba</i>
Swamp White oak	<i>Quercus bicolor</i>
Scarlet oak	<i>Quercus coccinea</i>
Southern Red oak	<i>Quercus falcata</i>
Shingle oak	<i>Quercus imbricaria</i>
Overcup oak	<i>Quercus lyrata</i>
Bur oak	<i>Quercus macrocarpa</i>
Black Jack oak	<i>Quercus marilandica</i>
Swamp Chestnut oak	<i>Quercus michauxii</i>
Chinquapin oak	<i>Quercus muehlenbergii</i>
Cherrybark oak	<i>Quercus pagoda</i>
Pin oak	<i>Quercus palustris</i>
Willow oak	<i>Quercus phellos</i>
Chestnut oak	<i>Quercus prinus</i>
Northern Red oak	<i>Quercus rubra</i>
Shumard oak	<i>Quercus shumardii</i>
Post oak	<i>Quercus velutina</i>
Black oak	<i>Quercus stellata</i>

Table A2 - Conifers

Common Name	Species Name
Eastern red cedar	<i>Juniperus virginiana</i>
Shortleaf pine	<i>Pinus echinata</i>
Pitch pine	<i>Pinus rigida</i>
Eastern white pine	<i>Pinus strobus</i>
Virginia pine	<i>Pinus virginiana</i>

Table A3 - Shrubs and Soft Mast Producers

Common Name	Species Name
Red maple	<i>Acer rubrum</i>
Sugar maple	<i>Acer saccharum</i>
Common alder	<i>Alnus serrulata</i>
Serviceberry	<i>Amelanchier arborea</i>
Pawpaw	<i>Asimina triloba</i>
American Hornbeam	<i>Carpinus caroliniana</i>
Sugarberry	<i>Celtis laevigata</i>
Butttonbush	<i>Cephalanthus occidentalis</i>
Redbud	<i>Cercis canadensis</i>
Alternate-leaf Dogwood	<i>Cornus alternifolia</i>
Silky Dogwood	<i>Cornus amomum</i>
Flowering Dogwood	<i>Cornus florida</i>
Gray Dogwood	<i>Cornus racemosa</i>
American Hazelnut	<i>Corylus americana</i>
Hawthorn species	<i>Crataegus</i> spp. (native species only)
Persimmon	<i>Diospyros virginiana</i>
Autumn Olive	<i>Elaeagnus umbellata</i>
Burning Bush	<i>Euonymus atropurpureus</i>
White ash	<i>Fraxinus americana</i>
Green ash	<i>Fraxinus pennsylvanica</i>
Bicolor lespedeza	<i>Lespedeza bicolor</i>
Spicebush	<i>Lindera benzoin</i>
Red mulberry	<i>Morus rubra</i>
Wild Plum	<i>Prunus americana</i>

Common Name	Species Name
Chicksaw Plum	<i>Prunus angustifolia</i>
Wild Black cherry	<i>Prunus serotina</i>
Common chokecherry	<i>Prunus virginiana</i>
Crabapple species	<i>Pyrus</i> spp. (native species only)
Shining or Winged sumac	<i>Rhus copallinum</i>
Smooth sumac	<i>Rhus glabra</i>
Staghorn sumac	<i>Rhus hirta</i>
Blackberry	<i>Rubus allegheniensis</i>
American Elder	<i>Sambucus canadensis</i>
Sassafras	<i>Sassafras albidum</i>
Steeple Bush	<i>Spiraea tomentosa</i>
Lowbush Blueberry	<i>Vaccubium</i> spp.
Viburnum species	<i>Viburnum</i> spp. (native species only)

Appendix B - Plant Species and Characteristics for Revegetation

Information in this Appendix is either taken verbatim or adapted from the following publication: Raffaelli, B, L, and W. G. Vogel. 1978. ***A Guide for Vegetating Surface Mined Lands for Wildlife in Eastern Kentucky and West Virginia***, U.S. Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C. Publication Number. FWS 14-16-0009-77-923. 89 pages.

Typically, the species and seeding mixtures given in this appendix (Tables B1.1 through B5.1) should be used; however, alternative species and mixtures can be considered if demonstrated to the cabinet, on a case-by-case basis, to be more desirable for achieving the postmining land use and for controlling erosion.

The species recommended in the following paragraphs and tables have differing values to wildlife. Information given in Tables B1.1 through B1.8 summarize the values of those plant species to the wildlife species which utilize them. In general, plant species choices in reclamation plantings must provide a mixture of species which supply either food, cover, or both. Other important considerations in choosing plant species are tolerance to sunlight, or the lack of it, and pH of the soil where planting is to occur (explained in the notes below Tables B4.1A/B and B5.1).

The basic components of reclamation plantings are herbs, shrubs, and trees, which are discussed in the following paragraphs.

