WETLAND MITIGATION PROJECT PHASE II
NATURAL RESOURCE
RESTORATION DESIGN PLAN

FERNALD CLOSURE PROJECT
FERNALD, OHIO

NOVEMBER 2003

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

20911-PL-0002
REVISION 0
FINAL

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES AND FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

A1PIII	Area 1, Phase III
A6PI	Area 6, Phase I
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
FCP	Fernald Closure Project
NRRDP	Natural Resource Restoration Design Plan
NRRP	Natural Resource Restoration Plan

1.0 PROJECT OVERVIEW

This Natural Resource Restoration Design Plan (NRRDP) is for the Wetland Mitigation Phase II Project located in Area 6, Phase I (A6PI) of the Fernald Closure Project (FCP). This NRRDP also provides the restoration approach for the remainder of the Northern Woodlot designated as Area 1, Phase III (A1PIII). The total project area consist of approximately 63 acres of land bordered by Paddys Run on the west, the Old North Supply Road on the east, the rail line to the south, and the property boundary of the FCP to the north. The Wetland Mitigation Phase II Project and the restoration of the remainder of A1PIII will complete restoration activities for the Northern Woodlot as described in the Natural Resource Restoration Plan (NRRP) , (DOE 2002). The January 2002 NRRP has not been approved by the Fernald Natural Resource Trustees (NRTs), but is the version that is being implemented by Fluor Fernald per the requirements of their Closure Contract with DOE.

Objectives for the Wetland Mitigation - Phase II Project include the creation of new shallow marsh wetland system with surrounding, diverse upland habitat across the 8-acre site. The Wetland Mitigation Phase II Project will create four additional acres of wetlands required under the June 1995 DOE mitigation agreement with the Ohio Environmental Protection Agency, the U.S. Fish and Wildlife Service, and Ohio Department of Natural Resources. The new wetland acreage will serve as part of the compensation for wetland acreage lost during remedial activities in other portions of the FCP. A total of 11.87 acres of wetlands have been impacted during remediation requiring the creation of 17.8 acres of new wetlands.

Restoration objectives for the Northern Woodlot Enhancement consists of converting approximately 30 acres of former pasture to prairie and implementing invasive species control measures to reduce bush honeysuckle, multiflora rose, and Russian olive populations in the area. Compensatory restoration of the FCP is part of the proposed settlement for natural resource damages under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

2.0 SITE DESCRIPTION

2.1 WETLAND MITIGATION - PHASE II

The A6PI Project Area covers approximately 8 acres and was used as borrow area for various construction projects in the past. The area receives drainage from the 26 acre delineated wetland to the north of the project in A1PIII. A second drainage swale historically flowed into the project area but was altered during construction of the rail yard. The design for the project will divert flow from the Northern Woodlot into the newly created wetland basins. A watershed evaluation study conducted in 1996 indicates that adequate flow exists from the drainage swales to the north to support wetland mitigation in this area (DOE 1997). Clay was removed from the western end of the project area creating a depression that drains into the drainage ditch running parallel with the railroad track to Paddys Run Stream. Borrow was suspended to the east when sand was found mixed in the clay in the remaining acreage of the area. A soils map and description of soil types identified is available in Appendix A. The topography is hilly and fairly well drained. Fescue covers the bulk of the area. Scattered saplings have begun to infiltrate the area.

Slash and debris from trees and shrubs cut prior to borrow operations have been pushed into a north/south windrow through project area. The windrow has acted as a source for wildlife habitat in the area.

2.2 NORTHERN WOODLOT ENHANCEMENT

The Northern Woodlot is bordered by Paddys Run Stream to the west, agricultural fields to the north, and the former North Construction Road to the east. A6PI and the Silos Delivery Road make the southern boundary. The land is relatively flat on the southern half of the area; however, the property on the north and western edge has upland soils on a rising topography. The southern boundary soils range from moderately well drained silt loam soils to very poorly drained silty clay loam soils (Appendix A).

Approximately 26 acres of the woodlot (Figure 2-1) was delineated as a wetland (DOE 1993). The wetland receives water flow from moderately well drained to well drained soils in the northern portion of the woodlot and from additional lands north of the FCP property line. Flow out of the wetland currently occurs at two locations (Figure 2-1). Flow on the east is through a catch basin and culvert adjacent to the Silos Delivery Road. Flow will also enter the new wetland from an existing channel on the west side of the Wetland Mitigation Phase II Project Area.

Vegetation in the woodlot consists of trees, shrubs, and pasture grasses. Young stands of oak and hickory developed from trees that were located in the fence line around the area's pastures prior to government purchase of the land. Other tree species spread from the riparian corridor along Paddys Run along the southern boundary and into the wetlands. The Riparian corridor consists of trees along Paddys Run stream on the western edge of the woodlot and has been intact since before Fernald's establishment.

Ohio University conducted a floristic inventory of the Northern Woodlot in 1998 identifying a diverse fauna (Ohio University 1998). Two hundred eighty-two species were identified in the study. The area was identified as consisting mostly of old fields and thicket forests. In a recent walkdown of the area, the old fields were seen as pasture fields that are being invaded with woody shrubs (i.e., *Rubus spp., Rosa spp., Lonicera spp., Elaeagnus spp.*). The thicket forests consist of stands of young trees with a heavy understory of honeysuckle and multiflora rose. Grapevine (*Vitas spp.*) has overtaken the overstory in some areas of the forest stands.

5192

1345500 1346000 1346500 1347000 1347500 1348000 1348500 1349000 1349500 1350000 1350500 1351000

484500 484000 483500 483000 482500 482000 481500

N

S.R. 126

CLEARED PATHS (1)

HISTORICAL SITE (3)

PADDY'S RUN

OLD ACCESS ROAD

NORTHERN WOODLOT

WESTERN WATER FLOW FROM WOODLOT TO A6P1

AREA 6 PHASE I PROJECT AREA

EASTERN WATER FLOW FROM WOODLOT TO A6P1

PADDYS RUN ROAD

SP-7

HAUL ROAD

SP-1

LEGEND:

WETLANDS AREA

IDENTIFIED ARCHEOLOGICAL SITE

SCALE

400 200 0 400 FEET

North Wetlands/wetlands1993.dgn STATE PLANAR COORDINATE SYSTEM 1983 21-JULY-2003

000007

1993 JURISDICTIONAL WETLANDS & WATERS OF THE U.S.

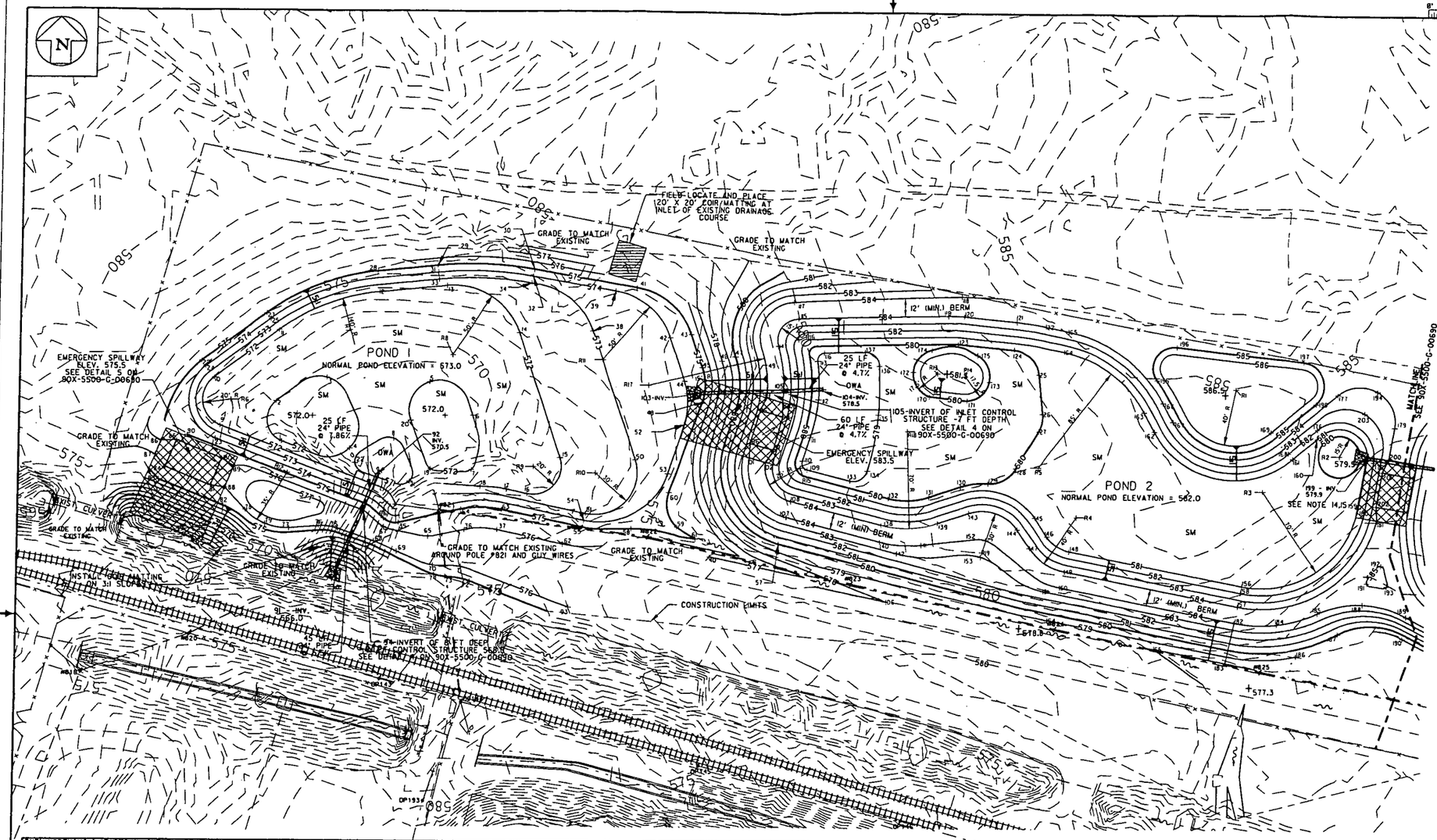
FIGURE 2-1

TABLE 3-3
(Continued)

Scientific Name	Common Name	Form	Function	Placement	Riparian	Beech-Maple	Oak-Hickory
Quercus bicolor	Swamp White Oak	Canopy tree	Diversity, mast		4		
Quercus coccinea	Scarlet Oak	Canopy tree	Cover, mast				2
Quercus inbricaria	Shingle Oak	Canopy tree	Diversity, mast				4
Quercus macrocarpa	Bur Oak	Canopy tree	Diversity, mast		1		
Quercus muhlenbergii	Chinquapin Oak	Canopy tree	Diversity, mast				7
Quercus palustris	Pin Oak	Canopy tree	Cover		7	13	
Quercus rubra	Red Oak	Canopy tree	Cover, mast			11	43
Quercus shumardii	Shumard Oak	Canopy tree	Diversity, mast				6
Quercus velutina	Black Oak	Canopy tree	Cover, mast				6
Tilia americana	Basswood	Canopy tree	Cover, aesthetics		6	29	
Ulmus rubra	Slippering Elm	Canopy tree	Cover		4		19
Alnus serrulata	Smooth Alder	Shrub	Cover	wet			9
Asimina triloba	Pawpaw	Understory tree	Fruit, diversity		6	6	
Carpinus caroliniana	American Hornbeam	Understory tree	Diversity, mast		19	30	
Cephalanthus occidentalis	Buttonbush	Shrub	Cover	wet			9
Cornus florida	Flowering Dogwood	Understory tree	Aesthetics	wet			12
Cornus racemosa	Gray Dogwood	Understory tree	Cover				9
Corylus americana	Hazelnut	Shrub	Diversity	wet	22		18
Hamamelis virginiana	Witch Hazel	Shrub	Cover		28	38	
Hypericum spathulatum	Shrubby St. Johns Wort	Shrub	Diversity	wet	20		22
Ilex verticallata	Winterberry	Shrub	Aesthetics	wet	27		16
Lindera benzoin	Spicebush	Shrub	Cover			30	11
Ostrya virginiana	Hop-Hornbeam	Understory tree	Diversity	wet	21	18	10
Rhus aromatica	Fragrant Sumac	Shrub	Aesthetics				14
Rhus glabra	Smooth Sumac	Shrub	Aesthetics	edge			14
Rosa caroliniana	Carolina Rose	Shrub	Aesthetics		23		
Rosa palustris	Swamp Rose	Shrub	Esthetics	wet			37
Rubus occidentalis	Black Raspberry	Shrub	Fruit	edge			32
Salix discolor	Pussy Willow	Shrub	Cover	wet			5
Sambucus canadensis	Elderberry	Shrub	Fruit	wet			41

TABLE 3-3
(Continued)

Scientific Name	Common Name	Form	Function	Placement	Riparian	Beech-Maple	Oak-Hickory
Spirea alba	Meadowsweet	Shrub	Esthetics	wet			6
Staphylea trifolia	Bladdernut	Shrub	Diversity	edge		3	6
Symphoricarpos orbiculatus	Coralberry	Shrub	Diversity				17
Viburnum acerifolium	Mapleleaf Viburnum	Shrub	Diversity			8	4
Viburnum prunifolium	Blackhaw Viburnum	Shrub	Cover			20	33



NOTES:

1. CONTRACTOR SHALL INSTALL AND MAINTAIN EROSION AND SEDIMENT CONTROLS INCLUDING CHECK DAMS AS PER TECHNICAL SPECIFICATION SECTION 02270 SURFACE WATER MANAGEMENT AND EROSION CONTROL.
2. EXCAVATE PONDS, DEPRESSIONS, AND DITCHES IN ACCORDANCE WITH TECHNICAL SPECIFICATION SECTION 02200. SURFACE IRREGULARITIES SHALL BE LEFT IN DISTURBED AREAS.
3. REFER TO TECHNICAL SPECIFICATION SECTION 02930 FOR PERMANENT VEGETATION.
4. WET AREA PERMANENT SEED TO BE APPLIED IN PONDS, DEPRESSIONS AND DITCHES. SEE DITCH AND POND DETAIL.
5. DRY AREA PERMANENT SEED TO BE APPLIED ON ALL DISTURBED AREAS OTHER THAN WET AREAS.
6. TOPSOIL SHALL BE APPLIED MIN. 6" DEEP OVER ENTIRE AREA EXCEPT FOR THE BOTTOM OF EACH POND.
7. FIELD ADJUST HORIZONTAL ALIGNMENTS OF PONDS AND DITCHES TO FIT EXISTING CONDITIONS.
8. CLEAR AND GRUB AREAS TO BE GRADED. SEED DISTURBED DRY AREA WITH DRY AREA SEED . SEED DISTURBED WET AREA WITH WET AREA SEED. SEE TYPICAL CROSS SECTIONS ON 90X-5500-G-00690.
9. GRID COORDINATE SYSTEM CORRESPONDS TO THE STATE PLANAR NORTH AMERICAN DATUM (NAD) 1983 OHIO SOUTH.
10. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL DATUM. (SEA LEVEL DATUM REFERS TO NATIONAL GEODETIC VERTICAL DATUM (NGVD))
11. TOPOGRAPHY BASED UPON JULY 2003 FLYOVER. ACTUAL ELEVATIONS MAY DIFFER FROM THOSE SHOWN. FIELD VERIFY EXISTING CONDITIONS, SURVEY INFORMATION AND UTILITY LOCATIONS BEFORE CONSTRUCTION BEGINS.
12. INSTALL GEOSYNTHETIC EROSION MAT PER MANUFACTURER'S RECOMMENDATIONS. EROSION MAT SHALL BE TURF REINFORCED MATTING TRM C350 MANUFACTURED BY NORTH AMERICAN GREEN OR APPROVED EQUAL.
13. PIPE SHALL BE HDPE SDR 17 (MIN.).
14. SEE 90X-5500-G-00690 FOR DIMENSIONS OF CONDUIT OUTLET PROTECTION.
15. CONDUIT OUTLET PROTECTION SHALL CONSIST OF GEOTEXTILE FILTER FABRIC OVERLAIN BY ODOT TYPE D DUMPED ROCK FILL.
16. USE COR MATTING IN AREAS INDICATED ON THE DRAWING.

