EMH&T

A legacy of **experience**. A reputation for **excellence**.

5500 New Albany Road
Columbus, Ohio 43054
Phone: 614-775-4500
Fax: 614-775-4802
Toll Free: 1-888-775-EMHT

emht.com

2011-0496

Walnut Woods Stream and Wetland Monitoring Report- 2016

Columbus Regional Airport Authority

February 2017

Engineers | Surveyors | Planners | Scientists

TABLE OF CONTENTS

TABLES

APPENDICES

EXHIBITS

FIXED STATION PHOTOGRAPHS

1.0 INTRODUCTION

The Walnut Woods mitigation project involves the restoration of approximately 2,700 linear feet of Big Run just upstream of Walnut Creek, extending southwest of Lithopolis Road, east of Richardson Road and north of Hayes Road in Madison Township, Franklin County, Ohio. The project also involves the restoration of emergent and forested wetland. The project site is located on the former Eastside Nursery property; located in the Big Run Watershed. Prior to restoration, Big Run was a substantially degraded intermittent tributary to Walnut Creek with excellent restoration potential. Restoration activities are expected to have a significant beneficial effect upon water quality and wildlife habitat within the Walnut Creek Watershed. The restoration activities completed at Walnut Woods are intended to stand as pooled mitigation for the NetJets Headquarters expansion, as well as mitigation for a number of other expansion projects at the Port Columbus International Airport. See Appendix A for a copy of permits utilizing mitigation at Walnut Woods.

The restored stream is required to be monitored yearly for a total of five (5) years. This report summarizes the results of the fifth and final monitoring event. The restored wetland is required to be monitored over the course of ten (10) years. This report summarizes the results of the second monitoring event. Monitoring reports are submitted to the United States Army Corps of Engineers and Ohio Environmental Protection Agency. The purpose of the monitoring report is to discuss riparian and wetland plant community development, maintenance and/or remedial activities, and whether the stream and wetlands are meeting set performance standards.

This document provides the results of 2016 monitoring activities. The restored stream achieved the warmwater habitat aquatic life use designation as documented by the physical habitat and IBI assessments, fulfilled the native species performance requirement, and was in attainment of the invasive species performance requirement. The macroinvertebrate sampling effort was not used in determining whether or not the stream met the warmwater habitat aquatic life use designation as the summer sampling flow regime was insufficient for an accurate representation of the ICI according to the Ohio EPA publication: 2014 Updates to Biological Criteria for the Protection of Aquatic Life: Volume III. However, with warmwater habitat attainment as documented by the physical habitat and IBI assessment techniques, **the CRAA is requesting that the stream mitigation area be deemed successful and that no additional monitoring is to be required.**

The wetland monitoring plots and VIBI assessments exceeded all performance standards throughout the forested and non-forested wetland areas except for the invasive plant performance requirement. Invasive plant coverage across the entire wetland area was determined to be above the performance requirement threshold limits. Initial treatment efforts proved successful in killing a majority of the invasive plant cover within the wetland and surrounding area. Maintenance spraying will continue on an as needed basis to ensure the site stays on a trajectory toward meeting the invasive plant performance metric. Monitoring activities during 2018 will update the extent of invasive plants across the site and document the progression of the remaining performance requirements for the forested and non-forested wetland areas.

2.0 STREAM AND WETLAND MITIGATION PLAN

The Walnut Woods mitigation project consists of the restoration of 2,700 linear feet of stream, restoration of over 20 acres of wetland, and conservation of surrounding upland buffer totaling approximately 60.1 acres within the Walnut Woods Metro Park in Groveport, Ohio (Exhibits 1 and 2). The restoration improvements will have a significant beneficial effect upon water quality and wildlife habitat within the Walnut Creek watershed (HUC 05060001180). The stream and wetland restoration within the Metro Park serve as mitigation for permitting activities for capital improvement projects the Columbus Regional Airport Authority (CRAA) is undertaking at Port Columbus. As the mitigation area is part of a Metro Park property, future management and preservation of the site by competent, responsible steward is assured. The site is also protected by an environmental covenant with the Ohio EPA (Appendix B).

2.1 Stream Restoration Plan Details

The natural channel design restoration approach for Big Run included lowering of bank heights and slope stabilization, reduction in streambank erosion potential, and riparian vegetation restoration. The ability to transport stream flows and sediment in such a manner that the channel maintains its dimension, pattern, and profile without either aggrading or degrading was the premise upon which the natural channel design for Big Run was based. The restoration of Big Run utilized a Priority Level 2 natural channel design approach on over 2,700 linear feet of stream. A new floodplain was excavated east of the existing channel alignment and extended north to the Walnut Woods property boundary near the confluence of Big Run with Walnut Creek. The goal for the restoration reach on Big Run was to construct a Rosgen Type 'C' stream channel with correlation to the bankfull dimensions calculated using the USGS regression equations. An as-built plan, longitudinal profile, and geomorphic summary for the restored stream channel are included in Exhibits 3-3C.

The Big Run restoration reach has an 8.5 square mile watershed. The flow conditions for Big Run have improved after the stream restoration, with respect to competency and the capacity to transport sediment and maintain the integrity of channel bedform features. The stream currently receives intermittent flow as water velocity slows during summer months as the stream seems to be connected to the water table.

The riparian corridor of the restored stream channel was planted with trees and shrubs. Within the buffer area, woody stems were spaced to produce densities that allow sufficient room for plant growth over time. Woody live-stakes were installed along the outside meander bends of the stream channel. Tree and shrub spacing was slightly staggered within three (3) stream corridor zones in order to increase shade coverage, with shrubs interspersed throughout the trees. The proposed planting densities indicated on Exhibit 4 allow for sufficient room for plant growth over time, but are dense enough to encourage a robust corridor. The species selected for planting within each zone are also indicated on Exhibit 4. All species indicated are native to the region and cold hardy. Value to wildlife was also considered when preparing the plant species list.

Disturbed areas, such as side slopes, were seeded with a rapidly germinating annual cover mixture to provide erosion control and prevent the establishment of undesirable species. In addition, the riparian buffer was seeded with an Eastern Ecotype Native Grass Mix, ERNMX 177, to promote stabilization of exposed soils and provide additional wildlife habitat.

2.2 Wetland Restoration Plan Details

Approximately 22 acres of emergent and forested wetland were restored within two (2) wetland cells on existing hydric soils in the northwestern portion of the property, as shown on Exhibit 2. The forested portion of the wetland area was designed to have a normal pool depth of 0.0 (saturated) to 0.2 feet (inundated), which is conducive to supporting an eventual forested wetland plant community. The emergent portion of the wetland area was designed with a normal pool depth of approximately 0.2 to 1.0 foot. The exact location of the forested and emergent wetland areas within each cell were determined during final design in conjunction with the natural grade of the land, with the intent of minimizing earth moving activities that would disturb the existing hydric soils. Hydrology is being supplied to the wetlands by overland runoff from the surrounding hillsides, as well as the plugging of existing agricultural tiles. Shallow earthen berms were constructed around both wetland perimeters to retain hydrology. Additional grading occurred just south of the wetland cells to promote surface runoff into the cells. Substantial plantings of hydrophytic trees, shrubs, and forbs was included in the wetland plans in order to promote the development of a diverse vegetative community and help to preclude infiltration of invasive species.

The vegetation concept for the wetland areas is to restore forested and emergent wetland habitat that will meet a minimum VIBI score comparable to a Category 2 designation at the end of the monitoring period. A total of approximately five (5) to six (6) acres within Cells 1A and 1B were planted with a variety of native, cold-hardy tree and shrub species, focusing on a diversity of high quality woody species. Trees were planted in densities approximately equivalent to 134 trees per acre using 3-gallon stock. The shrubs were planted in densities equivalent to approximately 60 shrubs per acre using 3-gallon stock. Additional live stake material was installed to promote understory diversity. Installation of native herbs and sedges throughout the forested wetland area is intended to provide a dense cover of native plants, thereby reducing the opportunity for invasion by exotic species. A variety of native herbaceous wetland plugs were installed within the emergent portions of the wetland cells in densities of approximately 2,722 per acre. In addition, 3 gallon shrubs (48 per acre) and live stakes (109 per acre) were installed throughout the emergent wetland areas. In addition to the proposed woody and herbaceous plantings, the wetland cells were seeded with a Facultative Wetland (FACW) Wetland Meadow Mix (ERNMX 122). Exhibit 5 presents proposed planting specifications for the wetland mitigation site.

An approximate 25-foot wide transitional upland buffer has been established around the proposed wetland cells. The buffer was initially seeded with an Eastern Native Habitat Mix (ERNMX 173) and a cover crop was seeded to stabilize the soils. The wetland buffer was planted with a mixture of native trees and shrubs as indicated on Exhibit 5.

2.3 Determination of Mitigation Credits

Restoration activities at the Walnut Woods mitigation site will provide compensatory mitigation for impacts associated with a number of expansion projects at the Port Columbus Airport. The projects proposed for mitigation at Walnut Woods are listed in Table 1. Table 2 tracks the type and amount of credit banked at Walnut Woods.

Table 1
Projects for Mitigation at Walnut Woods

Project Name	USACE Authorization Date	USACE Permit Number	Ohio EPA Authorization Date	Ohio EPA Permit Number
Loop Road	5/14/2009	2006-2164-2	5/7/2007	073082/073083
NetJets Corporate Headquarters	4/12/2011	2003-270 SCR	3/9/2011	083460
CRCF on 17th and Stelzer	N/A	N/A	3/23/2009	083438
Turkey Run Detention Basin	4/12/2011	2009-184	3/24/2010	093492
Replacement Runway 10/28	6/23/2011	2003-270-1	1/19/2011	103655/103683

Table 2
Type and Quantity of Credit Banked at Walnut Woods

Project Name	Credits Banked at Walnut Woods				Stream/Wetland Credit Remaining		
					Forested Credit Available	Non-forested Credit Available	Stream Credit Available
	Forested Wetland	Non-forested Wetland	Stream (LF)	Initial Credit	11.3	11.2	2,700
Loop Road	-	0.28	-		11.3	10.92	2,700
NetJets Headquarters	1.25	2.685	360		10.05	8.235	2,340
CRCF	-	4.317	-		10.05	3.918	2,340
Turkey Run	2.31	0.58	-		7.74	3.338	2,340
Replacement Runway	1.975	0.21	888		5.765	3.128	1,452
Amount Remaining					**5.765**	**3.128**	**1,452**

3.0 MONITORING METHODOLOGY

3.1 Performance Standards

The objective of the stream and wetland monitoring plan is to survey the site on an annual basis to determine whether the goals set forth in the 401/404 permits have been obtained or are progressing in the appropriate direction. The wetland cells will be monitored for a period of ten (10) years. The restored segment of Big Run and its associated riparian corridor will be monitored for a period of five (5) years post-construction. Accepted performance standards for the stream restoration project are indicated below.

Stream Performance Standards
Within five (5) years after the completion of construction, the restored portion of Big Run at Walnut Woods Metro Park will meet the following performance criteria:

- **QHEI:** The restored segment of Big Run shall achieve a minimum average QHEI score of 60 by the end of the 5-year monitoring period. This represents an average QHEI score improvement of approximately 30 points compared to the baseline assessments.

- **Warm-water Habitat:** Meet the criteria for the warm-water habitat (WWH) aquatic life use designation.

- **Native Species:** A total of 80% if the restored channel's riparian zone shall be covered by native shrub and herbaceous species.

- **Invasive Species:** The restored channel's riparian zone shall contain no more than 5% relative cover of any invasive species.

Wetland Performance Standards
Within ten (10) years after the completion of construction, mitigation wetlands at Walnut Woods Metro Park shall meet the following performance criteria:

- **Wetland Criteria**: All mitigation wetland areas must eventually meet wetland criteria. The restored wetlands will be delineated using the procedures for comprehensive determinations outlined in the 1987 Corps of Engineers Delineation Manual and the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region* (USACE, 2008) or successor documents. The boundaries will be mapped using geographic position system (GPS) instruments or traditional survey methods. The respective amounts of emergent and intended forested wetland habitat present will be identified. A wetland delineation will be conducted during monitoring years 5 and 10.

- **VIBI**: Both the non-forested and intended forested portions of the wetlands must achieve a minimum VIBI score of 51, equivalent to an ORAM Category 2 wetland (score range 51-62), as described in Table 7 of the *Field Manual for the Vegetation Index of Biotic Integrity v. 1.4* (Mack, 2007), by the end of the 10-year monitoring period. This scoring range pertains to wetlands in the Eastern Corn Belt Plains (ECBP) ecoregion.

- **Woody Vegetation**: Forested components of the mitigation wetlands shall be demonstrated by graphing standard forest measures (frequency, density, dominance, and importance values) against time, to be on a trajectory towards becoming forested wetlands.

- **Open water**: The wetland areas can have no more than 10% unvegetated open water by the end of the 10-year monitoring period.

- **Native Wetland Species**: The wetlands must have greater than 75% of their total area vegetated with native, perennial hydrophytes by the end of the 10-year monitoring period. A total of 80% of the total area of each mitigation wetland shall be covered by native tree, shrub and herbaceous species.

- **Invasive Species**: No more than 5% of the wetland and buffer areas can be vegetated with invasive species as defined in the ORAM listing of invasive species by the end of the 10-year monitoring period.

- **Wetland buffers**: A minimum of 50% of the perimeter of the combined wetland edges shall have slopes no greater than 15:1.

If after the required post construction monitoring is completed and the stream restoration area is demonstrated, by graphing measurements against time, to be on a trajectory toward the stated performance criteria, the applicant may request that the OEPA and USACE consider the restoration area deemed successful and request that no additional monitoring or corrective measures be required. If required performance goals have not been met, the monitoring period may be extended and the project owner may be required to provide corrective measures, alternatives or request revisions of the performance standards.

3.2 Monitoring Protocol

Monitoring of the mitigation stream and wetland began in the spring and summer of 2011, after the first growing season following completion of mitigation construction. Table 3 identifies the anticipated monitoring schedule for the stream and wetland mitigation areas. Routine data will be collected during site visits and forwarded in a report to the USACE and Ohio EPA by December 31 of each of the monitoring years. The monitoring reports will identify the extent to which the Walnut Woods mitigation site is meeting the performance goals set forth in the 401/404 permits. Specific information regarding monitoring frequency, activities and reporting for the restoration area is provided in the following sections.

Table 3
Stream and Wetland Monitoring Schedule

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Stream	X	X	X	X	Hold[1]	X	-	-	-	-
Wetland	X	Off year	Hold[2]	Hold[2]	Hold[2]	X	Off year	X	Off year	X

X denotes year in which monitoring occurred/ will occur.
[1] Stream monitoring was put on hold in 2015 in order to address habitat alteration from beaver dams.
[2] Wetland monitoring was put on hold while hydrology issues were investigated.

Stream Monitoring

During the first site visit, fixed station photo locations were established and their locations were captured with a GPS unit. Additionally, fixed station photos were taken, stream transects were chosen and demarcated and captured with a GPS unit.

A total of eight (8) transects were established along the restored section of Big Run. In order to get an accurate representation of the stream through sampling, the transects were established as evenly as possible, in terms of linear feet along the stream. Four (4) transects were established at riffle features and four (4) transects were established at pool features. Each transect was marked with two (2) white PVC poles anchored with ½-inch rebar. These poles were placed opposite one another in the floodplain of the stream, along the riparian corridor. The locations of the transects are shown on Exhibit 4. Each transect was visually delineated in the field as extending thirty (30) feet on either side of the PVC poles.

Photographs, geomorphological measurements, vegetation diversity, and aerial coverage estimates (for native and invasive species) were taken at each stream transect. Stream monitoring data forms were used to record required vegetative characteristics and geomorphological measurements at each stream transect. Fixed station photographs were also taken along the riparian corridor of the stream. These representative photographs are collected from the fixed locations during yearly summer monitoring and are included in each monitoring report for comparative purposes.

Two (2) representative stream sections were chosen to perform physical and biological assessments using the Qualitative Habitat Evaluation Index (QHEI), Index of Biotic Integrity (IBI), and Invertebrate Community Index (ICI). The QHEI is conducted yearly for a total of five (5) monitoring years. The ICI and IBI are to be conducted during the first, third, and last monitoring event. **However, summer sampling flow regimes were insufficient for an accurate ICI interpretation during the last stream monitoring event and will not be used in the final performance standard assessment.**

A summary of the parameters to be monitored annually along the relocated channel include the following:

- An as-built survey of stream profile and cross section, including the stream bed and banks, will be conducted along the restored segment and presented within the Year 1 monitoring report.
- Additional surveys of stream profile and cross section, including the stream bed and banks, will be conducted during the third and fifth monitoring events.
- Cross-sectional measurements will be taken annually at each sampling point.
- QHEI data will be collected along two (2) representative reaches within the restored segment of Big Run during each annual monitoring event.
- Along the length of the restored stream segment, percent total vegetation cover and dominant species present within each stratum will be determined at each of the eight (8) transect locations annually.

Parameters to be monitored biannually along the relocated channel include the following:

- ICI and IBI data will be collected along two (2) representative reaches within the restored segment of Big Run.

Wetland Monitoring

The wetland cells will be monitored over a 10 year period ending in 2020. The first monitoring visit was conducted in 2011. Monitoring was then suspended for three (3) years during 2013-2015 while hydrological investigations were conducted to determine why certain portions of the cells were not transforming into wetland habitat. After the investigations were completed and solutions implemented, monitoring resumed in 2016 for the second monitoring event. All monitoring plots and VIBI plots were rearranged throughout each wetland cell in 2016 to more accurately sample the current quality of the proposed emergent and forested wetland areas. Monitoring will continue on a biannual basis until the originally proposed 2020 completion date. A timeline of events and management activities are detailed later in this report.

A total of seven (7) wetland monitoring plots were established across the restoration site (Exhibit 2). Five (5) plots were established in proposed forested wetland areas and two (2) plots were established in proposed non-forested wetland areas. Plots were located in wetland areas that are most representative of the vegetative communities within each cell. Data collected in May of each year includes quantitative hydrology measurements taken at each of the wetland plots. Surface water inundation or depth of soil saturation is measured at the center point of each monitoring plot. In addition, one (1) grab sample will be collected from each outlet control structure for water chemistry analysis in May of each monitoring year if standing water is present. The samples will be analyzed for ammonia, nitrates, nitrite, carbon, total sulfates, total iron, total manganese, specific conductivity, pH, turbidity, total suspended solids, heavy metals and biochemical oxygen demand. The late summer site visit is used to collect information on plant species composition, relative abundance, and density. The previously described data, along with photo-documentation, are collected at each of the wetland monitoring plots during each monitoring event. Wetland monitoring data forms are used to record required vegetative, hydrological, and soil characteristics at each of the emergent and forested wetland monitoring plots. Additionally, woody stem density and tree height measurements are collected for each of the forested wetland plots to document the persistence and survivability of woody plant species. Fixed station photographs were also taken across representative wetland areas.

Two (2) VIBI plots were established in a proposed forested and non-forested wetland area in order to provide data on the quality of these habitat types. The fixed VIBI plots are the standard layout with 4 intensive modules each. VIBI assessments were, and will continue to be performed according to the *Field Manual for the Vegetation Index of Biotic Integrity for Wetlands v. 1.4* (Mack, 2007). The first VIBI assessment was conducted in 2011 during the first growing season following construction. However, due to the corrective actions that took place during 2013-2015, it was determined that the VIBI plots would be established in new areas that more accurately reflect the quality of the forested and non-forested habitat within the site. VIBI assessments at these new locations were conducted during 2016 and will be repeated in 2018 and 2020.

4.0 STREAM MONITORING RESULTS

4.1 Vegetation Assessment

The dominant streamside vegetation along the reach of Big Run was primarily comprised of conservative herbaceous plants and a diversity of shrub and tree species. The typical dominant herbaceous species were white heath aster (*Symphyotrichum ericoides)*, Canada goldenrod (*Solidago canadensis)*, Virginia wildrye (*Elymus virginicus*), and cup plant (*Silphium perfoliatum*). American sycamore (*Platanus occidentalis*), swamp white oak (*Quercus bicolor*), eastern cottonwood (*Populus deltoides*), and red maple (*Acer rubrum*) were the dominant trees throughout the floodplain. Black willow (Salix nigra), peachleaf willow (*Salix amygdaloides*), and sandbar willow (*Salix exigua*) were the dominant streamside trees and shrubs. The streamside willows have aggressively spread along the outside bend of meanders and adjacent streamside areas. This has stabilized the stream banks and provided valuable instream cover and habitat to help develop and support a diverse aquatic community throughout the stream. Evidence of recruitment from the surrounding forested areas is prominent as newly established seedlings were observed throughout the corridor. The monitoring plots calculated approximately 93.25% of the riparian zone was covered by native shrub and herbaceous species. Additional information on the range of species identified within the vegetation transects can be found on the stream data forms located in Appendix C. Photographs of the vegetation transects and general stream photographs can be found within the Photograph section of the report.

Reed canary grass (*Phalaris arundinacea*) was the only invasive plant identified within the stream corridor during 2016 monitoring efforts. The increase in reed canary grass cover coincided with the disturbances created by beaver activity. The invasive grass was primarily focused along both stream banks throughout the middle portion of the restored stream segment where backwater increased behind the dams. Before invasive plant treatment began, the cover of invasive plants was 3.3% of the total stream corridor. Invasive plant treatment efforts during 2016 thoroughly treated the stream banks as seen in Photograph 9. These efforts likely reduced invasive plant cover to below 2% of the total stream corridor; this amount is well within performance requirements.

4.2 Channel Morphology

As-Built Data

An As-Built longitudinal profile was captured for the stream in Year 1 (2011) and was graphed using RIVERMorph Version 4.3.0. (Exhibit 3b). A Geomorphic Summary Table is included as Exhibit 3c. This summary table depicts the major geomorphological parameters of the stream design and compares them to the parallel As-Built parameters. The graphical output for the longitudinal profile of the stream shows that at least 2,700 linear feet of the relocated channel has varied morphology, with deeper pools and shallow riffles. This provides visual evidence that the riffle-pool sequences were constructed as designed and remain functional in this stream. 2016 observations show no apparent morphological changes to the stream channel along the entirety of the restored stream.

The dimension measurements for the two (2) surveyed cross-sections are included in Table 4. The morphology of the surveyed cross-sections resulted in a Rosgen classification of a C-type channel for the riffle transect and an E-type channel for the pool transect. Both cross-sections exhibited high width/depth and entrenchment ratios, which is typical morphology for a stable stream. The mean and maximum depths of the pool have remained much deeper than the riffle. This would be expected of a stream with well-developed riffle/pool sequences. The surveyed cross sections in 2016 provide evidence as to stream stability when compared to the dimensional parameters of the 2011 measurements. The variance across data was not significant to document large changes in stream stability as measurements were not taken from fixed locations across the stream channel. The minor fluctuations surrounded maximum depth in the pool transect. The increase in the maximum depth in the pool transect can be attributed to sand being the predominant substrate. This has allowed the thalweg to become more developed as the stream has found its own natural flow pattern within the constructed beltwidth.

Table 4
Dimension Measurements for the Surveyed Cross-Sections

Year	Cross-section	Mean Depth (ft)	Max. Depth (ft)	Bankfull Width (ft)	Floodprone Width (ft)	Width/ Depth Ratio	Bankfull Area (ft^2)	Entrenchment Ratio
2011	1-Riffle	0.86	1.25	17.9	>100	20.80	15.50	>5.6*
	2-Pool	1.30	2.25	17.5	>100	13.50	22.80	>5.7*
2013	1-Riffle	0.73	0.88	17.9	>100	24.5	13.0	>5.6*
	2-Pool	1.42	2.70	17.5	>100	12.3	24.9	>5.7*
2016	1-Riffle	0.83	1.4	17.9	>100	21.56	14.85	>4.9*
	2-Pool	1.66	3.0	17.5	>100	10.54	29.05	>5.1*

*Assuming floodprone width at cross-section is greater than 100ft.

Geomorphologic Parameters

Table 5 presents the 2016 morphological measurements for the relocated and restored stream at each of the eight (8) monitoring transects. When compared to Year 1 dimensional measurements, the stream has remained relatively stable. However, a trend towards deeper mean and maximum bankfull depth across pool transects is observed. This is the result of stream bed substrate being dominated by finer material which has allowed for scour and migration of bed material during bankfull events. This provides evidence that the stream is finding its own natural flow pattern within the constructed belt width of the stream.

Table 5
Dimension Measurements for the Relocated Stream

Transect No.	Bankfull Width (ft)	Mean Bankfull Depth (ft)	Maximum Bankfull Depth (ft)	Floodprone Width (ft)	Cross-sectional Area (ft^2)	Entrenchment Ratio	Width/Depth Ratio	Rosgen Stream Classification at Transect
1 Pool	17.9	1.55	3.9	>100	27.74	>5.58*	11.54	E
2 Riffle	17.4	1.38	2.1	>100	24.01	>5.7*	12.60	C
3 Pool	17.2	1.63	3.1	>100	28.03	>5.81*	10.55	E
4 Riffle	17.0	1.56	2.5	>100	26.52	>5.88*	10.89	E
5 Pool	16.3	1.48	3.0	>100	24.12	>6.13*	11.01	E
6** Riffle	17.9	0.83	1.4	>100	14.85	>5.58*	21.56	C

Table 5 continued

Transect No.	Bankfull Width (ft)	Mean Bankfull Depth (ft)	Maximum Bankfull Depth (ft)	Floodprone Width (ft)	Cross-sectional Area (ft²)	Entrenchment Ratio	Width/Depth Ratio	Rosgen Stream Classification at Transect
7**	17.5	1.66	3.0	>100	29.05	>5.71*	10.54	E
8 Riffle	17.0	0.71	1.3	>100	12.07	>5.88*	23.94	C

*Assuming floodprone width is greater than 100 feet.

** Transects 6 & 7 were also used for the As-Built survey.

The 2016 morphological measurements taken along the stream transects indicate that the restored stream is holding up to design standards. The entrenchment ratios are above 2.2, evidence that the stream is well-connected to its floodplain. Historically, width-to-depth ratios were above 12.0 for all transects indicating an overwide C-type channel. However, 2016 measurements indicate width-to-depth ratios were mainly below 12.0 indicating the majority of stream transects would be classified as an E-type channel as defined by Rosgen. According to research provided by land-grant universities made available by extension.org, “E-type channels represent the developmental “end point” of channel stability and fluvial process efficiency for streams undergoing a natural sequence of system evolution.” The overwide design parameter for the restored segment of the stream (C-type channel) has allowed for the fine streambed substrate to respond to scouring stream flows and bankfull events and develop a natural flow pattern across the constructed streambed. E-type channels respond and react to bankfull events which allow for adjustment and migration to other stream types over the course of short time periods. It should be noted that there is some discrepancy between the As-Built bankfull measurements and the bankfull measurements that were gathered during stream monitoring. This discrepancy is not a sign that the stream was not built as designed. Rather, the difference is based solely on the fact that ‘natural indicators’ were used during in-the-field stream monitoring in order to estimate bankfull stage. These natural indicators do not necessarily match up to the constructed As-Built bankfull.

4.3 Qualitative Habitat Evaluation Index Assessment

Two (2) QHEI assessments were completed for the restored section of Big Run. These sections correspond to the reach terminating upstream of Transect 2 (QHEI section 1), and the reach terminating upstream of Transect 4 (QHEI section 2). The purpose of performing QHEI calculations along these reaches was to get the most representative sample of habitat quality for Big Run within project boundaries. The scores for the two (2) QHEI segments for all monitoring years are noted in Table 6.

Table 6
Big Run QHEI Scores

Year	QHEI score for Segment 1	QHEI score for Segment 2
1	57	60.5
2	58	59
3	61.5	62.5
4	62	62
5	65	65

For the fifth year in a row, both QHEI sections fall within the 'Good' narrative range and currently exceed the goal score of 60 for WWH designation. The QHEI score for each segment falls within the range of QHEI values for wading reference sites in the Eastern Cornbelt Plains Ecoregion (US EPA, 1999). The dominant substrate throughout each segment is sand and gravel. The bankfull events have efficiently transported silt and other fine material through the system preventing excessive siltation and embeddedness across stream bed features. Instream cover has dramatically increased since 2011 as streamside trees and shrubs have expanded along the outside bend of meanders and adjacent areas. This has increased stream bank stability and prevented erosion throughout the length of the restored stream. The increase in woody vegetation has substantially increased overhanging vegetation and rootmats which have increased microhabitat within the stream channel. Riparian width is substantial and floodplain quality is good for both QHEI sections. The QHEI data forms are included in Appendix D.

4.4 Index of Biotic Integrity Assessment

An Index of Biotic Integrity (IBI) assessment was completed for the restored section of Big Run as part of 2016 monitoring activities. Fish sampling, identification, data form completion, and index calculations were performed using the methodology specified within the *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition* (US EPA, 1999). All applicable updates to this document were also referenced during the IBI calculation. The sections sampled correspond to the reach terminating directly downstream of Transect 3 (IBI section 1), and the reach terminating directly downstream of Transect 6 (IBI section 2) as seen on Exhibit 2. The purpose of performing IBI calculations along these reaches was to obtain the most representative sample of the fish community for Big Run within project boundaries. The IBI scores for each monitoring year are noted in Table 4. Data forms detailing the findings of the sampling effort are located in Appendix E.

Table 7
Big Run IBI Scores

Year	Segment 1 Score	Segment 2 Score	Combined Score	Narrative Evaluation*
2011	17	28	25	Poor
2013	32	38	40	Good
2016	37	35	41	Good

*Narrative evaluation based on streams found in the Eastern Corn Belt Plains Ecoregion

The IBI scores for each stream segment have dramatically improved since 2011. The increase in scores can be attributed to the continual development of instream habitat and the stream's direct connectivity to a biologically suitable waterway (Walnut Creek). The continual development of streamside woody vegetation has increased shade across portions of the restored stream and created microhabitat suitable to support a diversity of aquatic life. Fourteen (14) different species of fish were identified during the 2016 sampling. This species assemblage is noteworthy considering the small drainage area of Big Run. It is expected that instream habitat will continue to develop as the streamside vegetation matures. This will increase the diversity and abundance of fish and maintain the Warmwater Habitat designation for the section of the restored stream in future years. The 2016 IBI sampling of the restored section of Big Run met the Warmwater Habitat designation and permit performance requirements.

4.5 Invertebrate Community Index (ICI) Assessment

According to the *Biological and Water Quality Study of Walnut Creek and Selected Tributaries* 1996, portions of Big Run are strongly influenced by groundwater source and sinks. The portion of Big Run within the mitigation area is directly connected to the water table through a shallow gravel seam. This connection causes the stream to transition toward interstitial/intermittent flow during the summer months as stream flow dissipates into the dropping water table. Observations during 2016 found stream flow to transition toward intermittent flow during the third week of June. This coincided with the beginning of the Ohio EPA's recommended ICI sampling period. The lack of perennial flow during the ICI sampling period caused macroinvertebrate abundance and diversity to plummet as current velocities are insufficient to support a diverse macroinvertebrate community throughout the intermittent portions of the stream. These conditions created an inaccurate interpretation of the ICI according to the quantitative sampling procedures as described in the 2014 updates to *Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities*. It is expected that the macroinvertebrate community will continue to fluctuate on an annual basis in response to ground water levels. As the stream continues to naturalize from its post-construction condition, the invertebrate population may eventually improve in diversity and quality over time as additional species have time to colonize the perennially ponded portions of the restored stream reach. Based on the intermittent flow regime of Big Run during the recommended sampling period, **the ICI assessment was determined to not be a useful assessment tool in determining the quality and diversity of invertebrate organisms within the restored steam segment.** Therefore, based on the guidance of the Ohio EPA quantitative sampling document, the ICI assessment will not be a determining factor in deciding whether or not the stream meets the warmwater habitat assessment as the stream lacks the sufficient hydrology to meet the warmwater habitat parameters of the ICI assessment.

5.0 STREAM MANAGEMENT ACTIVITIES

As previously discussed in update letters, several beaver dams were erected within the restored portion of Big Run during 2014 and 2015 (Photographs 11-13). The series of beaver dams consequently backed up an additional four (4) feet of stagnant water in certain portions of the stream. The excessive ponding eliminated riffle/pool sequences along the restored stream channel, settled out excessive levels of silt, and lowered levels of dissolved oxygen throughout the stream. These changes shifted the quality of aquatic life found throughout the stream as tolerant organisms capable of withstanding these conditions took over. The beavers were ultimately trapped and the dams were removed during December 2015. The restoration of normal stream flows flushed the system of silt during peak winter and early spring flooding. The stream habitat appears to be functioning near normal as a representative fish community was able to quickly colonize the previously impacted stream reach. The macroinvertebrate community will be inherently slower to recover, although the lack of siltation and reemergence of microhabitat throughout the restored reach give evidence toward a successful recovery.

Reed canary grass expanded in coverage in response to increased levels of hydrological disturbance from beaver dam creation. The rapid increase in inundation and saturation along the stream channel eliminated the existing riparian corridor vegetation that was not adapted to prolonged levels of inundation. This allowed reed canary grass to expand in coverage to approximately 3.3% of the total riparian corridor. Maintenance spraying efforts focused on treating the coverage of reed canary grass throughout the riparian corridor to avoid recruitment into other areas across the site. As seen in site photographs, treatment was successful in eliminating the extent of the invasive grass. Current levels of invasive plant cover remain well below the 5% threshold limit for the riparian area.

6.0 STREAM PERFORMANCE STANDARD REVIEW

The performance standards for the mitigation stream are summarized in Table 8.

Table 8
Stream Performance Review

Performance Requirement	Measurement	Final Monitoring Assessment	Attainment
Physical Habitat Assessment	QHEI score ≥ 60	QHEI score = 65	Yes
Warmwater Habitat Aquatic Life Use Designation	IBI score ≥40	IBI score = 41	Yes
Warmwater Habitat Aquatic Life Use Designation	ICI score ≥36	n/a	-
Native Species	80% of the riparian zone covered by native shrub and herbaceous species	93.25% of riparian zone covered by native species	Yes
Invasive Species	Riparian zone contain ≤5% relative cover of invasive species	2% cover of invasive species	Yes

The collected monitoring data demonstrates a lack of sufficient hydrology that would be necessary to meet the criteria of Warmwater Habitat using the ICI assessment according to Ohio EPA guidance documents. The intermittent summer flow regime prevents the establishment of a diverse macroinvertebrate community. However, given the Warmwater Habitat designation in the physical habitat and IBI assessments indicating improved water quality and successful habitat improvement, **the CRAA requests the mitigation stream be deemed successful and that no additional monitoring be required as the stream meets all other performance requirements.**

7.0 WETLAND MONITORING RESULTS

Wetland monitoring activities were on hold from 2013-2015 as hydrology concerns and other matters were addressed throughout the wetland. A summary of the management activities including a timeline of events can be found in Appendix F. Monitoring activities conducted during 2016 confirmed that the management activities were successful in remediating the developmental issues that were preventing the wetland from being on a trajectory toward meeting performance requirements. It is the intention of the CRAA to continue with the originally scheduled monitoring timeline, monitoring on a biannual basis with the final monitoring event in 2020.

The extent of developed wetland within Cell 1A and Cell 1B was delineated on September 1, 2016 to evaluate the impact of the previous maintenance activities. As seen on Exhibit 2, a total of 16.47 acres of wetland was delineated within the two (2) cells. Based on this extent, approximately 73.2% of the originally designed acreage (22.5 acres) converted to wetland habitat. Table 9 identifies the total amount of forested and non-forested wetland credit banked at Walnut Woods and the total amount of each habitat that has established to date. The wetlands will be re-delineated during the next monitoring event (2018) to document any further change in wetland boundaries.

Table 9
Development of Wetland Area and Mitigation Credit Utilized

Wetland Type	Mitigation Credit Utilized	Developed Wetland Credit	Balance
Forested	5.535	8.27	2.735
Non-forested	8.072	8.20	0.128
TOTAL	**13.607**	**16.47**	**+2.863**

7.1 Forested Wetland Assessment

A total of 8.27 acres of forested wetland has developed to date at the Walnut Woods mitigation site. In order to assess the quality of the forested wetland habitat, five (5) vegetation plots were evenly distributed throughout the proposed forested wetland area and one (1) VIBI plot was established in a representative forested wetland area. Exhibit 2 shows the location of each plot and representative photographs are included in the Photographs section of this report.

Vegetation Plot Assessment

The vegetation plots identified Calico aster (*Symphyotrichum laterifolium*), Virginia wild rye (*Elymus virginicus*), and a bur marigold (*Bidens sp.*) as the dominant plants for the forb stratum. Pin oak (*Quercus palustris*), swamp white oak (*Quercus bicolor*), and green ash (*Fraxinus pennsylvanica*) were the dominant trees identified throughout the plots. Hydrology in the spring was generally saturated at the surface across the forested wetland areas. Hydrology in the summer varied from being moist, but not saturated at the surface, to dry. Table 10 presents how the data collected throughout the forested plots compares to performance requirements. Additional information and photographs of each plot are located on the wetland data forms found in Appendix G.

Table 10
Forested Wetland Plot Review

Performance Metric	Plot 1	Plot 2	Plot 3	Plot 4	Plot 7	Average	Performance Metric Attainment
Percent Open Water	0%	0%	0%	0%	0%	0%	Yes
Native Perennial Hydrophyte Cover	66.5%	100%	52.5%	97.5%	62.5%	75.8%	Yes
Invasive Plant Cover	0%	0%	0%	0%	0%	0%	Yes
Tree Density	485	405	647	9,915	850	597[1]	-[3]
Average Tree Height[2] (cm)	28.3	56.0	28.75	196.1	62.8	43.9[1]	-[3]

[1] Calculation excludes Plot 4 information to avoid outlier effects.
[2] Tree height is calculated by averaging the midpoint of the size class of each individual tree. The overall average is not weighted for density within each plot.
[3] Comparison of graphed trajectories over time will determine attainment.

Forested VIBI Assessment

EMH&T performed the VIBI-E evaluation of the proposed forested wetland area on July 20, 2016. The results of the VIBI assessment are included in Table 11. The overall score represented in this table and throughout the report reflects the ACOE region score. The VIBI plot location is provided on Exhibit 2. Photographs of the VIBI plot can be seen in the Photographs section. Additionally, VIBI data forms and summary information detailing the breakdown of the individual metrics for the VIBI plot are included in Appendix H.

Table 11
Forested VIBI-E Plot Summary

Parameter	Forested Plot
VIBI-E Score (ACOE Region)	**64**
Metric 1 Carex	10
Metric 2 Dicot	10
Metric 3 Shrub	3
Metric 4 Hydrophyte	10
Metric 5 A/P Ratio	0
Metric 6 FQAI	7

Table 11 continued

Parameter	Forested Plot
Metric 7 %Sensitive	0
Metric 8 %Tolerant	7
Metric 9 %Invasives	10
Metric 10 Biomass	7

The forested VIBI plot exceeded the VIBI performance metric score of 51. The plot was dominated by a diversity of sedges and hydrophytic dicots which led to high scores across many of the metric parameters. The plot also lacked a large proportion of tolerant species and invasive graminoids suggesting a diverse layer of conservative plants has been established throughout the wetland as a total of 61 different species of plants were identified within the plot. Due to the diversity and dominance of perennial plants across the VIBI plot, it is expected that the forested wetland area will continue to meet performance requirements over the remaining monitoring period. Table 12 lists additional information collected as part of the VIBI assessment and identifies how it compares to performance standards.

Table 12
Forested VIBI Plot Review

Performance Requirement	Measurement	Forested VIBI Plot	Performance Metric Attainment
VIBI Score	≥51	64	Yes
Invasive Graminoid Cover	≤5%	0.43%	Yes
Native Perennial Hydrophyte Cover	≥75%	89.81%	Yes
Percent Open Water	<10%	0%	Yes
Tree Density	Trajectory towards forested	2,173/acre	Yes

7.2 Non-Forested Wetland Assessment

A total of 8.20 acres of non-forested wetland habitat has been developed to date at the Walnut Woods mitigation site. In order to assess the quality of the non-forested wetland habitat, two (2) vegetation plots were distributed throughout typical portions of the proposed non-forested wetland area and one (1) VIBI plot was established in a representative non-forested wetland area. Exhibit 2 shows the location of each plot and representative photographs are included in the Photographs section of this report.

Vegetation plot Assessment

The non-forested wetland vegetation plots identified bottlebrush sedge (*Carex lurida*), wool grass (*Scirpus cyperinus*), rough barnyard grass (*Echinochloa muricata*), and swamp rose mallow (*Hibiscus moscheutos)* as the dominant plants across the forb stratum. Buttonbush (*Cephalanthus occidentalis*) was the dominant plant in the shrub stratum. Hydrology in the spring varied from two (2) inches of inundation to being saturated at the surface. Hydrology in the summer varied from being moist, but not saturated at the surface to dry throughout the non-forested wetland areas. Table 13 presents how the data collected throughout the non-forested plots compares to performance requirements. Additional information and photographs of each plot are located on the wetland data forms found in Appendix G.

Table 13
Non-Forested Wetland Plot Review

Performance Metric	Plot 5	Plot 6	Average	Performance Metric Attainment
Percent Open Water	0%	0%	0%	Yes
Native Perennial Hydrophyte Cover	90%	108%	99%	Yes
Invasive Plant Cover	0%	0%	0%	Yes

Non-forested VIBI Assessment

EMH&T performed the VIBI-E evaluation of the proposed non-forested wetland area on July 20, 2016. The results of the VIBI assessment are included in Table 14. The overall score represented in this table reflects the ACOE region score. The VIBI plot location is provided on Exhibit 2. Photographs of the VIBI plot can be seen in the Photographs section. Additionally, VIBI data forms and summary information detailing the breakdown of the individual metrics for the VIBI plot are included in Appendix I.

Table 14
Non-Forested VIBI-E Plot Summary

Parameter	Non-forested Plot
VIBI-E Score (ACOE Region)	**78**
Metric 1 Carex	10
Metric 2 Dicot	10
Metric 3 Shrub	10
Metric 4 Hydrophyte	10
Metric 5 A/P Ratio	7

Table 14 Continued

Parameter	Non-forested Plot
Metric 6 FQAI	7
Metric 7 %Sensitive	0
Metric 8 %Tolerant	7
Metric 9 %Invasives	10
Metric 10 Biomass	7

The non-forested VIBI plot exceeded the VIBI performance metric score of 51. The plot was dominated by a diversity of sedges, wetland shrubs, and hydrophytic dicots which led to high scores across many of the metric parameters. The plot also lacked a large proportion of tolerant species and invasive graminoids suggesting a diverse layer of conservative plants has been established throughout the wetland as a total of 60 different species of plants were identified within the plot. Due to the diversity and dominance of perennial plants across the VIBI plot, it is expected that the non-forested wetland area will continue to meet performance requirements over the remaining monitoring period. Table 15 lists additional information collected as part of the VIBI assessment and identifies how it compares to performance standards.

Table 15
Non-Forested VIBI Plot Review

Performance Requirement	Measurement	Forested VIBI Plot	Performance Metric Attainment
VIBI Score	≥51	78	Yes
Invasive Graminoid Cover	≤5%	0.00%	Yes
Native Perennial Hydrophyte Cover	≥75%	69.93%	No
Percent Open Water	<10%	0%	Yes
Shrub Density	n/a	255/acre	-

7.3 Invasive Species

The extent of invasive plants throughout the wetland cells was mapped in 2016. As seen on Exhibit 6, the wetland cells contained approximately 3.21 acres of invasive plants. This represents approximately 19% of the total wetland area which is above the performance requirement of 5%. The entirety of the invasive plant population within the wetland was sprayed during the latter part of the growing season. As seen in Photographs 18-19, the treatment effort was successful in eliminating a large portion of the invasive plants. Maintenance spraying will continue on an as needed basis to keep the trajectory of invasive plant coverage below the 5% threshold limit. Additionally, invasive plants were sprayed outside of the mitigation wetland area in an attempt to prevent additional recolonization around the wetland mitigation cells in order to prevent future invasion.

7.4 Wetland Management Activities

A drain tile investigation was performed in September 2013 to address hydrological issues in the northern wetland cell. The tile investigation revealed two (2) locations of existing drain tile in the wetland cell. The tile lines were excavated and approximately 45-60 feet of drain tile was removed from each location. The excavated areas were repacked with soil and subsequently reseeded with a wetland seed mix. Photographs 23-24 show the exposed drain tile during the investigation and the repacked areas following removal of the drain tile. The impacted areas appear to hold additional water and the vegetation is now dominated by wetland species. A final measure was taken to further address water loss from the restored wetland areas. Three (3) of the designed pools within the wetland were over-excavated and relined with clay and compacted to prevent further water loss from the wetland. Photographs 25-28 reveal a significant increase in inundation around the fixed areas.

Following the hydrology corrections, additional woody plants were installed throughout the wetland in order to increase the diversity and evenness of woody plant material throughout the wetland cells. In January, 2,000 live stakes were installed throughout each wetland cell. In the fall of 2015, approximately 6,400 bare root trees were planted within the proposed forested sections of the wetland. The species selected were high quality hardwood species (pin oak, swamp white oak, and silver maple) that would increase the quality of wetland habitat upon maturity. The supplemental planting was performed in order to increase the density of trees throughout the wetland. Initial monitoring indicates that survivability was high during the first year of establishment. Future monitoring will continue to measure density and height across all planted species in order to determine if the wetland is on a forested trajectory.

As previously stated in Section 7.3, invasive plants were thoroughly treated throughout the wetland area during 2016. Reed canary grass was the primary invasive plant in the northern wetland cell and cattails (Typha sp.) were the dominant invasive plants in the southern wetland cell. Initial results reveal a successful treatment effort as close to 100% of the invasive plant cover was treated and died prior to the end of the growing season. Follow-up spot spraying will be performed in order to keep the invasive plant coverage under performance requirements in future years.

8.0 CONCLUSIONS

2016 monitoring activities summarized in this report document the final monitoring event for the restored portion of Big Run and the second monitoring event for the restored wetland located at Walnut Woods Metro Park. Monitoring of the stream revealed development has dramatically progressed over the monitoring period. As noted in the QHEI data forms, riffle/pool sequences and stream banks remain intact with no signs of erosion or degradation, sand and gravel are the dominant stream substrates as stream flows have prevented excessive siltation across streambed features, and streamside woody vegetation is maturing and providing cover to support a diverse aquatic community. The stream's physical habitat is expected to continue to develop as streamside and floodplain vegetation continue to mature. The aquatic community has continued to diversify over the monitoring period as documented by the improvement of IBI scores, which are currently meeting warmwater habitat criteria. The macroinvertebrate community has been slower to develop due to limited hydrology during summer months as the stream has a strong connection to the water table. The stream's connection to the water table causes fluctuations in flow regime throughout the year despite the large drainage area. The intermittent flow regime and isolated pool habitats during summer sampling periods has limited macroinvertebrate diversity as minimum current speeds for an acceptable ICI interpretation are not met. It is expected that the macroinvertebrate community will slowly increase and diversify as streamside vegetation matures and offers additional habitat and shade across the stream channel. Evidence of this transition is further substantiated as physical habitat and fish community assessments document the stream as a diverse warmwater habitat resource. Woody plant recruits continue to establish throughout the riparian corridor on an annual basis and the forb stratum is comprised of a diversity of native plants. Invasive plant populations have remained well below the 5% threshold limit over the course of the monitoring period. Expansion of reed canary grass along the stream banks during the latter part of the monitoring period was directly attributed to the construction of beaver dams and the resulting buildup of backwater. The excessive levels of inundation eliminated the existing vegetative community along the stream banks allowing reed canary grass an opportunity to expand in cover. Invasive plant treatment efforts during 2016 focused on eliminating the extent of streamside invasive plants to prevent spread into other parts of the corridor. As reported in Table 9, the restored stream achieved the warmwater habitat aquatic life use designation through the physical habitat and IBI assessments, fulfilled the native species performance requirement, and was in attainment of the invasive species performance requirement. Following Ohio EPA quantitative sampling recommendations, macroinvertebrate community sampling was not determined to be an accurate interpretation of invertebrate quality due to the lack of stream hydrology. However, with warmwater habitat attainment through the physical habitat and IBI assessment techniques, **the CRAA is requesting that the stream mitigation area be deemed successful and that no additional monitoring is to be required** since monitoring data demonstrates a lack of sufficient hydrology to meet WWH through ICI sampling.

Wetland monitoring efforts were on hold from 2013-2015 as maintenance and other repairs were made to the wetland mitigation area. Monitoring efforts during 2016 concluded the previous efforts were successful in increasing the amount of water held throughout the wetland cells as forested and non-forested wetland areas closely resembled the designed limits. The current extent of the wetland area is 16.47 acres, of which 8.27 acres is developing toward forested wetland habitat. As reported in Table 10, the amount and distribution of wetland habitat types exceeds the amount of mitigation credit utilized at the Walnut Woods mitigation site to date. The monitoring plots and VIBI assessments exceeded all performance standards throughout the forested and non-forested wetland areas except for the invasive plant performance requirement. The forested wetland area was dominated by a diversity of sedges and hydrophytic dicots which led to a VIBI score of 64, tree densities approached 600 stems/acre, native perennial hydrophyte cover exceeded 75%, and the wetland area contained less than 10% open water. The non-forested wetland area was dominated by a diversity of sedges, wetland shrubs, and high quality wetland species which led to a VIBI score of 78. Given the plant community and existing hydrogeomorphic (HGM) classification of the non-forested wetland area, this score is representative of Category 3 wetlands and is determined to be of extremely high importance and value. The non-forested area had less than 10% open water and the average cover of native perennial hydrophytes across all plots exceeded 75%. Invasive plant coverage across the entire wetland area was determined to be 3.21 acres or 19% of the total wetland area. Initial treatment efforts proved successful in killing a majority of the invasive plant cover within the wetland and surrounding area. Maintenance spraying will continue on an as needed basis to ensure the site stays on a trajectory toward meeting the invasive plant performance metric. Monitoring activities during 2018 will update the extent of invasive plants across the site and document the progression of the remaining performance requirements for the forested and non-forested wetland areas.

9.0 CITATIONS

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Franklin County Engineering Department. 2005. *Road Map and Street Locator*.

Kirk, Scott C. 2012. *Monthly Water Inventory Report for Ohio*. Published by the Ohio Department of Natural Resources, Division of Water, 1939 Fountain Square, Columbus, Ohio 43224.

Kirk, Scott C. 2013. *Monthly Water Inventory Report for Ohio*. Published by the Ohio Department of Natural Resources, Division of Water, 1939 Fountain Square, Columbus, Ohio 43224.

Ohio EPA. 1987 (Updated January 1, 1988). *Biological Criteria for the Protection of Aquatic Life: Volume II. Users Manual for Biological Field Assessment of Ohio Surface Waters*. Ohio EPA, Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio.

Ohio EPA. 9/30/89. *Addendum to Biological Criteria for the Protection of Aquatic Life: Volume II. Users Manual for Biological Field Assessment of Ohio Surface Waters*. Ohio EPA, Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio.

Ohio EPA. 2006. *Biological and Water Quality Study of Walnut Creek and Tributaries*. Ohio EPA Technical Report DSW/EAS/2006-12-8. Ohio EPA, Division of Surface Water, Columbus, Ohio.

Ohio EPA. 2000. *Appendices to the 2000 Ohio Water Resource Inventory*. Ohio EPA, Division of Surface Water, Columbus, Ohio.

Ohio EPA, 2008. *Ohio 2008 Integrated Water Quality Monitoring and Assessment Report*. Ohio EPA, Division of Surface Water, Columbus, Ohio.

Ohio EPA. 2006. *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)*. Ohio EPA, Division of Surface Water, Columbus, Ohio.
River Institute, Center for Applied River Science, 2004.

Ohio EPA. 2/21/13. *2013 Updates to Biological Criteria for the Protection of Aquatic Life: Volume III. Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities.* Ohio EPA, Division of Surface Water, Ecological Assessments Section, Columbus, Ohio.

Rosgen, D.L.. 1996. *Applied River Morphology*. Pagosa Springs, Colo. Wildland Hydrology Books.

Rosgen, D.L. and Silvey, H.L. 2007. *The Reference Reach Field Book, Third Edition*. Wildland Hydrology, Inc., Fort Collins, CO.

