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CONCEPTUAL WETLAND MITIGATION PLAN
AREA 1, PHASE I MITIGATION SITE
FERNALD
ENVIRONMENTAL MANAGEMENT PROJECT

In Hamilton and Butler Counties Ohio

October 1998

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APPENDIX 1. SAMPLE PLANT SPECIFICATION LISTING FROM WETLAND MITIGATION PLAN FOR ANOTHER SITE

1.0. INTRODUCTION

This document provides a conceptual framework for development of 6.09 acres of wetland area to replace wetlands already disturbed or destroyed on the site of the Fernald Environmental Management Project (FEMP), Fernald Ohio. Regulatory authority and direction for this process derives from Section 404 of the Clean Water Act and is being regulated by U.S. EPA per its authority under CERCLA. This document has been prepared by Munro Ecological Services Inc. (MES), under contract to Fluor Daniel Fernald (FDF) for the U.S. Department of Energy (DOE).

As a result of a 1993 approved wetland delineation by the U.S. Army Corps of Engineers, Louisville District, approximately 36 acres of jurisdictional wetlands were identified within the 1050-acre Fernald property, which are subject to compensatory wetland mitigation requirements under Sections 404 and 401 of the Clean Water Act (Ebasco 1993). DOE estimates that approximately 10 acres of wetland will be impacted during remediation of the site under CERCLA, which will require mitigation.

On 20 June 1995, DOE met with representatives from the U.S. Environmental Protection Agency (US EPA), Ohio Environmental Protection Agency (OEPA), U.S. Fish and Wildlife Service (US FWS), and Ohio Department of Natural Resources (ODNR) to discuss wetland mitigation requirements at DOE's Fernald Site near Cincinnati, Ohio. Key aspects of the discussion included DOE's preference for addressing mitigation requirements on-property and mitigating the entire 10 acre wetland impacts through restoration or creation actions. All parties agreed to an established mitigation ratio of 1:1.5 acres, resulting in a regulatory commitment of 15 acres of mitigation wetlands.

This document is intended to request and elicit technical comments regarding the plan concepts presented. This conceptual plan will be followed by the final wetland mitigation plan for the same area. Suggestions and technical comments that are returned will be reviewed by DOE, and will be considered in the development of the final mitigation plan. Without any suggested changes, the final mitigation plan will be produced to closely follow the conceptual plan below.

2.0. SETTING

This wetland mitigation project is a small part of the demolition and cleanup of a former uranium processing plant and its associated debris and waste material The goal is to returned the land to functional and natural conditions under agreement between DOE, US EPA, and the state of Ohio. The present upland area subject of this mitigation plan is one of the first areas to be certified as clean per the final remediation levels for soil at the site. Upon preliminary site inspection and review it was decided that the site considered in this plan met basic needs for an area to be converted into wetland and a decision was made to proceed with mitigation planning. The wetland acreage proposed for the current site is not sufficient in itself to fully compensate for all wetland impacts on the FEMP. Additional wetland area will be constructed and planted when suitable land is certified and made available through the site cleanup process.

3.0. SITE DATA AND SPECIFICATIONS

The mitigation site is located in the northeast corner of the FEMP and is referred to as Area 1, Phase I (A1PI). The site was previously a grazed pasture and is currently disturbed grassland covered with mixed forage and stabilization grasses and many weedy forbs. The site is bordered to the west by the North Access Road and on the east by the FEMP property fence. Few of the plants on the site are native. Several remnant water and sediment control features exist on the site. The prime modification of the site as a result of site cleanup has been the removal of contaminated surface soils of the site. Approximately six inches of surface soils has been

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removed and placed in a permanent on-site disposal facility across the road. The A1PI site is now ready for revegetation and final cover.

Relevant site data follows:

Acreage of the site:	12.70 (paving to fence)
Acreage of wetland proposed:	6.09
Number of wetland basins proposed:	8
Linear orientation of site:	North-South
Elevation range on site:	+597 to +620
Classification of proposed wetlands:	Palustrine, forested, shrub swamp, herbaceous meadow, open fresh water

4.0. WETLAND MITIGATION CONCEPTS

The following wetland mitigation plan is designed to provide more than sufficient wetland conditions, functions and values to satisfy full regulatory and technical wetland needs as required by the Federal government and Ohio regulatory processes for the full extent of wetland area to be constructed under this plan.

4.1. CONCEPTUAL DRAWINGS

The wetland mitigation concept consists of an 8-basin cascade comprising a freshwater palustrine wetland system with varied vegetation cover. The basins are connected by gravity-flow channels, each basin flowing into the next, with Basin #1 being the lowest and discharging to adjacent land.

A set of conceptual drawings is attached (Figures 6 - 10). The drawings are self explanatory and provide the graphic illustration of the following written concepts. Illustrations from other sites of structures, methods and techniques proposed to be used within the wetland area are included as examples (Figures 1 - 5). Unless substantial comments or revisions are received, the final mitigation plan will closely follow this concept plan.

4.2. DESIGN BASED ON ECOLOGICAL RESTORATION CONCEPTS

Ecological restoration supporting wetland design concepts are the basis for this plan. Ecological restoration as per the technical definition is:

> **The process of intentionally altering a site to produce a defined, indigenous, historic ecosystem. The goal is to emulate the structure, function, and diversity and dynamics of the specified ecosystem.**

This simple definition provides a solid basis for rebuilding natural lands and plant systems so that they are truly like those systems that previously existed or exist elsewhere.

4.2.1. RESTORATION MODEL BASED ON PRE-DISTURBANCE ECOLOGICAL CONDITIONS

The written ecological restoration model is a description which captures the essence and character of the ecological restoration. This model will be part of the final wetland mitigation plan and will provide the relevant

historic and reference information, descriptions ,and interpretation to support the design of the wetland area as representative of natural and local conditions. Some aspects of near-historic conditions may be inferred or interpreted due to lack of present day comparable sites in the local area, however this is normal in ecological restoration projects. The design intent is to re-make a form of wetland that was present on the landscape in prior years rather than to make a fabricated planting assemblage that has never existed. Ample evidence exists to support flatland wetland restoration in a region in which those areas were largely destroyed by farming.

4.2.2. USE OF PLANTS NATIVE TO HAMILTON AND BUTLER COUNTIES

Native species and native species communities are universally adapted to living in the environments that they originally inhabit. The dynamics of introducing species from outside the local region will take many thousands of years to settle out and reach balance. There is no reason to use species not native to the project area. For purposes of this project we have designated Butler and Hamilton Counties as the full extent of native plant range that is acceptable for this project. If a plant has not been recorded to be native to these two counties, or the recorded range is not immediately adjacent to these counties, those species will not be used.