Herbs

Herbaceous plants are of a non-woody type which are used to provide coverage to bare or disturbed soil and thus prevent erosion and stabilize the area. They are classified as forbs or grasses. Many of the forbs are legumes which fix atmospheric nitrogen and make it available to other plants. Many herbaceous plants are important food sources for wildlife and also supply needed cover (see Tables B1.1 through B1.5).

Herbaceous plants are either annual, biennial, or perennial. Some species that are well suited to use on strip mined lands are given in Tables B2.1 through B2.3. Annuals are perhaps the most effective species to plant for quick cover because they rapidly establish vegetative growth, flower, and die within a single growing season. Annuals reproduce only from the seed they produce. Some species such as Kobe and Korean lespedeza naturally regenerate a stand from these seeds, but most do not. Biennials establish themselves the first year, flower and produce seed the second year and then die. Perennial plants normally live three years or longer, die back each year, and produce seed crops annually for life.

Also given in Tables B2.1 through B2.3 are pH limits and growth seasonality. Cool season species grow mostly in the spring and fall but are nearly dormant or grow poorly in the summer. Warm season species grow during late spring and summer and are dormant in early spring and fall. All are dormant in the winter. Generally, stands of cool season species can be established from either spring or fall seedings.

Herbaceous plantings constitute the basic element of soil stability on reclaimed sites. Since they are the basic element of stability, they will also be the basic element of wildlife habitat on the reclaimed site. Mixtures of herbaceous plants that are of particular value to wildlife are given in Tables B3.1A through B3.4B. As previously recommended in this document, all herbaceous mixtures should come from the listings in Tables B3.1A through B3.4B and be applied within the times specified.

Trees

Trees are woody plants which generally have but one main stem arising from ground level. They provide food for wildlife in the form of seeds or mast, have value as wildlife cover, and provide erosion control on outcrops when planted with herbaceous species. Some species which are adaptable to use on strip mined lands are given in Tables B4.1A and B4.1B .

The recommended trees can be subdivided into hardwoods and softwoods, or conifers. Hardwoods are deciduous, or drop their leaves each fall, and generally produce seed or mast crops which supply food to wildlife (Table B1.7). Softwoods, or conifers, are generally evergreen and are particularly valuable as cover for wildlife (Table B1.6).

Shrubs

Shrubs are woody plants with few to many stems arising from ground level. They usually are smaller than most trees and are extremely valuable sources of wildlife cover and food. Some shrubs are also useful for controlling soil erosion and can be utilized for screening and windbreaks for cropland. When properly planted and managed, some species such as amur privet form natural fence rows or field borders. Some shrub species that are adaptable to use on strip mined lands are given in Tables B4.1A and B4.1B.

When planting to support wildlife populations, it is helpful to know how soon food supplies will be produced. The average time that it takes for the recommended shrubs to begin seed production is shown in Tables B5.1A and B5.1B. Many shrubs are important food sources for wildlife and also supply needed cover (Table B1.8).

List of Plant Species Recommended for Revegetating Surface Coal Mined Lands in Kentucky (Tables B1.1 through B1.8)

Table B1.1 - Herbs (Perennial Grasses)

Plant	Species Name	Wildlife Usage	Wetland Species
Bahiagrass	<i>Paspalm notatum</i>	Seed, Herbage, Cover	Yes
Barnyard grass, Wild millet	<i>Echinochloa</i> spp.	Cover, Herbage, Seed	Yes
Bentgrass	<i>Agrostis</i> spp.	Cover, Herbage, Seed	No
Bermuda grass	<i>Cynodon dactylon</i>	Herbage, Seed	No
Blue grama	<i>Bouteloua gracilis</i>	Herbage, Seed, Cover	No
Bluegrass (Kentucky, Canada)	<i>Poa</i> spp.	Herbage, Seed	No
Bluestems	<i>Andropogon</i> (except annual), <i>Bothriochloa</i> , <i>Schizachyrium</i> . spp.	Cover, Herbage, Seed	No
Bromegrass	<i>Bromus</i> spp.	Cover, Herbage, Seed	No
Buffalograss	<i>Buckloe dactyloides</i>	Herbage, Cover, Seed	No
Cordgrass	<i>Spartins</i> spp.	Cover, Herbage, Seed	Yes
Cutgrass	<i>Leersia</i> spp.	Cover, Herbage	Yes
Dallisgrass	<i>Paspalm dilatatum</i>	Seed, Herbage, Cover	No
Deertongue	<i>Panicum cladestinum</i>	Herbage, Seed, Cover	Yes
Eastern gammagrass	<i>Tripsacum dactyloides</i>	Herbage, Seed, Cover	Yes
Indian grass	<i>Sorghastrum nutans</i>	Cover, Herbage, Seed	No
Nutsedge,	<i>Chufa Cyperus</i> spp.	Cover, Herbage	Yes
Oats (after April 15)	<i>Avena sativa</i>	Seed, Herbage	No
Orchardgrass	<i>Dactylis glomerata</i>	Herbage, Seed, Cover	No
Perennial ryegrass	<i>Lolium perenne</i>	Herbage, Seed	No
Red fescue (E. KY only)	<i>Festuca rubra</i>	Herbage, Seed, Cover	No
Redtop	<i>Agrostis alba</i>	Cover, Herbage, Seed	Yes
Reed canarygrass	<i>Phalaris arundacea</i>	Cover, Seed, Herbage	Yes
Reedgrass	<i>Phragmites australis</i>	Cover, Seed, Herbage	Yes
Rye	<i>Secale cereale</i>	Seed, Herbage	No
Sideoats grama	<i>Bouteloua curtipendula</i>	Herbage, Seed, Cover	No