PNT	NORTHING	EASTING	ELEV
1	482598.27	1346612.20	572.0
2	482627.17	1346608.01	572.0
3	482644.34	1346643.19	572.0
4	482593.54	1346660.33	572.0
5	482641.50	1346715.98	572.0
6	482617.65	1346747.09	572.0
7	482578.75	1346746.71	572.0
8	482600.77	1346691.20	571.0
9	482609.32	1346568.55	572.0
10	482643.95	1346583.68	572.0
11	482678.25	1346609.14	572.0
12	482705.78	1346615.41	572.0
13	482710.62	1346727.29	572.0
14	482677.00	1346779.63	572.0
15	482587.43	1346810.17	572.0
16	482561.43	1346786.99	572.0
17	482564.61	1346772.39	572.0
18	482566.55	1346753.58	572.0
19	482578.96	1346717.45	572.0
20	482613.80	1346703.01	572.0
21	482570.00	1346702.85	571.0
22	482583.05	1346664.03	571.0
23	482599.98	1346564.97	574.0
24	482651.94	1346557.66	574.0
25	482686.23	1346603.11	574.0
26	482655.93	1346554.64	575.0
27	482690.72	1346600.10	575.0
28	482720.71	1346677.90	575.0
29	482724.98	1346720.24	575.0
30	482722.45	1346789.81	575.0
31	482720.01	1346720.74	574.0
32	482717.52	1346788.95	574.0
33	482715.03	1346721.24	573.0
34	482712.60	1346788.08	573.0
35	482540.02	1346695.87	575.0
36	482535.25	1346742.38	576.0
37	482535.30	1346766.01	576.0
38	482678.59	1346831.86	573.0
39	482707.28	1346847.45	574.0
40	482516.64	1346916.33	577.0
41	482709.73	1346862.46	575.0
42	482674.17	1346886.15	574.0
43	482676.61	1346901.16	575.0
44	482642.97	1346896.78	574.0
45	482652.87	1346909.26	575.0
46	482657.71	1346925.46	578.0
47	482660.82	1346932.96	580.0
48	482627.94	1346909.55	575.0
49	482620.42	1346933.39	580.0
50	482586.25	1346863.35	573.0
51	482547.26	1346828.57	573.0
52	482611.81	1346897.15	574.0
53	482576.23	1346885.93	574.0
54	482542.35	1346827.59	574.0
55	482537.47	1346826.55	575.0
56	482588.25	1346923.25	580.0
57	482526.10	1346966.37	580.0
58	482536.49	1346861.11	575.0
59	482537.95	1346892.73	575.0
60	482562.80	1346886.99	575.0
61	482529.41	1346906.27	575.0
62	482525.13	1346812.71	576.0
63	482549.95	1346769.20	575.0
64	482550.04	1346739.81	575.0
65	482530.31	1346716.54	576.0
66	482543.18	1346684.66	575.0
67	482536.94	1346684.88	576.0
68	482526.61	1346678.16	576.0
69	482519.27	1346694.73	576.0
70	482509.39	1346720.20	575.0
71	482508.48	1346740.17	576.0
72	482498.04	1346746.71	575.0
73	482501.28	1346729.33	575.0
74	482502.76	1346721.20	575.0
75	482535.58	1346652.82	576.0
76	482537.38	1346639.24	576.0
77	482535.74	1346618.32	576.0
78	482548.82	1346587.02	576.0
79	482538.80	1346601.22	576.0
80	482585.52	1346570.04	575.5
81	482566.17	1346562.24	575.5
82	482551.61	1346571.61	575.0
83	482570.29	1346525.26	575.0
84	482579.25	1346529.77	575.5
85	482598.61	1346537.57	575.5
86	482598.19	1346526.63	576.0
87	482588.11	1346522.56	576.0
88	482564.83	1346572.48	576.0
89	482580.00	1346578.59	576.0
90	482602.30	1346544.98	575.0
91	482507.30	1346652.68	566.0
92	482575.01	1346680.28	570.5
93	482479.49	1346817.33	576.0
94	482550.65	1346670.36	568.5
95	482622.64	1346951.62	583.5
96	482598.55	1346944.92	583.5
97	482594.00	1346961.30	583.5
98	482618.08	1346968.00	583.5
99	482631.80	1346956.01	584.0
100	482628.40	1346967.71	584.0
101	482588.29	1346944.49	584.0
102	482585.06	1346956.10	584.0
103	482634.52	1346908.39	574.5
104	482637.81	1346995.93	578.5
105	482636.82	1346969.64	577.3
106	482484.64	1347043.45	578.0
107	482545.45	1346971.44	584.0
108	482557.06	1346974.48	584.0
109	482579.91	1346985.89	579.0
110	482586.25	1346982.39	579.0
111	482603.29	1346987.76	579.0
112	482630.47	1346993.03	579.0
113	482658.14	1346992.04	579.0
114	482669.02	1346983.94	584.0
115	482688.51	1346977.95	584.0
116	482663.89	1346956.88	579.0
117	482700.43	1346974.65	584.0
118	482704.57	1347094.09	584.0
119	482690.67	1347084.87	584.0
120	482690.48	1347096.08	584.0
121	482686.77	1347133.70	584.0
122	482683.53	1347154.91	584.0
123	482670.73	1347091.76	580.0
124	482666.83	1347132.08	580.0
125	482649.15	1347150.00	580.0
126	482620.91	1347153.15	580.0
127	482608.44	1347150.45	580.0
128	482581.81	1347134.55	580.0
129	482570.78	1347115.06	580.0
130	482568.22	1347095.04	580.0
131	482560.61	1347072.88	580.0
132	482559.53	1347045.99	580.0
133	482571.96	1347016.26	579.0
134	482579.10	1347028.46	579.0
135	482619.55	1347035.69	579.0
136	482654.67	1347035.89	579.0
137	482664.47	1347029.69	579.0
138	482540.19	1347038.92	584.0
139	482541.70	1347079.38	584.0
140	482528.00	1347038.10	584.0
141	482525.92	1347067.58	584.0
142	482519.67	1347050.16	583.0
143	482549.30	1347101.53	584.0
144	482537.67	1347136.16	584.0
145	482546.05	1347148.60	581.0
146	482532.60	1347157.65	581.0
147	482524.23	1347145.21	584.0
148	482522.05	1347173.49	581.0
149	482507.34	1347170.54	584.0
150	482495.78	1347167.14	584.0
151	482492.98	1347155.66	583.0
152	482529.70	1347113.83	584.0
153	482517.64	1347110.31	583.0
154	482471.94	1347158.91	581.1
155	482451.62	1347234.96	578.0
156	482508.82	1347239.63	581.0
157	482482.68	1347293.80	584.0
158	482492.49	1347295.76	582.0
159	482526.72	1347269.10	581.0
160	482604.03	1347349.15	581.0
161	482589.62	1347331.99	581.0
162	482554.41	1347379.51	581.0
163	482497.39	1347296.74	581.0
164	482665.48	1347167.98	581.0
165	482680.17	1347171.04	584.0
166	482629.47	1347238.79	584.0
167	482615.80	1347246.11	584.0
168	482593.45	1347328.78	582.0
169	482608.77	1347315.92	586.0
170	482633.08	1347072.00	580.0
171	482630.11	1347098.85	580.0
172	482650.34	1347060.29	580.0
173	482643.78	1347114.67	580.0
174	482666.54	1347073.41	580.0
175	482685.95	1347106.10	580.0
176	482610.78	1347349.42	582.0
177	482635.91	1347363.79	584.0
178	482587.49	1347390.15	582.0
179	482612.62	1347404.52	584.0
180	482553.58	1347384.44	582.0
181	482545.65	1347393.00	584.0
182	482470.91	1347291.45	584.0
183	482441.50	1347285.56	578.0
184	482469.72	1347322.03	584.0
185	482478.11	1347351.46	584.0
186	482446.80	1347336.34	579.0
187	482463.03	1347365.99	580.0
188	482484.63	1347383.42	584.0
189	482475.91	1347414.87	584.0
190	482459.16	1347412.42	579.0
191	482500.12	1347386.52	585.0
192	482512.94	1347396.34	585.0
193	482497.97	1347400.42	585.0
194	482638.47	1347392.28	584.0
195	482645.78	1347234.25	585.0
196	482669.75	1347247.94	585.0
197	482659.10	1347339.06	585.0
198	482629.20	1347348.02	585.0
199	482589.99	1347400.71	579.9
200	482585.06	1347395.88	584.0
201	482580.55	1347396.47	583.4
202	482555.87	1347392.46	583.4
203	482622.61	1347383.21	583.0
R1	482639.40	1347290.19	586.5
R2	482591.64	1347365.49	579.5
R3	482566.03	1347310.48	580.7
R4	482546.56	1347178.39	580.4
R5	482582.27	1347150.63	580.1
R6	482627.99	1346575.72	571.5
R7	482660.87	1346732.31	571.2
R8	482580.97	1346791.24	571.0
R9	482566.49	1346693.46	572.0
R10	482576.57	1346834.95	573.0
R11	482658.03	1346838.02	574.0
R12	482575.71	1346616.63	576.0
R13	482649.60	1347077.78	581.5
R14	482647.56	1347097.59	581.5
R15	482581.24	1346980.81	579.5
R16	482673.51	1346978.25	581.7
R17	482639.96	1346871.40	563.5
R18	482607.90	1347056.65	579.3
R19	482520.92	1347111.27	583.0

FOR POND, ISLAND AND DITCH TYPICAL CROSS SECTIONS SEE 90X-5500-G-00690.

LEGEND

- 15 — RESTORATION CONTROL POINT AND RADIUS POINT
- x 585.0 — SPOT ELEVATION
- 615 — PROPOSED CONTOUR
- EXISTING CONTOUR
- VEGETATION
- FLOW ARROW
- CONDUIT OUTLET PROTECTION
- FLOW LINE OF DITCH
- LIMIT OF GEOSYNTHETIC EROSION MAT
- OWA — OPEN WATER - AQUATIC
- SM — SHALLOW MARSH

000013

50 0 50 100
GRAPHIC SCALE

NO.	REVISIONS	DATE	DWN. BY	APP'D.
0	ISSUED CERTIFIED FOR CONSTRUCTION	#JO	8/05/03	

NOTE. FLUOR FERNALD CADD DRAWING. DO NOT REVISE MANUALLY.

REF. DWG. NO.

CONFIGURATION MANAGEMENT DRAWING — YES / NO

COGNIZANT ENGINEER — DATE

APPROVALS

CIVIL & STR.		SAFETY ENG.
ELECTRICAL		MAINTENANCE
ENGINEER		FIRE PROTECT.
INSTRUMENT		WASTE MANAGE
MECHANICAL		SECURITY
		PROJECTS
CHECKED		CONSTRUCTION
APPROVED		QUALITY
		CADD SERVICES

Fernald Closure Project

FLUOR FERNALD, INC.

U.S. DEPARTMENT OF ENERGY

FIGURE 3-1

WETLAND MITIGATION
PHASE II PROJECT
AREA 6, PHASE I GRADING PLAN
SCALE 1" = 30'

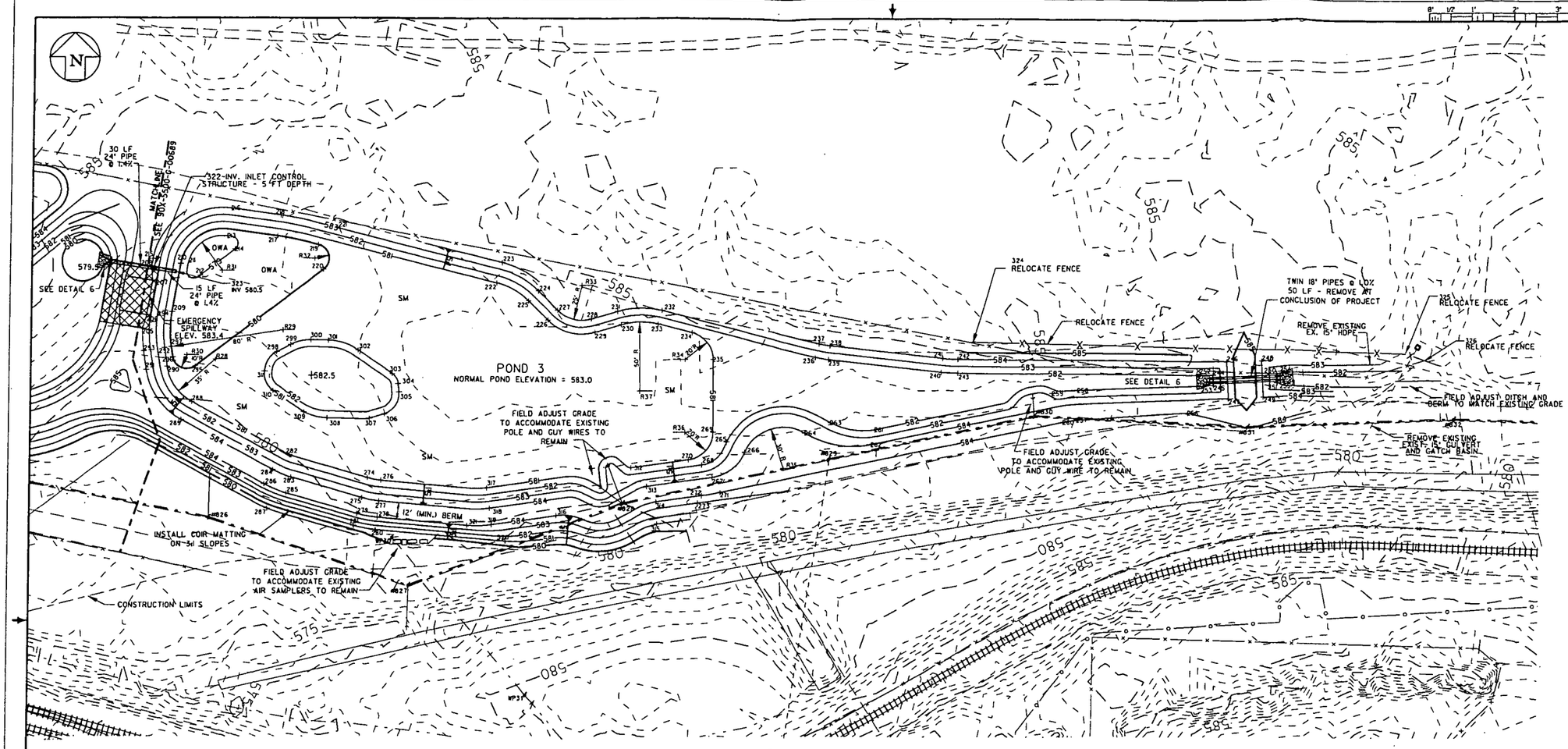
PROJ. NO. 2098
DATE 8/5/03
DRAWN RJO

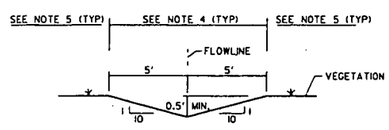
90X-5500-G-00689 | 0

FILE NAME:/osdf/north wetlands/90XG0689.dgn

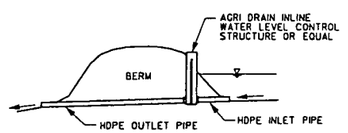
FCPS.DGN 5/30/03

5192

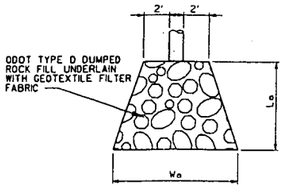




RESTORATION DITCH TYPICAL CROSS SECTION (1)

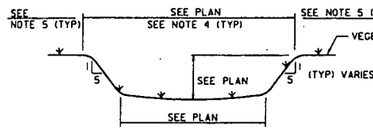


WATER LEVEL CONTROL STRUCTURE DETAIL (4)

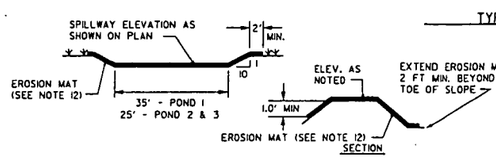


	Lo	Wo
POND 1 OUTLET	18'	6'
POND 2 OUTLET	9'	6'
POND 3 OUTLET	18'	6'
TWIN CULVERTS	28'	14'

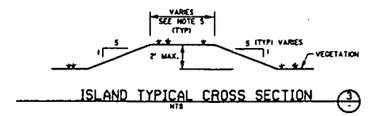
TYPICAL RIP RAP DETAIL (6)



POND TYPICAL CROSS SECTION (2)



TYPICAL SPILLWAY DETAIL (5)



ISLAND TYPICAL CROSS SECTION (3)