4.2.3. USE OF RANDOMIZED PLANT COMMUNITY AND CLUSTERING METHODS

The planting methods will not include use of grids or on-center specifications. Densities of all plants will be based on naturally occurring densities and planted on a stock-per-acre basis. Planting will be done using specified cover types and patches with known area and known stock quantities planted in randomized locations. Densities will be determined by using previously recorded sites, newly selected local reference sites, and other relevant data. This method allows for greater diversity in planting design while making stock counting and survival determination relatively simple.

4.2.4. NATURAL PLANT DENSITIES AND DIVERSITY

Counts and surveys of densities and spacing of naturally occurring forest and shrub communities will be used as the basis for planting specification densities on many projects. Natural levels of diversity have also been determined from reference sites and used as the basis for specifying diversity of plantings. These methods will be used for the mitigation plan to assure that the mitigation wetlands come close to replicating reference wetlands in the midwest. Historic conditions will be taken into account when developing native plant species lists and native plant community groupings. It is well known that the diversity of remnant wetlands on the site and in nearby areas has been much reduced by grazing, compaction, weed invasion and other negative factors. It is also understood that most of the wetlands of the high and relatively flat lands of this region of Ohio were long ago cleared and drained for farming purposes, so they are no longer well represented on the landscape. These factors will be considered in compiling planting specifications and planting lists.

4.2.5. FEATURES THAT WILL ENCOURAGE USE BY DIVERSE WILDLIFE SPECIES

No direct introduction or re-introduction of any wildlife species to the site is proposed. Birds, mammals and herpetofauna travel across the landscape. Features are included that will encourage those species to use the mitigation on a transient or permanent basis. Some of these features are noted below.

4.2.5.1. AQUATIC

This site is not designed to accommodate fish. Although two deep areas (eight or ten feet in depth, Figures 8 - 10) the habitat is designed for invertebrates, not fish. All deep areas will be surrounded by broad marshy shallows so that accidental falls into deep water will be nearly impossible. Headwater areas are often ephemeral open water areas and only a few species of small fish can survive under moist stones in dry periods.

The aquatic species the site is designed for are frogs, salamanders and aquatic insects. The small ponds distributed around the mitigation site are of varying depth (generally less than one foot) and marsh cover. Some will frequently dry up and some will retain water all year nearly every year. This variation of ephemeral ponds or "vernal pools" will allow selection of appropriate breeding and rearing areas. The variation of pool depths will also allow for use of different pools in years of varying wetness.

Some mammal species that frequent or depend on water will likely thrive in the mitigation area. Muskrat, meadow voles and some shrews will find suitable habitat there.

4.2.5.2. AVIAN

Songbirds, both migratory and non-migratory as well as some waterfowl are likely to frequent the mitigation area. Thickets, brush piles, stump structures, grassland insects, and berry bushes will all provide songbird habitats. The shallow pools, periodic mudflats, marshy stream, and perches will support waterfowl use of the mitigation site. Mallard ducks will likely find the ponds and wood ducks will find suitable protective habitat. To the extent that grass foraging species arrive, various methods will be employed to prevent denudation of plantings prior to full establishment. For this reason waterfowl use will not be encouraged until at least the second year post-construction.

4.2.5.3. TERRESTRIAL

No specific species of terrestrial mammals are considered in the mitigation plan. A number of species will arrive, including skunk, fox, rabbit, opossum, mice and others. They will find suitable habitat. Whitetail deer will arrive but may need to be deterred during the first year or two. Rubbing of young trees and nibbling of new shrubs can damage new restoration plantings. Deer fencing (black heavy duty plastic 1" x 2" mesh) may be necessary to protect the new plantings and may be placed around the site perimeter until plant growth is well established. If deer fence is used, baffles will be constructed to allow human passage through the fence.

4.2.5.4. INOCULATION/PLACEMENT

The use of inoculant materials will be incorporated into the final wetland construction plan. Pond muck material from local healthy ponds will be used in the new ponds (small amounts with great diversity and potential). Some native forest soils and organic surface materials will be introduced into the renovated soils of the wetland mitigation site. These will be introduced by the shovel full in many locations in order to provide small starter points for the spread of mycorrhizae, macroinvertebrates, fungus and mushroom spores, insect larvae, terrestrial mollusks, etc. Other inoculant methods will also be used.

4.2.5.5. HABITAT FEATURES

Habitat will be developed for a number of fauna species. Some will be specific to a single species and some will suit a group like waterfowl or songbirds. Nest boxes, nesting areas, brush and stump pile features, shallows and emergent marsh areas, perches, and food sources will be incorporated into habitat design.

4.2.6. USE OF LOCAL GENETIC STOCK TO THE EXTENT POSSIBLE

The planting specifications for the mitigation plan will emphasize obtaining as much local genetic stock material as possible. Transplant of some existing on-site stock will be considered. Purchase of native plant stock salvaged in the region will also be done. Given the size of the planting area, substantial material will have to be purchased from other regions. A database of growers and suppliers of native plant stock has been compiled and will be used to assure some component or percentage of local material.

4.2.7. MOSQUITO CONTROL

The presence of mosquitoes will be minimized by the design and planting of the marsh system. Each pond area will be inoculated with pond muck containing some dragonfly larvae. Dragonfly larvae thrive on eating any other insect larvae in very shallow water and are prime mosquito eaters. The adult dragonflies also are consumers of adult mosquitoes. The designed conditions will make it difficult for mosquitoes to survive. Larval mosquitoes are more commonly found in water that has poor quality. Surface water quality is closely monitored as a regulatory issue and as such water quality is not anticipated to pose a problem. The basins will be constructed so that water quality is high. Mosquitoes have not been a problem in other constructed wetland areas where these methods have been used.

Bats will be encouraged by placement of snag trees and roosting and rearing structures of several designs. Their presence is desired as consumers of flying insects, primarily mosquitoes and flies.

4.2.8. USE OF REDUNDANCY IN PLANTING

In ecological restoration planting work it is usually not possible to construct and plant a fully functional and fully aged site due to money and other constraints. Unlike landscaping plantings where the shrubs, trees, and ornamental herbs must fit a classic image as soon as the contractor leaves the job site, restoration plantings usually are, at best, starter material rather than finished product. Usually young shrubs and trees are planted, and the area is seeded rather than planting full densities of mature plants. This produces a thin appearance with lots of unprotected plants and harsher than normal exposure to wind and sun. Mulching must often take the place of natural humus layers and soils are often far from natural in quality. These conditions require the use of additional means to insure survival, to "jump-start" or accelerate the self-renewing ability of the system, and to fill in some of the various species and structural gaps that otherwise will exist for a season or two.

Redundancy is useful for solving these problems. When seeding of forbs and grasses, interplanting of one-year plugs in a low density will provide redundancy. In pond construction, many aquatic species will arrive on duck feet or other natural means, but inoculating buckets of pond bottom muck from existing healthy ponds will produce abundant aquatic insects and copepods (and no mosquitoes) during the first season. When planting trees for forest conditions it is wise to plant some trees as large as possible, some small stock, and some as acorns and nuts or seedlings allowing for some herbivory of one size while others survive. Redundant planting and inoculation will be incorporated into this mitigation plan.