Rosgen, D.L. and Silvey, H.L. 1998. *Field Guide for Stream Classification, Second Edition*. Wildland Hydrology, Pagosa Springs, CO.

USDA-NRCS. United States Department of Agriculture - (Soil Conservation Service) Natural Resources Conservation Service. 2004. *Soil Survey of Franklin County, Ohio*. Available online: http://websoilsurvey.nrcs.usda.gov/app/.

USFWS. United States Department of the Interior, Fish and Wildlife Service. 1995. National Wetland Inventory Map, *Canal Winchester, Ohio* quadrangle. Available from the Ohio Department of Natural Resources, Division of Real Estate and Land Management.

USFWS. United States Department of the Interior, Fish and Wildlife Service. 11/08. *Federally-Listed Species by Ohio Counties*. Available from USFWS Reynoldsburg Ecological Services Field Office, 6950 Americana Pkwy, Suite H, Reynoldsburg, OH 43068-4127.

USGS. United States Geological Service. 1985. *Canal Winchester, Ohio* Quadrangle, 7.5 minute Series (Topographic). Maps prepared by the U.S. Geological Survey and revised in cooperation with State of Ohio Agencies. For sale from the U.S. Geological Survey, Reston, Virginia 22092.

APPENDIX A:

Permits Utilizing Mitigation Credit at Walnut Woods

OhioEPA
State of Ohio Environmental Protection Agency

STREET ADDRESS:
Lazarus Government Center
50 W. Town St., Suite 700
Columbus, Ohio 43215

TELE: (614) 644-3020 FAX: (614) 644-3184
www.epa.state.oh.us

MAILING ADDRESS:
P.O. Box 1049
Columbus, OH 43216-1049

OHIO E.P.A.
OCT 26 2009
ENTERED DIRECTOR'S JOURNAL

Certified Mail

October 26, 2009

I certify this to be a true and accurate copy of the official documents as filed in the records of the Ohio Environmental Protection Agency.

By: Date: 10-26-09

Ms. Elaine Roberts
Columbus Regional Airport Authority
4600 International Gateway
Columbus, Ohio 43219

Re: Franklin County / Columbus / Mifflin Township
Grant of Section 401 Water Quality Certification (Preferred Alternative) and/or Isolated Wetlands Permit dated November 24, 2008
Project to expand the NetJets Corporate Headquarters on Bridgeway Avenue
ACOE Project No: LRH-2003-270-SCR
Ohio EPA ID No.: 083460

Ladies and Gentlemen:

The director of Ohio Environmental Protection Agency hereby authorizes the above referenced project under one or both of the following authorities and is subject to the following modifications and/or conditions:

Section 401 Water Quality Certification
Pursuant to Section 401 of the Federal Water Pollution Control Act, Public Law 95-217, the director of Ohio Environmental Protection Agency hereby certifies that the above referenced project will comply with the applicable provisions of Sections 301, 302, 303, 306, and 307 of the Federal Water Pollution Control Act.

Ohio Isolated Wetland Permit
Pursuant to Ohio Revised Code Chapter 6111 and Ohio Administrative Code Chapter 3745-1, and other applicable provisions of state law, the director of Ohio Environmental Protection Agency hereby concludes that the above-referenced project will comply with the applicable provisions of Sections 6111.03 and 6111.04 of the Ohio Revised Code.

This authorization is specifically limited to a Section 401 Water Quality Certification and/or Ohio Isolated Wetlands Permit with respect to water pollution and does not relieve the applicant of further Certifications or Permits as may be necessary under the law. I have determined that a lowering of water quality within the Little Walnut Creek watershed 05060001-180 as authorized by this Section 401 Water Quality Certification/Ohio Isolated Wetlands Permit is necessary. I have made this determination based upon the consideration of all public comments, and including the technical, social, and economic considerations concerning this application and its impact on waters of the state.

I. ON-SITE WATER RESOURCES AND IMPACTS

A. Site Setting

Site Location: Franklin/Columbus/Mifflin Township
HUC 14-Digit and Drainage Name: 05060001-180
Parcel Size: Increase project area from 19 acre, 200,000 square foot facility to a 57 acre 765,000 square foot facility including new office space, potential aircraft hanger expansion, flight safety building, and parking.

B. Streams

Stream ID	Type* E, I, or P	QHEI/HHEI Score*	Total Length on Site (lf)	Total Length Impacted (lf)	Impact Type	% Avoided
Stream A	ephemeral	-/17	190	190	fill	0.0
Stream D	perennial	55/-	960	275		86
			1,150	465		72

* As provided by applicant

C. Wetlands

Wetland ID	Iso or JD	Forested or Non?	ORAM/ Cat	Total Acreage on Site	Total Acreage Impacted	% Avoided	Mitigation Ratio	Mitigation Acreage
A	Jurisdictional	NF	14/1*	0.45	0.45	0.0	1.5:1	0.675
B	Jurisdictional	NF	33/2*	0.20	0.20	0.0	2:1	0.40
C	Jurisdictional	NF	18/1	0.03	0.03	0.0	1.5:1	0.045
D	Jurisdictional	NF	21/1	0.06	0.06	0.0	1.5:1	0.09
E	Jurisdictional	NF	12/1	0.10	0.10	0.0	1.5:1	0.15
F	Jurisdictional	NF	34.5/2	0.55*	0.55	0.0	2:1	1.1
G	Jurisdictional	NF	6/2	0.01	0.01	0.0	1.5:1	0.015
H	Jurisdictional	NF	25/1	0.14*	0.14	0.0	1.5:1	0.21
I	Jurisdictional	F	43/2	0.50*	0.50	0.0	2.5:1	1.25
Totals				2.04	2.04	0.0		3.935

*ORAM/Category scores based upon OEPA revisions dated May 11, 2009.

D. Lakes

No lake impacts are authorized by this water quality certification/isolated wetlands permit.

II. GENERAL CONDITIONS

A. All water resources and their buffers which are to be avoided shall be clearly indicated on site drawings and demarcated in the field with suitable materials, prior to site disturbance. These materials shall remain in place and be maintained throughout the construction process.

B. Best Management Practices (BMPs) must be employed throughout the course of this project to avoid the creation of unnecessary turbidity which may degrade water quality or adversely affect aquatic life outside of the project area.

C. Temporary fill shall consist of suitable non-erodible material or shall be stabilized to prevent erosion.

D. Procedures shall be developed and implemented to eliminate the possibility of spills and to control dust that may enter the waterway by runoff or point discharge.

E. Unpermitted impacts to surface water resources and/or their buffers occurring as a result of this project will be reported within 24 hours of occurrence to Ohio EPA for further evaluation.

F. In temporary impact areas where trees have been removed to facilitate construction, they shall be replaced with appropriate native tree species.

G. Stormwater basins on the site which have Extended Detention or Permanent Pool water quality features shall meet the design specifications in Ohio EPA Permit OHC000003 effective April 21, 2008. Storm water basins on site which have water quality features (Forebay, Aquatic Benches and Wetlands, Optimum Flow Length, Reverse Flow Pipe, Optimum Pool Depth, Shading and Buffer Plants, and Runoff Reuse) shall meet the design specifications contained in the Ohio Department of Natural Resources Rainwater and Land Development document, second edition, 1996, or successor document.

H. Stormwater management measures shall be inspected immediately after each rainfall and at least daily during periods of prolonged rainfall. Specifications for any necessary repairs and removal of sediment deposition shall be developed as needed in the Stormwater Pollution Prevention Plan for the site.

I. In the event that there is a conflict between the Section 401 and/or Isolated Wetlands permit application and the conditions within this water quality certification and/or isolated wetlands permit, the condition shall prevail unless Ohio EPA agrees, in writing, that the Section 401 and/or Isolated Wetlands permit application or other provision prevails.

J. Representatives from the Ohio EPA, Division of Surface Water will be allowed to inspect the authorized activity at any time deemed necessary to insure that it is being or has been accomplished in accordance with the terms and conditions of this water quality certification.

K. This proposal may require other permits from Ohio EPA. For information concerning application procedures, contact the Ohio EPA District Office at the following address:

Central District Office, 50 West Town Street, Columbus, Ohio 43215.

L. This water quality certification shall be effective for a period of five years from the date of issuance of the Section 404 Permit. However, stream and wetland mitigation obligations described in Section III below will remain in force should the performance criteria specified in Section III.D have not been meet within the prescribed time frames.

III. MITIGATION

A. Description of Required Mitigation

The applicant is authorized to conduct stream and wetland mitigation at the proposed Eastside Nursery site located in Madison Township, Franklin County, southwest of Lithopolis Road, east of Richardson Road, and north of Dellen Road. The Eastside Nursery mitigation site is to be a single user pooled mitigation site to locally accommodate the mitigation needs for various projects undertaken by the Columbus Regional Airport Authority. The Eastside Nursery mitigation site will provide 2,700 linear feet of stream mitigation credits and 22.5 acres of wetland mitigation credit. The requirements described in Section III. A. 1 and 2 below shall be conducted at the Eastside Nursery site to satisfy stream and wetland mitigation requirements for the NetJets Expansion project covered by this Section 401 Water Quality Certification (083460).

1. Wetlands

   a. Restore 2.685 acres of non-forested wetlands that meet criteria for Category 2 wetlands or greater at the Eastside Nursery site.

   b. Restore 1.25 acres of forested wetlands that meet criteria for Category 2 wetlands or greater at the Eastside Nursery site.

2. Streams

   Restore 700 linear feet of Big Run at the Eastside Nursery Site to meet a minimum Qualitative Habitat Evaluation Index (QHEI) score of 60 and meet criteria for the warmwater habitat aquatic life use designation.

B. Timing of Mitigation Requirements

1. Within thirty (30) days from the date of the authorized Section 404 Permit, the applicant shall submit a Final Stream and Wetland Mitigation Plan to Ohio EPA for review and approval. The Final Stream and Wetland Mitigation Plan shall contain a schedule of implementation.

2. The mitigation monitoring period shall commence after the 1st growing season following completion of mitigation construction and shall continue through a five-year monitoring period for the stream restoration and a ten year period for wetland mitigation, unless otherwise agreed upon by Ohio EPA.

3. For mitigation with a preservation component, the applicant shall submit to Ohio EPA an either acceptable, notarized, recorded, and filed conservation easement or environmental covenant held by an organization meeting the requirements of section 5301.68 of the Ohio Revised Code. The conservation easement or environmental covenant shall protect, in perpetuity, all wetlands associated with the Eastside Nursery Wetland Mitigation site utilized by the CRAA.

C. General Monitoring and Reporting Requirements

1. Monitoring Reports: Annual reports containing the data listed in the appropriate subsections below shall be submitted to Ohio EPA for each of five consecutive years (1, 2, 3, 4 and 5) for stream restoration and every other year of the ten years (1, 3, 5, 7 and 10) for wetland mitigation following completion of mitigation construction. The first annual report is due to Ohio EPA by December 31 of the first full year following completion of mitigation construction. All subsequent reports shall be submitted by December 31st of each of the subsequent monitoring years. The applicant may include any additional information that it believes relevant for Ohio EPA's consideration.

2. As-built Drawings: As- built drawings shall be submitted within 180 days following completion of construction for both stream and wetland mitigation sites. The drawings shall be no larger than 11" by 17" for each of the mitigation streams and wetlands.

3. Photographs: A representative observation point shall be selected in each plant community type in distinct mitigation area. This shall be a point which best represents the characteristics of the entire plant community. The observation points shall be marked on the base map.

   Applicant shall take photographs from these points during all five years for five years in the case of streams and bi-annually for 10 years in the case of wetlands. Each color photo point shall be photo documented from the same position and angle during July of each monitoring year.

4. Credit/Debit Accounting: The applicant shall maintain a detailed accounting of the stream and wetland mitigation credits at the Eastside Nursery mitigation site. The accounting shall include a) the total acres of wetlands and linear feet of streams as initially built and approved, b) the wetland acreage and/or linear footage of streams debited for each 401 water quality certification, isolated wetland permit, or nationwide permit, and c) the balance of available wetland acreage and linear footage of streams available for use as mitigation and the US permit number and/or OEPA ID number. The applicant shall submit items a through c above in writing, for every 401 water quality or isolated wetland permit mitigated at the Eastside Nursery site by the CRAA.

D. Wetland Mitigation Monitoring and Reporting Requirements

1. Monitoring Reports: Cells 1A and 1B of the Eastside Nursery Wetland Mitigation Site shall be monitored for a period of not less than 10 years. Reports that contain the data listed in the appropriate subsections below, shall be submitted to Ohio EPA for the 1st, 3rd, 5th, 7th and 10th years starting after the 1st full growing season following completion of mitigation construction. The first annual report is due to Ohio EPA by December 31 of the first full year following completion of mitigation construction. All subsequent reports shall be submitted by December 31st of each of the subsequent monitoring years.

   The applicant may include any additional information that it believes relevant for Ohio EPA's consideration.

2. As-built Drawings: An as-built drawing shall be submitted to Ohio EPA within 180 days of construction completion.

3. Physical Measurements: A plan view and at least one cross-section through the short axis and another through the long axis is required for each mitigated wetland. This information will be collected as part of the as-built survey completed for each mitigated wetland.

4. Water Chemistry Monitoring: A representative grab sample(s) shall be collected in May of each monitoring year in each wetland mitigation area where standing water is present. The samples shall be analyzed for ammonia, nitrates, nitrite, carbon, total sulfates, total iron, total manganese, specific conductivity, pH, turbidity, total suspended solids, heavy metals and biochemical oxygen demand.

5. Hydrology Monitoring: Water level data shall be collected in May and late August or September of each monitoring year. Ground water levels shall be measured in the absence of inundated conditions.

6. Soils Monitoring: A soil sample shall be collected and analyzed from each VIBI plot and each focus plot for each year that monitoring reports are required. The analysis should provide a brief description (including the presence or lack of hydric soil indicators) of the soil as well as the soil color, matrix and chroma as per the Munsel Soil Color chart. This data, along with the name of the soil map unit name (soil series and phase) shall be included in each monitoring report in a tabular format.

7. Vegetation Monitoring: The location and name of each plant community type within the mitigation area and buffer area shall be marked on a scaled drawing or scaled aerial photograph (base map) and named.

   A representative observation point shall be selected in each plant community type in each distinct wetland mitigation area. This shall be a point which best represents the characteristics of the entire plant community. The observation points shall be marked on the base map.

   The dominant plant species shall be visually determined in each vegetation layer of each community type, and the scientific names of these species shall be included in the report. Dominant species are those species which have the greatest relative basal area (woody overstory), greatest height (woody overstory), greatest percentage of aerial coverage (herbaceous understory), and/or greatest number of stems (woody vines).

8. Vegetation Index of Biotic Integrity (VIBI): The applicant shall assess the mitigation wetlands to obtain a VIBI score according to methods approved by Ohio EPA (http://www.epa.state.oh.us/dsw/401/401.html) during the growing season of the 1st, 3rd, 5th, 7th and 10th years after completion of construction of the mitigation wetlands.

9. Wetland Delineation: The applicant shall conduct a delineation of the restored mitigation wetlands during the growing seasons of the 5th and 10th years after completion of construction of the mitigation wetlands using the United States Army Corps of Engineers 1987 Wetland Delineation Manual (or successor document). The delineation shall be submitted with the 5th and 10 year reports.

10. Fourth Year Site Review: The applicant shall arrange an on-site mitigation meeting with Ohio EPA during the growing season after the 3rd year report has been submitted. The purpose of this inspection is to determine if the mitigation project has been constructed in accordance with the agreement between the applicant and Ohio EPA. If necessary, Ohio EPA may make recommendations to improve the wetland. The applicant is responsible for undertaking any reasonable modifications identified by Ohio EPA.

11. Eighth-Year Site Review: The applicant shall arrange an on-site mitigation meeting with Ohio EPA during the growing season after the 7th year report has been submitted. The purpose of this inspection is to determine if the mitigation project has been constructed in accordance with the agreement between the applicant and Ohio EPA. If necessary, Ohio EPA may make recommendations to improve the wetland. The applicant is responsible for undertaking any reasonable modifications identified by Ohio EPA.

12. Additional site visits may be performed at the request of Ohio EPA or the Applicant.

E. Stream Mitigation Monitoring and Reporting Requirements

The restored segment of Big Run shall be monitored annually for five years. Monitoring for QHEI, IBI, and ICI shall be conducted at two sites within the restored channel reach on the Eastside Nursery site. These two sites will be mutually agreed upon by the applicant and the Ohio EPA. Monitoring utilizing QHEI, IBI and ICI shall be conducted and reported in years 1, 3 and 5 of monitoring. The applicant may include any additional information that it believes relevant for Ohio EPA's consideration.

1. Quality Habitat Evaluation Index (QHEI): QHEI values for Big Run shall be calculated according to methods approved by Ohio EPA based on sampling conducted and included in the monitoring report for years one, three and five.

2. Index of Biotic Integrity (IBI): IBI values for Big Run shall be calculated according to methods approved by Ohio EPA based on sampling conducted and included in the monitoring report for years one, three and five.

3. Invertebrate Community Index (ICI): ICI values for the former Big Run shall be calculated according to methods approved by Ohio EPA based on sampling conducted and included in the monitoring report for years one, three and five.

4. Invasive Plant Species: Vegetative monitoring shall be conducted within the constructed belt-width of Big Run during years one, three, and five. A diagram depicting the scientific and common name and location for each invasive plant species and its relative abundance shall be included in the monitoring report for each year that sampling is required.

5. Physical Measurements: A plan view, longitudinal profile along the thalweg, and at least one cross-section through a pool area and another through a riffle area is required for the restored stream. Additional cross sections may be required if necessary to accommodate significant variations in slope, entrenchment or other key morphological parameters.

   Plan view measurements shall be those measurements necessary to determine sinuosity, meander length, belt width, radius of curvature, and meander arc length.

   Longitudinal profile measurements shall be those measurements necessary to determine average water surface slope, riffle slope, pool slope, and riffle/pool or step/pool sequences.

   Cross-sectional measurements shall include those measurements necessary to determine bankfull width, bankfull mean depth, bankfull maximum depth, flood prone area width, entrenchment ratio, and bankfull cross-sectional area.

F. Performance Criteria

1. Wetlands:

Within ten years after completion of construction, mitigation wetlands 1A and 1B of the Eastside Nursery Wetland Mitigation Site shall meet the following performance criteria:

a. Develop a minimum of 2.685 acres of non-forested wetlands and 1.25 acres of forested wetlands as determined by United States Army Corps of Engineers 1987 Wetland Delineation Manual (or successor document including regional supplements as appropriate).

b. Attain a Vegetative Index of Biotic Integrity (VIBI) score of 51 for each plant community type.

c. Contain no more than 5 % invasive species.

d. Contain no less than 75% areal coverage of native perennial hydrophytes (FAC+, FACW, OBL).

e. Contain less than 10% of its total area as "unvegetated open water" defined as inundated areas where there is no or minimal emergent, rooted aquatic bed, (e.g. *Nuphar advena*, *Nymphaeae odorata*, *Potamogeton spp.*), or submersed or floating non-rooted aquatic bed (e.g. *Utricularia spp.*, *Ceratophyllum spp*. excluding species in the *Lemnaceae*) vegetation growing in the area of inundation.

f. A minimum 50%of the perimeter shall have slopes no greater than 15:1.

g. Forested components of the mitigation wetlands shall be demonstrated by graphing standard forest measures (frequency, density, dominance, and importance values) against time, to be on a trajectory towards becoming forested wetlands.

2. Streams

   Within five years after completion of construction, the restored 2,700 linear feet of Big Run on the Eastside Nursery site shall meet the following performance criteria:

   a. Attain a Qualitative Habitat Evaluation Index (QHEI) score of 60.

   b. Meet criteria for the warmwater habitat aquatic life use designation.

G. Contingency Plans

1. If the mitigation areas are not performing as proposed by the end of the fifth year of post construction monitoring for the stream restoration and tenth year of post construction for the wetland restoration, the monitoring period may be extended and/or the applicant may be required to revise the existing mitigation or seek out new or additional mitigation areas. However, if after the required post construction monitoring is completed, the stream and wetland mitigation areas are demonstrated, by graphing measurements against time, to be on a trajectory toward the stated performance criteria, the applicant may request that Ohio EPA consider the mitigation areas deemed successful and that no additional monitoring be required.

2. For the stream restoration, specifically, if the monitoring data demonstrates a lack of sufficient hydrology that would be necessary to meet the criteria of WWH, the applicant may request Ohio EPA consider the mitigation areas deemed successful and that no additional monitoring is to be required.

3. The applicant may provide any other information it wishes Ohio EPA to consider when determining whether the stream or wetland mitigation sites are meeting, or have met, the performance criteria required above. Ohio EPA may reduce or increase the number of years for which monitoring is required to be conducted based on the effectiveness of the mitigation.

4. Any deviations from the monitoring period described in this water quality certification must be approved by Ohio EPA in writing.

IV. NOTIFICATIONS TO OHIO EPA

All notifications, correspondence, and reports regarding this Section 401 Water Quality Certification and/or Isolated Wetlands Permit shall reference the following information:

Applicant: Columbus Regional Airport Authority
Project: NetJets Headquarters Expansion
Ohio EPA ID#: 083460

and shall be sent to:

Ohio EPA, Division of Surface Water, 401 Unit
Lazarus Government Center
50 West Town Street
P.O. Box 1049
Columbus, Ohio 43216-1049

You are hereby notified that this action of the director is final and may be appealed to the Environmental Review Appeals Commission pursuant to Section 3745.04 of the Ohio Revised Code. The appeal must be in writing and set forth the action complained of and the grounds upon which the appeal is based. The appeal must be filed with the Commission within thirty (30) days after notice of the director's action. The appeal must be accompanied by a filing fee of $70.00 which the Commission, in its discretion, may reduce if by affidavit you demonstrate that payment of the full amount of the fee would cause extreme hardship. Notice of the filing of the appeal shall be filed with the director within three (3) days of filing with the Commission. Ohio EPA requests that a copy of the appeal be served upon the Ohio Attorney General's Office, Environmental Enforcement Section. An appeal may be filed with the Environmental Review Appeals Commission at the following address:

Environmental Review Appeals Commission
309 South Fourth Street, Room 222
Columbus, OH 43215

Sincerely,

Chris Korleski

Chris Korleski
Director

cc:
Susan Fields, U.S. Army Corps of Engineers, Huntington District
Stacey Heaton, CRAA, 4600 International Gateway, Columbus, OH 43219
John Watts, Columbus Metroparks, 1069 West Main Street, Westerville, Ohio 43081-1181
Kevin Pierard, U.S. EPA, Region 5
Mary Knapp, U.S. Fish & Wildlife Service
Brian Mitch, ODNR, Division of Real Estate & Land Management
Jeff Bohne, Ohio EPA, Central District Office
Susan Applegate, OEPA, DEFA
Pat Hoyng, EMH&T, 5500 New Albany Road, Columbus, OH43054
Miles Hebert, EMH&T, 5500 New Albany Road, Columbus, Ohio 43054
Dave Snyder, Ohio Historical Preservation Office, 1982 Velma, Columbus, OH 43211
Tom Harcarik, Ohio EPA, DSW, 401 Reviewer
Mike Smith, Ohio EPA, DSW, Mitigation Coordinator

Appendix I
Stream and Wetland Mitigation Report Submission Schedule
OEPA ID No. 083460

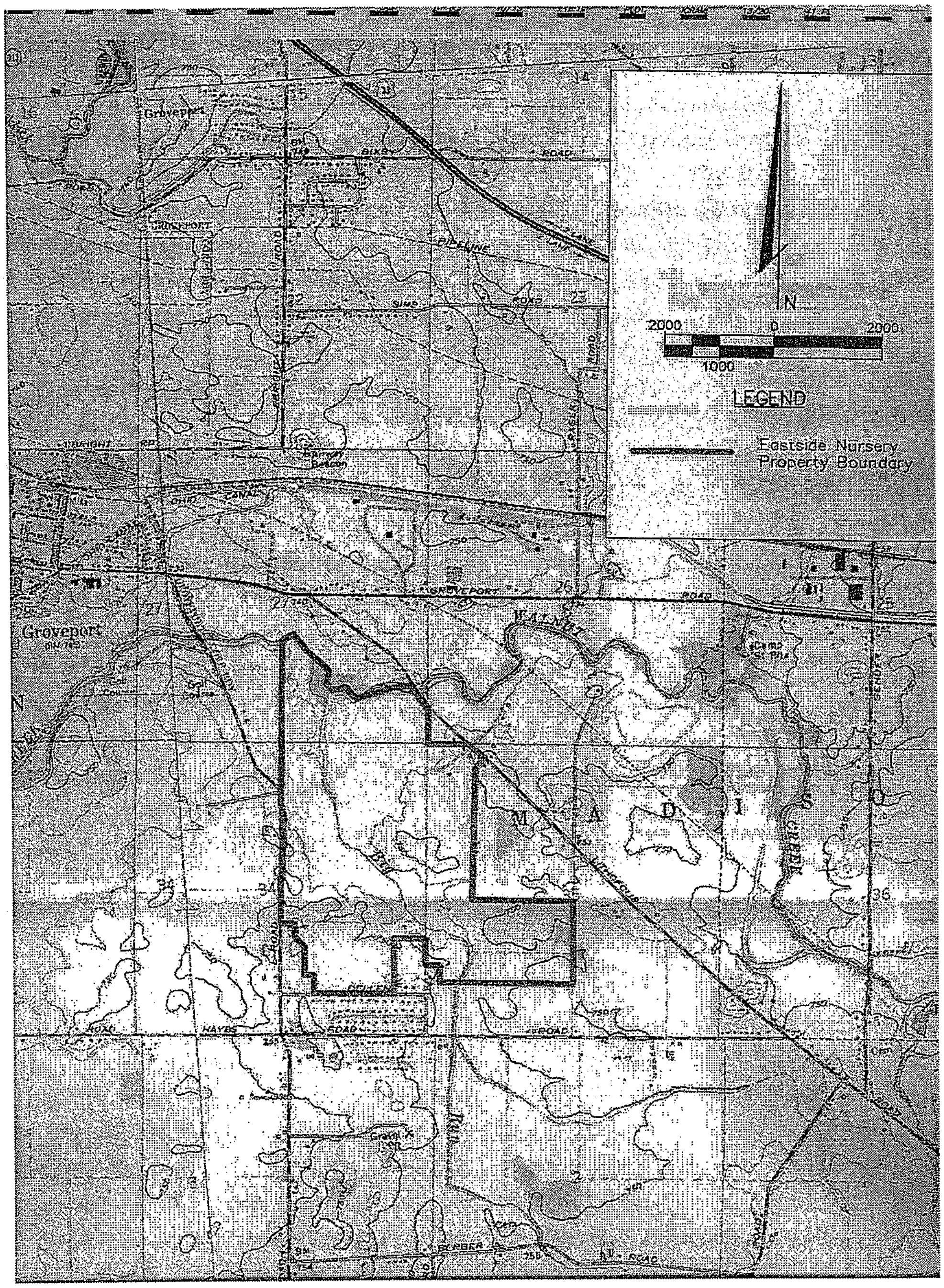
Streams Mitigation Reporting

	Year 1	Year 2	Year 3	Year 4	Year 5
Submit Report	X	X	X	X	X
As Built Drawings	180 days				
Photos	X	X	X	X	X
QHEI	X	X	X	X	X
IBI/ICI Data	X		X		X
Physical Measurements	X		X		X
Regulatory Site Visit			X		

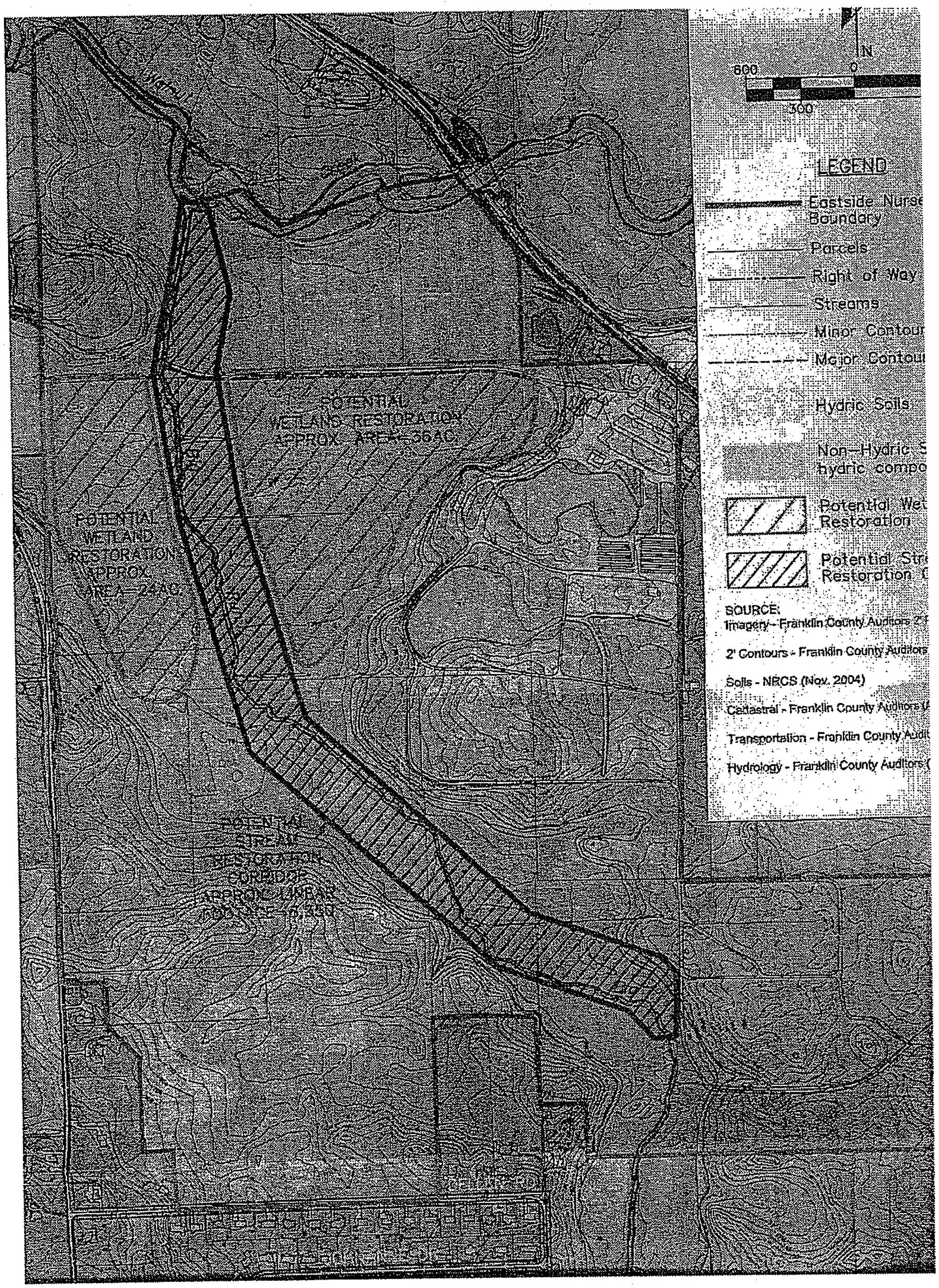
Wetlands Mitigation Reporting

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10
Submit Report	X		X		X		X			X
As Built Drawings (days after construction)	180									
Photos	X		X		X		X			X
Physical Measurements	X		X		X		X			X
Water Chemistry	X		X		X		X			X
Hydrology Monitoring	X		X		X		X			X
Soils Monitoring	X		X		X		X			X
Vegetation Monitoring	X		X		X		X			X
VIBI	X		X		X		X			X
Wetland Delineation					X					X
Regulatory Site Visit				X				X		

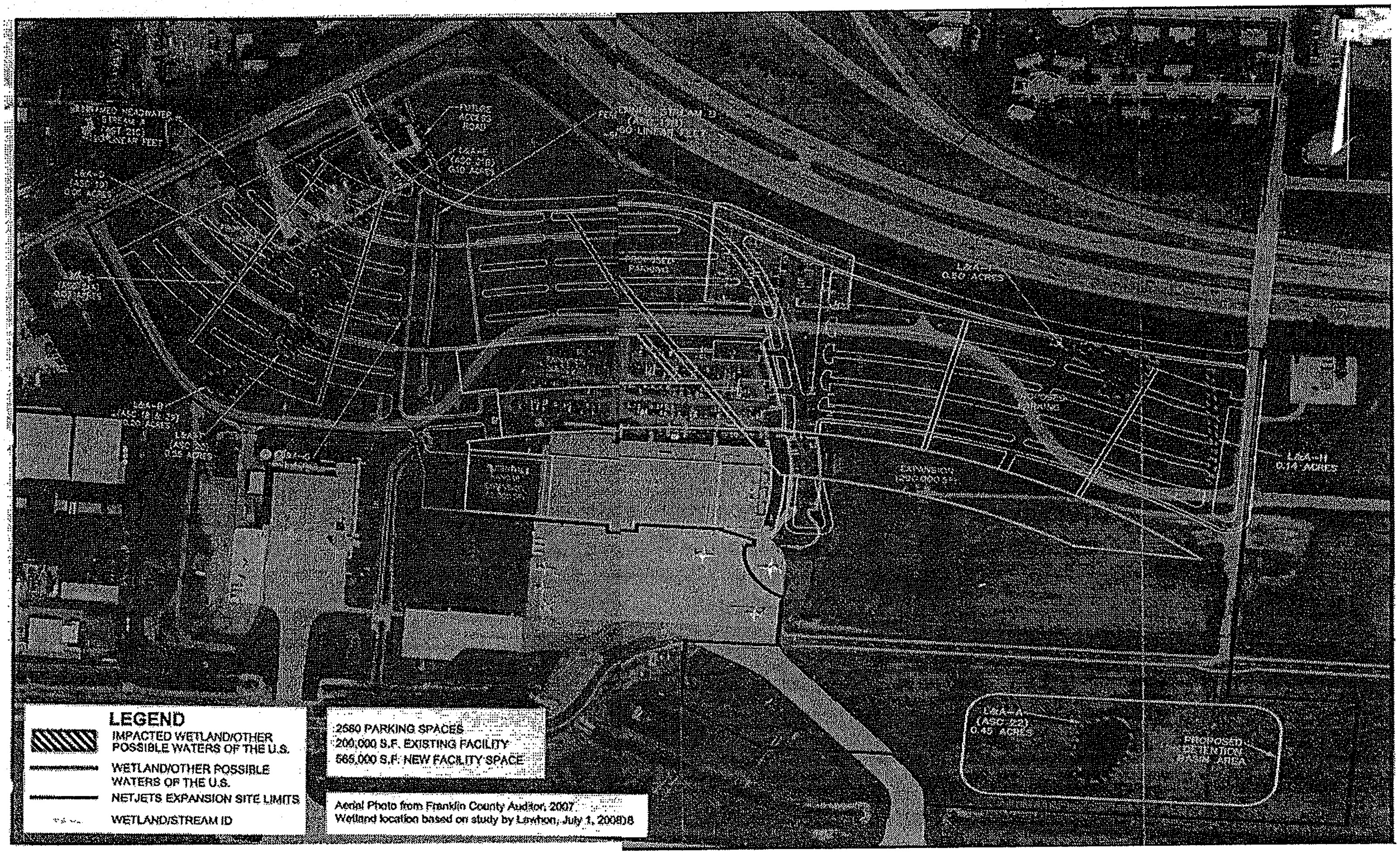
Appendix II
Eastside Nursery – General Location Map
OEPA ID No. 083460



Appendix III
Eastside Nursery Potential Mitigation Areas
OEPA ID No. 083460



Appendix IV
NetJets Headquarters Expansion Site
OEPA ID No. 083460



Aerial Photo from Franklin County Auditor, 2007
Wetland location based on study by Lawhon, July 1, 2008

Ohio | Environmental
Protection Agency
John R. Kasich, Governor
Mary Taylor, Lt. Governor
Scott J. Nally, Director

March 9, 2011

Certified Mail

Ms. Elaine Roberts
Columbus Regional Airport Authority
4600 International Gateway
Columbus, Ohio 43219

Re: Franklin/Columbus/Mifflin Township
Grant of Section 401 Water Quality Certification (Preferred Alternative) and/or Isolated Wetlands Permit dated October 26, 2009
Project to expand the NetJets Corporate Headquarters on Bridgeway Avenue
ACOE Project No: LRH-2003-270-SCR
Ohio EPA ID No.: 083460

Dear Ms. Roberts:

Notice is hereby given that Ohio EPA approves NetJets' November 22, 2010 request to modify the October 26, 2009 water quality certification authorizing impacts associated with the construction of the NetJets Corporate Headquarters. The redesigned project reduces stream impacts from 465 linear feet to 240 linear, thereby reducing the stream mitigation obligation to be performed at the Eastside Nursery from 700 linear feet to 360 linear feet.

This modification replaces only those conditions of the October 26, 209 Section 401 certification described below. All other terms and conditions of the October 26, 2009 certification remain in full force and effect.

1. Page2. Item I.B Stream Impacts

Stream ID	Type* E, I, or P	QHEI/HHEI Score*	Total Length on Site (lf)	Total Length Impacted (lf)	Impact Type	% Avoided
Stream A	ephemeral	-/17	190	190	fill	0.0
Stream D	perennial	55/-	960	50		86
			1,150	240	▨	72

1. Page 4 Item III.A.2. Stream Mitigation

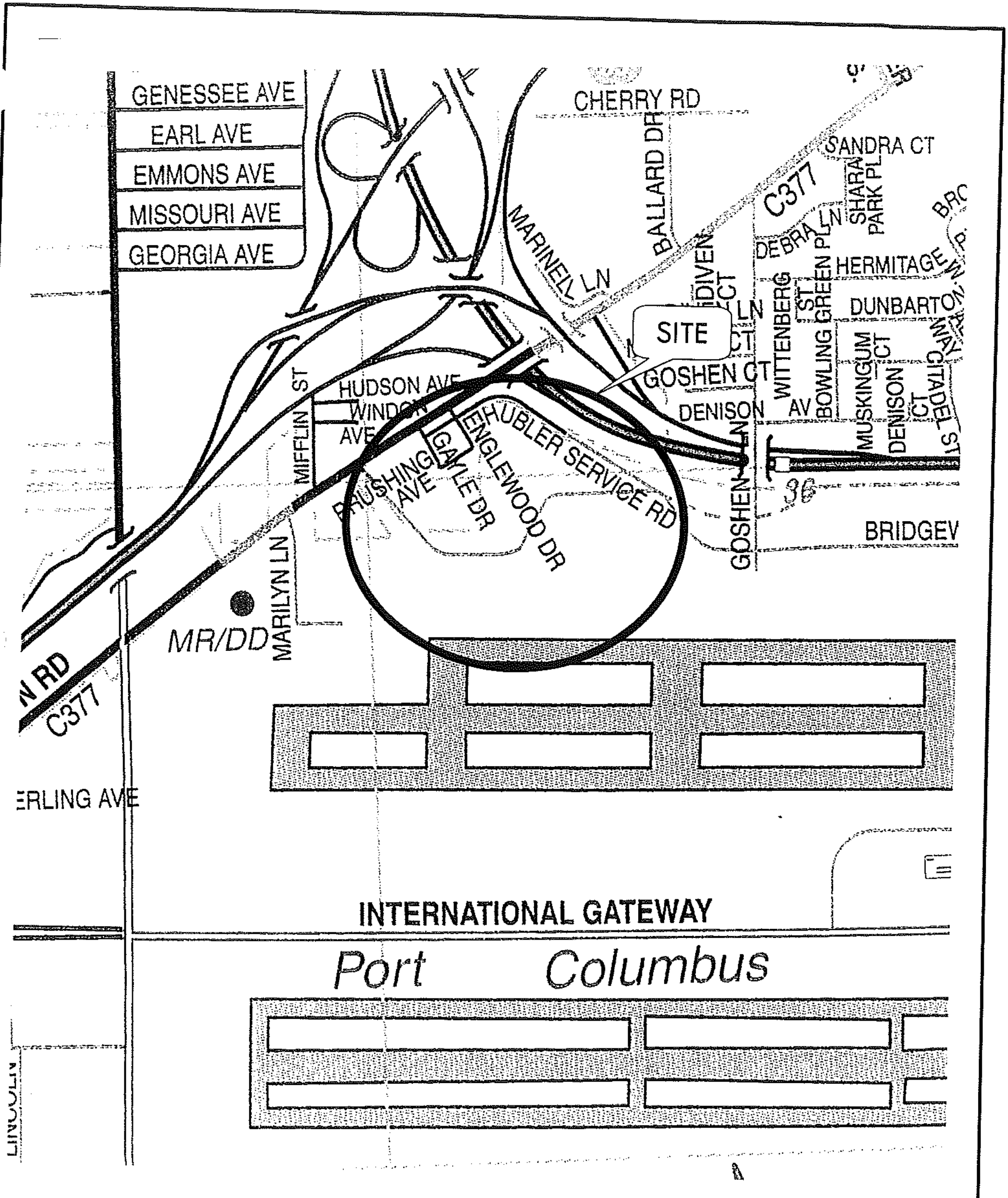
   Restore 360 linear feet of Big Run at the Eastside Nursery Site to meet a minimum Qualitative Habitat Evaluation Index (QHEI) score of 60 and meet criteria for the warmwater habitat aquatic life use designation.

Please feel free to contact me at 614-644-2139 or tom.harcarik@epa.state.oh.us if you have any questions.

Sincerely,

Thomas C. Harcarik, Supervisor
Wetland Permitting Section
Division of Surface Water

cc: Teresa Spagna, U.S. Army Corps of Engineers, Huntington District
Stacey Heaton, CRAA, 4600 International Gateway, Columbus,OH 43219
Tom Mentel, CRAA, 4600 International Gateway, Columbus,OH 43219
Todd W. Sloan, The Daimler Group, 1533 Lakeshore Drive, Columbus, Ohio 43204
John Watts, Columbus Metroparks, 1069 West Main Street, Westerville, Ohio 43081-1181
Kevin Pierard, U.S. EPA, Region 5
Mary Knapp, U.S. Fish & Wildlife Service
Brian Mitch, ODNR, Division of Real Estate & Land Management
Jeff Bohne, Ohio EPA, Central District Office
Susan Applegate, OEPA, DEFA
Pat Hoyng, EMH&T, 5500 New Albany Road, Columbus, OH43054
Miles Hebert, EMH&T, 5500 New Albany Road, Columbus, Ohio 43054
Dave Snyder, Ohio Historical Preservation Office, 1982 Velma, Columbus, OH 43211
Jeffrey Boyles, Ohio EPA, DSW, Mitigation Coordinator



EMH&T

Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4800
M C M X X V I

N

SCALE: 1" = 1000'

0 500 1000 2000 Feet

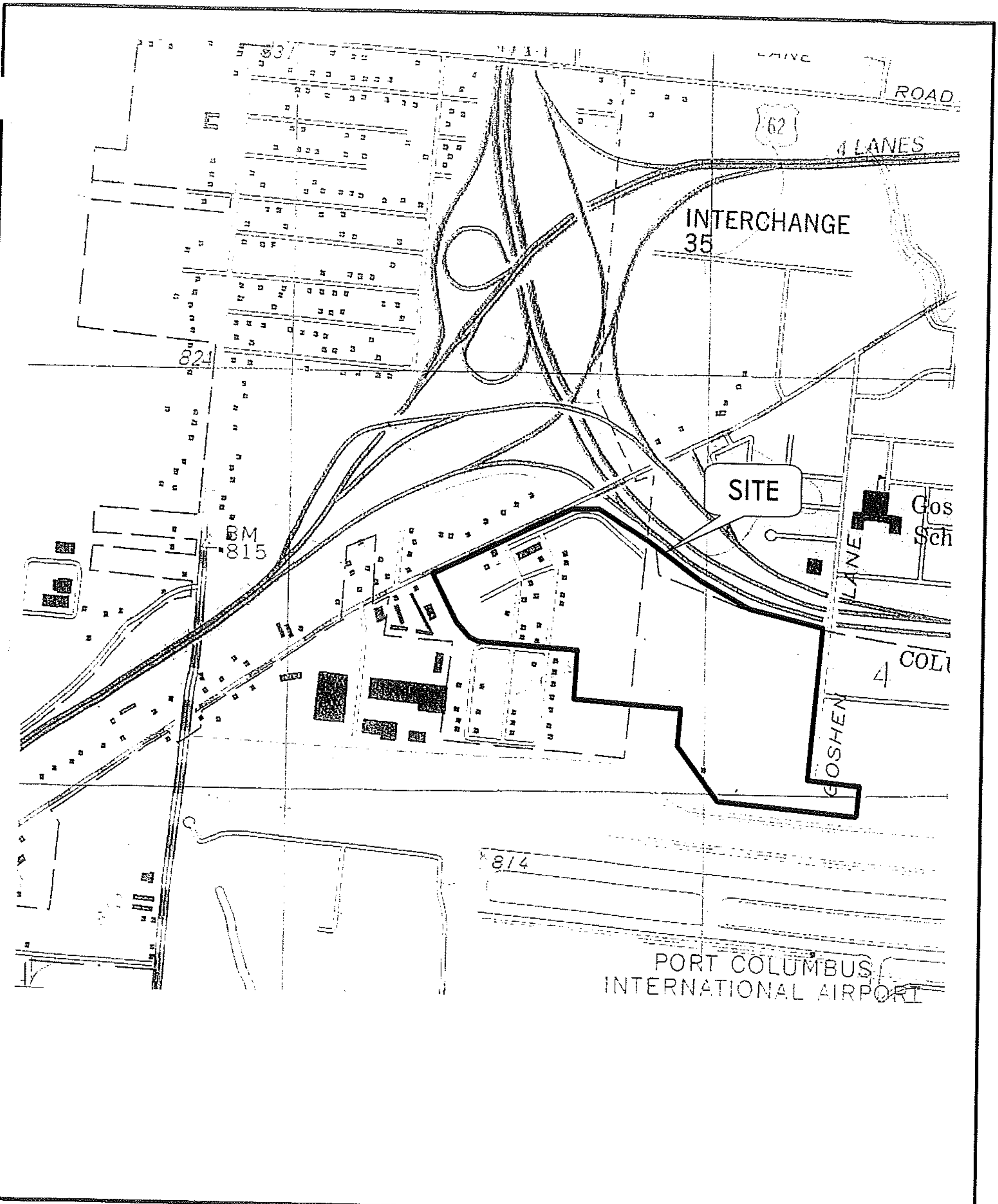
COLUMBUS, OHIO

COLUMBUS REGIONAL AIRPORT AUTHORITY

AREA LOCATION MAP

Exhibit 1

Source:
- FRANKLIN COUNTY ENGINEERS (2007)



EMH&T

Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4500
M C M X C V I

N

SCALE: 1"= 1000'

0 500 1000 2000 Feet

COLUMBUS, FRANKLIN COUNTY

COLUMBUS REGIONAL AIRPORT AUTHORITY

TOPOGRAPHIC MAP

Exhibit 2

Source:
- USGS NORTHEAST COLUMBUS QUAD (1995)

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
502 EIGHTH STREET
HUNTINGTON, WEST VIRGINIA 25701-2070

REPLY TO
ATTENTION OF

APR 12 2011

Operations and Readiness Division
Regulatory Branch
2003-270-SCR

Ms. Elaine Roberts
Columbus Regional Airport Authority
4600 International Gateway
Columbus, Ohio 43219

Dear Ms. Roberts:

Enclosed are one original and one copy of validated Department of the Army Permit Number 2003-270-SCR, authorizing you to discharge of dredged/fill material into approximately 240 linear feet of stream channels and 2.04 acres of wetlands in conjunction with the development of the Northwest Airfield, including the construction of the NetJets Corporate Headquarters Expansion project. The proposed project area is located within a 57 acre site on the north side of the Port Columbus Regional Airport, along Bridgeway Avenue, partially in the Mifflin Township and the City of Columbus, in Franklin County, Ohio. The proposed activities would impact Mason Run (Stream D), an unnamed tributary of Mason Run (Stream A) and nine wetlands within the 57 acre project site.

The original copy of this permit is for your records. The enclosed copy of the authorization must be supplied to the project engineers responsible for the construction activities.

If any changes in the location and plans of the work are found necessary, revised plans must be submitted to this office for approval as required by law, before work is initiated. It is imperative that this office be notified two weeks prior to the commencement of construction, and again upon completion of activities.

Upon completion of the work, the attached certification must be signed and returned to this office. If you have any questions, please contact Teresa Spagna of the North Regulatory Section at 304-399-5210.

Sincerely,

Ginger Mullins

f Rebecca Rutherford
Chief, North Regulatory Section

Enclosures

Copies Furnished:

Mr. Jeromy Applegate
U.S. Fish and Wildlife Service
4625 Morse Road, Suite 104
Columbus, Ohio 43230
With enclosures

Mr. Brian Mitch
ODNR-Environmental Policy Coordinator
2045 Morse Rd., Building C-4
Columbus, Ohio 43229-6693
With enclosures

Ms. Wendy Melgin
US EPA, Region V, WW-16-J
77 West Jackson St.
Chicago, Illinois 60604-3590
With enclosures

Mr. Jeff Boyles
Ohio EPA
Lazarus Government Building
Post Office Box 1049
Columbus, Ohio 43216-3669
With enclosures

Permit Number: 2003-270-SCR

Name of Permittee: Columbus Regional Airport Authority

Date of Issuance: April 12, 2011

Upon completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

Huntington District
U. S. Army Corps of Engineers
502 8th Street
Huntington, West Virginia 25701-2070
Attn: OR-FN

Please note that your permitted activity is subject to a compliance inspection by an U. S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation was completed in accordance with the permit conditions.

Signature of Permittee Date

PM: Teresa Spagna

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: Columbus Regional Airport Authority	File Number: 2003-270	Date: 4/12/2011
Attached is:		See Section below

	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A
x	PROFFERED PERMIT (Standard Permit or Letter of permission)	B
	PERMIT DENIAL	C
	APPROVED JURISDICTIONAL DETERMINATION	D
	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/CECW/Pages/reg_materials.aspx or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:
Ginger Mullins, Chief, Regulatory Branch, 304-399-5710
Rebecca Rutherford, Chief, North Regulatory Section, 304-399-5210
Mark Taylor, Chief, Energy Resource Section, 304-399-5610
LuAnne Conley, Chief, South Regulatory Section, 304-399-5710
Address: U.S. Army Corps of Engineers
Regulatory Branch
502 8th Street
Huntington, WV 25701

If you only have questions regarding the appeal process you may also contact:
Pauline Thorndike
U.S. Army Corps of Engineers
Great Lakes and Ohio River Division
550 Main Street, Room 10032
Cincinnati, OH 45202-3222
TEL (513) 684-6212; FAX (513) 684-2460
pauline.d.thorndike@usace.army.mil

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

_______________________ Signature of appellant or agent.	Date:	Telephone number:

DEPARTMENT OF THE ARMY PERMIT

Permittee Columbus Regional Airport Authority

Permit No. 2003-270-SCR

Issuing Office Huntington District

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description: You are authorized to discharge dredged and fill material into 240 linear feet of stream channels and 2.04 acres of wetlands in conjunction with the development of the Northwest Airfield, including the construction of the NetJets Corporate Headquarters Expansion project in accordance with the drawings attached hereto.

Project Location: The project site is located (latitude 39° 59' 15.51" N and longitude -82° 54' 19.85" W) within the Mason Run watershed located on north side of the Port Columbus Regional Airport property, along Bridgeway Avenue, partially in the Mifflin Township and the City of Columbus, in Franklin County, Ohio. The project activities would impact Mason Run (Stream D), an unnamed tributary of Mason Run (Stream A) and nine wetlands within the 57 acre project site.

Permit Conditions:

General Conditions:

1. The time limit for completing the work authorized ends on December 31, 2021. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

Special Conditions:

Special conditions are found on the attached sheet titled "SPECIAL CONDITIONS FOR THE DEPARTMENT OF THE ARMY SECTION 404 CLEAN WATER ACT PERMIT 2003-270-SCR ISSUED TO COLUMBUS REGIONAL AIRPORT AUTHORITY FOR DEVELOPMENT OF THE NORTHWEST AIRFIELD, INCLUDING THE CONSTRUCTION OF THE NETJETS CORPORATE HEADQUARTERS CAMPUS FACILITY AT THE PORT COLUMBUS REGIONAL AIRPORT"

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

   ( ) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).