PNT	NORTHING	EASTING	ELEV
205	482543.01	1347409.22	584.0
206	482552.66	1347412.23	583.4
207	482577.33	1347416.24	583.5
208	482587.58	1347415.51	584.0
209	482585.06	1347430.32	580.0
210	482589.58	1347436.13	580.0
211	482588.75	1347441.06	579.0
212	482581.14	1347450.03	579.0
213	482609.36	1347469.17	579.0
214	482600.02	1347474.61	579.0
215	482592.91	1347476.41	584.0
216	482628.17	1347471.93	583.0
217	482609.46	1347504.66	580.0
218	482624.32	1347506.73	583.0
219	482603.12	1347534.18	580.0
220	482585.50	1347537.81	580.0
221	482615.31	1347547.14	583.0
222	482515.78	1347662.23	581.0
223	482590.32	1347665.92	584.0
224	482569.97	1347692.12	583.0
225	482562.86	1347685.09	581.0
226	482549.09	1347699.02	581.0
227	482556.20	1347706.05	583.0
228	482549.96	1347730.61	583.0
229	482540.36	1347733.40	581.0
230	482545.83	1347752.22	584.0
231	482555.43	1347749.42	583.0
232	482555.97	1347780.93	583.0
233	482546.28	1347778.47	581.0
234	482540.04	1347803.05	581.0
235	482520.85	1347818.13	581.0
236	482522.68	1347891.76	582.0
237	482532.38	1347894.22	584.0
238	482530.89	1347902.46	584.0
239	482520.95	1347901.38	582.0
240	482512.07	1347982.56	582.0
241	482522.01	1347983.64	584.0
242	482521.42	1347993.96	584.0
243	482511.42	1347993.91	582.0
244	482510.44	1348175.33	582.0
245	482503.20	1348175.76	582.0
246	482520.39	1348184.76	584.0
247	482493.63	1348186.34	584.0
248	482520.76	1348209.74	584.0
249	482494.75	1348211.27	584.0
250	482511.76	1348220.29	582.0
251	482505.14	1348220.68	582.0
252	482508.22	1348172.94	581.5
253	482505.23	1348175.09	581.5
254	482510.04	1348222.90	582.0
255	482507.04	1348223.05	582.0
256	482483.21	1348157.53	584.0
257	482477.67	1348078.86	584.0
258	482499.23	1348079.33	582.0
259	482496.97	1348061.22	582.0
260	482476.16	1348069.00	584.0
261	482470.49	1347935.36	582.0
262	482459.72	1347932.72	584.0
263	482475.42	1347903.59	582.0
264	482467.94	1347885.33	584.0
265	482461.14	1347828.73	582.0
266	482453.78	1347841.89	584.0
267	482476.96	1347808.38	583.0
268	482435.48	1347818.33	584.0
268	482444.54	1347810.99	582.0
269	482468.24	1347818.64	581.0
270	482448.24	1347801.43	581.0
271	482424.67	1347824.36	584.0
272	482422.35	1347811.14	584.0
273	482416.91	1347808.38	583.0
274	482435.10	1347571.56	581.0
275	482420.69	1347567.39	584.0
276	482433.32	1347581.01	581.0
277	482418.38	1347579.67	584.0
278	482406.43	1347578.60	584.0
279	482409.16	1347564.05	584.0
280	482397.49	1347577.51	581.0
281	482400.44	1347561.82	581.0
282	482451.73	1347515.26	581.0
283	482435.48	1347516.32	584.0
284	482441.01	1347502.99	584.0
285	482423.95	1347512.98	584.0
286	482430.50	1347497.19	584.0
287	482412.93	1347499.16	579.0
288	482490.20	1347444.92	581.0
289	482477.07	1347437.67	584.0
290	482515.53	1347427.24	581.0
291	482513.26	1347412.42	584.0
292	482528.89	1347425.19	581.0
293	482526.61	1347410.37	584.0
294	482555.89	1347425.39	581.0
295	482515.95	1347447.23	580.0
296	482522.36	1347431.25	580.0
297	482529.65	1347430.14	580.0
298	482529.65	1347430.14	580.0
298	482526.10	1347504.93	581.0
299	482531.37	1347515.10	581.0
300	482534.73	1347529.45	581.0
301	482534.50	1347541.83	581.0
302	482527.55	1347563.64	581.0
303	482510.53	1347588.58	581.0
304	482503.29	1347592.90	581.0
305	482497.34	1347593.51	581.0
306	482481.46	1347582.96	581.0
307	482478.22	1347572.32	581.0
308	482478.56	1347541.48	581.0
309	482482.76	1347524.15	581.0
310	482498.14	1347502.54	581.0
311	482512.06	1347496.61	581.0
312	482442.42	1347760.13	584.0
313	482428.89	1347771.66	584.0
314	482417.72	1347778.33	584.0
315	482401.66	1347779.13	581.0
316	482407.64	1347706.88	584.0
317	482427.85	1347656.86	581.0
318	482412.99	1347658.96	584.0
319	482401.11	1347660.63	584.0
320	482389.20	1347670.05	581.0
321	482400.66	1347643.01	584.0
322	482586.03	1347416.95	580.3
323	482583.66	1347433.04	580.5
324	482533.13	1348004.85	N/A
325	482526.31	1348312.11	N/A
326	482521.72	1348325.78	N/A
R28	482520.84	1347461.84	580.1
R29	482541.78	1347509.21	580.4
R30	482523.88	1347441.14	579.9
R31	482584.60	1347465.72	579.2
R32	482593.43	1347531.72	579.8
R33	482573.97	1347723.63	584.2
R34	482520.66	1347798.13	581.8
R35	482442.37	1347869.63	584.1
R36	482468.05	1347798.64	580.9
R37	482497.82	1347766.17	580.8

SEE NOTES ON 90X-5500-G-00689

LEGEND

- 65 — RESTORATION CONTROL POINT AND RADIUS POINT
- × 585.0 — SPOT ELEVATION
- 615 — PROPOSED CONTOUR
- EXISTING CONTOUR
- VEGETATION
- FLOW ARROW
- ODOT ITEM 601.07 TYPE D DUMPED ROCK FILL
- FLOW LINE OF RESTORATION DITCH
- LIMIT OF GEOSYNTHETIC EROSION MAT
- OWA — OPEN WATER - AQUATIC
- SM — SHALLOW MARSH

000014

50 0 50 100
GRAPHIC SCALE

NO.	REVISIONS	DATE	DWN. BY	APP'D.
0	ISSUED CERTIFIED FOR CONSTRUCTION	1/05/03	WJO	

NO.	REVISIONS	DATE	DWN. BY	APP'D.

REF. DWG. NO.

NOTE: FLUOR FERNALD CADD DRAWING. DO NOT REVISE MANUALLY.

CONFIGURATION MANAGEMENT DRAWING — EXISTING STRUCTURES OR CONDITIONS MAY VARY FROM THOSE SHOWN. SEE NOTES.

COGNIZANT ENGINEER DATE

APPROVALS		
		SAFETY ENG.
CIVIL & STR.		MAINTENANCE
ELECTRICAL		FIRE PROTECT.
ENGINEER		WASTE MANAGE
INSTRUMENT		SECURITY
MECHANICAL		PROJECTS
		CONSTRUCTION
CHECKED		QUALITY
APPROVED		CADD SERVICES

Fernald Closure Project

FLUOR FERNALD, INC.

U.S. DEPARTMENT OF ENERGY

FIGURE 3-2

WETLAND MITIGATION
PHASE II PROJECT
AREA 6, PHASE I GRADING PLAN DETAIL
SCALE 1" = 30'

PROJ. NO. 7059	
DATE 8/5/03	90X-5500-G-00690 0
DRAWN WJO	

FILE NAME:/asaf/north wetlands/90XG0690.dgn

FGP3.DGN 5/30/03

5192

PATCH 1 =
29,300 SF
0.67 AC

RIPARIAN PATCH
76651 SF
1.75 ACRES

PATCH 2 =
1116Ø SF
0.26 AC

SEE FIGURE 3-4
FOR AREA 1, PHASE III
RESTORATION PLAN

AREA 12
AREA = 304673 SF
7.0 ACRES

PATCH 4 =
24260 SF
0.56 AC

BEECH MAPLE PATCH
AREA = 227815 SF
5.25 ACRES

PATCH 8 =
6300 SF
0.14 AC

PATCH 5 =
2068Ø SF
0.47 AC

PATCH 7 =
4480 SF
0.10 AC

PATCH 3 =
7370 SF
0.17 AC

PATCH 6 =
17060 SF
0.39 AC

PATCH 9 =
5690 SF
0.13 AC

PRELIMINARY
INFORMATION ONLY
CADD SERVICES

000015

50 0 50 100
GRAPHIC SCALE

NO.	REVISIONS	DATE	DWN. BY	APPD.	NO.	REVISIONS	DATE	DWN. BY	APPD.	REF. DWG. NO.

NOTE:
FLUOR FERNALD CADD DRAWING. DO NOT REVISE MANUALLY.

CONFIGURATION MANAGEMENT DRAWING — YES / NO

SEE NOTE 1

COGNIZANT ENGINEER DATE

APPROVALS

CIVIL & STR.		SAFETY ENG.	
ELECTRICAL		MAINTENANCE	
ENGINEER		FIRE PROTECT.	
INSTRUMENT		WASTE MANAGE.	
MECHANICAL		SECURITY	
		PROJECTS	
CHECKED			
APPROVED			

Fernald Closure Project

FLUOR FERNALD, INC.

U.S. DEPARTMENT OF ENERGY

WETLAND MITIGATION
PHASE II PROJECT
AREA 6, PHASE I PLANTING PLAN

DATE 07/15/03
DRAWN K.L. RABBITT

FIGURE 3-3

FCPSJDGN 5/30/03

FILE NAME: Planting Plan Figure 3_3.dgn

5192

N

ROUNDUP APPLICATION
UPLAND PRAIRIE
AREA = 363788
8.35 ACRES

SPARSE WOODLOT OAK HICKORY

ROUNDUP APPLICATION
UPLAND PRAIRIE
AREA = 258883
5.94 ACRES

OAK HICKORY
AREA = 773098
17.75 ACRES

SPARSE WOODLOT BEECH MARLE
AREA = 448685
10.3 ACRES

RODEO ® APPLICATION
WET PRAIRIE 2
AREA = 115231
2.65 ACRES

WET PRAIRIE 1
AREA = 482356
11.07 ACRES

AREA 10
AREA = 298237
6.85 ACRES

SEE FIGURE 3-3
FOR AREA 6, PHASE I
PLANTING PLAN

100 0 100 200
SCALE: 1"=100'

PRELIMINARY
INFORMATION ONLY
NOT FOR CONSTRUCTION
000016

NO.	REVISIONS	DATE	DWN. BY	APPD.	NO.	REVISIONS	DATE	DWN. BY	APPD.	REF. DWG. NO.

NOTE.
FLUOR FERNALD CADD DRAWING, DO NOT REVISE MANUALLY.

CONFIGURATION MANAGEMENT DRAWING
YES NO
REVIEW STRUCTURES OR COMPONENTS PROPOSED TO BE USED ARE WITHIN THE CONFIGURATION CONTROL SET FORTH.
COGNIZANT ENGINEER DATE

APPROVALS			
CIVIL & STR.		SAFETY ENG.	
ELECTRICAL		MAINTENANCE	
ENGINEER		FIRE PROTECT.	
INSTRUMENT		WASTE MANAGE.	
MECHANICAL		SECURITY	
CHECKED		PROJECTS	
APPROVED			

Fernald Closure Project
FLUOR FERNALD, INC.
U.S. DEPARTMENT OF ENERGY

WETLAND MITIGATION
PHASE II PROJECT
AREA I, PHASE III RESTORATION PLAN

DATE 07/15/03
DRAWN R.L. RASBITT

FIGURE 3-4

FCP3.DGN 5/30/03

FILE NAME: Planting Plan Figure 3-4.dgn

4.0 FIELD IMPLEMENTATION

Field implementation of the A6PI Wetland and A1PIII restoration projects is described below and in the attached planting and seeding specifications.

4.1 SEQUENCE OF ACTIVITIES

Restoration of A6PI and A1PIII will be conducted in three phases, starting in fall of 2003. Table 4-1 below identifies the sequence and timing of the individual areas.

TABLE 4-1
SEQUENCE OF A6PI RESTORATION ACTIVITIES

Phase	Timeframe	Restoration Activities
I	Summer 2003	• Complete certification sampling within the Wetland Mitigation footprint (i.e., A6PI). • Kill existing vegetation in upland pasture fields and approximately 3 acres of wetland pastures. • Set up project trailer adjacent to gate W-19 (across from Rail House) • Establish laydown area adjacent to trailer.
II	Fall 2003	• Seed upland and wetland pasture fields with native prairie seeds to convert to prairie. • Excavate and grade Wetland Mitigation area to create three interconnected basins. • Install water level control structures. • Remove culvert structures crossing the road to divert water to basins. • Amend any subsoil materials exposed in excavation footprint with topsoil, mulch, or compost. • Seed excavation footprint with native prairie seed. • Install erosion control matting to emergency spillways. • Install live willow cuttings in spillways and narrow drainages.
III	Spring 2004	• Install grass and wildflower plugs in and/or around created basins.
IV	Fall 2004	• Kill and remove invasive species and grapevine within woodland patch areas. • Install trees and shrubs to patches within the Wetland Mitigation area to create wet woodlands.

4.2 ESTABLISH PRAIRIE IN NORTHERN WOODLOT

Two methods are planned for the establishment of prairie in the area. Wetland pastures on the eastern boundary of area were mowed to reduce grass height in the fall of 2002. Mowing was followed in the fall by seeding native wetland grass and forb mixture into soil and pasture with seed drill. Mix contained no cover crop seed (e.g., Canada wild rye, Virginia Wild Rye, or ReGreen®) since area is already vegetated. The remainder of the old pasture fields will be established as follows. Pastures on the western end of area are to be sprayed with a polyphosphate herbicide formula to kill existing pasture grasses prior to seeding.

Rodeo®, is the formula for use in wetland areas and Roundup® will be utilized in upland areas on north. Woody stems in the prairie footprint will be sprayed with herbicide to kill the plants and the remaining stems will be removed mechanically at a later time. Licensed subcontract personnel will apply herbicide via a truck-mounted boom sprayer and/or a backpack sprayer in accordance with state and federal regulations. Seeding areas will be sprayed up to two times prior to seeding. The area will be allowed to brown over (approximately two weeks) prior to seeding with native wetland seed mix.

All prepared prairie areas will be seeded per the attached specification (Appendix B) and as indicated in Figure 3-3. As stated above, areas will be seeded after herbicide application.

4.3 CONSTRUCTION STARTUP

As shown in Table 4-1, startup involves the setup of the project trailer and laydown area. Trailer will be moved into place, leveled, and contractor will secure it in place using anchors. Steps will be secured to trailer. Electricians will hook trailer to supplied electric from adjacent pole. A laydown area will be established using rope and T-post to identify boundaries. Laborers will install silt fence in southwest drainage from the project to outfall ditch.

4.4 EXCAVATION AND GRADING

Three shallow basins will be constructed within the Wetland Mitigation footprint as outlined in the Grading Plan (Figure 3-1 and 3-2). Fluor Fernald's Soils Project will self-perform the construction of the wetlands. Personnel and equipment from the Borrow Area Project will be relocated to the Wetland Mitigation Project at the conclusion of borrow activities for the season. Soil from the excavation should remain at the site and be used for the construction of berms and to attain grade in western basin. Any wood debris will be stockpiled for possible future use in basin bottoms and brush piles. Side slopes should be constructed with at least 5:1 slope ratio. Any slope greater than 3:1 will be covered with coir matting to protect the slope as listed in Section 02930. Emergency spillways will be constructed at elevations denoted in Figure 3-2 and to specifications included therein.

Water control structures, as specified in Figure 3-2, will be installed between each basin and in outfall from area. The structure will be installed to allow for easy access to stop logs. Flow to the structure and out to the next basin will be through buried pipe. Ingress and egress points will contain guards to prevent rodents and other pests from entering pipes. All pipe outlets and the inlet of the double culvert installed at the eastern end of Pond 3 will contain rip-rap as shown on Figures 3-1 and 3-2 to protect from washout.

The catch basin and two culverts crossing the road on eastern edge of area will be taken out. Construction will set up barriers to prevent inadvertent traffic along the road. Structures will be removed using a trackhoe. The holes left will be backfilled with clay from basin excavation. Road will be re-established and opened for vehicular traffic. New culverts will be installed parallel to the road in two locations to allow for small vehicle access into the project area to the water control structures from the south. An additional pair of culverts will be installed parallel to the road on the eastern edge of A6PI into A1PIII to provide access for planting in Beech-Maple and Riparian patches. Culverts installed at the East end of A6PI will be removed once project activities are complete.