4.3. DESIGN FOR A NATURAL APPEARANCE

Natural configurations will be emulated in the mitigation design to the extent that fieldwork and existing data will support. Straight lines will not be used. The essence of the design is to make the entire site look like it had developed naturally rather than being designed.

4.3.1. USE OF RANDOMNESS AND NATURAL SHAPES

A combination of randomness, curves, and observable natural shapes and patterns are the basis for design in the mitigation concept plans. These lines best approximate natural conditions. Stream meanders shape and periodicity have been developed from aerial photography of nearby streams. No streams currently exist on the mitigation site. The randomness of vegetation community associations on the landscape have been used as the basis for size and shapes of designed planting areas.

4.3.2. NO STRAIGHT LINES USED IN DESIGN

In nature very few straight lines exist. In many landscape designs for wetland mitigation and reforestation work straight lines are used for on-center plant spacing, to simplify grading work, to achieve measured exact densities, or to accommodate simple or machine planting methods. When such straight-line designs are used the site does not have the capacity to become natural in appearance. For this reason curved lines have been employed in the mitigation design. In the proposed landscape shapes, shorelines, vegetation clusters, and colonization patterns no straight lines or features will be used so that the site closely parallels natural conditions. Randomness, natural shapes, and clustering patterns will be used in the final mitigation plan. In the final mitigation plan other local shape patterns may be introduced where appropriate.

4.3.3. VISUAL BARRIERS AND SIGHT LINES

Because the site is relatively linear and has a permanent public road along one long side, highway noise and visual presence are an issue. The need for isolation of portions of the site arises. The questions raised by highway presence are:

How much of the site should be visible from the road?

How much road noise should be accepted or deflected?

How much should a visitor or a green heron be aware of the road noise and of vehicle passage when standing in any wetland basin?

Where should views of the internal portion of the site be allowed and where should they be excluded?

Though it is desirable for portions of the constructed wetlands to be visible to passers-by, too much visibility will reduce the use of the site by wildlife species and too little visibility will reduce the appeal of the site to passers-by. These points are resolved in the mitigation design through use of embankments, tree and shrub plantings, and basin placement. The use of these components will give drivers several glimpses into the basins as they pass the site, but occlude views along most of the roadside

4.4. MAXIMIZE WETLAND AREA ON MITIGATION SITE

Wetland area has been maximized to the extent possible on the site and balanced with the need to provide:

Reasonable maximum slopes rather than steep slopes or cliffs between basins.
Preservation of existing monitoring, utility, and access infrastructure.
Reasonable merging with existing contours at the site edges.
Reasonable emulation of natural conditions in the region.

The proposed plan provides the most wetland area possible, addressing the other considerations. The plan provides a reasonable balance.

4.5. DESIGN TO MAXIMIZE WETLAND SYSTEM ECOLOGICAL FUNCTION

The final plan will provide sufficient features, stipulations, and specifications to create a diverse wetland system which will thrive and provide its own distinctive synergy after it is completed. The core of the final plan will be to build a full and complex wetland, providing all of the necessary parts of the ecosystem so it will begin to work on its own. The final plan will provide water in various depths and regimes, seeds and fruits for reseeding and consumption by birds, herpetofauna, mammals, and insects, cover in the form of structures, shrub thickets, trees,

and cavities, inoculation of water and soil with organisms, and some degree of isolation. Design elements relating to ecological function will largely be imbedded into the plan details and will not necessarily be self-evident in plan figures.

When construction and planting of the mitigation site is complete it will be a crude and rudimentary ecological system, rather than complex and complete from an ecosystem perspective. It will take weeks to months to charge the system with water, months to years for insects to colonize the site, months to years for birds, mammals, and herpetofauna to find the site, years for the trees to mature, and an unknown amount of time for the system to become a fully functional system. This is normal and natural. The site will have been be jump-started to the extent possible but time will be necessary for the system to become natural.

The use of the various published and formal wetland functional assessment programs and methods which are traditionally used for evaluating wetland mitigation performance is not proposed. These traditional means have short life spans and are usually rejected only a few years after they are introduced. To assess the functional capacity of the constructed wetland areas they will be compared to written ecological target community descriptions rather than being assessed numerically. Target community description will include description and quantification of growth patterns, the quantities and nature of species that arrive on the site, the number of nesting and rearing species that settle on the site, and other projections that are easily viewed, listed, interpreted and verified. This approach has been used quite successfully on a number of wetland mitigation projects.

4.6. ALLOW FOR EXISTING MITIGATION SITE RESTRICTIONS

Several limiting factors must be understood and factored into any mitigation design. The factors generally cause restrictions in maximum wetland area achievable or in grading obstructions. Utility poles and lines, monitoring stations and their associated clear zones, gravel roads, and the narrow shape of the site are all restrictions to mitigation design. The design either allows for these limitations, or incorporates them into design features

4.6.1. AIR MONITORING STATIONS

Several air monitoring stations exist on the mitigation site. The station to the north requires a designated cleared tree and obstruction-free zone surrounding the collection point (related to turbulence and collection of good samples). This precludes tree planting around the station. This constraint also precludes making a visual screen to hide the structure. In future when the monitoring equipment is not needed it should be removed (including poles and structure).

4.6.2. VEHICLE ACCESS ROADS

Several of the monitoring stations that exist on the mitigation site must be provided with access via small truck on a permanent basis. Gravel roads are or will be constructed to these locations. The final mitigation plan will stipulate that when these monitoring facilities are no longer needed and are removed, the access road gravel will be removed and replaced with topsoil planted with native grassland species.

Alternatively, the gravel roads may be converted to parking for natural area users when the site is opened for public use. The expansion of these roads and parking/turn around areas into planted areas will be limited to upland areas and should not exceed more than 20% of the existing gravel road coverage and may include no wetland encroachment.

4.6.3. OVERHEAD LINES

Overhead utility lines are present along the adjacent paved road. The lines are about 40 feet from the edge of paving. These lines cause a necessary setback of tree planting and grading under the lines and at the pole locations. No trees will be planted within 20 feet of the lines and no grading will alter the existing topography under the lines by more than three feet.

4.6.4. LINEAR SHAPE OF SITE

The north/south linear nature of the site partially restricts the emulation of natural wetland patterns present in this region prior to farming and development. Those systems (from remnant areas, vegetation literature, and speculation) were widespread rather than narrow linear features. The linear nature of the site as well as its topographic relief prevent construction of a single unit wetland basin covering nearly the whole site. Such a structure would necessarily have long, straight steep sides and would look far from natural when completed. The resolution is to provide a series of flat basins tiered or terraced down the gradual hillside. The basin containment embankments have been designed to be minimal, and the terraces are located to give the minimal grade separation from basin to basin.