   (X) Section 404 of the Clean Water Act (33 U.S.C. 1344).

   ( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

2. Limits of this authorization:

   a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.

   b. This permit does not grant any property rights or exclusive privileges.

   c. This permit does not authorize any injury to the property or rights of others.

   d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability: In issuing this permit, the Federal Government does not assume any liability for the following:

   a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.
   b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

   c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

   d. Design or construction deficiencies associated with the permitted work.

   e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision: This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

   a. You fail to comply with the terms and conditions of this permit.

   b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).
   c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

Elaine Roberts 4-7-11

(PERMITTEE) (DATE)

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

Ginger Mullins April 12, 2011

(DISTRICT ENGINEER) (DATE)
ROBERT D. PETERSON
Colonel, Corps of Engineers

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

(TRANSFEREE) (DATE)

SPECIAL CONDITIONS FOR THE DEPARTMENT OF THE ARMY SECTION 404 CLEAN WATER ACT PERMIT 2003-270-SCR ISSUED TO COLUMBUS REGIONAL AIRPORT AUTHORITY FOR DEVELOPMENT OF THE NORTHWEST AIRFIELD, INCLUDING THE CONSTRUCTION OF THE NETJETS CORPORATE HEADQUARTERS CAMPUS FACILITY AT THE PORT COLUMBUS REGIONAL AIRPORT

1. The permittee is hereby authorized to discharge dredged and/or fill material into 240 linear feet of stream channel and 2.04 acres of wetland in conjunction with the development of the Northwest Airfield, including the construction of the NetJets Corporate Headquarters Expansion Project . This Department of the Army (DA) Section 404 Clean Water Act permit remains contingent upon and must be constructed in accordance with drawings attached hereto.

2. The water quality certification and modification issued by the Ohio Environmental Protection Agency (OEPA) dated October 26, 2009 and March 9, 2011 respectively are attached hereto and made a part of this permit. All conditions attached to or contained therein are hereby incorporated by reference as being special conditions of the DA permit.

3. The permittee shall display a copy of this DA permit at the site and ensure all contractors are aware of its terms and conditions.

4. The permittee is required to apply for and secure all necessary permits, certifications or other approvals from federal, state or local regulatory agencies, prior to commencing construction activity. These other federal, state or local approvals and all conditions attached to or contained therein are hereby incorporated by reference as being special conditions of this DA permit.

5. Construction activities will be performed during low flow conditions. Appropriate site specific best management practices (BMP) for sediment and erosion control will be fully implemented during construction activities at the site. The BMPs include, but are not limited to, the utilization of silt fences, check dams, mulching and seeding. No area for which grading has been completed will be unseeded or unmulched for longer than 14 days. All disturbed areas will be seeded and/or revegetated with native species and approved seed mixes that preclude hazardous wildlife and the establishment of non-native invasive species. Specifically, any un-vegetated riparian corridor will be re-established with species native to Ohio.

6. As-built drawings, certified by a professional engineer, shall be furnished to this office within 60 days of completion of construction showing the location and configuration, as well as all pertinent dimensions and elevations of each project component authorized under this DA permit.

7. Should new information regarding the scope and/or impacts of the project become available that was not submitted to this office during our review of the proposal, the permittee shall submit written information concerning proposed modification(s) to this office for review and evaluation, as soon as practicable.

8. Representatives from the United States Army Corps of Engineers (USACE) shall be allowed to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of this DA permit.

Compensatory Mitigation

9. The USACE-Huntington District has determined the use of compensatory mitigation credits accrued at the "Eastside Nursery Site" and described in the "Eastside Nursery Final Mitigation Plan…" and dated February 9, 2010 is acceptable to offset the unavoidable impacts to waters of the United States. This mitigation site is to be a single user pooled mitigation site to locally accommodate the mitigation needs for various projects undertaken by the Columbus Regional Airport Authority. According to the final approved "Eastside Nursery Final Mitigation Plan…," this pooled mitigation site provides 11.3 acres of forested wetlands, 11.2 acres of emergent wetlands and 2,700 linear feet of stream at this composite mitigation site. To compensate for unavoidable adverse impacts to waters of the United States, the permittee will ensure the following mitigation measures are successfully implemented and monitored as described in the compensatory mitigation plan (CMP) and as stipulated in this DA Permit:

> a. restore and permanently protect 2.685 acres of non-forested Category 2 wetlands, 1.25 acres of forested Category 2 wetlands and 360 linear feet of Big Run at the "Eastside Nursery Site."

The permittee shall implement the mitigation work plan and complete the initial construction and plantings in accordance with the timeframes specified in the final CMP. Completion of all elements of this CMP is a requirement of this DA permit.

10. The permittee shall dedicate in perpetuity by an appropriate real estate instrument or other long-term protection mechanism 2.685 acres of non-forested Category 2 wetlands, 1.25 acres of forested Category 2 wetlands and 360 linear feet of Big Run restored at the "Eastside Nursery Site." The permittee shall survey the mitigation areas, develop appropriate restrictive instruments for the surveyed areas, and submit the appropriate real estate instrument or other long-term protection mechanism to the USACE-Huntington District for approval prior to the initiation of construction on the mitigation site.

a. The protective real estate instrument or other long-term protection mechanism must stipulate that the mitigation areas shall be properly marked and shall not be disturbed, except by those activities that will not adversely affect the intended extent, condition and function of the mitigation areas. The real estate instrument must, to the extent appropriate and practicable, prohibit incompatible uses (e.g., clear cutting) that might otherwise jeopardize the objectives of the compensatory mitigation project. Livestock grazing, and similar activities are not allowed unless written permission is granted by the USACE-Huntington District.
b. The instrument or mechanism must also include a map depicting the boundary of the preservation sites.

c. Upon notification in writing by this office of approval of the protective real estate instrument or long-term protection mechanism, it shall be filed and recorded with the Franklin County Auditor within 60 days of this written notification.
d. The restriction shall not be removed from the deed or modified without written approval of the USACE-Huntington District and conveyance of any interest in the property must be subject to the recorded instrument or mechanism. Any proposed activities, including transfer of title to, or establishment of any other legal claims over, the compensatory mitigation sites within the protected easement areas must be coordinated through this office 60 days in advance.

Natural Stream Design

11. The permittee must use natural stream design techniques and concepts, based on reference stream pattern, profile and dimensions using sound geomorphology techniques, to determine the appropriate hydrogeomorphic configuration of the off-site mitigation stream channel (360 linear feet of Big Run). The constructed in-stream habitat within the off-site restored channel of Big Run will be installed in a manner to correct or ameliorate some of the noted physical impairments along Big Run with the goals of restoring stability and promoting aquatic habitat within the channel while also helping to preserve water quality within the Walnut Creek mainstem . A 225 foot wide wooded riparian corridor using native plantings will be established along the restored channel. The new channel configuration will conform to the restored watershed size and shape and be capable of transporting the corresponding stream flow and bedload. The use of grout is prohibited to prevent the loss of hydrology in the created stream channel. The permittee shall immediately notify the USACE-Huntington District to discuss other alternative methods.

Planting

12. A minimum of a 50-foot vegetated buffer zone (25 feet on each stream side), consisting of native non-invasive grasses, shrubs and trees will be planted along 360 linear feet of restored Big Run. Woody stems shall be irregularly placed along the corridor and low growing shrubs will be planted between trees. All grasses, shrubs and trees shall be selected based upon their hydrologic and edaphic tolerances, and shall be native to the project area. Loosely graded non-compacted topsoil or topsoil substitutes that include, when possible, woody debris and native seeds shall be used in the riparian area. Selection of ground cover shall be based on soil pH and the growth habit of the species. Slow growing ground cover species insures soil stabilization while allowing tree seedlings to emerge above the ground cover, ensuring their survival.

As Built Submittal

13. Within 6 weeks of completion of mitigation construction (i.e. site preparation and planting), a report must be submitted to the USACE-Huntington District describing the as-built status of the off-site stream restoration and off-site wetland restoration projects. If mitigation construction is initiated in, or continues throughout the year, but is not completed by December 31 of any given year, the permittee will provide the USACE-Huntington District, a letter providing the date mitigation work began and the work completed as of December 31. The letter will be sent no later than January 31 of the next year.

> a. As-built channel surveys will be conducted to document the dimension, pattern and profile of the 360 linear feet restored segment of Big Run. Permanent cross-sections will be established during this survey for use during future monitoring surveys. At a minimum, two permanent cross-sections will be established in each mitigation area. The locations will be selected to represent approximately 50 percent of the pool habitat and 50 percent of the riffle habitat. The as-built surveys will include photographic documentation at cross-sections and structures, a plan view diagram and vegetation information for at least two sites along the restored channel. The location of plantings and other installations or structures shall be indicated on mapping.
>
> b. As-built surveys will be conducted to document the topography, any inlet/outlet structures and the location and extent of the designed plant community types at the restored 2.685 acres of non-forested wetlands, 1.25 acres of forested wetlands at the "Eastside Nursery Site." Within each community type the plan will show the species planted. There will also be a soil profile description and the actual measured organic content of the topsoil. This will be included in the first monitoring report unless there are grading and/or soil modifications and/or additional plantings of different species in subsequent years. Representative photographs of the wetland mitigation site must be taken from the same locations for each monitoring event. Photographs must be dated and clearly labeled with the direction from which the photograph was taken. The photograph sites must also be identified on mapping.

Performance Standards

14. Implementation of the CMP must ensure the mitigation stream segments, surrounding riparian areas and established wetlands meet the performance standards outlined below. If the mitigation efforts do not meet the performance standards outlined in the CMP, Section 401 Water Quality Certification and modification dated October 26, 2009 and March 9, 2011 respectively and special conditions of this individual permit authorization, corrective measures and/or additional mitigation will be required.

Waters of the United States and Surrounding Buffer and Riparian Zones for Off-Site Mitigation

- The restored stream channel of Big Run must develop and maintain definable bed and bank with an ordinary high water mark and exhibit a surface hydrological connection to navigable waters of the United States in order to meet the definition of waters of the United States under the Regulatory Program regulations.
- Restored wetlands at the "Eastside Nursery Site" must develop and maintain wetland characteristics consistent with the USACE Midwest Regional Supplement in order to meet the definition of waters of the United States under the Regulatory Program regulations.
- Waters of the United States must function at the level of ecological performance prescribed in the mitigation plan.
- Buffer and riparian zones and other areas integral to the enhancement of the aquatic ecosystem must function as the intended type of ecosystem component and at the level of ecological performance prescribed in the mitigation plan.

Off-Site Stream Mitigation

- A minimum of 360 linear feet of restored segment of Big Run at the "Eastside Nursery Site" and 0.8 acre of riparian buffer habitat must be present and be functioning as the intended type of waters of the United States and at the level of ecological performance prescribed in the mitigation plan.
- The restored segment of Big Run off-site must attain a minimum Qualitative Habitat Evaluation Index (QHEI) of 60 and meet criteria for the warmwater habitat aquatic life use designation.
- A total of 80% of the restored channel's riparian zone shall be covered by native shrub and herbaceous species.
- The restored channel's riparian zone shall contain no more than 5 percent relative cover of any invasive species.

Off-Site Wetland Mitigation

- A total of 2.685 acres of restored non-forested Category 2 wetlands and 1.25 acres of forested Category 2 wetlands as determined by an investigation of waters completed in accordance with the USACE Midwest Regional Supplement or successor document must be functioning as the intended type of waters of the United States and at the level of ecological performance prescribed in the mitigation plan.
- The off-site mitigation wetlands must attain a Vegetation Index of Biotic Integrity score of 51 or higher for each plant community type.

- The 2.685 acres of the off-site mitigation wetlands must attain an Ohio Rapid Assessment Method (ORAM) score equivalent to a Category 2 non-forested wetland.
- The 1.25 acres of the off-site mitigation wetlands must attain an ORAM score equivalent to a Category 2 forested wetland.
- The mitigation wetland must have less than 10% of its total area as unvegetated open water.
- A minimum of 75% of all dominant plant species within the restored wetlands must have an indicator status of obligate, facultative wetland or facultative.
- A total of 80% of the total area of the mitigation wetland shall be covered by native tree, shrub and herbaceous species.
- The restored wetlands and their upland buffer shall contain no more than 5 percent relative cover of any invasive species.
- A minimum of 50% of the perimeter shall have slopes no greater than 15:1.
- The restored wetlands must exhibit a surface water connection to navigable waters of the United States.

Monitoring

15. The off-site restored channel of Big Run shall be monitored annually for 5 years while the off-site restored wetlands shall be monitored every other year for 10 years following completion of the applicant's proposed compensatory mitigation efforts. Annual report containing the data listed in this DA permit as well as the OEPA Section 401 Water Quality Certification and modification dated October 26, 2009 and March 9, 2011 respectively shall be submitted to the USACE by December 31 for each of the five consecutive years (1, 2, 3, 4 and 5) for off-site stream restoration and every other year of the ten years (1, 3, 5, 7 and 10) for the off-site wetland restoration. The first report must contain as-built drawings of all mitigation areas and their surrounding riparian and/or upland buffer areas. All reports must provide a status of the off-site restored stream segment and off-site restored wetlands, including photographs and narrative descriptions of channel and wetland development. The District Engineer may extend the monitoring past the minimum period based upon a determination that performance standards stated herein, in the CMP have not been met or the compensatory mitigation project(s) is not on track to meet them (e.g. high mortality rate of vegetation, absence of an ordinary high water mark, lack of habitat diversity, lack of hydrology, lack of surface hydrological connection to the tributary system). The District Engineer may also revise the monitoring requirements when remediation is required. The District Engineer may require monitoring of the mitigation sites more often than annually during the early stages of development to quickly address problems and/or concerns associated with the mitigation site.

16. Evaluations, as outlined in Special Condition 17, shall be performed to determine whether the mitigation efforts are on track to meet performance standards identified under Special Condition 14 above to allow for mid-course adjustments and to report on any unanticipated benefits or problems as a result of the monitoring program. The information accumulated through this process will be used to adjust strategy periodically on the basis of what has been learned. If the mitigation site(s) are generally progressing as expected or if progress is slower than expected but would probably meet mitigation goals and objectives within a reasonable amount of time, no action would be necessary. However, physical actions might be required to maintain aquatic resource development on course toward its goals or significant changes in parts of the implemented mitigation plan could be required.

17. In order to provide a comparison of restored stream and riparian area development throughout the years of required monitoring, the scores of the QHEI, Invertebrate Community Index, Index of Biotic Integrity, and Native and Invasive Plant Species Monitoring will be provided with each submitted monitoring report. In order to provide a comparison of wetland area development throughout the years of required monitoring, the scores of the ORAM and Invasive Plant Species Monitoring will be provided with each submitted monitoring report.

18. To ensure coordination with resource agencies one original and five copies of the monitoring report must be submitted for review. Failure to submit monitoring reports constitutes permit non-compliance.

19. Annual monitoring reports must include details sufficient for an inspector to determine compliance with performance standards and to identify any required remedial actions. At a minimum, information outlined in the enclosed USACE Regulatory Guidance Letter (RGL) No. 08-03 and titled "Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Creation, Restoration, and/or Enhancement of Aquatic Resources" as well as the Ohio Environmental Protection Agency Section 401 Water Quality Certification and modification dated October 26, 2009 and March 9, 2011 must be provided. Combined 401/404 monitoring reports are preferred.

20. Monitoring reports are required by December 31 of each monitoring year even if no work is conducted during the reporting period.

Remedial Actions

21. Remedial actions taken during the monitoring period shall be described. These actions may include, but are not limited to, removing debris, replanting, controlling invasive species, regrading the site, applying additional topsoil or soil amendments, adjusting site hydrology, etc. Remedial measures may be necessary to achieve or maintain achievement of the success criteria and otherwise improve the extent to which the mitigation site(s) replace the functions and values lost due to project impacts.

22. If an annual performance criterion is not met for all or any portion of the mitigation project(s) in any year, or if the final performance standards are not met, the applicant shall prepare an analysis of the cause(s) of failure, if determined necessary by the USACE-Huntington District, and propose remedial actions for approval. The applicant's Contingency Plan or other corrective measures will be required to be performed by the permittee as directed by the District Engineer.

23. If performance standards are not met, a brief explanation of the difficulties and potential remedial actions or additional compensatory mitigation proposed by the permittee, including a timetable, must be provided. The District Engineer will ultimately determine if the mitigation site is successful for a given monitoring period.

Monitoring Inspections

24. The permittee shall arrange an on-site meeting with the USACE-Huntington District during the growing season following submittal of the first, third and fifth year reports for the stream restoration site and first, third, fifth, seventh and tenth reports for the wetland restoration site. The purpose of the meeting is to determine if the stream and wetland mitigation sites have been constructed in accordance with the mitigation plan and are functioning as expected. A current jurisdictional determination documenting the limits of all waters of the United States shall be provided for verification with the fifth year report for the off-site stream restoration site and with the fifth and tenth year reports for the off-site wetland restoration site.

25. Problems at the mitigation areas shall be addressed and potential solutions must be incorporated into actions the permittee would take to allow the mitigation areas to reach their proposed functional status. The permittee is responsible for implementing reasonable corrective measures recommended by the USACE-Huntington District.

Release

26. The permittee's responsibility to complete the required compensatory mitigation as set forth in Special Condition 9 will not be considered fulfilled until the permittee has demonstrated a sustainable level of mitigation success and has received written verification from the USACE-Huntington District that areas within the mitigation areas meet the success criteria established under Special Condition 14.

27. Following submittal of the fifth year monitoring report for the stream restoration site and tenth year monitoring report for the wetland restoration site, a determination of the mitigation success will be made by the USACE-Huntington District. If the performance standards have been achieved, the applicant would be released from future monitoring requirements. However, if success criteria have not been adequately met, the applicant may be required to implement contingency measure(s), including additional mitigation, to ensure compensation adequately

offsets the loss of waters in association with the proposal as determined in the sole discretion of the District Engineer. Monitoring may be extended for a longer period if completed mitigation is not functioning as predicted in the CMP. Additionally, the permittee will purchase credits from an approved mitigation bank and/or preserve aquatic resources or other alternative mitigation as determined by the USACE-Huntington District in the event the District Engineer determines that additional mitigation and monitoring would not ensure adequate compensation for impacts to waters of the United States.

Endangered Species Act Coordination

28. The Northwest Airfield Development and NetJets Corporate Headquaters Expansion Project and off-site "Eastside Nursery Site" lie within the range of the Indiana bat (*Myotis sodalis*), a Federally-listed endangered species. Since first listed as endangered in 1967, their population has declined by nearly 60%. Several factors have contributed to the decline of the Indiana bat including the loss and degradation of suitable hibernacula, human disturbance during hibernation, pesticides, and the loss and degradation of forested habitat, particularly stands of large, mature trees. Fragmentation of forest habitat may also contribute to declines. Summer habitat requirements for the species are not well defined but the following are considered important:

a. Dead or live trees and snags with peeling or exfoliating bark, split tree trunk and/or branches, or cavities, which may be used as maternity roost areas.
b. Live trees (such as shagbark hickory and oaks) which have exfoliating bark.
c. Stream corridors, riparian areas, and upland woodlots which provide forage sites.

If it is determined that suitable habitat for the Indiana bat may be located within the wooded areas of the impact and/or off-site mitigation site, the permittee shall preserve trees and associated habitats exhibiting any of the characteristics listed above wherever possible. Should suitable habitat be present that cannot be saved during construction activities, these trees shall be cut prior to April 1 and after September 30.

29. The permittee is reminded this DA Permit authorization does not authorize the "take" of a threatened or endangered species as defined under the Endangered Species Act. In the absence of separate authorization (e.g. Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the USFWS, both lethal and non-lethal "takes" of protected species are in violation of the Endangered Species Act. Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the USFWS or their World Wide Web page at http://www.fws.gov/r9endspp/endspp.html.

30. Section 7 obligations under Endangered Species Act must be reconsidered if new information reveals impacts that may affect federally listed species or critical habitat in a manner not previously considered, the proposed project is subsequently modified to include activities which were not considered during Section 7 consultation with the USFWS, or new species are listed or critical habitat designated that might be affected by the subject Northwest Airfield Development and NetJets Corporate Headquaters Expansion Project and off-site "Eastside Nursery Site."

Cultural Resources

31. In the event any previously unknown historic or archaeological sites or human remains are uncovered while accomplishing the activity authorized by this DA permit, the permittee must cease all work immediately and contact local, state and county law enforcement offices (only contact law enforcement on findings of human remains), the USACE-Huntington District Regulatory Branch and Ohio State Historic Preservation Office. The USACE-Huntington District Regulatory Branch will initiate the Federal, state and tribal coordination required to comply with the National Historic Preservation Act and applicable state and local laws and regulations. Federally recognized tribes are afforded a government-to-government status as sovereign nations and consultation is required under Executive Order 13175 and 36 CFR Part 800.

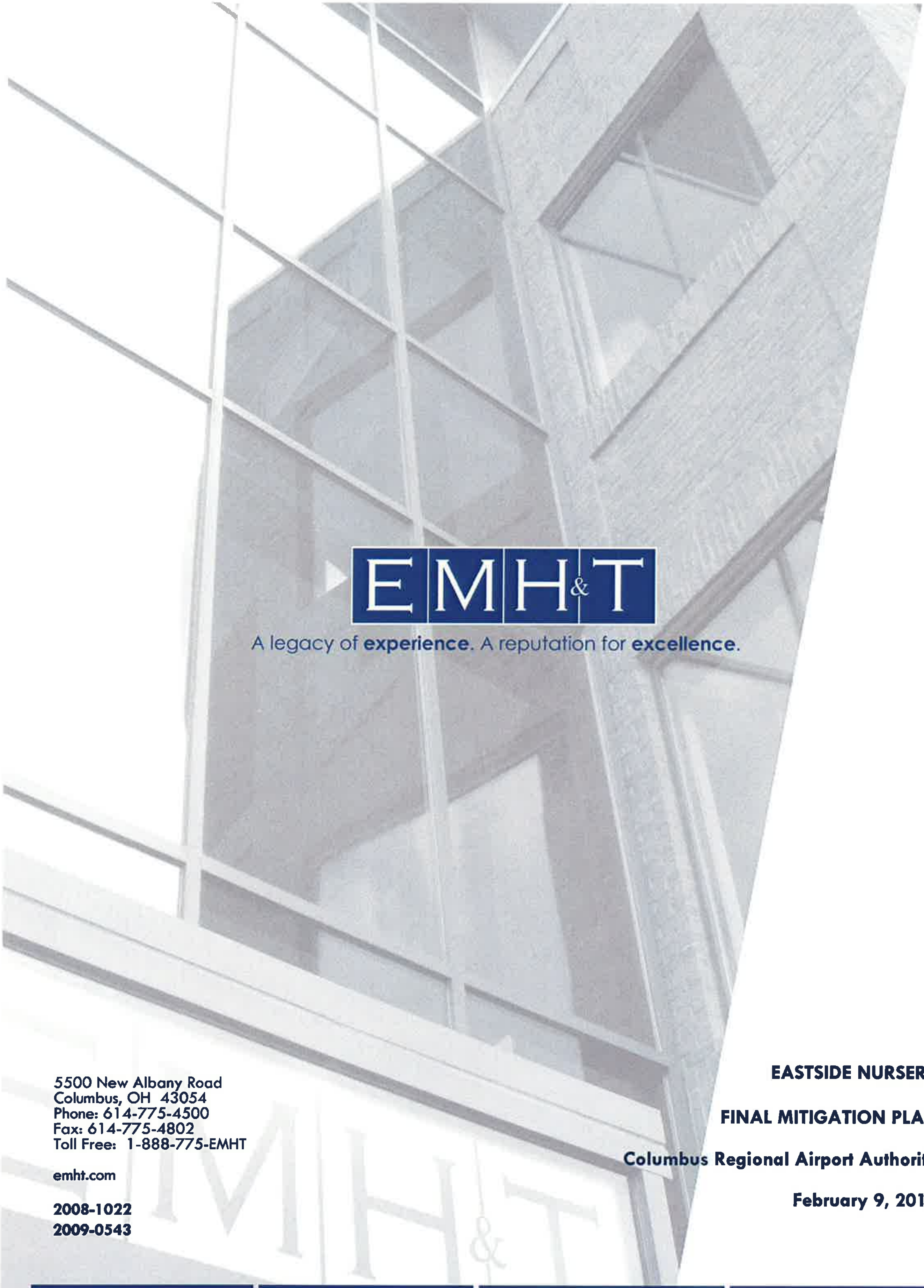
Project Compliance

32. If it is determined the permittee's authorized discharges of dredged/fill material associated with the Northwest Airfield Development and NetJets Corporate Headquaters Expansion Project and off-site "Eastside Nursery Site" are in non-compliance with the permit terms and conditions, the permittee must immediately take necessary actions to bring its project into compliance with the terms and conditions of this DA permit. Failure to do so can result in the modification, suspension or revocation pursuant to 33 CFR 325.7 or enforcement procedures pursuant to 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring permittees to comply with the terms and conditions of their permit and for the initiation of legal action where appropriate.

Other Requirements

33. The culvert base or invert at the location of the substrate of the 50 linear feet of Stream D will be installed below the sediment to allow natural channel bottom to develop and to be retained. The channel bottom substrate would be similar to and contiguous with the immediate upstream and downstream reaches of the stream.

34. The permittee shall maintain a detailed accounting of the stream and wetland mitigation credits at the "Eastside Nursery Site." The accounting shall include the total acres of wetlands and linear feet of streams as initially built and approved under a Nationwide Permit 27 verification dated March 19, 2010. Additionally, the wetland acreage and/or linear footage of streams debited shall be included for each Section 401 Water Quality Certification, isolated OEPA wetland permit, or USACE DA permit. The balance of available wetland acreage and linear footage of streams for use shall also be noted for use as future mitigation.



EMH&T

A legacy of **experience.** A reputation for **excellence.**

EASTSIDE NURSERY

FINAL MITIGATION PLAN

Columbus Regional Airport Authority

February 9, 2010

5500 New Albany Road
Columbus, OH 43054
Phone: 614-775-4500
Fax: 614-775-4802
Toll Free: 1-888-775-EMHT

emht.com

2008-1022
2009-0543

Engineers | Surveyors | Planners | Scientists

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

1.0 INTRODUCTION

A Final Mitigation Plan has been prepared in support of on-going permitting activities associated with capital improvement projects at Port Columbus International Airport (Port Columbus), as well as potential future impacts at Port Columbus and Rickenbacker International Airport (Rickenbacker). The Columbus Regional Airport Authority (CRAA) is committed to a proactive approach to provide compensatory mitigation for anticipated wetland and stream impacts from its scheduled capital projects through the foreseeable planning horizon of 2020. Since 2006, CRAA has engaged in a continuing dialogue with the United States Army Corps of Engineers, Huntington District (USACE), the Ohio Environmental Protection Agency (Ohio EPA), Columbus and Franklin County Metro Parks (Metro Parks), the Ohio Department of Natural Resources (ODNR) and other parties to locate a suitable site at which an ecologically meaningful mitigation project sufficient to meet all CRAA's foreseeable mitigation needs could be efficiently and cost-effectively developed.

As a result of these efforts, CRAA has entered into partnership with Metro Parks to develop a consolidated wetland and stream mitigation site at the Eastside Nursery property in southeastern Franklin County. The location of the Eastside Nursery property is indicated on the area location map provided as Exhibit 1. Metro Parks concluded a purchase agreement with the owners of the Eastside Nursery property in December 2008. Under the agreement, the nursery continued operating under lease through 2009. The terms of CRAA's partnership with Metro Parks regarding development of the proposed mitigation site is outlined in a Memorandum of Agreement (MOA) between CRAA and Metro Parks. A copy of the MOA is included in Appendix A.

The identification of the Eastside Nursery property as a candidate restoration/mitigation site was initially based on an indication of hydric soils within the property. The area of hydric soils has been previously converted to agricultural, including tree/shrub nursery, activities and lacks evidence of existing wetland features due to the anthropogenic activities. The property also includes a highly degraded portion of the Big Run channel within the property. Big Run is a tributary to Walnut Creek and exhibits classic symptoms of degradation including eroding channel banks and a lack of bedform features such as pools and riffles. The resulting channel lacks stable bed form features and demonstrates evidence of high bank erosion potential. The potential for wetland and stream restoration on the property was further examined in a report entitled *Columbus Regional Airport Authority – Wetland & Stream Feasibility Analysis*, dated February 6, 2009, prepared for the CRAA by EMH&T. The feasibility study report identified the potential for 58 acres of wetland restoration within various portions of the property and approximately 7,400 linear feet of stream restoration along Big Run.

The Final Mitigation Plan accounts for restoration of approximately 22.5 acres of wetland and approximately 2,700 linear feet of the Big Run channel on the Eastside Nursery property. The proposed restoration will serve as mitigation for currently planned and future possible wetland/stream impacts at Port Columbus and Rickenbacker. The implementation of the stream and wetland restoration activities will be based on detailed final engineering efforts to guide the construction of the restoration features. Any additional restoration activities at Eastside Nursery property will be performed by Metro Parks.

2.0 MITIGATION GOALS AND OBJECTIVES

The goals of the proposed CRAA Final Mitigation Plan are listed below.

- Accomplish ecologically meaningful mitigation sufficient to compensate for anticipated wetland and stream impacts from proposed CRAA capital projects at Port Columbus through 2020.

- Accomplish mitigation locally, within the Big Walnut Creek or surrounding watersheds (HUCs 05060001-130, -140, -150, -160, -170,-180).

- Accomplish mitigation in a cost effective and ecologically meaningful manner that makes efficient use of both existing natural resources and public funds.

Portions of the Eastside Nursery site contain native hydric soils and are topographically flat, making those areas a candidate for wetland restoration. Restoration of wetland hydrology is proposed to be accomplished by the interruption of surface and subsurface flow, including a combination of minimal site grading to concentrate and collect surface runoff as well as the destruction of any field tile drains to restore a more natural groundwater condition. Groundwater conditions will also be beneficially impacted by the stream restoration activities described below.

Mitigation of stream impacts associated with the CRAA projects will be accomplished through restoration of a portion of the existing Big Run channel which flows from south to north through the Eastside Nursery property. Big Run has its confluence with Walnut Creek at the Eastside Nursery northern property boundary. There is evidence that Big Run has historically been channelized and the channel is also impaired by both active erosion of stream banks and deposition of sediment within the channel. Furthermore, the entire length of the channel on the parcel is denuded and lacking any meaningful riparian buffer. The highly impaired channel condition provides an excellent opportunity for stream channel and riparian corridor restoration.

Mitigation activities proposed to occur on the Eastside Nursery property include the items listed below.

- Development of two wetland cells totaling approximately 22.5 acres along the west side of Big Run and designed to achieve a Category 2 designation. Both cells will consist of a mixed forested and emergent wetland habitat. A minimum 25 foot wooded buffer will be established around each wetland cell.

- Restoration along approximately 2,700 linear feet of degraded intermittent channel (Big Run) using natural channel design techniques beginning just upstream of the confluence with Walnut Creek and extending upstream to a point adjacent to the proposed wetland cells. The restoration will include the establishment of a wooded riparian corridor using native plantings, with an average width of 50 feet along the restored channel length.

3.0 MITIGATION SITE SELECTION

In an effort to identify a suitable mitigation site for stream and wetland impacts associated with the various capital improvement projects scheduled for Port Columbus, the CRAA explored numerous opportunities for partnership with Metro Parks. The Eastside Nursery site was purchased by Metro Parks in December 2008 and will be available for use after nursery activities cease at the end of 2009. The site is in a desirable location for ecological restoration, being located in close proximity to Walnut Creek in the outskirts of the Village of Groveport. Big Run, a direct intermittent tributary to Walnut Creek, is substantially degraded and has excellent restoration potential. The proposed improvements would have a significant beneficial effect upon water quality and wildlife habitat within the Walnut Creek watershed (HUC 05060001180). This meets the goal of completing mitigation requirements locally, as this watershed is adjacent to the Big Walnut Creek watershed where the proposed impacts will occur. The respective locations of the Port Columbus International Airport, Rickenbacker International Airport and Eastside Nursery mitigation side are indicated on Exhibit 3. As the mitigation area would be part of a Metro Parks property, future management and preservation of the site by competent, responsible stewards would be assured.

The Eastside Nursery property is a 482 acre parcel of land as shown on Exhibit 2. The portion of the property proposed for the CRAA mitigation activities consists of approximately 105 acres. The described restoration is only a portion of the restoration potential within the property but is sufficient to meet the CRAA's current and anticipated future needs for mitigation.

3.1 Watershed Issues

The Eastside Nursery mitigation site is located within the Walnut Creek 11-digit HUC identified as 05060001180 which includes the portion of the watershed downstream of the Sycamore Creek confluence with the Scioto River. The *Biological and Water Quality Study of Walnut Creek and Tributaries* (Ohio EPA, 2006) indicates that the Walnut Creek mainstem within this subwatershed HUC is designated Warm Water Habitat (WWH). Fish and macroinvertebrate sampling indicated attainment of this designation at the time of the study. The mainstem was found to support populations of a number of rare, threatened and declining fish species. The presence of these species prompted the Ohio EPA to recommend that the reach be assigned to the Superior High Quality Water antidegradation tier.

According to the *Appendices to the Year 2000 Ohio Water Resource Inventory* (Ohio EPA, 2000), much development is occurring within this largely agricultural watershed. The Ohio EPA noted continued development of warehouses and other commercial buildings near the Rickenbacker International Airport (Ohio EPA, 2006). The agricultural and urban land uses within the watershed have had an impact on tributaries to this segment of Walnut Creek, portions of which are in partial or non-attainment of their designated aquatic life uses (Ohio EPA, 2008). Channelization, flow alterations, bacterial contamination from package plants and other wastewater sources, sedimentation from agricultural sources and other contamination from urban sources were noted within the *2008 Integrated Water Quality Monitoring and Assessment Report* (Ohio EPA, 2008). Portions of the watershed are in non-attainment of the Primary Contact Recreation Use Designation due to pathogen contamination. Fish tissue analysis also revealed impairments due to pollutants and PCBs. These various impairments caused the Ohio EPA to list this subwatershed as a Priority Impaired Water on the 303(d) list.

The Big Run tributary, which flows through a predominantly agricultural watershed, is currently designated as WWH and Coldwater Habitat (CWH) (OAC 3745-1-09, effective 4/23/08). The WWH segment includes the portion of the stream that flows through the Eastside Nursery property. Sampling conducted by Ohio EPA for the 2006 study at a site just upstream from the property (Hayes Road) showed the stream to be in non-attainment of the WWH designation due to dewatering of unknown origin and organic nutrient enrichment suspected to originate from the adjacent Century Acres Waste Water Treatment Plant (WWTP). Past stream channelization and riparian disturbances were also suspected to be contributing to the high nutrient levels in the stream. Water sampling showed bacterial counts exceeding 30-day maximum and geometric mean standards, likely due to the WWTP discharge. Samples along this reach exceeded the median background for total dissolved solids. This segment of Big Run received a Qualitative Habitat Evaluation Index (QHEI) score of 40, which is in the *poor* narrative range. This score reflected a lack of sinuosity and instream habitat (riffles and pools), moderate to heavy siltation, fair to poor channel development, and lack of fast current that is characteristic of the entire channel from Hayes Road to the confluence with Walnut Creek. Index of Biotic Integrity (IBI) and Invertebrate Community Index (ICI) scores assessed at this sampling location indicate fish and benthic communities within the *fair* narrative range.

The proposed restoration of Big Run and adjacent wetland areas is anticipated to have a beneficial effect on the Walnut Creek watershed. The mitigation project will correct or ameliorate some of the noted physical impairments along Big Run with the goals of restoring stability and promoting aquatic habitat within the channel, while also helping to preserve water quality within the Walnut Creek mainstem. A portion of Big Run will be restored using natural channel design techniques to create a sinuous channel with appropriate instream habitat features (e.g. pools and riffles), within a forested floodplain and riparian corridor. The project will help to reduce erosion along the restoration reach and subsequent deposition of silt, sediment and nutrients within Walnut Creek located downstream. In addition, the project will convert an agricultural field currently drained by field tiles into a biologically productive wetland habitat constructed in existing hydric soils. Removal of field tiles will allow for the restoration of more natural hydrologic conditions within the wetland areas. The restored wetland areas will help to attenuate runoff of sediment and nutrient loading within both Big Run and Walnut Creek.

3.2 Practicability of Restoration

Big Run is a substantially altered tributary to Walnut Creek that flows through the Eastside Nursery property. Big Run has been historically maintained in a channelized condition and lacks any significant sinuosity or instream habitat. The riparian corridor along this portion of Big Run is essentially denuded, except for a few scattered small caliper trees. The stream is notably incised, with bank heights averaging 5.25 feet along the channel, and Bank Height Ratios (BHR) ranging between 1.14 and 1.52. BHR values exceeding 1.2 generally characterize an unstable, incised channel. Big Run would substantially benefit from a complete restoration of the channel following natural channel design principles and the establishment of a planted riparian corridor.

The Eastside Nursery property also provides ample opportunity for wetland restoration, particularly in areas adjacent to and west of Big Run. A large swath of existing hydric soils and relatively flat topography in this area will provide the basis for wetland restoration. Initial feasibility studies indicate that existing surface and subsurface flow conditions can be modified in this area to support wetland development. Subtle grading around the area will be employed to retain surface hydrology within the proposed wetland cells, and a tile system currently draining the site will also be disrupted to retain water within the wetlands. Installation of native forbs and woody plants will kick-start the development of a healthy wetland ecosystem and help to preclude intrusion by invasive species.

4.0 BASELINE INFORMATION

4.1 Site Location

As shown on Exhibit 1, the subject property is located southwest of Lithopolis Road, east of Richardson Road and north of Hayes Road. The geographical coordinates for the site are 39.843373 N latitude, -82.865067 W longitude. The site is located within the Walnut Creek watershed (HUC 05060001180). The mitigation project will correct or ameliorate some of the noted physical impairments along Big Run with the goals of restoring stability and promoting aquatic habitat within the channel, while also helping to preserve water quality within the Walnut Creek mainstem. The project will also restore wetland areas currently impacted by agricultural practices, serving to protect Big Run and the downstream Walnut Creek from sediment and nutrient loading commonly associated with that land use.

4.2 Existing Land Use

The majority of the property consisted of an active nursery operation until the end of 2009. Planted tree and shrub stock still cover most of the area to the east of Big Run while active agricultural fields cover the area to the west. Anthropogenic influences on the site have shaped current land use. Since nursery activities have ceased, the restoration potential of the site can be realized.

4.3 Topography

As shown the USGS topographic map (Exhibit 2), the southeastern and southwestern portions of the study area are at an approximate elevation of 750 feet (National Geodetic Vertical Datum), before sloping down towards Big Run at an elevation of approximately 730 feet according to the USGS 7.5' Series *Canal Winchester, Ohio* quadrangle (USGS, 1985). The east central portion of the study area is also at an approximate elevation of 750 feet, before sloping down towards Big Run. Big Run bisects the study area, flowing from southeast to northwest, and has a gradient of 8.27 feet/mile. Walnut Creek is located adjacent to the northern property boundary. The site is topographically flat which promotes a wetland restoration approach.

4.4 Mapped Soils

A hydric soil is *a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation* (USDA-NRCS, 2006). According to the Soil Survey of Franklin County Ohio (Exhibit 4), one hydric soil is mapped for the project site. Most of the soils on the site have the potential for hydric inclusions (NRCS, 2004). Table 1 summarizes the soil types indicated for the study area according to the Natural Resource Conservation Service (NRCS, 2008). The site was originally chosen for restoration activities because of the indication of hydric soils on the property. Hydric soils are a necessary component of successful wetland restoration.

TABLE 1
Mapped Onsite Soils Summary

Mapped Soil Unit	Inclusions	Hydric	Non-Hydric	Location of Hydric Inclusions
Celina silt loam with 2-6% slopes (CeB)	Kokomo	N	Y	Depressions on till plains
Crosby silt loam with 2-6% slopes (CrB)	Kokomo	N	Y	Depressions
Eel silt loam, occasionally flooded (Ee)	Sloan	N	Y	Depressions
Miamian silty clay loam with 6-12% slopes (MlC2)	Kokomo	N	Y	Depressions
Miamian silt loam with 2-6% slopes (MkB)	Kokomo	N	Y	Depressions
Ockley silt loam with 0-2% slopes (OcA)	Westland	N	Y	Depressions
Ockley silt loam with 2-6% slopes (OcB)	-	N	Y	-
Shoals silt loam, occasionally flooded (Sh)	Sloan	N	Y	Depressions
Sloan silt loam with 0-2% slopes (So)	-	Y	-	-

4.5 Flood Hazard Information

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) was reviewed for the site. The project area is shown on the FIRM for Franklin County and Incorporated Areas (Number 39049C1 Panels 0451K and 0453K, dated June 17, 2008). As shown in Exhibit 5, much of the site is within Zone AE, which corresponds to special flood hazard areas subject to inundation by the 100-year (1% annual chance) floodplain for which base flood elevations have been determined. Floodway areas within Zone AE are indicated by white hatching along Big Run and Little Walnut Creek. The Floodway is the stream channel along with any adjacent floodplain areas that must be kept free of encroachment so that the 100-year floodplain can be carried without substantial increases in flood heights. Other portions of the site are indicated as Zone X (shaded), which are areas of the 500-year (0.2% annual chance) floodplain and Zone X (unshaded), which are areas determined to be outside the 500-year floodplain.

As part of the *Columbus Regional Airport Authority – Wetland & Stream Feasibility Analysis* (EMH&T, 2009) performed for the property, a detailed flood hazard impact study was completed in conformance with the requirements of the National Flood Insurance Program (NFIP) and the adopted floodplain management regulations of Franklin County. The study is required due to the proposed restoration activities within the regulatory floodway of Big Run, and to demonstrate that the proposed project will not increase calculated 100-year flood elevations. Since the proposed restoration activities are within the 100-year floodplain and floodway of Big Run, an NFIP permit from the Franklin County Economic Development and Planning Department was obtained for the project.

4.6 National Wetland Inventory

According to the National Wetland Inventory (NWI) Map of the *Canal Winchester, Ohio* quadrangle (USFWS, 1995), six NWI features are indicated within the study area (Exhibit 6). Table 2 summarizes the NWI feature types indicated for the site. Actual field investigations to determine the presence of jurisdictional Waters of the United States were performed as described under Section 4.9.

TABLE 2
Onsite NWI Features

NWI Symbol	Classification
PEMA	Palustrine, Emergent, Temporarily Flooded
PEMCd	Palustrine, Emergent, Seasonally Flooded, Partially Drained/ Ditched
PUBGh	Palustrine, Unconsolidated Bottom, Intermittently Exposed, Diked/ Impounded

4.7 Threatened and Endangered Species

The United States Fish and Wildlife Service (USFWS) published list of endangered and threatened species in Ohio (11/2008) was reviewed. According to the list, four endangered species are found distributed within Franklin County, including *Myotis sodalis* (Indiana bat), *Noturus trautmani* (Scioto madtom), *Pleurobema clava* (clubshell mussel) and *Epioblasma torulosa rangiana* (northern riffleshell). *Villosa fabalis* (rayed bean mussel) is listed as a candidate species in Franklin County, Ohio. *Haliaeetus leucocephalus* (bald eagle) and *Epioblasma triquetra* (Snuff Box) are listed as species of concern in Franklin County, Ohio.

According to Clark, B. K., et. al., *Myotis sodalis* is found in Ohio during summer months through September. Preferred habitat includes large *living or dead trees with large cavities, cracks or exfoliated bark* (1987). Tree species including *Ulmus americana* (American elm), *U. rubra* (slippery elm), *Quercus stellata* (post oak), *Q. rubra* (red oak), *Carya ovata* (shagbark hickory), *C. cordiformis* (bitternut hickory), *Populus deltoides* (Eastern cottonwood), *Acer saccharinum* (silver maple) and *Fraxinus pennsylvanica* (green ash) have been documented as used by reproductively active females in Michigan (Kurta, et. al., 1993). The subject property is primarily open field, with a narrow wooded corridor along Walnut Creek. The Walnut Creek corridor may contain trees that exhibit preferred *Myotis sodalis* habitat; however, no clearing along Walnut Creek is proposed. A few small, sporadically located trees are also present along Big Run and may be removed during restoration; however, the channel is primarily denuded of woody vegetation. Portions of the property currently in nursery production contain rows of small caliper nursery tree stock which would not provide roost habitat for *Myotis sodalis.*

The known occurrences of *Epioblasma torulosa rangiana, Noturus trautmani* and *Pleurobema clava* within Franklin County have only been from the Big Darby Creek of the Scioto River basin. In addition, *Noturus trautmani* has only been collected from the lower Big Darby Creek, and has not been recorded in over 30 years (Fazio, 1993). Since the streams on this property do not drain into the Big Darby watershed, the restoration project would not likely impact these species.

Villosa fabalis "occurs in small, shallow rivers, in and near riffles," and is also found "in slow flowing rivers, and along the shallow, wave-swept shores of lakes," (Carman, 2001). *Epioblasma triquetra* "occurs in clean, swift small and medium sized rivers" (Michigan Natural Features Inventory, 2007). Because of the large amount of siltation in Walnut Creek and the severe undercutting occurring in Big Run, the potential for mussel development within the onsite streams are unlikely; therefore, the mitigation project is not likely to have an impact upon these species.

According to the ODNR, Division of Wildlife, *Haliaeetus leucocephalus* has been recorded in 57 of Ohio's 88 counties. The ideal habitat for the bird is a secluded site within two miles of water so that the bird has access to a source of fish. The bird will also feed on groundhogs, rabbits, squirrels, hawks, owls, ducks, gulls, and other small mammals or birds, in addition to carrion (ODNR, 1/20/04). The subject property does not contain super canopy trees that would likely be suitable for this species. No bald eagles or eagle nests were observed on the subject property.

Upfront coordination with USFWS was initiated by EMH&T concerning possible impacts to threatened and endangered species. The USFWS June 5, 2009 response letter is attached in Appendix B. In the letter, the USFWS recommended that Best Management Practices (BMPs) be utilized to minimize sedimentation and erosion along Big Run and prevent impacts to Walnut Creek. They also recommended that stream activities be completed during periods of low flow to reduce stream impacts. The USFWS recommends planting disturbed areas with native riparian species to prevent non-native, invasive plant establishment and for maximum benefit, the riparian areas should not be mowed. The USFWS also recommends the restoration area be protected through the use of a conservation easement or environmental covenant, held by a conservation agency, to ensure appropriate management of the restored area.

Due to the project type, location, and onsite habitat, the USFWS do not expect impacts to the following species: *Haliaeetus leucocephalus, Noturus trautmani, Villosa fabalis,* and *Epioblasma triquetra.* The USFWS recommends the use of BMPs to avoid sediment impacts to Walnut Creek and ultimately the species *Pleurobema clava.* The USFWS also stated that "Myotis sodalis habitat appears to be within the riparrin buffer along Walnut Creek and the trees should be saved whenever possible but if they cannot be avoided, they should only be cut between September 30 and April 1."

ODNR was contacted for any information available concerning the presence of state listed endangered, threatened and proposed species or their habitat for the project site. ODNR was requested to provide information through a formal search of the ODNR Natural Heritage Database. The database search revealed that no records of rare or endangered species or their habitat were present on the project site. In addition, no records of existing or proposed state nature preserves, unique ecological sites, geologic features, breeding or non-breeding animal concentrations, state parks, state forests, scenic river, or wildlife areas are present within the project area (ODNR, 05/18/09). A copy of the ODNR letter is also included in Appendix B.

4.8 Cultural Resources

Professional archaeologists with EMH&T conducted a Cultural Resources Management Literature Review for a 2 kilometer (1.2 mile) radius around the project area. The information gathered from the literature review indicates that the project area has never been professionally surveyed, but does contain previously identified cultural resources. Archaeological site 33-FR-2537 is a prehistoric period site recorded by Jonathan E. Bowen of the Ohio Historical Society. It is unclear from the form what the exact nature of the discovery was for the site, but the site does include a very rare Paleo-Indian fluted point. The site form also indicates that the site was reportedly still intact in 2006. The location of Walnut Creek along the northern edge of the project site and Big Run within center of the project site indicates a high probability that many additional prehistoric archaeological sites could be located within the project area. The results of the literature review also identified a mid-1800s brick house within the survey radius that was recommended as eligible for the listing on the National Register of Historic Places. This house is located at 4980 Lithopolis Road and has Greek revival elements. The house was recommended as eligible by Jeff Darbee of the Ohio Historic Preservation Office in 1975. The historic map and atlas search indicated that two additional houses were once located within the survey radius as well. Related archaeological deposits may be present around all three houses.

Based on the results of the Cultural Resources Management Literature Review, a Phase I Cultural Resources Management (CRM) Survey was recommended for the Eastside Nursery Restoration Project Site. A Phase I CRM Survey was completed on the restoration site in June 2009. Based on the results of the survey, 13 previously unknown archaeological sites (33-Fr-[2745-2757]) were identified. Sites 33-Fr-(2745-2747, 2750-2752 and 2757) were isolated find spots that contained a single artifact each. Sites 33-FR-(2748-2749 and 2753-2756) were small, low-density prehistoric lithic scatters. Only one diagnostic artifact was recovered within the project area. This artifact consisted of a fragmented Late Archaic Brewerton corner-notch point recovered from site 33-Fr-2745. Based on the survey findings, no further work is recommended for any of these archaeological sites. A copy of the Phase I CRM survey report is included as Appendix C.

4.9 Wetland and Stream Delineation

A routine delineation to determine the location and extent of Waters of the United States, including streams and wetlands, was conducted by EMH&T for the approximately 482 acre Eastside Nursery property on November 6, 2008. Potential Waters of the United States were identified and delineated in accordance with the June 5, 2007 Regulatory Guidance Letter No. 07-01 issued by the USACE following the United States Supreme Court Decision Rapanos vs. United States. Identification of potential jurisdictional wetlands required characterization of plant community types, identification of hydric soils, and evidence of hydrologic indicators for each community type. For all potential wetland areas, dominant species in the tree, sapling, shrub, woody vine and herb layers were determined, in accordance with the 1987 Wetlands Delineation Manual. The boundaries of areas in which all three wetland criteria were met were identified and measured in the field. The delineation map for the property is included as Exhibit 7.

The delineation identified one potentially non-jurisdictional wet area, four non-jurisdictional ponds, a non-jurisdictional irrigation ditch and two jurisdictional streams. Walnut Creek flows adjacent to the northern property boundary, while Big Run flows through the central portion of the property. Together the two jurisdictional streams flow for 9,525 linear feet on the site. This delineation was submitted to the USACE for verification on December 12, 2008. The USACE verified the results of the Jurisdiction Waters Investigation for the CRAA mitigation site on October 29, 2009. A copy of the verification letter is included as Appendix D.

4.10 Assessment of Existing Conditions – Big Run

Big Run is an intermittent, second order tributary to Walnut Creek (HUC 05060001180) that flows in a northerly direction across the Eastside Nursery property. The alignment of Big Run is linear, with an existing channel sinuosity of 1.09. The stream has been significantly hydromodified through channel realignment (straightening) and dredging. The banks along the stream are very steep to vertical and sit as much as 7 feet above the baseflow channel. The banks have slumped, slipped or failed at several locations along Big Run due to high near-bank shear stress during peak flow events, exacerbated by the denuded, steep to vertical, unstable sandy streambanks. These impairments have lead to erosion, mass wasting, onsite and offsite sediment loading into the Walnut Creek catchment. Degradation of the sand/silt dominated streambed and bank failure, together with the presence of large depositional sand bars shows the existing channel has the competency (the ability to transport sediment in terms of particle size), but lacks the capacity (the ability to transport sediment, as measured by the quantity it can carry past a given point in a unit of time) due to its severely impaired condition.

