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**NORTHERN PINES PLANTATION
NATURAL RESOURCE
RESTORATION DESIGN PLAN**

**FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO**



OCTOBER 2002

**U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE**

**20911-PL-0001
REVISION A
DRAFT**

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LIST OF ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CW	coefficient of wetness
DOE	U.S. Department of Energy
DOE-FN	U.S. Department of Energy – Fernald
DOT	U.S. Department of Transportation
FEMP	Fernald Environmental Management Project
MSL	mean sea level
NPP	Northern Pines Plantation
NRRDP	Natural Resource Restoration Design Plan
NRRP	Natural Resource Restoration Plan
NRTs	Natural Resource Trustees
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
QAJSP	Quality Assurance Job-Specific Plan
S&H	Safety and Health
SDFP	Soil and Disposal Facility Project
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION

The scope of the Northern Pine Plantation (NPP) Restoration Project includes the conversion of the planted pine plantation in the northern portion of the Fernald Environmental Management Project (FEMP) to the early stages of a deciduous forest with interspersed areas of wetlands and grasslands. The NPP Restoration Project is part of the larger Northern Woodlot Restoration Project that also includes the Northern Woodlot Enhancement and the Wetland Mitigation Phase II. These three projects cover approximately 200 acres of the Fernald Site. This plan will focus only on the NPP Enhancement and later Natural Resource Restoration Design Plans (NRRDPs) will focus on the Wetland Mitigation Phase II and Northern Woodlot Enhancement Project.

This NRRDP addresses ecological restoration of the NPP, pursuant to the conceptual design set forth in the FEMP Natural Resource Restoration Plan (NRRP; DOE 2002a) and the Conceptual Design for the NPP Restoration Project (DOE 2000). The NRRP has been developed by Fluor Fernald Inc., and the Department of Energy – Fernald Office (DOE-FN) working with the U.S. Fish and Wildlife Service (USFWS) and the Ohio Environmental Protection Agency (OEPA). DOE-FN, USFWS, and OEPA work jointly as Natural Resource Trustees (NRTs) of the Fernald Site acting in an advisory and oversight role in the planning, implementation and monitoring of the restoration of the Fernald Site. Ecological restoration at the FEMP is being implemented to compensate for natural resource injuries under Section 107 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) that occurred at the Fernald Site as a result of Production Operations. Another significant driver for Restoration is the tentative settlement of the 1986 State of Ohio Claim, filed under CERCLA Section 107, for natural resource injuries at the FEMP.

1.1 SITE DESCRIPTION

The area referred to as the NPP encompasses approximately 70 acres in the northeast corner of the FEMP property (Figure 1-1). The NPP area was certified clean in 1997 as part of the Area 1, Phase I Soil Certification Process (DOE 1998a). The 70-acre area within the scope of this project contains an area of deciduous forest covering approximately 20 acres and the pine plantation planted in the early 1970s that covers approximately 50 acres. The NPP is bordered on the north by State Route 126 and is bordered on all remaining sides by site access roads.

1.1.1 Topography

The topography of the NPP has not been significantly altered as a result of site operations. Elevations in the NPP generally increase from south to north from 595 feet above mean sea level (MSL) to 705 feet above MSL (Figure 1-2). The portion of the project area containing the pine plantation is more gently sloping with elevations ranging from 595 feet above MSL to 630 feet above MSL from south to north. Slopes in the northern portion of the NPP containing the deciduous woodlot are much steeper than the elevations in the southern portion of the project area. The NPP contains several small drainage features that carry surface water to a drainage ditch that borders the southern boundary of the project area. Several small drainage swales traverse the project area. Drain tiles installed during past agricultural activities still exist in the NPP. A number of wet areas also exist in the project area, providing excellent opportunities for wetland/vernal pool creation.

1.1.2 Vegetation

The NPP contains two distinct communities of vegetation (Figure 1-3). Approximately 20 acres of the NPP consists of a deciduous woodlot that predates DOE presence at the Fernald Site. The woodlot contains many large, mature canopy trees such as oak, hickory and ash. In many areas, the under story of the deciduous woodlot is dominated by amur honeysuckle. Wild Grape is also prevalent in the area. The woodlot is very steeply sloped with elevations ranging from 635 feet above MSL at the southern edge to 705 feet above MSL at the northern edge along State Route 126.

The pine plantation was planted in 1972 and covered approximately 50 acres of the NPP project area. In January/February 2002, approximately 40 percent of the pine plantation was cleared during a logging operation to open the area for future restoration activities. The pine plantation consisted of alternating rows of Austrian pines (*Pinus nigra*) and white pines (*Pinus strobus*). Each "row" of pines consisted of a densely planted grouping of the same species approximately 50 to 75 feet in width. The Austrian pines were infected with a Diplodia Tip Blight fungus and the majority of the trees were either dead or severely stressed at the time removal took place. The white pines were healthier than the Austrian pines, but were also stressed due to overcrowding in the pine plantation. The clearing targeted almost all of the Austrian pines, but left significant stands of white pines (with some Austrian pines) to provide winter cover and nesting areas for wildlife. The logging operation was completed in the winter to minimize impacts to wildlife populations (e.g., birds and mammals) that may be using the area for cover and/or nesting. All trees cleared from the area were chipped and the majority of chips (approximately 4,500 cubic yards) were moved to the Southern Waste Units for use as a soil amendment during restoration. Less than

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1 1,000 cubic yards of wood chips were left in the NPP project area for use as mulch for trees and shrubs
2 during restoration.

3
4 All cleared areas in the NPP project area that will not be graded for the creation of wetlands and vernal
5 pools were seeded with native prairie grasses in Spring 2002. Seeded areas encompass approximately
6 20 acres.

7
8 1.1.3 Soils

9 Soils in the NPP are relatively undisturbed. Drain tiles resulting from past agricultural use of the NPP
10 have been found in several areas. Field investigations indicate that soils have a high content of organic
11 matter, tend to remain moist and are very suitable for restoration. Soil pH levels were investigated in
12 Spring 2002 to determine if the pine plantation had contributed to acidic conditions. Measurements were
13 taken with a portable pH meter at approximately 20 locations in the NPP. All results ranged between
14 6.4 and 7.2 or in the normal range. The soils in the NPP will not require any amendment or treatment
15 prior to the initiation of restoration work.

16
17 1.2 PROJECT OVERVIEW

18 The overall restoration objective is to enhance the NPP by increasing the diversity of vegetation in the
19 area and creating new wetland and vernal pool features. Native deciduous trees and shrubs will be
20 planted among remnant patches of pines. Existing drainage swales and depressions will be expanded,
21 creating new wetland features. Five new wetland areas and two new vernal pools will be created in the
22 NPP. The existing stand of deciduous trees in the northwestern portion of the NPP will remain
23 unchanged, other than continued efforts to eliminate invasive species (e.g., honeysuckle, wild grape,
24 garlic mustard, multiflora rose) during project implementation and monitoring. Four large plots of trees
25 and shrubs will be installed in more dense concentrations than has been used on previous restoration
26 projects. The total number of trees and shrubs planned for the area will not change. Access corridors for
27 deer movement will be interspersed throughout the project area. All cleared areas of the NPP project area
28 will be seeded with native prairie grasses.

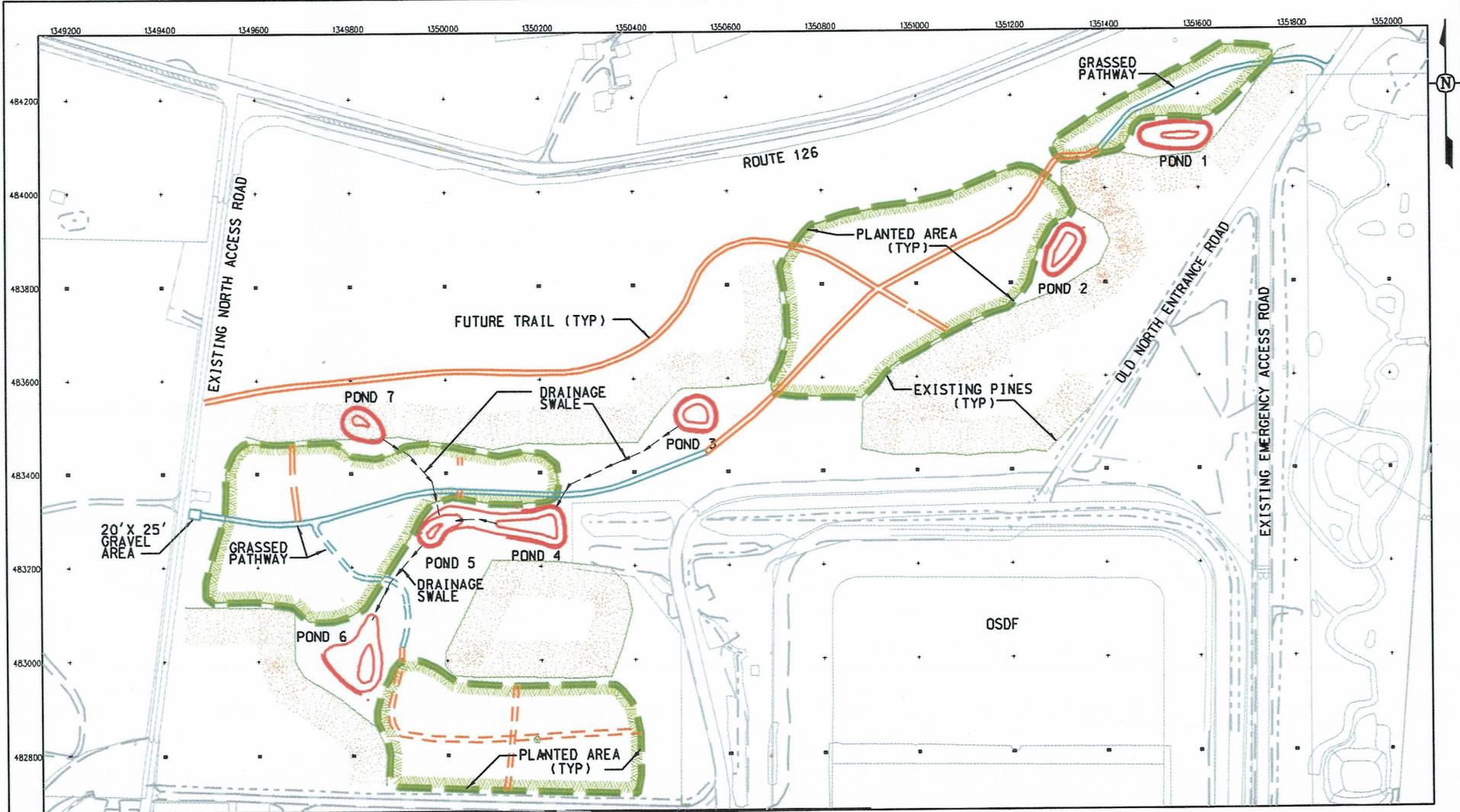
29
30 The public use plans for the FEMP include the construction of walking trails through the Northern Pines
31 Plantation (DOE 2002b). To allow for the movement of equipment and material in and out of the project
32 area, access paths will be installed through the Northern Pines Restoration Project and later converted to
33 walking trails (Figure 1-3).

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1 In January 2002, the schedule for field implementation of the NPP Restoration Project was accelerated to
2 2002, as part of an effort to complete site closure by 2006. In order to prepare for planting in Fall 2002,
3 clearing of the pines and some seeding had to be carried out in Winter/Spring 2002, prior to development
4 of this NRRDP. This NRRDP outlines the plans for grading and revegetation work in the NPP. Grading
5 work is planned for September 2002 with planting starting in October 2002. Planting in the NPP will
6 cover at least four planting seasons and should be completed in early 2004. This NRRDP also details the
7 process for maintenance, monitoring, herbivore control, access path construction, and wildlife amenities.



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##FILE##

STATE PLANAR COORDINATE SYSTEM 1983

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LEGEND:

-  PLANTING AREA BOUNDARY
-  PINES BOUNDARY
-  ACCESS PATH AND TRAIL
-  ACCESS PATH

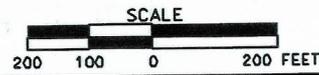
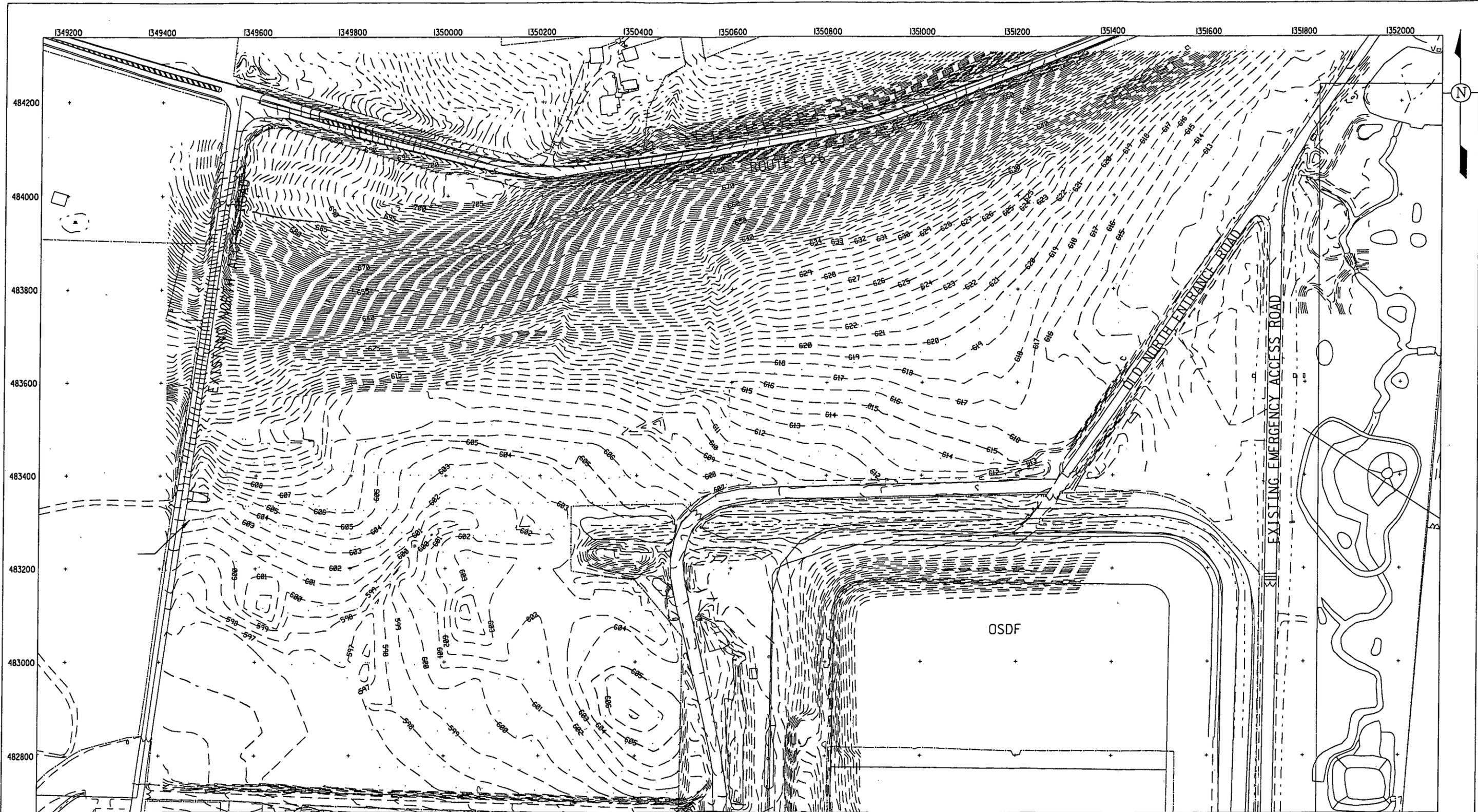


FIGURE 1-1. PINE PLANTATION RESTORATION PLAN

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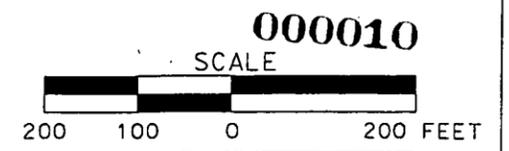


FIGURE 1-2. TOPOGRAPHY OF NOTHERN PINE PLANTATION

2.0 DESIGN COMPONENTS AND GOALS

As stated above, the purpose of this NRRDP is to enhance the NPP. The enhancement is composed of three major objectives: reduction of mono-culture acreage, creation of vernal pool/wetland acreage, and revegetation with native trees, shrubs, grasses and forbs. The actions taken will reduce the amount of acreage of low diversity pine plantation and develop those acres into interspersed patches of upland woodlots and native grasslands. The planting and seeding plans are based on the design components above (Figure 1-3). These components are discussed in more detail below.