4.6.5. STORMWATER HANDLING

The site presently has several stormwater and/or sedimentation basins. The wetland basins constructed under this mitigation plan will exceed both holding capacity and silt capture and retention capacity of the existing basins. Some wetland basins will temporarily perform wetland and sedimentation functions.

During construction of the wetland system the basins will provide all necessary silt capture and stormwater retention needed for wetland construction purposes.

4.7. CAREFUL ATTENTION TO HYDROLOGY AND WATER HANDLING

The essence of constructing and planting a new wetland system on any site is understanding the existing precipitation, watershed, hydrology, and hydraulics of that site and using that knowledge is used to construct a substrate using these base conditions efficiently and effectively to emulate naturally occurring wetland sites.

This wetland mitigation system sits relatively high on the watershed and receives only intermittent surface flow. No flowing water is present on the site except during and after precipitation events. Therefore all possible runoff and precipitation must be captured and directed to the basins and the water must be held tightly and be absorbed by the soils, rather than being shed quickly from the land.

Recharge of any lens-perched or general area aquifer from surface water of the mitigation site cannot be accommodated on the mitigation site due to the required discharge of all surface water to the neighboring farm. It is also not possible since there is minimal potential for perched water in the site substrate since the soils over the Miami aquifer are primarily clays and not sands.

The basic hydrologic concept for the system is a braided series of basins connected by gravity flow channels or swales using relatively precise water level outlet structures (Figures 8-10). The basins are to be placed at various elevations so that each one flows into the next with Basin #1 being the lowest and discharging to adjacent land. The basin-to basin elevation will typically be two or three feet with a maximum of seven feet expected (Figure 7). Basin design will be relatively flat with only a few inches of variation in order to provide maximum wet surface. The basins will be fitted to the existing topography to the extent possible so that the site has a natural appearance. The open water depths will typically be one or two feet

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Wetland construction on this type of site has been done effectively, but the construction details, grading, liner placement, and vegetation cover must all be done more carefully than on sites with a greater water excess. This site can be characterized as having a nominal water supply.

The hydrology downslope and offsite should be unaffected by this project. It is a requirement that water flowing overland off of the FEMP site to the east be maintained per the request of the adjacent landowner.

4.7.1. USE OF COMPACTED CLAY LINERS

Natural clays from the FEMP site will be used in the wetland mitigation basins to assure full water retention. Natural clays will be used as material for the compacted clay liners under wetland basins. The clay will be one foot thick under the entire wetland area of each basin and will be two feet thick under any larger or deeper ponds (Figure 6). The clay will be required to meet proctor testing and will be compacted using vibrating roller-compactors as needed. If available natural occurring clays and silts do not meet compaction standards then additional clay material will be imported to the site. Integrity of the liner will be assured through density testing with standard nuclear density testing equipment. Clay installation and specification figures and diagrams will be provided. This method has produced consistent results in constructed ponds and wetlands as long as specifications are fully applied during construction.

4.7.2. DESIGN TO HOLD AND RETAIN WATER

Clay liner material will be placed below final wetland grades to insure water retention in wetland basins. The basins will be constructed to hold water to the maximum extent possible. Basin outlets will be designed to discharge water as slowly as possible to allow for percolation of water into wetland soils. The basins will be constructed to absorb water in soils modified by incorporation of substantial volumes of wood chips or sawdust into the topsoil mix.

4.7.3. AMENDMENT OF SOILS TO RETAIN MOISTURE

The topsoil of the wetland mitigation site has been scraped off to remove specific amounts of contaminated material from former production activities. This removal of the surface, along with previous use as agricultural land has reduced the normal A-horizon of the native soils. The topsoil layer (top one foot) of the mitigation area (wetland and upland areas) will be amended to improve its ability to support diverse plant growth. Amendments including lime, sand, sawdust, wood chips, composted manure, composted yard waste, mushroom soil and or other natural materials (and possibly minimal amounts of fertilizer) will be used to bring the soil character back to a more natural condition. The prime amendment will be locally available wood chips and sawdust. This wood material will be added and mixed with the topsoil of the site to provide organic matter, moisture retention capability, and enhanced root penetration. This wood material will be added at rates of 2.5 to 5 pounds per square foot of topsoil area. Amended topsoil will be placed after basic grading and contouring has been completed. Final topsoil will be graded using LGP (low ground pressure) equipment.

Mulch placement over surface soils provide additional organic materials for forest and shrub areas. Wood chips, composted material, shredded leaves, sawdust, and other suitable materials will be used. Thickness of mulch may vary but is expected to be about four inches. Some limited areas will have heavy mulch (eight inches or more) along with inoculation of natural forest litter to introduce some element of forest soil biology to the site.

Materials with nutrient content will be used sparingly and in locations not likely to leach into the basins. Clays and silts need to be provided with sufficient amendments in order for them to be hospitable environments for growing plants. The cost of importing large volumes of native topsoil and wetland soil would be very high and those soils are likely to be laden with high weed content. If such stockpiles are stored very long they have very

little live content except weed seed. In using onsite and locally available organic materials for amendments cost will be reduced and soils of adequate character will be formulated.

4.7.4. DESIGN OF WATER STRUCTURES FOR MINIMAL MAINTENANCE

Water control structures will be designed specifically for reliability, adjustment to fine tune the water levels, low visibility, and minimal maintenance. Structures will be designed for the specific dynamics of each basin. Some will be built as seepage discharges and some as over-the-top discharges. The use of pipes or gratings will be avoided. All materials used will be considered permanent materials. The larger structures will be concrete.

Several basins will be provided with concrete outlet structures with stop logs to allow for fine tuning during the monitoring period. It is expected that stop log structures will be completed in final form at year two by pouring concrete (in minimal quantity) into the structure at the selected final elevation. The structures will be designed for this simple transition.

Various means will be used to transfer water from higher to lower elevations in channels between basins. Swales covered with coir (coconut husk fiber) fiber mesh, buried log structures, and rock placements will be used by themselves and in combination to produce variations in the limited amount of flowing water segments. Surface water flow on the site is expected to occur only for short periods of time following precipitation.

4.7.5. DESIGN FOR VARIETY IN SURFACE HYDROLOGIC CONDITIONS

Each basin will be designed as a slight variation from each other basin. Variables will include:

- Basin size.
- Presence of stream or ponds.
- Size and depth of ponds.
- Maximum flooding depth and duration.
- Isolation or connection to open water.
- Ratio of open water to vegetated wetland.

Some open water will be planned; however, the prime intent of this design is to create vegetated wetland conditions. Open water presence will be minimized.

The system will be designed as a freshwater palustrine wetland with varied vegetation cover and sufficient upland cover and buffering.

Bioengineering methods such as pole-drains or "chip drains" will be used on small basins at the top of the system to allow seep drainage from the basin as a means of producing a slow water release.