A limited amount of topsoil is available in the A6PI project area. Most of the exposed soil at grade will be subsoil material. All exposed subsoil material will be amended in place with topsoil from existing stockpiles on site. In the event that topsoil is not available, compost material will be acquired from an off-site source and used for amendment in the project area. A minimum of 6 inches of topsoil will be used over the surface of the project area. Amendment will not be required in areas where standing pools of water are expected.

Following amendment, the area will be seeded (Figure 3-4) by Fluor Fernald labor, pursuant to the attached seeding specification (Appendix B). Seeding will also occur in the northern woodlot after appropriate herbicide application has occurred (Figure 3-4). Flour Fernald personnel will be responsible for the acquisition, application, and maintenance of the seed. Appropriate seed mix will be seeded to each area as indicated in Figure 3-4.

Fluor Fernald labor will install erosion control matting specified in this Grading Plan. Material will be stretched over the area to be covered. The edges will be entrenched and secured in accordance with the manufacturer's specifications. Wooden stakes and metal staples will be used to secure the matting to the soil surface to ensure matting to soil contact. Frequency and alignment will be at intervals specified by the manufacturer.

At the direction of the restoration ecologists, wood debris will be placed along bottom of basins to create wildlife habitat. Materials should be secured in place to prevent movement during high water and to prevent possible damage to water control structures.

4.5 PLANTING ACTIVITIES

Planting activities involve the establishment of trees, shrubs, live cuttings, and herbaceous plants across the project areas. As documented in the NRRP, densities for restoration areas are generally 160 trees/acre and 90 shrubs/acre. All efforts will be made during planting to achieve the above stated densities. Some planting will occur on the edge of woodlot to the north of the wetland basins (Figure 3-3). Plants will be installed in available open areas between existing trees to enhance current densities to restoration levels. Planting on the edge of the Northern Woodlot may vary from typical densities due to availability of open planting areas.

4.5.1 Live Cuttings

Live stakes will be installed as soon as possible upon receipt. Any plants that are stored for more than 24 hours at the staging area shall be healed in with woodchip mulch and watered as needed to prevent stress. Laborers will install willow cuttings in areas designated by restoration ecologist. An appropriate size pilot hole will be created in the ground with hammer and rod. The live stake will then be driven into the ground to a depth of at least half the length of the live cutting and up to two-thirds the length of the cutting. Laborer must ensure that there is good soil to cutting contact. Ground should be moistened after installation if the ground is dry to encourage root development.

4.5.2 Native Grasses and Forbs

The use of herbaceous plants will be on inner slopes and in shallow areas of basins. Herbaceous plants will be delivered to the site in 2-inch square open-bottomed pots. These plants will be staged in water immediately upon arrival at the site. Herbaceous plant installation will be conducted using a dibble bar or shovel. Plants will be carefully removed from their pot and placed into the planting hole, keeping the root mass and soil ball intact. The plant is then gently pressed into place by hand. Laborers will make sure that no roots are exposed. If the ground is dry, planting area should be moistened after installation to ensure plant establishment.

Some native grasses from onsite wetlands will be transplanted to the basins, if feasible, along with soils and muck from the wetland. The transplants will aid in the development of a healthy wetland environment.

Geese have been a problem in recent projects in the establishment of grass and wildflower plugs. Canada Geese tend to pull the plugs out of the ground when they feed on them and the plugs die from the exposure. Goose fence may be installed to make predation by geese more difficult. If installation is

required, 2-foot stakes will be driven into the ground around perimeter of each basin. Heavy duty fishing line will then be stretched around the stakes at heights of 3 inches, 6 inches, and 9 inches. Fishing line would be wrapped around each stake going around the basin. Additionally, fishing line will be strung back and forth across the top of the basin to prevent the geese from flying into and landing within each basin. Flagging will be hung at frequent intervals along fishing line to make them visible to laborers and visitors: this should prevent inadvertent tripping of personnel on fence, but will hinder geese from landing in the area.

4.5.3 Saplings and Shrubs

Woody plants will be installed in the same manner as other ecological restoration projects at the FCP. Habitat templates will be divided into smaller planting patches. Each planting patch will be laid out in the field. The plants themselves will be staged at the project site and tagged with metal number tag. Laborers will place plants in patches as designated by restoration ecologist and install the plants pursuant to the planting specifications in Appendices C and D. Small working piles of mulch may be created throughout the project in upland areas as needed to support planting using mulch from Northern Pines Project stockpile. This "random patch" method allows the restoration ecologist to strategically place specific species based on its habitat requirements, distribution patterns, exposure, topography, deer pressure, hydrology, soils, etc.

All plant material will be procured from local sources, to the degree possible. All trees shall be at least one-gallon container size, grown in "spin out" containers to prevent root binding. Shrubs must also be grown in spin out containers, and must be at least 1 foot tall. Certain species may not be available locally, if at all. The restoration ecologist will determine the appropriate substitution for a plant. The function of the tree as listed in Table 3-1 will be used as a guide to determining substitutions. The Natural Resource Trustees will be notified of any substitutions as part of the consolidated monitoring program discussed in the NRRP.

All plant material will be delivered to the project area directly. A laydown area will be established adjacent to the mulch stockpile area, where plant material may be staged. The mulch stockpile used in the Northern Pines Project will be utilized. Any plants that are stored for more than 24 hours at the staging area shall be healed in with woodchip mulch.

4.6 MAINTENANCE ACTIVITIES

Maintenance is critical to restoration success. Activities that will be required for the A6PI Wetland and A1PIII restoration areas may include watering, deer control, and invasive species control. These activities are discussed in more detail below.

4.6.1 Watering

Each plant will be watered at the time of installation. Watering will also be carried out as needed during the first six weeks following plant installation as required per Specification 2940. Watering will also be carried out beyond the initial six-week period as directed by the restoration ecologist if drought conditions persist during the first growing season.

Water is not directly available for the project area. Water will be made accessible for watering operations via polyethylene tanks on trailers or water trucks. Watering will be carried out either directly via hose, tree gator and/or bucket, or remotely via water cannon. Watering may be carried out during the second growing season if significant drought conditions occur similar to the summer of 1999 and 2002.
For seeded areas, the planting window restrictions in the attached seeding specification help to ensure that sufficient soil moisture exists for germination and survival of seeds. Weather patterns will be a contributing factor in timing of seed application. Some watering may be needed the first season if drought conditions threaten the survival of germinated seed.

4.6.2 Deer Control

Installed trees and shrubs must be protected from deer browsing and rubbing in order for forest restoration efforts to be successful. At a minimum, field personnel will install deer tubes around all planted trees. In addition, a latex-based taste repellent will be applied to all received plant material and systemic deer repellent/fertilizer tablets will be placed in rootball of plant prior to installation. Another physical means of protection for newly planted species is the planting of shrubs in a clumped configuration and the installation of fencing around shrub patches. These measures have proven to be moderately effective in past restoration efforts.

4.6.3 Invasive Species

The forest restoration concept developed in the NRRP depends on ecological succession as the primary component. Without adequate control, invasive and aggressive species may impede or prevent natural succession and alter the intended course of maturation for restored areas. Therefore, field personnel will mechanically remove or apply glyphosphate herbicide to bush honeysuckle, multiflora rose, thistle

varieties, garlic mustard, autumn olive, grapevines, Typha spp., and Phragmites spp., present in A1PIII planting areas.

4.7 MONITORING

Both Implementation and Functional Monitoring will be conducted for A6PI restoration. For Implementation Phase Monitoring, water level measurements, water quality measurements, wetland plant surveys and soil analysis will be carried out for a three-year period. Monitoring will also be documented with photographs. Plant survival and herbaceous coverage will only be evaluated in the first year after project completion. To facilitate plant survival evaluations, all sapling trees and shrubs will be tagged with a unique number, which will be recorded on patch-specific data sheets. Mortality counts will be conducted at the end of the first growing season following completion of project area restoration. For Implementation Monitoring of seeded areas, herbaceous cover will be evaluated pursuant to the process and criteria set forth in the 2002 Consolidated Monitoring Report for Restored Areas (DOE 2003).

Functional Monitoring will also commence following restoration. In accordance with the current Functional Monitoring schedule, completed prairie areas will be evaluated in 2004 and completed forest areas will be evaluated in 2005. As with Implementation Monitoring methods, the methods, results, analyses, and reporting are conducted under the Annual Consolidated Monitoring Report for Restored Areas.

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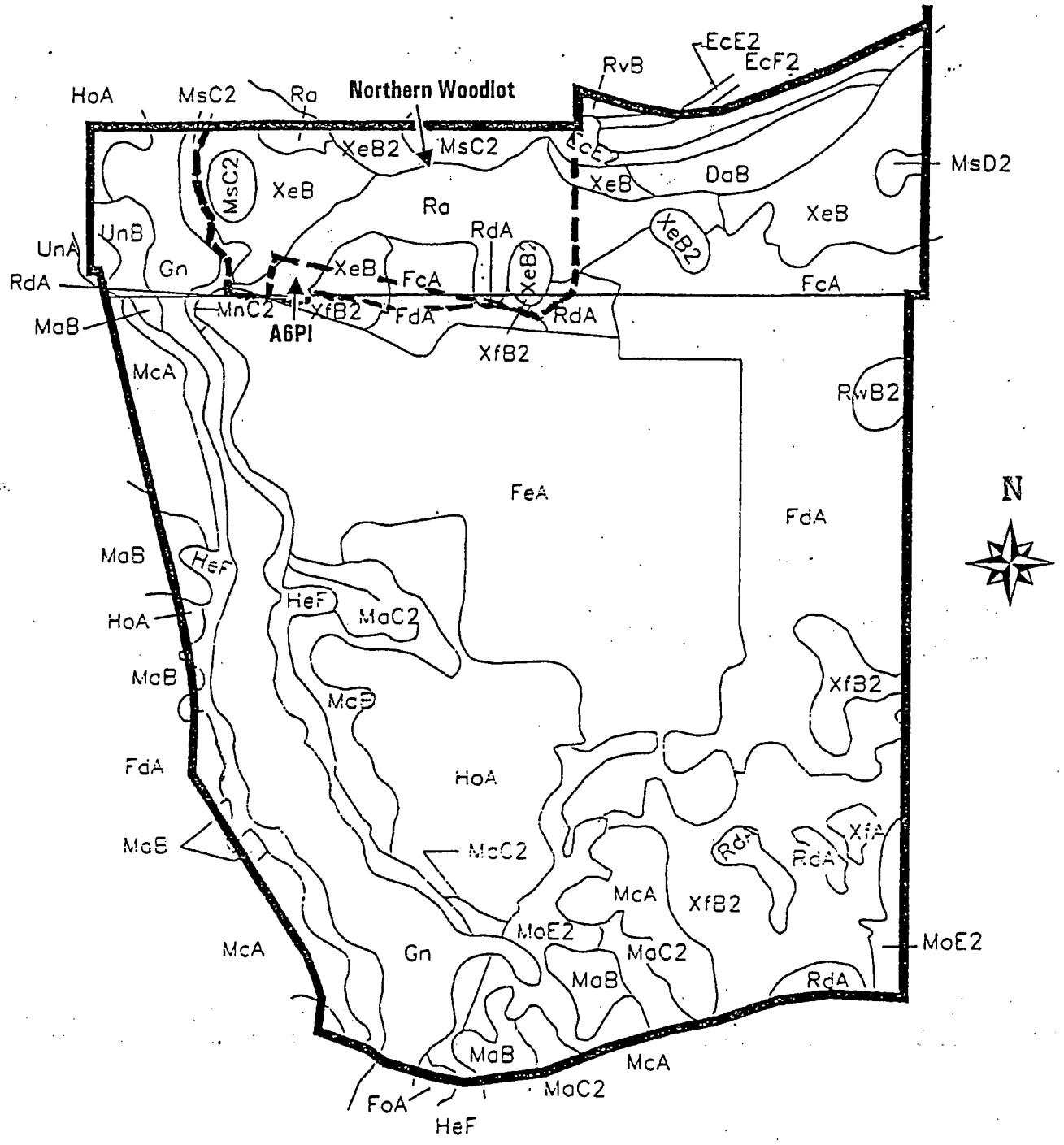
APPENDIX A

SCS SOILS DRAINAGE CLASSIFICATION

APPENDIX A
SOILS CLASSIFICATIONS FOR THE WETLAND MITIGATION - PHASE II PROJECT

Symbol	Name	Slopes (%)	Drainage Classification
EcE2	Eden silty clay loam	15-25	Well drained
FcA and FdA	Fincastle silt loam	0-2	Somewhat poorly drained
FdA/FcA	Fincastle silt loam	0-2	Somewhat poorly drained
MsC2	Miamian-Russell silt loam	2-6	Well drained
Ra	Ragsdale silty clay loam	Level	Very poorly drained
RdA	Raub silt loam	0-2	Somewhat poorly drained
RvB	Russell-Miamian silt loam	2-6	Well drained
XeB	Xenia silt loam	2-6	Moderately well drained
XeB2	Xenia silt loam	2-6	Moderately well drained
XeB/XfB2	Xenia silt loam	0-6	Moderately well drained
XfB2	Xenia silt loam	0-2, eroded	Moderately well drained
XfB2/XeB	Xenia silt loam	0-6	Moderately well drained

Source: SCS (1980, 1982)



FERNALD CLOSURE PROJECT SOIL MAP

Soil Survey of

BUTLER COUNTY, OHIO

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Ohio Department of Natural Resources
Division of Lands and Soils, and
Ohio Agricultural Research and Development Center

Eden series

The Eden series consists of moderately deep, well drained, slowly permeable soils on hillsides. These soils formed in residuum weathered from interbedded calcareous shale and limestone. Bedrock is at a depth of 20 and 40 inches. Slope ranges from 15 to 50 percent.

Eden soils are similar to Miamian and Wynn soils. Miamian soils are deep and formed almost entirely in glacial till; they have a thin loess mantle. Wynn soils formed partly in till and commonly have a thin loess mantle.

Typical pedon of Eden silty clay loam, 25 to 50 percent slopes, moderately eroded, about 1 mile west of Ross, Ross Township, T. 3 N., R. 2 E., section 32, from northeast corner, 1,550 feet south and 400 feet west:

A1—0 to 5 inches; very dark brown (10YR 3/3) silty clay loam; moderate fine subangular blocky structure; friable; 5 percent limestone flagstones on surface and in horizon; neutral; abrupt smooth boundary.

B2t—5 to 20 inches; olive brown (2.5Y 4/4) flaggy silty clay; moderate fine subangular blocky structure; firm; thin continuous olive brown (2.5Y 4/3) coatings; thin patchy olive brown (2.5Y 4/4) clay films; 20 percent thin limestone flagstones; neutral to mildly alkaline; neutral to mildly alkaline at a depth of 15 to 20 inches; gradual smooth boundary.

B3—20 to 27 inches; light olive brown (2.5Y 5/4) silty clay; moderate medium and fine subangular blocky structure; firm; grayish brown (2.5Y 5/2) ped surfaces; 10 percent limestone flagstones; moderately alkaline; clear smooth boundary.

Cr—27 to 40 inches; interbedded clay shale and thin bedded hard fossiliferous limestone (Ordovician age); strong effervescence; moderately alkaline.

Interbedded shale and limestone (paralithic contact) is at a depth ranging from 20 to 40 inches. The solum ranges from 14 to 30 inches in thickness. Coarse fragments of limestone flagstones make up 0 to 15 percent of the A horizon, 10 to 25 percent of the B horizon, and 25 to 40 percent of the C horizon. The solum ranges from slightly acid to moderately alkaline.

The A1 horizon generally is less than 6 inches thick and ranges from dark brown (10YR 3/3) to very dark grayish brown (2.5Y 3/2). It ranges from heavy silt loam to silty clay.

The B horizon ranges from brown (10YR 4/3) to olive (5Y 4/4). It generally does not have mottles. It is silty clay or clay. Some pedons have a silty clay loam B1 horizon less than 5 inches thick. In some pedons, the B3 horizon has few or common thin clay films.

EcE2—Eden silty clay loam, 15 to 25 percent slopes, moderately eroded. This moderately deep, steep, well drained soil is on valley walls and hillsides. Most areas are dissected by shallow drainageways. Interbedded shale and limestone bedrock commonly outcrop in many of these waterways. Limestone flagstones are common on the surface in places (fig. 4), especially in and around waterways. Intermittent sidehill seeps commonly occur along the surface of the nearly impervious shale bedrock. Most areas are elongate or fan shaped and range from 5 to 200 acres in size.