2.1 REDUCTION OF PINE ACREAGE

The Fernald NRTs agreed on a cutting design for the NPP to thin the amount of diseased pine trees and create areas for deciduous and herbaceous planting sites. The NRTs agreed that there would be several islands of pines that were not cleared and would continue to provide winter cover and spring nesting areas for wildlife.

The NPP contained alternating bands of Austrian pines and white pines with a small grouping of Norway spruce (*Picea rubens*) trees (Figure 2-1). The Austrian pine stands were not contiguous stands. The rows contained thinning numbers of pines and an understory filled with heavy thickets of invasive species. Invasive species were able to invade the area as overstory pines were weakened through competition from adjacent trees, competition with wild grape vine, and loss of leaf mass due to leaf tip blight. Rows of white pines were a mono-culture with limited understory. Competition for canopy space was resulting in large numbers of the dead white pines that had been out competed by their neighbors.

Approximately 19 acres of pines within the designated cut area were removed in January/February 2002 using a whole tree feller-buncher and skid to a chipper (Figure 2-1). Brush and honeysuckle that were located in the understory were bunched with the pines and transported to the chipper. Stumps were ground in place using a stump grinder and all debris raked from the area. Ruts created during cutting and skidding operations were smoothed out during the raking action leaving the surface compatible for further restoration activities. The newly cleared opening left the pines in four distinct groupings. The eastern most group acts as a barrier to the North Access Road running along the total eastern edge and includes Austrian pines, white pines, and spruce. Another patch of white and Austrian pines is located on the western end of the northern edge and is adjacent to the deciduous trees. The southwest corner of the pine plantation remains uncut; as well as, an island of pines located to the east, adjacent to the road around Cell 1 of the On-Site Disposal Facility (Figure 2-1).

1 2.2 CREATION OF WETLANDS AND VERNAL POOLS

2 To create wetland and vernal pool areas within the footprint of the NPP, it is necessary to slightly alter
3 existing drainage patterns. Hydrology of the area was evaluated through field investigation over multiple
4 years to determine what areas would be conducive to the creation of wetlands and vernal pools. It has
5 been determined that only minor modifications to the existing drainage patterns in the NPP will result in
6 the enhancement of five wetland areas and the creation of two new vernal pools.

7
8 The NPP has natural drainage ways that empty into the NPP footprint (Figure 1-2). Most of these
9 drainage areas flow to one of several drainage tiles that carry water to a drainage ditch on the south end of
10 the NPP. The topography for the site is gently sloping; therefore, the natural drainage across the
11 landscape is very slow. The drainage tiles were installed prior to construction of the FEMP when the land
12 was being farmed to quickly drain water from the site. The tiles alter the natural flow across the area and
13 limit the amount of wet areas within the NPP. Any existing drain tiles that carry water out of the NPP
14 will be plugged.

15
16 Water drains from the deciduous forest in the northern portion of the NPP and flows through shallow
17 swales to the southwest corner of the project area (Figure 1-2). Much of this water flows into a drain tile
18 within the pine boundary on the edge of the cut area. Some of the water in high flow events will continue
19 to flow across the western end of the cut area and join swales flowing across the area. A pair of drainage
20 swales flow onto the FEMP from State Route 126 and flow through the eastern end of the deciduous
21 forest and skirt the boundary of pines before turning westward across the center of the cut area.

22
23 Grading would be required to create small berms and form basins adjacent to existing drainage swales
24 slowing drainage out of the area and creating new water holding capacity. Approximately 5,000 cubic
25 yards of soil will need to be graded to form the basins and pools (Figures 1-3 and 1-4).

26
27 2.3 REVEGETATION

28 Pursuant to the NRRP, revegetation of the NPP is designed to restore the early stages of pre-settlement
29 plant communities native to southwest Ohio. The revegetation plan for the NPP will include four large
30 patches of forest plantings consisting of both beech-maple and oak-hickory forest types. Unlike previous
31 forest restoration projects, trees and shrubs will be planted in more densely grouped patches as part of an
32 overall strategy to minimize deer impacts. Consistent with the comment responses on the Conceptual
33 Restoration Design, shrub densities will be increased in select patches in the NPP to create a more
34 pronounced edge habitat (DOE 2000). On average, shrub densities will be approximately 155 shrubs per

1 acre across the NPP project. Each of the four densely grouped forest patches will be separated by
2 corridors of prairie grass that correspond to anticipated travel corridors of white-tailed deer
3 (Brewer 2002). The planting approach for the NPP would result in the same overall per acre densities of
4 trees and shrubs as used in previous restoration projects (i.e., 160 saplings, 90 shrubs and 400 seedlings
5 per acre); however, the plants would be more concentrated to leave corridors for deer movement. The
6 total number of trees and shrubs planned for the NPP will not increase. Consideration will also be given
7 to removing plants more prone to deer damage from the edges of the planting patches.

8
9 Corridors of prairie grass would be planted at locations where deer movement has been observed
10 historically or is anticipated to occur in the future. Areas of prairie grass would also be planted around
11 wetland and vernal pool features and along the main drainage swale that will transect the NPP. In
12 drainage areas and areas containing wetlands and vernal pools, the wet prairie mix will be planted
13 (Appendix A, Seeding Specification). In more upland areas and areas to be planted with trees and shrubs,
14 seeding with the upland prairie mix occurred in Spring 2002. Areas to be graded in late Summer 2002 for
15 wetland and vernal pool creation will be seeded in fall of 2002.

16 17 2.3.1 Native Prairie Grasses and Forbs

18 All planted areas will be seeded with a mix of native grasses and forbs. Table 2-1 provides the listing of
19 native grasses and forbs that will be used in the upland prairie mix. Table 2-2 provides the listing of
20 native grasses and forbs that will be used in the wet prairie mix. Seeding of the upland prairie mix
21 occurred in the spring of 2002 using the Truax seed drill. All areas requiring seeding after grading is
22 complete will be seeded with the Truax seed drill to the degree possible. Any areas not accessible with
23 the seed drill will be broadcast seeded by hand. All seeding will be conducted between October 1, 2002
24 and November 15, 2002 per the Seeding Specification (Appendix A).

25 26 2.3.2 Bioengineering and Erosion Control

27 Pursuant to the NRRP, erosion-prone areas will be stabilized through bioengineering techniques. As part
28 of the NPP project, coir fabric will be installed in areas that will receive regular and/or concentrated flow.
29 The inflow and outfall points into wetlands and vernal pools will be seeded with the wet prairie mix and
30 covered with coir matting. Coir matting will be stapled using standard sod staples and staked as needed.
31 All areas installed with coir matting will be planted with dormant willow cuttings on approximately
32 2-foot centers. An equal mix of black willow (*Salix nigrum*) and silky willow (*Salix sericea*) dormant
33 cuttings will be planted in each area. All bioengineering erosion control activities will be conducted
34 pursuant to the specifications (Appendix B)

2.3.3 Forest Communities

The NPP Restoration Project will include the planting of two types of forest communities depending on the topography and hydrology of the area. The central portion of the NPP has a more even topography and generally has an increased amount of soil moisture. The central portion of the NPP will be more conducive to the beech-maple forest template. Some mesophytic species (sycamore, butternut) will be planted within the beech-maple template in select areas adjacent to drainage swales or wetland/vernal pool areas. Topography in the NPP becomes more sloped and better drained on the eastern and western edges of the project area. The eastern and western edges of the NPP will be more conducive to the oak-hickory template. Both templates are described in greater detail below. Four large patches of forest plantings will be installed in the NPP project area (Figure 1-3).

2.3.3.1 Beech-Maple Forest Template

The beech-maple forest represents the climax community of glaciated areas. Braun (1941) describes the beech-maple forest as the “northern mesophytic expression of the deciduous forest.” Shade-tolerant beech (*Fagus grandifolia*) were able to take over the established oak-hickory forests once moisture increased after glaciation (Braun 1934). Sugar maple (*Acer saccharum*) co-dominates this forest type, except where moisture is too great. This appears to be a primary area of distinction between beech-maple and mesophytic forest. Sugar maple comprises 25 to 50 percent of beech-maple forest and less than 1 percent of mesophytic forest (Braun 1950). The specific species to be included in the beech-maple forest template are provided in Table 2-3.

In select locations within the beech-maple template, species more typical of a mixed mesophytic forest template will be planted. The mixed mesophytic forest has developed in unglaciated areas with adequate moisture. Perhaps the best example of this type of forest is found in the Allegheny and Cumberland mountains and plateaus (Braun 1941). Farther west is a broad transition to the drier oak-hickory forest. Braun (1950) terms this transition zone the “western mesophytic forest.” Western mesophytic and mixed mesophytic regions are differentiated by Gordon (1969), particularly in the extensive referencing of Braun’s work. Gordon does not make a distinction of the two forest types on his 1966 map of Ohio’s vegetation. The mesophytic forest species to be planted in select areas of the beech-maple templates are typical of the western mesophytic forest types described by Gordon (1969) and Braun (1941).

2.3.3.2 Oak-Hickory Forest Template

The oak-hickory forest type became dominant in the Ozark and interior plateaus as temperatures rose and humidity levels dropped in the middle of North America (Gordon 1969). Post-glacial periods of drying

1 encouraged the eastward and northward movement of the oak-hickory forests with the northwestern
2 extent of the movement residing in southwest Ohio (Braun 1941). Oak-sugar maple forests are
3 characterized by Gordon (1969) as the expression of the oak-hickory forest that dominates this portion of
4 southwest Ohio. The specific species to be included in the oak-hickory forest template are provided in
5 Table 2-4.

6 7 2.4 PUBLIC USE AMENITIES

8 Following restoration, the Northern Pines Plantation will be a forested area with wetland areas bordering
9 the majority of the southern edge. Access paths will be needed during restoration and monitoring to allow
10 equipment/personnel access. A portion of the access paths will be converted to walking trails prior to the
11 completion of site restoration as designated on Figure 1-3. Until the completion of public use amenities is
12 completed near the end of site restoration, the access paths will be mowed on a periodic basis. Figure 1-3
13 provides the planned layout of the completed restoration project.
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TABLE 2-1
UPLAND MESIC PRAIRIE SEED MIX

Grasses

Scientific Name	Common Name	CW	lb/acre
<i>Andropogon gerardi</i>	big bluestem	1	3
<i>Andropogon scoparius</i>	little bluestem	4	2
<i>Bouteloua curtipendula</i>	side-oats grama	5	0.5
<i>Elymus canadensis</i>	Canada wild-rye	1	25
<i>Lolium multiflorum</i>	annual rye	n/a	5
<i>Panicum virgatum</i>	Switchgrass	-1	0.5
<i>Sorghastrum nutans</i>	indian grass	2	2
Total =			38

Forbs

Scientific Name	Common Name	CW	oz/acre
<i>Asclepias tuberosa</i>	Butterflyweed	5	2
<i>Aster laevis</i>	smooth aster	5	0.25
<i>Aster novae-angliae</i>	New England aster	-3	0.125
<i>Astragalus canadensis</i>	Canada milkvetch	-1	0.375
<i>Baptisia australis</i>	blue false indigo	5	3.5
<i>Baptisia leucantha</i>	white false indigo	3	3.5
<i>Cassia fasciculata</i>	partridge pea	4	1.75
<i>Echinacea pallida</i>	pale purple coneflower	5	1.5
<i>Echinacea purpurea</i>	purple coneflower	5	1.5
<i>Eryngium yuccifolium</i>	rattlesnake master	-1	0.75
<i>Eupatorium purpureum</i>	sweet Joe pye-weed	0	0.1875
<i>Heliopsis helianthoides</i>	Ox-eye sunflower	5	1.25
<i>Lespedeza capitata</i>	round-headed bush clover	3	0.5
<i>Liatris pycnostachya</i>	prairie blazingstar	1	1.75
<i>Monarda fistulosa</i>	Bergamot	3	0.125
<i>Penstemon grandiflorus</i>	Beardtongue	5	0.75
<i>Petalostemum purpureum</i>	purple prairie clover	5	0.25
<i>Ratibida pinnata</i>	yellow coneflower	5	0.375
<i>Rudbeckia hirta</i>	black-eyed Susan	3	0.125
<i>Silphium perfoliatum</i>	Cupplant	-2	3.75
<i>Solidago rigida</i>	stiff goldenrod	4	0.0625
<i>Tradescantia ohioensis</i>	Spiderwort	2	1
<i>Verbena hastata</i>	blue vervain	-4	0.125
<i>Verbena stricta</i>	hoary vervain	5	0.25
Total =			25.75

CW = Coefficient of Wetness

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1
2
3

**TABLE 2-2
WET PRAIRIE SEED MIX**

Grasses

Scientific Name	Common Name	CW	lb/acre
<i>Andropogon gerardi</i>	big bluestem	1	3
<i>Calamagrostis canadensis</i>	blue joint grass	-5	0.5
<i>Carex hystericina</i>	porcupine sedge	-5	1 (oz/ac)
<i>Carex vulpinoidea</i>	fox sedge	-5	1 (oz/ac)
<i>Elymus canadensis</i>	Canada wild-rye	1	25
<i>Panicum virgatum</i>	Switchgrass	-1	0.5
<i>Scirpus atrovirens</i>	dark green bulrush	-5	1 (oz/ac)
<i>Spartina pectinata</i>	prairie cordgrass	-4	1
<i>Lolium multiflorum</i>	annual rye	n/a	5
Total =			38