4.7.6. ALLOWANCE FOR VARIABILITY IN WEATHER PATTERNS

The basin construction design will allow the system to function regardless of wetter or drier years than normal. Micro-variation of grades, planting redundancy, use of mulches and soil amendments, and other considerations will provide some flexibility in the system. Water structure design will slow discharge to moderate the surge-drought conditions that currently exist on the site. The extent of woody plantings will also cool the soil, provide more shade, and allow for soil development, all of which will help to retain moisture and moderate the micro-climate of the site and provide for greater resiliency of the system.

5.0. DESIGN FOR STRAIGHTFORWARD ECOLOGICAL SUCCESS AND PERFORMANCE MONITORING

The monitoring plan will include a graphic map of the site showing monitoring points, photo locations, walking routes and main features of the site. A calendar of monitoring visits will be timed with phenological and seasonal events so that the maximum useful data is collected at one time. Timing will be based on ecological occurrences rather than monthly calendar dictates. Data recording sheets and directions for use will be provided as a means of providing ecological characterization with an emphasis on indicators of ecological synergy or positive change. Collection of a visual record will be stipulated. Photographs will be taken at standard points using wide-angle single shot, panoramic multiple photographs, and stereo pairs will be stipulated. The inclusion of these photographs in monitoring reports will be required.

It is the goal of the monitoring plan to produce a self-evident proof of success (or unlikely failure). The intent is to collect data and evidence in various forms to indicate that the mitigation efforts are exhibiting positive change. It is expected that a five-year monitoring period will be required for this site.

6.0. FINAL MITIGATION PLAN

Upon concurrence of reviewers on basic design content, the final wetland mitigation plan will be prepared including the following information:

ECOLOGICAL RESTORATION MODEL, text, figures, historic/ecological basis for the work.
GRADING, text and plan including soils amendments and liner details.
PLANTING, text and plan.
HYDROLOGY, text and plan.
SEDIMENTATION AND EROSION CONTROL, text, and plan.
STRUCTURES, text, design plan drawings and specifications.
SOILS HANDLING AND AMENDMENTS, text and methods
FEATURES AND AMENITIES, drawings, text, wildlife considerations.
CONSTRUCTION LOGISTICS AND TIMING, text and table.
OVERSIGHT AND SITE SUPERVISION PROTOCOLS (QA, QC), text.
MONITORING PLAN, text, maps, data sheets, and instructions.
REFERENCES, full bibliography.

REFERENCES

EBASCO Environmental, 1993, Wetlands delineation report of the Fernald Environmental Management Project, Butler & Hamilton Counties, Ohio. prepared for FERMCO, Cincinnati, OH.

Munro, John W. 1991. Wetland restoration in the mitigation context. Restoration & Management Notes 9(2):80-86

Figure 1. Wildlife habitat amenities such as this stump/brush pile (above), or denning structure under construction (below),used on other wetland mitigation/restoration sites will be modified and used for the Fernald Northeast corner mitigation site.

Figure 2. Wildlife amenity structures such tethered, floating, or edge logs (above), or the paired wood duck nest boxes placed in open water (below) will be used in ponds of the Fernald wetland mitigation site. Other nest boxes for various bird species will also be used.

Figure 3. Water level outlet and control structure designs such as these, (both shown during construction and incomplete), will be adjusted to site conditions and used as basin outlets.

Figure 4. Wildlife habitat amenities such as the three shown above: left - heron roosting pole, center mallard nest basket, right - osprey or hawk nesting platform, will be used in the wetland mitigation design for the Fernald Northeast corner wetland mitigation area.

Figure 5. The top photograph shows a permanent elevation reference point placed in a constructed wetland basin. Structures like these will be installed in some or all of the eight wetland basins for easy in-basin elevation checks. The bottom photograph shows the use of placed snag trees, rock placements as underwater habitat, and several other nest structures as part of mitigation wetland pond design (under construction).