Slopes are typically smooth, though steep, and the waterways are not deeply cut in V-shaped ravines as they are in till soils, such as Hennepin or Miamian soils. The shale and limestone bedrock has been very resistant to downcutting. Many waterways throughout this map unit are scenic, dropping over a whole series of hard limestone ledges. The soft shale layers between the hard rock layers have been undercut, resulting in a long series of waterfalls and pools.

Typically, the surface layer is very dark brown, friable silty clay loam about 6 inches thick. The subsoil is about 23 inches thick. The upper part is olive brown, firm silty clay that is 20 percent limestone flagstones. The lower part is light olive brown, firm silty clay that is about 10 percent limestone flagstones. The substratum is calcareous, interbedded clay shale and thin-bedded limestone. In some small areas the surface layer is very dark grayish brown, and in other areas the surface layer is silt loam.

Included with this soil in mapping are small areas where the soil is severely eroded. In these areas, the surface layer typically is calcareous, olive brown clay or silty clay, and depth to bedrock is commonly very shallow. Also included are small areas of well drained Wynn soils on the less steep, upper and lower parts of slopes. These inclusions make up 5 to 15 percent of some of the larger areas.

In this Eden soil, permeability is slow, and the available water capacity is low. Runoff is rapid. Reaction ranges from neutral to mildly alkaline in the root zone. Organic-matter content is low as a result of the loss of surface soil by erosion. Root development is restricted by shale and limestone bedrock.

This soil is too steep for farming. Most of the acreage is in pasture or woodland, and the potential for these uses is medium. The soil has low potential for building sites and sanitary facilities because of steep slopes and limited depth to bedrock.

This soil is commonly in pasture, but, if overgrazed, the hazard of erosion is severe. Control of erosion and maintenance of a maximum stand of forage species are management concerns. During seeding, using cover crops or companion crops, trash mulching, or no-till seeding helps control erosion. Certain legumes, such as crownvetch, grow well because they tolerate droughtiness. Proper stocking, pasture rotation, and timely application of fertilizer help to maintain a maximum stand c forage species. Some less steep areas that have bee farmed in the past now are in brushy pasture, commonl Canadian bluegrass, thornapple, and redcedar. Potentia pond reservoir sites are limited. Because of steep slopes, embankments must be high if there is to b adequate water area. The clay shale makes the pond bottom water-tight, but there is danger of seepage along the top of the rock layers.

Management is difficult if this soil is used for wood land. The soil is clayey. The hazard of erosion is severe and use of harvesting equipment is severely limited. Logging roads and skid trails should be constructed on th contour where practical. Mechanical tree planting an weed control can be accomplished if safety precaution are taken. Woodland improvement for timber productio requires exclusion of undesirable species and poorl formed trees.

This soil is poorly suited to most nonfarm uses be cause of the steep slopes and limited depth to bedrock It is subject to slip if fill is put on top of it, if the toe c the slope is undercut, or if surface water or ground wate saturates the area. The interbedded shale and limeston bedrock underlying this soil at a depth of 20 to 40 inches makes excavation for most uses difficult and expensive however, the bedrock is rippable by heavy equipmen and rarely requires blasting. The many flagstones mak the soil undesirable for construction. Ground water flow ing on the surface of the nearly impervious shale ca cause seeps on some slopes and in waterways. Wate can seep into excavations if not intercepted, and seep age is common on the lower parts of slopes.

This soil is in capability subclass VIe; woodland suit ability subclass 3c.

Fincastle series

The Fincastle series consists of deep, somewhat poorly drained soils on uplands and in till filled valleys. These soils formed in a mantle of loess and in the underlying calcareous loam or clay loam glacial till of Wisconsin age. Permeability is slow or moderately slow in the subsoil and slow in the underlying till. Slope ranges from 0 to 6 percent.

Fincastle soils are commonly adjacent to Russell and Xenia soils. Russell and Xenia soils are not dominantly 2 in chroma below the Ap horizon.

Typical pedon of Fincastle silt loam, 0 to 2 percent slopes, about 1 mile northeast of Jericho, Liberty Township, R. 3, T. 3, section 9, from southwest corner, 200 feet north and 2,100 feet east:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A&B—8 to 13 inches; dark grayish brown (10YR 4/2) silt loam (A) and grayish brown (10YR 5/2) silt loam (B); few fine distinct yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; friable; few small very dark brown iron-manganese concretions; medium acid; clear smooth boundary.

B21tg—13 to 20 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; thin continuous grayish brown (10YR 5/2) clay films on peds and lining pores; few small dark brown iron-manganese concretions and stains; medium acid; clear wavy boundary.

B22tg—20 to 28 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin continuous brown (10YR 4/2) clay films on all peds and lining pores; medium acid; clear wavy boundary.

B23tg—28 to 33 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; common iron-manganese stains, mostly on faces of peds; neutral; clear wavy boundary.

IIB24tg—33 to 38 inches; dark brown (10YR 4/3) clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; weak to moderate medium subangular blocky structure; firm; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds, 6 percent small angular till pebbles; neutral; clear smooth boundary.

IIB3—38 to 41 inches; dark brown (10YR 4/3) clay loam; few medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; weak medium angular blocky structure; firm; 8 percent small angular till pebbles; few segregations of carbonates; mildly alkaline; clear irregular boundary.

IIC—41 to 62 inches; brown (10YR 5/3) light clay loam; common medium and coarse distinct grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/6) mottles; massive; friable; strong effervescence; moderately alkaline.

The silt capping ranges from 20 to 40 inches in thickness. The solum typically is 36 to 46 inches thick and ranges from 36 to 60 inches in thickness.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2. An A2 horizon is present in some pedons. Reaction ranges from slightly acid to strongly acid.

The matrix of the B2 horizon has hue of 10YR, value of 4 and 5, and chroma of 2 to 4. Most horizons between the base of the A horizon and 30 inches have ped coatings of 2 or lower chroma. The upper part of the B2 horizon, which formed in loess, is silty clay loam; the lower part, which formed in glacial till, is clay loam.

The C horizon is light clay loam or loam.

FcA—Fincastle silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on flats in high lying positions of the upland landscape. Most areas are oblong or irregular in shape and range from 3 to 150 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The next layer is about 5 inches thick. It is dark grayish brown, friable silt loam mixed with grayish brown silt loam that has a few yellowish brown mottles. The subsoil is about 28 inches thick. The upper part is dark yellowish brown, mottled, firm silty clay loam; the lower part is dark brown, mottled, firm clay loam. The substratum, to a depth of 62 inches, is brown light clay loam.

Included with this soil in mapping, and making up as much as 10 percent of the map unit, are small areas of nearly level Xenia and Ragsdale soils. The dark colored, wetter Ragsdale soils are in the lower lying areas of the landscape, and the better drained Xenia soils are on the slight rises.

In this Fincastle soil, permeability is moderately slow to slow in the subsoil and slow in the substratum. Available water capacity is high. Surface runoff from cultivated areas is slow, and the soil tends to dry slowly. Tilth is fair. The subsoil has a moderate shrink-swell potential. The root zone is normally deep, because the water table remains deep enough during the cropping season to allow crops common to the area to be grown. The soil commonly is medium acid except where limed. The water table is seasonally high for long periods in winter and spring.

Most of the acreage of this soil is farmed. It has high potential for cultivated crops, hay, pasture, and trees. It has low to medium potential for building site development and sanitary facilities. It has medium potential for recreational uses.

This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. Although it has slow or moderately slow permeability, subsurface drainage lines or surface drains help to reduce excess wetness. Maintaining good soil structure is important. The soil is low in organic-matter content and is susceptible to surface crusting. It can be used for row crops year after year if management is optimum. It dries slowly in spring, and planting may be delayed in undrained areas.

This soil has high potential for pasture or hay. Overgrazing or grazing when the soil is too wet, however, can cause surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to hardwood trees. In existing stands, tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed by spraying, cutting, or girdling. Wetness is a hazard when planting or harvesting trees.

The use of this soil for homesites and septic tan absorption fields is limited by wetness (fig. 6) and moder ately slow permeability to slow permeability in the sub soil. Performance of septic systems can sometimes b improved by increasing the size of the leach field c providing an alternate leach field. The soil is bette suited to dwellings without basements than to dwelling with basements. Surface and subsurface drainage lower the seasonal high water table. Landscaping building site helps to keep surface water away from foundations Local roads can be improved by artificial drainage an using a suitable base material.

This soil is in capability subclass IIw; woodland suit ability subclass 3o.

FdA—Fincastle silt loam, bedrock substratum, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on uplands. It is on tops of hills, which have only a thin smear of stony till over the bedrock. These areas are shaped by the underlying bedrock. Most areas are oblong or irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The next layer is about 5 inches thick. It is dark grayish brown, friable silt loam mixed with grayish brown silt loam that has a few yellowish brown mottles. The subsoil is about 29 inches thick. The upper part is brown, mottled, friable light silty clay loam; the middle part is yellowish brown, mottled, firm silty clay loam; and the lower part is yellowish brown, mottled, firm clay loam. The substratum, to a depth of about 56 inches, is flaggy light clay loam till. It contains many angular till pebbles and many limestone flagstones averaging about 6 inches across and 2 inches in thickness. These flagstones make up 15 to 30 percent of the volume of the till. Commonly, a 6 to 18 inch layer of this stony till substratum rests directly on the underlying shale and limestone bedrock.

Included with this soil in mapping, and making up 5 to 10 percent of the map unit, are small areas of moderately well drained Xenia, bedrock substratum, soils on slight rises and as strips along the map unit boundary. Also included are small areas of nearly level, somewhat poorly drained soils that have shale and limestone bedrock at a depth of 20 to 40 inches and a few small areas of nearly level Fincastle soils.

In this Fincastle soil, permeability is moderately slow or slow in the subsoil and very slow in the substratum. Available water capacity is medium. Surface runoff from cultivated areas is slow, and the soil tends to dry slowly. Tilth is fair. The subsoil has moderate shrink-swell potential. The root zone is normally deep, because the water table remains deep enough during the cropping season to allow crops common to the area to be grown. The soil commonly is medium acid except where limed. The water table is seasonally high for long periods in winter and spring.

Most of the acreage of this soil is farmed. The soil has high potential for cultivated crops, hay, pasture, and trees. It has low to medium potential for building sites and sanitary facilities. It has medium potential for recreational uses.

This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. Wetness is the main limitation to farming. The soil has a moderate capacity for storing and releasing plant nutrients. Subsurface drainage lines or surface drains help to reduce excess wetness. Maintaining good soil structure is important. The surface layer is low in organic-matter content and susceptible to surface crusting. The soil can be used for row crops year after year if management is optimum. It dries slowly in spring, and planting may be delayed in undrained areas. Rock interferes with excavation for subsurface drains and waterways in farm drainage. Crop yields are also influenced because seepy areas tend to occur where rock is at a minimum depth.

This soil has high potential for pasture. Overgrazing or grazing when the soil is too wet, however, will cause surface compaction and poor tilth. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to such native hardwood trees as oak, ash, and maple. In existing stands, tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed by spraying, cutting, or girdling. Wetness is a hazard when planting or harvesting trees.

This soil has limited use for homesites and septic tank absorption fields because of wetness and moderately slow to slow permeability in the subsoil. It is better suited to dwellings without basements than to dwellings with basements. Any included areas of gently sloping Xenia soils should be used for homesites if feasible. Performance of septic systems can sometimes be improved by increasing the size of the leach field or providing an alternate leach field. Surface and subsurface drainage lowers the seasonal high water table. Landscaping building sites helps to keep surface water away from foundations. Local roads can be improved by artificial drainage and using a suitable base material.

The stony till and interbedded shale and limestone underlying this soil make excavation for most uses difficult and expensive; however, the stony till and bedrock is rippable by heavy equipment and rarely requires blasting. The many stones in the till make it undesirable to use in pond embankments.

Miamian series

The Miamian series consists of deep, well drained, moderately slowly permeable soils on till plains, end moraines, and till filled valleys. These soils formed in a thin layer of loess and the underlying loamy till. Slope ranges from 2 to 50 percent.

Miamian soils are commonly adjacent to Celina soils and are mapped in a complex with Hennepin and Russell soils. Celina soils have 2-chroma mottles in the upper 10 inches of the argillic horizon. Hennepin soils are shallow to till and Russell soils formed in a mantle of loess more than 18 inches thick.

Typical pedon of Miamian silt loam, 2 to 6 percent slopes, moderately eroded, about 2 miles northeast of Astoria, Madison Township, T. 3 N., R. 4 E., section 29, from southwest corner, 50 feet north and 1,500 feet east:

Ap—0 to 6 inches; brown (10YR 4/3) silt loam; weak fine granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

B1—6 to 10 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderately medium subangular blocky structure; friable; thin very patchy brown (10YR 4/3) clay films on surfaces of peds and lining voids; slightly acid; clear wavy boundary.

IIB21t—10 to 16 inches; dark yellowish brown (10YR 4/4) heavy clay loam; strong medium subangular blocky structure; firm; thin continuous brown (10YR 4/3) clay films; few roots; 2 percent coarse fragments; common iron-manganese stains on surfaces of peds; neutral; clear smooth boundary.

IIB22t—16 to 20 inches; dark yellowish brown (10YR 4/4) heavy clay loam; strong medium and coarse subangular blocky structure; firm; thin continuous brown (10YR 4/3) clay films on surfaces of peds; few roots; 3 percent coarse fragments; mildly alkaline; clear irregular boundary.

IIB3t—20 to 22 inches; dark yellowish brown (10YR 4/4) clay loam; weak coarse subangular blocky structure; firm; thin patchy brown (10YR 4/3) clay films on major vertical surfaces of peds; few roots on clay films; 5 percent coarse fragments; 3 percent highly weathered limestone fragments; mildly alkaline; slight effervescence; clear wavy boundary.

IIC1—22 to 30 inches; yellowish brown (10YR 5/4) loam; massive; friable; 10 percent coarse fragments; strong effervescence; moderately alkaline; diffuse smooth boundary.

IIC2—30 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; 10 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 20 to 35 inches in thickne
The loess mantle is less than 18 inches thick.

The Ap horizon has hue of 10YR, value of 4 or 5, a
chroma of 2 or 3. It is silt loam or clay loam.

The B1 horizon has hue of 10YR, value of 4 or 5, a
chroma of 3 or 4. It is silty clay loam or heavy silt loa

The IIB2 and IIB3 horizons have hue of 10YR
7.5YR, value of 4 or 5, and chroma of 3 to 6. They
clay loam or clay.

The C horizon is loam or clay loam; stony analogs
in some pedons.

MsC2—Miamian-Russell silt loams, 6 to 12 percent slopes, moderately eroded. These deep, moderately sloping, well drained soils are on hillsides and along waterways on rolling till plains. Areas are irregular or linear in shape and range from 3 to 50 acres in size.

This map unit is about 60 percent Miamian silt loam and 30 percent Russell silt loam. The irregular areas that surround waterways are more than 60 percent Miamian soil. In the linear areas, the Miamian soil commonly is adjacent to the steep or very steep slope breaks of hillsides, and the Russell soil is adjacent to the gently sloping, smooth, lower parts of hillsides. In the irregular areas, the Miamian soil is on the slope breaks and the Russell soil is in the smoother areas.

Typically, the Miamian soil has a surface layer of brown, friable silt loam about 8 inches thick. The subsoil is dark brown and dark yellowish brown, firm clay loam about 14 inches thick. The substratum, to a depth of 60 inches, is dark yellowish brown, firm loam.

Typically, the Russell soil has a dark brown, friable silt loam surface layer about 7 inches thick. The subsoil is about 27 inches thick. The upper part is brown, firm silt loam and silty clay loam, and the lower part is strong brown, brown, and yellowish brown, firm clay loam. The substratum, to a depth of 60 inches, is brown, firm loam.

Included with these soils in mapping are areas of soils, in similar or higher positions on the landscape, in which the substratum is more than 15 percent stone fragments. Also included are a few areas of severely eroded soils that have a pebbly or flaggy clay loam surface layer and areas of soils where slope is more than 12 percent.

Permeability is moderately slow in the Miamian soil. In the Russell soil, it is moderate in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the substratum. The available water capacity is moderate in the Miamian soil and high in the Russell soil. Surface runoff is medium. The surface layer varies in reaction because of local liming practices. The organic-matter level is low in both soils as a result of erosion of the surface layer. These soils are especially susceptible to gully and rill erosion.