Plant	Species Name	Wildlife Usage	Wetland Species
Switchgrass	<i>Panicum virgatum</i>	Cover, Seed, Herbage	Yes
Tall oatgrass	<i>Arrhenatherum elatius</i>	Herbage, Seed, Cover	No
Timothy	<i>Phlenm pratense</i>	Seed, Herbage	No
Wheat grass	<i>Agropyron spp.</i>	Herbage, Seed, Cover	No

Table B1.2 - Herbs (Annual grasses)

Plant	Species Name	Wildlife Usage	Wetland Species
Annual ryegrass	<i>Lolium multiflorum</i>	Herbage, Seed	No
Foxtail millet.	<i>Setaria italica</i>	Seed	No
Japanese millet	<i>Echinochloa spp.</i>	Seed	Yes
Oats (<i>before April 15</i>)	<i>Avena sativa</i>	Seed, Herbage	No
Pearl millet	<i>Pennisetum glaucum</i>	Seed	No
Proso (Broomcorn) millet	<i>Panicum milaceum</i>	Herbage, Seed, Cover	Yes
Rye (<i>before April 15</i>)	<i>Secale cereale</i>	Seed, Herbage	No
Sorghams	<i>Sorgham spp.</i>	Seed	No
Sudangrass	<i>Sorgham sudanense</i>	Seed	No
Weeping lovegrass	<i>Eragrostis curvula</i>	Cover, Herbage, Seed	Yes
Winter wheat	<i>Triticum aestivum</i>	Seed, Herbage	No

Table B1.3-Herbs (Perennial legumes)

Plant	Species Name	Wildlife Usage	Wetland Species
Alfalfa Medicago	<i>Medicago spp.</i>	Herbage, Seed, Cover	No
Alsike clover	<i>Trifolium hybridum</i>	Herbage, Seed	Yes
Appalow lespedeza	<i>Lespedeza cuneata</i> cv. Appalow	Cover, Seed, Herbage	No
Birdsfoot trefoil	<i>Lotus corniculatus</i>	Herbage, Cover	No
Crimson clover	<i>Trifolium incarnatum</i>	Herbage, Seed	No
Hop clover	<i>Trifolium spp.</i>	Herbage, Seed	No
Kura clover	<i>Trifolium spp.</i>	Herbage, Seed	No
Red clover (<i>biennial /short-lived perennial</i>)	<i>T. pratense</i>	Herbage, Seed	No
White, Ladino clover	<i>Trifolium repens</i>	Seed, Herbage	No

Plant	Species Name	Wildlife Usage	Wetland Species
Zig-zag clover	<i>Trifolium</i> spp.	Herbage, Seed	No

Table B1.4 - Herbs (Annual legumes)

Plant	Species Name	Wildlife Usage	Wetland Species
Big flower vetch	<i>Vicia grandiflora</i>	Herbage, Seed, Cover	No
Common (Kobe) (<i>good seeder</i>)	<i>Lespedeza striata</i>	Seed, Herbage	Yes
Cowpea (Black-eyed pea)	<i>Vigna unguiculata</i>	Seed, Herbage	No
Hairy vetch	<i>Vicia villosa</i>	Herbage, Seed, Cover	No
Korean lespedeza (<i>good seeder</i>)	<i>L. stipulacae</i>	Seed	No
Partridge pea	<i>Cassia fasciculata</i>	Seed	No
Soybean	<i>Glycine max</i>	Seed, Herbage	No

Table B1.5 - Herbs (Non-legumous forbs)

Plant	Species Name	Wildlife Usage	Wetland Species
Buckwheat	<i>Fagopyrum esculentum</i>	Seed, Herbage	Yes
Lupine	<i>Lupinus</i> spp.	Seed, Herbage	No
Sunflower	<i>Helianthus annuus</i>	Seed	Yes
Sweetflag	<i>Acorus calamus</i>	Cover	Yes

Table B1.6 - Woody plants (Trees-Evergreens)

Plant	Species Name	Wildlife Usage	Wetland Species	Commercial Value
Eastern redcedar	<i>Juniperus virginiana</i>	Cover, Seed, Browse	No	Minimal
Eastern white pine	<i>Pinus strobus</i>	Cover, Seed, Browse	No	Good to Excellent
Larch	<i>Larix leptolepis</i>	Cover, Seed, Browse	Yes	Minimal
Loblolly pine	<i>Pinus taeda</i>	Cover, Seed, Browse	No	Good to Excellent
Mugho pine	<i>Pinus mugo mughus</i>	Cover, Seed, Browse	No	Minimal