The consequence of channelization, incision (vertical containment), confinement (lateral containment), major floods, changes in sediment regime, loss of riparian vegetation and shifts in stream base level are attributed causes and effects for existing conditions along the impaired project reach. The effects of these anthropogenic changes are accelerated streambank erosion, channel incision, land loss, aquatic habitat loss, lowering of the water table, land productivity reduction and in-stream and downstream sedimentation.

To quantify existing conditions of physical impairments on Big Run, EMH&T conducted a topographic field survey on the project site during November 2008. The survey included 11 stream channel cross-sections, together with approximately 2,000 linear feet of longitudinal profile at the upstream and downstream reaches of the stream on the Eastside Nursery site. The survey vertical control is tied to 1988 North American Vertical Datum (NAVD 88) and State Plane South Zone Coordinates for horizontal control. Field survey data was supplemented by topographic data published by the Franklin County Auditor's Office, as shown and noted on several exhibits contained within this report.

Four of the eleven impaired conditions stream cross-sections transect the proposed restoration reach on Big Run: XS C-19 at impaired profile station 0+00.00, XS B-18 at station 8+52.30, XS A-17.4 at station 16+25.29, and XS A-17 at impaired profile station 22+15.17. The total length of the lower Big Run impaired conditions longitudinal profile survey is 1,133 linear feet to its confluence with Walnut Creek (refer to "Lower Big Run, Impaired Longitudinal Profile, March 17, 2009" included with the information in Appendix E).

A second impaired longitudinal profile is also provided in Appendix E that simply connects the thalweg elevations at the four stream cross-sections and the confluence with Walnut Creek. The purpose of this profile is to illustrate the degree of channel incision using Bank Height Ratios (BHR = Lowest Bank Height/Maximum Bankfull Depth = LBH/D_{MAX}). The profile shows that the channel along the restoration reach is moderately to deeply incised. The calculations in Summary Table 1 in Appendix E show BHR values range from 1.14 at cross-section C-19 (slightly incised, impaired profile station 0+00.00) to 1.52 at cross-section A-17.4 (deeply incised, impaired profile station 16+25.29). The degree of channel incision increases in the downstream direction where Big Run has down cut into the Quaternary alluvial deposits on the Walnut Creek floodplain.

An existing conditions geomorphologic and hydraulic relationships impairment analysis was completed to statistically quantify data minimum, maximum, mean and median values, provided in Summary Table 1, within Appendix E. In addition to the profile and table already referenced, Appendix E contains supporting data, including cross-section plots and impaired Rosgen Stream Type classification forms. These forms indicate that three of the four analyzed cross-sections, using the Rosgen Classification of Natural Rivers, show Big Run is an incised E Stream Type (D.L. Rosgen, 1996).

Two Qualitative Habitat Evaluation Index (QHEI) assessments were performed along representative reaches on Big Run during August 11, 2008. The evaluated reaches, shown on Exhibit 7, received scores of 31 and 28.5, respectively, placing them in the 'poor' narrative rating category as described in the QHEI manual (Ohio EPA, 2006). The QHEI field data sheets are included in Appendix F. Results of the geomorphic and QHEI assessments show that Big Run is a highly degraded stream both physically and from the standpoint of aquatic habitat potential. The proposed improvements to the stream would have a significant beneficial effect upon water quality and wildlife habitat within the Walnut Creek watershed.

5.0 MITIGATION WORK PLAN

5.1 Geographic Boundaries of the Mitigation Site

The Eastside Nursery property consists of one parcel with a total area of approximately 482 acres located at 6723 Lithopolis Road, near Groveport, Ohio 43125 (Franklin County Auditor's Parcel ID Number 180-000301-00). The property is located southwest of Lithopolis Road, east of Richardson Road and north of Hayes Road in Madison Township, Franklin County, Ohio. The parcel was acquired by Metro Parks on December 19, 2008 with the understanding that a portion of the site will be cooperatively restored with a functional wetland, stream and a riparian corridor, incorporating aquatic and terrestrial habitat features. A portion of these improvements will serve as mitigation for on-going permitting activities for capital improvement projects the CRAA is undertaking at Port Columbus, as well as potential future wetland/stream impacts.

The Eastside Nursery property is located in the Big Run Watershed, an intermittent tributary to Walnut Creek, which is substantially degraded and has excellent restoration potential. The proposed improvements would have a significant beneficial effect upon water quality and wildlife habitat within the Walnut Creek Watershed (HUC 05060001180). This meets the goal of completing mitigation requirements locally, as this watershed is adjacent to the Big Walnut Creek Watershed, where the proposed CRAA impacts will occur. As the mitigation area is part of a Metro Parks property, future management and preservation of the site by competent, responsible stewards would be assured.

Specific mitigation work plans for the CRAA stream and wetland project proposed for the Eastside Nursery site are discussed in detail in following sections.

5.2 Stream Mitigation Work Plan

An off-line restoration approach (stream channel relocation) is proposed for Big Run, as shown on Exhibits 8A-8C. The existing linear, incised stream channel will be naturally restored with appropriate pattern, profile and dimension to convey bankfull flows, together with the competency and capacity to entrain the high sediment supply from Big Run's 8.5-square mile watershed (refer to Exhibit 3) without aggrading or degrading. In-stream habitat features will be constructed on Big Run to promote the potential for aquatic macroinvertebrates and fish colonization in the restored channel as shown on Exhibits 9A-9B. A beltwidth will be excavated, creating an appropriately sized floodplain valley to convey flood flows. A comprehensive planting plan will be implemented along the channel, including streamside, floodplain and riparian zones. The planting plan will reflect native vegetative plantings, including ground cover, shrubs, mid-story and canopy species as shown on Exhibit 10. Following restoration, the existing Big Run channel will be backfilled with material excavated from the new floodplain.

5.2.1 Design Specifications

The natural channel design approach for Big Run includes lowering of bank heights and slope stabilization, reduction in streambank erosion potential and riparian vegetation restoration. Reconnecting the bankfull channel to a functional floodplain will alleviate channel and near-bank shear stress and shear velocity during flood events. Further improvements include aquatic habitat potential, reduction of channel sediment loading and a stable downstream grade transition into the existing alignment.

The alignment of the relocated stream corridor and the designed sinuosity of the channel will allow for an increase of the total length of the stream, replacing the existing approximately 2,450 linear feet of impaired stream channel with approximately 2,700 linear feet of restored and geomorphically stable channel that is in dynamic equilibrium with its landform. One permanent, pedestrian bridge crossing, shown on Exhibit 8C, will be established along the new channel to provide pedestrian/vehicular access for site maintenance and emergency access. The restored channel will include features associated with the principles of natural channel design and fluvial geomorphology, including pool/riffle sequences, and a connection to the adjacent floodplain. Exhibits 8A-8C presents the proposed alignment for Big Run. Exhibits 9A-9B provide final engineering plans and construction specifications for the stream and its in-stream structures, as well as typical sections.

The ability to transport streamflows and sediment in such a manner that the channel maintains its dimension, pattern and profile without either aggrading or degrading is the premise upon which the natural channel design for Big Run is based. The materials used to construct riffles and other substrate material placed in the channel will be sized based on the quantified stream power and the critical shear stress at bankfull stage required to initiate movement of bedload materials, thus restoring dynamic equilibrium that will maintain the stream channel dimension, pattern and profile.

As a component of the natural channel design for Big Run, the multiple regression equations for estimating flood-peak discharges in rural, unregulated streams in Ohio, with map-based and field-based explanatory variables, published in USGS open file report *Techniques for Estimating Flood-Peak Discharges of Rural, Unregulated Streams in Ohio*, Water Resources Investigations Report 89-4126 (March 1990) was utilized. Using the multiple regression equations published in Table 1 of the cited document, and using field- and map-based variables, the regional regression equations were used to empirically predict flood-peak discharges for 2-, 5-, 10-, 25-, 50- and 100-year frequency discharges. A discharge versus frequency linear-log plot was created and a power trendline curve fit to the data points. Bankfull discharge is estimated at 300 cubic feet per second (cfs) with a return interval of 1.7 years. The discharge versus frequency plot is included with the information in Appendix E.

Bankfull width (W_{BKF}) = 31.0 feet, bankfull mean depth (D_{BKF}) = 2.3 feet, and bankfull cross-sectional area (A_{BKF}) = 71.8 square feet are derived from the multiple regression equations published in Table 9 in USGS open file report *Bankfull Characteristics of Ohio Streams and Their Relation to Peak Streamflows*, Scientific Investigations Report 2005-5153 (January 12, 2006). In addition, we also considered observations of a stable section of the Big Run channel, upstream of Oregon Road. The empirical data approximates the quantified data in Table 3, and has been carried forward into the design.

There are several design approaches that have been utilized for the restoration and stabilization of incised and degraded channels. In "*A Geomorphologic Approach for Restoration of Incised Rivers*" (Rosgen, 1996) four approaches (Priority Level 1 through Priority Level 4) are presented for the restoration of incised rivers. Only Priority Level 1 or Priority Level 2 would constitute restoration for the purpose of providing mitigation. In general terms, Priority Level 1 involves raising the bankfull channel to the elevation of its abandoned floodplain; Priority Level 2 entails lowering (excavating) the floodplain, and in some cases, raising the streambed to restore connection between the bankfull channel and its floodprone area. Utilizing either Priority Level 1 or Priority Level 2 design approaches, the bankfull channel is restored to a stable geomorphologic condition in which the channel is in dynamic equilibrium with its landform.

The proposed restoration on Big Run will utilize a Priority Level 2 natural channel design approach. A new floodplain will be excavated east of the existing channel alignment and extend north to the Eastside Nursery property boundary near the confluence of Big Run with Walnut Creek. The down valley slope of the constructed floodplain is controlled by the tie-in elevation points of with existing incised channel at the upstream and downstream limits of the restoration reach. The average fall-line slope of the proposed valley is 0.00287 feet per foot or 0.287 percent.

This approach will provide stable channel boundary conditions based upon natural channel design principles, which reconnects the bankfull channel to a functional floodplain with sufficient streamway width for stable meander geometry. Impaired geomorphologic and hydraulic relationships for Big Run, as well as the proposed design conditions for the stream restoration project, are presented in Summary Table 1in Appendix E. The restoration plan with typical riffle and pool cross-sections, dimensions and specifications for the restored stream is presented on Exhibits 8A-8C and 9A-9B. Based upon the impaired conditions hydraulic analyses and flood-peak discharge regression analyses (USGS WRIR 89-4126), bankfull discharge is estimated at 300 cfs. Table 3 presents a summary of the existing and proposed morphological attributes within the Big Run restoration reach.

TABLE 3
Big Run Channel Morphology Summary

Parameter	Existing Conditions Median Values		Proposed Conditions
	On-site(impaired)	**Oregon Road**	
Bankfull Width (ft)	35.7	36.8	31
Beltwidth	-----	-----	225
Mean Depth (ft)	2.7	2.0	2.3
Maximum Depth (ft)	6.4	2.9	3.5
Width/Depth Ratio	13.0	18.4	13.4
Bankfull Area (sq ft)	97.4	73.5	71.8
Sinuosity[3]	1.09	-----	1.22
Slope of Channel (ft/ft)	0.00293	-----	0.0017
Channel Material D_{50} (mm)	2 (V. Coarse Sand)[4]	-----	28.7 (Coarse Gravel)
Movable Particle (mm)	80.1 (Small Cobble)	-----	75.2 (Small Cobble)
Stream Classification	E 6	-----	C 4

[1] Floodplain width and an elevation corresponding to 2 times bankfull maximum depth
[2] Ratio of floodprone width to bankfull width
[3] Length of stream channel/length of valley
[4] Existing substrate was characterized visually; a riffle pebble count was not collected

5.2.2 Construction Methods, Timing and Sequence

Large earthmoving equipment will be used to excavate the stream valley and riparian corridor prior to the construction of the channel. Small earthmoving equipment will be used to construct the channel and bedform features. The proposed construction sequence will incorporate best management practices to minimize erosion and the risk of onsite and offsite sedimentation. The valley excavation and channel construction will occur off-line from the existing watercourse and will be isolated from the flows in the existing channel by maintaining an earthen plug at the upstream limits of the restoration reach. An earthen plug will also be installed and maintained at the downstream end of the restoration reach during construction to contain sediment to the off-line project corridor. The newly constructed channel will be stabilized prior to introduction of flows. EMH&T will provide oversight for the construction of the wetland and stream mitigation projects.

A temporary stream crossing will be needed along the existing Big Run channel during construction to allow adequate access for construction equipment, as shown on Exhibit 8C. All temporary crossings will be removed and stabilized as part of the stream restoration construction sequence. Access to the restoration area will be provided through the adjacent fields and existing driveway used during nursery operations. Construction vehicle ingress/egress will be provided from an existing driveway along Lithopolis Road.

Planting along the restored stream, as detailed in Section 5.2.4, will take place during the first appropriate planting season following construction, creating optimal conditions for vegetation establishment and success. All plant materials will be inspected prior to planting. Plants showing signs of stress will be replaced. Plantings will be periodically inspected to ensure success.

5.2.3 Hydrologic Sources

The Big Run restoration reach has an 8.5 square mile watershed. The flow conditions for Big Run are anticipated to improve after the stream restoration, with respect to competency and the capacity to transport sediment and maintain the integrity of channel bedform features.

5.2.4 Riparian Corridor Planting Plans

Significant planting of native trees and shrubs is planned along the restored Big Run channel. The planting plan for Big Run is divided into three 'zones' which will be planted accordingly depending on proximity to the stream, as shown on Exhibit 10. *Zone 1* includes the outside meanders of the stream, *Zone 2* comprises the immediate streamside area, and *Zone 3* is the floodprone, upland riparian buffer. Trees and shrubs will be slightly staggered within the zones to increase shade coverage, with shrubs interspersed throughout the trees. The proposed planting densities indicated on Exhibit 10 allow for sufficient room for plant growth over time, but are dense enough to encourage a robust corridor. The species selected for planting within each zone are indicated on Exhibit 10. All species indicated are native to the region and cold hardy. Value to wildlife was also considered when preparing the plant species list, and some of the proposed species promote potential habitat for *Myotis sodalis*.

Disturbed areas, such as side slopes, will be seeded with a rapidly germinating annual cover mixture to provide erosion control and prevent the establishment of undesirable species. In addition, the riparian buffer will be seeded with a Native Grass Mix to promote stabilization of exposed soils and provide additional wildlife habitat. Seeding specifications are provided on Exhibit 10.

5.2.5 Grading Plan

Preliminary earthwork volume calculations indicate approximately 45,300 cubic yards of earth materials will be excavated to grade out the designed stream valley and the restored offline Big Run stream channel. Excavated soils will be stored in an on-site upland location, temporarily stabilized with seeding, or disposed off-site. A portion of the excavated material will be used in the construction of other mitigation features on the site and used to fill in the old Big Run channel. Any excavated soil not otherwise disposed of will be graded on site and stabilized with permanent seeding. A specific grading plan for the entire mitigation site, including sediment and erosion control specifications for the excavation and on-site storage of soils, has been generated as part of the final engineering plans.

5.2.6 Sediment and Erosion Control

Erosion and sediment control will be provided as part of the construction of the various mitigation activities in accordance with the State of Ohio's Authorization for Stormwater Discharges, prepared under the National Pollutant Discharge Elimination System (NPDES) regulations, promulgated by the Ohio EPA. Best management practices to be performed as part of erosion and sediment control measures for the restoration of Big Run are described on the following page. These items are documented in an erosion and sediment control plan and Stormwater Pollution Prevention Plan (SWPPP) prepared as part of the final engineering plans.

- As mentioned previously, the offline (relocated) portion of the stream will be isolated from flow in the existing channel by maintaining earthen plugs at the upstream and downstream ends, prior to where the offline channel intersects the existing incised channel. Only after the offline portions of the stream channel have been stabilized will flow be routed through the restored reach.

- Off-line stream restoration work will be constructed in the dry by using pumps and hoses to dewater the excavated valley and channel of any accumulated surface runoff or groundwater. The discharge water will be filtered through a constructed dewatering sediment trap or sediment filtration bag constructed of nonwoven polyethylene fiber fabric prior to discharge of treated stormwater from the project site.

- As part of the construction of the stream valley, aggregate check dams may be placed intermittently to disrupt flow attributed to rainfall runoff that accumulates within the excavated stream corridor, preventing the concentration of flows that would exacerbate erosion.

- Both temporary and permanent seeding will be implemented as required under NPDES regulations and guidelines.

All sediment control structures and measures utilized will remain in place during construction activities until the site has been stabilized. Areas disturbed during construction will be seeded to establish vegetative cover and decrease erosion potential. The prepared erosion and sediment control plan and SWPPP will provide guidance on necessary construction practices and sequence. Construction inspection will verify that these practices and sequences are being followed.

5.3 Wetland Mitigation Work Plan

Wetland restoration will occur via improvements to an agricultural field containing hydric soils on the northwestern portion of the property to restore hydrologic conditions conducive to an eventual wetland environment. A total of approximately 22.5 acres of wetland habitat will be restored within two separate wetland cells. Approximately 11.3 acres of the wetland is intended to develop the hydrology and plant community conducive to the eventual development of forested wetland habitat while the remaining approximately 11.2 acres will be developed as emergent wetland. Existing agricultural activities will be ceased, and the mitigation design proposes to restore both surface and groundwater flow conditions to the pre-agriculture condition. Field tile will be removed and some grading for embankments performed to capture surface runoff within the mitigation area. To promote the rapid re-vegetation of the mitigation area, significant planting of the appropriate herbaceous, shrub and tree species will be performed.

5.3.1 Design Specifications

Approximately 22.5 acres of emergent and forested wetland will be restored within two wetland cells on existing hydric soils in the northwestern portion of the property, as shown on Exhibit 11A. The forested portion of the wetland areas will be designed to have a normal pool depth of 0.0 (saturated) to 0.2 feet (inundated), which is conducive to supporting an eventual forested wetland plant community. The emergent portion of the wetland areas will be designed with a normal pool depth of approximately 0.2 to 1.0 foot. The location of the forested and emergent wetland areas has been determined to minimize earth moving activities that would disturb the existing hydric soils. Hydrology will be supplied to the wetlands by overland runoff from the surrounding hillsides, as well as locating and plugging existing agricultural tiles. Shallow earthen berms will be constructed around both wetland perimeters to retain hydrology. Additional grading will occur just south of the wetland cells to promote surface runoff into the cells. Substantial plantings of hydrophytic trees, shrubs and forbs will be included in the wetland plans to promote the development of a diverse vegetative community and help to preclude infiltration of invasive species.

The sustainability of the design of the wetland mitigation cells are based on their simplicity. The majority of the grade alterations related to a shallow embankment and diversion of flow from a swale south of the wetland cells are to facilitate the required landform and to provide the hydrology adequate to support the wetland mitigation. Existing hydric soils and evidence of a sustained groundwater condition further contribute to the sustainability of the design of the site.

5.3.2 Hydrologic Sources

A watershed area of approximately 126 acres (refer to Exhibit 3) provides surface water runoff to the mitigation site. Additionally, there is evidence of a seasonal shallow groundwater condition that will support wetland hydrology. Grading of a shallow earthen berm will promote the capture of surface water within the wetland areas. Field tile exploration through trenching and crushing will take place to reverse the drained soil condition previously established to promote agriculture use of the site. The exploratory trench will be backfilled with cohesive clay material to further improve water retention within the wetland areas. Where porous material, such as sand or gravel, is found within the inspection trench, it will be over-excavated and backfilled with cohesive clay material. In performing this activity, a low permeability "curtain" will exist around the perimeter of the wetland cells to further sustain the saturated groundwater condition. Exhibit 11A shows a plan view of the wetland mitigation site and reflects the location of the proposed grading that will promote the development of wetlands within this area. Exhibit 12 depicts the details of the embankment and field tile exploration that will occur around a portion of the perimeter of the wetland restoration areas.

5.3.2.1 Outlet Structure Design

There are two outlet features for each wetland cell: one overflow spillway and one outlet control structure along the shallow embankment. The spillways are reinforced with stone and geotextile material and are designed to discharge excess flow during large rainfall events. The outlet structures will have stop logs that will allow for manipulation of the normal pool elevation within the wetland cells as needed for maintenance activities.

The design of the outlet structures for each wetland cell is such that it will maintain the desired normal operating pool elevation when there is sufficient hydrology to support that elevation. When the source hydrology to the wetland cells exceeds the amount necessary to sustain that pool elevation, due to large rainfall events, the excess flow will be discharged through the overflow spillways. Wetland Cell 1B discharges directly into Cell 1A, and Cell 1A discharges into an existing swale north of the cell.

5.3.2.2 Embankment Construction and Access

All construction of embankments and the clay curtain will be performed using cohesive clay material borrowed from other areas on the mitigation site. The constructed embankments will have side slopes of no steeper than 15:1. Access will be provided through the adjacent fields and existing driveways used during nursery operations. Construction vehicle ingress/egress will be provided from an existing driveway along Lithopolis Road.

5.3.2.3 Sustainability of Water Source (Water Budget)

The watershed associated with the wetland restoration areas is 126 acres and provides for 5.6 to 1 ratio of watershed area to wetland area, which should be more than sufficient to sustain the wetland areas. The hydrology source for the wetland mitigation site is sufficient to maintain a saturated soils condition within the intended forested portion of the wetland areas and saturated to inundated conditions within the designated emergent areas for extended portions of the year. To further promote these conditions, any field tiles that exist within the wetland restoration areas will be eliminated within the limits of the mitigation site.

5.3.3 Geotechnical Investigations

A subsurface investigation was completed and presented by Resource International, Inc., in a report dated November 2008. The investigation included thirty-four (34) soil borings drilled to a depth of 15.0 feet below the existing ground surface. The borings were located in the areas of potential wetland restoration and along the proposed stream restoration corridor. The investigation found that the soil consists of 0 to 14 inches of topsoil with an average depth of nine (9) inches. Sod farming on this site in the past could be a reason for the shallow topsoil depths in some areas. Natural cohesive clays and silts were found below the topsoil to a minimum depth below existing ground of four (4) feet and an average depth of 8.5 feet. Granular soils such as sand and gravel were found below the cohesive soils. A hydraulic conductivity test was performed on three (3) cohesive soil samples. The typical requirement for a soil used in a clay liner is a hydraulic conductivity rate of 1×10^{-7} cm/s. The test results for the cohesive soil samples met this typical requirement. Based on these results and the recommendations from Resource International, Inc., it is anticipated that the cohesive soils below the topsoil will be suitable to hold water since they meet the typical permeability requirements of a clay liner. Any granular soils encountered during construction of the wetland will be over excavated to a depth of three (3) feet and backfilled with cohesive soil that meets the permeability requirement.

5.3.4 Grading Plan

The proposed wetland restoration areas are relatively flat, and minimal grading will be necessary to achieve the desired topography and hydrology. Subtle earthen embankments will be constructed around portions of both wetland perimeters to retain hydrology within the areas suitable for the establishment of an eventual forested/emergent community. Construction of the embankments is estimated to require 14,520 cubic yards of material. The wetland design takes advantage of existing topographic variations to create saturated/shallowly inundated forested wetland areas and deeper, inundated emergent areas with minimal grading. Specific grading specifications are shown on Exhibit 11A.

5.3.5 Construction Methods, Timing and Sequence

Large and small earthmoving equipment will be used to excavate and fill in accordance with the engineering plans, including the use of appropriate machinery to obtain compaction of any fill material. There is no clearing of existing vegetation required for the development of the wetland area. Where excavation is required, the (hydric) topsoil layer will be removed and stockpiled for later application within the wetland mitigation areas. Construction sequencing will minimize risk of sedimentation to areas adjacent to the mitigation site.

Wetland restoration construction is proposed to begin during 2010, with planting of the site to be conducted in the summer and fall of 2010 or spring of 2011. Timing is contingent upon securing the necessary environmental and construction permits for the project. EMH&T will be responsible for oversight of the construction of the wetland and stream mitigation project.

5.3.6 Wetland Planting Plan

The vegetation plan concept for the wetland areas is to restore forested and emergent wetland habitat that will meet a minimum VIBI score comparable to a Category 2 designation at the end of the monitoring period. A total of approximately 11.3 acres within Cells 1A and 1B will be planted with a variety of native, cold-hardy tree and shrub species, focusing on a diversity of high quality woody species. Trees will be planted in densities approximately equivalent to 134 trees/acre (18 x 18 foot spacing), using 3-gallon stock. The shrubs will be planted in densities equivalent to approximately 60 shrubs/acre (30 x 30 foot spacing), using 3-gallon stock. Additional live stake material will be installed (25 x 25 foot spacing) to promote understory diversity. Installation of native herbs and sedges (1 gallon containers – 30 x 30 foot spacing) in the forested wetland areas is intended to provide a dense cover of native plants, thereby reducing the opportunity for invasion by exotic species. A variety of native herbaceous wetland plugs will be installed within the emergent portions of the wetland cells on approximate 6 foot centers (2,722 per acre). In addition, 3 gallon shrubs (30 x 30 foot centers) and live stakes (20 x 20 foot centers) will also be installed in the emergent wetland areas. In addition to the proposed woody and herbaceous plantings, the wetland cells will be seeded with a Facultative Wetland (FACW) Wetland Meadow Mix (ERNMX 120) or approved equal.

Exhibits 13A-13B present proposed planting specifications for the wetland mitigation site. Final species selection will depend upon the actual hydrologic conditions realized across the wetland areas following construction, as well as availability at the time of planting. Planting is anticipated to occur as seasonally appropriate following completion of the mitigation wetland basin.

There are many herbaceous species suited to a forested wetland that will not be able to survive the full sun conditions present in the first few years of wetland development. Supplemental plantings within the forested portion of the wetland areas are planned for the spring before the fourth year of monitoring to increase the diversity of shade tolerant herbaceous species, such as ferns (30 x 30 foot spacing). These future plantings are also indicated on Exhibits 13A-13B.

An approximate 25 foot wide transitional upland buffer will be established around the proposed wetland cells. The buffer will be initially seeded with an Native Habitat Mix and over seeded to stabilize the soils. The wetland buffer will be planted with a mixture of native trees (3 gallon containers – 20 x 20 foot spacing) and shrubs (3 gallon containers, 30 x 30 foot spacing), as indicated on Exhibits 13A-13B.

5.3.7 Sediment and Erosion Control

Erosion and sediment control will be provided as part of the construction of the various mitigation activities in accordance with the State of Ohio's Authorization for Stormwater Discharges, prepared under the National Pollutant Discharge Elimination System (NPDES), published by the Ohio EPA. The best management practices to be performed as part of erosion and sediment control measures for each of the mitigation activities are described below. Each of the following items is documented within the final engineering plans and SWPPP.

- **Sediment Filter Fabric Fence:** Sediment fencing will be used to intercept sediment-laden runoff from areas of disturbance, protecting the surrounding undisturbed area adjacent to the mitigation site.

- **Temporary/Permanent Seeding:** Seeding will be used to stabilize graded areas upon completion of those activities. Disturbed areas that will remain un-worked for 21 days or more shall be temporarily seeded or protected within seven calendar days of the disturbance. All disturbed areas will be permanently seeded once the final grade has been established.

- **Dewatering:** Should dewatering of the wetland mitigation site become necessary during construction, it will be performed using pumps and hoses. The discharge water will be filtered through a constructed dewatering sediment trap before allowing it to leave the project area.

All sediment controls that are utilized will be kept in place during construction activities and until the site has been stabilized. All areas disturbed during construction will be seeded to encourage the establishment of a vegetative cover and decrease erosion potential. The prepared SWPPP will provide guidance on necessary construction practices and sequences. Construction inspection will verify that these practices and sequences are being followed.

6.0 DETERMINATION OF MITIGATION CREDITS

Mitigation activities at the Eastside Nursery property will provide compensatory mitigation for wetland and stream impacts associated with a number of current and future expansion projects at the Port Columbus Airport. Some of the current projects proposed for mitigation at the Eastside Nursery property are listed below along with the required mitigation for each site, if known.

- Replacement Runway Alternative 3Cb 2018 Development

- Ultimate Stormwater Management Site - Turkey Run

- Consolidated Rental Car Facility
  Mitigation required: restore 4.317 acres of non-forested wetlands.

- Replacement Parking Lot West of 10R RPZ

- Northern Airport Development Area - NetJets Apron
  Mitigation required: 300 LF of stream.

- Outfall 004 - Impacts included in Replacement Runway

- NetJets Campus including Detention Basin
  Mitigation required: 700 LF of stream, restore 2.685 acres non-forested and 1.25 acres of forested wetlands.

- Expansion of Red Lot (after runway moves)

- Remaining mitigation needed for Loop Road
  Mitigation required: 0.28 acre of non-forested wetland.

Approximately 22.5 acres of wetland mitigation will be accomplished through the development of Wetland Cells 1A and 1B. Approximately 6 acres of the total wetland restoration will be developed as forested wetland habitat through native tree and shrub plantings; the remainder (16.5 acres) will be developed as emergent wetland. In addition, 2,700 linear feet of stream restoration will be generated along a segment of the degraded Big Run channel.

7.0 SCHEDULE OF IMPLEMENTATION

The implementation schedule is based on the project being awarded January 15, 2010.

ACTIVIY	**START DATE**
Award Project	January 15, 2010
Shop Drawing Submittal	Within 10 Days of Notice to Proceed
Start Construction	February 5, 2010
Start Planting of all Non-Woody Material	May 1, 2010
Start Planting of all Woody Material	September 15, 2010
Project Construction Complete	December 15, 2010
Start Compliance Monitoring	May 1, 2011

8.0 PERFORMANCE STANDARDS

Proposed ecological performance standards for each feature of the mitigation site are summarized in the following sections. The wetland cells will be monitored every other year for 10 years. The restored segment of Big Run and its associated riparian corridor will be monitored annually for a period of 5 years post-construction. The specific monitoring protocol proposed for the wetland and stream features is discussed below.

8.1 Stream Performance Standards

The Big Run channel will be restored using natural channel design methods to reestablish a stable channel with functional instream habitat. Significant riparian plantings will be installed along the restored channel. Proposed performance standards for the channel and restored buffer are provided below.

- **QHEI:** The restored segment of Big Run shall achieve a minimum average QHEI score of 60 by the end of the 5 year monitoring period. This represents an average QHEI score improvement of approximately 30 points compared to the baseline assessments.

- **Stream Substrate:** The bottom substrate of Big Run shall consist of a mixture of small cobble and gravel sized material.

- **Riparian Buffer Width:** The riparian buffer will have an average width of 50 feet or greater from the top of both streambanks. There will be some overlap between the western stream buffer and the adjacent wetland buffer.

- **Native Species:** The riparian buffer will consist of 80% native Ohio woody cover by the end of the 5 year monitoring period.

- **Buffer Plantings:** A minimum of 80% of the woody riparian buffer plantings will have survived by the end of the 5 year monitoring period.

8.2 Wetland Performance Standards

Wetland Cells 1A and 1B will be developed to the west of and adjacent to the restored Big Run channel. Of the approximately 22.5 acres of restored wetlands, approximately 5 to 6 acres of the restored wetland total will be designed and planted to develop forested wetland habitat; the remainder of the cells will be established as emergent wetland habitat. Wetland performance standards for the proposed restored wetland cells are summarized below.

- **Wetland Criteria:** All mitigation wetland areas must eventually meet wetland criteria. The restored wetlands will be delineated using the procedures for comprehensive determinations outlined in the 1987 Corps of Engineers Delineation Manual and the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region* (USACE, 2008) or successor documents. The boundaries will be mapped using geographic position system (GPS) instruments or traditional survey methods. The respective amounts of emergent and intended forested wetland habitat present will be identified. A wetland delineation will be conducted during monitoring years 5 and 10.

- **VIBI:** Both the non-forested and intended forested portions of the wetlands must achieve a minimum VIBI score of 51, equivalent to an ORAM Category 2 wetland (score range 51-62), as described in Table 7 of the *Field Manual for the Vegetation Index of Biotic Integrity v. 1.4* (Mack, 2007), by the end of the 10-year monitoring period. This scoring range pertains to wetlands in the Eastern Corn Belt Plains (ECBP) ecoregion.

- **Woody Stem Count:** The forested portion of Wetland Cells 1A and 1B must achieve one hundred (100) healthy and free-growing trees per acre by the end of the 10-year monitoring period, to be determined using woody stem count methodology.

- **Open water:** The wetland areas can have no more than 10% unvegetated open water by the end of the 10-year monitoring period.

- **Native Wetland Species:** The wetlands must have greater than 75% of their total area vegetated with native, perennial hydrophytes by the end of the 10-year monitoring period.

- **Invasive Species:** No more than 5% of the wetland areas can be vegetated with invasive species as defined in the ORAM listing of invasive species by the end of the 10-year monitoring period.

9.0 MONITORING PROTOCOL

Monitoring of the mitigation features will begin after the first growing season following completion of mitigation construction. Routine data will be collected during these site visits and will be forwarded in a report to the USACE and Ohio EPA by December 31 of each of the monitoring years. The monitoring reports will identify the extent to which the Eastside Nursery mitigation site is meeting the performance goals set forth in this final mitigation plan. Specific information regarding monitoring frequency, activities and reporting for the stream and wetland restoration areas is provided in the following sections. An as-built survey will be conducted for the restored features following construction and included within the comprehensive monitoring reports.

9.1 Stream Monitoring

The objective of stream monitoring is to determine whether the restored stream remains stable after initial construction and meets performance goals related to instream habitat quality. The restored Big Run stream will be monitored annually for 5 consecutive years post-construction. One monitoring event per monitoring year will take place in late summer during low flow conditions. Two (2) permanent sampling points will be selected for specific monitoring activities along Big Run. Sample point locations will represent both pool and riffle features and will be permanently marked in the field. Each sample location will be located with GPS equipment and indicated on mapping within the monitoring reports. The entire restored length of the stream will also be visually evaluated for any areas of instability or other problems.

At sample point locations, cross-sectional survey data will be taken to review channel stability over time. Photographs of the sampling point locations will be taken during the annual monitoring events. During the survey and layout phase of construction, permanent control points will be identified. An as-built horizontal and vertical survey will be performed that will give a permanent record of the constructed channel geometry. The as-built survey data will be provided within 180 days following completion of stream construction.

Parameters to be monitored along the relocated channel include those listed below.

- An as-built survey of stream profile and cross section, including the stream bed and banks, will be conducted along the restored segment and presented within 180 days following construction completion.

- Index of Biotic Integrity (IBI) and Invertebrate Community Index (ICI) shall be calculated, according to methods approved by Ohio EPA, based on sampling conducted and included in the monitoring report for years one, three and five.

- Cross-sectional measurements will be taken at each sampling point.

- QHEI data will be collected along two representative 200-foot long reaches within the restored segment of Big Run and included in the monitoring report for years one, three and five.

- Along the length of the restored stream segment, riparian corridor plantings will be checked for survivability. Percent total vegetation cover, percent survival of planted species, and dominant species present within each stratum will be determined at each of the 2 sample point locations.

Monitoring reporting for Big Run will provide information on habitat development and will include data results for the profile and cross-sectional measurements, QHEI, IBI, ICI and vegetation surveys. Photographic documentation of the stream from fixed positions will also be included, as well as discussion on whether the stream is meeting its performance goals. In addition, unacceptable development or other problems will be discussed, including details of any corrective actions that may have been necessary.

9.2 Restored Wetland Monitoring

Wetland Cells 1A and 1B will be monitored over a 10 year period, with monitoring to occur twice annually during years 1, 3, 5, 7 and 10. The first monitoring visit will be in May, followed by a second visit in August or September. Data collected in May of each year will include quantitative hydrology measurements. Surface water inundation or depth of soil saturation will be measured at permanent points associated with the vegetation sample points. In addition, one grab sample shall be collected from each wetland cell for water chemistry analysis in May of each monitoring year. The samples will be analyzed for ammonia, nitrates, nitrite, carbon, total sulfates, total iron, total manganese, specific conductivity, pH, turbidity, total suspended solids, heavy metals and biochemical oxygen demand. The late summer site visit will be used to collect information on plant species composition, relative abundance and density. These data, along with the quantitative hydrology measurements and photo-documentation, will be collected at each of the permanent sample quadrants. Photographs of all sample quadrants will be taken for monitoring year comparisons.

A Vegetation Index of Biotic Integrity (VIBI) will be conducted within the emergent and forested portions of the wetlands during years 1, 3, 5, 7 and 10 years of monitoring. VIBI assessments will be performed according to the *Field Manual for the Vegetation Index of Biotic Integrity for Wetlands v. 1.4* (Mack, 2007). Two (2) fixed plots (20 meter x 50 meter) will be established within each cell to provide data for both the emergent and forested habitat types. The fixed plots will be standard VIBI plots having 4 intensive modules each. The fixed plots will be analyzed individually, providing four separate values for each type analysis. Woody stem counts will be performed for the forested VIBI fixed plots using the methodology specified within the *Field Manual for the Vegetation Index of Biotic Integrity for Wetlands v. 1.4* (Mack, 2007). Basic forest community measures, including frequency, density and dominance will be collected and importance values calculated for the forested wetland area.

Appropriate mapping of the restored wetland area will be included with each monitoring report. This mapping will indicate VIBI locations as marked in field, photo locations and any other pertinent information. Representative photographs of the wetland will be collected from fixed locations during vegetative surveys conducted in the growing season and will be included in subsequent monitoring reports for comparative purposes.

10.0 SITE MANAGEMENT AND MAINTENANCE

10.1 Site Maintenance Plan

The CRAA will be responsible for maintenance of the restored wetlands, stream and associated buffers through the monitoring period. Maintenance efforts will be documented within the annual monitoring reports reviewed by the USACE and Ohio EPA. Metro Parks will manage the larger nursery property and the mitigation site in perpetuity following the completion of the monitoring period.

Per the mitigation wetland performance standards detailed within Section 7.2, the restored wetlands shall contain no more than 5% invasive species as defined in the Ohio Rapid Assessment Methodology (ORAM) listing of invasive species. In addition, stream performance standards specified in Section 7.1 require a minimum of 80% native woody cover within the riparian buffer along Big Run. As such, an aggressive approach to invasive species management will occur at the site. A check for invasive species will be conducted within the riparian buffer and wetland areas during the monitoring events. Eradication methods for identified populations of invasive species will be applied in a species specific manner and will likely involve a combination of techniques. Invasives will be managed by hand-pulling to the extent practicable. An aquatic herbicide, such as Rodeo®, will be utilized to control invasives if hand-pulling becomes impractical. Cut-stump treatment of woody invasives may also be employed as necessary.

The mitigation performance standards also specify requirements related to the survival of planted material within the riparian buffer and wetland areas. In order to meet these requirements, inspections of the health and vigor of the plantings will be conducted during the monitoring events. Any problems related to survival of the planted species will be identified during the monitoring events, and suitable remedial action will be taken. This may involve watering during drought periods, control of nuisance wildlife, installation of additional plant material or other methods.

10.2 Adaptive Management Plan

Adaptive Management is a systematic process for developing knowledge and continually improving project development by learning from previous projects and their performance outcomes (River Institute, 2004). A comprehensive monitoring plan for the mitigation stream and wetland areas, as described in Section 8.0 *Monitoring Protocol*, has been developed. The monitoring plan provides an opportunity for any potential problems that would hinder the attainment of the performance goals to be identified. The applicant, engineers, contractors and agencies will be made aware of any issues as they are identified, and approaches to correct the problems will be developed and implemented. Subsequent monitoring reports will document any corrective actions taken and their success. All corrective actions will be conducted in consultation with the USACE and Ohio EPA.

10.3 Long-term Management Plan

Long-term management and maintenance of the CRAA mitigation site, beyond the 5- and 10-year monitoring periods associated with the permitting process, will be the responsibility of Metro Parks. Necessary long-term management measures may include invasive species control, debris and litter removal, and maintenance of fences or other barriers to limit access to the site. Metro Parks will continue to manage the restored wetland and stream features as natural areas and conduct management activities as needed to maintain their natural functions. Financial responsibility for long-term management and maintenance of the site and implemented mitigation measures will be the responsibility of Metro Parks.

11.0 SITE PROTECTION INSTRUMENT

Metro Parks intends to develop the Eastside Nursery property as both a protected natural resource and future accessible park land. The CRAA mitigation area would be part of the Metro Parks property and will be protected by an Environmental Covenant with the Ohio EPA, providing for protection of the area in its restored state in perpetuity. The covenant language will be consistent with the requirements of the Ohio EPA and Ohio Revised Code §5301.80 through §5301.92. A copy of the draft Environmental Covenant will be provided to the USACE and Ohio EPA for review once it has been prepared.

12.0 FINANCIAL ASSURANCES

CRAA will remain responsible for ensuring the success of the proposed mitigation measures through the proposed 5- and 10-year monitoring period, along with providing adequate financial resources to ensure successful implementation of the proposed Final Mitigation Plan. Funding for mitigation construction and other responsibilities assigned to CRAA in accordance with the MOA will be secured through normal CRAA capital project budgeting and planning procedures. Metro Parks will be assigned financial responsibility for long-term management and maintenance of the site in accordance with the terms of the MOA. Metro Parks has sufficient financial resources to implement these responsibilities and it is considered a priority in the operational management of their land holdings. Funding for long-term management and maintenance of the site will be allocated through normal Metro Parks budgeting and planning procedures.

13.0 CONCLUSIONS

The Columbus Regional Airport Authority (CRAA) has entered into partnership with Metro Parks to develop a consolidated wetland and stream mitigation site at the 482 acre Eastside Nursery property in southeastern Franklin County. The Eastside Nursery site provides ample opportunity for stream restoration along Big Run, as well wetland restoration in areas adjacent to the west of Big Run. The portion of the property proposed for mitigation activities consists of approximately 105 acres, which includes the wetland and streams restoration described below. The described restoration is only a portion of the restoration potential within the property but is sufficient to meet the CRAA's current and anticipated future needs for mitigation.
Mitigation activities proposed to occur on the Eastside Nursery site include the items listed below.

- Development of two wetland cells totaling approximately 22.5 acres and designed to achieve at least a Category 2 designation. One cell will consist of a mixed forested and emergent wetland habitat, while the second cell will consist entirely of emergent wetland. A minimum 25 foot wooded buffer will be established around each wetland cell.

- Restoration along approximately 2,700 linear feet of degraded intermittent channel (Big Run) using natural channel design techniques, including the establishment of a wooded riparian corridor using native plantings.

Big Run is a substantially altered tributary to Walnut Creek that flows through the Eastside Nursery property. Big Run has been historically maintained in a channelized condition and lacks any significant sinuosity or instream habitat. The on-site stream is notably incised and exhibits evidence of bank instability. The riparian corridor along this portion of Big Run is essentially denuded, except for a few scattered small caliper trees. Big Run would benefit substantially from a complete restoration of the channel following natural channel design principles and the establishment of a planted riparian corridor. Stream mitigation will be accomplished through restoration of a portion of the existing Big Run channel which flows from south to north through the property. The impaired channel condition provides an excellent opportunity for stream and riparian corridor restoration.

A large swath of existing hydric soils and relatively flat topography in this area will provide the basis for wetland restoration. The area of hydric soils has been previously converted to agricultural uses, including a tree/shrub nursery and row crops. Presently, the property lacks evidence of existing wetland features due to the anthropogenic activities. Initial hydrologic studies indicate that surface flow can be captured in this area to support wetland development. Subtle grading around the area will be employed to retain hydrology within the proposed wetland cells. A drainage tile system currently draining the site will be disrupted to retain water within the wetlands as well. Installation of native forbs and woody plants will kick-start the development of a healthy wetland ecosystem and help to preclude intrusion by invasive species.

The Eastside Nursery mitigation site is located within the Walnut Creek 11-digit HUC identified as 05060001180, which includes the portion of the watershed downstream of the Sycamore Creek confluence. The proposed restoration of Big Run and adjacent wetland areas is anticipated to have a beneficial effect on the Walnut Creek watershed. The mitigation project will correct or ameliorate some of the noted physical impairments along Big Run with the goals of restoring stability and promoting aquatic habitat within the channel, while also helping to preserve water quality within the Walnut Creek mainstem.

14.0 CITATIONS

Compensatory Mitigation for Losses of Aquatic Resources; Final Rule. Federal Register 73 (10 April 2008): 19670-19705.

Clark, B. K., J. B. Bowles, and B. S. Clark. 1987. *Summer habitat of the endangered Indiana bat in Iowa.* Amer. Midl. Nat. 118: 32-39.

FEMA. Flood Emergency Management Agency. 2008. Flood Insurance Rate Map for Franklin County, Ohio. Panel 453 of 465. Map number 39049C0453K. Available from the Ohio Department of Natural Resources, Division of Water.

Franklin County Engineering Department. 2005. *Road Map and Street Locator.*

Kurta, A., D. King, J. A. Teramino, J. M. Stribley, and K. J. Williams. 1993a. *Summer Roosts of the endangered Indiana Bat (*Myotis sodalis*) on the northern edge of its range.* Am. Mid. Nat. 129: 132-138.

Mack, John J. 2001. *Ohio Rapid Assessment Method for Wetlands v. 5.0, User's Manual and Scoring Forms.* Ohio EPA Technical Report WET/2001-1. Ohio Environmental Protection Agency, Division of Surface Water, 401/Wetland Ecology Unit, Columbus, Ohio.

Mack, John J. 2007. *Integrated Wetland Assessment Program. Part 9: Field Manual for the Vegetation Index of Biotic Integrity for Wetlands v. 1.4.* Ohio EPA Technical Report WET/2007-6. Ohio Environmental Protection Agency, Wetland Ecology Group, Division of Surface Water, Columbus, Ohio.

ODNR, Division of Wildlife. 2004. *Life History Notes: Bald Eagle.* Retrieved March 2, 2005 from the World Wide Web: http://www.ohiodnr.com/wildlife/resources/wildnotes/pub383.htm. Ohio Administrative Code (OAC), Chapter 3745-18. Effective 7/18/02.

Ohio EPA. 2000. *Appendices to the 2000 Ohio Water Resource Inventory.* Ohio EPA, Division of Surface Water, Columbus, Ohio.

Ohio EPA. 2006. *Biological and Water Quality Study of Walnut Creek and Tributaries.* Ohio EPA Technical Report DSW/EAS/2006-12-8. Ohio EPA, Division of Surface Water, Columbus, Ohio.

Ohio EPA, 2008. *Ohio 2008 Integrated Water Quality Monitoring and Assessment Report.* Ohio EPA, Division of Surface Water, Columbus, Ohio.

Ohio EPA. 2006. *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI).* Ohio EPA, Division of Surface Water, Columbus, Ohio.

River Institute, Center for Applied River Science, 2004.

Rosgen, D.L.. 1996. *Applied River Morphology.* Pagosa Springs, Colo. Wildland Hydrology Books.

Rosgen, D.L. and Silvey, H.L. 2007. *The Reference Reach Field Book, Third Edition.* Wildland Hydrology, Inc., Fort Collins, CO.

Rosgen, D.L. 1998. *The Reference Reach – A Blueprint for Natural Channel Design.* ASCE Conference on River Restoration in Denver Colorado – March 1988, Reston, VA.

Rosgen, D.L. and Silvey, H.L. 1998. *Field Guide for Stream Classification, Second Edition.* Wildland Hydrology, Pagosa Springs, CO.

Rosgen, D.L. 1997. *A Geomorphological Approach to Restoration of Incised Rivers.* Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision, Denver CO.

Schumm, S.A., Harvey, M.D., and Watson, C.C. 1984. *Incised Channels: Morphology, Dynamics and Control.* Water Resource Publication, Littleton, CO.

USACE. 2008. Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region, ed. J. S. Wakely, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-0827. Vicksburg, MS: U. S. Army Engineer Research and Development Center.

USDA-NRCS. United States Department of Agriculture - (Soil Conservation Service) Natural Resources Conservation Service. 2004. *Soil Survey of Franklin County, Ohio.* Available online: http://websoilsurvey.nrcs.usda.gov/app/.

USDA-Forest Service. 1994. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique.* General Technical Report RM-245, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

USFWS. United States Department of the Interior, Fish and Wildlife Service. 1995. National Wetland Inventory Map, *Canal Winchester, Ohio* quadrangle. Available from the Ohio Department of Natural Resources, Division of Real Estate and Land Management.

USFWS. United States Department of the Interior, Fish and Wildlife Service. 11/08. *Federally-Listed Species by Ohio Counties.* Available from USFWS Reynoldsburg Ecological Services Field Office, 6950 Americana Pkwy, Suite H, Reynoldsburg, OH 43068-4127.

USGS. United States Geological Service. 1985. *Canal Winchester, Ohio* Quadrangle, 7.5 minute Series (Topographic). Maps prepared by the U.S. Geological Survey and revised in cooperation with State of Ohio Agencies. For sale from the U.S. Geological Survey, Reston, Virginia 22092.

USGS. 1990. *Techniques for Estimating Flood-Peak Discharges of Rural, Unregulated Streams in Ohio.* Water Resources Investigations Report 89-4126.

USGS. 2006. *Bankfull Characteristics of Ohio Streams and Their Relation to Peak Streamflows.* Scientific Investigations Report 2005-5153.

----------.1985. *Hydric Soils of the United States.* USDA-SCS National Bulletin No. 430-5-9. Washington, D.C.

----------. 2008. National Hydric Soils List by State. Available online from the website of the Natural Resources Conservation Service: http://soils.usda.gov/use/hydric/.

APPENDIX A

Memorandum of Agreement (MOA)

AGREEMENT BETWEEN THE COLUMBUS REGIONAL AIRPORT AUTHORITY ("CRAA") AND THE COLUMBUS AND FRANKLIN COUNTY METROPOLITAN PARK DISTRICT ("METRO PARKS")

This Agreement ("Agreement") is entered into this 2nd day of November, 2009 (the "Effective Date"), by and between the Columbus Regional Airport Authority (hereinafter the "CRAA"), an Ohio port authority organized and existing pursuant to Chapter 4582 of the Ohio Revised Code and owner and operator of Port Columbus International, Rickenbacker International and Bolton Field Airports (hereinafter the "Airports"), and Columbus and Franklin County Metropolitan Park District (hereinafter "Metro Parks"), an Ohio political subdivision organized and existing pursuant to Chapter 1545 of the Ohio Revised Code (collectively referred to hereafter as "the Parties").

RECITALS

WHEREAS, CRAA anticipates engaging in construction and expansion activities at the Airports, which activities will impact certain wetlands and streams that may be regulated by the United States Army Corps of Engineers (hereinafter "USACE") and/or the Ohio Environmental Protection Agency (hereinafter "OEPA");

WHEREAS, impacts to wetlands and streams as part of the construction and expansion activities will require CRAA to obtain a permit from the USACE under Section 404 of the Clean Water Act, and certification from OEPA under Section 401 of the Clean Water Act, and/or an isolated wetlands permit from OEPA under Chapter 6111 of the Revised Code (hereinafter "Permits");

WHEREAS, Metro Parks owns 482 acres of land located between Lithopolis, Groveport, Richardson and Hayes roads, near Canal Winchester, Ohio, as further described in Exhibit A (hereinafter, the "Project Site");

WHEREAS, the parties anticipate that the Permits will require CRAA to mitigate impacts to wetlands by means of restoration, creation, enhancement or preservation of wetlands and to mitigate impacts to streams by restoration, enhancement or preservation, which mitigation is currently estimated to include approximately twenty-two (22) acres of wetlands on the Project Site made up of cells 1A and 1B as shown on Exhibit A, which is hereby incorporated into and made a part of this Agreement by reference and approximately two thousand seven hundred (2,700) linear feet of stream located on the Project Site adjacent to cells 1A and 1B as shown on Exhibit A (such wetland and stream restoration, creation, enhancement and/or preservation are hereinafter referred to as the "Mitigation Project"); and

WHEREAS, CRAA desires to satisfy all of its anticipated wetlands and stream mitigation obligations under the Permits by creating, restoring and/or enhancing wetlands and streams at the Project Site;

WHEREAS, Metro Parks, in furtherance of its mission to conserve open spaces and create opportunities for people to experience nature, desires to partner with the CRAA to develop or improve a system of wetlands and streams for integration into the Project Site to enhance the Project Site's offerings and further CRAA's satisfaction of its mitigation obligations; and

WHEREAS, Metro Parks, based on its current knowledge of anticipated mitigation requirements as described herein has the resources and expertise to manage and maintain the Mitigation Project at the Project Site pursuant to the terms of this Agreement.