Forbs

Scientific Name	Common Name	CW	oz/acre
<i>Angelica atropurpurea</i>	Angelica	-5	3
<i>Asclepias incarnata</i>	swamp milkweed	-5	4.5
<i>Aster novae-angliae</i>	New England aster	-3	0.5
<i>Cassia hebecarpa</i>	wild senna	-3	7.5
<i>Desmodium canadense</i>	Canada tick trefoil	1	4.75
<i>Eupatorium maculatum</i>	spotted Joe pye-weed	-5	0.5
<i>Liatris spicata</i>	marsh blazingstar	0	2
<i>Lobelia siphilitica</i>	great blue lobelia	-4	0.125
<i>Monarda fistulosa</i>	Bergamot	3	0.375
<i>Ratibida pinnata</i>	yellow coneflower	5	0.75
<i>Rudbeckia hirta</i>	black-eyed Susan	3	0.25
<i>Verbena hastata</i>	blue vervain	-4	0.25
Total =			24

4

**TABLE 2-3
 BEECH-MAPLE FOREST TEMPLATE**

Scientific Name	Common Name	Form	Function	Placement	2002 Fall	2003 Spring	2003 Fall	2004 Spring
<i>Acer nigrum</i>	Black Maple	canopy tree	Cover			38	63	25
<i>Acer saccharinum</i>	Silver Maple	canopy tree	Cover	wet	6	9	15	6
<i>Acer saccharum</i>	Sugar Maple	canopy tree	cove,mast		22	72	120	36
<i>Asimina triloba</i>	Pawpaw	understory tree	fruit, diversity			8	14	5
<i>Carpinus caroliniana</i>	Hornbeam	understory tree	diversity, mast			3	6	2
<i>Carya cordiformis</i>	Bitternut Hickory	canopy tree	cover		13	5	13	3
<i>Carya laciniosa</i>	Shellbark Hickory	canopy tree	cover , mast		10	29	46	17
<i>Celtis occidentalis</i>	Hackberry	canopy tree	Diversity	edge	3	2	9	4
<i>Cornus alternifolia</i>	Alternate Leaf Dogwood	understory tree	diversity, aesthetic			1	2	1
<i>Crataegus mollis</i>	Downy Hawthorne	understory tree	Cover			3	5	2
<i>Fagus grandifolia</i>	Beech	canopy tree	cover, mast			129	211	81
<i>Fraxinus americana</i>	White Ash	canopy tree	cover		8	20	29	
<i>Fraxinus pennsylvanicum</i>	Green Ash	canopy tree	Cover			14	31	17
<i>Juglans cinerea</i>	Butternut	canopy tree	mast, diversity			1	3	1
<i>Juglans nigra</i>	Black Walnut	canopy tree	mast, diversity		16	36	58	22
<i>Liriodendron tulipifera</i>	Tulip Poplar	canopy tree	cover, aesthetics		4	17	14	6
<i>Ostrya virginiana</i>	Hop-Hornbeam	understory tree	Diversity	wet	1	2	4	2
<i>Populus deltoides</i>	Cottonwood	canopy tree	Diversity			9	15	6
<i>Prunus serotina</i>	Black Cherry	canopy tree	Fruit		12	28	46	17
<i>Quercus palustris</i>	Pin Oak	canopy tree	cover			19	32	12
<i>Quercus rubra</i>	Red Oak	canopy tree	cover, mast		12	17	24	13
<i>Tilia americana</i>	Basswood	canopy tree	cover, aesthetics			40	65	25
<i>Alnus serrulata</i>	Smooth Alder	shrub	Cover	wet		5	8	3
<i>Asimina triloba</i>	Pawpaw	understory tree	fruit, diversity			4	6	2
<i>Campsis radicans</i>	Trumpet Creeper	vine	Esthetics	edge	16			
<i>Carpinus caroliniana</i>	American Hornbeam	understory tree	diversity, mast			15	24	9
<i>Celastrus scandens</i>	Bittersweet	shrub	diversity				6	
<i>Cephalanthus occidentalis</i>	Buttonbush	shrub	Cover	wet		19	25	9
<i>Cornus amomum</i>	Silky Dogwood	understory tree	Cover	wet		3	3	3
<i>Corylus americana</i>	Hazelnut	shrub	Diversity	wet		4	8	3
<i>Crateagus crus-galli</i>	Cockspur Hawthorne	understory tree	Diversity		3	2	2	0
<i>Crateagus mollis</i>	Downy Hawthorne	understory tree	Cover			14	22	8

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**TABLE 2-3
 BEECH-MAPLE FOREST TEMPLATE**

Scientific Name	Common Name	Form	Function	Placement	2002 Fall	2003 Spring	2003 Fall	2004 Spring
<i>Hamamelis virginiana</i>	Witch Hazel	shrub	Cover			23	37	14
<i>Hypericum spathulatum</i>	Shrubby St. Johns Wort	shrub	Diversity	wet		11	11	9
<i>Ilex verticallata</i>	Winterberry	shrub	Esthetics	wet		13	20	9
<i>Lindera benzoin</i>	Spicebush	shrub	Cover			15	25	10
<i>Ostrya virginiana</i>	Hop-Hornbeam	understory tree	Diversity	wet	3	15	23	9
<i>Physocarpus opulifolius</i>	Ninebark	shrub	Diversity	edge	22	2	3	1
<i>Prunus americana</i>	American Plum	understory tree	diversity, fruit		14	1	2	1
<i>Rhus aromatica</i>	Fragrant Sumac	shrub	Esthetics					
<i>Rhus typhina</i>	Staghorn Sumac	shrub	Esthetics		64	4	6	2
<i>Rosa caroliniana</i>	Carolina Rose	shrub	Esthetics		24			
<i>Rosa palustris</i>	Swamp Rose	shrub	Esthetics	wet		22	37	14
<i>Salix discolor</i>	Pussy Willow	shrub	Cover	wet		10	17	7
<i>Sambucus canadensis</i>	Elderberry	shrub	Fruit	wet		13	24	8
<i>Spirea alba</i>	Meadowsweet	shrub	Esthetics	wet		10	16	7
<i>Staphylea trifolia</i>	Bladdernut	shrub	Diversity	edge	21			
<i>Symphoricarpos orbiculatus</i>	Coralberry	shrub	Diversity		33			
<i>Viburnum acerifolium</i>	Mapleleaf Viburnum	shrub	Diversity			12	18	7
<i>Viburnum prunifolium</i>	Blackhaw Viburnum	shrub	Cover		30			
<i>Zanthoxylum americanum</i>	Prickly Ash	shrub	Diversity		6	2		

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**TABLE 2-4
 OAK-HICKORY FOREST TEMPLATE**

Scientific Name	Common Name	Form	Function	Placement	2002 Fall	2003 Spring	2003 Fall	2004 Spring
<i>Acer rubrum</i>	Red Maple	canopy tree	cover	wet	50	17	28	25
<i>Acer saccharum</i>	Sugar Maple	canopy tree	cove,mast		16	19	28	20
<i>Aesculus glabra</i>	Ohio Buckeye	understory tree	diversity	wet		32	52	19
<i>Carya cordiformis</i>	Bitternut Hickory	canopy tree	cover		11	10	11	7
<i>Carya ovata</i>	Shagbark Hickory	canopy tree	cover, mast		39	14	21	8
<i>Celtis occidentalis</i>	Hackberry	canopy tree	diversity	edge	3	7	6	2
<i>Cercis canadensis</i>	Redbud	understory tree	aesthetics	edge	9	3	5	2
<i>Cornus drumondii</i>	Roughleaf Dogwood	understory tree	cover	edge	3	1	2	1
<i>Cornus florida</i>	Flowering Dogwood	understory tree	aesthetics		5	2	3	1
<i>Cornus racemosa</i>	Grey Dogwood	understory tree	cover		24	7	13	5
<i>Fraxinus americana</i>	White Ash	canopy tree	cover		31	30	52	31
<i>Fraxinus pennsylvanicum</i>	Green Ash	canopy tree	cover	wet		15	14	
<i>Fraxinus quadrangulata</i>	Blue Ash	canopy tree	cover, diversity		4	1	2	1
<i>Gymnocladus dioica</i>	Kentucky Coffeetree	canopy tree	diversity		6	2	3	1
<i>Juglans cinerea</i>	Butternut					3	5	2
<i>Liriodendron tulipifera</i>	Tulip Poplar	canopy tree	cover, aesthetics		3	7	15	9
<i>Liquidambar styraciflua</i>	Sweetgum					1	2	1
<i>Platanus occidentalis</i>	Sycamore					9	14	5
<i>Quercus alba</i>	White Oak	canopy tree	cover, mast		62	25	40	16
<i>Quercus bicolor</i>	Swamp White Oak					4	7	2
<i>Quercus coccinea</i>	Scarlet Oak	canopy tree	cover, mast		9	3	4	2
<i>Quercus inbricaria</i>	Shingle Oak	canopy tree	diversity, mast		6	2	3	1
<i>Quercus muhlenbergii</i>	Chinquapin Oak	canopy tree	diversity, mast		10	3	5	2
<i>Quercus prinus</i>	Chestnut Oak	canopy tree	diversity			1	2	
<i>Quercus rubra</i>	Red Oak	canopy tree	cover, mast		18	30	52	16
<i>Quercus shumardii</i>	Shumard Oak	canopy tree	diversity, mast		10	3	6	2
<i>Quercus velutina</i>	Black Oak	canopy tree	cover, mast		16	6	10	4
<i>Ulmus rubra</i>	Slippering Elm	canopy tree	cover		19	7	19	7
<i>Alnus serrulata</i>	Smooth Alder	Shrub	cover	wet		5	8	3
<i>Amelanchier arborea</i>	Downy Serviceberry	Shrub	fruit, diversity	wet	35			
<i>Campsis radicans</i>	Trumpet Creeper	Vine	esthetics	edge	17			
<i>Ceanothus americanus</i>	New Jersey Tea	Shrub	diversity	wet	6			

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TABLE 2-4
 OAK-HICKORY FOREST TEMPLATE

Scientific Name	Common Name	Form	Function	Placement	2002 Fall	2003 Spring	2003 Fall	2004 Spring
<i>Celastrus scandens</i>	Bittersweet	Shrub	diversity			6	3	3
<i>Cephalanthus occidentalis</i>	Buttonbush	Shrub	cover	wet		10	20	7
<i>Cercis canadensis</i>	Redbud	understory tree	esthetics		25			
<i>Cornus amomum</i>	Silky Dogwood	understory tree	cover	wet		3	7	1
<i>Cornus drummondii</i>	Roughleaf Dogwood	understory tree	diversity		4			
<i>Cornus florida</i>	Flowering Dogwood	understory tree	esthetics		17			
<i>Cornus racemosa</i>	Gray Dogwood	understory tree	cover		42			
<i>Corylus americana</i>	Hazelnut	Shrub	diversity	wet		3	3	1
<i>Crateagus crus-galli</i>	Cockspur Hawthorne	understory tree	diversity		22		2	1
<i>Hypericum spathulatum</i>	Shrubby St. Johns Wort	Shrub	diversity	wet		8	20	3
<i>Ilex verticallata</i>	Winterberry	Shrub	esthetics	wet		11	18	9
<i>Physocarpus opulifolius</i>	Ninebark	Shrub	diversity	edge	22	2	3	1
<i>Prunus americana</i>	American Plum	understory tree	diversity, fruit		14	1	2	1
<i>Rhus aromatica</i>	Fragrant Sumac	Shrub	esthetics		15			
<i>Rhus glabra</i>	Smooth Sumac	Shrub	Esthetics	edge	10	1	3	1
<i>Rosa caroliniana</i>	Carolina Rose	Shrub	Esthetics		24			
<i>Rosa setigera</i>	Prairie Rose	Shrub	Cover	wet	46	11	16	7
<i>Rubus occidentalis</i>	Black Raspberry	Shrub	Fruit	edge	46			
<i>Salix discolor</i>	Pussy Willow	Shrub	Cover	wet		10	16	6
<i>Sambucus canadensis</i>	Elderberry	Shrub	Fruit	wet		14	23	9
<i>Sassafras albidum</i>	Sassafras	understory tree	Diversity		6			
<i>Spirea alba</i>	Meadowsweet	Shrub	Esthetics	wet		10	17	6
<i>Symphoricarpos orbiculatus</i>	Coralberry	Shrub	Diversity		40			
<i>Viburnum prunifolium</i>	Blackhaw Viburnum	Shrub	Cover		45			
<i>Zanthoxylum americanum</i>	Prickly Ash	Shrub	Diversity		6	0	2	2

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Before



After

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Figure 2-1 Northern Pine Plantation Tree Removal

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3.0 GRADING PLAN

Grading requirements for the NPP will consist of expanding existing drainage swales and wet areas to create vernal pool and wetland features (Figures 1-3 and 1-4 respectively). Two vernal pools will be constructed in the northern portion of the NPP project area and five wetland features will be constructed around existing drainage swales in the NPP. A path for access into the NPP planting areas will also be installed as part of the grading plan. Grading activities will be completed in the late summer/early Fall 2002.

3.1 ACCESS ROAD CONSTRUCTION

Access into the NPP will consist of a mowed access path starting at the existing North Construction Road on the western edge of the NPP and extending into each of the areas to be planted with trees and shrubs. The access road will need to cross the drainage swale traversing the NPP in two locations to provide access into the eastern portions of the NPP. The road will be constructed by grading soil to provide a level surface followed by seeding. Geogrid material will be used to construct the road at the drainage swale crossings and other locations where wet conditions warrant additional support. No other improvements to the road will be planned. The road will be mowed periodically to ensure visibility and safe access into the area. Figure 1-3 shows the location of the planned access road.

3.2 VERNAL POOL

Two vernal pools will be constructed along the remaining stand of pine trees in the northern portion of the NPP (Figure 1-3). The vernal pool features consist of a shallow depression approximately 50 feet in diameter and approximately 3 feet deep. It is expected that the vernal pools will become inundated with water during wet periods in the spring and fall. The vernal pools will be constructed with at least 3:1 side slopes to ensure the safety of anyone in the area. Soil excavated from the vernal pools will be used for the creation of berms around the pools. Any excess soil generated during excavation of the vernal pools will be "wasted" in the area immediately adjacent to the excavation. Several types of amphibians should benefit from the creation of this additional habitat.

3.3 FIELD IMPLEMENTATION

All earthwork and construction activities will take place in the late summer/early Fall 2002. Revegetation efforts will be initiated after October 1, 2002. Earthwork is expected to take two to three weeks to complete. Fluor Fernald, through the utilization of the on-site construction services contractor, will conduct all earthwork and construction activities. Fluor Fernald will ensure that all applicable policies,

- 1 procedures, and regulations will be met in the planning and implementation of the work. The Soil and
- 2 Disposal Facility Project (SDFP) Construction and Restoration personnel will oversee all earthwork and
- 3 construction activities. The permanent seed mixes outlined in Tables 2-1 and 2-2 will be used to seed
- 4 disturbed areas as early as possible after earthwork is complete in Fall 2002.