Plant	Species Name	Wildlife Usage	Wetland Species	Commercial Value
Pitch pine	<i>Pinus rigida</i>	Cover, Seed, Browse	No	Good to Excellent
Pitch X Loblolly hybrid	<i>Pinus rigida X taeda</i>	Cover, Seed, Browse	No	Good to Excellent
Red pine	<i>Pinus resinosa</i>	Cover, Seed, Browse	No	Good to Excellent
Scotch pine	<i>Pinus sylvestris</i>	Cover, Seed, Browse	No	Valuable for Christmas Tree Plantations
Shortleaf (Yellow) pine	<i>Pinus echinata</i>	Cover, Seed, Browse	No	Good to Excellent
Spruces	<i>Picea spp.</i>	Cover, Seed, Browse	No	Valuable for Christmas Tree Plantations
Virginia pine	<i>Pinus virginiana</i>	Cover, Seed, Browse	No	Good to Excellent

Table B1.7 - Woody plants (Trees-Deciduous)

Plant	Species Name	Wildlife Usage	Wetland Species	Commercial Value
Aspen (Bigtooth, Quaking)	<i>Populus spp.</i>	Browse, Cover	No	Minimal
American beech	<i>Fagus grandifolia</i>	Mast, Browse, Cover	No	Good to Excellent
American sycamore	<i>Plantanus occidentalis</i>	Seed, Browse	Yes	Good to Excellent
Baldcypress	<i>Taxodium distichum</i>	Cover, Seed, Browse	Yes	Good to Excellent
Black cherry (E. KY only)	<i>Prunus serotina</i>	Fruit, Browse, Cover	No	Good to Excellent
Black locust	<i>Robina pseudoacacia</i>	Seed, Cover, Browse	No	Minimal
Black maple	<i>Acer nigrum</i>	Seed, Browse	No	Good to Excellent

Plant	Species Name	Wildlife Usage	Wetland Species	Commercial Value
Black walnut	<i>Juglans nigra</i>	Mast, Browse, Cover	No	Good to Excellent
Black willow	<i>Salix nigra</i>	Browse, Cover	Yes	Minimal
Bur oak	<i>Quercus macrocarpa</i>	Mast, Browse, Cover	No	Good to Excellent
Chestnut oak	<i>Quercus prinus</i>	Mast, Browse, Cover	No	Good to Excellent
Chinese chestnut	<i>Castanea mollissima</i> spp.	Mast, Browse	No	Minimal
Crab apple	<i>Malus</i> spp.	Fruit, Cover, Browse	No	Minimal
Eastern cottonwood (W. KY only)	<i>Populus deltoides</i>	Browse, Cover	Yes	Good to Excellent
European black alder	<i>Alnus glutinosa</i>	Cover, Seed, Browse	Yes	Minimal
Flowering dogwood	<i>Cornus florida</i>	Fruit, Browse, Cover	No	Minimal
Green ash	<i>Fraxinus pennsylvanica</i>	Seed, Browse	Yes	Good to Excellent
Hickory	<i>Carya</i> spp.	Mast, Browse, Cover	Yes (Shellbark Hickory)	Good to Excellent
Honey locust	<i>Gledista triacanthos</i>	Seed, Cover, Browse	No	Minimal
Northern red oak	<i>Quercus rubra</i>	Mast, Browse, Cover	No	Good to Excellent
Osage-orange (Hedge apple) (W. KY only)	<i>M. pomifera</i>	Fruit, Browse, Cover	No	Minimal
Pin oak	<i>Quercus palustris</i>	Mast, Browse, Cover	Yes	Minimal
Red maple	<i>Acer rubrum</i>	Seed, Browse	Yes	Good to Excellent
River birch	<i>Betula nigra</i>	Browse, Seed, Cover	Yes	Minimal
Russian olive	<i>Elaeagnus angustifolia</i>	Fruit, Cover	No	Minimal
Sassafras	<i>Sassafras albidum</i>	Browse, Seed, Cover	No	Minimal
Sawtooth oak	<i>Quercus</i> spp.	Mast, Browse, Cover	No	Minimal
Scarlet oak	<i>Quercus coccinea</i>	Mast, Browse, Cover	No	Minimal
Silver maple	<i>Acer saccharinum</i>	Seed, Browse	Yes	Good to Excellent