These soils have medium potential for farming, and most areas are used for corn and soybeans. The soils have high potential for pasture, hay, and woodland. They have medium potential for building site development, medium to low potential for sanitary facilities, and medium potential for many recreational uses.

The hazard of erosion is severe. Minimum tillage, winter cover crops, grassed waterways, stripcropping, and contour farming, however, can minimize soil loss. These soils crust after rain, but the regular addition of crop residue and other forms of organic matter can reduce crusting and increase fertility. Internal drainage is adequate for farming. Measures to conserve soil moisture, such as minimum tillage and soil mulching, can benefit crops. The regular addition of fertilizer and other soil amendments, as recommended by soil tests, also benefits crops. Control of erosion and maintenance of fertility and organic-matter content are the main management concerns.

Using these soils for permanent pasture or hay is effective in controlling erosion. Pasture and hay commonly are grass-legume mixtures, generally bluegrass and clover. Grazing when this soil is wet will cause surface compaction, excessive runoff, and poor tilth. The trash-mulch method of pasture renovation can practically eliminate further erosion. Proper stocking and pasture rotation help to keep pasture and the soil in good condition.

These soils are well suited to trees. Plant competition is a concern, but tree seeds and seedlings survive and grow well if competing vegetation is controlled. Many wooded areas are in oak-hickory or beech-maple forest types. Plant competition is the only limitation to planting or harvesting trees.

These soils are suitable for homesites. They are moderately well suited to most recreational uses. They do not have sufficient strength and stability to support vehicular traffic, but roads can be built if a suitable base material is used. The moderately slow permeability limits use for septic tank absorption fields, but it can be overcome by increasing the size of the leach field or using an alternate leach field. Construction sites should be landscaped to drain surface water away from the buildings.

These soils are in capability subclass IIIe; woodland suitability subclass 1o.

Ragsdale series

The Ragsdale series consists of deep, very poorly drained soils that have slow permeability. These soils formed in calcareous or neutral, silty deposits. They are in depressions on the Wisconsin glacial till plain. Slope is 0 to 2 percent.

Ragsdale soils are commonly adjacent to somewhat poorly drained Fincastle and moderately well drained Xenia soils. Ragsdale soils have a darker colored A horizon than either of these soils.

Typical pedon of Ragsdale silty clay loam, about 1.3 miles east of College Corner, Oxford Township, T. 5 N., R. 1 E., section 5, from northwest corner, 165 feet south and 1,300 feet east:

Ap—0 to 8 inches; very dark gray (10YR 3/1) light silty clay loam; few fine faint light olive brown (2.5Y 5/3) mottles; weak medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

A12—8 to 12 inches; very dark gray (10YR 3/1) silty clay loam; few fine distinct brown (10YR 4/3) mottles in lower part; moderate fine and medium granular structure; slightly acid; gradual wavy boundary.

B21tg—12 to 18 inches; dark gray (10YR 4/1) silty clay loam; common fine faint brown (10YR 5/3) mottles; weak fine subangular blocky structure; friable; common roots; thin very patchy dark gray (10YR 4/1) clay films on some faces of peds; slightly acid; clear wavy boundary.

B22tg—18 to 30 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak fine prismatic structure parting to moderate fine and medium subangular blocky; firm; few roots; thin continuous gray (10YR 5/1) clay films on faces of peds; few brown (10YR 5/3) mottles on vertical faces of peds and many brown (10YR 4/3) mottles on horizontal faces of peds; neutral; gradual wavy boundary.

B23tg—30 to 50 inches; yellowish brown (10YR 5/4) light silty clay loam; many medium distinct grayish brown (10YR 5/2) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; thin very patchy gray (10YR 5/1) clay films on faces of peds; neutral; clear wavy boundary.

C1—50 to 60 inches; yellowish brown (10YR 5/4) silt loam; common coarse distinct gray (10YR 5/1) mottles; massive; friable; mildly alkaline; clear wavy boundary.

C2—60 to 72 inches; yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) silt loam; few medium distinct gray (10YR 5/1) mottles; massiv friable; mildly alkaline; clear wavy boundary.

The solum ranges from 36 to 52 inches in thickness. is slightly acid to neutral and ranges from silt loam silty clay loam.

The B horizon, to a depth of 30 to 40 inches, has hu of 10YR to 5Y, value of 4 or 5, and chroma of 1 or Mottles have hue of 10YR or 2.5Y, value of 4 or 5, ar chroma of 1 to 6. The lower part of the B horizc commonly has higher chroma in the matrix than th upper part ranging from brown to yellowish brown wi low chroma mottles.

Ra—Ragsdale silty clay loam. This nearly level, deep, very poorly drained soil is on the Wisconsin glacial till plain. It is in long, narrow, and depressional areas or in shallow basins. This soil is subject to ponding as a result of runoff from higher, adjacent soils. Areas commonly range from 3 to 200 acres in size.

Typically, the surface layer is very dark gray, friable light silty clay loam about 12 inches thick. The subsoil is about 38 inches thick. The upper part is dark gray and gray, mottled, firm silty clay loam, and the lower part is yellowish brown, mottled light silty clay loam. The substratum, to a depth of 72 inches, is yellowish brown, mottled, friable silt loam.

Included with this soil in mapping are small intermingled areas of Raub soils in which the lower part of the subsoil formed in glacial till and soils that have a silt loam surface layer. Also included are small linear areas of Fincastle or Xenia soils along the boundaries of this soil and small areas of Patton soils, generally in the lowest part of the depression.

This Ragsdale soil has slow permeability and high available water capacity. Runoff is slow. The soil has a seasonal high water table but if adequately drained, it provides a deep rooting zone for most commonly grown annual crops. The surface layer is high in organic-matter content and in ability to store and release plant nutrients.

If adequately drained, this soil is well suited to crops commonly grown in the county, such as corn and soybeans. It has high potential for pasture, woodland, and wildlife habitat. It has low potential for building site development, sanitary facilities, and recreational uses.

Wetness is a hazard. The soil dries slowly in spring because of the seasonal high water table. It can be drained by subsurface drainage lines and surface ditches if adequate outlets are established. It is highly susceptible to compaction if worked when wet. Returning crop residues to the soil improves fertility, reduces crusting, and increases water infiltration. Maintenance of fertility and control of wetness are the main management concerns.

If drained, this soil is well suited to pasture or hay. Overgrazing or grazing when the soil is too wet, however, can cause surface compaction and poor tilth. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to hardwood trees. In existing stands, tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed by spraying, cutting, or girdling. Wetness is a hazard when planting or harvesting trees.

This soil is poorly suited as building sites and for sanitary facilities because of wetness and the seasonal high water table. Subsurface drains are commonly used to lower the water table if suitable outlets are available. Landscaping building sites helps to keep surface water away from foundations. Local roads can be improved by artificial drainage and using a suitable base material.

This soil is in capability subclass IIw; woodland suitability subclass 2w.

Raub series

The Raub series consists of deep, somewhat poorly drained soils that have slow permeability. These soils formed in a mantle of loess and in the underlying calcareous, loamy glacial till of Wisconsin age. Slope ranges from 0 to 6 percent.

Raub soils are similar to Brenton soils and are commonly adjacent to Dana and Fincastle soils. Brenton soils are similar to Raub soils, but they formed in lacustrine material. Raub soils are wetter and more mottled in the B horizon than Dana soils. They differ from Fincastle soils in having a darker colored A horizon and are better drained.

Typical pedon of Raub silt loam, 2 to 6 percent slopes, about 1.1 miles east of Le Sourdsville, Lemon Township, R. 3, T. 3, section 29, from northwest corner, 165 feet south and 1,300 feet east:

Ap—0 to 10 inches; black (10YR 2/1) silt loam; weak fine granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

A12—10 to 15 inches; very dark gray (10YR 3/2) silt loam; moderate medium granular structure; friable; many roots; slightly acid; abrupt wavy boundary.

B21t—15 to 21 inches; dark grayish brown (10YR 4/2) silty clay loam; many medium distinct brown (10YR 5/3) mottles; moderate medium subangular blocky structure; friable; common roots; thin very dark grayish brown (10YR 3/2) clay films on faces of peds; medium acid; clear wavy boundary.

B22t—21 to 37 inches; brown (10YR 5/3) silty clay loam; many medium distinct gray (10YR 5/1) mottles; moderate medium subangular blocky structure; firm; few roots; thin dark gray (10YR 4/1) clay films on faces of peds; medium acid; clear wavy boundary.

IIB3—37 to 43 inches; brown (10YR 5/3) clay loam, common medium distinct gray (10YR 5/1) mottles; weak coarse subangular blocky structure; friable; neutral; abrupt wavy boundary.

IIC—43 to 60 inches; mottled yellowish brown (10YR 5/4) and gray (10YR 6/1) loam; structureless, massive; friable; slight effervescence; mildly alkaline.

The silt mantle ranges from 22 to 42 inches in thickness, and the solum ranges from 36 to 60 inches in thickness. The mollic epipedon ranges from 11 to 18 inches in thickness. Reaction ranges from medium acid to neutral depending upon the amount of lime that has been applied.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. The upper part of the B horizon is silty clay loam, and the lower part is clay loam. The upper part is medium acid to strongly acid, and the lower part is neutral.

RdA—Raub silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained, dark colored soil is on glacial till plains. It is in areas adjacent to and surrounding depressions and drainageways. Areas are rounded and oblong and range from 3 to 20 acres in size.

Typically, the surface layer is black, friable silt loam about 10 inches thick. The subsurface layer is very dark gray silt loam 5 inches thick. The subsoil is about 28 inches thick. The upper part is dark grayish brown, mottled, friable silty clay loam; the middle part is brown, mottled, firm silty clay loam; and the lower part is brown mottled, friable clay loam. The substratum, to a depth of 60 inches, is yellowish brown mottled loam.

Included with this soil in mapping are a few small areas of very poorly drained, dark colored Ragsdale soils in which the lower part of the subsoil formed in silty material rather than in weathered glacial till. Also included are a few small areas of moderately well drained Dana soils in the more sloping areas.

This Raub soil has slow permeability and high available water capacity. Surface runoff is slow. The surface layer is high in organic-matter content, and tilth is good. The rooting zone ranges from medium acid to slightly acid unless limed. The water table is high in winter and spring.

If drained, Raub soil is well suited to crops commonly grown in the county. Most of the acreage is in corn, soybeans, wheat, and hay, and the soil has high potential for these uses if properly managed. It also has high potential for pasture, woodland, and wildlife habitat. It has medium to low potential for most building site development and sanitary facilities and medium potential for most recreational uses.

Drainage is the main management concern if this soil is used for farming. Maintaining good soil structure is also a concern. Soil compaction is a concern when heavy machinery is used. The soil can be used for continuous row crops if management is optimum. It dries slowly in spring, and planting may be delayed in areas not drained.

This soil is suited to both pasture and trees, but rarely is used for either because of its suitability for more valuable crops.

This soil is poorly suited as building sites and for sanitary facilities because of wetness. Performance of septic systems can sometimes be improved by providing an alternate leach field or installing curtain drains around the absorption field to lower the water table. Landscaping building sites helps to keep surface water away from foundations. This soil is better suited to dwellings without basements than to dwellings with basements. Local roads can be improved by artificial drainage and using a suitable base material.

This soil is in capability subclass IIw; woodland suitability subclass not assigned.

Russell series

The Russell series consists of deep, well drained soils on uplands and in till filled valleys. These soils have moderate permeability in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the substratum. They formed in loess and in the underlying calcareous glacial till of Wisconsin age. Slope ranges from 2 to 18 percent.

These soils have a solum that is less than 40 inches thick. This is less than defined for the series, but this difference does not materially affect use or management.

Russell soils are similar to Uniontown soils and commonly are adjacent to Fincastle and Xenia soils. Uniontown soils formed in lacustrine material. Russell soils do not have mottles that are 2 in chroma as is characteristic of the Fincastle and Xenia soils.

Typical pedon of Russell silt loam, 2 to 6 percent slopes, moderately eroded, about 2 miles southeast of College Corner, Oxford Township, T. 5 N., R. 1 E., section 8, from southeast corner, 1,520 feet north and 1,920 feet west:

Ap—0 to 7 inches; dark brown (10YR 4/3) silt loam; moderate medium granular structure; friable; neutral; abrupt smooth boundary.

B1—7 to 10 inches; brown (10YR 5/3) silt loam; moderate medium subangular blocky structure; friable; slightly acid; clear wavy boundary.

B21t—10 to 22 inches; brown (7.5YR 5/4) light silty clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin patchy yellowish brown (10YR 5/4) clay films on faces of peds; medium acid; clear wavy boundary.

IIB22t—22 to 27 inches; strong brown (7.5YR 5/6) clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; thin patchy dark brown (7.5YR 4/4) clay films and pale brown (10YR 6/3) coatings on some vertical faces of peds; 2 percent till pebbles; few fine very dark brown (10YR 2/2) manganese concretions; neutral; clear wavy boundary.

IIB23t—27 to 33 inches; brown (7.5YR 5/4) clay loam; weak medium subangular blocky structure; firm; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; 4 percent till pebbles; mildly alkaline; clear smooth boundary.

IIB3—33 to 36 inches; yellowish brown (10YR 5/4) clay loam; weak medium subangular blocky structure; firm; 8 percent till pebbles; slight effervescence; mildly alkaline; clear smooth boundary.

IIC—36 to 60 inches; brown (10YR 5/3) loam; massive; firm; 10 percent till pebbles; strong effervescence; moderately alkaline.

The solum ranges from 36 to 56 inches in thickness but is commonly 36 to 46 inches thick. The loess mantle ranges from 22 to 36 inches in thickness. Thickness of the solum is generally the same as the depth to calcareous till.

The Ap horizon is dark grayish brown or dark brown. In wooded areas, there is a dark colored A1 horizon, 1 inch to 3 inches thick. The A horizon ranges from medium acid to neutral.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It ranges from heavy silt loam to silty clay loam.

The IIBt horizon is similar in color to the Bt horizon. It ranges from light to medium clay loam. The B horizon ranges from medium acid to mildly alkaline.

RvB—Russell-Miamian silt loams, 2 to 6 percent slopes. These deep, gently sloping, well drained soils are on upland ridges and long smooth hillsides. They are also on large convex rises and foot slopes in valleys that have been partly filled with till by glacial action. Individual areas are irregular in shape and range from 3 to 100 acres in size.

This map unit is about 50 percent Russell silt loam and 30 percent Miamian silt loam. Russell soil is generally on the mid and lower parts of smooth or concave side slopes and on the broader ridgetops. Miamian soil is generally on narrow convex ridges, slope breaks, and sides of drainageways, especially where the topography is somewhat hummocky. The two soils are so intricately mixed, or so small that it is not practical to separate them in mapping.

Typically, Russell soil has a dark brown friable silt loam surface layer about 8 inches thick. The subsoil is about 30 inches thick. The upper part is brown, friable silt loam and firm silty clay loam, and the lower part is strong brown, brown, and yellowish brown, firm clay loam. The substratum, to a depth of about 60 inches, is brown, firm loam. The till substratum is variable in thickness but is generally at least 4 feet thick over bedrock.

Typically, the Miamian soil has a brown friable silt loam surface layer about 6 inches thick. The subsoil is about 20 inches thick. The upper part is yellowish brown, friable silty clay loam, and the lower part is dark yellowish brown, firm clay loam. The substratum, to a depth of 60 inches, is yellowish brown, firm calcareous loam that is variable in thickness. It is generally at least 4 feet thick over bedrock and is about 10 percent small limestone fragments.

Included with these soils in mapping, and making up about 10 percent of the unit, are small areas of Russell-Miamian, bedrock substratum, soils on higher landscape positions. These soils are more than 15 percent stone fragments in the lower part of the subsoil and in the substratum. Also included are small areas of moderately well drained Xenia soils on the lower part of side slopes. Many areas have small yellowish brown eroded spots.

Permeability is moderate in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the substratum in the Russell soil. It is moderately slow in the Miamian soil. Available water capacity is high in the Russell soil and moderate in the Miamian soil. Surface runoff is medium from both soils. Reaction ranges from medium acid to mildly alkaline in the subsoil and varies widely in the surface layer as a result of local liming practices. The organic-matter content of these soils is low. The surface layer is friable and easily tilled throughout a fairly wide range of moisture content. It has a tendency to puddle during rain and crust upon drying. Root development is restricted below a depth of about 38 inches in the Russell soil and below a depth of about 26 inches in the Miamian soil by compact, loamy glacial till. The silty surface layer and long slopes make these soils especially susceptible to further sheet and rill erosion.