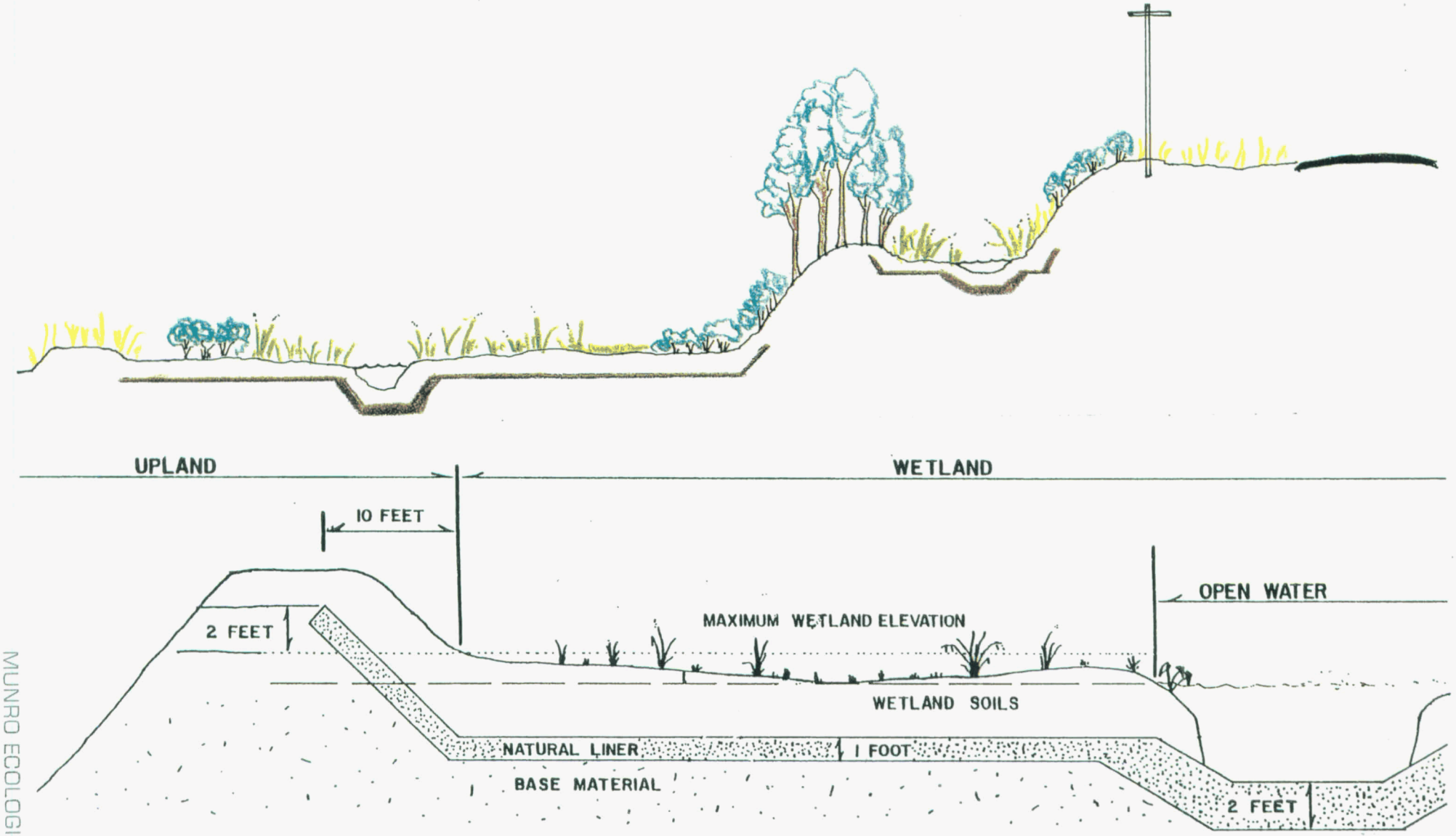

Figure 6. Two cross section views of the mitigation area show vegetation placement and liner placement concepts. The above cross section through basins #1 and #8 (unscaled) shows trees used as visual screen, variation in vegetation cover and the relation to the adjacent paved road. The lower cross section shows MES typical specifications for clay liner placement under constructed wetland basins.

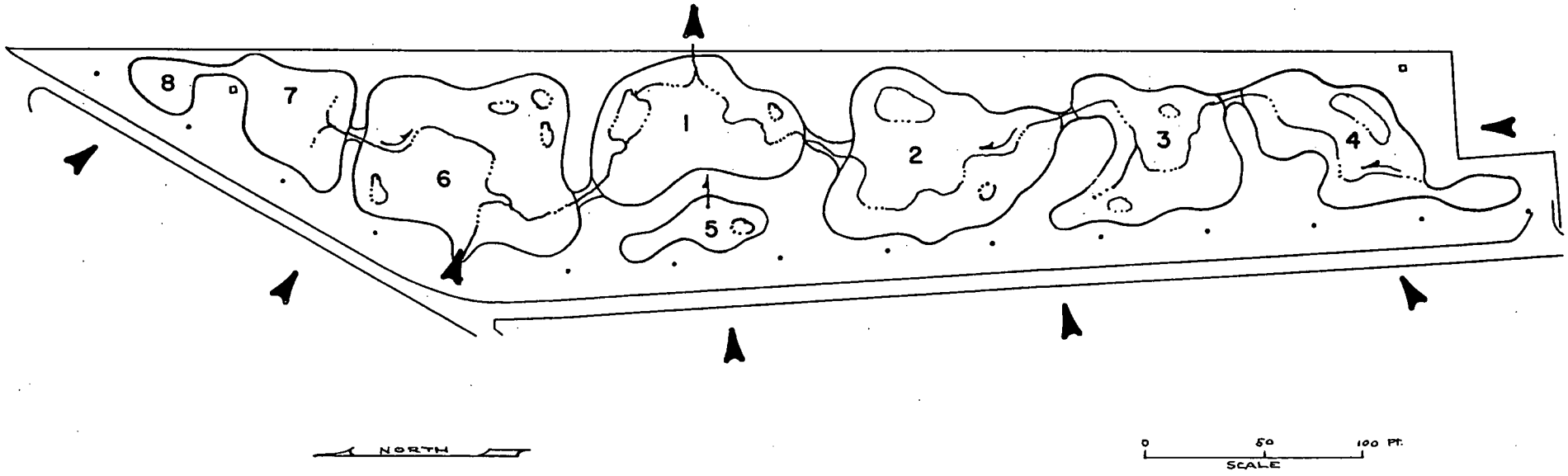

Figure 7. The hydrology of the mitigation area is illustrated here. The small feeding watershed for the wetland mitigation area is generally to the West and South of the mitigation area. Some water enters the site from overland flow and some via pipe under the road. Basin #1 will collect all flows from the site. Further details relating to water availability and hydrology will be included in the final mitigation plan.

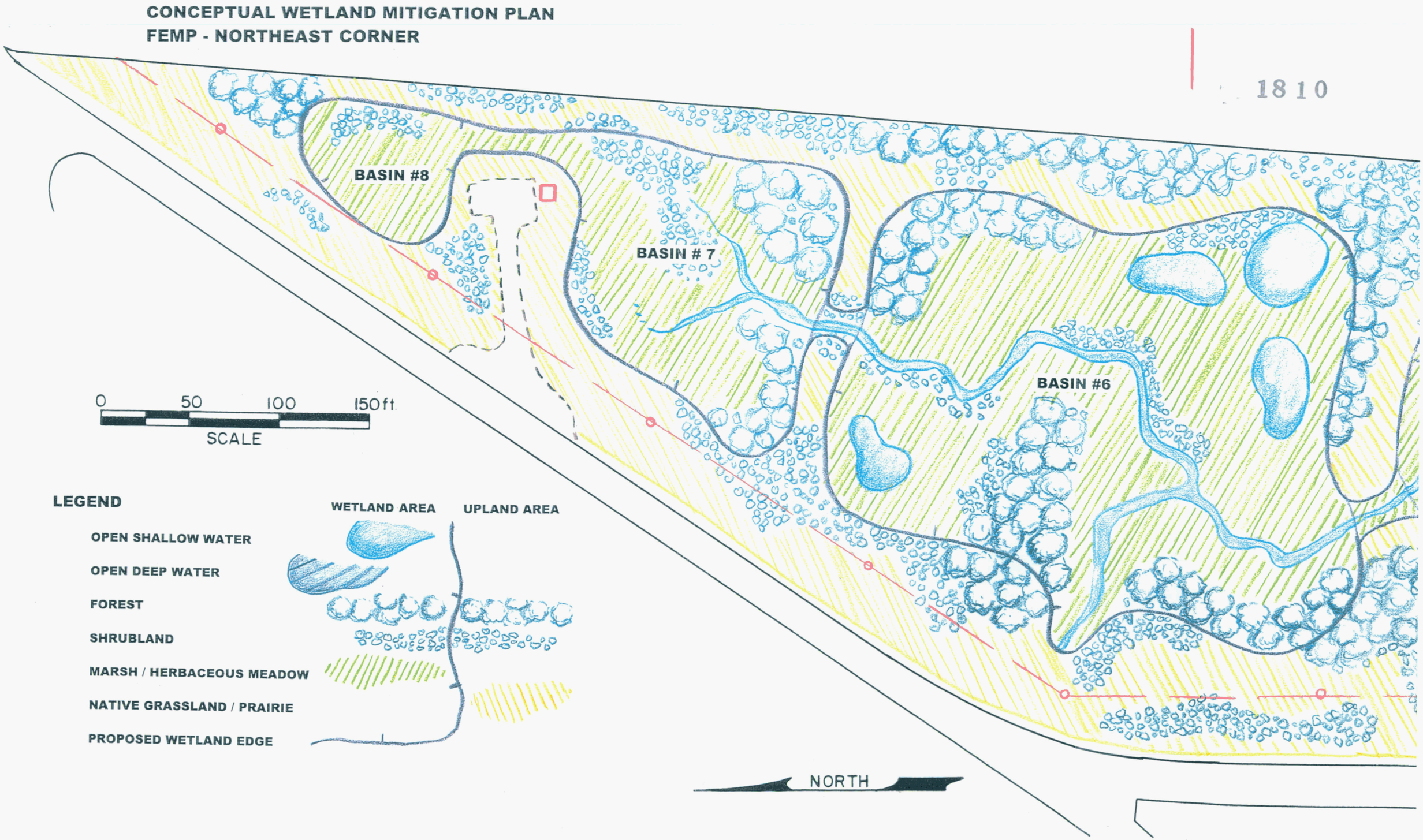

Figure 8. Conceptual wetland mitigation plan for the Fernald Northeast corner mitigation area.