Plant	Species Name	Wildlife Usage	Wetland Species	Commercial Value
Sourwood	<i>Oxydendrum arboreum</i>	Seed, Browse	No	Minimal
Southern red oak	<i>Quercus pagoda</i>	Mast, Browse, Cover	No	Good to Excellent
Sugar maple (W. KY only)	<i>Acer saccharum</i>	Seed, Browse	Yes	Good to Excellent
Sweet birch	<i>Betula lenta</i>	Browse, Seed, Cover	No	Good to Excellent
Sweetgum	<i>Liquidambar styraciflua</i>	Seed, Cover	Yes	Good to Excellent
Sycamore	<i>Plantanus occidentalis</i>	Seed, Cover	Yes	Good to Excellent
Tulip, yellow, hybrid poplars	<i>Liriodendron spp.</i>	Seed, Browse	No	Good to Excellent
White ash	<i>Fraxinus americana</i>	Seed, Browse	No	Good to Excellent
White oak	<i>Quercus alba</i>	Mast, Browse, Cover	No	Good to Excellent
Willow	<i>Salix spp.</i>	Browse, Cover	Yes	Minimal

Table B1.8 - Woody plants (Shrubs)

Plant	Species Name	Wildlife Usage	Wetland Species
American elder	<i>Sambucus canadensis</i>	Cover, Seed, Browse	No
Amur privet	<i>Ligustrum amurense</i>	Fruit, Cover	No
Arrowwood, Cranberry	<i>Viburnum spp.</i>	Fruit, Browse, Cover	No
Autumn olive	<i>Elaeagnus umbellata</i>	Fruit, Browse, Cover	No
Bayberry	<i>Myrica pennsylvanica</i>	Fruit, Browse, Cover	No
Bicolor lespedeza	<i>Lespedeza bicolor</i>	Seed, Herbage, Cover	No
Bristly locust	<i>Robina fertilis</i>	Cover, Seed	No
Chokecherry	<i>Prunus virginiana</i>	Fruit, Browse, Cover	No
Coralberry	<i>Symphoricarpos orbiculatus</i>	Fruit, Browse, Cover	No
Fragrant sumac (E. KY only)	<i>Rhus aromatica</i>	Fruit, Browse, Cover	No

Plant	Species Name	Wildlife Usage	Wetland Species
Gray dogwood	<i>Camus foemina</i>	Fruit, Browse, Cover	Yes
Hawthorne	<i>Crataegus spp.</i>	Cover, Fruit, Browse	No
Indigobush (<i>E. KY only</i>)	<i>Amorpha fruticosa</i>	Cover, Browse, Seed	Yes
Japan lespedeza	<i>Lespedeza japonica</i>	Seed, Herbage, Cover	No
Korean barberry	<i>Berberis koreana</i>	Fruit, Browse, Cover	No
Memorial rose	<i>Rosa wichuraiana</i>	Cover, Fruit, Browse, Seed	No
Morrow honeysuckle	<i>Lonicera morrowii</i>	Fruit, Browse, Cover	No
Purple osier willow	<i>Salix purpurea</i>	Browse, Cover	Yes
Red-osier dogwood	<i>Cornus stolonifera</i>	Fruit, Browse, Cover	Yes
Rose-acacia locust	<i>Robina hispida</i>	Cover, Seed	No
Rugosa rose (<i>E. KY only</i>)	<i>Rosa rugosa</i>	Cover, Fruit, Browse, Seed	No
Serviceberry	<i>Amelanchier laevis</i>	Fruit, Cover, Browse	No
Shining sumac	<i>Rhus copallina</i>	Fruit, Browse, Cover	No
Siberian peashrub	<i>Caragana arborescens</i>	Cover, Browse, Seed	No
Silky dogwood (<i>E. KY only</i>)	<i>Cornus amomum</i>	Fruit, Browse, Cover	Yes
Thunberg lespedeza	<i>Lespedeza thunbergii</i>	Seed, Herbage, Cover	No
Western sandcherry	<i>Prunus bessevi</i>	Fruit, Browse, Cover	No
Wild or American plum	<i>Prunus americana</i>	Fruit, Browse, Cover	No

Wildlife Usage Explanation for Tables B1.1 through B1.8:

- Browse - bark, buds, twigs, small branches, and whole heads of fruit;
- Herbage - herbage or foliage;
- Mast - nuts and acorns (hard mast);
- Fruit - soft mast such as fruit and berries; and
- Seeds - dry fruits, grains, and seeds.

Browse, herbage or foliage, mast, fruit and seed are components of diet used by wildlife species to differing degrees and are arranged in descending order of their overall importance to wildlife.