Most of the acreage of these soils is used for farming. They have high potential for cultivated crops, hay, pasture, and trees. They have medium to high potential as building sites and for sanitary facilities.

These soils are suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Where used for cultivated crops, there is a moderate hazard of erosion. Maintenance of tilth is a major management concern. Tillage, cover crops, contour farming, and grassed waterways help prevent further erosion. In many areas slopes are long enough and smooth enough to be strip-cropped or terraced and farmed on the contour. Returning crop residues to the soil and adding barnyard manure increase organic-matter content, improve ferility, reduce crusting, and increase water infiltration.

Use of these soils for pasture or hay is also effective in reducing erosion. Grazing when the soil is too wet can cause surface compaction, excessive runoff, and poor tilth. Pasture rotation and restricted use during wet periods are important.

These soils are well suited to trees, and some small areas remain in native hardwoods. Tree seeds, cuttings, and seedlings survive and grow well if competing vegetation is controlled or removed by site preparation or by spraying, cutting, or girdling. There are few soil limitations to planting or harvesting trees.

Many of these soils are good homesites. They are well suited to recreational uses. Because they do not have sufficient strength and stability to support vehicular traffic, the base material needs to be strengthened or replaced if these soils are used for roads. The moderately slow permeability limits use of the soils for septic tank absorption fields, but can be overcome by increasing the absorption area or by providing an alternate leach field. Construction sites should be landscaped to drain surface water away from the buildings.

These soils are in capability subclass IIe; woodland suitability subclass 1o.

Xenia series

The Xenia series consists of deep, moderately well drained soils on glacial till plains and in till filled valleys. These soils formed in a mantle of loess and the underlying calcareous glacial till over Ordovician bedrock in many areas. They have moderately slow permeability. Slope is 0 to 6 percent.

Xenia soils are commonly adjacent to Fincastle and Russell soils. Fincastle soils are dominantly 2 in chroma below the Ap horizon and Russell soils lack 2-chroma mottles in the upper 10 inches of the argillic horizon.

Typical pedon of Xenia silt loam, 2 to 6 percent slopes, about 3 miles south of Monroe, Liberty Township, R. 3, T. 3, section 9, from southwest corner, 430 feet north and 2,190 feet east:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; neutral; clear smooth boundary.

B&A—6 to 10 inches; brown (10YR 5/3) (B, 60 percent) and grayish brown (10YR 5/2) (A, 40 percent) heavy silt loam; weak fine and medium subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

B21t—10 to 14 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine and medium subangular blocky structure; friable; thin patchy grayish brown (10YR 5/2) clay films on surfaces of peds; medium acid; clear smooth boundary.

B22t—14 to 20 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on surfaces of peds; medium acid; clear wavy boundary.

B23t—20 to 25 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) silty clay loam; common fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on surfaces of peds; common small very dark brown (10YR 2/2) iron-manganese concretions; medium acid; clear wavy boundary.

IIB24t—25 to 31 inches; yellowish brown (10YR 5/4 and 5/6) silty clay loam; few fine faint grayish brown (10YR 5/2) mottles; moderate coarse subangular blocky structure; firm; thin very patchy grayish brown (10YR 5/2) clay films on surfaces of peds; few fine very dark brown (10YR 2/2) iron-manganese concretions; 2 percent fine angular till pebbles; neutral; clear smooth boundary.

IIB3—31 to 37 inches; dark yellowish brown (10YR 4/4) clay loam; few medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; 5 percent fine angular till pebbles in upper part and limestone segregations in lower part of horizon; mildly alkaline; abrupt irregular boundary.

IIC—37 to 72 inches; olive brown (2.5YR 4/4) light clay loam; many medium distinct grayish brown (2.5YR 5/2) mottles; massive; firm; 8 percent angular till pebbles; strong effervescence; moderately alkaline.

The thickness of the solum and depth to carbonates ranges from 36 to 50 inches. The loess cap ranges from 22 to 36 inches in thickness.

The Ap horizon is 10YR 4/2 or 10YR 3/4. It ranges from medium acid to neutral. It is silt loam.

The B2 horizon is 10YR 4/4, 10YR 5/4, or 10YR 4/3. It is silty clay loam. The IIB2 horizon and IIB3 horizons formed in till and are similar to the B2 horizon in color, but are clay loam.

The C horizon is clay loam or loam till.

XeB—Xenia silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on the till plain and in the till filled valleys. Most areas are rounded or irregular in shape and 2 to 90 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The next layer is brown and grayish brown, heavy silt loam. The subsoil is about 27 inches thick. The upper part is dark yellowish brown and yellowish brown, mottled silty clay loam, and the lower part is dark yellowish brown, mottled clay loam. The substratum, to a depth of 60 inches, is olive brown, mottled light clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Fincastle soils in the low areas and the well drained Russell-Miamian soil complex on rises. A few areas of the moderately well drained Celina soils are included where the loess cap is less than 18 inches thick.

The Xenia soil has moderately slow permeability, high available water capacity, and medium runoff. It has a high water table in the subsoil in spring. It has low organic-matter content in the surface layer, and it has good tilth. Reaction is medium acid to mildly alkaline in the rooting zone.

This soil has high potential for cultivated crops, and most areas are used as cropland. Corn, soybeans, small grains, and hay are the principal crops. Potential is high for pasture, woodland, and wildlife habitat. Potential is medium for building site development, and low for most sanitary facilities, and medium for most recreational developments.

The erosion hazard is moderate. Minimum tillage, winter cover crops, and grassed waterways will prevent excessive soil loss. The soil's natural drainage generally is adequate for farming, but random subsurface drainage lines to drain wet spots will benefit most crops. Some areas require lime applications to maintain proper soil reaction in the rooting zone. The surface layer of this soil crusts after a hard rain, but the regular addition of organic matter reduces the crusting and also increases the fertility level. Maintenance to control erosion and the fertility and organic matter levels are the main management concerns.

The use of this soil for pasture or hay is effective in controlling erosion. Grazing when the soil is wet, however, will cause surface compaction, excessive runoff, and poor tilth. Proper stocking, pasture rotation, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Various adapted species grow in the woodlots. Plant competition is a moderate limitation, but tree seedlings survive and grow well if the competing vegetation is controlled. There are no other limitations for planting or harvesting trees on this soil.

This soil is suited to homesites, and it is well suited to recreational uses. Because it does not have sufficient strength and stability to support vehicular traffic, the base material needs to be replaced if the soil is used for roads. The moderately slow permeability limits use for septic tank absorption fields but can generally be overcome by increasing the absorption area, using curtain drains, or providing an alternate leach field. Homesites should be landscaped so that surface drainage is away from buildings.

This soil is in capability subclass IIe; woodland suitability subclass 1o.

XeB2—Xenia silt loam, 2 to 6 percent slopes, moderately eroded. This deep, gently sloping, moderately well drained soil is on till plains and in till filled valleys. Most areas are rounded or regular in shape and range from 2 to 75 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The next layer is brown and grayish brown heavy silt loam. The subsoil is about 26 inches thick. The upper part is dark yellowish brown and yellowish brown, mottled silty clay loam, and the lower part is dark yellowish brown, mottled clay loam. The substratum, to a depth of 60 inches, is olive brown, mottled light clay loam.

Included with this soil in mapping are small areas of the moderately well drained Celina soils where the loess mantle is less than 18 inches thick. Also included are a few areas of the Russell-Miamian soil complex near streambanks.

The Xenia soil has moderately slow permeability, high available water capacity, and medium runoff. It has a high water table in spring. The soil has low organic-matter content in the surface layer, and it has fair tilth. Reaction is medium acid to mildly alkaline in the rooting zone.

This soil has high potential for cultivated crops, and most areas are used as cropland. Corn, soybeans, small grains, and hay are the principal crops. Potential is high for pasture, woodland, and wildlife habitat. It is fair for building site development, low for most sanitary facilities, and medium for most recreational developments.

The erosion hazard is moderate. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil loss. Internal natural drainage of the soil generally is adequate for farming, but random subsurface tile lines to drain wet spots will benefit most crops. Some areas require lime applications to maintain the proper soil reaction in the rooting zone. The surface layer of this soil crusts after a hard rain, but the regular addition of organic matter will reduce soil crusting and also improve soil fertility. Maintenance to control erosion, soil fertility, and organic-matter levels is the main management concern.

The use of this soil for pasture or hay is effective in controlling erosion. Grazing when the soil is wet will cause surface compaction, excess runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods will help keep the pasture and the soil in good condition.

This soil is well suited to trees. A wide variety of adapted species are commonly in the woodlots. Plant competition is a moderate limitation, but tree seedlings survive and grow well if the competing vegetation is controlled. There are no other limitations for planting or harvesting trees.

This soil has limited use for septic tank absorption fields because of its moderately slow permeability and seasonally high water table. Those limitations have been minimized in some areas, however, by using subsurface drains to lower the water table and by increasing the leaching area or providing for an alternate leach field. The soils wetness and low strength limit use for homes with basements and small commercial buildings. The seasonal high water table is also a limitation for homes without basements. The high frost action potential requires that footings and foundations be placed below the frost line. Suitable base material should be used where roads and streets are constructed.

This soil is in capability subclass IIe; woodland suitability subclass 1o.

XfB2—Xenia silt loam, bedrock substratum, 2 to 6 percent slopes, moderately eroded. This deep, gently sloping, moderately well drained soil is on bedrock-controlled till plains. Most areas are circular or irregular in shape and 2 to 200 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is 29 inches thick. The upper part is firm, brown silty clay loam; the middle part is firm, dark yellowish brown silty clay loam that has grayish brown mottles; and the lower part is firm, dark yellowish brown clay loam with grayish brown mottles. The substratum, to a depth of 50 inches, is dark yellowish brown stony clay loam that is 15 to 30 percent limestone flagstones. Interbedded shale and limestone bedrock of Ordovician age is at a depth of 50 inches. The bedrock is at a depth of 48 to 72 inches. It is more than 66 percent soft clay shale and less than 34 percent crystaline, fossiliferous, thin-bedded limestone.

Included with this soil in mapping are small areas of the somewhat poorly drained Fincastle, bedrock substratum, soils, the well drained Russell-Miamian, bedrock substratum, soils, and the well drained Wynn soils. The Fincastle soils are grayer in the subsoil than this Xenia soil and are in low areas, usually at the head of waterways and in shallow basins. The Russell-Miamian soils are less gray in the subsoil and are on the upper part of the slopes, generally near the crest and shoulder. The Wynn soils are also less gray in the subsoil but have bedrock 20 to 40 inches below the surface. Also included are some areas that are deeper than 72 inches to bedrock.

This soil has moderately slow permeability, moderate available water capacity, and medium runoff. The surface layer is low in organic-matter content, and tilth is good. Reaction is medium acid to mildly alkaline in the rooting zone. The water table is perched over the subsoil in spring.

This soil has high potential for cultivated crops, and most areas are used as cropland. Corn, soybeans, wheat, and hay are the major crops. This soil also has high potential for pasture and woodland and for wildlife habitat. Potential is medium for building site development and low for sanitary facilities. Potential is medium to high for most recreational development.

The erosion hazard is moderate. Minimum tillage, winter cover crops, and grassed waterways prevent excessive soil loss. Natural drainage of the soil generally is adequate for farming, but installing random subsurface lines to drain wet spots will benefit most crops. In some areas of this soil, lime applications are required to maintain proper reaction in the rooting zone. The surface layer crusts after rain, but the addition of organic matter reduces crusting and improves soil fertility. Maintenance to control erosion and soil fertility and organic-matter levels is the main management concern.

Using this soil for pasture or hay is effective in controlling erosion. Grazing when the soil is wet, however, can cause surface compaction, excessive runoff, and poor tilth. Proper stocking, pasture rotation, and restricted use during wet periods help keep the pasture and the soil in good condition.

This soil is well suited to trees. Plant competition is a moderate limitation, but tree seeds and seedlings survive and grow well if the competing vegetation is controlled. There are no other limitations for planting or harvesting trees.

Moderately slow permeability and a seasonal high water table limits use of this soil for septic tank absorption fields. The high water table and depth to bedrock are also limitations for shallow excavations. Soil wet-

TABLE 16.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the text explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
AvA---------- Avonburg	D	None--------	---	---	1.0-3.0	Perched	Jan-Apr	>60	---	High-----	High-----	High.
Bt---------- Brenton	B	None--------	---	---	1.0-3.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Moderate.
CdD2*, CdE*: Casco----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
Rodman----------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
CeB---------- Celina	C	None--------	---	---	1.5-3.0	Perched	Jan-Apr	>60	---	High-----	High-----	Moderate.
CnC2---------- Cincinnati	C	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	High.
CrA---------- Crosby	C	None--------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Moderate.
DaA, DaB---------- Dana	B	None--------	---	---	3.0-6.0	Perched	Mar-Apr	>60	---	High-----	Moderate	Moderate.
DbB---------- Dana	B	None--------	---	---	3.5-6.0	Perched	Mar-Apr	40-60	Rippable	High-----	Moderate	Moderate.
EcE2, EcF2-------- Eden	C	None--------	---	---	>6.0	---	---	20-40	Rippable	---	Moderate	Low.
Ee---------- Eel	C	Occasional	Brief-----	Oct-Jun	3.0-6.0	Apparent	Jan-Apr	>60	---	High-----	Moderate	Low.
ElA, ElB2, ElC2, EnA, EnB2-------- Eldean	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
EuA*, EuB*: Eldean----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
Urban land.												
FcA, FcB---------- Fincastle	C	None--------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Moderate.
FdA, FdB---------- Fincastle	C	None--------	---	---	1.0-3.0	Perched	Jan-Apr	48-72	Rippable	High-----	High-----	Moderate.
Gn---------- Genesee	B	Common------	Brief-----	Oct-Jun	>6.0	---	---	>60	---	Moderate	Low------	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Go*:												
Genesee	B	Common	Brief	Oct-Jun	>6.0	---	---	>60	---	Moderate	Low	Low.
Urban land.												
HeE2*, HeF*:												
Hennepin	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Miamian	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
HoA	C	None	---	---	1.0-2.0	Apparent	Nov-Mar	>60	---	---	High	Moderate.
Henshaw												
La	B	Rare	---	---	3.0-6.0	Apparent	Mar-May	>60	---	Moderate	Low	Low.
Landes												
Lg	A	Occasional	Very brief	Jan-Dec	>6.0	---	---	>60	---	Low	Low	Low.
Lanier												
MlB2, MlC2, MlD2, MnC3, MnD3	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Miamian												
MsC2*, MsD2*:												
Miamian	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Russell	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
MtC2*:												
Miamian	C	None	---	---	3.0-6.0	Perched	Feb-Apr	48-72	Rippable	Moderate	Moderate	Moderate.
Russell	B	None	---	---	3.5-6.0	Perched	Mar-Apr	48-72	Rippable	High	Moderate	Moderate.
MuC*:												
Miamian	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Urban land.												
OcA, OcB	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Ockley												
Pa	B/D	None	---	---	0-2.0	Apparent	Mar-Jun	>60	---	High	High	Low.
Patton												
Pg*.												
Pits												
PrB	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Princeton												
Ra	B/D	None	---	---	0.-1.0	Apparent	Dec-May	>60	---	High	High	Low.
Ragsdale												

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
RdA, RdB---------- Raub	C	None--------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Moderate.
Rh*. Riverwash												
Rn---------- Ross	B	Occasional--	Very brief	Nov-Jun	4.0-6.0	Apparent	Feb-Apr	>60	---	Moderate	Low------	Low.
RpB---------- Rossmoyne	C	None--------	---	---	1.5-3.0	Perched	Jan-Apr	>60	---	High-----	High-----	High.
RtB---------- Russell	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
RvB*, RvB2*: Russell----------	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
Miamian----------	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
RwB*, RwB2*: Russell----------	B	None--------	---	---	3.5-6.0	Perched	Mar-Apr	48-72	Rippable	High-----	Moderate	Moderate.
Miamian----------	C	None--------	---	---	3.0-6.0	Perched	Feb-Apr	48-72	Rippable	Moderate	Moderate	Moderate.
RxB*: Russell----------	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
Urban land.												
Sh---------- Shoals	C	Common------	Brief-----	Oct-Jun	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Low.
SlA---------- Sleeth	C	None--------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Low.
St---------- Stonelick	B	Occasional	Very brief	Nov-Jun	>6.0	---	---	>60	---	Moderate	Low------	Low.
ThA---------- Thackery	B	None--------	---	---	1.5-3.0	Apparent	Jan-Apr	>60	---	Moderate	Moderate	Moderate.
TpA---------- Tippecanoe	B	None--------	---	---	3.0-6.0	Apparent	Mar-Apr	>60	---	Moderate	High-----	Moderate
Ud*. Udorthents												
Uf*: Udorthents.												
Dumps.												