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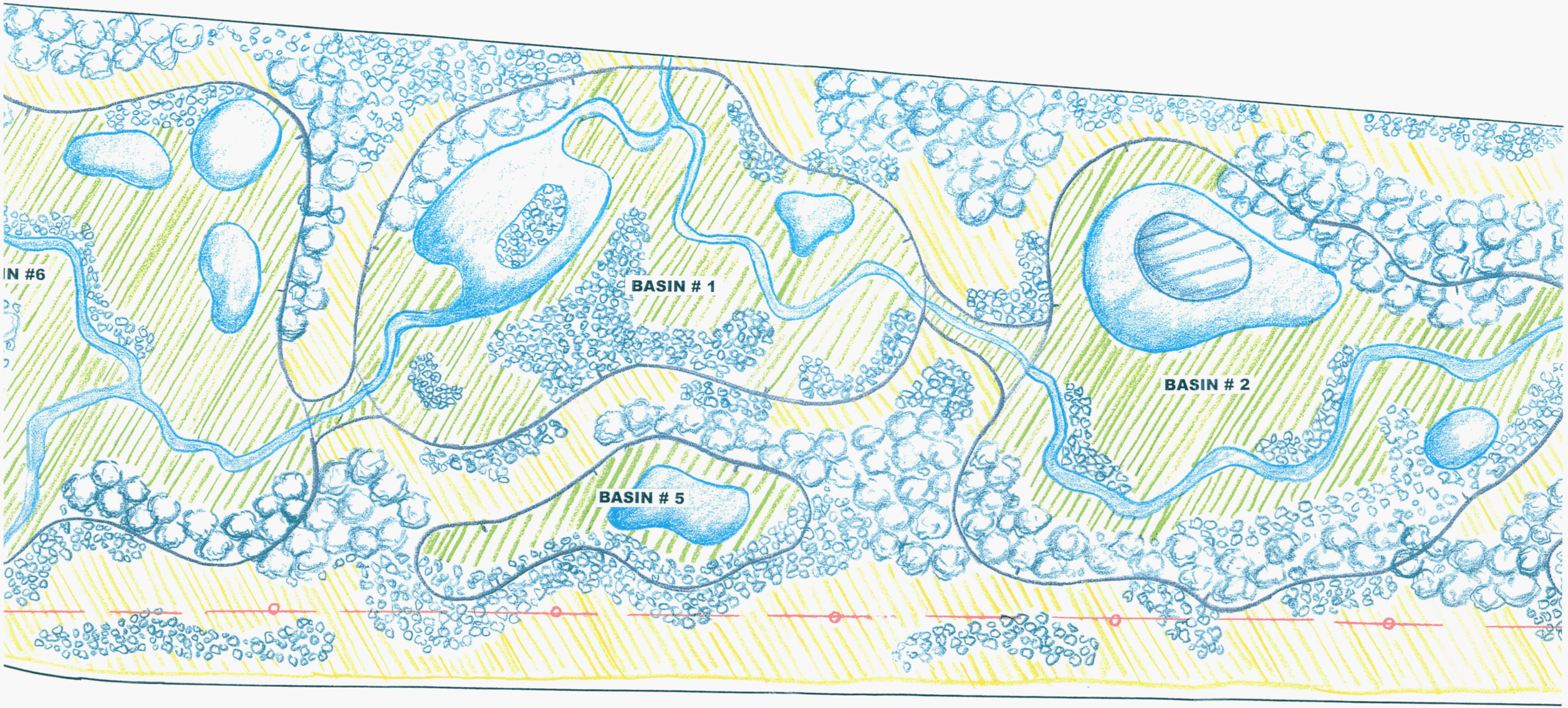
PANEL #1

CONCEPTUAL WETLAND MITIGATION PLAN
FEMP - NORTHEAST CORNER

1810



23

PANEL #2

Figure 9. Conceptual wetland mitigation plan for the Fernald Northeast corner mitigation area.

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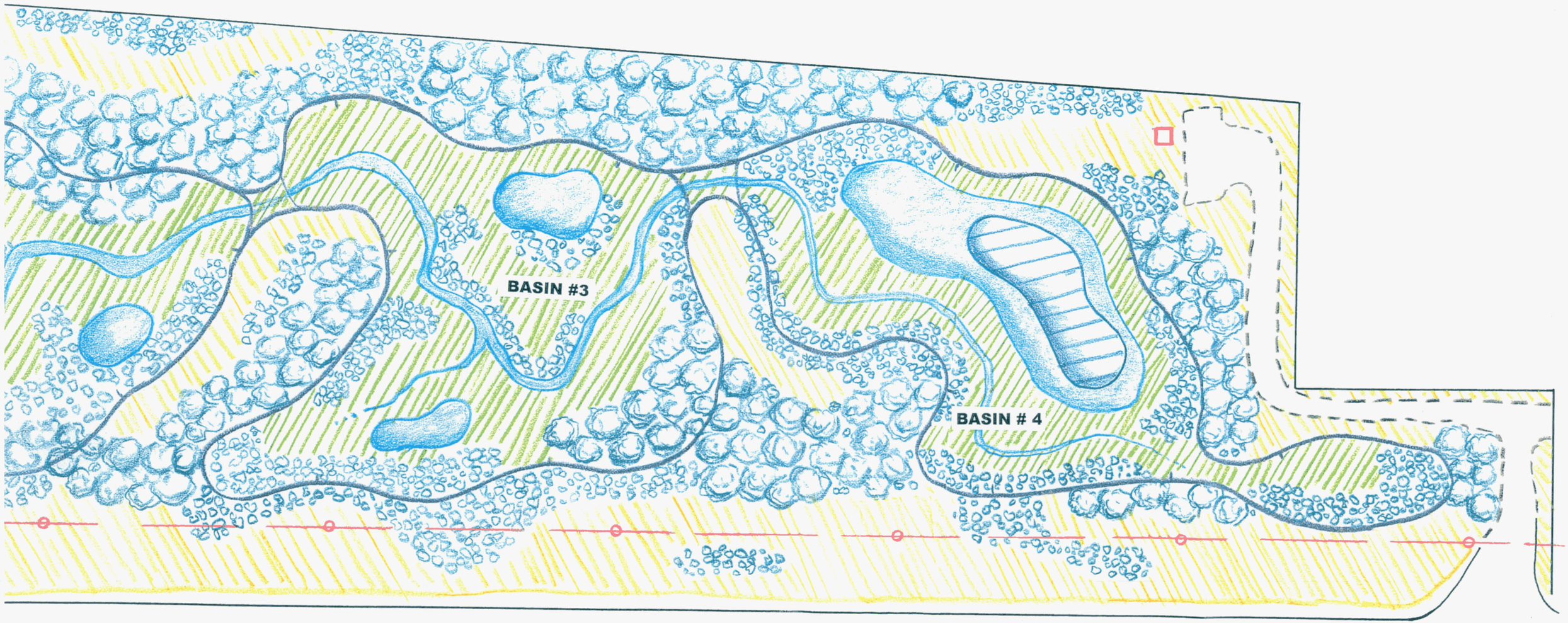
PANEL #2