4.0 PLANTING PLAN

This section describes the specific approaches that will be used to plant the various vegetative communities specified for the NPP.

4.1 PLANTING AND PATCH DESIGN

Figure 1-3 shows the location of forest and prairie grass patches for the NPP. Each planting patch is comprised of a mixture of native grasses and forbs (for grass patches) or native saplings, shrubs and seedlings (for forest patches). Patches will be planted pursuant to the densities outlined in Section 2.0. The specifications for seeding prairie grasses and forbs are provided in Appendix A. The specifications for planting all trees and shrubs are outlined in Appendix B. Similar to those utilized in previous restoration projects, field implementation of all planting activities will be coordinated through the use of the patch pages provided in Appendix C. The patch pages document the number and types of species to be planted in each patch, as well as the amount of mulch and seed required. Also, patch pages provide a means of documenting the schedule of water applied to a particular patch. Appendix C provides additional detail regarding the use of patch pages.

Each large Patch identified in Figure 1-3 will be broken into smaller planting plots for forest patches. The smaller planting plots will be identified in the field with a specific color flag. The same color ribbon will be used to identify all trees and shrubs to be planted in that specific plot. Trees and shrubs will then be planted in the plot without the identification of a specific planting location for individual plants. Oversight of the planting operation will be provided by SDFP Restoration Management to ensure that the spacing of the planting is appropriate and any special considerations are observed during planting.

4.2 PONDS AND WETLANDS

Two vernal pools constructed during late Summer 2002 will provide new habitat for amphibians and reptiles. It is anticipated that these pools will hold water during periods of increased rainfall. The areas will be seeded with the seed mix identified in Table 2-2 as soon as possible after construction activities are complete. In addition to the seeding, the following plugs will be planted on approximately 2-foot centers in the spring of 2003: bottlebrush sedge (*Carex lurida*), awl-fruited sedge (*Carex stipata*), fox sedge (*Carex vulpinoidea*), Joe pye weed (*Eupatorium maculatum*), soft rush (*Juncus effusus*), cardinal flower (*Lobelia cardinalis*), great blue lobelia (*Lobelia siphilitica*), dark green bulrush (*Scirpus atrovirens*), and woolgrass (*Scirpus cyperinus*).

1 4.3 FIELD IMPLEMENTATION

2 Planting activities for the NPP are scheduled to begin in October 2002 and be complete in 2004. All
3 revegetation activities will be coordinated and supervised by SDFP Restoration Management using an
4 on-site construction services contractor. Fluor Fernald will ensure that all applicable policies, procedures,
5 and regulations will be met in the planning and implementation of the work. The NRTs have approval
6 authority for this NRRDP. Fluor Fernald will assign a restoration ecologist that is responsible for
7 coordinating the handling, planting, maintenance, and monitoring of the NPP vegetation.

8 9 4.3.1 Planting Window

10 The fall planting window extends from October 1 until the ground is frozen in the winter. The spring
11 planting window extends from the beginning of March (or earlier depending on weather) until May 15.
12 The restoration ecologist in coordination with the Fernald NRTs will determine whether conditions are
13 appropriate for planting.

14 15 4.3.2 Sequencing

16 The planting sequence is designed to minimize travel through completed patches. The installation of
17 trees and shrubs will begin in Patch 1 located in the northeast corner of the NPP (Figure 1-3). The second
18 patch to be planted will be Patch 2. It is anticipated that all of Patch 1 and a portion of Patch 2 can be
19 installed in the Fall 2002. Saplings and shrubs will be planted first and seedlings will be installed last to
20 avoid impacting planted seedlings. Patches 3 and 4 will be installed in later planting seasons. All areas
21 affected by grading activities will be seeded with the wet prairie mix in Fall 2002. Herbaceous plant
22 plugs will be installed around wetlands and vernal pools in Spring 2003. Plant material orders have been
23 staggered to accommodate this approach.

24
25 Attempts will be made to sequence the delivery of plant material to minimize the amount of time that
26 plant stock is exposed. Alterations in the sequence may occur due to plant material delivery. Installation
27 of plant material will take precedence over maintaining the proper sequence of patches. Trees and shrubs
28 will usually be planted as soon as possible after delivery in order to minimize the time a plant spends out
29 of the ground.

30 31 4.3.3 Plant Material Availability/Substitutions

32 Procurement of trees and shrubs have been planned through a long-term contract with two separate
33 growers in an attempt to guarantee that all the specified plant species, quantities, and sizes will be
34 available. In the event that specific plant stock is not available, each tree and shrub species has been

1 assigned a substitution category that any substitution must meet in order to fulfill the same habitat role as
2 the original species. Substitution categories include cover, mast, diversity, aesthetics, and fruit. No
3 cultivars, hybrids, or plants non-native to southwest Ohio will be accepted as substitutes.

4 5 4.3.4 Planting Procedure

6 Each habitat patch will be flagged for species placement by the restoration ecologist. Usually, species
7 will be distributed throughout the patch. A few species will be specified for a clumped distribution,
8 where several of the individual plants are placed closely together. The restoration ecologist will adjust
9 species locations according to patch-specific hydrological and topographical conditions.

10
11 All plant material will be installed in accordance with the specifications included in Appendix B. In
12 general, laborers will dig sapling planting holes mechanically or by hand, install the plant to the
13 appropriate height, backfill by hand, and water. Transport materials (flagging, twine, etc.) will be
14 removed prior to installation. Slow release fertilizer tablets will be placed in each planting hole at the
15 manufacturer's specified rate.

16
17 The laborers will randomly place seedlings under the supervision of the restoration ecologist. Seedlings
18 will be planted by hand with a dibble bar or spade. Mycorrhizal fungi will be utilized in the planting of
19 wetland plugs and all seeding activities. Wetland plugs will be inoculated with endomycorrhizal fungi by
20 the vendor prior to delivery. All grass/forb seeding will be supplemented with endomycorrhizal
21 inoculation as well. Inoculate will be mixed into the seed mix prior to drilling or broadcasting. Container
22 grown trees and shrubs will not be inoculated.

23 24 4.3.5 Mulching

25 All planted vegetation will be mulched prior to project completion. Tree saplings and shrubs will receive
26 a wood chip mulch ring at least 4 feet in diameter, 4 inches thick. Seedlings will receive a mulch ring at
27 least 2 feet in diameter, 4 inches thick. Mulch will not be piled against the stem of the vegetation.

5.0 MONITORING AND MAINTENANCE

Monitoring and maintenance will be carried out to ensure that the restoration of the NPP is successful and meets the stated goals of the project. All monitoring and maintenance will be carried out by Fluor Fernald Restoration Management, utilizing site labor as needed, with oversight provided by DOE.

5.1 MONITORING

Monitoring will be carried out in two phases per the approach agreed upon between the Fernald NRTs as noted in the 2001 Consolidated Monitoring Report for Restored Areas at the FEMP (DOE 2002c). The initial phase of monitoring will last two years after project completion in 2004 and will focus on the survival of the tree sapling and shrub species planted. Planting activities in the NPP are expected to be complete in spring of 2004 resulting in the initiation of monitoring activities in summer of 2004. The second phase of monitoring will last until 2007 and will be less intensive, focusing on the continued growth of the trees and general use of the area. Monitoring will be focused on the planted saplings and shrubs only. Seedlings will be over planted assuming 50 percent mortality to reach the desired stem density per acre. Because the seedlings will be over planted and a high mortality is expected, quantitative monitoring of a representative sample of seedlings will be included in the long-term monitoring.

5.1.1 Near-Term Success Criteria

The near-term success criteria are based on the survival of the trees and shrubs planted. The goal of the project as explained earlier in this design is to plant the right mix and density of plants to help the development of a multi-use habitat enhancement to support habitat quality enhancement. The first step towards successfully reaching that goal is to ensure survival of planted material. The results of the monitoring outlined below will be submitted to the NRTs in the annual Consolidated Monitoring Report for Restored Areas at the FEMP. This report is due by December 1 of the year after project completion. The first monitoring report containing information on the NPP will be submitted by December 1, 2003.

5.1.1.1 Saplings/Shrubs

In the first year after planting (i.e., Summer 2004), monitoring will be carried out to ensure 80 percent survival of all planted saplings and shrubs. Each planted plot must maintain 80 percent survival of saplings and shrubs. Monitoring will be carried out once per year in summer to determine the amount of living plant material. Mortality counts will be conducted in each planted plot. Trees and shrubs that have a majority (i.e., greater than 50 percent) of the plant die back into the crown or beyond a normal pruning line shall be considered dead. Any plot that has less than 80 percent survival of planted saplings and

1 shrubs will require the planting of replacement species. The number of replacements planted will have to
2 bring the number of living saplings and shrubs up to a number not less than 80 percent of the original
3 number of saplings and shrubs planted in the plot. After monitoring is conducted in early summer, any
4 required replacements will be ordered and planted in the fall of the same year. In the event that
5 replacements cannot be received during the fall planting window, replacement planting will occur the
6 following spring.

7
8 5.1.1.2 Grasses and Forbs

9 There will be a requirement for 90 percent coverage of grasses at the end of the first growing season after
10 project completion to ensure adequate stabilization of the area. At least 50 percent of the area will be
11 established in native grass cover at the end of the first growing season. It is anticipated that the first
12 growing season will be dominated by the growth of the cover crop and the permanent grasses and forbs
13 will start to establish by the end of the second growing season. Seeding of all upland areas occurred in
14 Spring 2002 with the upland prairie seed mix. All areas impacted by grading activities will be seeded in
15 the Fall 2002. Any upland areas disturbed during planting of trees and shrubs will be reseeded as needed
16 throughout the project. Percent cover will be determined using meter square quadrats consistent with
17 previous restoration projects. If 90 percent cover is not achieved and sustained in later growing seasons,
18 additional grasses and forbs will be interseeded into growth grasses at a rate to be determined.

19
20 5.1.2.2 Invasive/Aggressive Species

21 The presence of invasive species will be identified during the monitoring. The invasive species of
22 concern include, but are not limited to, the following: bush honeysuckle, wild grape, phragmites,
23 multiflora rose, cattail (*Typha spp.*), thistle (*Cirsium spp.*) and garlic mustard. Management to extirpate
24 honeysuckle, wild grape and thistle will be carried out as described in Section 5.2.2.1. Other invasive
25 species will be managed only if significant problems develop as determined by DOE in consultation with
26 the NRTs on a case-by-case basis.

27
28 5.1.2. Long-Term Monitoring Parameters

29 The long-term monitoring parameters will focus on the continued growth of the saplings and the use of
30 the area by wildlife. The long-term monitoring will be conducted every year until 2007 to ensure that the
31 saplings are growing within normal parameters. Long-term monitoring is carried out on a rotating basis
32 with each habitat (e.g., forest, wetland, prairie) monitored every third year. The NPP will be monitored as
33 part of the forest habitat in 2005. The saplings will be the focus of the long-term monitoring since the
34 development of the forest canopy is a key element in the natural succession process. Tip growth in a

1 representative sample of seedling will occur on an annual basis. The other important indicator regarding
2 the long-term health of the system is the type of wildlife that is using the area and the presence of
3 invasive/aggressive species being established in the restored area.

4
5 5.1.2.2 Sapling Growth

6 The growth of the saplings will be monitored in the forest plots during the functional monitoring process.
7 The caliper readings are not being proposed during the near-term success monitoring to allow the trees
8 time to acclimate with the new location and avoid taking caliper readings on trees that may die. The
9 growth of the saplings will be measured by taking caliper readings for diameter breast-height measuring
10 tip growth and identifying fruit production on a statistically significant, random subset of the saplings in
11 each forest plot. The measurements will be conducted in summer (i.e., June or July) of the monitoring
12 year. Baseline caliper readings will be taken in Summer 2004 to serve as a basis for comparison during
13 the monitoring events. Trees selected for the baseline caliper readings will be flagged with weatherproof
14 tags and will comprise the subset monitored during the functional monitoring period. The results of the
15 baseline caliper readings will be presented in the monitoring report prepared in 2004. Reports from the
16 long-term monitoring events will also be submitted as part of the annual Consolidated Monitoring Report
17 for Restored Areas at the FEMP by December 1 of each year.

18
19 5.1.2.2 Wildlife Use

20 Observations will also be made during the functional monitoring process regarding wildlife using the
21 area. A list of the wildlife observed in the project area will be compiled by DOE and the Fluor Fernald
22 Natural Resource Team and will be presented as part of the long-term monitoring reports. Wildlife use
23 will also be compared against baseline wildlife data on the area.

24
25 5.1.3 Adaptive Management

26 The concept of "Adaptive Management" will be used in making decisions regarding needed maintenance
27 and management of restored areas. Adaptive Management is defined as, "a continuing process of
28 planning, monitoring and adjusting with the objective of improving the project implementation and
29 outcomes." Adaptive management will allow the NRTs flexibility in making decisions regarding needed
30 maintenance and management of restored areas. Restored areas will be very dynamic in nature and set
31 standards or rules may not always apply to all situations in the field. The use of adaptive management
32 will be used to optimize the progress of restored areas towards functional success of restored habitats.
33 Adaptive management will not be used to increase the scope of restoration projects.

1 5.2 MAINTENANCE

2 Regularly scheduled maintenance activities will be required to ensure both the near-term and long-term
3 success of the NPP ecological restoration. These activities are discussed below.

4
5 5.2.1 Watering

6 Each plant will be watered at the time of installation as described in Section 4.3.4. Watering will be
7 carried out beyond the initial planting if normal rainfall conditions do not occur (approximately 1 inch per
8 week). Watering will be carried out using one of the following methods: direct watering of tree/shrub
9 with hose or watering using tree gator, water truck or sprinkler. Watering may be carried out during the
10 second growing season if significant drought conditions occur similar to the summers of 1999 and 2002.
11 Under normal rainfall conditions, watering after planting should not be necessary.

12
13 5.2.2 Invasive/Aggressive Species Control

14 The establishment of invasive and aggressive species can be a significant problem in restored areas
15 because they can out-compete desired species. Efforts will be employed to control invasive and
16 aggressive species in the years immediately following restoration to give planted material the best chance
17 to become established.

18
19 5.2.2.1 Near-Term Control

20 As part of the monitoring carried out during the first year following restoration, invasive or aggressive
21 species that require removal will be identified and flagged by the Fluor Fernald Restoration Team. The
22 NPP will be surveyed twice; once before June 1 and once after October 1. Honeysuckle and Multiflora
23 rose will be removed and/or sprayed. The first sweep is proposed for Fall 2003. Sweeps would be
24 conducted as needed until the end of the Implementation Monitoring period.

25
26 5.2.2.2 Long-Term Control

27 During each long-term monitoring event, an assessment of invasive/aggressive species becoming
28 established in the NPP will be made. Species that should be extirpated (e.g., bush honeysuckle, wild
29 grape and thistle) will be identified. Site labor will be used to extirpate selected invasive/aggressive
30 species using the EZ-ject Lance or cutting as soon after the monitoring event as possible.