NOW THEREFORE, in consideration of the mutual benefits resulting to the CRAA and Metro Parks, the Parties mutually agree as follows:

1. **Section 1 - Intent of Agreement**

The intent of the Parties in entering into this Agreement is to assist CRAA in completing the Mitigation Project anticipated to be required by the Permits on property owned by Metro Parks.

2. **Section 2 - Contingency**

The Parties' rights and obligations set forth in this Agreement are contingent upon the issuance of the Permits in final form, including the necessary concurrence by both USACE and OEPA to proceed with all material aspects of the Mitigation Project contemplated by this Agreement. In the event that the USACE or the OEPA fail to provide all necessary approvals within one (1) year of the Effective Date or at any time rescinds prior approvals as provided by law, regulation or rule, prior to commencing construction of the Mitigation Project, then the Parties shall use good faith efforts to negotiate an extension or alternative solution to meet the objectives of both Parties as described in this Agreement, provided that the Parties reserve the right, without being subject to claims or damages from the other, to terminate this Agreement if they are unable to negotiate an extension or alternative solution.

3. **Section 3 - The Project**

The Mitigation Project shall consist of the following activities, as applicable:

a. The construction of the Mitigation Project in substantial accordance with the Mitigation Project design documents dated October, 2009, and may be subsequently amended by OEPA and/or USACE (the "Project Design"), which includes but is not limited to:

   i. Grading, excavation, construction, enhancement, restoration and filling activities and all other activities reasonably necessary to construct the Mitigation Project pursuant to the Project Design, and in such a manner that provides sufficient collection, storage, and drainage of surface flow water;

ii. Planting of wetland and stream buffer area vegetation suitable for proposed wetland and stream hydrology. All vegetation planted for the Mitigation Project shall be species that are native to Central Ohio;

iii. Mitigation Project access by CRAA and its consultants and agents for purposes of monitoring, reporting and report submittal as required by the Permits and applicable laws;

iv. Necessary maintenance, repair and corrective actions required to comply with the Permits and meet the OEPA and USACE standards for the Mitigation Project to be deemed successful and released from further monitoring; and

v. Such other activities consistent with this Agreement upon which the parties mutually agree.

b. Preservation of the Mitigation Project, including preservation of any required wetland and stream buffers, in compliance with the Permits and pursuant to an environmental covenant, conservation easement or declaration of deed restriction in one of the forms substantially as set forth in Exhibit B ("Environmental Covenant"); and

c. Execution and recording of the Environmental Covenant with the Franklin County Recorder's Office.

4. **Section 4 - Obligations of Metro Parks**

a. Metro Parks shall provide a portion of the Project Site sufficient to accommodate the anticipated Mitigation Project.

b. Provided that the Permits have been issued in final form and all other necessary governmental authorizations have been obtained with respect to wetland and stream impacts, Metro Parks shall cause to be constructed the Mitigation Project consistent with Section 3(a) of this Agreement and perform activities identified in Section 3(b) and (c) in order to complete the Mitigation Project in accordance with any and all requirements imposed by applicable law, regulation or rule, including but not limited to the Permits.

c. In the performance of its obligations under this Agreement, Metro Parks shall comply with all applicable federal, state and local laws and regulations, and administrative compliance requirements.

d. Metro Parks shall not authorize any consultant, contractor or professional service provider change order requests for any work related to the Mitigation Project without prior authorization from the CRAA or its representatives, which authorization shall be considered in a timely manner and not be unreasonably withheld.

e. Metro Parks shall comply with the requirements of the Environmental Covenant.

f. Metro Parks shall be responsible for all costs and expenses associated with the Project Site after the USACE or OEPA have deemed the Project successful and released the Project Site from further monitoring and improvements.

g. CRAA shall permit construction by Metro Parks of the visitor facilities in conjunction with, during or after construction of the Mitigation Project, provided that Metro Parks shall pay for all costs and expenses associated with construction, operations and maintenance of the visitor facilities, which such visitor facilities will not unreasonably interfere with the Mitigation Project or compliance with the mitigation obligations under the Permits.

5. <u>Obligations of CRAA</u>

a. CRAA shall be solely responsible for and pay all costs and expenses incurred by Metro Parks related to construction of the Mitigation Project in accordance with this Agreement.

  i. Metro Parks shall periodically provide to the CRAA a complete and accurate invoice of costs and expenses incurred in the performance of work and activities related to the Mitigation Project, with accompanying payment applications or similar documentation from consultants, contractors, vendors, suppliers and professionals in a timely manner. In the cases of pay application requests for Lump Sum items, the CRAA's identified financial responsibility shall be 33% of the Lump Sum item.

  ii. The CRAA shall pay Metro Parks within twenty-one (21) days of receipt of an invoice from Metro Parks. Metro Parks reserves, and has, the right to cease all work performed pursuant to this Agreement in the event the CRAA fails to fully pay Metro Parks within 10 days of the payment due date (or 31 days of receipt of an invoice), without being subject to claims or damages of the CRAA. In the cases of pay application requests for Lump Sum items, the CRAA shall reimburse 33% of the approved Lump Sum item.

  iii. The CRAA shall pay for all costs and expenses, and have sole responsibility, related to the development and creation of the Mitigation Project Design, including any design work necessary for change orders, if any, and applying for and obtaining necessary local, state or federal permit approvals for the Mitigation Project, and satisfying all other Permit requirements and activities not otherwise addressed herein.

  iv. The CRAA shall pay for all costs and expenses related to monitoring and maintenance of the Mitigation Project throughout the monitoring period required by the Permits and applicable law, provided that CRAA may seek approval from OEPA to reduce the number of years such monitoring is required.

   v. The CRAA shall pay for all costs and expenses related to necessary maintenance, repair and corrective actions required to meet the OEPA and USACE standards for the Mitigation Project during the monitoring period to be deemed successful.

b. The CRAA shall pay for and provide financial assurances, if any, required by OEPA, USACE or the Permits with respect to the Mitigation Project.

c. The CRAA shall reasonably cooperate with Metro Parks to the extent necessary for Metro Parks to construct and complete the Mitigation Project.

Remainder of page is blank

IN WITNESS HEREOF, the Parties hereto have executed this Agreement, which shall become effective upon signature by authorized representatives by both parties as of the Effective Date.

COLUMBUS REGIONAL AIRPORT AUTHORITY

Elaine Roberts

Elaine Roberts, A.A.E.
President & CEO

BFM

CRAA
LEGAL

COLUMBUS AND FRANKLIN COUNTY METROPOLITAN PARK DISTRICT

10/14/09

John O'Meara
Executive Director

APPENDIX B

Endangered Species Coordination Information

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
4625 Morse Road, Suite 104
Columbus, Ohio 43230
(614) 416-8993 / FAX (614) 416-8994

June 5, 2009

TAILS: 31420-2009-TA-0609

Mr. Patrick Hoyng
EMHT
5500 New Albany Road
Columbus, OH 43054

Dear Mr. Hoyng:

This is in response to your May 11, 2009 email requesting information on federally listed species within the vicinity of the proposed Eastside Nursery mitigation/restoration site. The 482-acre site is located east of Richardson Road, north of Hayes Road, and west of Lithopolis Road in Groveport, Franklin County, Ohio. The site currently contains an active tree nursery and agricultural fields.

There are no Federal wildlife refuges, wilderness areas, or Critical Habitat within the vicinity of this site.

Wetland and stream mitigation/restoration will occur within the center of the site along Big Run. The Service recommends that Best Management Practices (BMP's) be utilized to minimize sedimentation and erosion along Big Run and prevent impacts to Walnut Creek. To reduce stream impacts we recommend that stream activities be completed during periods of low flow.

Prevention of non-native, invasive plant establishment is critical in maintaining quality habitats. We recommend planting disturbed areas with native riparian species, for example willows, dogwoods, and cottonwoods. For maximum benefits on water quality and bank stabilization, riparian areas should not be mowed.

The Service recommends that the mitigation area be protected through the use of a conservation easement or environmental covenant, held by a conservation agency, to ensure appropriate management of this important habitat. Conservation easements provide an additional measure of protection and allow for annual monitoring of the site by an independent third party.

The project lies within the range of the **bald eagle** (*Haliaeetus leucocephalus*), a species protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Due to the project type, location, and onsite habitat, this species would not be expected within the project area, and no impact to this species is expected. Relative to this species, this precludes the need for further action on this project as required by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

ENDANGERED SPECIES COMMENTS:

The proposed project lies within the range of the **Indiana bat** *(Myotis sodalis)*, a Federally-listed endangered species. Since first listed as endangered in 1967, their population has declined by nearly 60%. Several factors have contributed to the decline of the Indiana bat, including the loss and degradation of suitable hibernacula, human disturbance during hibernation, pesticides, and the loss and degradation of forested habitat, particularly stands of large, mature trees. Fragmentation of forest habitat may also contribute to declines. Summer habitat requirements for the species are not well defined but the following are considered important:

> (1) dead or live trees and snags with peeling or exfoliating bark, split tree trunk and/or branches, or cavities, which may be used as maternity roost areas;
> (2) live trees (such as shagbark hickory and oaks) which have exfoliating bark;
> (3) stream corridors, riparian areas, and upland woodlots which provide forage sites.

The Service recommends that the mitigation/restoration includes reforestation with native tree species. A list of suitable tree species has been included. You have indicated that an active nursery exists onsite and it will continue to operate until the end of 2009 when the remaining ornamental trees will be removed. The nursery trees are all small diameter trees and do not provide suitable habitat for the Indiana bat. Big Run currently lacks any forested riparian corridor. According to aerial photographs the only suitable habitat for the Indiana bat appears to be located along Walnut Creek. Therefore, we recommend that trees along Walnut Creek exhibiting any of the characteristics, listed above, as well as surrounding trees, be saved wherever possible. But, if they cannot be avoided, they should only be cut between September 30 and April 1.

The proposed project lies within the range of the **clubshell mussel** (*Pleurobema clava*) with potential habitat for this species located within Walnut Creek. The Service recommends that the proposed activities use BMP's to avoid sediment impacts to Walnut Creek.

The proposed project lies within the range of the **Scioto madtom** (*Noturus trautmani*), **northern riffleshell** (*Epioblasma torulosa rangiana*), **rayed bean mussel** (*Villosa fabalis*), and **snuffbox mussel** (*Epioblasma triquetra*). Due to the project location, description, and onsite habitat no impact is expected for these species.

This technical assistance letter is submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C.661 et seq.), the Endangered Species Act of 1973, as amended, and is consistent with the intent of the National Environmental Policy Act of 1969, and the U.S. Fish and Wildlife Service's Mitigation Policy.

If you have any questions regarding our response or if you need additional information, please contact Jenny Finfera at extension 13.

Sincerely,

Mary Knapp

Mary Knapp, Ph.D.
Field Supervisor

Enclosures: Native tree species for Indiana bat habitat
Recommended native Grasses

cc: ODNR, DOW, SCEA Unit, Columbus, OH

Suggested Native Tree Species for Indiana Bat Habitat

^*Black Ash	*Fraxinus nigra*
+^*Green Ash	*Fraxinus pennsylvanica*
+White Ash	*Fraxinus americana*
^*River Birch	*Betula nigra*
+^Eastern Cottonwood	*Populus deltoids*
^American Elm	*Ulmus americana*
Slippery Elm	*Ulmus rubra*
^Bitternut Hickory	*Carya cordiformis*
^*Shagbark Hickory	*Carya ovata*
^Shellbark Hickory	*Carya laciniosa*
*Black Locust	*Robinia pseudoacacia*
^*Red Maple	*Acer rubrum*
^*Silver Maple	*Acer saccharinum*
*Sugar Maple	*Acer saccharum*
+*Black Oak	*Quercus velutina*
Post Oak	*Quercus stellata*
*Red Oak	*Quercus rubra*
^Shingle Oak	*Quercus imbricaria*
^*White Oak	*Quercus alba*
Sassafras	*Sassafras albidum*
^*Sycamore	*Plantanus occidentalis*
^Black Willow	*Salix nigra*

^ Indicates bottomland or mesic species; suitable for planting near rivers and streams

* Indicates tree species available from the Ohio Division of Forestry (2001)

+ Species most likely to survive on reclaimed mine land.

It is recommended that no more than 25% of the trees planted are one species. This will provide diversity necessary for wildlife habitat.

Ohio Field Office
U.S. Fish and Wildlife Service

Recommended Native Grasses

We strongly discourage planting invasive ground covers for reclamation/restoration purposes. Invasive species degrade the native biodiversity that is essential for maintaining high quality fish, wildlife, and plant habitats. We recommend planting native grasses and legumes, such as those listed below:

Big bluestem	*Andropogon gerardii*
Side-oats grama	*Bouteloua curtipendula*
Canada wild rye	*Elymus canadensis*
Riverbank wild rye	*Elymus riparius*
Virginia wild rye	*Elymus virginicus*
Switchgrass	*Panicum virgatum*
Little bluestem	*Schizachyrium scoparium*
Indian grass	*Sorghastrum nutans*
Prairie cordgrass	*Spartina pectinata*
Partridge pea	*Chamaecrista fasciculate*

Ohio Department of Natural Resources

TED STRICKLAND, GOVERNOR SEAN D. LOGAN, DIRECTOR

Division of Natural Areas & Preserves
Steven D. Maurer, Chief
2045 Morse Road, F-1
Columbus, OH 43229-6693
Phone: (614) 265-6453 Fax: (614) 267-3096

May 18, 2009

Patrick Hoyng
EMH&T, Inc.
5500 New Albany Rd.
Columbus, OH 43054

Dear Mr. Hoyng:

After reviewing our Natural Heritage maps and files, I find the Division of Natural Areas and Preserves has no records of rare or endangered species near the EMH&T, Inc. Eastside Nursery Mitigation Site project #2009-0543. The site is located in Secs. 27, 34, and 35, Madison Twp., Franklin Co., Canal Winchester Quadrangle.

There are no existing or proposed state nature preserves at the project site. We are also unaware of any unique ecological sites, geologic features, breeding or non-breeding animal concentrations, state parks, state forests, scenic rivers, or wildlife areas within the project area.

Our inventory program has not completely surveyed Ohio and relies on information supplied by many individuals and organizations. Therefore, a lack of records for any particular area is not a statement that rare species or unique features are absent from that area. Although we inventory all types of plant communities, we only maintain records on the highest quality areas.

Please contact me at (614) 265-6409 if I can be of further assistance.

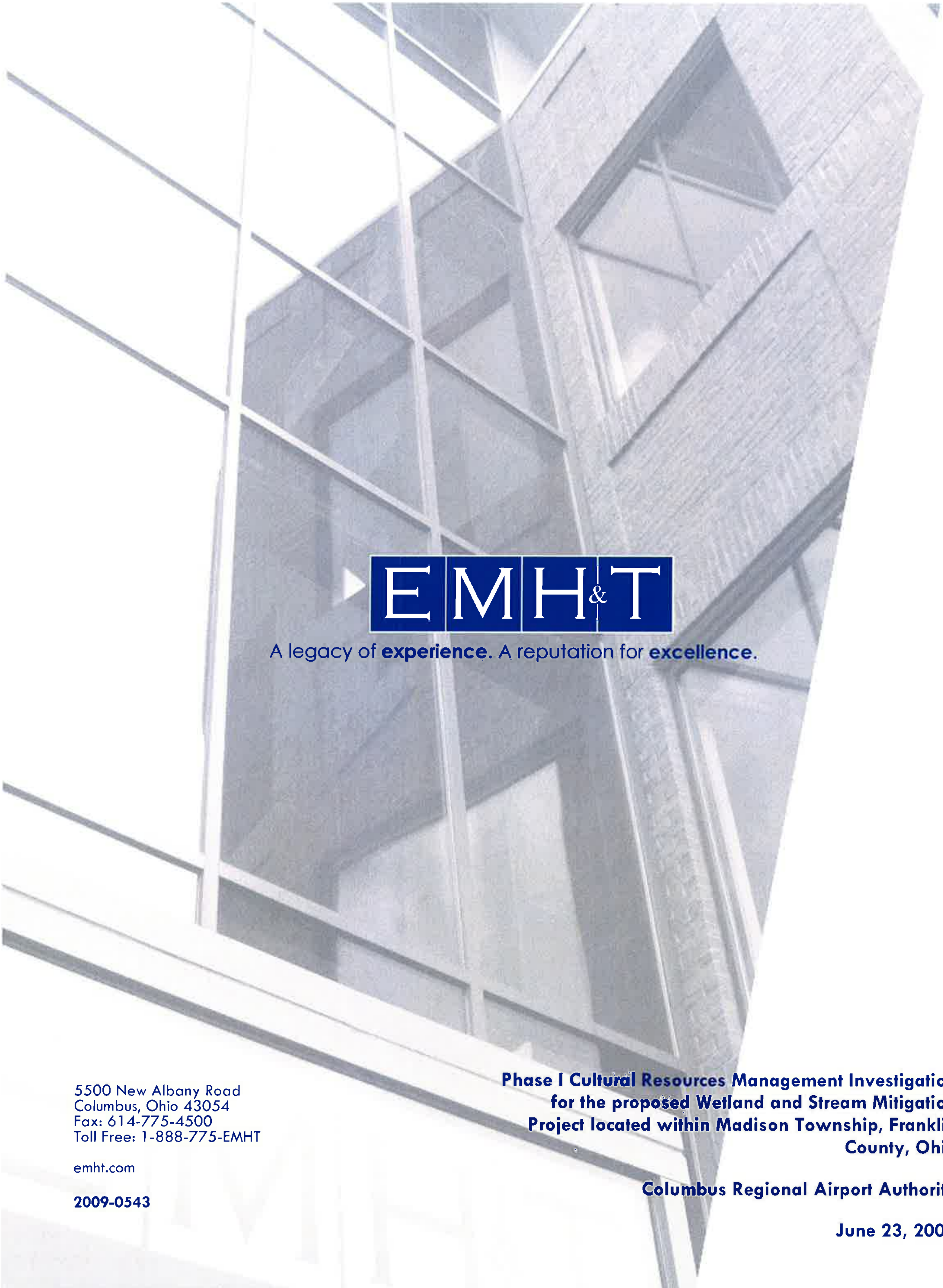
Sincerely,

Butch Grieszmer

Butch Grieszmer, Data Specialist
Resource Services Group

APPENDIX C

Phase I Cultural Resources Management Investigation



EMH&T

A legacy of **experience**. A reputation for **excellence**.

5500 New Albany Road
Columbus, Ohio 43054
Fax: 614-775-4500
Toll Free: 1-888-775-EMHT

emht.com

2009-0543

Phase I Cultural Resources Management Investigation for the proposed Wetland and Stream Mitigation Project located within Madison Township, Franklin County, Ohio

Columbus Regional Airport Authority

June 23, 2009

Engineers | Surveyors | Planners | Scientists

Phase I Cultural Resources Management Investigation for the proposed Wetland and Stream Mitigation Project located within Madison Township, Franklin County, Ohio.

By:

Scott M. Derick

Submitted To:

Columbus Regional Airport Authority (CRAA)
4600 International Gateway
Columbus, OH 43219

Submitted By:

Joel Brown, P.I.
EMH&T, Inc.
Cultural Resources Department
5500 New Albany Road
Columbus, OH 43054
Phone: (614) 775-4530 Fax: (614) 775-4802

Lead Agency:

United States Army Corps of Engineers, Huntington Division

Project #: 2009-0543

23 June 2009

Table of Contents

i. Abstract

A Phase I Cultural Resources Management investigation was conducted by the Cultural Resources Department of EMH&T, Inc. for the proposed wetland and stream mitigation project located within Madison Township, Franklin County, Ohio during June of 2009. These investigations were performed for the Columbus Regional Airport Authority (CRAA) under direction of the United States Army Corps of Engineers, Huntington District (USACE).

The project area is located in central Madison Township. The project area consists of two separate parcels. The wetland mitigation area is located east of Richardson Road and west of Big Run. It is an irregularly shaped parcel that is contained entirely within an agricultural field. Based on the preliminary plans, this area will contain two wetland cells that are each approximately 9.1 ha (22.5 a) in size. The stream mitigation area consists of a 91.4 ha (300 ft) wide corridor that extends 822 m (2,700 ft) along Big Run. The corridor is located within an existing portion of the Eastside Nursery.

Through a combination of surface collection and sub-surface testing strategies, a total of 13 previously unknown archaeological sites were identified within the project area. Sites 33-Fr-(2745-2757) consisted of either isolated finds or small, low-density lithic scatters. Only one site (33-Fr-2745) contained an artifact associated with a specific time period. This isolated find spot was represented by a Late Archaic Brewerton corner-notch point. No further work is recommended for the project area.

ii. Acknowledgements

Project Manager

Joel Brown

Principal Investigator

Joel Brown

Supervisors of Fieldwork

Scott M. Derick

Technical Staff

Field Crew

Scott M. Derick
Elaine Meyer

Literature Review

Scott M. Derick

Graphics

Scott M. Derick

Report Production

Kelly Davis

iii. Figures and Exhibits

Figures

Exhibits

I. Introduction

A Phase I Cultural Resources Management investigation was conducted by the Cultural Resources Department of EMH&T, Inc. for the proposed wetland and stream mitigation project located within Madison Township, Franklin County, Ohio during the month of May. These investigations were performed for the Columbus Regional Airport Authority (CRAA) under the direction of the United States Army Corps of Engineers, Huntington District (USACE).

The project area is located in central Madison Township (Figures 1 and 2). The project area consists of two separate parcels separated by Big Run. The wetland mitigation area is located east of Richardson Road and west of Big Run. It is an irregularly shaped parcel that is contained entirely within an agricultural field. Based on the preliminary plans, this area will contain two wetland cells that will equal approximately 9.1 ha (22.5 a) in size. The stream mitigation area consists of a 91.4 ha (300 ft) wide corridor that extends 822 m (2,700 ft) along the eastern edge of Big Run. The corridor is located within an existing portion of the Eastside Nursery.

The project area is situated in the southeast part of the county, which is contained in the Columbus Lowland. This region is characterized by areas of low relief surrounded by relative uplands (Brockman 1998). The project area itself is located on ground moraine (Pavey et al. 1999). The topography of the project area is best described as nearly level with small isolated rises.

The Area of Potential Effect (APE) for this particular project should largely be limited to the footprint of the ground disturbance and immediately adjacent areas. This APE was established based on the fact that much of the work for the proposed project will occur below grade.

II. Environmental Setting

2.1. Climate

The climate in Franklin County is cold in the winter and warm in the summer. The average winter temperature is 0.5°C, (31°F); low temperatures can reach single digits or even into the negatives (USDA, SCS 1980). The average high temperature during the summer is 22.7° C (73° F), with highs possibly reaching triple digits (USDA, SCS 1980). The total annual precipitation is 92.7 cm (36.5 in) (USDA, SCS 1980). The prevailing winds are generally out of the south-southwest.

2.2. Physiography

Franklin County is located within the glaciated till plain of Central Ohio (Brockman 1998). The landscape varies from level to gently rolling hills. Elevation above sea level in the county ranges from 344 m (1,130 ft) in the northeast corner to 204 m (670 ft) along the southern boundary where the Scioto River exits the county (USDA, SCS 1980).

2.3. Geomorphology

Franklin County has been glaciated during at least two different glacial periods. The first being the Illinoian which occurred about 130,000-300,000 years ago, leaving a layer of fine, well-sorted sands (USDA, SCS 1980). The Wisconsin glacial episode occurred about 50,000-16,000 years ago (USDA, SCS 1980). When the Wisconsin glacier retreated it resulted in an abundance of sediment-laden melt water, creating gravel outwashes along the Scioto River and its tributaries (USDA, SCS 1980).

The surface deposits in the county are primarily ground moraine with thin bands of end moraine (Pavey et al 1999). Areas of ground moraine characteristically have nearly level to gently rolling landscape. End moraines are areas where the glaciers stopped for a period of time leaving behind an elongated pile of till. This resulted in end moraines being about 20 to 50 feet higher than the surrounding ground moraine. Other landscape features include kames and eskers. These hummocky hills are prevalent in the southern part of the county (Pavey et al 1999).

2.4. Geology

The bedrock underlying the glacial deposits in Franklin County is sedimentary in nature. The two systems present include the Devonian and Mississippian Systems (USDA, SCS 1980). The Devonian System, the older of the two, is present primarily in the western portion of the county and consists of dolomitic limestone, Columbus and Delaware limestones and Ohio and Olentangy shales (USDA, SCS 1980). The limestone is located mostly along the Scioto River Valley and the shale is located along the Olentangy River Valley (USDA, SCS 1980). The Mississippian System is present in the eastern portion of the county. This system consists of mostly alternating beds of Bedford shales, Berea sandstone, Sunbury shale, and Cuyahoga sandstone (USDA, SCS 1980).

2.5. Hydrology

The principal waterway of Franklin County is the Scioto River. Its numerous tributaries include the Olentangy River and Darby, Walnut, Blacklick and Alum Creeks. All of these drainages flow south to the Ohio River (Sherman 2000[1925]).

2.6. Soils

The project area is contained within the Medway-Genesee-Sloan and Miamian-Celina soil associations. The Medway-Genesee-Sloan association consists of deep, nearly level soils that range from well-drained to poorly-drained (USDA, SCS 1980). The Miamian-Celina association contains deep, nearly level to very steep soils that are moderately well-drained (USDA, SCS 1980). The specific soils included within the project corridor include: Genesee silt loam (Gn), Eel silt loam (Ee), Shoals silt loam (Sh), Sloan silt loam (So), Ockley silt loam (OcB) and Miamian silty clay loam (MIC2). Genesee and Eel soils are deep, well drained soils formed in the floodplains (USDA, SCS 1980). These soils were located primarily in the area of the test units. Shoals and Sloan soils are deep, somewhat poorly drained soils formed in alluvium from upland terraces (USDA, SCS 1980). These two soils make up the majority of the project area. The Ockley and Miamian soils are deep, well drained soils that were formed in glacial outwash (USDA, SCS 1980).

2.7. Fauna

Central Ohio's rolling hills and numerous waterways provide an environment where faunal populations can thrive. The diverse habitats of open prairie, swamps, and dense forests create a habitat for a very diverse group of wildlife. Some of the common mammal species that were prevalent in Central Ohio prehistorically include: black bear, elk, wolf, woodland bison, white-tailed deer, red fox, bobcat, beaver, muskrat, groundhog, opossum, raccoon, rabbit, squirrels, various members of the weasel family and skunks. This list is not comprehensive, but it covers the mammals that appear in the archaeological record more frequently (Funk 1993). One major change in the faunal population from prehistoric times to historic times is a decrease in population of large mammals and predators. Historic peoples during the late 1700's and 1800's found the large predators such as the wolf and black bear a nuisance and a very definite danger to themselves and their livestock. Some animal numbers have been greatly increased due to modern changes to the environment. The white-tailed deer are more plentiful now than ever in their history. The main reason being farmlands make ideal habitats for them, as it provides excellent cover and a steady food supply.

2.8. Flora

Central Ohio is characterized as being primarily Beech Forest with small dispersed areas of Elm-Ash Swamp Forests, Prairie Grasslands, Sphagnum Peat Bogs and Mixed Oak Forests (Melvin 1970). Trees found in this region include members of the oak, maple, ash, and locust families. Nut trees, such as black walnut, hickory, hazelnut, and butternut are present in the forests. Trees that are found in wet/swampy habitat would include elms, ash, box elder, buckeye, hawthorn and sassafras. This list is not exhaustive, but it includes the trees most commonly encountered in Ohio. Prehistoric and historic peoples utilized a large number of plants in Ohio. Some of the plants used for medicinal purposes include:

wild leek, turtlehead, great lobelia, goldenseal, yarrow, horsetail and Solomon's seal. Many native plants were also used for food, such as, arrowhead, wild leek, chickweed, blackberry, elderberry, wild garlic, cattail, wild ginger, wild onion, cucumber root, swamp cabbage and wild strawberry (Henn 1998, Murphy 1990).

III. Prehistoric Cultural Setting

3.1. Introduction

Ohio has a long culture history dating back to the end of the last ice age. The following text is meant as a brief introduction to what is known of the unrecorded prehistoric period in Ohio. This summary is merely meant as an introduction to the various cultures and artifacts which may be encountered during the current cultural resources management investigation.

* The date ranges for each period are the result of numerous chronometric dates taken from various sites across the Midwest and the end and beginning dates are estimations which are subject to change as new sites are identified.

3.2. Paleo-Indian Period: 10050-8050 BC

It is generally accepted that the Paleo-Indians migrated to this area from the Southwest and Plains states. These nomadic people traveled in small groups hunting and gathering. In addition to the rather sparse plant foods, many types of animals were hunted. They hunted and butchered mammoths and mastodons but it appears that they killed weakened or wounded individuals as well as scavenged carcasses. Other large mammals that may have been hunted include giant beaver, giant ground sloth and bison. In addition to the mega-fauna, caribou, elk and rabbit have all been located in dated Paleo-Indian contexts. Archaeological evidence recovered from eastern Paleo-Indian sites has confirmed the use of nut and berry resources by these early inhabitants (Hooge and Lepper 1992).

Paleo-Indian sites are typically located near kettle bogs, end moraines and glacial kames (Tankersley et al. 1990). In Ohio, the majority of the Paleo-Indian sites are comprised mostly of isolated find spots of fluted points (Prufer and Baby 1963). Other site types include small campsites, chert quarries, butchering and kill sites. Sites which may be associated with habitation are usually located on hilltops and bluffs which overlook the larger tributary valleys.

Paleo-Indian artifacts include fluted projectile points, lanceolate shaped projectile points, drills, burins made on flakes and broken points, denticulates, alternately beveled knives, backed knives, unifacial knives, square knives, unifacial endscrapers with and without graver spurs, sidescrapers, pitted stones and adzes to name a few of the more common cultural trappings (Gramly 1992, Converse 1973). Subsurface features and evidence of structural remains are exceedingly rare from this period.

3.3. Archaic Period: 8050-300 BC

3.3.1. Early Archaic Period: 8050-4550 BC

With the recession of the glacier and the extinction of the Pleistocene mega-fauna, the Early Archaic Indians faced some major changes. Broad leaf forests were replacing the spruce and pines that previously dominated the terrain. Increasing dryness and warming made large, previously inhospitable tracts of land available and opened up the majority of Ohio to settlement. More space, combined with the increasing sources of food, led to a sustained population growth throughout the Archaic. Archaic populations had base camps which were centrally located for the best access to the most resources (Chapman 1985).

From these base camps smaller groups or individuals would make forays to collect resources to bring back to the base camps (Chapman 1985). During the winter, small family groups would radiate out from the base camp, returning again when resources were more plentiful. Early Archaic groups were still nomadic in nature, much like the Paleo-Indians of the preceding period.

With the expansion of the broadleaf forests, plant foods became more prominent in the diet (Fagan 1995). In addition, herd animals became the focus of hunting. Deer, elk, caribou and bison were probably the main sources of protein. Smaller animals that are common today such as rabbits, squirrel, mink, fox and others were also important for their meat as well as fur.

Early Archaic artifacts include large beveled knives such as Dovetails (St. Charles), Thebes and Lost Lakes, Kirk varieties, and bifurcated points such as Lake Eries, MacCorkles and LeCroys (Justice 1987, Converse 1973). Tools found on Early Archaic sites include endscrapers, sidescrapers and utilized flakes among others. Groundstone and slate artifacts became common during this period for the first time. These included various axes, chisels, gouges, and bannerstones. Early Archaic artifacts are found throughout the state in geographically diverse environments and made from many different flint types. This would seem to indicate that Early Archaic populations were utilizing a wider range of food sources and habitats than previously exploited in the Paleo-Indian Period.

3.3.2. Middle Archaic Period: 4550-3050 BC

The Middle Archaic Period in Ohio is not very well understood. Many Middle Archaic sites within Ohio consist of isolated finds and small lithic scatters only identifiable as such based on the recovery of diagnostic point types.

This period occurs at the end of a warm, dry trend known as the hypsithermal climatic interval. The drying of the environment led to a decrease in forests, which were being replaced by grasslands. This in turn led to technological developments to deal with the more arid environment. In more northerly climes like Michigan this period is marked by a transition from a spruce to pine to deciduous forest (Fitting 1970). Important sites from this period are all located well south of the Ohio region. New groundstone implements such as pitted anvils, grinding stones and pestles make their appearance. These appear to be a result of utilizing more plant foods, especially nuts and starchy seeds that become more common with the drying of the environment. Whitetail deer and turkey were the most important game animals. Riverine resources such as shellfish, fish and waterfowl were also important. The ephemeral nature of most Middle Archaic sites in Ohio suggests a low population with high mobility. It has been postulated that during this time period the lack of Middle Archaic type sites is best explained by a lack of environments to which the Middle Archaic people were best adapted (Fitting 1970).

Middle Archaic artifacts which may be encountered in Ohio include; Eva points, Morrow Mountain points, Raddatz points and White Springs points. The ranges for these are all limited to extreme southern Ohio along the Ohio River, with the exception of Raddatz points which are found throughout Ohio (Justice 1987)

3.3.3. Late Archaic Period: 3050-300 BC

During the Late Archaic Period, rising waters from the melting of the last of the glaciers created a focus on riverine environments. Plant foods seemed to gain importance and a population increase followed accordingly (Fagan 1995). A more sedentary lifestyle is evident with good examples of storage pits and re-occupied base camps. Pottery was first introduced in the Southeast during this period around 2500 BC (Fagan 1995). It is also during this period that rather unique culturally based mortuary expressions are first seen.

The Glacial Kame Culture (2950-2450 BC) is a unique burial cult of the Late Archaic Period. It was labeled based on the way the dead were buried in the gravelly glacial deposits of the same name. It is most common in the northwest part of the state. This culture was involved in the importation of exotic trade goods. Conch shells were brought from the coasts, cannel coal from Southern Ohio and copper from the Upper Peninsula of Michigan. Some of the burial items recovered include; sandal sole gorgets, shell gorgets, copper celts and awls, birdstones, humped back gorgets and constricted center gorgets (Converse 1979).

Late Archaic artifacts include the following point types; various Brewerton, Matanzas, Table Rock, Bottleneck, Lamoka, Karnak, McWhinney, Ashtabula, Turkey tail and Meadowood points (Justice 1987). Slate gorgets are first present during this period and are often found as burial goods. Many of these point types have overlapping distributions indicating a lot of movement between peoples and a high diversity of tool types.

3.4. Woodland Period

3.4.1. Early Woodland Period: 500 BC-100 AD

The Early Woodland Period is sometimes known as the period of the Adena Culture. The Early Woodland period is marked by changes in subsistence practices, social organization, cultural traits and regional exploitation of resources. The Early Woodland populations likely followed a hunter-gatherer subsistence pattern with a greater reliance on gathering. There also appears to have been a primitive form of social hierarchy beginning among populations of the Early Woodland period. It is during the Early Woodland period that the practice of constructing earthen mounds for burial practices first begins. It is also during this period that a greater degree of regionalism and territorialism is seen.

It is during the Early Woodland period in Ohio that the use of ceramic vessels becomes common. These early ceramics are usually quite thick and usually poorly fired. The ceramics were often flat-bottomed vessels with lug handles. Often, cordmarking is present on the exterior and interior of the vessel. Latter ceramic designs include stamped designs and incised lines (Tuck 1978). The practice of building earthworks and burial mounds also first appears during the Early Woodland period.

The construction of residential dwellings as well as the increased use of ceramics is often used to suggest an increase in sedentism of the Early Woodland populations. The Early Woodland peoples also appear to have had established home ranges which a single political unit (likely the family) would exploit for providing the necessary resources for survival.

Artifacts which are considered to be diagnostic of the Early Woodland (Adena Culture) of Ohio include weak-shouldered lobate-stemmed spear or dart points such as Cresap Stemmed, Kramer, Robbins, Dickson Contracting Stemmed, and Adena Stemmed projectile points, bar and keel shaped gorgets, cigar-shaped and block-end-tube smoking pipes, quadriconcave gorgets, bi-concave gorgets, elliptical gorgets, indented gorgets, loafstones, bar amulets, keyhole pendants, bell-shaped pendants, boatstones, bust-type birdstones, and expanding center gorgets (Webb and Snow 1945; Webb and Baby 1966[1957]; Dragoo 1963, Converse 1978).

3.4.2. Middle Woodland Period: AD 0-450

The Middle Woodland period is perhaps one of the most visible of all of Ohio's prehistoric populations due to their construction of large-scale geometric earthworks. For this reason, the Middle Woodland period of Ohio is often thought of as the period of the Hopewell culture. The Hopewell culture practiced an elaborate mortuary cult that involved mound and earthwork construction, the importation of exotic trade goods, elaborate ceremonial items and cremation practices.

It is during the Middle Woodland period that there appears to be an increase in the levels of social organization as evidenced by the burial populations and associated burial items, which have been recovered. However, the burial populations are limited and do not appear to include any individuals of the perceived lower classes of Hopewell society.

The Middle Woodland period is also noted for its monumental architecture in the form of large geometric earthworks. These shapes include circles, octagons and squares and more symbolic forms such as a bear paw, a menorah-like form, a horseshoe-like form (Atwater 1820; Squier and Davis 1848), and even what appears to be an outline of a giant Hopewellian House for the Dead [Mound City] (Shumaker 1965). The Hopewell peoples also constructed large earthen enclosures which were often placed in specific locations to take advantage of natural features such as is seen at Fort Hill in Highland County and at Fort Ancient in Warren County.

The ceramic technology becomes more refined during the Middle Woodland period. The ceramics which are produced by the Middle Woodland populations are thinner walled than that of the Early Woodland and are better fired. The highest quality ceramics are often recovered in burial mound contexts. The utilitarian ceramics are more rarely encountered. This is likely due to the poor preservation factors at most of these habitation sites (Licking County Archaeological and Landmarks Society [LCALS] 1985).

Artifacts which are considered to be diagnostic of the Middle Woodland (Hopewell Culture) of Ohio include projectile points such as Snyders, Steuben Expanded Stem, Bakers Creek and Chesser Notched. Other items which are considered diagnostic are bladelets, prepared bladelet cores, squared celts, rectangular two-hole gorgets, expanding center gorgets, boat shaped gorgets, reel-shaped gorgets, boatstones, anchor pendants, shovel-shaped pendants, pentagonal pendants, trapezoidal pendants, cones, and bust type birdstones, among other items.

3.4.3. Late Woodland: AD 450-1000

The Late Woodland period is markedly different from the preceding prehistoric periods in Ohio. During the Late Woodland period, regionalism of specific cultural groups becomes apparent in the archaeological record. The evidence of long distance trafficking of exotic trade goods is no longer as prevalent as it was in the preceding Middle Woodland period. Late Woodland populations practiced agricultural oriented subsistence practices. The crops produced by these populations included maize, beans, sunflower and squash. Other features of Late Woodland life included living in more permanent villages, some of which were surrounded by palisades that were for defensive purposes. There are several phases of the Late Woodland period in Ohio as well as several distinct cultural manifestations.

3.5. Late Prehistoric: AD 1000-1600

The Late Prehistoric period is marked by a move to larger, more permanent villages, full blown agriculture, particularly corn, and an apparent increase in warfare. Late Prehistoric sites seemed to focus on fertile, easily tilled river valleys or coastal areas (Brose et al 2001). The Late Prehistoric period in Central Ohio is sort of an enigma. With the Fort Ancient Culture developing in the south, Monongahela in the East, Whittlesey in the northeast and Western Basin in the northwest, Central Ohio seems to have served as a buffer between these different cultures. It is well known that large portions of the Eastern North America were unoccupied during this time (Brose et al 2001). Central Ohio seems to be one of those largely unoccupied areas.

IV. Historic Setting

4.1. Protohistoric to Historic

During the mid 1600's, European traders and explorers traveled through the Great Lakes region in search of pelts for the lucrative fur trade. The French primarily traded with the Great Lakes Indians, while the English concentrated on trading with the Iroquois and other groups east of the Great Lakes. The first recorded village in Ohio, Teanontoria was located on the western bank of the Maumee River (Tanner 1987). The Tionontati Indians occupied it in 1652-1653 (Tanner 1987). In the 1670's, three recorded Shawnee villages on the banks of the Little Miami also appear in Ohio (Tanner 1987). The Iroquois Wars of 1641-1701, were sporadic hostilities that covered a large area from the Plains to New England and into Canada. The fur trade played a major role in Iroquois aggressions towards their neighboring native populations. The large quantities of furs east of the Great Lakes had become depleted and were no longer able to support the Five Nations. They began to move westward into the land of the French and their allies. The Iroquois' westward expansion was greatly aided by the supplied firearms from the British. The Hurons, being decimated by the Iroquois, sought refuge among the Erie of Ohio and other native groups. Later the Iroquois expelled the Erie from their lands in northern Ohio (Tanner 1987). During the 1870's, the Iroquois were being ravaged by European diseases and could no longer sustain their widespread attacks. This gave the Great Lakes Indians and their French allies time to rebuild their numbers and defenses, thus ending the Iroquoian threat.

During the early to late 1700's, the French and British rivalry over the Indian trade had hit its peak. The French concentrated their trade on the Mississippi and the area surrounding Detroit. Using the numerous waterways for transportation they spread their trade across the Great Lakes region. The British concentrated mainly in the town of Albany in New York (Tanner 1987). In Ohio at this time, the Shawnee Indians began to consolidate its scattered groups in the lower half of the state. In the 1750's, the French and Indian forces fought the British at Pickawillany, capturing British traders and a Miami leader (Tanner 1987). The French then began to move south into Kentucky and into eastern Ohio, securing trade with the Indians. They remained in control of the trade in Ohio until the beginning of the Seven Years War in Europe. The conflict between France and Great Britain climaxed in the French and Indian War of 1754-60 (Tanner 1987). The war began with the defeat of General Braddock's British forces at Fort Duquesne in 1755 (Tanner 1987). The Great Lakes Indians supported the French as a way to stop the land hungry British from taking more Indian lands. The Indians concentrated their attacks on the British outposts and small settlements, also sending large numbers to aid the French battling the British militia. The final battle of the French and Indian War took place in Montreal on September of 1760 (Tanner 1987). With the French capitulation, and surrender of all military posts, the British gained full control of the trade routes. In 1763, Great Britain was granted the Ohio lands under the laws set forth in the Treaty of Paris (Tanner 1987).

The Ohio lands consisted of at least six different tribal groups circa 1768. The Ottawa and Miami were located in the northwest. The Shawnee were located primarily in the southwest. The Wyandot were located in the north-central part of the state. The Delaware and Mingo were in the eastern half of the state. The conflicts between the tribes had lessened considerably due to their concerns with the British. In 1795, the Treaty of Greeneville was established to move all native peoples north of the 42nd parallel (Tanner

1987). The last major development involving the Ohio Native Americans, British and Americans was The War of 1812. The battles that ensued culminated in the defeat of the British and the Indians being sent to reservations in Northwest Ohio.

4.2. Franklin County History

The first American to survey Franklin County was Lucas Sullivant in August of 1797 (Martin 1858). Sullivant was also the first settler to erect a cabin in what would later be known as Franklinton that same year. Other early settlers include the Armstrongs, Brickells, Dixons, Donigans and Marshals (Martin 1858). Franklin County was laid out on April 30, 1803, although its borders were not made official until 1857 (Moore 1930). Many of the early settlers arrived from Pennsylvania, Virginia and New England. Most of the early settlers were of German, Irish and English decent.

Other settlements began to emerge adjacent to the Scioto and Olentangy Rivers. The town of Worthington, named after the early statesmen, Thomas Worthington, was settled in 1803 on the banks of the Olentangy River. Columbus became the state capital in 1812, due to its central location and strong development (Moore 1930). In 1818 the town of Dublin was organized on the banks of the Scioto River and was an early contender for the title of capitol (Moore 1930). The Ohio-Erie Canal built in the early 1830's passed through the Southeast corner of Franklin County. In 1834, the National Road (State Route 40) was constructed through the center of Franklin County and passes by the Capitol building (Moore 1930). During the mid to late 1800's numerous small villages and towns began to emerge along the small waterways and new transportation routes. Franklin County is one of the most developed and heavily populated counties in Ohio. Franklin County is home to a wide array of national companies, large industries, state agencies, and numerous universities.

4.3. Madison Township History

Madison Township, located in the southeastern corner of Franklin County is the largest township in the county. It was officially organized in 1809 being formed from Hamilton Township. John Swisher esq. (from New Jersey) was likely the earliest settler and entered the township around 1802 (Martin 1858). Subsequent early settlers include Isaac Decker, Elias Decker and Charles Raney (Martin 1858).

Mathew Taylor erected the first mill in the township on Alum Creek on or around 1807 (Martin 1858). Thomas Rathmell was the first blacksmith in the township, setting up shop in 1816 (Martin 1858). George Kalb was the first school teacher (Martin 1858). The first town was laid out by Isaac Decker in 1817 (Martin 1858). The town was originally named Middletown but was later changed to Oregon. In 1829 a post office was established in the town but abandoned when Groveport opened its post office. In 1843 the western portion of Groveport was laid out by John B. Wert and was originally named Wert's Grove. The eastern half was laid out the following year and named Rarey's Port after its founder. The name was later changed to Groveport in 1846. The town of Winchester was originally located in Fairfield County, but became part of Franklin County in 1851. Winchester was laid out in 1826 and 1827 by Ruben Dave and John Culman (Martin 1858).

V. Literature Review

5.1. Introduction

The literature review encompasses a circular area of 2.0 km (1.2 mi.) in radius centered on the project area. This area includes portions of the United States Geological Survey (USGS) *1966 (Photorevised 1985; Minor Revision 1994) Canal Winchester* and the *1992 Lockbourne, Ohio, 7.5 Minute Series (Topographic)* map.

5.2. William C. Mills' *An Archaeological Atlas of Ohio* (1914)

In the early part of the past century the director of the Ohio Archaeological and Historical Society, William C. Mills, produced a generalized map of mound and site locations at the county level through personal inspection and correspondence. Examination of William C. Mills' *An Archaeological Atlas of Ohio* (1914) failed to identify any such resources in the project area (Figure 3). The atlas did identify a mound to the northwest of the project area. It is located along the western edge of Richardson Road.

5.3. Ohio Archaeological Inventory (OAI) Forms

There were a total of 3 previously identified archaeological sites (33-Fr-[28, 2537-2538]) located within the study radius. Archaeological site 33-Fr-28, known as the Decker Mound is located northwest of the project area along Walnut Creek. This appears to correlate to the mound shown on the Mills' atlas (1914), even though it is on the opposite side of the road. This is possible as many of the features shown on Mills' atlas were not field verified. Site 33-Fr-2537 is a prehistoric lithic scatter that contained a fluted Paleo point and another point of unknown temporal affiliation. This site is located south of the project area. Site 33-Fr-2538 is an isolated Early Archaic tool that was located just south of Hayes Road. None of these sites were located within or adjacent to the project area.

5.4. Ohio Historical Inventory (OHI) Forms

A review of the archived OHI forms stored at the OHPO was conducted prior to conducting the fieldwork. There were 3 previously recorded OHI properties (FRA-[2384-2385, 2515]-24) located within the study radius. Property FRA-2384-24 is an Italianate style house located at 2524 Lithopolis Road. This property has since been destroyed. Property FRA-2385-24 is a vernacular style house with Greek-Revival elements that is thought to have been built in the mid-1800's. The property is located at 4980 Lithopolis Road and was determined to be potentially eligible for inclusion onto the NRHP. This property has also been demolished. Property FRA-2515-24 is the Tedro Brant house, a vernacular farmhouse with Queen Anne elements located at 7521 Lithopolis Road. This property was determined not to be eligible for inclusion onto the NRHP.

5.5. National Register of Historic Places (NRHP) Files

A review of the archived NRHP files stored at the OHPO was conducted prior to the initiation of fieldwork. These investigations identified failed to identify any historic properties located within the study radius.

5.6. Cultural Resources Management (CRM) Reports

A review of the archived CRM reports stored at the OHPO failed to identify any previously surveyed areas within the study radius.

5.7. Historic Atlases and Topographic Maps

Atlases, pertinent histories, 15' series topographic maps and 7.5' topographic maps for Madison Township, Franklin County were researched for location of historic buildings and for past owners and their possible historical importance.

The earliest atlas found for Madison Township is the *Franklin County, Ohio* map (Wheeler 1842). The map does not show buildings or structures but does contain the names of early property owners (Figure 4). The property at this time was owned by C.B., W. Seymour, A. Dildane and S. Wooding's Hrs.

The *Franklin County, Ohio* map (Graham 1856) shows landowners, acreage and buildings (Figure 5). The property at this time was owned by W. T. Decker (52 a.) and S. Wooding (150 a.). There are no houses indicated within the project area.

The *Atlas of Franklin County and of the City of Columbus* (Caldwell 1872) shows property owners and house locations (Figure 6). The land at this time was owned by W. Seymour (64 a.) and F. Klemforth (117 a.). There were no houses indicated within the project area.

The *Map of Franklin County, Ohio* (Brand 1883) does not show buildings but does give acreage and property owners and in some cases the locations of mounds and other earthworks (Figure 7). The project area at this time was owned by Welton Seymour (118 a.), Fred Klemforth (113 a.), Wm. T. Decker (52 a.). No mounds were indicated within the project area.

The USGS *1925 (Reprinted 1952) East Columbus, Ohio 15 Minute Series (Topographic)* map fails to indicate any buildings located within the project area. The USGS *1966 (Photorevised 1985, Minor Revisions 1994) Canal Winchester Quadrangle, Ohio, 7.5 Minute Series (Topographic)* indicates that no buildings are located within the project area (Figure 2).

Review of the Madison Township histories failed to identify any of the landowners. It is assumed that they did not play a major part in the historical development of the local area.

VI. Research Design

The research design is a series of general questions used to direct the fieldwork by focusing the efforts towards a specific goal. The goal of this particular project is to locate, document and evaluate for the National Register of Historic Places all the cultural resources which may be located within the project area. The research design draws on the information gathered from the environmental situation, prehistoric and historic settings, locally specific literature review, historic maps and atlas review and authors' experience in the region. These factors are taken together to form a series of general research questions that are formulated prior to the initiation of fieldwork. The goal of the research questions is to develop expectations as to where and why cultural resources are located within the project area.

6.1. Fieldwork Methodologies

There are three basic methodologies that may be utilized during the fieldwork portion of these Cultural Resources Management Investigations; visual inspection, surface collection and subsurface investigations. The use of each methodology is dependent on the conditions experienced in the field.

6.1.1. Visual Inspection

All portions of the project area will be subjected to visual inspection. Visual inspection will be utilized to identify any structures, buildings, objects, or properties that are over 50 years old. It will also be used as a supplementary form of investigation to examine portions of the project area that may be steep, disturbed, or saturated.

6.1.2. Surface Collection

Any portions of the project area which offer sufficient bare ground surface visibility (>50%) will be subjected to surface collection methodologies. Surface collection will be conducted through pedestrian transects which will be paced at 3 m (10 ft) intervals. Where possible, all encountered artifacts may be initially flagged with pin flags for the purpose of defining spatial distribution of encountered archaeological sites. The pin flags will also allow the Principal Investigator to review the locations of the artifacts and to determine if concentrations, densities, or clusters are apparent on the inter-site level. If the Principal Investigator deems that there are no concentrations, densities, or clusters present at the encountered site, then the location and boundaries of the site will be plotted on a map and the artifacts will be grab sampled. If the Principal Investigator observes concentrations, densities, or clusters at an identified site then the artifacts will be collected by grid blocks, or the artifacts will be piece plotted.