Some Characteristics of Herbaceous Plants Suitable for Revegetating Surface Coal Mined Lands for Wildlife (Tables B2.1 through B2.3)

Table B2.1 - Grasses

Species	Lower pH Limit	Season <i>(see text for explanation)</i>	Duration <i>(see text for explanation)</i>
Redtop	4.5	Cool	Perennial
Big bluestem	4.5	Warm	Perennial
Little bluestem	4.5	Warm	Perennial
Oats	4.5	Cool	Annual
Bermuda grass	4.0	Warm	Perennial
Orchardgrass	4.5	Cool	Perennial
Japanese millet	4.5	Warm	Annual
Weeping lovegrass	4.0	Warm	Perennial
Annual ryegrass	4.5	Cool	Annual
Perennial ryegrass	4.5	Cool	Perennial
Deertongue	4.0	Warm	Perennial
Proso millet	5.0	Warm	Annual
Switchgrass	4.5	Warm	Perennial
Pearl millet	4.5	Warm	Annual
Reed canarygrass	4.5	Cool	Perennial
Timothy	4.5	Cool	Perennial
Rye	4.5	Cool	Annual
Foxtail millet	4.5	Warm	Annual
German millet	4.5	Warm	Annual
Indian grass	4.5	Warm	Perennial
Grain sorghum	5.0	Warm	Annual
Sudangrass X Sorghum hybrid	4.5	Warm	Annual
Wheat	4.5	Cool	Annual

Table B2.2 - Legumes

Species	Lower pH Limit	Season <i>(see text for explanation)</i>	Duration <i>(see text for explanation)</i>
Partridge pea	5.0	Warm	Annual
Soybean	5.0	Warm	Annual
Korean lespedeza	5.0	Warm	Annual
Common lespedeza	4.5	Warm	Annual
Kobe lespedeza	4.5	Warm	Annual
Birdsfoot trefoil	4.5	Cool <i>(normally planted in spring or fall but will grow in summer)</i>	Perennial
Alfalfa	5.5	Cool <i>(normally planted in spring or fall but will grow in summer)</i>	Perennial
Sweet clover	5.5	Cool	Biennial
Alsike clover	5.0	Cool	Perennial
Red clover	5.0	Cool	Biennial or Perennial
White clover	5.5	Cool	Perennial
Ladino clover	5.5	Cool	Perennial
Hairy vetch	5.5	Cool	Annual
Cowpea	4.5	Warm	Annual

Table B2.3 - Non-Legumous Forbs

Species	Lower pH Limit	Season <i>(see text for explanation)</i>	Duration <i>(see text for explanation)</i>
Buckwheat	4.5	Warm	Annual
Sunflower	5.0	Warm	Annual

***Suggested Herbaceous Mixtures for Wildlife Habitat and Erosion Control
(Tables B3.1A through B3.4B).***

Table B3.1A - Principal Species Mixture 1 for Seeding between February 15 through May 15

Mix Number	Principal Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>
1	Orchardgrass or Timothy	10 (<i>Orchardgrass</i>) 8 (<i>Timothy</i>)
1	White or Ladino clover	2
1	Red clover	6

Table B3.1B - Principal Species Mixture 2 for Seeding between February 15 through May 15

Mix Number	Principal Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>
2	Orchard grass or Timothy	10 (<i>Orchardgrass</i>) 8 (<i>Timothy</i>)
2	White or Ladino clover	2
2	Red clover	6
2	Korean and/or Kobe lespedeza	10

Table B3.1C - Principal Species Mixture 3 for Seeding between February 15 through May 15

Mix Number	Principal Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>
3	Orchard grass or Timothy	10 (<i>Orchardgrass</i>) 8 (<i>Timothy</i>)
3	Birdsfoot trefoil or Alfalfa	8 (<i>Birdsfoot trefoil</i>) 1 (<i>Alfalfa</i>)
3	Red clover	4

Table B3.1D - Principal Species Mixture 4 for Seeding between February 15 through May 15

Mix Number	Principal Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>
4	Wheat or Spring Oats	25 (<i>Wheat</i>) 32 (<i>Spring Oats</i>)
4	Switchgrass	10
4	Indian grass	10
4	Big bluestem	5

Mix Number	Principal Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>
4	Little bluestem	5
4	Birdsfoot trefoil	6

Table B3.1E - Temporary (Quick Cover) Species for Seeding between February 15 and May 15

Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>	Seeding Season
Wheat	30	February 15 to April 15
Spring oats	32	February 15 to April 15
Balbo rye	30	February 15 to April 15
Perennial ryegrass	10	February 15 to May 15
Annual ryegrass	5	February 15 to May 15
Weeping lovegrass	2	April 1 to May 15

Note: Add one of the following species to permanent mixtures I, II, or III. Do not add to Mixture 4. **

Table B3.2A - Principal Species Mixture 1 for Seeding May 15 through August 1

Mix Number	Principal Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>
1	Orchardgrass or Timothy	10 (Orchardgrass) 8 (Timothy)
1	Korean and/or Kobe lespedeza	15
1	Red clover	4
1	White clover or Birdsfoot trefoil	1 (White clover) 6 (Birdsfoot trefoil)
1	Alfalfa	12

Table B3.2B - Temporary Species for Seeding May 15 through August 1

Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>	Seeding Season
Sorghum	20	May 15 to August 1
Foxtail (German) millet	12	May 15 to August 1
Japanese millet	15	May 15 to August 1
Soybeans	40	May 15 to August 1
Cowpeas	40	May 15 to August 1
Pearl millet	10	May 15 to August 1

Add one to the permanent mixture in Table B3.C**

Note: If the perennial legumes or grasses fail to establish from the summer seeding, they can again be sown in late summer (August 15 to September 15) or early the following spring.