31
32 5.2.3 Deer Control

33 The use of deer repellants to reduce browsing and the installation of tree tubes to minimize "deer rubs" on
34 saplings will be implemented in the NPP in a manner consistent with previous restoration projects. The

- 1 design of the planting plan to allow corridors for deer movement was developed based on
- 2 recommendations by Fluor Fernald's Deer Consultant (Brewer 2002). If the trees and shrubs show signs
- 3 of unacceptable levels of mortality due to deer damage, DOE will evaluate the implementation of more
- 4 intensive deer controls in the Project Area.

1 Fluor Fernald Fire Protection will provide consultation and guidance regarding fire protection and Life
2 Safety Issues. As appropriate, Fire Protection provides necessary emergency response personnel and
3 equipment for emergencies that could adversely affect people, property, or the environment. The FEMP
4 Fire Protection functional area shall provide guidance to ensure that fire hazard issues are properly
5 addressed and proper safeguards are in place for all activities associated with this project.

6
7 The S&H representative assigned to this project is responsible for integration and compliance with fire
8 protection requirements as defined in Procedures PL-3020, FEMP Emergency Plan, and in RM-0013, Fire
9 Protection Requirements Manual.

10
11 6.3 QUALITY ASSURANCE
12 Activities related to the implementation of the project will be conducted in accordance with the Quality
13 Assurance Job-Specific Plan (QAJSP), described in Appendix E of the Sitewide Excavation Plan
14 (DOE 1998b). Quality Assurance personnel will ensure compliance with the QAJSP by conducting
15 surveillances and inspections necessary to verify work plan and construction design requirements.
16 Objective evidence of assessments will be documented and become part of project records.

17
18 6.4 WASTE MANAGEMENT
19 During construction activities, field personnel will generate wastes. Management of waste streams will
20 be coordinated with Waste Acceptance Organization through the Project Waste Identification Document
21 process.

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APPENDIX A

**SEEDING AND BIOENGINEERING EROSION
CONTROL SPECIFICATIONS**

**SECTION 02930
SEEDING AND BIOENGINEERING EROSION CONTROL****PART 1 GENERAL****1.1 SCOPE**

- A. This Section includes soil stabilization, which includes application of crusting agent, establishing vegetation by seeding and dormant live cuttings, and installing biodegradable erosion control materials. The work in this Section includes, but is not limited to; soil preparation, interim vegetation, permanent vegetation, application of fertilizer, application of mulches, application of crusting agent, and installation of erosion control materials.

1.2 RELATED SECTIONS AND PLANS

- A. Section 02940 - Planting

1.3 REFERENCES

- A. Latest version of Ohio Department of Natural Resources (ODNR) Rainwater and Land Development Standards (ODNR Rainwater and Land Development Standards).
- B. "Identification and Listing of Hazardous Waste," Title 40, Code of Federal Regulations (CFR), Part 261, Subpart E.C.
- C. "Federal Hazardous Material Transportation Law," U.S. Department of Transportation (U.S. DOT, 1994).

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Furnish seed labeled in accordance with U.S. Department of Agriculture (USDA) Rules and Regulations under the Federal Seed Act and applicable State seed laws. Furnish seed in sealed bags or containers bearing the date of expiration. Do not use seed after its date of expiration. Each variety of seed shall have a purity of not less than 90 percent by weight, a percentage of germination not less than 80 percent by weight, and a weed to seed content of not more than 0.75 percent by weight and contain no noxious weeds. Furnish seed mixtures having seed proportioned by weight in accordance with Tables 1 and 2 of the Northern Pine Plantation Natural Resource Restoration Design Plan (NPP NRRDP), and Table 02930-2 of this Section. Areas requiring permanent seeding during the summer months (July 1 – September 20) shall be seeded with 30 lbs/acre of ReGreen or stabilize with a crusting agent as specified in this Section, unless otherwise directed by the Construction Manager or the Restoration Ecologist. Stabilization performed during the summer shall be followed by fall application of the appropriate permanent seed mix.

- B. Permanent seed mixes shall be treated with fungal (mycorrhizae) inoculant and bacterial (rhizobium) inoculants. The specified legumes must be inoculated with the appropriate rhizobial strains.
- C. Furnish mulch meeting the following requirements:
1. Mulch shall be straw or wood cellulose fiber, free of clay, stone, foreign substances, and free of weeds.
 2. Straw should not contain sticks larger than 1/4-inch diameter or other materials that may prevent matting down during application. Use straw that is free from mold and other objectionable material for placing with mulch blower equipment or other equipment as approved by the Construction Manager. Straw shall be generally 6 inches or more in length.
 3. Straw shall be:
 - a. weed free straw from the Minnesota Crop Improvement Association certified weed free straw vendors;
 - b. straw that has been inspected and determined to be weed free by Central Ohio Seed Testing;
 - c. native prairie grass mulch; or
 - d. equivalent substitute as approved by the Construction Manager.
 4. Mulch applied by hydrospraying shall be a bonded fiber matrix containing wood fibers held together with a hydrocolloid-based binder, which upon drying becomes insoluble and non-dispersible. The fibers shall be composed of 100 percent wood or wood by-products and shall be 100 percent biodegradable. Use a bonded fiber matrix containing a green dye that will provide for easy visual inspection for uniformity of slurry spread. The bonded fiber matrix, including dye, shall contain no growth or germination inhibiting properties. The wood cellulose fiber shall be manufactured in such a manner that, after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous material. When sprayed on the ground, the material shall allow absorption and percolation of moisture. The wood cellulose fiber shall meet the following requirements:

<u>Item</u>	<u>Specification Limit</u>
Particle Length	0.4 inch (maximum)
Particle Thickness	0.047 inch (maximum)
PH	4.0 to 8.5
Ash Content	1.6 % (maximum)
Water Holding Capacity (based on fiber dry weight)	500 % (minimum)
Moisture Content	12 % ± 3 % (by weight)

- D. Mulch binder agent shall be as approved by the Construction Manager and shall meet the following requirements:
1. The mulch binder shall be hydrocolloid base (guar gum) and shall not dissolve or disperse upon rewetting.
 2. The mulch binder shall not have hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR Part 261, Subpart C, for a hazardous waste in either its pre-applied or cured states.
 3. The mulch binder shall have a flash point greater than 200°F. The mulch binder shall be neither a flammable nor combustible liquid per U.S. Department of Transportation definition (DOT 1994). The mulch binder must not be susceptible to significant deterioration from exposure to the elements, including sunlight.
 4. The mulch binder shall be provided in concentrated solution and prepared so that it will not change in transportation or storage.
- E. The crusting agent shall be as approved by the Construction Manager and shall meet the following criteria:
1. pine sap emulsion comprised of a 100 percent organic emulsion produced from naturally occurring resins (pine sap); or a mixture of Conwed Fiber's Enviroblend hydraulic mulch and Finn Corporation's A-500 Hydro-Stik tacking agent (mulch binder); or an approved equal;
 2. not comprised of chloride, lignosulfonate, petroleum, or asphaltic-type emulsions;
 3. provide dust suppression and surface stability for exposed soils, both disturbed and undisturbed soils, and exposed coal fired ash (flyash);
 4. compatible with application via a hydro seeder, and must not require intense cleaning of equipment after application;
 5. non-tracking (i.e., will not stick to boots or tires) once cured;
 6. not have hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR Part 261, Subpart C, for a hazardous waste in either its pre-applied or cured states;
 7. have a flash point greater than 200 °F;
 8. be neither a flammable nor combustible liquid per DOT definition; and
 9. not be susceptible to significant deterioration from exposure to the elements, including sunlight.

- F. Woven coir erosion mat shall meet the following criteria:
1. coconut fiber content: 100%
 2. weight: 22 ounces per square yard
 3. thickness: 0.3 inches
 4. open area: 38%
 5. tensile strength: 1,350 lb/ft by 626 lb/ft (length by width)
 6. elongation: 34% by 38% (length by width)
- G. Coconut logs shall be constructed of 100% coconut fiber, 10-inch minimum diameter, 8-foot maximum length.
- H. Wood stakes for fastening coir mats and logs shall be as follows:
1. stakes for coir erosion mats shall be nominal 2 inch square, minimum 8 inches in length.
 2. stakes for coconut logs shall be nominal 2 inch square, minimum 35 inches in length.
- I. Metal staples for fastening coir mats shall be 11-gauge wire formed into a staple shape with minimum dimensions of 6 inches by 1 inch by 6 inches.
- J. Dormant live cuttings for bioengineering erosion control shall be as follows:
1. length: 2.5 foot minimum, 4 foot maximum
 2. diameter: 0.5 inch minimum, 2 inch maximum
 3. acceptable species include: silky dogwood (*Cornus amonum*), gray dogwood (*Cornus racemosa*), red osier dogwood (*Cornus stolonifera*), cottonwood (*Populus deltoides*), peachleaf willow (*Salix amygdaloides*), pussy willow (*Salix discolor*), sandbar willow (*Salix exigua*), black willow (*Salix nigra*), silky willow (*Salix sericea*), elderberry (*Sambucus canadensis*), and arrow wood (*Viburnum dentatum*). Additional species may be used upon approval by the Restoration Ecologist.
- K. Fertilizer:
1. Furnish commercial grade fertilizer, uniform in composition that meets the requirements of all State and Federal regulations and standards of the Association of Agricultural Chemists.
 2. Fertilizer shall be slow release complete fertilizer.
 3. Fertilizer for application within the NPP area shall be 34-0-10; other fertilizers may be approved by the Construction Manager or Restoration Ecologist. Fertilizers shall contain not less than 1 percent added sulfur and not more than 8 percent added iron, or an approved equal.

4. Fertilizer must have MSDS submitted in accordance with this Section.
5. Fertilizer shall be used for interim seeding only.
- L. Construction water shall be obtained from the on-site water source as directed by the Construction Manager.

2.2 EQUIPMENT

- A. Provide equipment of size and type to perform work specified in this Section.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

- A. Deliver containerized materials in uniform packages bearing the name of the manufacturer, the net weight and a statement of content. Deliver containerized materials to the site in original, properly labeled, unopened, clean containers each showing the manufacturer's guaranteed analysis conforming to applicable regulations and standards.
- B. Store materials in a dry area in a manner to prevent physical damage.

3.2 GENERAL

- A. Stabilization of disturbed areas by vegetation or by use of a crusting agent shall be performed at completion of excavation and stockpiles or within 7 calendar days of knowing a disturbed area will be idle for more than 45 calendar days, whichever is sooner.
- B. Crusting agents may be used as temporary measures prior to placement of interim vegetation after approval for the area by the Construction Manager.
- C. Disturbed areas which are scheduled to be significantly disturbed after initial stabilization and/or need effective erosion control immediately, are to be stabilized with the interim seed mix rate specified in this Section. Disturbed areas which are not scheduled to be significantly disturbed again are to be stabilized with the permanent seed mix rate specified in this Section. Soil piles, which require effective erosion control immediately, are to be stabilized with the interim seed mix rate or a crusting agent as specified in this Section.
- D. Stabilization of permanent slopes steeper than 3H:1V (horizontal to vertical) shall utilize coir matting as specified in Section 3.5 of this specification after application of seed mixture, unless otherwise specified by the Construction Manager or Restoration Ecologist.
- E. Area(s) to be seeded shall be generally free of debris, rock, root material, and other objects that may impede soil preparation and seeding activities. Perform soil preparation by tilling/cultivating, to a depth of approximately 2 inches, to eliminate uneven areas and low spots. Maintain lines, levels and contours.

- F. Repeat cultivation in areas where equipment used for hauling and spreading has compacted the area(s) to be seeded.

3.3 APPLICATION OF SEED AND CRUSTING AGENT

- A. The seeding season, for interim vegetation specified in this Section, is year round. However, if seeding is contemplated during the winter months of December through March, then field conditions should be assessed for ability to provide soil to seed contact. If field conditions do not support the ability to provide soil to seed contact then the area shall be stabilized with a crusting agent followed by seeding during conditions conducive to adequate soil to seed contact.
- B. The seeding seasons for permanent seeding in wet and dry areas are Spring Season between April 1 and July 1 and Fall Season between October 1 and November 15.
- C. Apply fertilizer, seed, and mulch to disturbed areas and areas excavated and graded under this Contract requiring seeding unless otherwise directed by the Construction Manager. Apply mulch within 24 hours of seeding; do not seed areas in excess of that which can be mulched within 24 hours. Winter application of seed and related materials are subject to adjustment as directed by the Construction Manager.
- D. Apply seed using either the drilling, broadcasting, or hydroseeding method, as described below:
 - 1. Seed drilling method:
 - a. This method shall be used for applying the permanent seed mix in accessible areas unless otherwise approved by the Construction Manager. The method may also be used for interim vegetation.
 - b. Prepare area to be seeded by loosening the soil to a minimum depth of 3 inches.
 - c. Apply commercial grade, slow release complete fertilizer, for interim vegetation only, at a rate of 150 lbs/acre at the time of preparing the seedbed for seeding.
 - d. Install seed with a seed drill to obtain a final planting depth of ¼ to ½ inch using the seed rates indicated in Tables 1 and 2 of the NPP NRRDP, and 02930-2 of this Section. All seed drilling should be done perpendicular to the direction of surface-water flow.
 - 2. Broadcast Seeding Method:
 - a. This method may be used for interim vegetation, and can be performed with the use of mechanical "cyclone" seeders, by hand seeding or by any other method which scatters seed over the soil surface.

- b. This method may also be used for permanent seeding in areas that are not accessible with the seed drill (i.e., sloped areas) as approved by the Construction Manager.
 - c. If Broadcast Method is used to apply permanent seed mix in sloped areas (3H:1V slope or steeper), seeding application rates in Tables 1 and 2 of the NPP NRRDP and 02930-2 of this Section shall be doubled.
 - d. Prepare the area to be seeded by loosening the soil to a minimum depth of 3 inches. This is critical to allow seeds to filter into the soil to avoid washout from runoff.
 - e. Apply commercial grade, slow release complete fertilizer, for interim vegetation only, at a rate of 150 lbs/acre at the time of preparing the seedbed for seeding.
 - f. Install seed by broadcasting evenly over the entire site using the seed rates indicated in Tables 1 and 2 of the NPP NRRDP and 02930-2 of this Section.
 - g. Rake the area after seeding.
 - h. Mulch and disc-anchor using weed free mulch at a rate of 2.0 tons per acre. Spread straw mulch, either by hand or by blowing method, at the rate of 2 air-dried tons per acre. During June through September, increase straw mulch application rate to 3 air-dried tons per acre.
3. Hydroseeding Method:
- a. This method may be used for interim vegetation only. Hydroseeding shall be a two-step process. The seed shall be applied first, followed by a separate application of the mulch. This is to ensure soil to seed contact.
 - b. The mixture tank shall be cleaned prior to use to ensure remnant seed is not introduced to the proposed seed mixture.
 - c. Prepare area to be seeded by loosening the soil to a minimum depth of 3 inches. This is critical to allow seeds to filter into the soil to avoid washout from runoff.
 - d. Apply commercial grade, slow release complete fertilizer, for interim vegetation only, at a rate of 150 lbs/acre. The fertilizer is to be mixed and applied with the mulch.
 - e. Install seed by hydroseeding evenly over the entire area using the seed rates indicated in Table 02930-2. Use a fan-type nozzle with approximately 500 gallons of water per acre to ensure even distribution.
 - f. Rake the area where accessible following seeding.