6.1.3. Subsurface Investigation

All portions of the project area which do not offer sufficient bare ground surface visibility (<50%), and are less than 15 degrees slope will be investigated through subsurface testing methodologies. Subsurface testing in the form of shovel test units will be performed at 15 m or 50 ft intervals in the form of a grid system across the whole of the project area except in areas of low probability. If the project consists of a corridor, units will be excavated at 15 m or 50 ft intervals along the length of the corridor except in areas of low probability. Areas of low probability include areas such as those that are seasonally inundated and poorly drained. In this case intervals may be increased at the discretion of the field supervisor. Also, the areas immediately surrounding known historic structures may be excavated at decreased intervals due to the increased probability of remains. These shovel test units measure .5 m x .5 m (1.6 ft x 1.6 ft). All soil from each unit will be screened through .25 in^2 hardware cloth. The artifacts from each unit will be bagged and labeled as such. The floor of each unit will be scraped level and examined for subsurface features. Any cultural features identified within a shovel test unit will be exposed, troweled and cleaned for pictures and a plan view drawing. Depending on the size and location of the feature it could either be quartered or halved and excavated by hand with appropriate profile drawings and pictures taken. If stratified fill is evident then the remaining portions of the feature could be excavated accordingly. A sample of fill measuring 3 liters (size permitting) will be collected for the purpose of flotation to recover organic remains (primarily prehistoric features). A portion of the feature not to exceed one half of the total size may be left *in situ* at the discretion of the field supervisor.

6.2. Artifact Analysis Methodologies

6.2.1. Prehistoric Period Artifact Analysis Methodology

After the completion of the fieldwork, trained personnel will conduct a detailed analysis on the artifacts that are recovered. All of the artifacts that are recovered will be maintained and inventoried by site designation. The artifacts that are non-diagnostic in nature will be classed into their functional attributes (described below). The analyses that will be conducted on the temporally diagnostic prehistoric artifacts that may be recovered from the project area will be based upon various projectile point and tool form typology sources and guides which will include but may not be limited to Bell (1958, 1960), Converse (1973, 1974, 1978, 1994), DeRegnaucourt and Georgiady (1998), Gramly (1992), Justice (1987), Perino (1968, 1971) and Waldorf and Waldorf (1987). A chert type analysis will also be performed on all of the chert artifacts that are collected based solely on the macroscopic attributes of each type.

6.2.2. Artifact Functional Categories

The following are definitions of the artifact functional categories, which will be used during the artifact analysis. These definitions will aid in the interpretation of the function expressed at the prehistoric sites that were encountered during these CRM Investigations. These definitions are modeled after Flenniken and Garrison (1975).

Primary Reduction Artifacts

Core: A core is a block of stone (usually chert) which shows evidence of manipulation by humans. Cores have at least one, but usually multiple, flake scars that are the result of hard hammer percussion strikes to create blanks for the purpose of tool production. The striking platform may or may not show evidence of preparation.

Primary Decortication Flakes: This type of flake is characterized by having cortex, or a weathered surface on the dorsal side of the artifact. The cortex or weathering covers an area of 50 percent or greater on the dorsal side. These flakes are usually caused by direct percussion techniques. These artifacts are the results of (1) checking a core for the quality of knappable chert, and (2) preparing a core for the removal of serviceable flakes for tool production. These types of artifacts often exhibit numerous flake scars or crushing at the platform due to prior failed attempts to remove the cortex.

Secondary Decortication Flake: This artifact type is characterized by having an area of less than 50 percent of the dorsal side of the artifact covered with a cortex or weathered surface. They also exhibit flake scars on the dorsal side from the removal of the primary decortication flakes.

Secondary Reduction Artifacts

Primary Thinning Flake: This artifact type represents the initial mode of the reduction of a blank, struck from a core, into a useable biface. These flakes usually lack cortex on the dorsal side of the flake. These artifacts are usually the result of hard percussion hammering at steep striking angles. They often have rather prominent platforms and bulbs of percussion on their ventral sides due to the stone or billet reduction techniques.

Secondary Thinning Flake: These artifacts often show numerous flake scars on the dorsal side due to the previous removal of lithic material during prior modes of bifacial reduction. These flakes are usually smaller and thinner than primary thinning flakes and are created through the implementation of soft hammering techniques such as the use of a billet, or through pressure flaking with an antler tine. Some secondary thinning flakes have a “v” shaped wedge on their proximal edge. This wedge is the result of the knapper over striking his mark during the reduction process.

Non-Attributable Reduction Artifacts

Shatter/Blocky Irregular: These artifacts are cubical and irregularly shaped pieces of lithic material which lack platforms and do not show clear negative or positive bulbs of percussion or associated features of conchoidal fractures.

Broken Flake: These artifacts, as the name suggests, are broken. They lack the diagnostic attributes, which allow them to be classed into a functional category such as a bulb of percussion, platform, flake scars and the artifacts original shape.

Finished Tool Forms

Utilized Flake: These artifacts, as their name suggests, are flakes that have been used as expedient tools. These flakes will show evidence of modification through intentional use. These artifacts include side scrapers, endscrapers, burins, denticulates, gravers, and basically all unifacial tool forms.

Biface: These artifacts are produced through the initial and secondary reduction methods already discussed. This artifact category includes all unfinished tool forms, which are modified on both the dorsal and ventral sides of the artifact. The artifacts in this category range from slightly bifacially modified blanks, to almost finished artifacts which only lack the diagnostic basal treatments.

Finished Biface, Diagnostic: As the category name suggests these bifaces have identifiable basal treatments, which allow them to be placed in a temporal framework to aid in interpretation of archaeological sites. These artifacts are commonly called points and knives.

Finished Biface, Non-Diagnostic: As the category name suggests, these bifaces are broken or do not otherwise fit into an identifiable category and they show features, such as notches, stems, or sharpening which suggest they are finished bifaces. However, they are so fragmentary that they cannot be confidently attributed to a specific type.

6.2.3. Historic Period Artifact Analysis Methodology

After the completion of the fieldwork, an artifact analysis will be conducted by trained personnel, on the historic period artifacts that may have been recovered. Historic period artifacts will be maintained and inventoried by site. They will be typed through the use of various guidebooks and other resources for the purpose of determining the approximate age of the artifacts as well as to aid in site interpretation. The guidebooks and resources which will be used include, but are not limited to, the following: Ball (1984), DeBolt (1994), Feild (2001), Gurke (1987), Hume (1969), Ketchum (2000), Kovel and Kovel (1986a, 1986b), Lehner (1988), Majewski and O'Brien (1987), Manson and Snyder (1997), McAllister (2001), Newman (1970), Shuman (1998), South (1977), Sussman (1977) and Thorn (1947). After an analysis has been performed and the artifacts have been inventoried, the site will be analyzed as to function, economic status of the inhabitants (when possible) and artifact patterning (when possible).

6.3. Background Information

A review of the archived OAI forms stored at the Ohio Historic Preservation Office (OHPO) was conducted in order to get the necessary background information. This research identified only 3 previously identified archaeological sites within the study area. These consisted of an identified Indian mound, a low-density lithic scatter and an isolated find spot. The two sites containing artifacts are located in the uplands overlooking Big Run. Though both these sites contained diagnostic artifacts it is misleading as they were collected by an avocational archaeologist that quite possibly did not notice or record debitage.

6.4. Expected Results

The information gathered during the literature review can be useful when trying to predict what cultural resources the project area may contain. However, the lack of previously recorded local cultural resource information makes understanding the prehistoric land use difficult. However, due to the projects close proximity to the Walnut Creek and Big Run and the fact that it does contain topographical relief; it is thought that the project does have good potential to contain previously unknown archaeological sites.

The early atlases and topographic maps failed to indicate any houses located within the project area. Therefore, it is unlikely that any historic era artifact deposits will be identified within the project area. If historic artifacts are recovered, they will likely be the result of secondary deposition.

6.5. Curation and Submission of Artifacts

In accordance with the property laws of the State of Ohio, all artifacts remain the property of the landowner till such a time as they relinquish their rights with the understanding that the artifacts will become the property of an acceptable curation facility. With the full cooperation of the landowner and pending acceptance of the artifacts by the selected curation facility, all artifacts will be washed and prepared for permanent curation. Until this time all artifacts will be stored in a temporary manner in a limited access facility under the direction of the Cultural Resources Department.

VII. Field Work and Interpretation

7.1. Introduction

The fieldwork that was conducted for the proposed wetland and stream mitigation project located within Madison Township, Franklin County, Ohio was completed in May of 2009. The weather conditions experienced during the fieldwork were generally seasonable and did not hinder these investigations.

The project area is located in central Madison Township (Figures 1 and 2). The project area consists of two separate parcels separated by Big Run. The wetland mitigation area is located east of Richardson Road and west of Big Run. It is an irregularly shaped parcel that is contained entirely within an agricultural field. Based on the preliminary plans, this area will contain two wetland cells that will equal approximately 9.1 ha (22.5 a) in size. The stream mitigation area consists of a 91.4 ha (300 ft) wide corridor that extends 822 m (2,700 ft) along the eastern edge of Big Run. The corridor is located within an existing portion of the Eastside Nursery.

7.2. Fieldwork

The wetland mitigation portion of the project was contained entirely within a plowed and weathered agricultural field (Exhibits 1-2). The boundaries of the field included Richardson Road to the west, a ditch to the north, Big Run to the east and nursery fields to the south. At the time of the fieldwork, surface visibility was excellent (Exhibit 3). The plowed field was surface collected at 7.5 (25 ft) intervals. If artifacts were encountered they were marked with a pin flag and the center of the site was located using a GPS unit. A total of 10 sites (33-Fr-[2745-2754]) were located within this portion of the project area (Figures 9 and 10).

The stream mitigation corridor was contained entirely within an existing tree nursery located east of Big Run (Exhibits 4-6). The ground cover necessitated the use of sub-surface testing strategies (Figure 9). In some areas supplemental surface collection was possible where ground surface was visible due to plowing (Exhibit 7). Due to the deep A-layer (28-55 cm) associated with the soils within this portion of the project area; a 20 inch auger attached to a 865 New Holland Bobcat was used to excavate the test units. Prior to the excavation of the test units, each test unit location was either pin flagged or marked using paint. The operator was told to excavate the units to a depth of approximately 60 cm (24 in). This method made it much easier to accurately excavate to the consistent depth necessary in the deeper soils. Although the holes were round, the volume was approximately the same if not more than a square hole due to being able to maintain a consistent hole width. The soil matrix was cast out around the hole and then was screened. The test units in this area showed natural stratigraphy (Figure 11). The datum for the test units was located at the northwest corner of the stream mitigation corridor (Figure 7). The test units were placed between the tree rows, which ran north/south. A total of 227 test units were excavated within the stream mitigation corridor. Three previously unknown archaeological sites (33-Fr-[2755-2757]) were identified within this portion of the project area (Figures 9 and 10).

The Area of Potential Effect (APE) for this particular project was set as the footprint of ground disturbance and adjacent areas which were all nursery or agricultural fields. An effort was made to identify any existing properties that would be affected by the proposed mitigation. None such properties were identified.

7.3. Site Descriptions

33-Fr-2745

This archaeological site is a prehistoric isolated find spot located within the wetland mitigation portion of the project area (Figures 9-10). The site location is zone 17, 340118 E, 4411365 N (NAD 27). This site was identified while surface collecting a dirt farm path located adjacent to the plowed agricultural field. The site is located on a prominent rise within the uplands overlooking Big Run. The artifact consisted of a fragmented Brewerton corner-notch point made of Delaware flint. This type of point is thought to date to the Late Archaic time period. The site size is estimated at 1 m^2 (10 ft^2).

33-Fr-2746

This archaeological site is a prehistoric isolated find spot located within the wetland mitigation portion of the project area (Figures 9-10). The site location is zone 17, 340349 E, 4411412 N (NAD 27). This site was identified while surface collecting a plowed and weathered agricultural field. It is located on a very slight rise within the Walnut Creek valley. The artifact consisted of a broken flake made from Vanport flint. The site size is estimated at 1 m^2 (10 ft^2).

33-Fr-2747

This archaeological site is a prehistoric isolated find spot located within the wetland mitigation portion of the project area (Figures 9-10). The site location is zone 17, 340369 E, 4411404 N (NAD 27). This site was identified while surface collecting a plowed and weathered agricultural field. It is located on a very slight rise within the Walnut Creek valley. The artifact consisted of an unfinished biface made from Upper Mercer flint. The site size is estimated at 1 m^2 (10 ft^2).

33-Fr-2748

This archaeological site is a small, low-density lithic scatter (n= 3) located within the wetland mitigation portion of the project area (Figures 9-10). The site location is zone 17, 340181 E, 4411301 N (NAD 27). This site was identified while surface collecting a plowed and weathered field. It is located on a very slight rise within the Walnut Creek valley. The site size is estimated at 2322 m^2 (25,000 ft^2). An inventory of the artifacts recovered is listed below.

Artifact	#	Material
Point Fragment	1	UM
Secondary thinning	2	UM (1), Vp (1)

*UM= Upper Mercer, Vp= Vanport

33-Fr-2749

This archaeological site is a small, low-density lithic scatter (n= 2) located within the wetland mitigation portion of the project area (Figures 9-10). The site location is zone 17, 340197 E, 4411114 N (NAD 27). This site was identified while surface collecting a plowed and weathered field. It is located on a very slight rise within the uplands. The site size is estimated at 1672 m^2 (18,000 ft^2). An inventory of the artifacts recovered is listed below.

Artifact	#	Material
Utilized flake	1	UM
Shatter	1	UM

*UM= Upper Mercer

33-Fr-2750

This archaeological site is a prehistoric isolated find spot located within the wetland mitigation portion of the project area (Figures 9-10). The site location is zone 17, 340255E, 4411051 N (NAD 27). This site was identified while surface collecting a plowed and weathered agricultural field. It is located on a very slight rise within the uplands. The artifact consisted of a broken flake made from Vanport flint. The site size is estimated at 1 m^2 (10 ft^2).

33-Fr-2751

This archaeological site is a prehistoric isolated find spot located within the wetland mitigation portion of the project area (Figures 9-10). The site location is zone 17, 340288 E, 4411084 N (NAD 27). This site was identified while surface collecting a plowed and weathered agricultural field. It is located on a very slight rise within the Walnut Creek valley. The artifact consisted of a primary thinning flake made from Upper Mercer flint. The site size is estimated at 1 m^2 (10 ft^2).

33-Fr-2752

This archaeological site is a prehistoric isolated find spot located within the northern portion of the permit area (Figures 9-10). The site location is zone 17, 340330 E, 4411152 N (NAD 27). This site was identified while surface collecting a plowed and weathered agricultural field. It is located on a very slight rise within the Walnut Creek valley. The artifact consisted of a piece of shatter made from Upper Mercer flint. The site size is estimated at 1 m^2 (10 ft^2).

33-Fr-2753

This archaeological site is a small, low-density lithic scatter (n= 2) located within the wetland mitigation portion of the project area (Figures 9-10). The site location is zone 17, 340363 E, 4411056 N (NAD 27). This site was identified while surface collecting a plowed and weathered field. It is located on a very slight rise within the Walnut Creek valley. The site size is estimated at 69 m^2 (750 ft^2). An inventory of the artifacts recovered is listed below.

Artifact	#	Material
Primary thinning	1	Vp
Unfinished Biface	1	Vp

*Vp= Vanport

33-Fr-2754

This archaeological site is a small, low-density lithic scatter (n= 3) located within the wetland mitigation portion of the project area (Figures 9-10). The site location is zone 17, 340492 E, 4411975 N (NAD 27). This site was identified while surface collecting a plowed and weathered field. It is located on a very slight rise within the uplands. The site size is estimated at 1161 m^2 (12,500 ft^2). An inventory of the artifacts recovered is listed below.

Artifact	#	Material
Primary thinning	2	UM (1), DI (1)
Secondary thinning	1	DI (1)

*Um= Upper Mercer, DI= Delaware

33-Fr-2755

This archaeological site is a small, low-density lithic scatter (n= 5) located within the stream mitigation portion of the project area (Figures 9-10). The site location is zone 17, 340463 E, 4411715 N (NAD 27). This site was identified during the excavation of the mechanically excavated auger test units located within an active tree farm along with supplemental surface collection. It is located on a very slight rise within the Walnut Creek valley. The site size is estimated at 162 m^2 (1,750 ft^2). An inventory of the artifacts recovered is listed below.

Artifact	#	Material
Broken	3	UM (2), DI (1)
Secondary thinning	2	Vp (1), DI (1)

*UM= Upper Mercer, Vp= Vanport, DI= Delaware

33-Fr-2756

This archaeological site is a small, low-density lithic scatter (n= 3) located within the stream mitigation portion of the project area (Figures 9-10). The site location is zone 17, 340483 E, 4411742 N (NAD 27). This site was identified during the excavation of the mechanically excavated auger test units located within an active tree farm and through supplementary surface collection. It is located on a very slight rise within the Walnut Creek floodplains. The site size is estimated at 69 m^2 (750 ft^2). An inventory of the artifacts recovered is listed below.

Artifact	#	Material
Broken	2	DI (1), Vp (1)
Primary thinning	1	UM

*UM= Upper Mercer, Vp= Vanport, DI= Delaware

33-Fr-2757

This archaeological site is a prehistoric isolated find spot located within the stream mitigation portion of the project area (Figures 9-10). The site location is zone 17, 340448 E, 4411814 N (NAD 27). This site was identified during the excavation of the mechanically excavated auger test units located within an active tree farm. It is located on a very slight rise within the Walnut Creek valley. The artifact consisted of a primary thinning flake made from Delaware flint. The site size is estimated at 1 m^2 (10 ft^2).

7.4. Conclusions

The fieldwork that was conducted for the proposed wetland and stream mitigation located within Madison Township, Franklin County, Ohio identified 13 previously unknown archaeological sites (33-Fr-[2745-2757]). Sites 33-Fr-(2745-2747, 2750-2752 and 2757) were isolated find spots that contained a single artifact each. Sites 33-FR-(2748-2749 and 2753-2756) were small, low-density prehistoric lithic scatters. Only one diagnostic artifact was recovered within the project area. This consisted of a fragmented Late Archaic Brewerton corner-notch point recovered from site 33-Fr-2745.

VIII. Expected Results Evaluation

There were expected results prepared before the commencement of the field work portion of these investigations, based on the background information and previous experience in the area. These questions were formulated so that the field work portion of these investigations could be conducted with some direction and with a set of goals in mind.

It was thought likely that the project area may contain previously unknown archaeological sites due to its close proximity to water and favorable topography. This fieldwork supported this expected result as 13 previously unknown archaeological sites were identified within the project area. These were located almost exclusively on the small rises located nearest to Big Run and Walnut Creek.

It was thought unlikely that historic artifacts would be identified within the project area. The fieldwork supported this expected result as no historic artifacts were recovered.

IX. Eligibility Assessment

The Phase I Cultural Resources Management Investigation conducted for the proposed wetland and stream mitigation project located within Madison Township, Franklin County, Ohio during the month of May identified 13 previously unknown archaeological sites (33-FR-[2745-2757).

Sites 33-Fr-2746, 2747, 2750-2752 and 2757 are all prehistoric period isolated finds lacking in temporal affiliation. Site 33-Fr-2745 is a prehistoric period isolated find that contained an artifact generally affiliated with the Late Archaic time period. These types of sites are generally considered to be related to transient hunting and gathering activities. Many of these types of finds are hunting losses or tool maintenance during hunting and gathering activities. None of these sites seem to possess the potential to yield additional information which would be important to the understanding of the prehistoric period in Madison Township, Franklin County, Ohio (Criterion D). These sites are not considered to be eligible for inclusion to the National Register of Historic Places because they fail to meet the minimum requirements as set forth by the United States Department of the Interior (USDI 1997). No further work is recommended for any of these archaeological sites.

Sites 33-Fr-2748-2749 and 2753-2756 are all temporally undefined low-density lithic scatters. These sites failed to produce many different classes of artifacts. They seem to be representative of small hunting-gathering campsites, tool curation or examples of food processing/procurement loci. These sites do not seem to possess the potential to yield additional information which would be important to the understanding of the prehistoric period in Madison Township, Franklin County, Ohio (Criterion D). These sites are not considered to be potentially eligible for inclusion to the National Register of Historic Places because they fail to meet the minimum requirements as set forth by the United States Department of the Interior (USDI 1997). No further work is recommended for these archaeological sites.

X. Bibliography

Atwater, C.
1820 Description of the Antiquities Discovered in the State of Ohio and Other Western States Communicated to the President of the American Antiquarian Society. In *Archaeologica Americana*, Vol. 1.

Baby, R. and M. Potter
1965 *The Cole Complex: A Preliminary Analysis of the Late Woodland Ceramics in Ohio and Their Relationship to the Ohio Hopewell Phase.* Papers in Archaeology No. 2. The Ohio Historical Society, Columbus.

Ball, D. B.
1984 Historic Artifact Patterning in the Ohio Valley. *Proceedings of the Symposium on Ohio Valley and Historic Archaeology.* Vol. 2:24-36.

Bell, R.E.
1958 *Guide to the Identification of Certain American Indian Projectile Points.* Special Bulletin No. 1, Oklahoma Anthropological Society, Norman.

1960 *Guide to the Identification of Certain American Indian Projectile Points.* Special Bulletin No. 2, Oklahoma Anthropological Society, Norman.

Brand, G. J.
1883 *Map of Franklin County, Ohio.* G. J. Brand & Co., Philadelphia.

Brockman, C. S.
1998 *Physiographic Regions of Ohio.* Ohio Department of Natural Resources.

Brose, D., C. W. Cowan and R. C. Mainfort
2001 *Societies in Eclipse: Archaeology of the Eastern Woodlands Indians, A.D. 1400-1700.* Smithsonian Institution Press, Washington

Caldwell, J. A.
1872 *Atlas of Franklin County and of the City of Columbus.* J. A. Caldwell and H. T. Gould, Columbus.

Chapman, J., P. A. Delcourt, P. A. Cridlebaugh, A. B. Shea, and H. R. Delcourt
1985 Man-Land Interaction: 10,000 Years of the American Indian Impact on the Native Ecosystems in the Lower Tennessee River Valley, Eastern Tennessee. *Southeastern Archaeology* 1(2):121-155.

Converse, R. N.
1973 *Ohio Flint Types.* The Archaeological Society of Ohio, Columbus.

1974 *Ohio Stone Tools.* The Archaeological Society of Ohio, Columbus.

1978 *Ohio Slate Types.* The Archaeological Society of Ohio, Columbus.

1979 *The Glacial Kame Indians.* The Archaeological Society of Ohio, Columbus.

1994 *Ohio Flint Types*. The Archaeological Society of Ohio, Columbus.

DeBolt, C. G.
1994 *DeBolt's Dictionary of American Pottery Marks – Whiteware & Porcelain.* Schroeder Publishing Co., Inc., Paducha.

DeRegnaucourt, T. and J. Georgiady
1998 *Prehistoric Chert Types of the Midwest.* Hothem House, Lancaster.

Dragoo, D. W.
1963 *Mounds for the Dead: An Analysis of the Adena Culture.* Carnegie Museum, Pittsburgh.

Feild, R.
2001 *Collector's Guide to Buying Antique Pottery and Porcelain.* Greenwich Editions, London.

Fagan, B.
1995 *Ancient North America: The Archaeology of a Continent.* Thames and Hudson, New York.

Fitting, J. E.
1970 *The Archaeology of Michigan.* The Natural History Press, Garden City, New York.

Flenniken, J. J. and E. G. Garrison
1975 Thermally altered novaculite and stone tool manufacturing techniques. *Journal of Field Archaeology* 2:125-131.

Gramly, R. M.
1992 *Guide to the Palaeo-Indian Artifacts of North America.* Persimmon Press, Buffalo.

Graham, J.
1856 *Map of Franklin County, Ohio.* R. C. Foote, Philadelphia.

Griffin, J. B.
1978 Late Prehistory of the Ohio Valley. In *Handbook of the North American Indians* Vol. 15, The Northeast. Edited by B. G. Trigger, pp. 547-559. Smithsonian Institution, Washington D.C.

Gurke, K.
1987 *Bricks and Brickmaking; A Handbook for Historical Archaeology.* The University of Idaho Press, Moscow.

Henn, R. L.
1998 *Wild Flowers of Ohio.* Indiana University Press, Bloomington and Indianapolis.

Hooge, P. and B. Lepper
1992 *Vanishing Heritage: Notes and Queries about the Archaeology and Culture*

History of Licking County Ohio. Licking County Archaeological and Landmarks Society, Newark.

Hume, I. N.
1969 *Historical Archaeology: A Comprehensive Guide*. Alfred A. Knopf, New York.

Justice, N. D.
1987 *Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States*. Indiana University Press, Bloomington and Indianapolis.

Ketchum, W. C.
2000 *American Pottery and Porcelain*. Chanticleer Press, Inc. NY.

Kovel, R. and T. Kovel
1986a *Kovel's Dictionary of Marks*. Crown Publishers, Inc. New York.

1986b *Kovel's New Dictionary of Marks*. Crown Publishers, Inc. New York.

Lehner, L.
1988 *Lehner's Encyclopedia of U.S. Marks on Pottery, Porcelain & Clay*. Collector Books, Paducah.

Licking County Archaeological and Landmarks Society (LCALS)
ca. 1985 *Discovering the Prehistoric Mound Builders of Licking County, Ohio*. Coyne Printing, Inc. Newark.

Majewski, T. and M. J. O'Brien
1987 The Use and Misuse of Nineteenth Century English and American Ceramics in Archaeological Analysis. In *Advances in Archaeological Method and Theory*, edited by M. J. Schiffer, 11:97-209. Academic Press, New York.

Manson, J. L. and D. M. Snyder
1997 *Evaluating Sites with Late Nineteenth or Early Twentieth Century Components of Eligibility in the National Register of Historic Places: Using Turn-of-the-Century Whitewares as Economic Indicators in Assessing Collections and Developing Contexts.* NCPTT Grant Number: MT-0424-5-NC-019.

Martin, W. T.
1858 *History of Franklin County*. Follett, Foster and Company, Columbus.

McAllister, L. S.
2001 *Collector's Guide to Feather Edge Ware*. Collector Books, Paducah.

Melvin, R.
1970 *A Guide to Ohio Outdoor Education Areas*. The Ohio Department of natural Resources and the Ohio Academy of Science, Columbus.

Mills, W. C.
1914 *An Archaeological Atlas of Ohio*. Ohio State Archaeological and Historical Society, Columbus.

Moore, O.
1930 *History of Franklin County, Ohio Vol. 1*. Historical Publishing Company, Indianapolis.

Morgan, R. G.
1952 Outline of Cultures in the Ohio Region. In *Archaeology of Eastern North America*, edited by J. B. Griffin, pp. 83-98. University of Chicago Press, Chicago.

Murphy, E. V. A.
1990 *Indian Uses of Native Plants*. Meyerbooks, Glenwood.

Newman, S.T.
1970 *A Dating Key for Post-Eighteenth Century Bottles*. Historical Archaeology 4:70-75.

Pavey, R., R. Goldthwait, C. Brockman, D. Hull, E. Swinford and R. Van Horn
1999 *Quaternary Geology of Ohio*. Ohio Division of Geological Survey Map No. 2.

Perino, G.
1968 *Guide to the Identification of Certain American Indian Projectile Points*. Special Bulletin No. 3, Oklahoma Anthropological Society, Norman.

1971 *Guide to the Identification of Certain American Indian Projectile Points*. Special Bulletin No. 4, Oklahoma Anthropological Society, Norman.

Potter, M. A.
1966 *Cole Ceramics: A Study of Late Woodland Pottery*. Unpublished M.A. thesis on file at the Ohio Historical Society, Department of Archaeology, Columbus.

1968 *Ohio's Prehistoric Peoples*. The Ohio Historical Society, Columbus.

Pratt, G. M. and D. R. Bush
1981 *Archaeological Resource Management in Ohio, A State Preservation Plan for Archaeology*. Copy available for review at the Ohio Historic Preservation Office, Columbus.

Prufer, O. H. and R. S. Baby
1963 *Paleo-Indians of Ohio*. Ohio Historical Society. Columbus.

Seeman, M. F.
1992 Woodland Traditions in the Midcontinent: A Comparison of Three Regional Sequences. *Research in Economic Anthropology*, Supplement 6, pages 3-46.

Sherman, C. E.
2000 [1925] *Map of Ohio Showing Principal Streams and Their Drainage Areas*. Ohio Department of Natural Resources, Division of Water, Columbus.

Shumaker, K. J.
1965 A Hopewellian Charnel House: A Reconstruction. *Ohio Archaeologist* V. 15, #2.

Shuman, J. A.
1998 *The Collector's Encyclopedia of Gaudy Dutch & Welsh.* Schroeder Publishing Co., Inc., Paducah.

South, S.
1977 *Method and Theory in Historical Archaeology.* Academic Press Inc., New York.

Squier, E. G. and E. H. Davis
1848 *Ancient Monuments of the Mississippi Valley: Comprising the Results of Extensive Original Surveys and Explorations. Smithsonian Contributions to Knowledge Vol. 1.* Smithsonian Institution, Washington.

Sussman, L.
1977 Changes in Pearlware Dinnerware, 1780-1830. In *Historical Archaeology* 11:105-111.

Tankersley, K. B., E. E. Smith, and D. R. Cochran
1990 Early Paleoindian Land Use, Mobility, and Lithic Exploitation Patterns: An Updated Distribution of Fluted Points in Indiana. In *North American Archaeologist,* 11(4):301-319.

Tanner, H. H.
1987 *Atlas of Great Lakes Indian History.* University of Oklahoma Press, Norman.

Thorn, C. J.
1947 *Handbook of Old Pottery and Porcelain Marks.* Tudor Publishing Company, New York.

Tuck, J. A.
1978 Regional Cultural Development, 3000-300 B. C. *Handbook of North American Indians* (15) Smithsonian Institution Press, Washington D.C.

United States Department of Agriculture, Soil Conservation Service (USDA, SCS)
1980 *Soil Survey of Franklin County, Ohio.* Soil Conservation Service, U. S. Department of Agriculture, Washington D. C. in cooperation with the Ohio Department of Natural Resources, Division of Lands and Soils, and the Ohio Agricultural Research and Development Center, Columbus.

United States Department of the Interior (USDI)
1997 *National Register Bulletin: How to Apply the National Register Criteria for Evaluation.* Washington.

Waldorf, V. and D. C. Waldorf
1987 *Story in Stone: Flint Types of the Central and Southern U. S.* Mound Builder Books, Branson.

Webb, W. S. and R. S. Baby
1966 [1957] *The Adena People No. 2.* The Ohio Historical Society, The Ohio State University Press, Columbus.

Webb, W. S. and C. E. Snow
1945 The Adena People. In *Reports in Anthropology and Archaeology VI*, Department of Anthropology, University of Kentucky, Lexington.

Wheeler, E. F.
1842 *Franklin County, Ohio.* E. F. Wheeler, Columbus

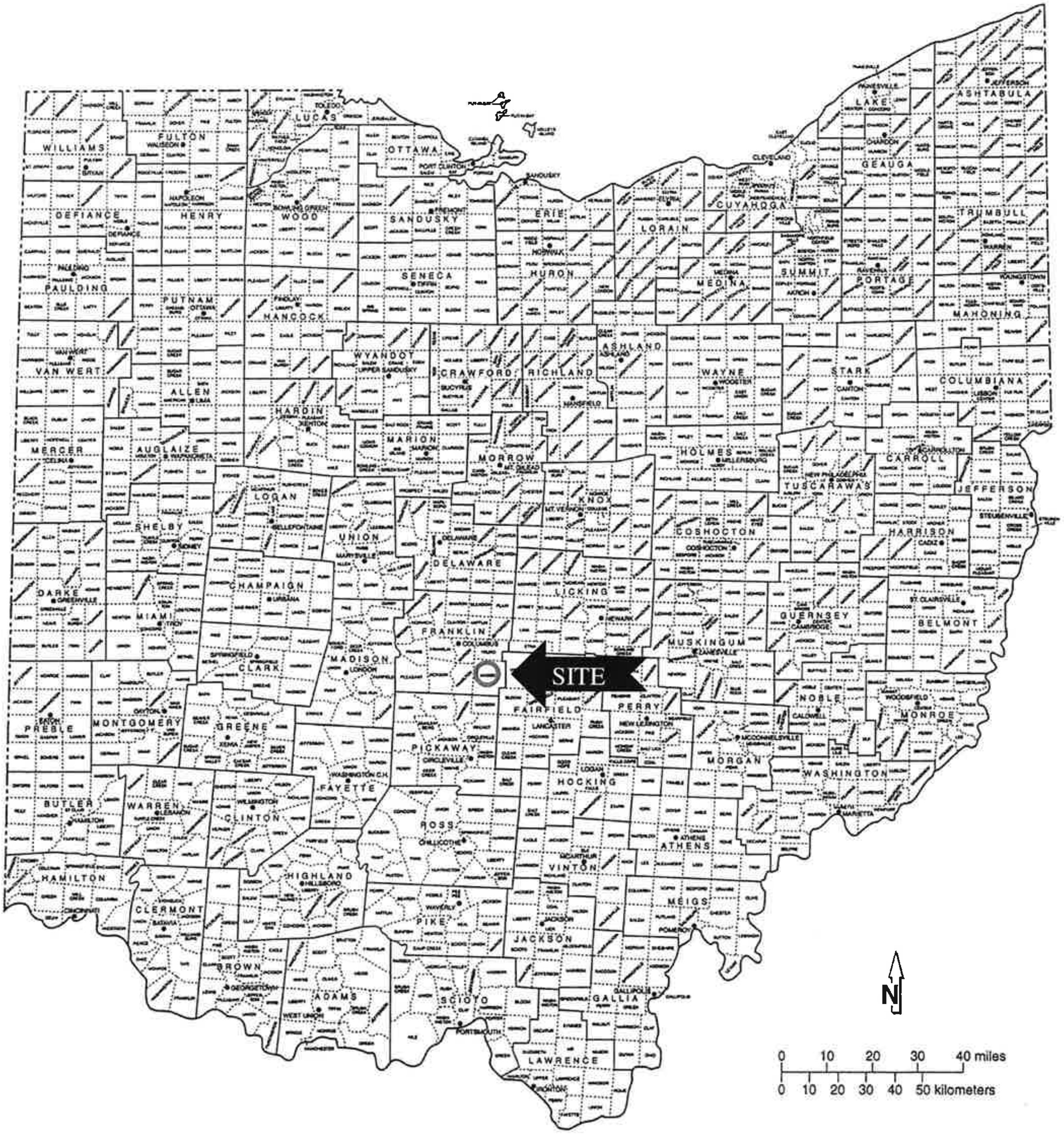


Figure 1. Political map of Ohio showing the approximate location of the project area.

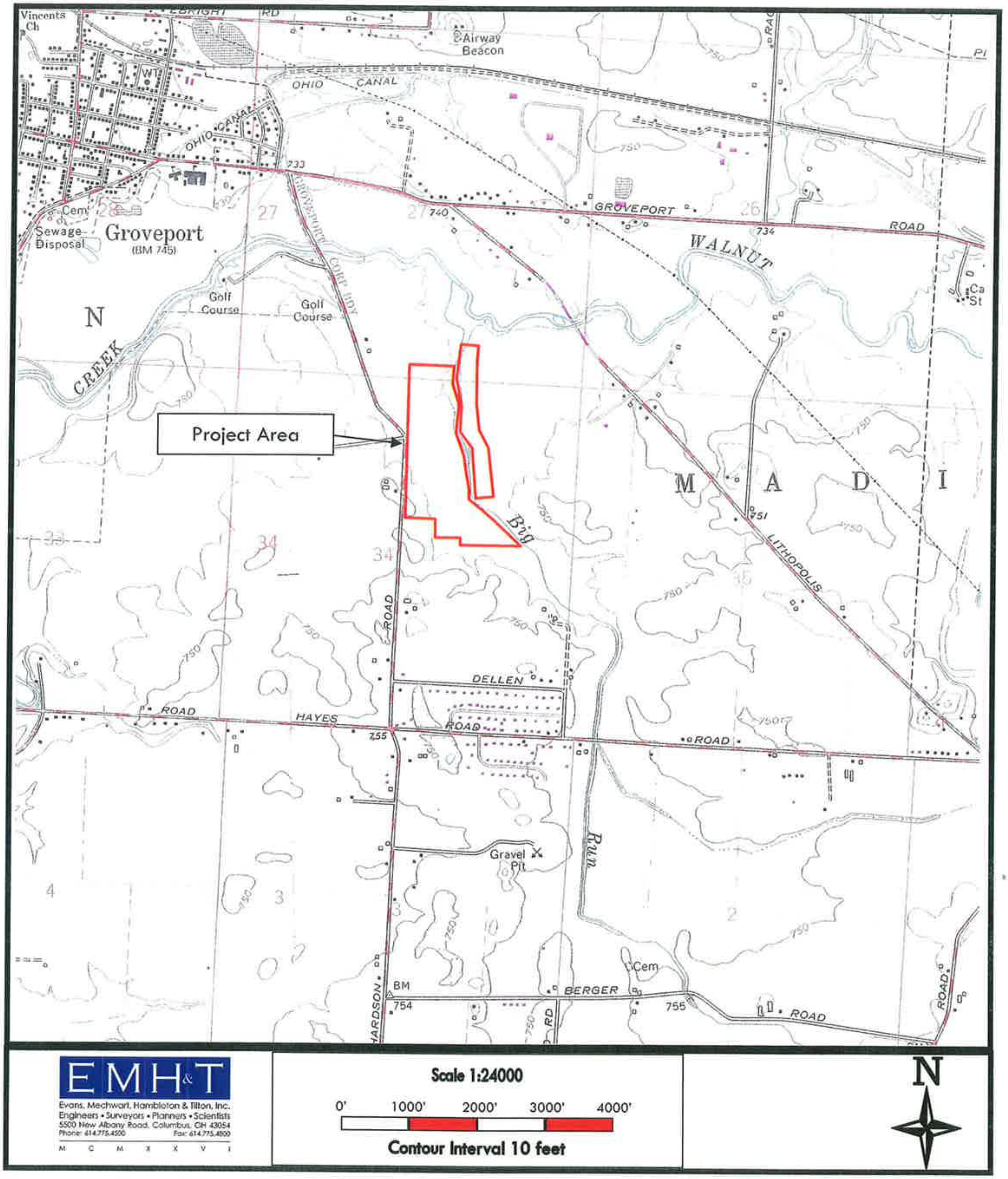


Figure 2. Portions of the United States Geological Survey (USGS) *1966 (Photorevised 1985; Minor Revision 1994) Canal Winchester* and *1992 Lockbourne, Ohio 7.5 Minute Series* (Topographic) maps showing the location of the project area.

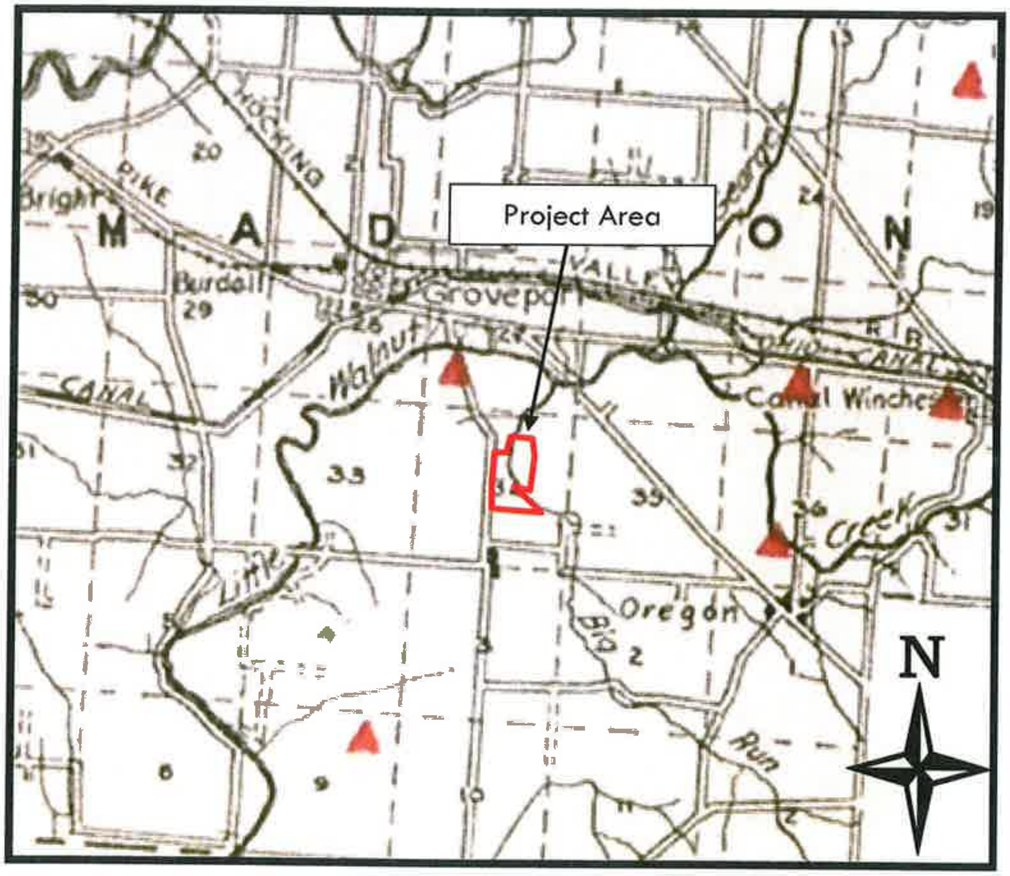


Figure 3. Portion of *An Archaeological Atlas* of Ohio (Mills 1914) showing the approximate location of the project area.

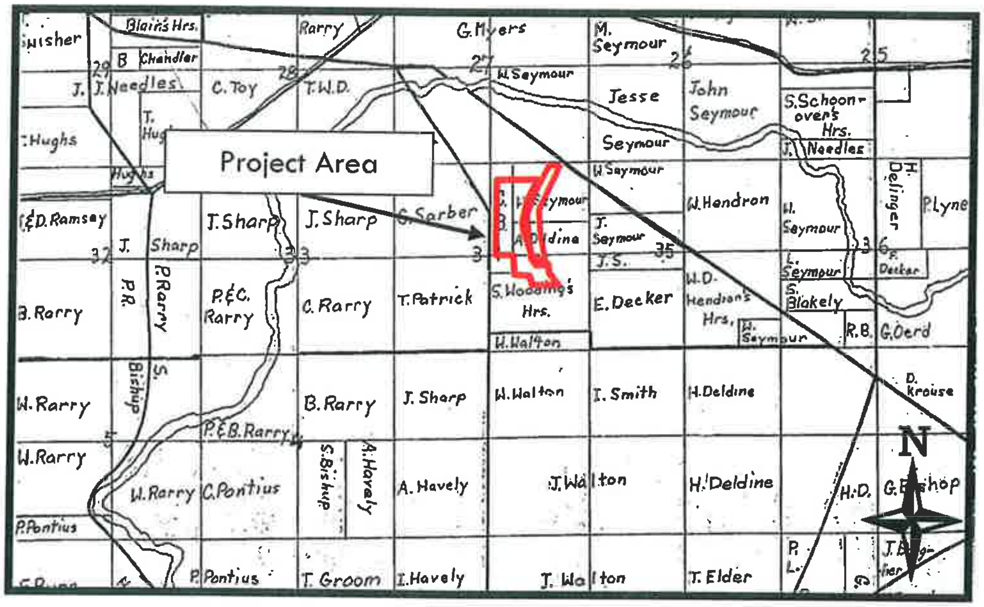


Figure 4. Madison Township portion of the *Franklin County, Ohio* map (Wheeler 1842) showing the approximate location of the project area.

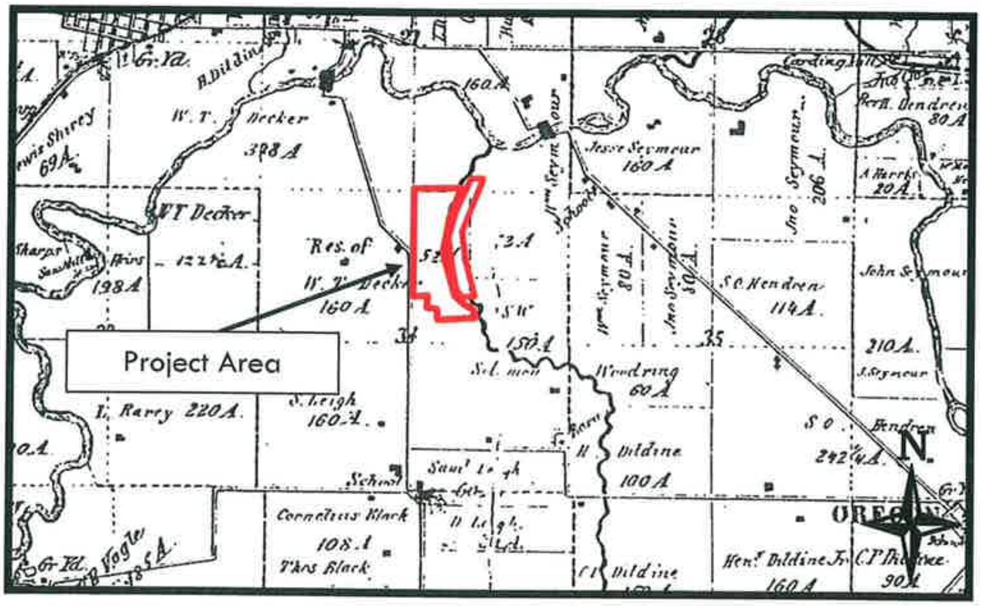


Figure 5. Madison Township portion of the *Map of Franklin County, Ohio* (Graham 1856) showing the approximate location of the project area.

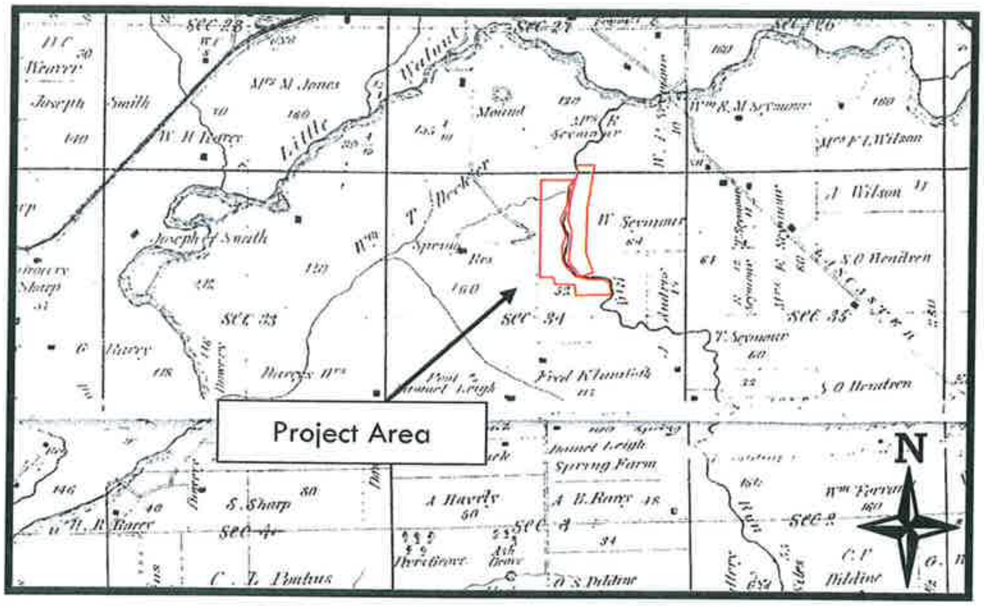


Figure 6. Madison Township portion of the *Atlas of Franklin County and of the City of Columbus* (Caldwell 1872) showing the approximate location of the project area.

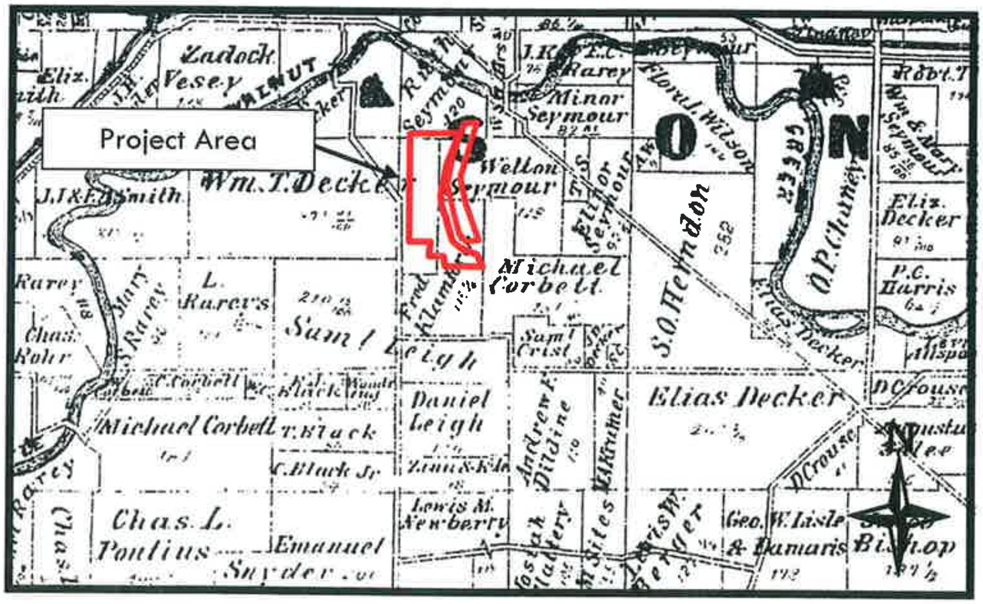


Figure 7. Madison Township portion of the *Map of Franklin County, Ohio* (Brand 1883) showing the approximate location of the project area.

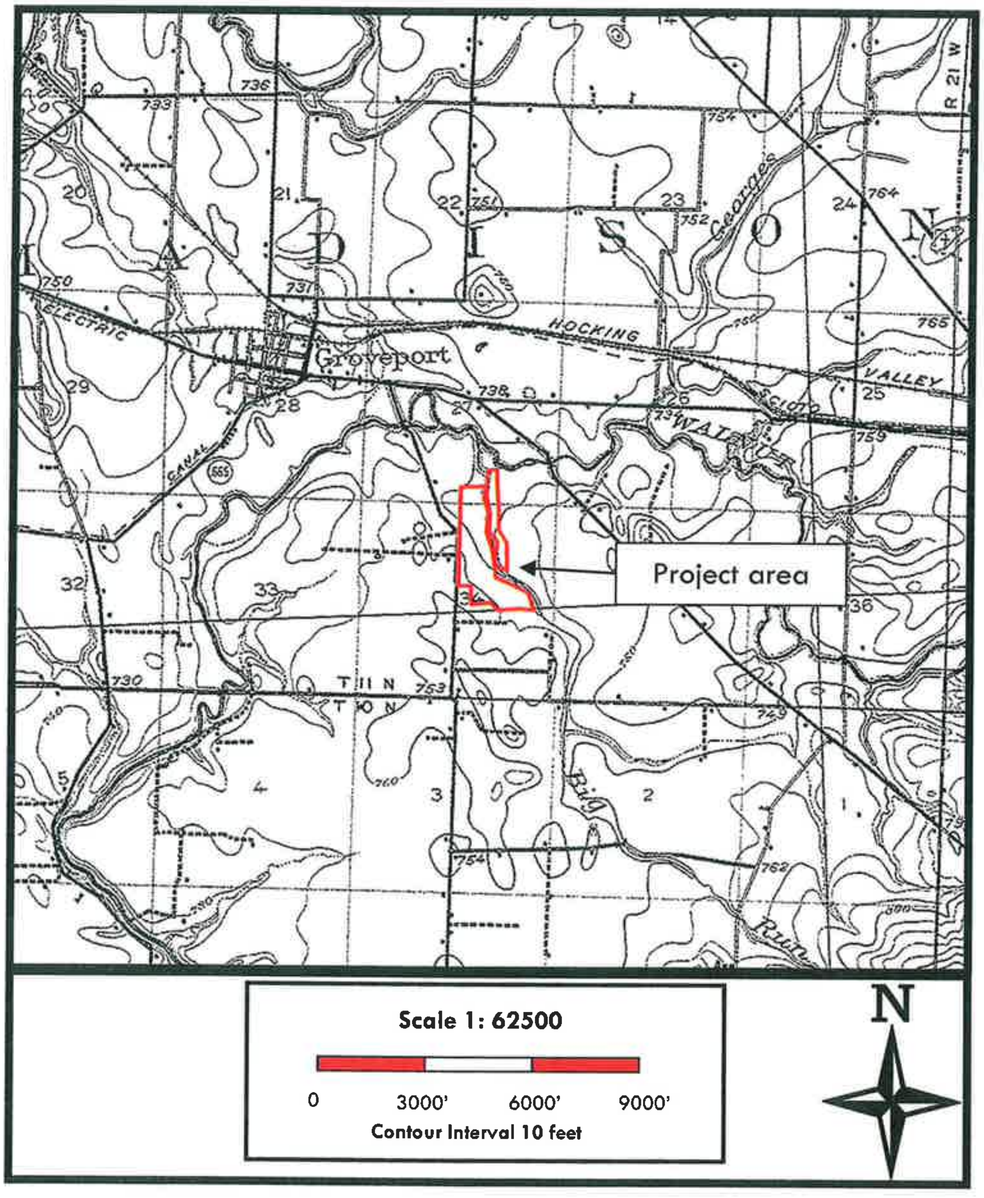


Figure 8. Portion of the USGS *1925 (Reprinted 1952) East Columbus, Ohio Quadrangle, Ohio 15' Series* (*Topographic*) maps showing the approximate location of the project area.