Table B3.3A - Principal Species Mixture 1 for Seeding between August 1 through October 1

Mix Number	Principal Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>
1	Orchardgrass or Timothy	10 (Orchardgrass) 8 (Timothy)
1	White or Ladino clover	2
1	Red clover	6

Table B3.3B - Principal Species Mixture 2 for Seeding between August 1 through October 1

Mix Number	Principal Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>
2	Orchardgrass or Timothy	10 (Orchardgrass) 8 (Timothy)
2	Alfalfa or Birdsfoot trefoil	15 (Alfalfa) 8 (Birdsfoot trefoil)
2	Red clover	4

Table B3.3C - Principal Species Mixture 3 for Seeding between August 1 through October 1

Mix Number	Principal Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>
3	Deertongue	12
3	Birdsfoot trefoil	8
3	Red clover	4

Table B3.3D - Temporary Species for Seeding between August 1 through October 1

Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>	Seeding Season
Winter wheat	30	August 1 to October 1
Balbo rye or winter rye	30	August 1 to October 1
Winter oats	32	August 1 to October 1
Perennial ryegrass	10	August 1 to October 1
Annual ryegrass	5	August 1 to October 1

Note: Add **one** to a permanent mixture.**

For Spring or Fall Seeding (February 15 to May 15; or August 1 to October 1)

Table B3.4A - Mixture for Wet or Poorly Drained Areas and Pond Borders

Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>	Seeding Season
Redtop	3	February 15 to May 15 or August 1 to October 1
Reed canarygrass	15	February 15 to May 15 or August 1 to October 1
Alsike clover	6	February 15 to May 15 or August 1 to October 1
Japanese millet (<i>February 15 to May 15 only</i>)	10	February 15 to May 15 or August 1 to October 1
Common annual lespedeza (<i>temporary species</i>)	10	February 15 to May 15 or August 1 to October 1

Table B3.4B - Mixture for Areas to be Stocked with Woody Plants

Species	Seeding Rate* <i>Pounds per acre of Pure Live Seed</i>	Seeding Season
Redtop	3	February 15 to May 15 or August 1 to October 1
Perennial ryegrass	5	February 15 to May 15 or August 1 to October 1
Birdsfoot Trefoil <i>and/or</i> Appalow lespedeza	10 (<i>Birdsfoot Trefoil</i>) 20 (<i>Appalow Lespedeza</i>)	February 15 to May 15 or August 1 to October 1
Foxtail millet (<i>temporary species</i>)	5	February 15 to May 15 or August 1 to October 1

Note: If both Appalow lespedeza and birdsfoot trefoil are used, cut their seeding rate in half.

*Seeding rates are for Pure Live Seed (PLS). Seeding rate of the permanent species can be increased if desired, but **do not exceed** the seeding rate of the temporary species.

**Use only one of the temporary species at the rates shown. If more than one is used, reduce seeding rate of each species according to number of species used; i.e., for two species use one-half seeding rate of each.

Some Basic Requirements of Trees Suitable for Revegetating Surface Coal Mined Lands (Tables B4.1A through B4.1B)

Table B4.1A - Conifer Requirements for Revegetating Surface Coal Mined Lands

Species	Lower pH Limit	Shade Tolerance*	Elevation
Eastern redcedar	5.0	Intolerant	No restrictions
Shortleaf pine	4.0	Intolerant	Below 2,500 feet
Pitch pine	4.0	Intolerant	No restrictions
White pine	4.5	Intermediate	No restrictions
Scotch pine	4.0	Intolerant	No restrictions
Virginia pine	4.0	Intolerant	Below 2,500 feet
Loblolly Pine	4.0	Intermediate	No restrictions

Table B4.1B - Hardwood Requirements for Revegetating Surface Coal Mine Lands

Species	Lower pH Limit	Shade Tolerance*	Elevation
Red maple	4.5	Intermediate	No restrictions
Silver maple	4.0	Intermediate	No restrictions
Sugar maple	4.5	Tolerant	No restrictions
European (black) alder	4.0	Intolerant	Below 2,500 feet
Sweet birch	4.5	Tolerant	No restrictions
River birch	4.0	Intermediate	Below 2,000 feet
European white birch	4.0	Intolerant	No restrictions
Chinese chestnut	4.5	Intermediate	No restrictions
Flowering dogwood	5.0	Tolerant	No restrictions
Russian olive	5.5	Intermediate	No restrictions
White ash	4.0	Intermediate	No restrictions
Green ash	4.0	Intermediate	No restrictions
Black walnut	5.0	Intolerant	No restrictions
Crabapple	4.5	Intolerant	No restrictions
Sweetgum	4.0	Intolerant	Below 3,000 feet
Tulip or yellow poplar	4.5	Intolerant	Below 3,000 feet
Sycamore	4.0	Intolerant	Below 2,500 feet
Sawtooth oak	4.0	Intolerant	No restrictions