- g. Apply sprayed mulch at a net dry weight of 2,000 pounds per acre minimum and 100 percent continuous coverage. Mix the mulch with water at a ratio of 50 pounds of mulch per 100 gallons of water.

E. Application of Crusting Agent:

1. Apply crusting agent in accordance with manufacturer's directions.
2. Unless otherwise specified by the manufacturer, dilute concentrated pine sap emulsion to ratio of 4 parts water to 1 part concentrate. Apply diluted pine sap emulsion at a rate of 2,500 gallons per acre.
3. Apply a mixture of Conwed Fiber's Enviroblend hydraulic mulch and Finn Corporation's A-500 Hydro-Stik mulch binder, using the hydroseeder, at the rate of 1,000 lbs/acre on flat surfaces; and 1,125 lbs/acre on slopes greater than 3H:1V. The mixture rate for each product shall be 20 lbs/acre on flat surfaces and 30 lbs/acre on greater than 3H:1V slopes for the hydraulic mulch; and 20 lbs/acre on flat surfaces and 30 lbs/acre on slopes greater than 3H:1V for the Hydro-Stik mulch binder.

3.4 BIOENGINEERING EROSION CONTROL

- A. Following seeding, install coir matting and/or coir logs in areas indicated on the Construction Drawings, on slopes steeper than 3H:1V, or in any other areas prone to erosion, as identified by the Construction Manager or the Restoration Ecologist. Installation is as follows:
1. coir matting: Stake coir matting on minimum 5 foot centers with wood stakes, angled upstream/upgradient. Use metal staples for added support, installing staples on minimum 5 foot centers between wood stakes and in additional areas so that the coir matting is in direct contact with the soil. The Restoration Ecologist shall direct the installation of additional stakes and/or staples as necessary. Overlap adjoining sections of coir matting 6 to 12 inches, with the upstream/upgradient matting laid on top. Sew adjoining sections of matting together with coir rope. Bury the upper edge of coir matting in a 6-inch trench.
 2. coir logs: Stake coir logs on 10 foot centers. Install 2 stakes opposite each other and tie the stakes together with coir rope. Sew adjoining coir logs together with coir rope.
- B. Secure all coir materials at the end of the day in preparation for unexpected rain events.
- C. Dormant live cuttings shall be installed as follows: Cut a point onto the bottom of the live cutting and drive into the soil on 4 foot centers using a dead blow hammer. Drive cuttings (minimum two-thirds, maximum four-fifths of their length) into soil angled slightly downstream/downgradient. Minimize damage to the cuttings when driving into the soil. If necessary, prepare a pilot hole by driving rebar into the soil and removing prior to inserting cuttings. Saw any damaged tops once the cuttings are installed.

Dormant live cuttings may be installed into coir matting or other areas prone to erosion as directed by the Restoration Ecologist.

3.5 MAINTENANCE

- A. Maintain the vegetated areas in satisfactory condition until acceptance of the vegetation by the Construction Manager. Maintenance of the vegetated areas includes repairing eroded areas, revegetating when necessary, watering, and mowing (if applicable). A satisfactory condition of vegetated area is defined as follows:
1. an area shall have a predominant stand of the seeded vegetation;
 2. within 3 weeks, germination must occur over 90 percent of the area with no single bare area greater than 3 square feet; and
 3. within 3 months, 90 percent of the area must be covered with mature vegetation.
- B. The above timeframes for germination and coverage requirements are to be delayed during the dormant season between November 1 and March 15 application of the seed. The performance criteria shall be measured at the beginning of the growing season (April 1) for seed applied during the previous dormant season.
- C. Areas that fail to meet these requirements shall be repaired or reseeded as necessary to produce an acceptable stand of vegetation, as specified in this Section.
- D. The acceptance inspection will be performed by the Construction Manager who will determine whether repair of vegetated areas or revegetation is required.
- E. Maintain areas with a crusting agent to ensure proper erosion control. The crusting agent shall be reapplied to eroded and bare areas as necessary.

**TABLE 02930-2
SEED MIX FOR INTERIM VEGETATION**

Species	Pounds Per Acre (lb/ac)
ReGreen	50
Annual Rye Grass	20
Canada Wild Rye	20

[END]

4520

APPENDIX B
PLANTING SPECIFICATIONS

000049

**SECTION 02940
PLANTING****PART 1 GENERAL****1.1 SCOPE**

- A. This Section includes the requirements for planting trees, shrubs, and herbaceous potted plants as shown on the Construction Drawings.

1.2 RELATED SECTIONS AND DOCUMENTS

- A. Section 02930 - Vegetation.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Container grown trees shall be a minimum of 6 feet in height, grown in "spin-out" containers and acquired from a local seed source if possible. Potting material shall be pre-inoculated with mycorrhizae.
- B. Container-grown shrubs shall be a minimum of 1 foot in height, grown in "spin-out" containers and acquired from a local seed source if possible. Potting material shall be pre-inoculated with mycorrhizae.
- C. Bareroot seedlings shall be pre-inoculated with ectomycorrhizae and shall not be exposed to the air any longer than possible prior to planting.
- D. Herbaceous potted plants shall be grown in open bottom, minimum 2-inch square, 3-inch deep containers. Potting material shall be inoculated with ectomycorrhizae.
- E. Fertilizer shall be slow-release tablet form, and not exceed a N-P-K mix of 22-5-10. Fertilizer shall contain not less than 1 percent added sulfur and not more than 8 percent added iron, or an approved equal.
- F. Mulch shall be an aged hardwood mulch, free of clay, stone, foreign substances, and free of weeds.
- G. Wooden stakes for staking trees as needed shall be nominal 2 inch square, approximately 18-inches in length.

2.2 EQUIPMENT

- A. Equipment for performing work in this section shall be low ground pressure equipment that will not compact amended soils.

PART 3 EXECUTION**3.1 GENERAL**

- A. Planting locations will be flagged in the field by the Restoration Ecologist. The Restoration Ecologist is the Fluor Fernald contact responsible for identifying locations of all plant material installation, verifying acceptance of delivered plant material, and ensuring proper installation.
- B. Unless otherwise approved by the Restoration Ecologist, all plant installation shall take place between October 1 and December 15 or February 15 and May 15.
- C. The Restoration Ecologist may restrict planting activities based on field conditions (e.g., droughts, unseasonable freezes).
- D. No plant installation may take place while the soil surface is frozen.
- E. Plant material delivered to the project site that will not be planted within 24 hours shall have their containers completely covered with woodchip mulch and kept moist with periodic watering.
- F. The Construction Manager will provide a source of water sufficient to support all field activities specified in this Section.

3.2 INSTALLATION OF CONTAINER-GROWN TREES AND SHRUBS (DETAIL A-1)

- A. Excavate planting pit to a depth such that the top of the ball, when planted, extends 1 to 2 inches above ground surface.
- B. Excavate the planting pit so that it is wider than the root ball by 9 inches on all sides.
- C. Scarify the sides of the planting pit using a shovel.
- D. Remove the plant from the container by carefully inverting the plant and loosening the root ball from the container, cutting the container if necessary. Keep the root ball as intact as possible. Handle the plant by the root ball only. Do not pull the plant from the container by the trunk of the tree or shrub.
- E. Add a slow-release fertilizer tablet or packet (e.g., Osmocote, Agriform or similar) around the ball per manufacturers recommendations.
- F. Set trees and shrubs such that the top of the ball extends 1 to 2 inches above the ground surface and that the trunk is vertical. Trunks shall have no appreciable lean, at the discretion of the Restoration Ecologist.
- G. Backfill around the root ball with a mixture of the topsoil and subsoil removed from the pit. Gently tamp the backfill as it is placed into the pit.

- H. Water the tree/shrub immediately after planting to saturate the upper 12 inches of soil.
- I. Remove any tags, labels, strings or wires from the plant, unless otherwise directed by the Restoration Ecologist.

3.3 INSTALLATION OF BAREROOT PLANTS (DETAIL A-2)

- A. Carry bareroot plants in a bucket of water (or moist sand or other moist medium) in the field to keep the roots from drying out. Bareroot plants shall not be stored in water for more than 6 hours at a time. Bareroot plants that require overnight storage shall have their root balls covered completely with hardwood mulch.
- B. Excavate the planting pit by hand using a dibble bar or spade. The pit shall be only broad enough to accommodate the roots when fully extended and only deep enough such that the uppermost roots will be just below ground surface.
- C. Set the plant and spread the roots in a natural pattern such that the roots are fully extended without touching the sides of the planting pit and that the uppermost roots are just below ground surface.
- D. Carefully work backfill (mix of topsoil and subsoil removed from the planting pit) through the fully spread root systems and water while backfilling.
- E. Firmly tamp backfill with the heel of the shoe when complete.
- F. Remove any tags, labels, and strings from the plant, unless otherwise directed by the Restoration Ecologist.

3.4 INSTALLATION OF HERBACEOUS POTTED PLANTS

- A. Place potted plant flats in standing water immediately upon delivery to the project site. Keep flats in water until installation.
- B. Excavate the planting pit by hand using a dibble bar or spade. The pit shall be only broad enough to accommodate the roots when fully extended and only deep enough such that the uppermost roots will be just below ground surface.
- C. Set the plant and spread the roots in a natural pattern such that the roots are fully extended without touching the sides of the planting pit and that the uppermost roots are just below ground surface.
- D. Carefully work backfill (mix of topsoil and subsoil removed from the planting pit) through the fully spread root systems and water while backfilling.
- E. Firmly tamp backfill with the heel of the shoe when complete.
- F. Remove any tags, labels, and strings from the plant, unless otherwise directed by the Restoration Ecologist.

3.5 PRUNING

- A. Once trees and shrubs are planted, prune off any dead or damaged limbs.
- B. All pruning shall involve removal of limbs back to a lateral branch or bud.
- C. Perform additional pruning at the request of the Restoration Ecologist.

3.6 MULCHING

- A. Apply a 4-inch layer of hardwood mulch over a circular area 4 feet in diameter surrounding balled and burlapped and container grown trees and shrubs. At the discretion of the Restoration Ecologist, straw may be used as a substitute for hardwood mulch.
- B. Apply a 4-inch layer of hardwood mulch over a circular area 2 feet in diameter surrounding each bare root or potted plant. At the discretion of the Restoration Ecologist, straw may be used as a substitute for hardwood mulch.
- C. Mulch shall be placed so as to not physically contact the plants.

3.7 WATERING

- A. Water all planted material weekly for 6 weeks following installation, unless otherwise directed by the Restoration Ecologist. Watering shall be sufficient to saturate the entire root ball. This typically requires the slow release of approximately 10 gallons of water for each plant.

3.8 STAKING AND GUYING

- A. Stake and guy trees only at the request of the Restoration Ecologist.

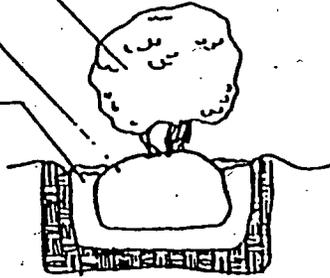
END OF SECTION

Detail A-1: Installation of Balled and Burlapped and Container-Grown Trees and Shrubs

SHRUB SET VERTICAL
WITH NO MORE THAN
10% LEAN

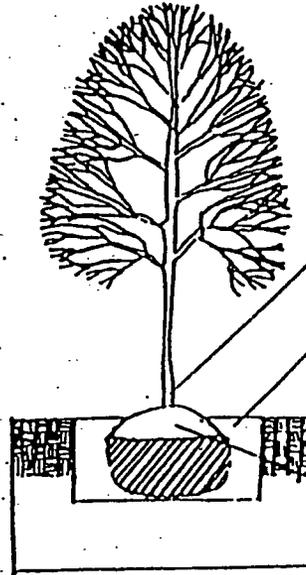
BALL SET SO THAT
ITS TOP IS APPROX.
1-2" ABOVE SOIL LINE

PLANTING PIT EXCAVATED
9" WIDER THAN BALL
ON ALL SIDES



TRUNK SET VERTICAL
WITH NO MORE THAN
10% LEAN

PLANTING PIT EXCAVATED
9" WIDER THAN BALL ON
ALL SIDES



BALL SET SO THAT
ITS TOP IS APPROXIMATELY
1-2" ABOVE SOIL LINE

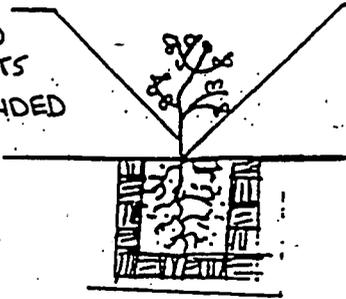
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Detail A-2: Installation of Bareroot Plants

PLANTING POT
LARGE ENOUGH TO
ACCOMMODATE ROOTS
IN A FULLY EXTENDED
POSITION



SET PLANT SUCH
THAT UPPER MOST
ROOTS ARE JUST
BELOW THE SOIL
SURFACE

-- 4520

APPENDIX C

PLANTING PATCH PAGES

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Appendix C

Beech-Maple Forest Template

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Scientific Name	Common Name	Placement	2002 Fall	PA1 Sec.1	PA1 Sec.2	PA2 Sec.4
<i>Acer saccharinum</i>	Silver Maple	wet	6		6	
<i>Acer saccharum</i>	Sugar Maple		22		22	
<i>Carya cordiformis</i>	Bitternut Hickory		13		13	
<i>Carya laciniosa</i>	Shellbark Hickory		10		10	
<i>Celtis occidentalis</i>	Hackberry	edge	3		3	
<i>Fraxinus americana</i>	White Ash		8		8	
<i>Juglans nigra</i>	Black Walnut		16		16	
<i>Liriodendron tulipifera</i>	Tulip Poplar		4		4	
<i>Ostrya virginiana</i>	Hop-Hornbeam	wet	1		1	
<i>Prunus serotina</i>	Black Cherry		12		12	
<i>Quercus rubra</i>	Red Oak		12		12	
<i>Campsis radicans</i>	Trumpet Creeper	edge	16	6	4	6
<i>Crateagus crus-galli</i>	Cockspur Hawthorne		3	1	1	1
<i>Ostrya virginiana</i>	Hop-Hornbeam	wet	3		3	
<i>Physocarpus opulifolius</i>	Ninebark	edge	22	11		11
<i>Prunus americana</i>	American Plum		14	6		8
<i>Rhus typhina</i>	Staghorn Sumac		64	26	12	26
<i>Rosa caroliniana</i>	Carolina Rose		24	6	12	6
<i>Staphylea trifolia</i>	Bladdernut	edge	21	3	15	3
<i>Symphoricarpos orbiculatus</i>	Coralberry		33	15	3	15
<i>Viburnum prunifolium</i>	Blackhaw Viburnum		30	15		15
<i>Zanthoxylum americanum</i>	Prickly Ash		6	1	4	1