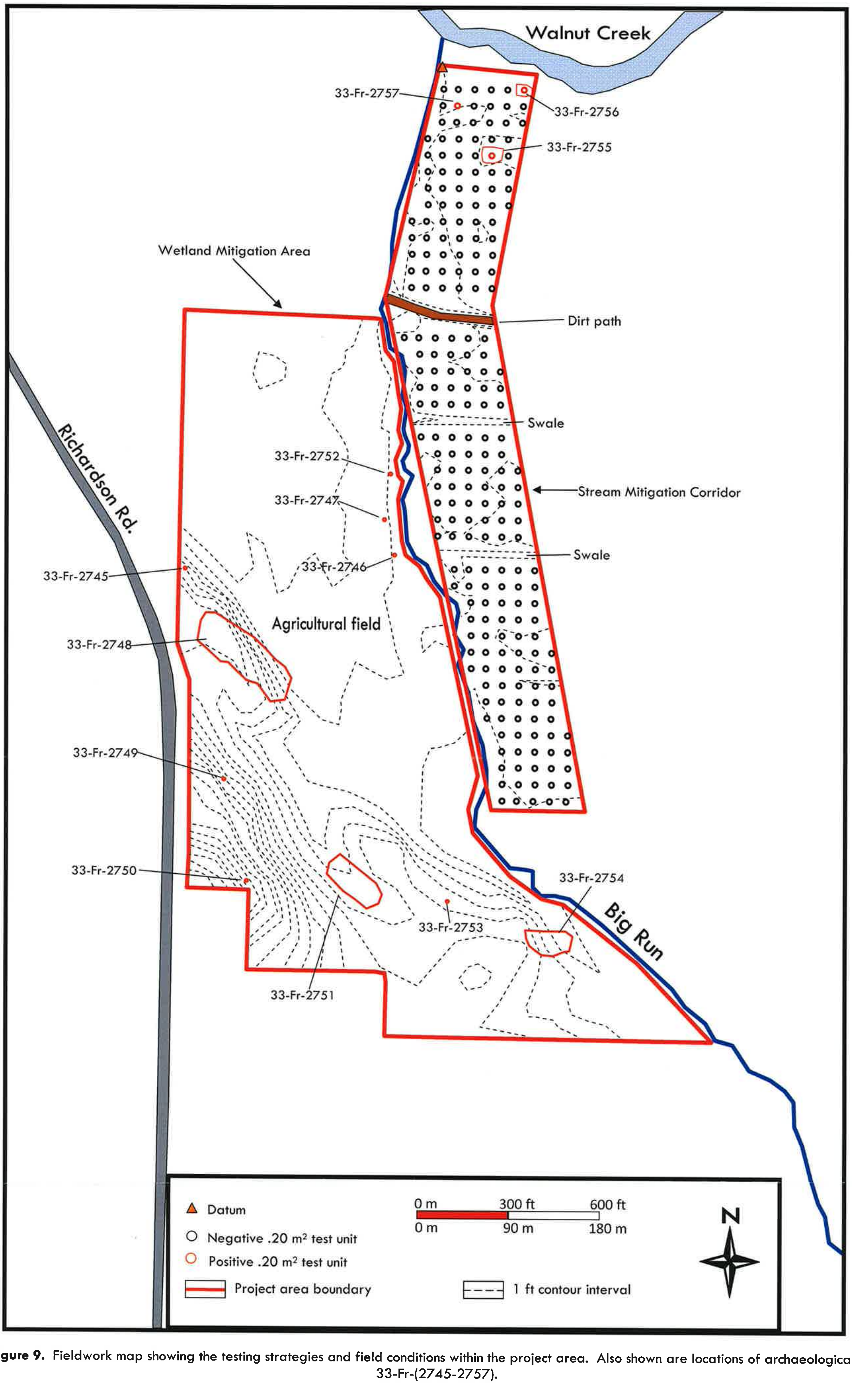


Figure 9. Fieldwork map showing the testing strategies and field conditions within the project area. Also shown are locations of archaeological sites 33-Fr-(2745-2757).

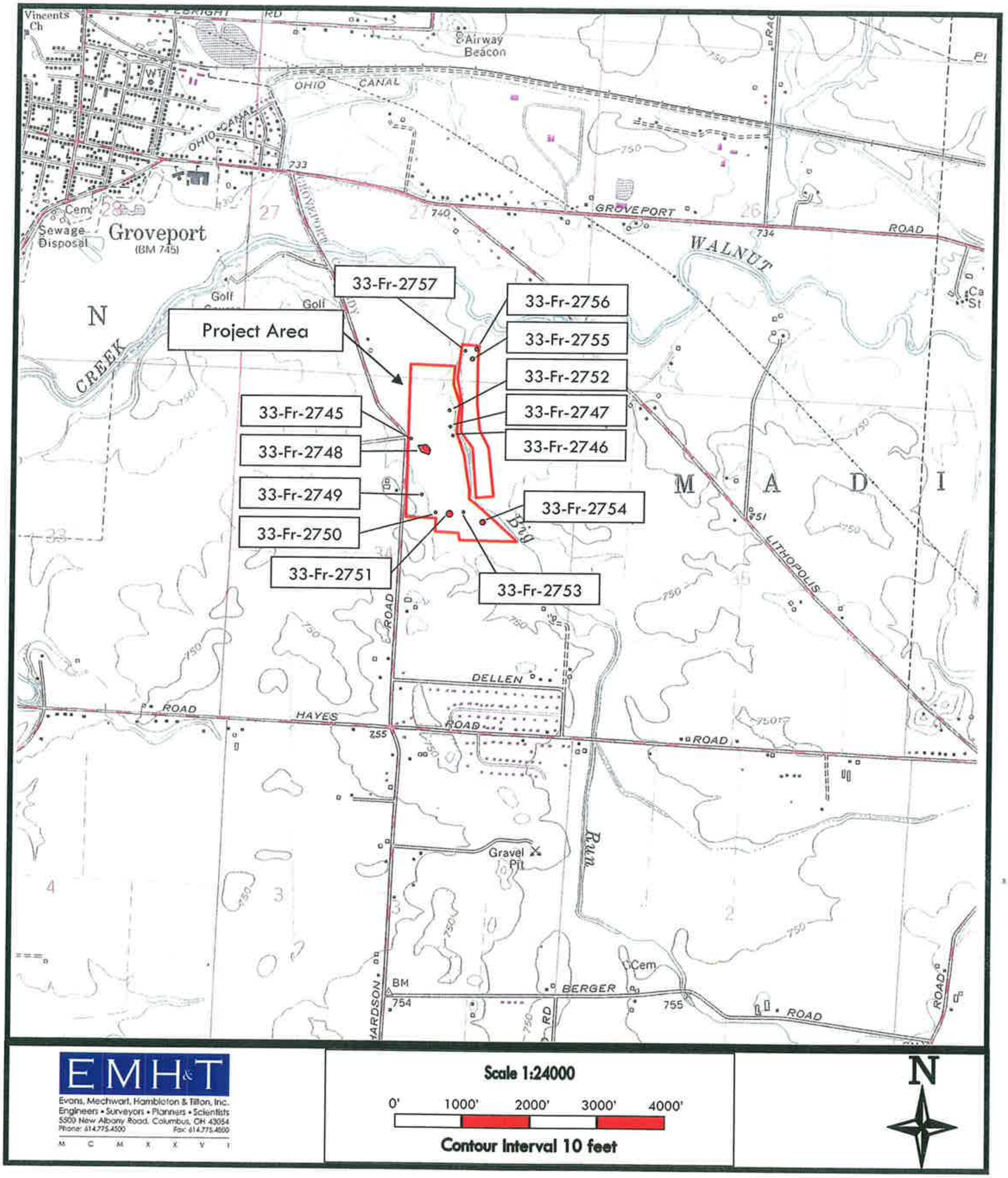
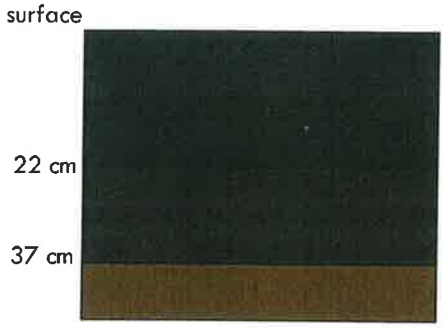


Figure 10. Portions of the United States Geological Survey (USGS) *1966 (Photorevised 1985; Minor Revision 1994) Canal Winchester* and *1992 Lockbourne, Ohio 7.5 Minute Series* (Topographic) maps showing the location of the project area and previously unknown archaeological sites 33-Fr-(2745-2757).

Typical Shovel Test Unit Profile



Soil Type: Shoals silt loam (Sh)

Ap Horizon- 0-22 cm. Very dark brown (10YR 2/2) silt loam, medium granular structure, abrupt smooth boundary.

B1 Horizon- 22-37 cm. Very dark brown (10YR3/2) silt clay loam. Moderate medium blocky structure.

B21g Horizon- 37-50 Dark gray brown (10YR4/2) silty clay loam and yellowish brown (10YR 5/6). Course sub-angular blocky structure.

Plan View of a Typical Shovel Test Unit in Shoals soil

Figure 11. Soil profile of a typical test unit and plan view photograph showing typical Shoals silt loam located within the project area.

Exhibit 1. View facing south showing the wetland mitigation portion of the project area located within an agricultural field.

Exhibit 2. View facing west showing the northern extent of the agricultural field contained within the wetland mitigation portion of the project.

Exhibit 3. View of the typical surface visibility within the plowed and weathered agricultural field.

Exhibit 4. View facing north showing Big Run.

Exhibit 5. View facing north showing the tree nursery located within the stream mitigation corridor.

Exhibit 6. View facing east showing the stream mitigation portion of the project area.

Exhibit 7. View of visible ground surface located within the tree nursery.

APPENDIX D

Jurisdictional Determination Verification Letter

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
502 EIGHTH STREET
HUNTINGTON, WEST VIRGINIA 25701-2070

REPLY TO
ATTENTION OF

OCT 29 2009

Operations and Readiness Division
Regulatory Branch
LRH-2003-270-SCR-UnTrib Big Walnut Creek

Ms. Elaine Roberts
Columbus Regional Airport Authority
4600 International Gateway
Columbus, Ohio 43219

Dear Ms. Roberts:

I refer to the information submitted on your behalf by EMH&T, Incorporated (EMH&T) regarding your proposal to establish a composite mitigation site referred to as the "Eastside Nursery Site." The proposed mitigation site is located south of Lithopolis Road in the Village of Groveport, Franklin County, Ohio. The submitted information includes a report entitled "*Eastside Nursery Investigation of Waters*" dated December 15, 2008. Ms. Susan Fields and Mr. Jim Spence performed a site investigation for the proposed mitigation site location on June 9, 2009.

The report describes the findings for a 483-acre site; however, EMH&T has submitted additional information indicated the Columbus Regional Airport Authority (CRAA) would only be utilizing a small portion of the 483-acre area as a proposed composite mitigation site. The approximate limits of CRAA's mitigation site are shown on the attached map. On your behalf, EMH&T has requested we provide approved jurisdictional determination for the area shown on this map.

The Corps of Engineers authority to regulate waters of the United States is based on the definitions and limits of jurisdiction contained in 33 CFR 328 and 33 CFR 329. Section 404 of the Clean Water Act requires that a Department of the Army (DA) permit be obtained prior to placing dredged or fill material into waters of the United States, including wetlands. Section 10 of the Rivers and Harbors Act of 1899 requires that a DA permit be obtained for any work in, on, over or under a navigable water.

According to the report and supplemental information submitted by EMH&T, the proposed composite site contains 2,379 linear feet of Big Run. Based on the information provided and other information available to us, this office has determined Big Run is a seasonally intermittent, relatively permanent water (RPW) and an indirect tributary to the Scioto River, a traditional navigable water (TNW). As such, we have determined Big Run is a jurisdictional water of the United States subject to regulation under Section 404 of the Clean Water Act.

This jurisdictional verification is valid for a period of five years from the date of this letter unless new information warrants revision of the delineation prior to the expiration date. This letter contains an approved jurisdictional determination for the subject site. If you object to this determination, you may request an administrative appeal under Corps regulations at 33 CFR Part 331. Enclosed you will find a Notification of Appeal Process (NAP) fact sheet and Request for Appeal (RFA) form. If you request to appeal this determination you must submit a completed RFA form to the Great Lakes and Ohio River Division Office at the following address:

Appeals Officer, Great Lakes and Ohio River Division
550 Main Street, Room 10032
Cincinnati, Ohio 45202-3222
Phone: (513) 684-7261 Fax: (513) 684-2460

In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete, that it meets the criteria for appeal under 33 CFR Part 331.5, and that it has been received by the Division Office within 60 days of the date of the NAP. Should you decide to submit an RFA form, it must be received at the above address by DEC 28 2009. **It is not necessary to submit an RFA form to the Division office if you do not object to the determination in this letter.**

This determination has been conducted to identify the limits of the Corps of Engineers' Clean Water Act jurisdiction for the particular site identified in this request. This determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985. If you or your tenant are United States Department of Agriculture (USDA) program participants, or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resources Conservation Service prior to starting work.

If you have any questions concerning the above, please contact Ms. Susan Fields of the North Regulatory Section at Susan.A.Fields@usace.army.mil or at (304) 399-5210.

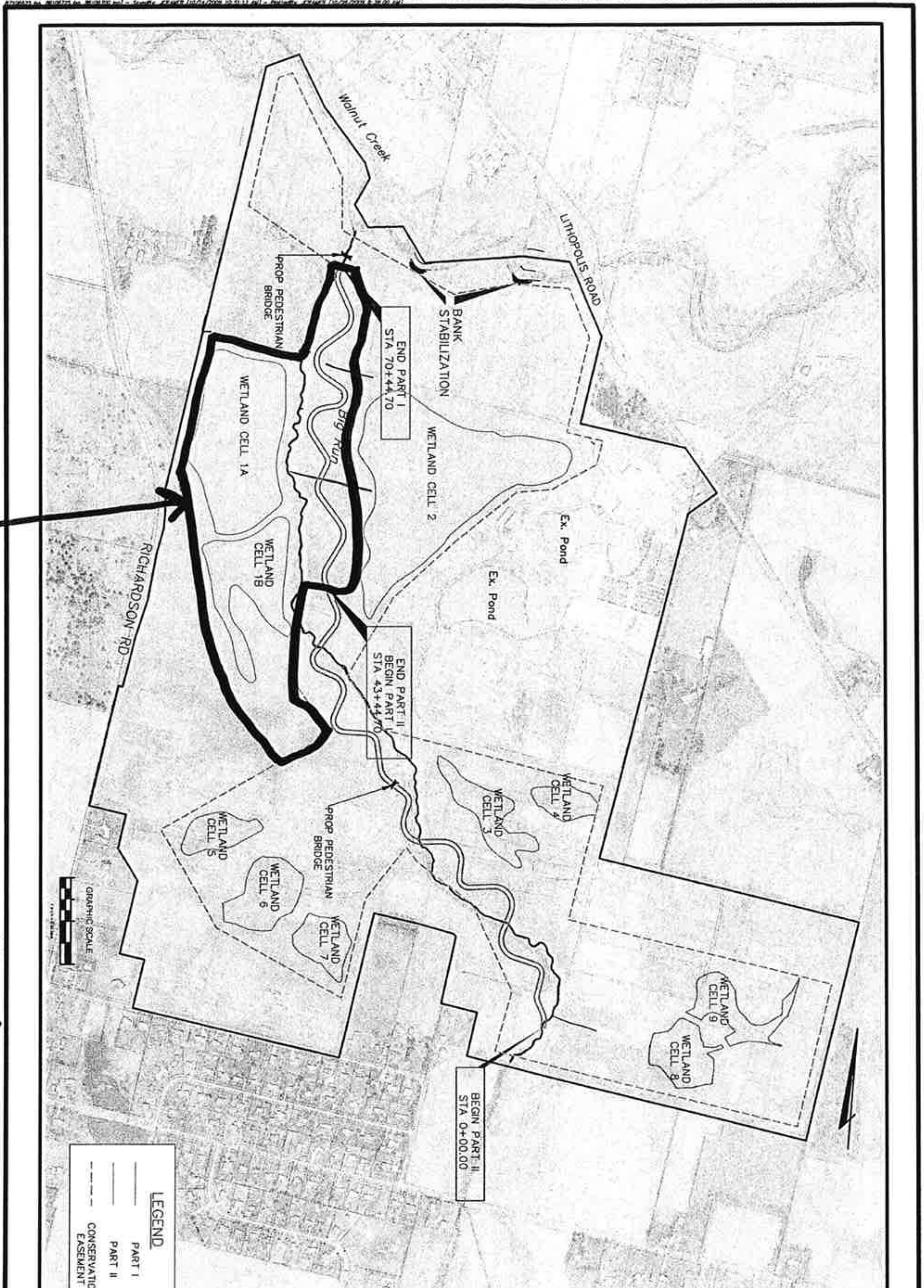
Sincerely,

Lee A. Pittman
Regulatory Project Manager
North Regulatory Section

Enclosures

CF: (w/out encls)
Mr. Patrick Hoyng
EMH&T, Inc.
5500 New Albany Road
Columbus, Ohio 43054

Mr. Tom Harcarik
OEPA, Division of Surface Water
Post Office Box 1049
Columbus, Ohio 43216-3669



CRAA Project JD limits

EMH&T

COLUMBUS REGIONAL AIRPORT AUTHORITY
PLANNING & ENGINEERING
4600 INTERNATIONAL GATEWAY
COLUMBUS, OHIO 43219
(614) 239-4000
(614) 239-7850 FAX

MADISON TOWNSHIP, FRANKLIN COUNTY, OHIO
WETLAND AND STREAM RESTORATION
AT
EASTSIDE NURSERY
EXHIBIT A: OVERALL STREAM AND WETLAND RESTORATION PLAN

Date October, 2009	Job No. 2009-0343
Scale 1" = 400'	Drawn By JAC

APPENDIX E

Big Run Impaired Conditions Geomorphic Analysis Data

Warren E. Knotts, P.G., Geomorphologist
Senior Water Resources Engineer
EMHT

February 8, 2010

Summary Table 1
Big Run Existing Incipient Point of Flooding Impairment Analysis

BIG RUN - IMPAIRED CONDITIONS - INCIPIENT POINT OF FLOODING GEOMORPHOLOGIC & HYDRAULIC RELATIONSHIPS GEOSTATISTICS & ROSGEN STREAM TYPE CLASSIFICATIONS

XS ID	W_{FPA}	W_{BKF}	ER	D_{BKF}	D_{MAX}	W/D	A_{BKF}	WP	R	LBH	BHR	S_{CH}	[1]Q_{BKF} (cfs)	$U = (1.49/n)R^{.67}S^{.5}$	$U_* = (gRS)^{1/2}$ (ft/sec)	U/U_*	Manning's n	Stream Power (lb/ft/sec)	Shear Stress (lb/ft^2)	Movable Particle (mm)	Movable Particle (mm)	Transport Capacity (lbs/sec)	Rosgen Classification
A-17 Pool	2252.70	31.60	71.11	3.49	8.40	9.08	110.44	37.40	2.95	9.03	1.08	0.00293	300.0	8.79	0.53	16.67	0.01890	54.85	0.539	96.5	41.0	62	E4 (Slightly Incised)
A-17.4 Pool	2491.07	44.38	56.13	2.48	5.95	17.90	109.97	48.13	2.28	7.32	1.23	0.00293	300.0	4.62	0.46	9.96	0.01879	54.85	0.417	79.9	31.3	51	C4 (Slightly Incised)
B-18	1779.31	31.11	57.19	2.31	4.85	13.47	71.74	34.10	2.10	5.39	1.11	0.00293	300.0	7.02	0.44	15.78	0.01884	54.85	0.384	75.2	28.8	69	C4 (Slightly Incised)
C-19	1457.46	42.50	34.29	1.96	5.43	21.68	83.16	46.28	1.80	5.43	1.00	0.00293	300.0	6.33	0.41	15.37	0.01885	54.85	0.329	67.1	24.5	72	C4
D-20	607.27	38.41	15.81	2.00	4.20	19.20	76.77	40.13	1.91	4.20	1.00	0.00293	300.0	6.59	0.42	15.53	0.01884	54.85	0.349	70.1	26.0	69	C4
G-23	883.15	22.77	38.78	3.00	5.60	7.59	68.39	26.48	2.58	5.60	1.00	0.00293	300.0	8.06	0.49	16.34	0.01884	54.85	0.472	87.5	35.6	72	E4
Conf WC					5.90					8.49	1.44			(Mean Velocity)	(Shear Velocity)	(Friction Factor)	$n=(1.49R^{.67}S^{.5})/u$	$\omega = \gamma QS$	$\tau = \gamma RS$	$152.02\tau^{0.7355}$	$77.966\tau^{1.042}$		Confluence Walnut Ck (Deeply Incised)

[1] Koltun, G.F. and Roberts, J.W. (March 1990). *Techniques for Estimating Flood-Peak Discharges of Rural, Unregulated Streams in Ohio*, USGS Water-Resources Investigations Report 89-4126.

g = gravitational acceleration = 3.174 ft/sec^2

γ = 62.4 lbs/ft^3 = specific weight of water

Rosgen Colorado Dataset
Power-Trendline
Modified Shields Eq.

Leopold, et al., 1964
Power-Trendline
Modified Shields Eq.

BIG RUN - FINAL 2,760 l.f. IMPAIRED CONDITIONS GEOMORPHOLOGIC STATISTICS

W_{FPA}		W_{BKF}		ER		D_{BKF}		D_{MAX}		W/D		A_{BKF}	
Mean	1578.49	Mean	35.13	Mean	45.55	Mean	2.54	Mean	5.76	Mean	14.82	Mean	86.75
Std Error	303.81	Std Error	3.33	Std Error	8.08	Std Error	0.24	Std Error	0.50	Std Error	2.33	Std Error	7.69
Median	1618.39	Median	35.01	Median	47.46	Median	2.40	Median	5.60	Median	15.69	Median	79.97
Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	#N/A
Std Dev	744.19	Std Dev	8.15	Std Dev	19.79	Std Dev	0.60	Std Dev	1.32	Std Dev	5.71	Std Dev	18.84
Variance	553821	Variance	66.41	Variance	391.57	Variance	0.36	Variance	1.74	Variance	32.55	Variance	355.05
Kurtosis	-1.63	Kurtosis	-0.83	Kurtosis	-0.51	Kurtosis	-0.51	Kurtosis	3.13	Kurtosis	-1.96	Kurtosis	-1.92
Skew	-0.13	Skew	-0.43	Skew	-0.33	Skew	0.82	Skew	1.40	Skew	-0.22	Skew	0.68
Range	1883.80	Range	21.61	Range	55.30	Range	1.53	Range	4.20	Range	14.09	Range	42.05
Min	607.27	Min	22.77	Min	15.81	Min	1.96	Min	4.20	Min	7.59	Min	68.39
Max	2491.07	Max	44.38	Max	71.11	Max	3.49	Max	8.40	Max	21.68	Max	110.44
Sum	9470.96	Sum	210.77	Sum	273.31	Sum	15.24	Sum	40.33	Sum	88.92	Sum	520.47
Count	6	Count	6	Count	6	Count	6	Count	7	Count	6	Count	6

WP		R		LBH		BHR		Movable Particle (mm)		Movable Particle (mm)	
Mean	38.75	Mean	2.27	Mean	6.49	Mean	1.12	Mean	79.39	Mean	31.21
Std Error	3.27	Std Error	0.18	Std Error	0.68	Std Error	0.06	Std Error	4.52	Std Error	2.53
Median	38.77	Median	2.19	Median	5.60	Median	1.08	Median	77.53	Median	30.04
Mode	#N/A	Mode	#N/A	Mode	#N/A	Mode	1.00	Mode	#N/A	Mode	#N/A
Std Dev	8.01	Std Dev	0.43	Std Dev	1.80	Std Dev	0.16	Std Dev	11.08	Std Dev	6.21
Variance	64.12	Variance	0.19	Variance	3.25	Variance	0.03	Variance	122.73	Variance	38.56
Kurtosis	-0.44	Kurtosis	-0.49	Kurtosis	-1.48	Kurtosis	1.83	Kurtosis	-0.62	Kurtosis	-0.47
Skew	-0.41	Skew	0.70	Skew	0.38	Skew	1.49	Skew	0.63	Skew	0.71
Range	21.65	Range	1.15	Range	4.83	Range	0.44	Range	29.41	Range	16.49
Min	26.48	Min	1.80	Min	4.20	Min	1.00	Min	67.13	Min	24.49
Max	48.13	Max	2.95	Max	9.03	Max	1.44	Max	96.54	Max	40.97
Sum	232.52	Sum	13.62	Sum	45.46	Sum	7.86	Sum	476.32	Sum	187.23
Count	6	Count	6	Count	7	Count	7	Count	6	Count	6

$152.02\tau^{0.7355}$
Colorado Dataset
Power-Trendline
Modified Shields Eq.

$77.966\tau^{1.042}$
Leopold, et al., 1964
Power-Trendline
Modified Shields Eq.

BIG RUN - IMPAIRED CONDITIONS - BANK HEIGHT RATIO - PROFILE ELEVATION DATA

STATION ID	STATION	TW ELEV.	BKF ELEV.	D_{MAX}	LOW BANK ELEV.	LBH	BHR
XS G-23	[2]MP	730.60	735.96	5.60	735.96	5.60	1.00
D-20	[2]MP	726.25	730.45	4.20	730.45	4.20	1.00
XS C-19	0+00.00	723.96	729.39	5.43	729.39	5.43	1.00
XS B-18	8+52.30	722.85	727.70	4.85	728.24	5.39	1.11
XS A-17.4	16+25.29	720.63	726.58	5.95	727.95	7.32	1.23
XS A-17	22+15.17	718.49	726.89	8.40	727.52	9.03	1.08
Conf L Walnut Ck	27+57.98	717.84	723.75	5.91	726.33	8.49	1.44

[2] MP = Impaired cross-section located on Franklin County Metro Parks impaired mitigation reach, upstream from CRAA project impaired mitigation study reach.

BIG RUN - IMPAIRED CHANNEL PATTERN, PROFILE & VALLEY GEOMETRY SUMMARY

BEST-FIT TRENDLINE SLOPES	VALLEY GEOMETRY
$S_{LOW\ BANK}$ = - 0.00144 ft/ft = 0.144 %	Stream Length (SL) = 2758 l.f.
S_{BKF} = - 0.00149 ft/ft = - 0.149 %	Valley Length (VL) = 2530 ft
Topographic Valley Fall Line - S_{VAL} = - 0.000794 ft/ft = - 0.0794 %	Sinuosity (k) = SL/VL = 1.09
S_{CH} = - 0.00293 ft/ft = - 0.293 %	S_{CH}/S_{VAL} = 3.69
	S_{CH} 3.69 x > S_{VAL} = Deeply Incised

Warren E. Knotts, P.G., Geomorphologist
Senior Water Resources Engineer
EMHT

February 8, 2010

Summary Table 2
Big Run at Eastside Nursery - Design Analysis

DESIGN	BIG RUN AT EASTSIDE NURSERY - NATURAL CHANNEL DESIGN, HYDRAULIC RELATIONSHIPS, SEDIMENT TRANSPORT & ROSGEN STREAM TYPE CLASSIFICATION											
	W_{FPA}	W_{BKF}	ER	D_{BKF}	D_{MAX}	W/D	A_{BKF}	WP	R	S_{CH} (ft/ft)	LBH	BHR	$Q_{BKF}=(1.4685/n)A_{BKF}R^{.67}S^{.5}$
BKF CH	295.00	31.00	9.52	2.71	3.50	11.44	84.00	32.65	2.57	0.001845	3.50	1.00	387.8
BKF POOL	311.00	40.00	7.78	2.75	5.50	14.55	110.00	42.71	2.58	0.001845	5.50	1.00	387.8

DESIGN	$U = (1.4865/n)R^{.67}S^{.5}$	$U^* = (gRS)^{1/2}$ (ft/sec)	U/U^*	$n = (1.4865*R^{.67}S^{.5})/u$	ω Stream Power (lb/ft/sec)	τ Shear Stress (lb/ft^2)	Riffle D50 (mm)	Riffle D84 (mm)	Movable Particle (mm)	Movable Particle (mm)	Transport Capacity (lbs/sec)	Transport Capacity (Tons/Day)	Rosgen Classification
BKF CH	4.62	0.12	37.63	0.0260	44.65	0.26	12.5	24.2	62.1	19.2	39.4 + 3.4 = 42.8	1,849	C4
BKF POOL	2.73	0.12	22.23	0.0441	44.65	0.30	12.5	24.2	62.3	22.2	68.8 + 9.8 = 78.6	3,396	C4

Design Sediment Transport Competency and Capacity Calculations		
$152.02\tau^{0.7355}$	$77.966\tau^{1.042}$	≤ 2 mm + ≥ 12.50 mm
Rosgen Colorado Dataset Power-Trendline Modified Shields Eq.	Leopold, et al., 1964 Power-Trendline Modified Shields Eq.	Wash Load + Bedload (D50) Sediment Transport Model Parker, 1990

(Mean Velocity) (ft/sec)

(Shear Velocity)

(Friction Factor)

(Manning's n)

$\omega = \gamma QS$

$\tau = \gamma RS$

Big Run Riffle Particle Distribution (n = 232)

g = gravitational acceleration = 3.174 ft/sec^2

γ = 62.4 lbs/ft^3 = specific weight of water

BKF CH = Bankfull Channel at a Riffle
BKF POOL = Bankfull Channel at a Pool

BIG RUN - PROPOSED CHANNEL PATTERN, PROFILE & VALLEY GEOMETRY SUMMARY	
BEST-FIT TRENDLINE SLOPES	VALLEY GEOMETRY
$S_{LOW\ BANK} = S_{BKF}$ = - 0.001845 ft/ft = - 0.185 %	Stream Length (SL) = 7,045 l.f.
S_{BKF} = - 0.001845 ft/ft = - 0.185 %	Valley Length (VL) = 5,752 ft
S_{CH} = - 0.001845 ft/ft = - 0.185 %	Sinuosity (k) = SL/VL = 1.22
S_{VAL} = - 0.00226 ft/ft = - 0.226 %	S_{VAL}/S_{CH} = 1.22

Multiple Regression Equations

For estimating bankfull characteristics of rurul, unregulated streams in Ohio

Job Name: Eastside Nursery
Job Number: 2008-1022
Stream Name: Big Run at Eastside Nursery

Drainage Area: 8.52 Square Miles 5450.81 Acres
MCSL: (main channel slope) 15.47 feet/mile 0.00293 feet/foot (from suveyed impaired conditions profile)
ELEV: (main channel elevation index) 730 elevation
$D50_{BED}$ (Riffle Bed D50 Particle Size) 12.5 mm Medium Gravel from Riffle Particle Distribution (n = 232)

Region A Multiple regression equations for estimating bankfull characteristics of rural, unregulated streams in Ohio with map-based explanatory variables[1].

$WBF_A = 9.6\ DA^{0.424}\ MCSL^{0.147} = \boxed{35.61}$ feet W_{BKF}

$DBF_A = 51.8\ DA^{0.263}\ ELEV^{-0.516} = \boxed{3.03}$ feet D_{BKF}

$ABF_A = 427\ DA^{0.718}\ MCSL^{0.213}\ ELEV^{-0.537} = \boxed{103.31}$ feet A_{BKF}

$QBF_A = 427\ DA^{0.718}\ MCSL^{0.213}\ ELEV^{-0.537} = \boxed{320.24}$ cf/sec Q_{BKF}

Region A Multiple regression equations for estimating bankfull characteristics of rural, unregulated streams in Ohio with map-based and field-based explanatory variables[2].

$WBF_A = 7.9\ DA^{0.405}\ MCSL^{0.100}\ D50_{BED}^{0.130} = \boxed{34.35}$ feet W_{BKF}

$DBF_A = 51.8\ DA^{0.263}\ ELEV^{-0.516} = \boxed{3.03}$ feet D_{BKF}

$ABF_A = 699\ DA^{0.701}\ MCSL^{0.173}\ ELEV^{-0.636}\ D50_{BED}^{0.119} = \boxed{102.77}$ feet A_{BKF}

$QBF = 5584\ DA^{0.890}\ MCSL^{0.537}\ ELEV^{-1.131}\ D50_{BED}^{0.436} = \boxed{284.11}$ cf/sec Q_{BKF}

$QBF = 0.280\ ABF^{1.320}\ LCSL^{0.364} = \boxed{343.38}$ cf/sec Q_{BKF}

[1 and 2] Bankfull Characteristics of Ohio Streams and Their Relation to Peak Streamflows, Scientific Investigations Report 2005-5153, USGS, January 2006, Tables 8 and 9, respectively.

Stream Corridor Protection Zone

For estimating floodprone or corridor width

Job Name: CRAA Stream Mitigation at Eastside Nursery
Job Number: 2008-1022
Stream Name: Big Run of Walnut Creek

Drainage Area: 8.52 Square Mile

Stream Corridor Protection Zone[1]

Width = 133 * DA ^ 0.43 = 334 feet

Width = 129 * DA ^ 0.43 = 324 feet

Beltwidth Equations[2]

BW_{10} = 147 * DA ^ 0.38 = 332

BW_5 = 74 * DA ^ 0.38 = 167

BW_3 = 44 * DA ^ 0.38 = 99

---

[1] Stormwater Drainage Manual, City of Columbus, Division of Sewerage and Drainage, Department of Public Utilities, March 2006.

[2] Rainwater and Land Development, Ohio's Standard for Stormwater Management, Land Development and Urban Stream Protection, Appendix 7: Planning for Streams, ODNR, DSWC, Third Edition, 2006.

Multiple Regression Equations

Techniques for Estimating Flood-Peak Discharges of Rural, Unregulated Streams in Ohio[1]

Job Name:	CRAA Stream Mitigation at Eastside Nursery
Job Number:	2008-1022
Stream Name:	Big Run of Walnut Creek

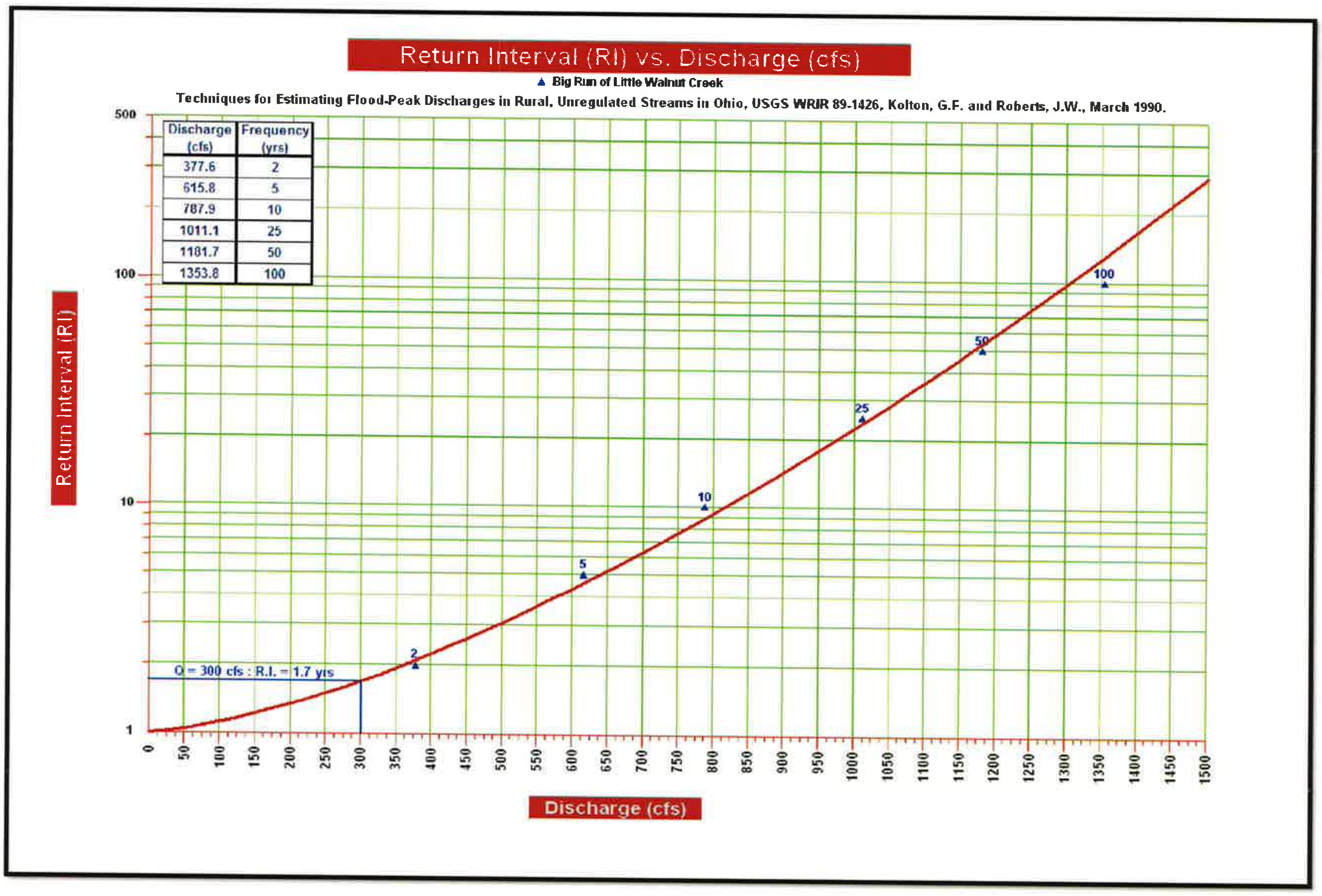
A: (drainage area)	8.5169	mile^2	5450.81 acres
SL: (main channel slope)	14.47	feet/mile	0.00274 ft/ft (Best-Fit Channel Trendline)
Storage: (Percent)	2.0	percent	(Storage Range for Region A: **0.0 to 5.6%**)

Table 1: Equations for estimating flood-peak discharges of rural, unregulated streams in Ohio (page 4 in cited USGS publication).[1]

Q_2	=	56.1(A)^0.782 (SL)^0.172 (Storage + 1)^ -0.297	=	386.0	cu ft/sec
Q_5	=	84.5(A)^0.769 (SL)^0.221 (Storage + 1)^ -0.322	=	633.5	cu ft/sec
Q_{10}	=	104(A)^0.764 (SL)^0.0.244 (Storage + 1)^ -0.335	=	812.9	cu ft/sec
Q_{25}	=	129(A)^0.760 (SL)^0.264(Storage + 1)^ -0.347	=	1045.9	cu ft/sec
Q_{50}	=	148(A)^0.757 (SL)^0.276 (Storage + 1)^ -0.355	=	1224.3	cu ft/sec
Q_{100}	=	167(A)^0.756 (SL)^0.285 (Storage + 1)^ -0.363	=	1404.3	cu ft/sec

---

[1] USGS Water-Resources Investigations Report 89-4126, Kolton, G.F. and Roberts, J.W. (March 1990)

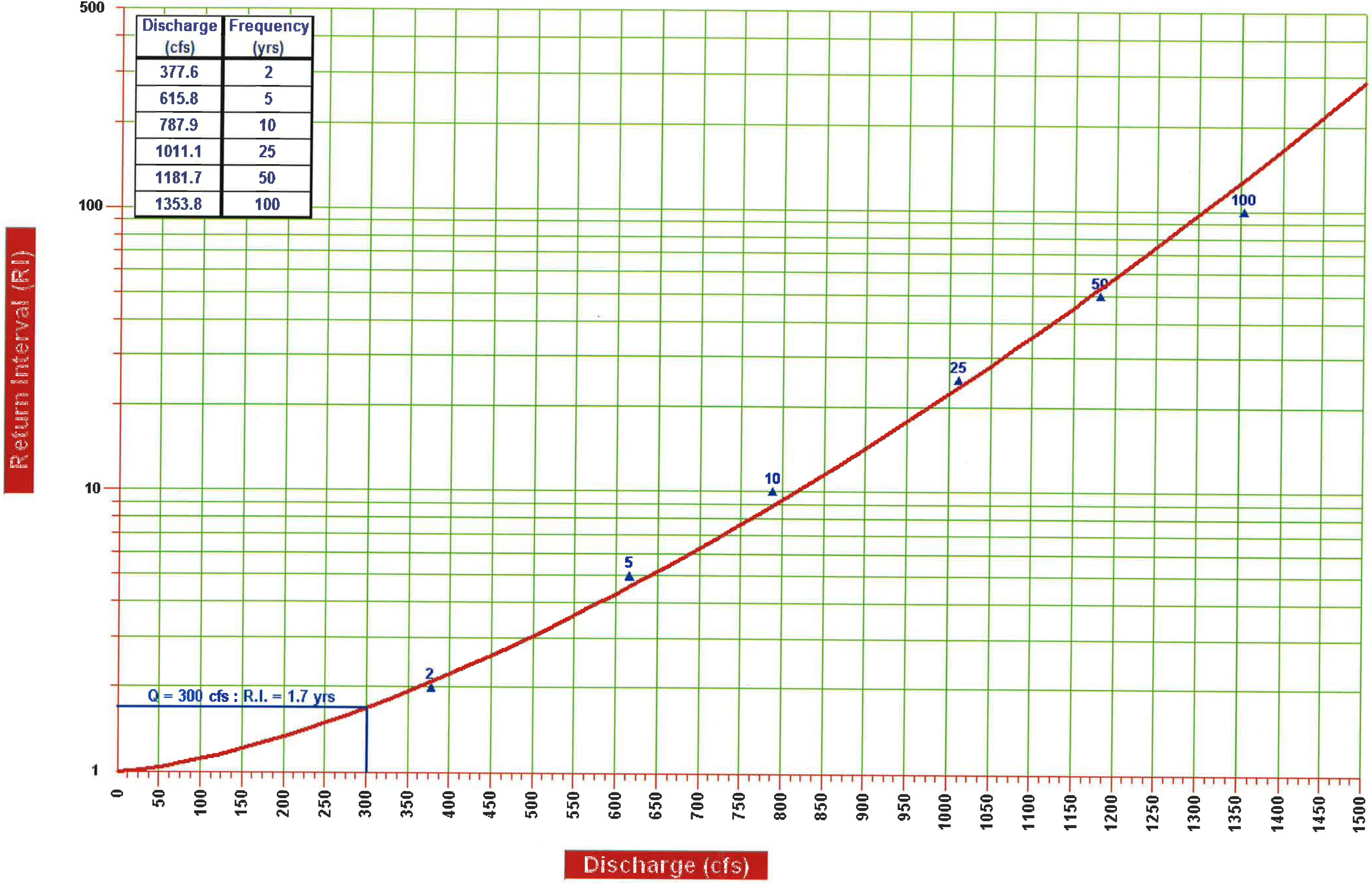


Discharge (cfs)	Frequency (yrs)
377.6	2
615.8	5
787.9	10
1011.1	25
1181.7	50
1353.8	100

Return Interval (RI) vs. Discharge (cfs)

▲ Big Run of Little Walnut Creek

Techniques for Estimating Flood-Peak Discharges in Rural, Unregulated Streams in Ohio, USGS WRIR 89-1426, Kolton, G.F. and Roberts, J.W., March 1990.



Discharge (cfs)	Frequency (yrs)
377.6	2
615.8	5
787.9	10
1011.1	25
1181.7	50
1353.8	100

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream: **Big Run - Design Riffle Cross-Section**

Basin: **Walnut Creek** Drainage Area: **5452.8** acres **8.52** mi^2

Location: **Big Run at Eastside Nursery**

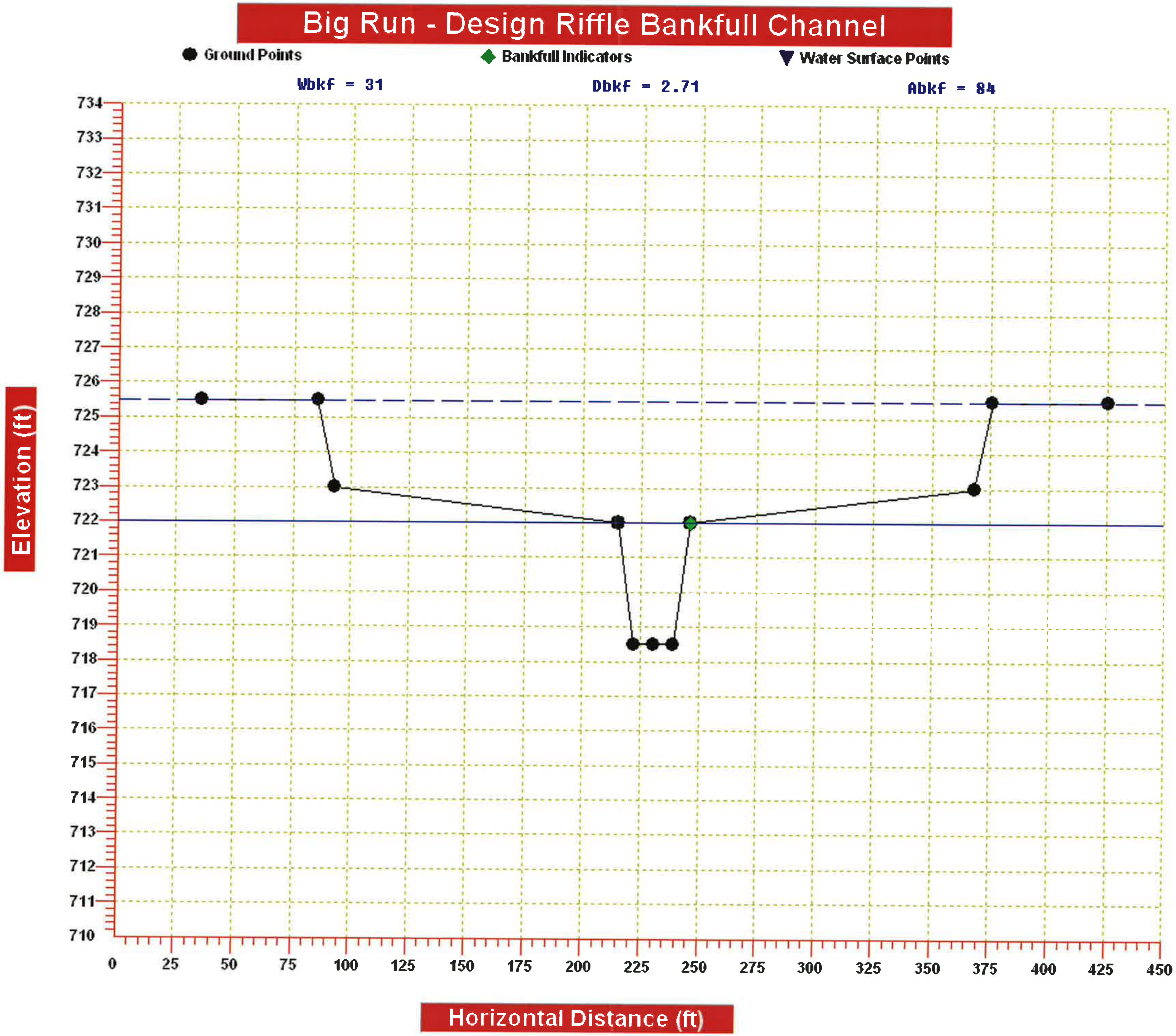
Twp.&Rge: **;** Sec.&Qtr.: **;**

Cross-Section Monuments (Lat./Long.): **39.83686 Lat / 82.86475 Long** Date: **08/04/09**

Observers: **MFH, WEK, JMH** Valley Type: VIII

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**31**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**2.71**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**84**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**11.44**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**3.5**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**295**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**9.52**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**12.47**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.001845**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1.22**	

Stream Type **C 4** (See **Figure 2-14**)


Big Run - Design Riffle Bankfull Channel
● Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
Wbkf = 31
Dbkf = 2.71
Abkf = 84
Elevation (ft)
734
733
732
731
730
729
728
727
726
725
724
723
722
721
720
719
718
717
716
715
714
713
712
711
710
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
425
450
Horizontal Distance (ft)

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream: **Big Run - Design Pool Cross-Section**

Basin: **LittWalnut Creek** Drainage Area: **5452.8** acres **8.52** mi^2

Location: **Big Run at Eastside Nursery**

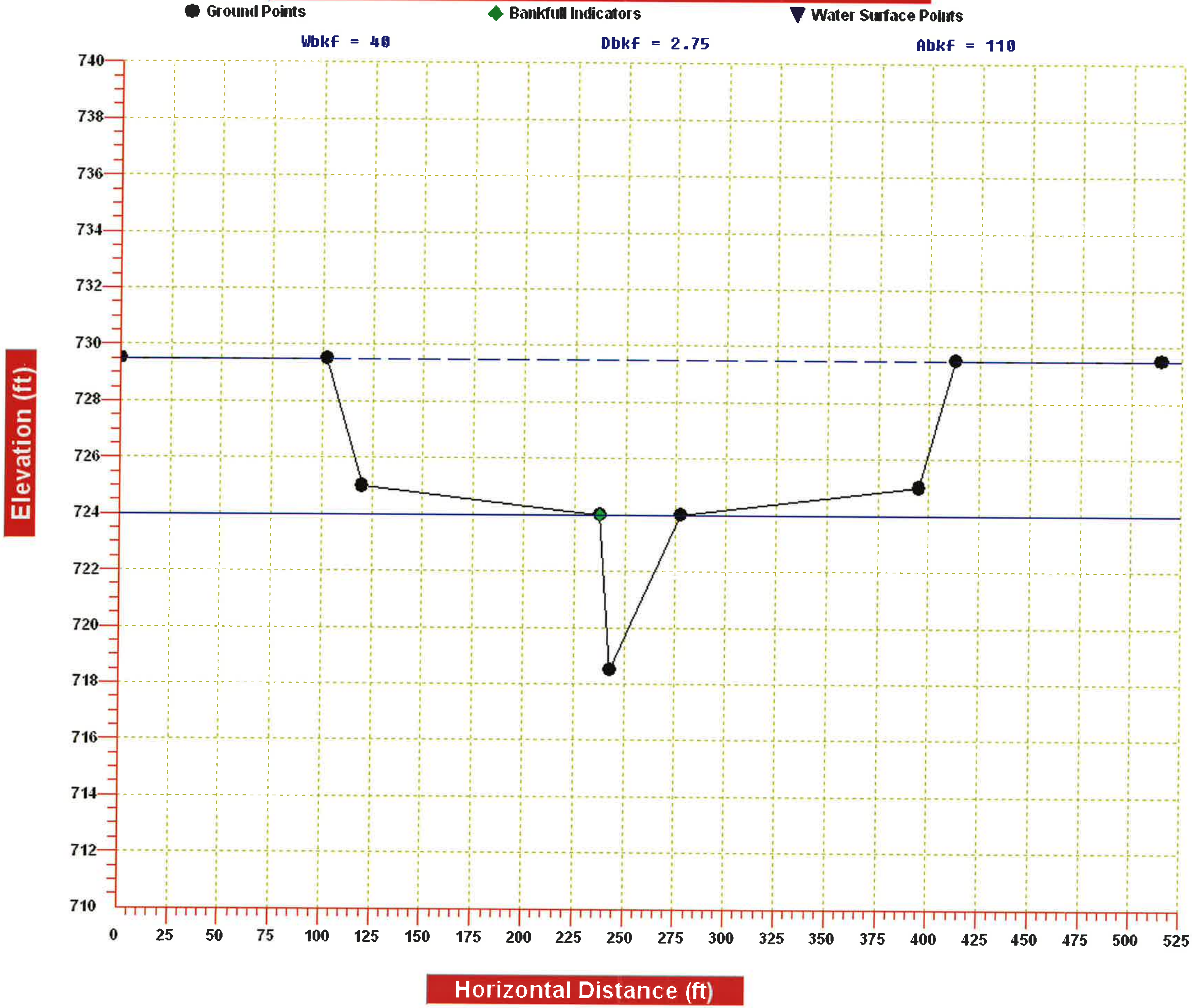
Twp.&Rge: **;** Sec.&Qtr.: **;**

Cross-Section Monuments (Lat./Long.): **39.83686 Lat / 82.86475 Long** Date: **08/04/09**