CONCEPTUAL WETLAND MITIGATION PLAN
FEMP - NORTHEAST CORNER



PANEL #3

Figure 10. Conceptual wetland mitigation plan for the Fernald Northeast corner mitigation area.

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Appendix 1. This partial specification listing for a wetland mitigation plan (Fairfield County, OH) done by MES for another site in Ohio provides a sample of the diversity, notes, and style of the planting lists and specifications that will be provided in the final mitigation plan for the FEMP Area 1 Phase I mitigation site. The species list for the FEMP site will be slightly different due to the fact that the species native to Fairfield County are not necessarily native to the FEMP area. The sample provided does not include upland area, text, or other details that were included in other parts of the document.

WETLAND COVER TYPES

MARSH (herbaceous) - Wh

Portions of the mitigation area that will be seasonally flooded and are expected to be nearly continuously saturated and will have herbaceous cover are designated as marsh. These areas will be planted by a combination of seeding of a prepared marsh seed mix and plug plantings. The plug-planted species will be provide a quick growth start with more developed plants and to interject smaller quantities of less common species or species more easily greenhouse grown than field germinated. Herbaceous marsh will cover 2.07 acres.

Specifications:

Preparation	Till or scarify prior to seeding
Plug size	2 inch dia. or larger (1 yr. stock)
Plugging rate	1500/ac. approx 6 ft. spacing
Seeding area	Entire
Seed application rate	30 lbs per acre
Straw mulching rate	3 tons per acre
Timing	Spring or fall seeding only

Seed mix to be determined by the project ecologist.
No lime or fertilizer is to be used unless specified by the project ecologist.
Seed and follow immediately with mulching and watering of entire area worked.

MARSH SPECIES LIST

SCIENTIFIC NAME	COMMON NAME
Alisma subcordatum	Water plantain
Andropogon gerardii	Big bluestem
Asclepias incarnata	Swamp milkweed
Aster puniceus	Swamp aster
Aster umbellatus	Flat-topped aster
Astersimplex	Panicled aster
Caltha palustris	Marsh marigold
Carex comosa	Sedge
Carex frankii	Frank's sedge
Carex lurida	Lurid sedge
Carex vulpinoidea	Fox sedge
Dicanthelium clandestinum	Deertongue
Eleocharis obtusa	Blunt spikerush
Elymus virginicus	Virginia wild rye
Eupatorium perfoliatum	Common boneset
Glyceria striata	Fowl manna grass
Hystrix patula	Bottlebrush grass
Juncus effusus	Soft rush
Lobelia cardinalis	Cardinal flower
Panicum virgatum	Switch grass
Parnassia glauca	Grass of Parnassus

Penthorum sedoides	Ditch stonecrop
Rudbeckia laciniata	Green-headed coneflower
Schyzachyrium scoparium	Little bluestem
Scirpus atrovirens	Dark green bulrush
Scirpus polyphyllus	Many-leaved bulrush
Scirpus validus	Great bulrush
Solidago gigantea	Late goldenrod
Sorghastrum nutans	Indian grass
Spartina pectinata	Prairie cordgrass
Verbena hastata	Blue vervain

SHRUB SWAMP - Ws

This wetland planting area will be stocked with native woody shrub swamp species common for this area of Ohio. A variety of shrub species has been selected to provide both shrub clump cover as well as species that are attractive and provide seed and berries used by wetland and upland wildlife species. The area to be planted in shrub swamp is 1.05 acres.

Specifications:

Mulch placement	Complete cover of planting patch area 4" thick.
Mulch material	Bark mulch or wood chips
Seeding area	None
Shrubs per acre	1365
Typical shrub size	24" to 36" potted or B&B stock

No lime or fertilizer is to be used unless specified by the project ecologist.

SHRUB SWAMP SPECIES LIST

SCIENTIFIC NAME	COMMON NAME
Alnus rugosa	Speckled alder
Aronia prunifolia	Purple chokeberry
Cephalanthus occidentalis	Buttonbush
Cornus amomum	Silky dogwood
Cornus femina var. racemosa	Gray dogwood
Cornus sericea	Red osier dogwood
Decodon verticillata	Swamp loosestrife
Euonymus obovatus	Running strawberrybush
Hydrangea arborescens	Wild hydrangea
Ilex verticillata	Winterberry
Lindera benzoin	Spicebush
Ribes americanum	Wild black currant
Rosa palustris	Swamp rose
Salix discolor	Pussy willow
Salix exigua	Sandbar willow
Salix sericea	Silky willow
Sambucus canadensis	Elderberry
Spiraea alba	Meadowsweet
Spiraea tomentosa	Steeplebush
Viburnum prunifolium	Blackhaw

SWAMP FOREST - Wf

This wetland planting area will be stocked with native woody forest species common for this area of Ohio. Tree species will be selected which are characteristic of different stages in forest community development to ensure successful establishment of a forest well beyond the early successional stage. Larger individuals will be planted to increase the probability of success in the development of upland forest. The area to be planted in swamp forest is 0.48 acres.

Specifications:

Mulch placement	Stem to 24 inches beyond the drip line of each woody stock plant 4 inches thick.
Mulch material	Bark mulch or wood chips
Seeding area	All areas not covered by mulch
Seed application rate	30 lbs per acre (not on collars)
Straw mulching rate	3 tons per acre (not on collars)
Trees per acre	436
Shrubs per acre	436
Typical shrub size	24" to 36" potted or B&B stock
Typical tree size	1 inch caliper, B&B stock

Seed mix to be determined by the project ecologist.
No lime or fertilizer is to be used unless specified by the project ecologist.

SWAMP FOREST SPECIES LIST

SCIENTIFIC NAME	COMMON NAME
Acer rubrum	Red maple
Fraxinus pennsylvanica	Green ash
Nyssa sylvatica	Tupelo
Quercus bicolor	Swamp white oak
Salix nigra	Black willow