Appendix C

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Oak-Hickory Forest Template

Scientific Name	Common Name	Placement	2002 Fall	PA2 Sec.1	PA2 Sec.2	PA2 Sec.3
<i>Acer rubrum</i>	Red Maple	wet	50	22	28	
<i>Acer saccharum</i>	Sugar Maple		16	13	3	
<i>Carya cordiformis</i>	Bitternut Hickory		11	9	2	
<i>Carya ovata</i>	Shagbark Hickory		39	28	11	
<i>Celtis occidentalis</i>	Hackberry	edge	3	2	1	
<i>Cercis canadensis</i>	Redbud	edge	9	8	1	
<i>Cornus drumondii</i>	Roughleaf Dogwood	edge	3	2	1	
<i>Cornus florida</i>	Flowering Dogwood		5	4	1	
<i>Cornus racemosa</i>	Grey Dogwood		24	18	6	
<i>Fraxinus americana</i>	White Ash		31	22	9	
<i>Fraxinus quadrangulata</i>	Blue Ash		4	4	0	
<i>Gymnocladus dioica</i>	Kentucky Coffeetree		6	4	2	
<i>Liriodendron tulipifera</i>	Tulip Poplar		1	1	2	
<i>Quercus alba</i>	White Oak		62	48	14	
<i>Quercus coccinea</i>	Scarlet Oak		9	9	0	
<i>Quercus inbricaria</i>	Shingle Oak		6	6	0	
<i>Quercus muhlenbergii</i>	Chinquapin Oak		10	8	2	
<i>Quercus rubra</i>	Red Oak		18	12	6	
<i>Quercus shumardii</i>	Shumard Oak		10	8	2	
<i>Quercus velutina</i>	Black Oak		16	14	2	
<i>Ulmus rubra</i>	Slippering Elm		19	12	7	
<i>Amelanchier arborea</i>	Downy Serviceberry	wet	35	11	24	
<i>Campsis radicans</i>	Trumpet Creeper	edge	17	4	3	4
<i>Ceanothus americanus</i>	New Jersey Tea	wet	6	1	5	
<i>Cercis canadensis</i>	Redbud		25	9	6	6
<i>Cornus drummondii</i>	Roughleaf Dogwood		4	4		
<i>Cornus florida</i>	Flowering Dogwood		17	7	2	2
<i>Cornus racemosa</i>	Gray Dogwood		42	14	7	8
<i>Crateagus crus-galli</i>	Cockspur Hawthorne		22	12		6
<i>Physocarpus opulifolius</i>	Ninebark	edge	22	6		7
<i>Prunus americana</i>	American Plum		14	3		5
<i>Rhus aromatica</i>	Fragrant Sumac		15		2	5
<i>Rhus glabra</i>	Smooth Sumac	edge	10	2		2
<i>Rosa caroliniana</i>	Carolina Rose		24	16		
<i>Rosa setigera</i>	Prairie Rose	wet	46	12	34	
<i>Rubus occidentalis</i>	Black Raspberry	edge	46	12	7	16
<i>Sassafras albidium</i>	Sassafras		6			1
<i>Symphoricarpos orbiculatus</i>	Coralberry		40	15		14
<i>Viburnum prunifolium</i>	Blackhaw Viburnum		45	16		15
<i>Zanthoxylum americanum</i>	Prickly Ash		6			

Appendix C

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Beech-Maple Forest Template

Scientific Name	Common Name	Placement	2003 Spring	PA1 Sec.1	PA1 Sec.2	PA2 Sec.4	PA3 Sec.1
Acer nigrum	Black Maple		38	14		24	
Acer saccharinum	Silver Maple	wet	9			9	
Acer saccharum	Sugar Maple		72	26		46	
Asimina triloba	Pawpaw		8	3		5	
Carpinus caroliniana	Hornbeam		3	2		1	
Carya cordiformis	Bitternut Hickory		5	2		3	
Carya laciniosa	Shellbark Hickory		29	5		24	
Celtis occidentalis	Hackberry	edge	2	2			
Cornus alternifolia	Alternate Leaf Dogwood		1	1			
Crataegus mollis	Downy Hawthorne		3	1		2	
Fagus grandifolia	Beech		129	35	25	69	
Fraxinus americana	White Ash		20	13		7	
Fraxinus pennsylvanicum	Green Ash		14			14	
Juglans cinerea	Butternut		1			1	
Juglans nigra	Black Walnut		36	12		24	
Liriodendron tulipifera	Tulip Poplar		17	6	2	9	
Ostrya virginiana	Hop-Hornbeam	wet	2			2	
Populus deltoides	Cottonwood		9	2	1	6	
Prunus serotina	Black Cherry		28	12		16	
Quercus palustris	Pin Oak		19	5		14	
Quercus rubra	Red Oak		17	7		10	
Tilia americana	Basswood		40	12	12	16	
Alnus serrulata	Smooth Alder	wet	5	2		1	2
Asimina triloba	Pawpaw		4				4
Carpinus caroliniana	American Hornbeam		15	3		6	6
Cephalanthus occidentalis	Buttonbush	wet	19	3		11	5
Cornus amomum	Silky Dogwood	wet	3			3	
Corylus americana	Hazelnut	wet	4			2	2
Crateagus crus-galli	Cockspur Hawthorne		2				2
Crateagus mollis	Downy Hawthorne		14	3		7	4
Hamamelis virginiana	Witch Hazel		23	7		8	8
Hypericum spathulatum	Shrubby St. John's Wort	wet	11	1		4	6
Ilex verticalata	Winterberry	wet	13			6	7
Lindera benzoin	Spicebush		15	4		6	5
Ostrya virginiana	Hop-Hornbeam	wet	15	2		6	7
Physocarpus opulifolius	Ninebark	edge	2				2
Prunus americana	American Plum		1	1			
Rhus typhina	Staghorn Sumac		4			2	2
Rosa palustris	Swamp Rose	wet	22	4		4	14
Salix discolor	Pussy Willow	wet	10	2		3	5
Sambucus canadensis	Elderberry	wet	13	3		5	5
Spirea alba	Meadowsweet	wet	10	3		6	1
Viburnum acerifolium	Mapleleaf Viburnum		12	2		6	4
Zanthoxylum americanum	Prickly Ash		2				2

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Appendix C

Oak-Hickory Forest Template

Scientific Name	Common Name	Placement	2003 Spring	PA2 Sec.3	PA4 Sec.3	PA4 Sec.4
Acer rubrum	Red Maple	wet	17	15		2
Acer saccharum	Sugar Maple		19	2		17
Aesculus glabra	Ohio Buckeye	wet	32	18		14
Carya cordiformis	Bitternut Hickory		10	1		9
Carya ovata	Shagbark Hickory		14	4		10
Celtis occidentalis	Hackberry	edge	7	4		3
Cercis canadensis	Redbud	edge	3	1		2
Cornus drumondii	Roughleaf Dogwood	edge	1			1
Cornus florida	Flowering Dogwood		2			2
Cornus racemosa	Grey Dogwood		7	5		2
Fraxinus americana	White Ash		30	6		24
Fraxinus pennsylvanicum	Green Ash	wet	15	15		
Fraxinus quadrangulata	Blue Ash		1			1
Gymnocladus dioica	Kentucky Coffeetree		2			2
Juglans cinerea	Butternut		3	3		
Liriodendron tulipifera	Tulip Poplar		7	4		3
Liquidambar styraciflua	Sweetgum		1	1		
Platanus occidentalis	Sycamore		9	9		
Quercus alba	White Oak		25	8		17
Quercus bicolor	Swamp White Oak		4	4		
Quercus coccinea	Scarlet Oak		3			3
Quercus inbricaria	Shingle Oak		2			2
Quercus muhlenbergii	Chinquapin Oak		3			3
Quercus prinus	Chestnut Oak		1	1		
Quercus rubra	Red Oak		30	10		20
Quercus shumardii	Shumard Oak		3	3		
Quercus velutina	Black Oak		6			6
Ulmus rubra	Slippering Elm		7	6		1
Alnus serrulata	Smooth Alder	wet	5		5	
Celastrus scandens	Bittersweet		6		6	
Cephalanthus occidentalis	Buttonbush	wet	10	10		
Cornus amomum	Silky Dogwood	wet	3		3	
Corylus americana	Hazelnut	wet	3		3	
Hypericum spathulatum	Shrubby St. John's Wort	wet	8		8	
Ilex verticallata	Winterberry	wet	11		11	
Physocarpus opulifolius	Ninebark	edge	2		2	
Prunus americana	American Plum		1		1	
Rhus glabra	Smooth Sumac	edge	1		1	
Rosa setigera	Prairie Rose	wet	11		11	
Salix discolor	Pussy Willow	wet	10		10	
Sambucus canadensis	Elderberry	wet	14		14	
Spiraea alba	Meadowsweet	wet	10		10	

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Appendix C

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Beech-Maple Forest Template

Scientific Name	Common Name	Placement	2003 Fall	PA3 Sec.1	PA3 Sec.2	PA3 Sec.3	PA3 Sec.4
<i>Acer nigrum</i>	Black Maple		63	11	25	18	9
<i>Acer saccharinum</i>	Silver Maple	wet	15	8	7		
<i>Acer saccharum</i>	Sugar Maple		120	15	49	38	18
<i>Asimina triloba</i>	Pawpaw		14	4	6	4	
<i>Carpinus caroliniana</i>	Hornbeam		6	1		2	3
<i>Carya cordiformis</i>	Bitternut Hickory		13	2	3	5	3
<i>Carya laciniosa</i>	Shellbark Hickory		46	4	20	10	12
<i>Celtis occidentalis</i>	Hackberry	edge	9	2	3	2	2
<i>Cornus alternifolia</i>	Alternate Leaf Dogwood		2			2	
<i>Crataegus mollis</i>	Downy Hawthorne		5	1	2	1	1
<i>Fagus grandifolia</i>	Beech		211	36	89	44	42
<i>Fraxinus americana</i>	White Ash		25			18	11
<i>Fraxinus pennsylvanicum</i>	Green Ash		31	12	19		
<i>Juglans cinerea</i>	Butternut		13		3		
<i>Juglans nigra</i>	Black Walnut		58	9	16	18	15
<i>Liriodendron tulipifera</i>	Tulip Poplar		14	4	10		
<i>Ostrya virginiana</i>	Hop-Hornbeam	wet	4		4		
<i>Populus deltoides</i>	Cottonwood		15	5	10		
<i>Prunus serotina</i>	Black Cherry		46	9	17	12	8
<i>Quercus palustris</i>	Pin Oak		32	10	16	3	3
<i>Quercus rubra</i>	Red Oak		24	6	6	6	6
<i>Tilia americana</i>	Basswood		65	13	3	21	28
<i>Alnus serrulata</i>	Smooth Alder	wet	8		6		2
<i>Asimina triloba</i>	Pawpaw		6		3	3	
<i>Carpinus caroliniana</i>	American Hornbeam		24		8	6	10
<i>Celastrus scandens</i>	Bittersweet		6		2	2	2
<i>Cephalanthus occidentalis</i>	Buttonbush	wet	25		18		7
<i>Cornus amomum</i>	Silky Dogwood	wet	13		3		
<i>Corylus americana</i>	Hazelnut	wet	8		2	2	4
<i>Crataegus crus-galli</i>	Cockspur Hawthorne		2			2	
<i>Crataegus mollis</i>	Downy Hawthorne		22		9	6	7
<i>Hamamelis virginiana</i>	Witch Hazel		37		13	12	12
<i>Hypericum spathulatum</i>	Shrubby St. John's Wort	wet	11		5		6
<i>Ilex verticillata</i>	Winterberry	wet	20		9		11
<i>Lindera benzoin</i>	Spicebush		25		7	9	9
<i>Ostrya virginiana</i>	Hop-Hornbeam	wet	23		5	9	9
<i>Physocarpus opulifolius</i>	Ninebark	edge	3			3	
<i>Prunus americana</i>	American Plum		2				2
<i>Rhus typhina</i>	Staghorn Sumac		6		1	2	3
<i>Rosa palustris</i>	Swamp Rose	wet	37		11	13	13
<i>Salix discolor</i>	Pussy Willow	wet	17		6		11
<i>Sambucus canadensis</i>	Elderberry	wet	24		10		14
<i>Spiraea alba</i>	Meadowsweet	wet	16		10	1	5
<i>Viburnum acerifolium</i>	Mapleleaf Viburnum		18		6	6	6

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Appendix C

Oak-Hickory Forest Template

Scientific Name	Common Name	Placement	2003 Fall	PA4 Sec.1	PA4 Sec.2	PA4 Sec.4
<i>Acer rubrum</i>	Red Maple	wet	28	4	18	6
<i>Acer saccharum</i>	Sugar Maple		28	18	6	4
<i>Aesculus glabra</i>	Ohio Buckeye	wet	52	16	30	6
<i>Carya cordiformis</i>	Bitternut Hickory		11	5	4	2
<i>Carya ovata</i>	Shagbark Hickory		21	10	8	3
<i>Celtis occidentalis</i>	Hackberry	edge	6	3	2	1
<i>Cercis canadensis</i>	Redbud	edge	5	2	2	1
<i>Cornus drumondii</i>	Roughleaf Dogwood	edge	2		2	
<i>Cornus florida</i>	Flowering Dogwood		3	1	2	
<i>Cornus racemosa</i>	Grey Dogwood		13	6	3	4
<i>Fraxinus americana</i>	White Ash		52	26	15	11
<i>Fraxinus pennsylvanicum</i>	Green Ash	wet	14	1	13	
<i>Fraxinus quadrangulata</i>	Blue Ash		2	2		
<i>Gymnocladus dioica</i>	Kentucky Coffeetree		3	3		
<i>Juglans cinerea</i>	Butternut		5		5	
<i>Liriodendron tulipifera</i>	Tulip Poplar		15	5	8	2
<i>Liquidambar styraciflua</i>	Sweetgum		2		2	
<i>Platanus occidentalis</i>	Sycamore		14	2	12	
<i>Quercus alba</i>	White Oak		40	20	12	8
<i>Quercus bicolor</i>	Swamp White Oak		7		7	
<i>Quercus coccinea</i>	Scarlet Oak		4			4
<i>Quercus inbricaria</i>	Shingle Oak		3	2	1	
<i>Quercus muhlenbergii</i>	Chinquapin Oak		5	1	1	3
<i>Quercus prinus</i>	Chestnut Oak		2	2		
<i>Quercus rubra</i>	Red Oak		52	22	18	12
<i>Quercus shumardii</i>	Shumard Oak		6	4	1	1
<i>Quercus velutina</i>	Black Oak		10	4	3	3
<i>Ulmus rubra</i>	Slippering Elm		19	7	7	5
<i>Alnus serrulata</i>	Smooth Alder	wet	8	4		4
<i>Celastrus scandens</i>	Bittersweet		3	3		
<i>Cephalanthus occidentalis</i>	Buttonbush	wet	20	2	18	
<i>Cornus amomum</i>	Silky Dogwood	wet	3	3		4
<i>Corylus americana</i>	Hazelnut	wet	13	2		1
<i>Crateagus crus-galli</i>	Cockspur Hawthorne		2	2		
<i>Hypericum spathulatum</i>	Shrubby St. John's Wort	wet	20	13		7
<i>Ilex verticillata</i>	Winterberry	wet	18	9	9	
<i>Physocarpus opulifolius</i>	Ninebark	edge	3	3		
<i>Prunus americana</i>	American Plum		2	2		
<i>Rhus glabra</i>	Smooth Sumac	edge	3			3
<i>Rosa setigera</i>	Prairie Rose	wet	16	13		3
<i>Salix discolor</i>	Pussy Willow	wet	16	7	8	1
<i>Sambucus canadensis</i>	Elderberry	wet	23	13	3	7
<i>Spirea alba</i>	Meadowsweet	wet	17	17		
<i>Zanthoxylum americanum</i>	Prickly Ash		2	2		