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
UnA, UnB---------- Uniontown	B	None--------	---	---	2.5-6.0	Apparent	Nov-May	>60	---	High-----	Low------	Moderate.
UpA*: Urban land.												
Eldean-----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
UsA*: Urban land.												
Patton-----------	B/D	None--------	---	---	0-2.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Low.
WbA--------------- Warsaw	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
WeA, WeB---------- Wea	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
WyB, WyB2, WyC2, WzC3---------- Wynn	B	None--------	---	---	>6.0	---	---	20-40	Rippable	Moderate	High-----	Low.
WuB*, WuC*: Wynn----------	B	None--------	---	---	>6.0	---	---	20-40	Rippable	Moderate	High-----	Low.
Urban land.												
XeA, XeB, XeB2---- Xenia	B	None--------	---	---	2.0-6.0	Apparent	Mar-Apr	>60	---	High-----	High-----	Moderate.
XfA, XfB, XfB2---- Xenia	B	None--------	---	---	2.0-4.0	Perched	Mar-Apr	48-72	Rippable	High-----	High-----	Moderate.

* See map unit description for the composition and behavior of the map unit.

APPENDIX B

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 Table 02930-1A, Table 02930-1B, 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 fibers; free of clay, stone, foreign substances, and free of weeds.

2. Straw should not contain sticks larger than ¼-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:

Item	Specification Limit
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 and 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 wires 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 pinesap emulsion to ratio of 4 parts water to 1 part concentrate. Apply diluted pinesap 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, s 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 - 1A
SEED MIX IN DRY AREAS FOR PERMANENT VEGETATION

Species	Pounds Per Acre (lb/ac)
Big Bluestem (*Andropogen gerardi*)	3.0
Little Bluestem (*Andropogen scoparius)*	2.0
Side-Oats Grama (*Bouteloua curtipendula*)	0.5
Indian Grass (*Sorghastrum nutans*)	2.0
Canada Wild-Rye (*Elymus canadensis*)	25
Switch grass (*Panicum virgatum*)	0.5
ReGreen	5.0
Wildflowers [1]:	1.5
Butterflyweed (*Asclepias tuberosa*)	
Smooth Aster (*Aster laevis*)	
Ox-eye Sunflower (Heliopsis helianthoides)	
Bergamot (*Monarda fistulosa*)	
Purple Coneflower (*Echinacea purpurea*)	
Yellow Coneflower (*Ratibida pinnata*)	
Black-Eyed Susan (*Rudbeckia hirta*)	
Spiderwort (*Tradescantia ohioensis*)	
Hoary Vervain (*Verbena stricta*)	
Beardtongue (*Penstemon grandiflorus*)	
Sweet Joe Pye-Weed (*Eupatorium purpureum*)	
Blue False Indigo (*Baptisia australis*)	
Partridge Pea (*Cassia fasciculata*)	
Rattlesnake Master (*Eryngium yuccifolium*)	
Round-headed Bush Clover (*Lespedeza capitata*)	
Stiff Goldenrod (*Solidago rigida*)	

[1] – Wildflower mix to be apportioned according to species aggressiveness and seed counts as determined by the Restoration Ecologist. If certain species are not available, appropriate substitutions will be determined by the Restoration Ecologist.

TABLE 02930 - 1B
SEED MIX IN WET AREAS[1] FOR PERMANENT VEGETATION

Species	Pounds Per Acre (lb/ac)
Big Bluestem (Andropogen gerardi)	3.0
Canada Wild-Rye (Elymus canadensis)	25
Switch Grass (Panicum virgatum)	0.5
Blue Joint Grass (Calamagrostis canadensis)	0.5
Porcupine Sedge (*Carex hystericina*)	1 ounce per acre (oz/ac)
Fox Sedge (*Carex stipata*)	1 ounce per acre (oz/ac)
Dark Green Bulrush (*Scirpus atrovirens*)	1 ounce per acre (oz/ac)
ReGreen	5.0
Prairie Cordgrass (*Spartina pectinata*)	1.0
Wildflowers [2]:	1.5
Red Milkweed (*Asclepias incarnata*)	
New England Aster (*Aster novae-angliae*)	
Wild Senna (*Cassia hebecarpa*)	
Sweet Joe-Pye Weed (*Eupatorium purpureum*)	
Sawtooth Sunflower (*Helianthus grosserratus*)	
Cardinal Flower (*Lobelia cardinalis*)	
Great Blue Lobelia (*Lobelia siphilitica*)	
Yellow Coneflower (*Ratibida pinnata*)	
Blue Vervain (*Verbena hastata*)	
Angelica (*Angelica atropurpurea*)	
Sweet Joe-Pye Weed (*Eupatorium maculatum*)	

(1) Seeding in drainage ditches or swales shall contain erosion mats as specified in Section 02270 after application of seed mixture.

(2) Wildflower mix to be apportioned according to species aggressiveness and seed counts as determined by the Restoration Ecologist. If certain species are not available, appropriate substitutions will be determined by the Restoration Ecologist.

TABLE 02930-2
SEED MIX FOR INTERIM VEGETATION

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

APPENDIX C

PLANTING SPECIFICATIONS

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 ecto-mycorrhizae 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 and 3-inch deep containers. Potting material shall be inoculated with ecto-mycorrhizae.

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 moist hardwood mulch and kept moist with periodic watering.

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

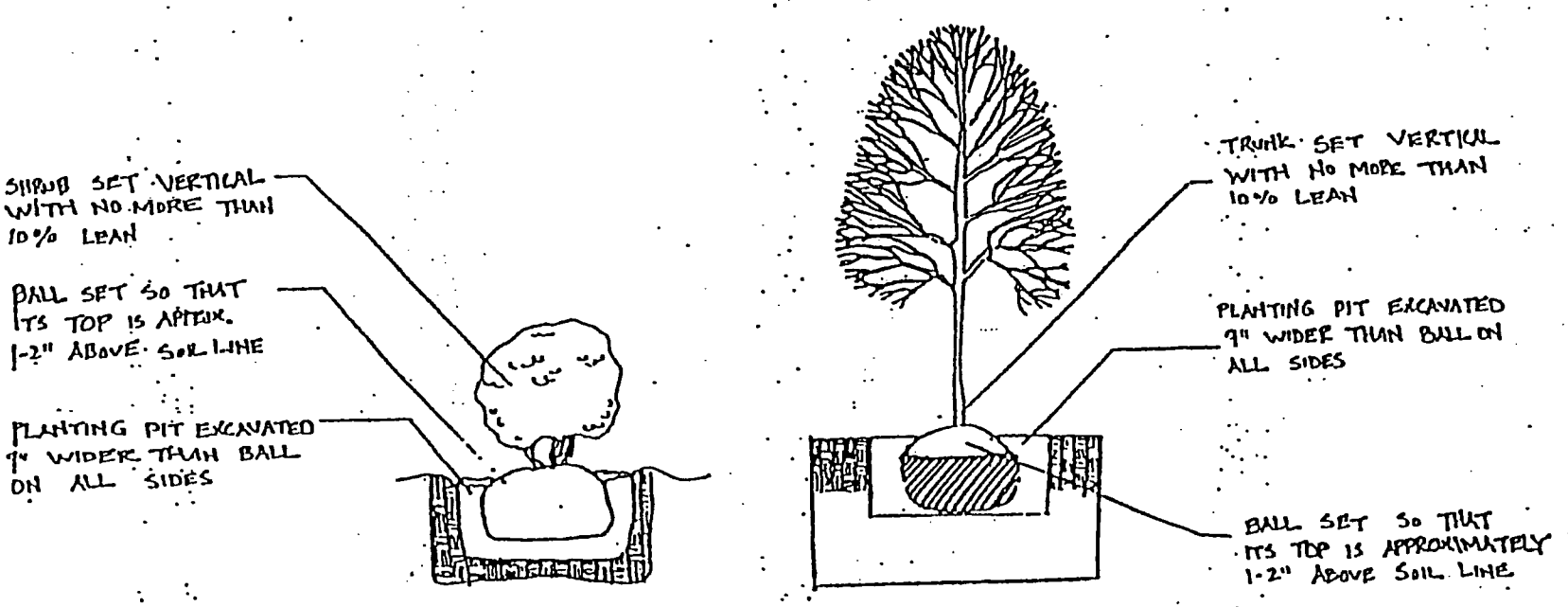
A. Water all planted material weekly for 6 weeks following installation, unless otherwise directed by the Restoration Ecologist. Watering shall be sufficient to saturate the entire root ball. This typically requires the slow release of approximately 10 gallons of water for each plant.

3.8 STAKING AND GUYING

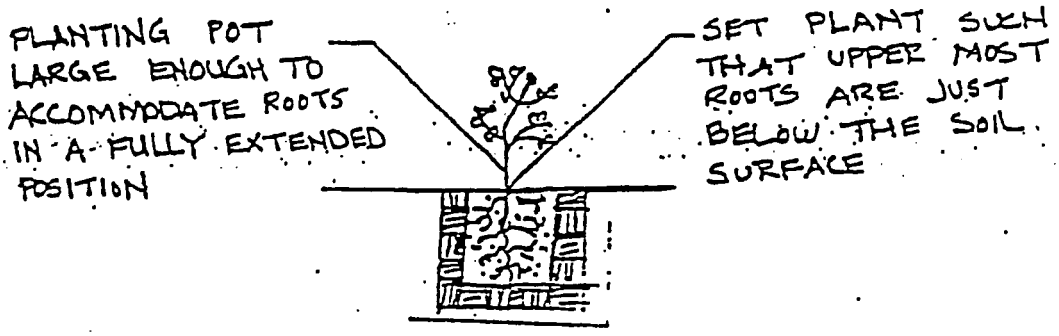
A. Stake and guy trees only at the request of the Restoration Ecologist.

END OF SECTION

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



Detail A-2: Installation of Bareroot Plants



APPENDIX D

PLANTING PATCH PAGES

Shrubs

Item	Scientific Name		Common Name	Riparian Forest	Beech-Maple Forest	Patch 1	Patch 2	Patch 3	Patch 4	Patch 5	Patch 6	Patch 7	Patch 8	Patch 9	Oak-Hickory Total
1	*Alnus serrulata*	rw	Smooth Alder			5		1			1		1	1	9
4	*Asimina triloba*	br	Pawpaw	6	6										0
6	*Carpinus caroliniana*	br	American Hornbeam	19	30										0
9	*Cephalanthus occidentalis*	w	Buttonbush			9							5	4	9
13	*Cornus florida*	h	Flowering Dogwood			6				2	1				12
14	*Cornus racemosa*	h	Gray Dogwood			5				2			1		9
15	*Corylus americana*	rw	Hazelnut	22					3	5	3		1	1	18
19	*Hamamelis virginiana*	br	Witch Hazel	28	38	6									0
20	*Hypericum spathulatum*	w	Shrubby St. John's Wort	20		1		1		7	5	3			22
21	*Ilex verticallata*	w	Winterberry	27		3		1	8	2	2		1	1	16
22	*Lindera benzoin*	br	Spicebush		30	3			4	3				1	11
23	*Ostrya virginiana*	brw	Hop-Hornbeam	21	18				3	2	2				10
26	*Rhus aromatica*	h	Fragrant Sumac									14			14
27	*Rhus glabra*	e	Smooth Sumac					4		6	4				14
29	*Rosa caroliniana*	es	Carolina Rose	23											0
30	*Rosa palustris*	rw	Swamp Rose				3	3	8			3	10	10	37
32	*Rubus occidentalis*	e	Black Raspberry			5	4	5		9	6		2	1	32
33	*Salix discolor*	rw	Pussy Willow									5			5
37	*Sambucus canadensis*	rw	Elderberry			3	5		13		3	2	8	7	41
39	*Spirea alba*	w	Meadowsweet										3	3	6
40	*Staphylea trifolia*	bhr	Bladdernut		3	3	3								6
41	*Symphoricarpos orbiculatus*	e	Coralberry			5	3			1	3		2	3	17
42	*Viburnum acerifolium*	b	Mapleleaf Viburnum		8								1	3	4
43	*Viburnum prunifolium*	bh	Blackhaw Viburnum		20	6	5		13	3	5		1		33
			Totals	166	153	60	23	15	52	42	35	27	36	35	325

APPENDIX D
PATCH PAGES FOR WETLAND MITIGATION PHASE II

Saplings

Item	Scientific Name	Common Name	Riparian Forest	Beech Maple Forest	Patch 1	Patch 2	Patch 3	Patch 4	Patch 5	Patch 6	Oak Hickory Total
45	*Acer nigrum*	Black Maple	17	37	0	0	0	0	0	0	0
46	*Acer rubrum*	Red Maple			16	7	5	13	10	8	59
47	*Acer saccharinum*	Silver Maple		28	0	0	0	0	0	0	0
48	*Acer saccharum*	Sugar Maple	22	135	17	8	7	16	14	12	74
49	*Aesculus glabra*	Ohio Buckeye	4		13	6	4	11	8	7	49
50	*Asimina triloba*	Pawpaw			2	0	0	2	2	0	6
51	*Carpinus caroliniana*	American Hornbeam	3	4	0	0	0	0	0	0	0
52	*Carya cordiformis*	Bitternut Hickory			2	2	2	2	2	2	12
53	*Carya laciniosa*	Shellbark Hickory	2	4	2	2	2	2	2	2	12
54	*Carya ovata*	Shagbark Hickory			6	2	1	4	4	3	20
55	*Celtis occidentalis*	Hackberry		9	3	2	2	2	2	2	13
56	*Cercis canadensis*	Redbud			1	0	0	1	1	0	3
57	*Cornus alternifolia*	Alternate-leaf Dogwood			1	1	1	1	1	1	6
58	*Cornus drumondii*	Roughleaf Dogwood			0	0	0	1	0	0	1
59	*Cornus florida*	Flowering Dogwood			0	1	0	0	0	0	1
60	*Cornus racemosa*	Gray Dogwood			2	2	2	2	2	2	12
61	*Crataegus mollis*	Down Hawthorne			1	0	0	1	1	1	4
62	*Fagus grandifolia*	Beech		180	0	0	0	0	0	0	0
63	*Fraxinus americana*	White Ash			23	11	9	20	18	14	95
64	*Fraxinus pennsylvanicum*	Green Ash	9	31	0	0	0	0	0	0	0
65	*Fraxinus quadrangulata*	Blue Ash			0	1	0	0	0	0	1
66	*Gymnocladus dioica*	Kentucky Coffetree			1	0	0	1	1	1	4
67	*Juglans cinerea*	Butternut	9		0	0	0	0	0	0	0
68	*Juglans nigra*	Black Walnut		15	3	0	0	3	3	3	12
69	*Liquidambar styraciflua*	Sweetgum	2		0	0	0	0	0	0	0
70	*Liriodendron tulipifera*	Tulip Poplar	2	2	4	2	1	5	3	3	18
72	*Platanus occidentalis*	Sycamore	4		0	0	0	0	0	0	0
73	*Populus deltoides*	Cottonwood	6		0	0	0	0	0	0	0
74	*Prunus serotina*	Black Cherry		15	4	2	2	3	2	3	16
75	*Quercus alba*	White Oak			8	3	3	6	6	5	31
76	*Quercus bicolor*	Swamp White Oak	4		0	0	0	0	0	0	0
77	*Quercus coccinea*	Scarlet Oak			1	0	0	0	1	0	2
78	*Quercus inbricaria*	Shingle Oak			1	0	0	1	1	1	4
79	*Quercus macrocarpa*	Bur Oak	1		0	0	0	0	0	0	0
80	*Quercus muhlenbergii*	Chinqapin Oak			1	1	1	2	1	1	7
81	*Quercus palustris*	Pin Oak	7	13	0	0	0	0	0	0	0
82	*Quercus prinus*	Chestnut Oak			0	0	0	0	0	0	0
83	*Quercus rubra*	Northern Red Oak		11	12	6	5	7	6	7	43
84	*Quercus shumardii*	Shumard Oak			1	1	1	1	1	1	6
85	*Quercus velutina*	Black Oak			1	1	0	1	2	1	6
86	*Tilia americana*	Basswood	6	29	0	0	0	0	0	0	0
87	*Ulmus rubra*	Slippery Elm	4		5	2	0	5	4	3	19
		Totals	104	515	131	63	48	113	98	83	536