Species	Lower pH Limit	Shade Tolerance*	Elevation
White oak	5.0	Intermediate	No restrictions
Pin oak	5.0	Intolerant	Below 1,500 feet
Red oak	4.0	Intermediate	No restrictions
Black locust	4.0	Intolerant	Below 3,000 feet
Sassafras	5.0	Intolerant	No restrictions

*Shade tolerance of species is generally categorized as follows:

- Tolerant - can withstand completely shaded conditions;
- Intermediate - partial shade is tolerated; plant requires some sunlight; and
- Intolerant - shade is not tolerated; plant requires full sunlight.

Some Basic Requirements of Shrubs Suitable for Revegetation Surface Coal Mined Lands. (Table B5.1)

Table B5.1 - Shrub Requirements for Revegetation of Coal Mined Lands

Species	Lower Limit pH	Shade Tolerance*	Time to fruit/seed (years)	Month of mature fruit/seed
Indigobush	4.0	Intermediate	3	August
Silky dogwood	4.5	Tolerant	4 - 5	August through September
Gray dogwood	5.0	Intermediate	5	September through October
Washington hawthorn	5.5	Intolerant	4 - 5	October through November
Autumn olive	4.0	Intermediate	3 - 4	August through October
Bicolor lespedeza	4.5	Intolerant	3	October through November
Amur privet	4.5	Tolerant	4	September through November
Bayberry	4.0	Intermediate	3 - 5	October
Fragrant sumac	4.5	Tolerant	5	July through August
Shining sumac	4.0	Intermediate	4	September through October
Smooth sumac	4.5	Intermediate	4	September through October
Bristly locust	3.5	Intolerant	3 - 5	September through October
Rugosa rose	5.0	Intolerant	3	July through September
Coralberry	5.0	Tolerant	3	September through October
Arrowwood viburnum	4.5	Tolerant	3 - 5	September through October
Cranberrybush	4.5	Intermediate	3 - 5	August through September

*Shade tolerance of species is generally categorized as follows:

- Tolerant - can withstand completely shaded conditions;
- Intermediate - partial shade is tolerated; plant requires some sunlight; and
- Intolerant - shade is not tolerated; plant requires full sunlight.

Appendix C - Optional Selection of Tree and Shrub Species for Non-commercial (Unmanaged) Forest Land (Tables C1 through C4)

Table C1 - Category 1

Hardwood - Hard mast producers
Black walnut
Hickory species
Oak species

Table C2 - Category 2

Soft Mast Producers
Amur privet
Arrowwood
Autumn olive
Barberry
Black cherry
Chokecherry
Coralberry
Cranberry
Fragrant sumac
Hawthorne
Memorial rose
Osage-orange
Red-osier dogwood
Rugosa rose
Russian olive
Service berry
Shining sumac
Other sumacs and roses (<i>except multiflora</i>)

Table C3 - Category 3

Cone Producing Evergreens
Eastern white pine
Loblolly pine
Pitch pine
Pitch X Loblolly
Scotch pine
Shortleaf pine
Virginia pine

Table C4 - Category 4

Optional Species
American elder
Aspen
Bald cypress
Bicolor lespedeza
Black alder
Black locust
Black maple
Black willow
Bristly locust
Cottonwood
Green ash
Honey locust
Indigobush
Japan lespedeza
Red maple
River birch
Sassafras Sycamore
Siberian peashrub
Silver maple
Sourwood
Sugar maple
Sweet birch

Optional Species
Sweetgum
Thunberg lespedeza
Tulip/yellow poplar
White ash

Use of this appendix is optional. It is intended to assist the applicant in complying with Section 6(1)(a) of 405 KAR 16:200 and 405 KAR 18:200. It provides a simple way to select a beneficial mix of tree and shrub species where the postmining land use is non-commercial (unmanaged) forest land.

This appendix may be completed and inserted in the permit application, thus providing the permittee flexibility to change his species selection during reclamation without obtaining a permit revision.

Select at least one species from each of categories 1, 2 and 3 (above), and at least one more species from any of the above four categories. At least two of the selected species must be tree (canopy) species.

This appendix is not appropriate for wetland areas.

Appendix D - Literature Cited

Rafaill, B. L. and W. G. Vogel. 1978. ***A Guide for Vegetating Surface Mined Lands for Wildlife in Eastern Kentucky and West Virginia***. U.S. Fish and Wildlife Services., U.S. Dept. of the Interior, Washington, D.C. Publication Number 14-16-0009-77-923. 89 pages.

Torbert, J. L., J. A. Burger, and T. J. Nichols. 1986. ***Reforestation Seed Mixtures for Hydroseeding Reclaimed Mine Land***. Virginia Cooperative Extension Service, VA. Publishing. 460-112. 6 pages.