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Appendix C

Beech-Maple Forest Template

Scientific Name	Common Name	Placement	2004 Spring	PA3 Sec.3	PA3 Sec.4	PA3 Sec.5
<i>Acer nigrum</i>	Black Maple		25		12	13
<i>Acer saccharinum</i>	Silver Maple	wet	6		6	
<i>Acer saccharum</i>	Sugar Maple		36		13	23
<i>Asimina triloba</i>	Pawpaw		5		5	
<i>Carpinus caroliniana</i>	Hornbeam		2			2
<i>Carya cordiformis</i>	Bitternut Hickory		3			3
<i>Carya laciniosa</i>	Shellbark Hickory		17		14	3
<i>Celtis occidentalis</i>	Hackberry	edge	4		2	2
<i>Cornus alternifolia</i>	Alternate Leaf Dogwood		1			1
<i>Crataegus mollis</i>	Downy Hawthorne		2		2	
<i>Fagus grandifolia</i>	Beech		81		36	45
<i>Fraxinus pennsylvanicum</i>	Green Ash		17		8	9
<i>Juglans cinerea</i>	Butternut		1			1
<i>Juglans nigra</i>	Black Walnut		22		10	12
<i>Liriodendron tulipifera</i>	Tulip Poplar		6		2	4
<i>Ostrya virginiana</i>	Hop-Hornbeam	wet	2		1	1
<i>Populus deltoides</i>	Cottonwood		6		2	4
<i>Prunus serotina</i>	Black Cherry		17		8	9
<i>Quercus palustris</i>	Pin Oak		12		5	7
<i>Quercus rubra</i>	Red Oak		13		6	7
<i>Tilia americana</i>	Basswood		25		11	14
<i>Alnus serrulata</i>	Smooth Alder	wet	3			3
<i>Asimina triloba</i>	Pawpaw		2			2
<i>Carpinus caroliniana</i>	American Hornbeam		9			9
<i>Cephalanthus occidentalis</i>	Buttonbush	wet	9			9
<i>Cornus amomum</i>	Silky Dogwood	wet	3			3
<i>Corylus americana</i>	Hazelnut	wet	3			3
<i>Crataegus mollis</i>	Downy Hawthorne		8			8
<i>Hamamelis virginiana</i>	Witch Hazel		14			14
<i>Hypericum spathulatum</i>	Shrubby St. John's Wort	wet	9			9
<i>Ilex verticallata</i>	Winterberry	wet	9			9
<i>Lindera benzoin</i>	Spicebush		10			10
<i>Ostrya virginiana</i>	Hop-Hornbeam	wet	9			9
<i>Physocarpus opulifolius</i>	Ninebark	edge	1			1
<i>Prunus americana</i>	American Plum		1			1
<i>Rhus typhina</i>	Staghorn Sumac		2			2
<i>Rosa palustris</i>	Swamp Rose	wet	14			14
<i>Salix discolor</i>	Pussy Willow	wet	7			7
<i>Sambucus canadensis</i>	Elderberry	wet	8			8
<i>Spirea alba</i>	Meadowsweet	wet	7			7
<i>Viburnum acerifolium</i>	Mapleleaf Viburnum		7			7

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Appendix C

Oak-Hickory Forest Template

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Scientific Name	Common Name	Placement	2004 Spring	PA4 Sec.2	PA4 Sec.3
<i>Acer rubrum</i>	Red Maple	wet	25		25
<i>Acer saccharum</i>	Sugar Maple		20		20
<i>Aesculus glabra</i>	Ohio Buckeye	wet	19		19
<i>Carya cordiformis</i>	Bitternut Hickory		7		7
<i>Carya ovata</i>	Shagbark Hickory		8		8
<i>Celtis occidentalis</i>	Hackberry	edge	2		2
<i>Cercis canadensis</i>	Redbud	edge	2		2
<i>Cornus drumondii</i>	Roughleaf Dogwood	edge	1		1
<i>Cornus florida</i>	Flowering Dogwood		1		1
<i>Cornus racemosa</i>	Grey Dogwood		5		5
<i>Fraxinus americana</i>	White Ash		31		31
<i>Fraxinus quadrangulata</i>	Blue Ash		1		1
<i>Gymnocladus dioica</i>	Kentucky Coffeetree		1		1
<i>Juglans cinerea</i>	Butternut		2		2
<i>Liriodendron tulipifera</i>	Tulip Poplar		9		9
<i>Liquidambar styraciflua</i>	Sweetgum		1		1
<i>Platanus occidentalis</i>	Sycamore		5		5
<i>Quercus alba</i>	White Oak		16		16
<i>Quercus bicolor</i>	Swamp White Oak		2		2
<i>Quercus coccinea</i>	Scarlet Oak		2		2
<i>Quercus inbricaria</i>	Shingle Oak		1		1
<i>Quercus muhlenbergii</i>	Chinquapin Oak		2		2
<i>Quercus rubra</i>	Red Oak		16		16
<i>Quercus shumardii</i>	Shumard Oak		2		2
<i>Quercus velutina</i>	Black Oak		4		4
<i>Ulmus rubra</i>	Slippering Elm		7		7
<i>Alnus serrulata</i>	Smooth Alder	wet	3	3	
<i>Celastrus scandens</i>	Bittersweet		3	3	
<i>Cephalanthus occidentalis</i>	Buttonbush	wet	7	7	
<i>Cornus amomum</i>	Silky Dogwood	wet	1	1	
<i>Corylus americana</i>	Hazelnut	wet	1	1	
<i>Crateagus crus-galli</i>	Cockspur Hawthorne		1	1	
<i>Hypericum spathulatum</i>	Shrubby St. John's Wort	wet	3	3	
<i>Ilex verticillata</i>	Winterberry	wet	9	9	
<i>Physocarpus opulifolius</i>	Ninebark	edge	1	1	
<i>Prunus americana</i>	American Plum		1	1	
<i>Rhus glabra</i>	Smooth Sumac	edge	1	1	
<i>Rosa setigera</i>	Prairie Rose	wet	7	7	
<i>Salix discolor</i>	Pussy Willow	wet	6	6	
<i>Sambucus canadensis</i>	Elderberry	wet	9	9	
<i>Spirea alba</i>	Meadowsweet	wet	6	6	
<i>Zanthoxylum americanum</i>	Prickly Ash		2	2	

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Appendix C

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SEEDLINGS SPECIES	COMMON NAME	Fall 2003	Beech/Maple		Oak/Hickory	
			PA1,Sec.2	Total	PA2,Sec.1	PA2,Sec.2
Acer saccharinum	Silver Maple	40	40			
Acer saccharum	Sugar Maple	322	46	386	233	153
Carya cordiformis	Bitternut Hickory	40		40	30	10
Carya laciniosa	Shellbark Hickory	40	20	20	14	6
Carya ovata	Shagbark Hickory	40		40	28	12
Fagus grandifolia	Beech	144	144			
Fraxinus americana	White Ash	96		96	71	25
Juglans nigra	Black Walnut	96	36	60	52	8
Liriodendron tulipifera	Tulip Poplar	40		40	25	15
Prunus serotina	Black Cherry	40		40	25	15
Quercus alba	White Oak	96		96	78	18
Quercus rubra	Red Oak	96		96	78	18

SPECIES	COMMON NAME	SPRING 2003	Beech/Maple			Oak/Hickory		
			Total	PA1,S ec.1	PA2,S ec.4	PA3,S ec.1	Total	PA2,S ec.3
Acer saccharinum	Silver Maple	96	96		70	26		
Acer saccharum	Sugar Maple	600	400	100	200	100	200	120 80
Carya cordiformis	Bitternut Hickory	40					40	30 10
Carya laciniosa	Shellbark Hickory	40	40	10	30			
Carya ovata	Shagbark Hickory	48					48	30 18
Fagus grandifolia	Beech	336	336	100	136	100		
Fraxinus americana	White Ash	120					120	80 40
Juglans nigra	Black Walnut	144	144	60	74	10		
Liriodendron tulipifera	Tulip Poplar	40	20	10	10		20	15 5
Prunus serotina	Black Cherry	48	48	15	33			
Quercus alba	White Oak	144					144	100 44
Quercus rubra	Red Oak	144	72	25	47		72	25 47

Appendix C

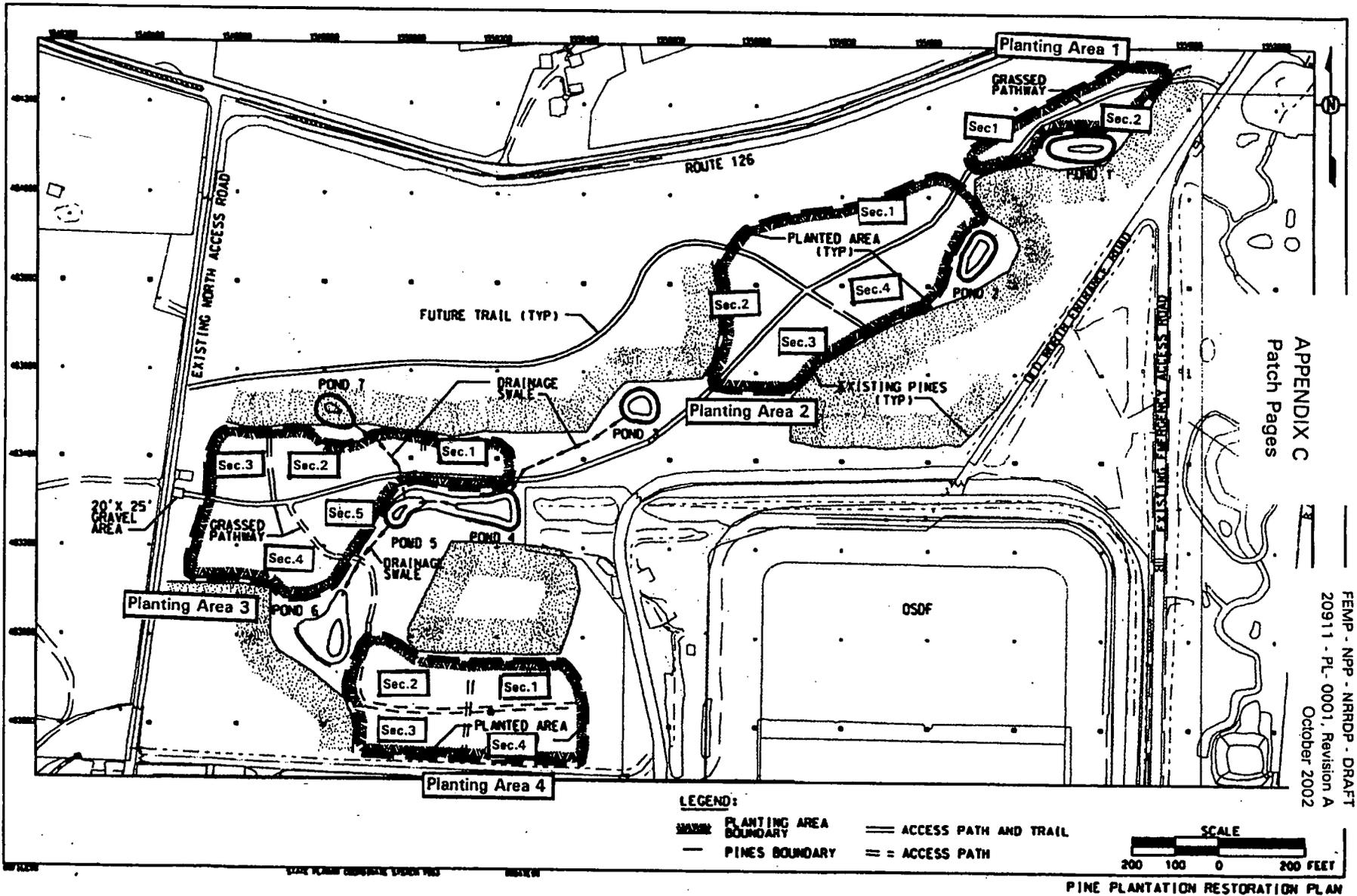
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SPECIES	COMMON NAME	FALL 2003	Beech/Maple				Oak/Hickory				
			Total	PA3,S ec.1	PA3,S ec.2	PA3,S ec.3	PA3,S ec.4	Total	PA4,S ec.1	PA4,S ec.2	PA4,S ec.4
Acer saccharinum	Silver Maple	172	172	36	50	36	50				
Acer saccharum	Sugar Maple	960	720	130	220	130	240	240	70	70	100
Carya cordiformis	Bitternut Hickory	76						76	20	25	31
Carya laciniosa	Shellbark Hickory	76			35		41				
Carya ovata	Shagbark Hickory	76						76	20	25	31
Fagus grandifolia	Beech	504	504	80	170	80	174				
Fraxinus americana	White Ash	192						192	50	50	92
Juglans nigra	Black Walnut	240	240	20	90	20	110				
Liriodendron tulipifera	Tulip Poplar	100	150	8	15	8	19	50	15	15	20
Prunus serotina	Black Cherry	76	76	4	20	30	22				
Quercus alba	White Oak	264						264	95	105	64
Quercus rubra	Red Oak	264	132	22	20	56	34	132	30	30	72

SPECIES	COMMON NAME	SPRING 2004	Beech/Maple		Oak/Hickory	
			Total	PA3,Sec.4	PA3,Sec.5	PA4,Sec.3
Acer saccharinum	Silver Maple	76	76	50	26	
Acer saccharum	Sugar Maple	360	200	150	50	160
Carya cordiformis	Bitternut Hickory	36				36
Carya laciniosa	Shellbark Hickory	36	36	24	12	
Carya ovata	Shagbark Hickory	28				28
Fagus grandifolia	Beech	168	168	100	68	
Fraxinus americana	White Ash	72				72
Juglans nigra	Black Walnut	96	96	65	31	
Liriodendron tulipifera	Tulip Poplar	60	42	28	14	18
Prunus serotina	Black Cherry	28	28	18	10	
Quercus alba	White Oak	120				120
Quercus rubra	Red Oak	120	60	46	14	60

APPENDIX C
Patch Pages

FEMP - NPP - NRRDP - DRAFT
20911 - PL - 0001, Revision A
October 2002



LEGEND:
 PLANTING AREA BOUNDARY ——— ACCESS PATH AND TRAIL
 PINES BOUNDARY ——— ACCESS PATH



PINE PLANTATION RESTORATION PLAN

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