Observers: **MFH, WEK, JMH** Valley Type: VIII

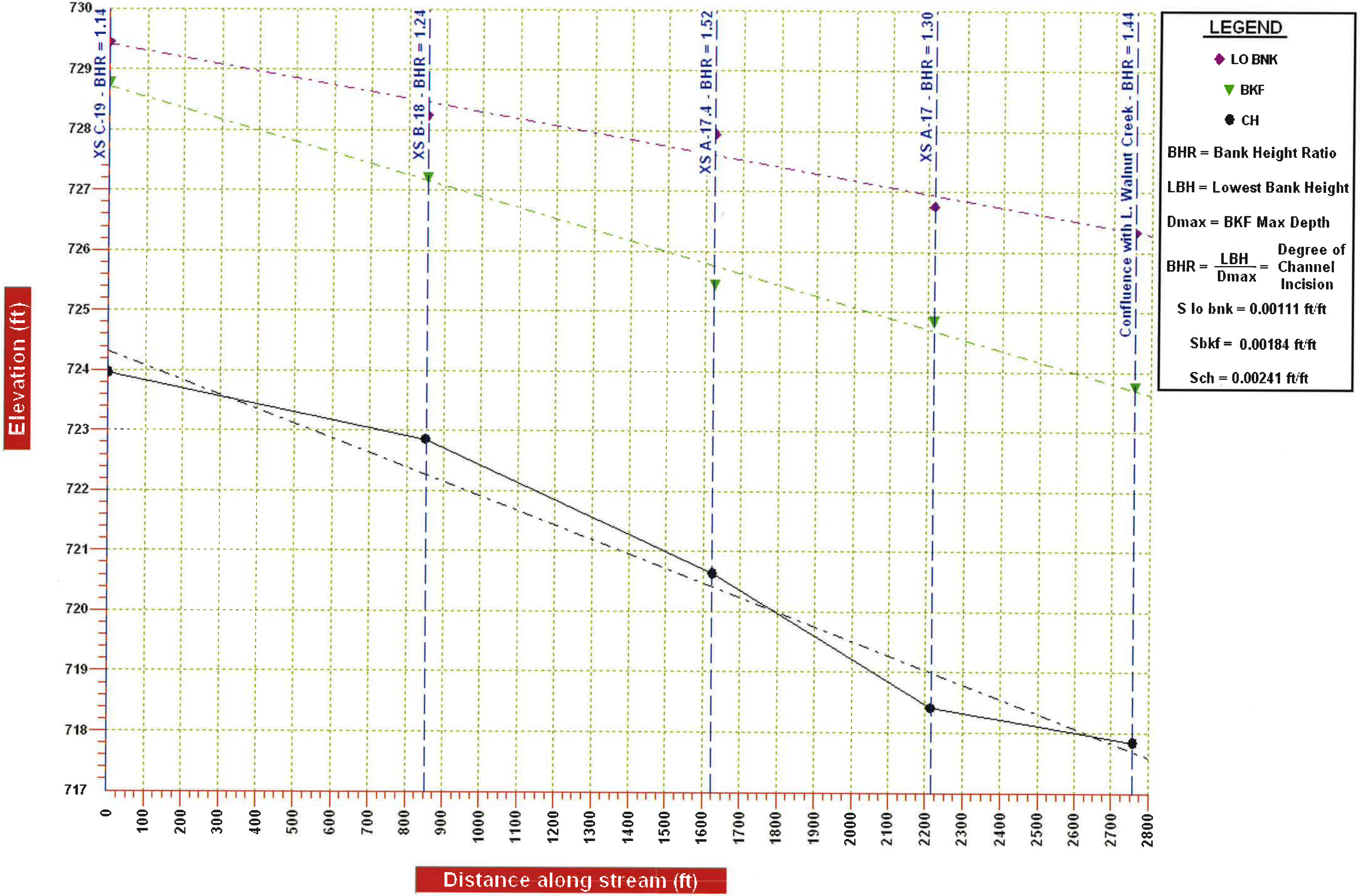
Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**40**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**2.75**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**110**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**14.55**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**5.5**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**311**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**7.78**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**12.47**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.001845**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1.22**	

Stream Type **C 4** (See **Figure 2-14**)

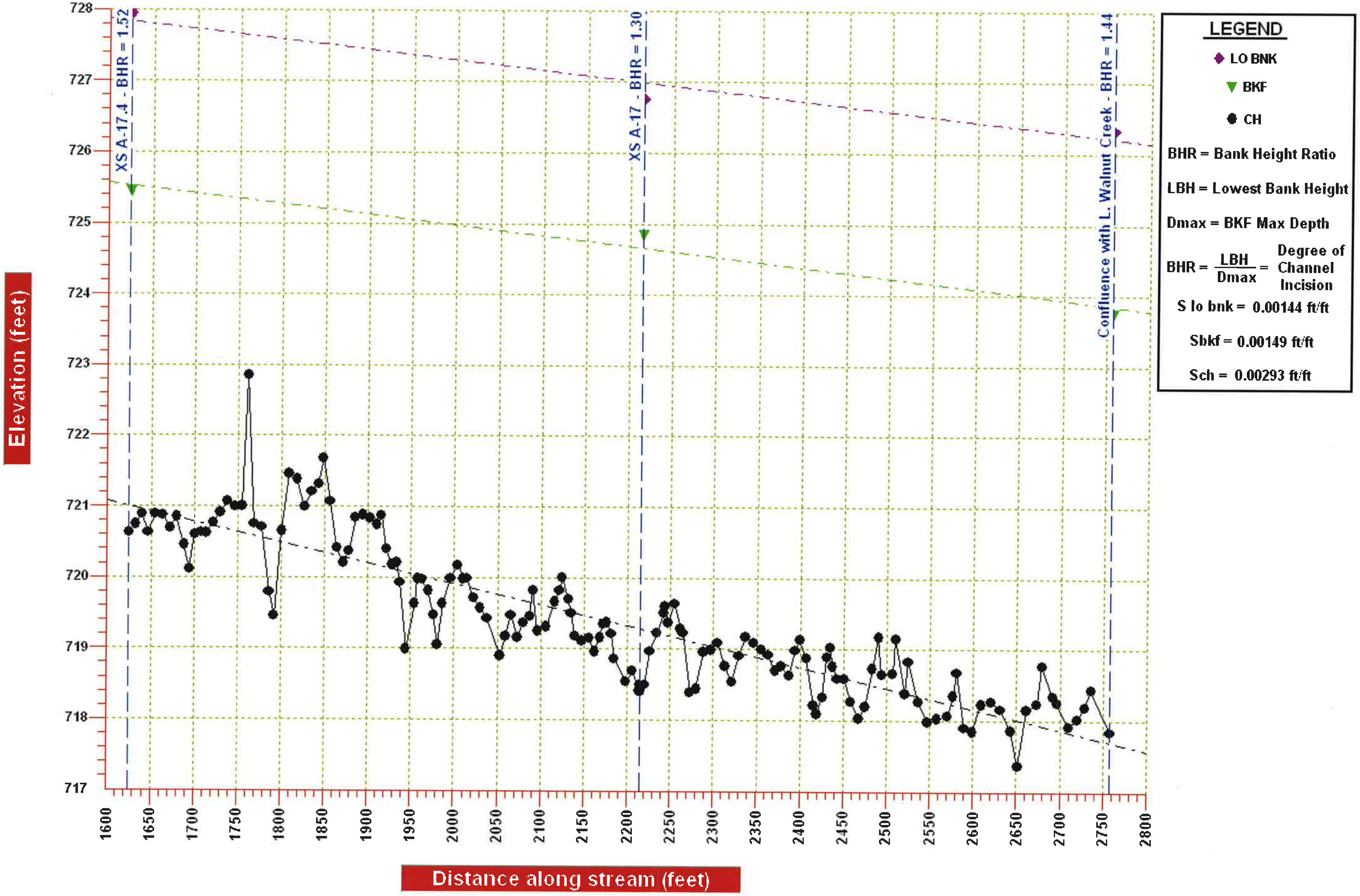


Big Run - Design Pool Cross-Section

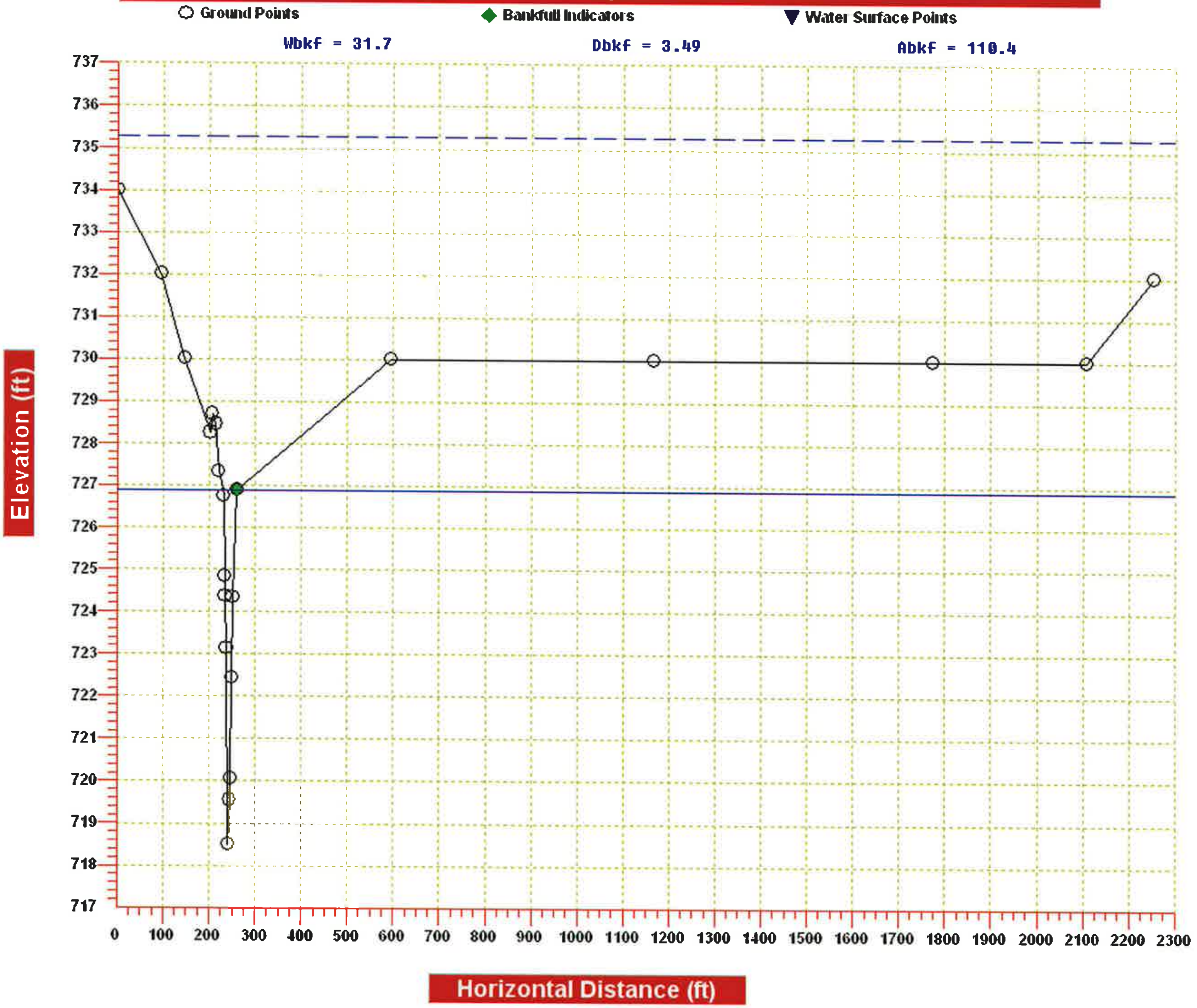
Lower Big Run - Bank Height Ratio - Impaired Profile - 3/17/2009



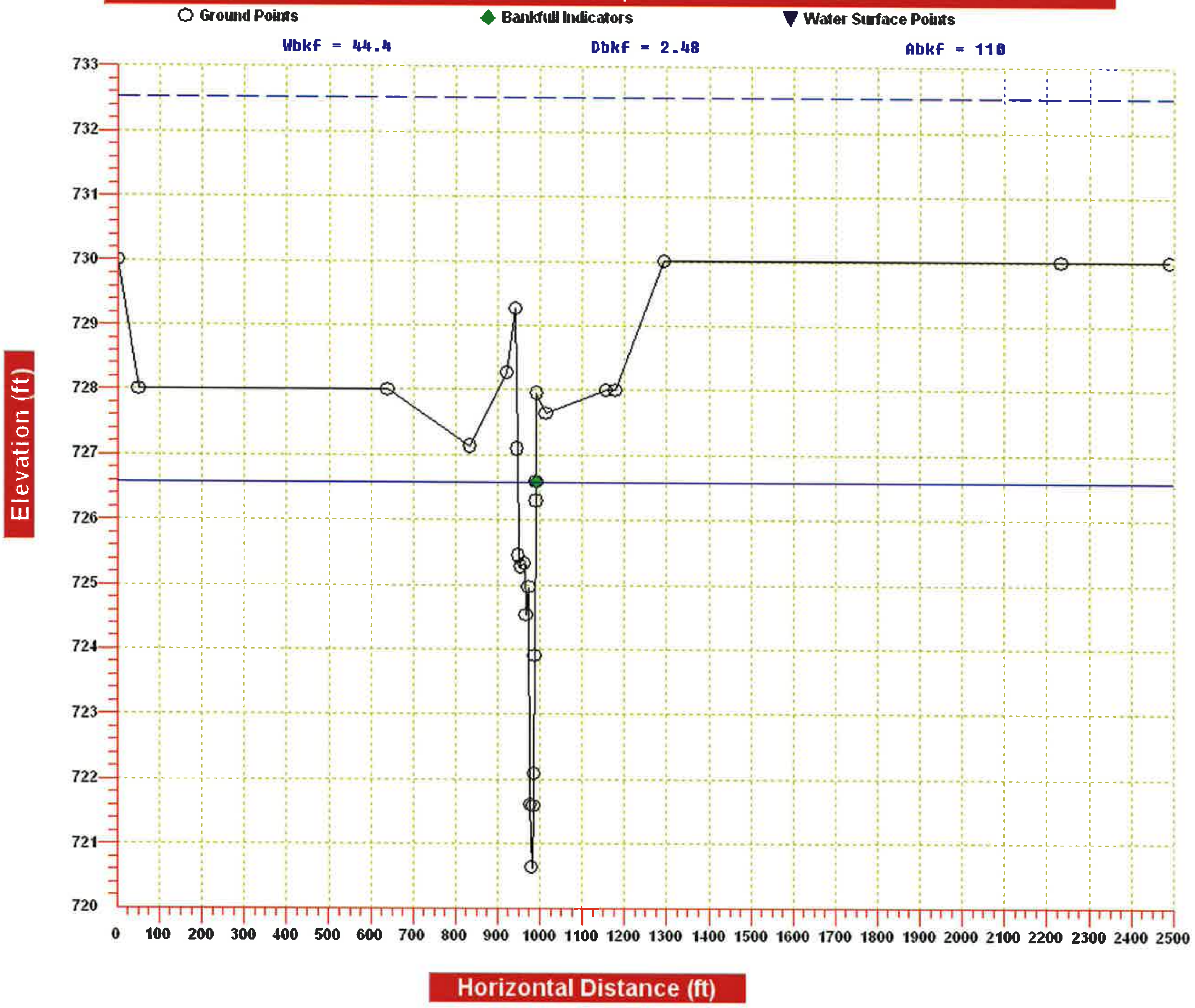
Lower Big Run - Impaired Longitudinal Profile - March 17, 2009



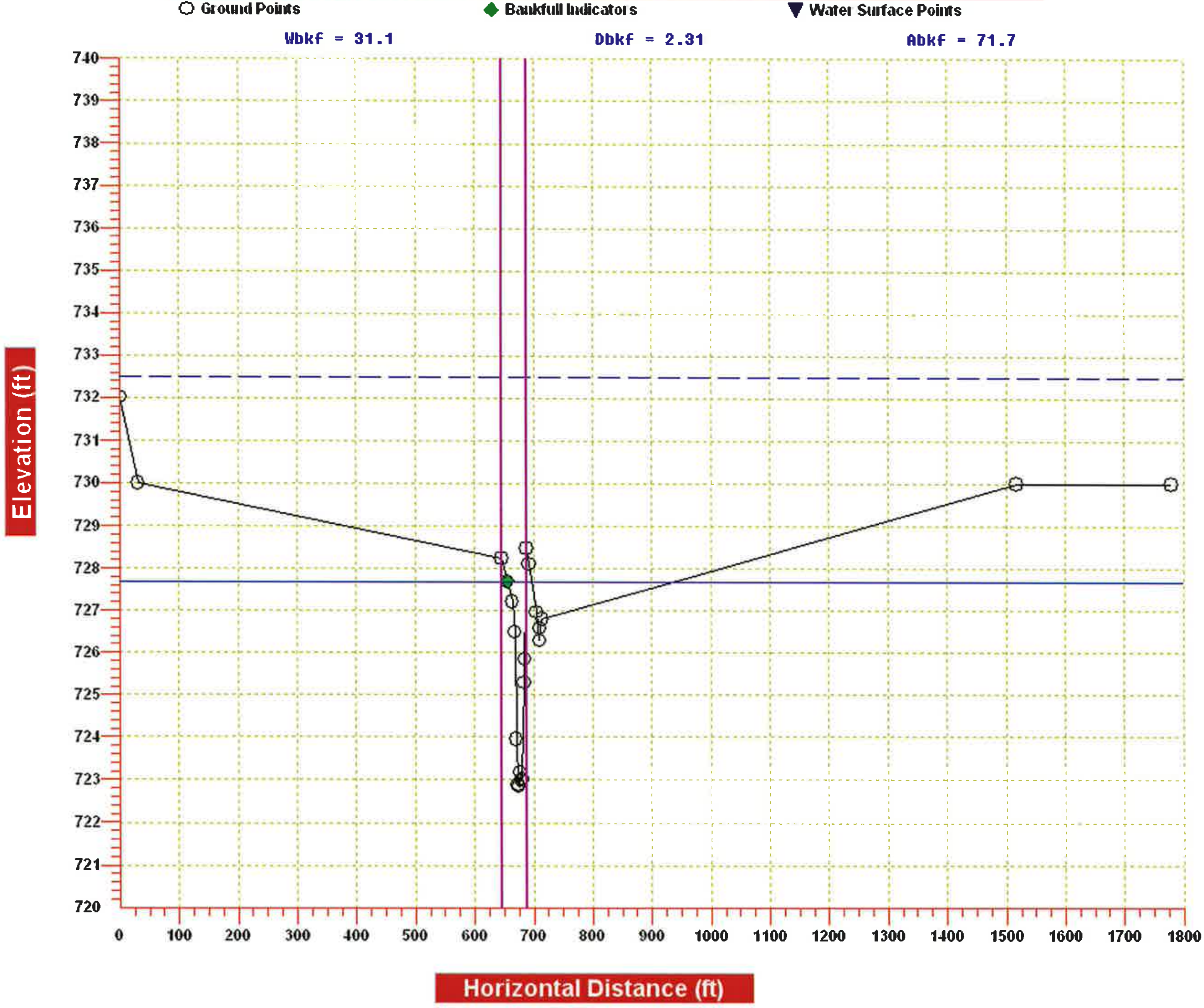
Big Run - Pool XS A-17 - Impaired Profile Sta. 22+15.17



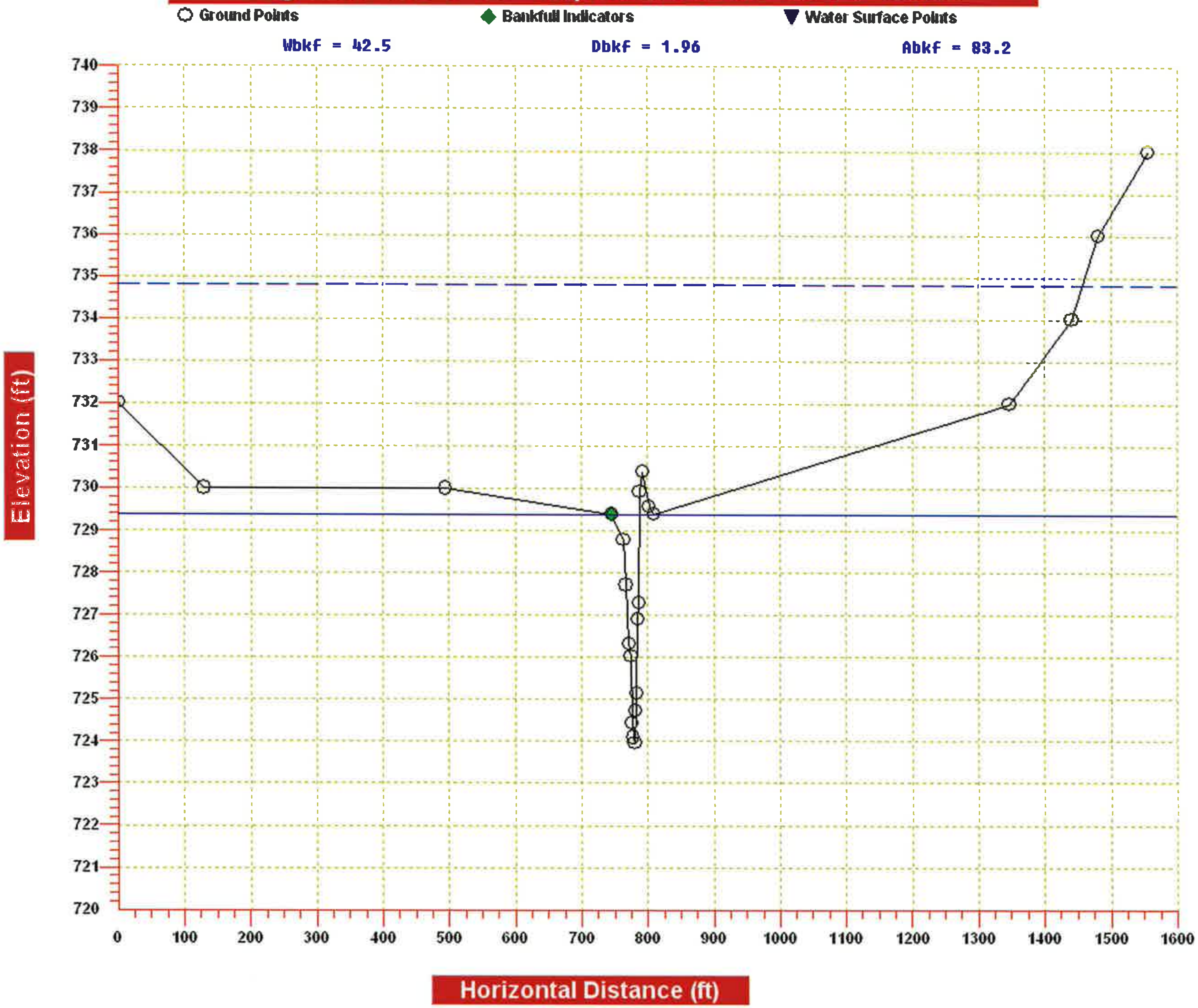
Big Run - Pool XS A-17.4 - Impaired Profile Sta. 16+25.29



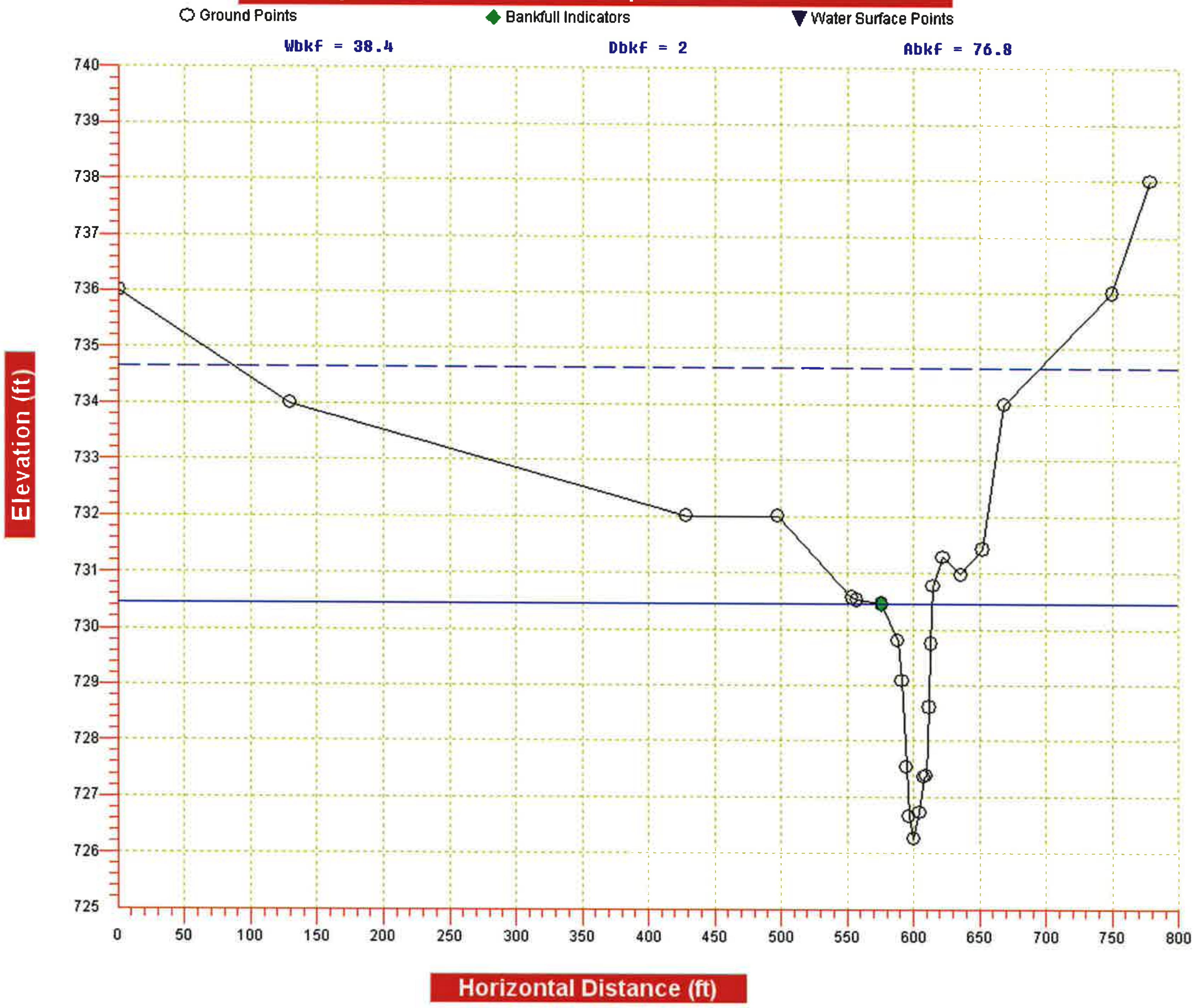
Big Run - XS B-18 - Impaired Profile Sta. 8+52.30

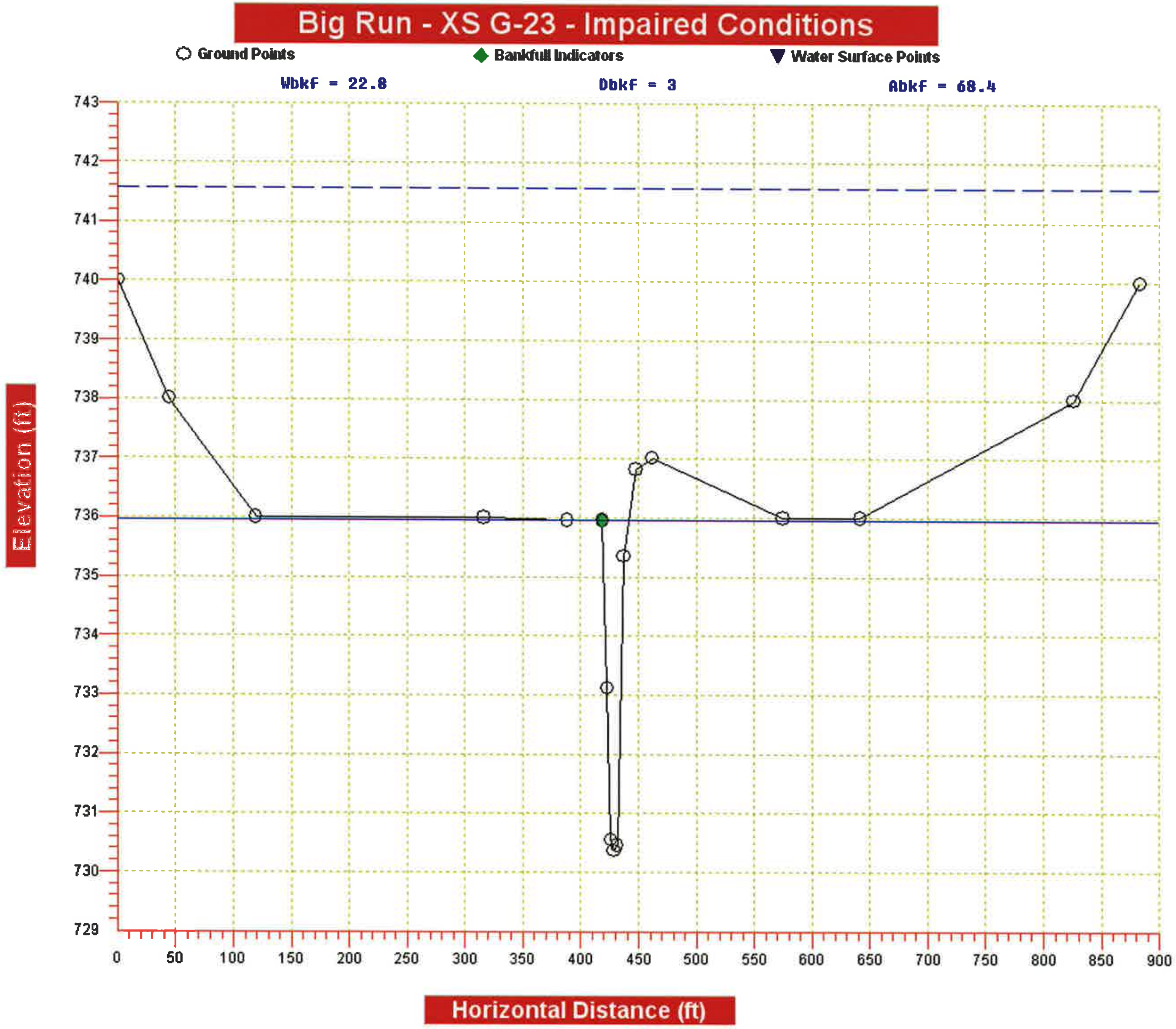


Big Run - XS C-19 - Impaired Profile Sta. 0+00.00



Big Run - XS D-20 - Impaired Conditions




Big Run - XS G-23 - Impaired Conditions
○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
Wbkf = 22.8
Dbkf = 3
Abkf = 68.4
Elevation (ft)
743
742
741
740
739
738
737
736
735
734
733
732
731
730
729
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
Horizontal Distance (ft)

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	**Big Run Impaired Cross-Section A-17**			
Basin:	**LittWalnut Creek**	Drainage Area: **5452.8** acres	**8.52**	mi^2
Location:	**Big Run at Eastside Nursery**			
Twp.&Rge: **;**		Sec.&Qtr.: **;**		
Cross-Section Monuments (Lat./Long.):	**39.83686 Lat / 82.86475 Long**		Date: **08/04/09**	
Observers:	**MFH, WEK, JMH**		Valley Type: VIII	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**31.17**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**3.54**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**110.41**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**8.81**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**8.4**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**2252.7**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**72.27**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**12.47**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.00293**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1.15**	

Stream Type **E 4** (See **Figure 2-14**)

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream: **Big Run Impaired Cross-Section A-17.4**

Basin: **LittWalnut Creek** Drainage Area: **5452.8** acres **8.52** mi^2

Location: **Big Run at Eastside Nursery**

Twp.&Rge: **;** Sec.&Qtr.: **;**

Cross-Section Monuments (Lat./Long.): **39.83686 Lat / 82.86475 Long** Date: **08/04/09**

Observers: **MFH, WEK, JMH** Valley Type: VIII

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**44.38**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**2.48**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**109.97**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**17.9**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**5.95**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**2491.07**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**56.13**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**12.47**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.00293**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1.15**	

Stream Type **C 4** (See **Figure 2-14**)

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream: **Big Run Imparied Cross-Section B-18**

Basin: **LittWalnut Creek** Drainage Area: **5452.8** acres **8.52** mi^2

Location: **Big Run at Eastside Nursery**

Twp.&Rge: **;** Sec.&Qtr.: **;**

Cross-Section Monuments (Lat./Long.): **39.83686 Lat / 82.86475 Long** Date: **08/04/09**

Observers: **MFH, WEK, JMH** Valley Type: VIII

Bankfull WIDTH (W_{bkf})
WIDTH of the stream channel at bankfull stage elevation, in a riffle section. **31.49** ft

Bankfull DEPTH (d_{bkf})
Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$). **2.3** ft

Bankfull X-Section AREA (A_{bkf})
AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section. **72.36** ft^2

Width/Depth Ratio (W_{bkf} / d_{bkf})
Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section. **13.69** ft/ft

Maximum DEPTH (d_{mbkf})
Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section. **4.85** ft

WIDTH of Flood-Prone Area (W_{fpa})
Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section. **1779.31** ft

Entrenchment Ratio (ER)
The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section). **56.5** ft/ft

Channel Materials (Particle Size Index) D_{50}
The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations. **12.47** mm

Water Surface SLOPE (S)
Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage. **0.00293** ft/ft

Channel SINUOSITY (k)
Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S). **1.15**

Stream Type **C 4** (See **Figure 2-14**)

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream: **Big Run Impaired Cross-Section C-19**
Basin: **LittWalnut Creek** Drainage Area: **5452.8** acres **8.52** mi^2
Location: **Big Run at Eastside Nursery**
Twp.&Rge: **;** Sec.&Qtr.: **;**
Cross-Section Monuments (Lat./Long.): **39.83686 Lat / 82.86475 Long** Date: **08/04/09**
Observers: **MFH, WEK, JMH** Valley Type: VIII

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**22.77**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**3**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**68.39**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**7.59**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**5.6**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**883.15**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**38.79**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**12.47**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.00293**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1.15**	

Stream Type **E 4** (See **Figure 2-14**)

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream: **Big Run Impaired Cross-Section D-30**
Basin: **LittWalnut Creek** Drainage Area: **5452.8** acres **8.52** mi^2
Location: **Big Run at Eastside Nursery**
Twp.&Rge: **;** Sec.&Qtr.: **;**
Cross-Section Monuments (Lat./Long.): **39.83686 Lat / 82.86475 Long** Date: **08/04/09**
Observers: **MFH, WEK, JMH** Valley Type: VIII

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**38.41**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**2**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**76.77**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**19.2**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**4.2**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**607.27**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**15.81**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**12.47**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.00293**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1.15**	

Stream Type **C 4** (See **Figure 2-14**)

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream: **Big Run Impaired Cross-Section G-23**

Basin: **LittWalnut Creek** Drainage Area: **5452.8** acres **8.52** mi^2

Location: **Big Run at Eastside Nursery**

Twp.&Rge: **;** Sec.&Qtr.: **;**

Cross-Section Monuments (Lat./Long.): **39.83686 Lat / 82.86475 Long** Date: **08/04/09**

Observers: **MFH, WEK, JMH** Valley Type: VIII

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**22.77**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**3**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**68.39**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**7.59**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**5.6**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**883.15**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**38.79**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**12.47**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.00293**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1.15**	

Stream Type **E 4** (See **Figure 2-14**)

APPENDIX F

QHEI Data Forms

OhioEPA

Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 31

Stream & Location: Big Run, Sample 1 Eastside Nursery ***RM:*** ___._ ***Date:*** 08/ 11 / 06

Scorers Full Name & Affiliation: M. Queen Darby

River Code: ___-___-___ ***STORET #:*** ______ ***Lat./ Long.:*** (NAD 83 - decimal °) __.____ /8_.____ *Office verified location* ☐

1] *SUBSTRATE*

Check *ONLY* Two substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐ ☐ BLDR /SLABS [10]			☐ ☐ HARDPAN [4]		
☐ ☐ BOULDER [9]			☐ ☐ DETRITUS [3]		
☐ ☐ COBBLE [8]			☐ ☐ MUCK [2]		
☐ ☐ GRAVEL [7]	5		☐ ☑ SILT [2]	30	
☑ ☐ SAND [6]	65		☐ ☐ ARTIFICIAL [0]		
☐ ☐ BEDROCK [5]					

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☑ 3 or less [0]

Comments

Check ONE (*Or 2 & average*)

ORIGIN
- ☐ LIMESTONE [1]
- ☑ TILLS [1]
- ☐ WETLANDS [0]
- ☐ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTURINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILT
- ☑ HEAVY [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

EMBEDDEDNESS
- ☑ EXTENSIVE [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Substrate 5 *Maximum 20*

2] *INSTREAM COVER*

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

- __ UNDERCUT BANKS [1]
- 1 OVERHANGING VEGETATION [1]
- __ SHALLOWS (IN SLOW WATER) [1]
- __ ROOTMATS [1]
- 1 POOLS > 70cm [2]
- __ ROOTWADS [1]
- __ BOULDERS [1]
- __ OXBOWS, BACKWATERS [1]
- __ AQUATIC MACROPHYTES [1]
- __ LOGS OR WOODY DEBRIS [1]

AMOUNT

Check ONE (*Or 2 & average*)
- ☐ EXTENSIVE >75% [11]
- ☐ MODERATE 25-75% [7]
- ☐ SPARSE 5-<25% [3]
- ☑ NEARLY ABSENT <5% [1]

Comments

Cover *Maximum 20* 4

3] *CHANNEL MORPHOLOGY*

Check ONE in each category (*Or 2 & average*)

SINUOSITY
- ☐ HIGH [4]
- ☐ MODERATE [3]
- ☑ LOW [2]
- ☐ NONE [1]

DEVELOPMENT
- ☐ EXCELLENT [7]
- ☐ GOOD [5]
- ☐ FAIR [3]
- ☑ POOR [1]

CHANNELIZATION
- ☐ NONE [6]
- ☐ RECOVERED [4]
- ☑ RECOVERING [3]
- ☐ RECENT OR NO RECOVERY [1]

STABILITY
- ☐ HIGH [3]
- ☐ MODERATE [2]
- ☑ LOW [1]

Comments Relocation of channel; canopy removal; dredging

Channel *Maximum 20* 7

4] *BANK EROSION AND RIPARIAN ZONE*

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ☐ ☐ NONE / LITTLE [3]
- ☑ ☑ MODERATE [2]
- ☐ ☐ HEAVY / SEVERE [1]

RIPARIAN WIDTH (L R)
- ☐ ☐ WIDE > 50m [4]
- ☐ ☐ MODERATE 10-50m [3]
- ☐ ☐ NARROW 5-10m [2]
- ☐ ☐ VERY NARROW < 5m [1]
- ☑ ☑ NONE [0]

FLOOD PLAIN QUALITY (L R)
- ☐ ☐ FOREST, SWAMP [3]
- ☐ ☐ SHRUB OR OLD FIELD [2]
- ☑ ☑ RESIDENTIAL, PARK, NEW FIELD [1]
- ☐ ☐ FENCED PASTURE [1]
- ☐ ☐ OPEN PASTURE, ROWCROP [0]
- ☐ ☐ CONSERVATION TILLAGE [1]
- ☐ ☐ URBAN OR INDUSTRIAL [0]
- ☐ ☐ MINING / CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian *Maximum 10* 3

5] *POOL / GLIDE AND RIFFLE / RUN QUALITY*

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ☐ >1m [6]
- ☑ 0.7-<1m [4]
- ☐ 0.4-<0.7m [2]
- ☐ 0.2-<0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH

Check ONE (*Or 2 & average*)
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ☑ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH > RIFFLE WIDTH [0]

CURRENT VELOCITY

Check ALL that apply
- ☐ TORRENTIAL [-1]
- ☐ VERY FAST [1]
- ☐ FAST [1]
- ☐ MODERATE [1]
- ☑ SLOW [1]
- ☐ INTERSTITIAL [-1]
- ☐ INTERMITTENT [-2]
- ☐ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current *Maximum 12* 6

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (*Or 2 & average*). ☑ NO RIFFLE [metric=0]

RIFFLE DEPTH
- ☐ BEST AREAS > 10cm [2]
- ☐ BEST AREAS 5-10cm [1]
- ☐ BEST AREAS < 5cm [metric=0]

RUN DEPTH
- ☐ MAXIMUM > 50cm [2]
- ☐ MAXIMUM < 50cm [1]

RIFFLE / RUN SUBSTRATE
- ☐ STABLE (e.g., Cobble, Boulder) [2]
- ☐ MOD. STABLE (e.g., Large Gravel) [1]
- ☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
- ☐ NONE [2]
- ☐ LOW [1]
- ☐ MODERATE [0]
- ☐ EXTENSIVE [-1]

Comments Instream features not present

Riffle / Run *Maximum 8* 0

6] *GRADIENT* (8.27 ft/mi)

DRAINAGE AREA (8.5 mi²)

- ☐ VERY LOW - LOW [2-4]
- ☑ MODERATE [6-10]
- ☐ HIGH - VERY HIGH [10-6]

%POOL: ( ) %GLIDE: (100)

%RUN: ( ) %RIFFLE: ( )

Gradient *Maximum 10* 6

OhioEPA

Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 28.5

Stream & Location: Big Run, Sample 2 ***RM:*** ___._ ***Date:*** 08 / 11 / 06

Eastside Nursery ***Scorers Full Name & Affiliation:*** M. Queen Darby

River Code: __-__-__ ***STORET #:*** ______ ***Lat./ Long.:*** (NAD 83 - decimal °) __.____ /8_.____ *Office verified location* ☐

1] *SUBSTRATE*

Check ***ONLY*** Two substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐ ☐ BLDR /SLABS [10]			☐ ☐ HARDPAN [4]		
☐ ☐ BOULDER [9]			☐ ☐ DETRITUS [3]		
☐ ☐ COBBLE [8]			☐ ☐ MUCK [2]		
☐ ☐ GRAVEL [7]			☐ ☑ SILT [2]	20	
☑ ☐ SAND [6]	80		☐ ☐ ARTIFICIAL [0]		
☐ ☐ BEDROCK [5]					

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☑ 3 or less [0]

Comments

Check ONE (*Or 2 & average*)

ORIGIN
- ☐ LIMESTONE [1]
- ☑ TILLS [1]
- ☐ WETLANDS [0]
- ☐ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTURINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILT
- ☐ HEAVY [-2]
- ☑ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

EMBEDDEDNESS
- ☑ EXTENSIVE [-2]
- ☑ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Substrate 6.5 *Maximum 20*

2] *INSTREAM COVER*

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

- __ UNDERCUT BANKS [1]
- 1 OVERHANGING VEGETATION [1]
- __ SHALLOWS (IN SLOW WATER) [1]
- 1 ROOTMATS [1]
- __ POOLS > 70cm [2]
- __ ROOTWADS [1]
- __ BOULDERS [1]
- __ OXBOWS, BACKWATERS [1]
- 1 AQUATIC MACROPHYTES [1]
- __ LOGS OR WOODY DEBRIS [1]

AMOUNT

Check ONE (*Or 2 & average*)
- ☐ EXTENSIVE >75% [11]
- ☐ MODERATE 25-75% [7]
- ☐ SPARSE 5-<25% [3]
- ☑ NEARLY ABSENT <5% [1]

Comments

Cover 4 *Maximum 20*

3] *CHANNEL MORPHOLOGY*

Check ONE in each category (*Or 2 & average*)

SINUOSITY
- ☐ HIGH [4]
- ☐ MODERATE [3]
- ☑ LOW [2]
- ☐ NONE [1]

DEVELOPMENT
- ☐ EXCELLENT [7]
- ☐ GOOD [5]
- ☐ FAIR [3]
- ☑ POOR [1]

CHANNELIZATION
- ☐ NONE [6]
- ☐ RECOVERED [4]
- ☑ RECOVERING [3]
- ☐ RECENT OR NO RECOVERY [1]

STABILITY
- ☐ HIGH [3]
- ☐ MODERATE [2]
- ☑ LOW [1]

Comments

Relocation of channel; canopy removal; dredging

Channel 7 *Maximum 20*

4] *BANK EROSION AND RIPARIAN ZONE*

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ☐ ☐ NONE / LITTLE [3]
- ☑ ☑ MODERATE [2]
- ☑ ☑ HEAVY / SEVERE [1]

RIPARIAN WIDTH (L R)
- ☐ ☐ WIDE > 50m [4]
- ☐ ☐ MODERATE 10-50m [3]
- ☐ ☐ NARROW 5-10m [2]
- ☐ ☐ VERY NARROW < 5m [1]
- ☑ ☑ NONE [0]

FLOOD PLAIN QUALITY (L R)
- ☐ ☐ FOREST, SWAMP [3]
- ☐ ☐ SHRUB OR OLD FIELD [2]
- ☐ ☑ RESIDENTIAL, PARK, NEW FIELD [1]
- ☐ ☐ FENCED PASTURE [1]
- ☑ ☐ OPEN PASTURE, ROWCROP [0]
- ☐ ☐ CONSERVATION TILLAGE [1]
- ☐ ☐ URBAN OR INDUSTRIAL [0]
- ☐ ☐ MINING / CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian 2 *Maximum 10*

5] *POOL / GLIDE AND RIFFLE / RUN QUALITY*

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ☐ > 1m [6]
- ☐ 0.7-<1m [4]
- ☐ 0.4-<0.7m [2]
- ☑ 0.2-<0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH

Check ONE (*Or 2 & average*)
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ☑ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH > RIFFLE WIDTH [0]

CURRENT VELOCITY

Check ALL that apply
- ☐ TORRENTIAL [-1]
- ☐ VERY FAST [1]
- ☐ FAST [1]
- ☐ MODERATE [1]
- ☑ SLOW [1]
- ☐ INTERSTITIAL [-1]
- ☐ INTERMITTENT [-2]
- ☐ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current 3 *Maximum 12*

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (*Or 2 & average*). ☑ **NO RIFFLE [metric=0]**

RIFFLE DEPTH
- ☐ BEST AREAS > 10cm [2]
- ☐ BEST AREAS 5-10cm [1]
- ☐ BEST AREAS < 5cm [metric=0]

RUN DEPTH
- ☐ MAXIMUM > 50cm [2]
- ☐ MAXIMUM < 50cm [1]

RIFFLE / RUN SUBSTRATE
- ☐ STABLE (e.g., Cobble, Boulder) [2]
- ☐ MOD. STABLE (e.g., Large Gravel) [1]
- ☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
- ☐ NONE [2]
- ☐ LOW [1]
- ☐ MODERATE [0]
- ☐ EXTENSIVE [-1]

Comments Instream features not present

Riffle / Run 0 *Maximum 8*

6] *GRADIENT* (8.27 ft/mi)

DRAINAGE AREA (8.5 mi^2)

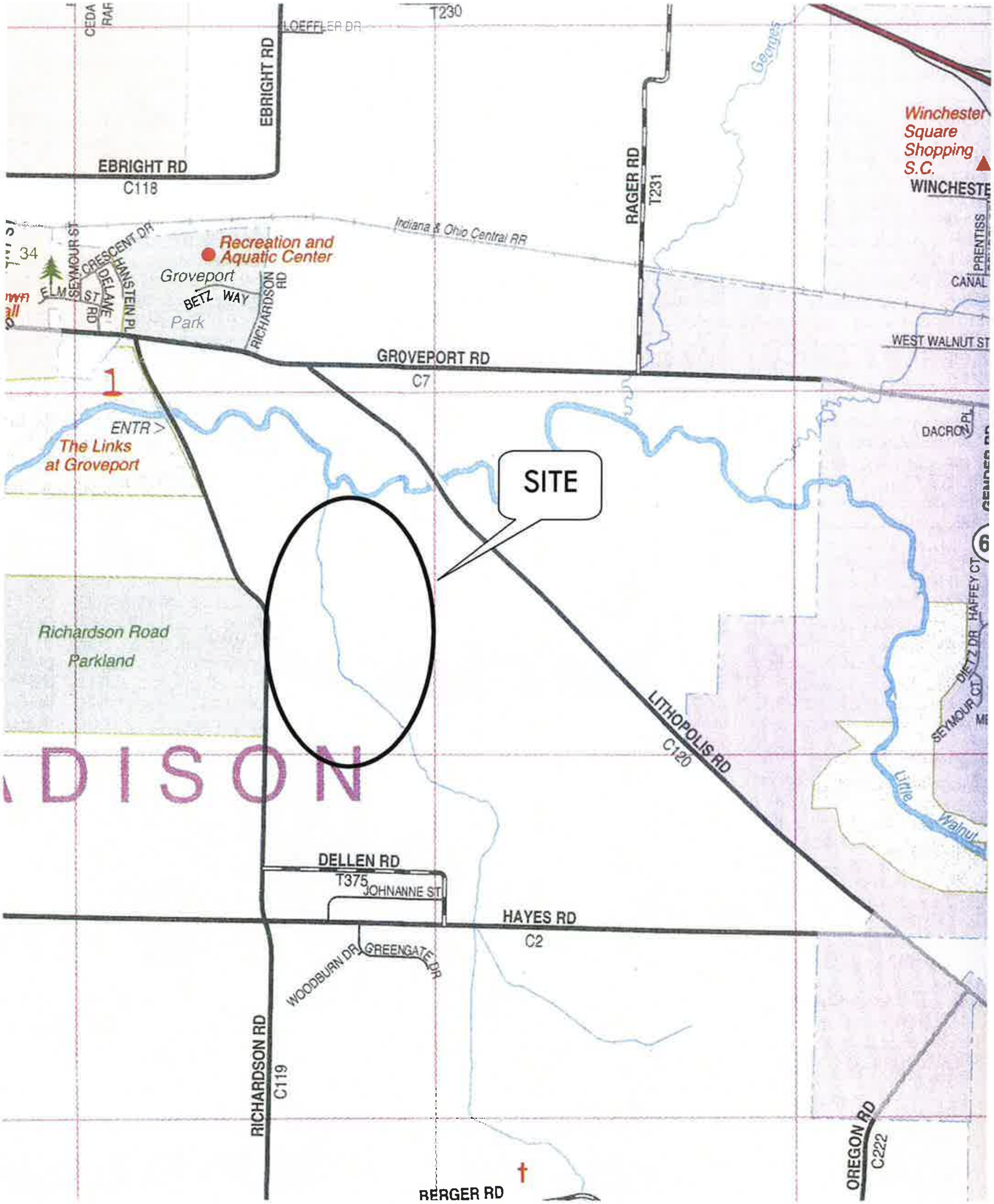
- ☐ VERY LOW - LOW [2-4]
- ☑ MODERATE [6-10]
- ☐ HIGH - VERY HIGH [10-6]

%POOL: __ %GLIDE: 100

%RUN: __ %RIFFLE: __

Gradient 6 *Maximum 10*

EXHIBITS



EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4800
M C M X X V I

N

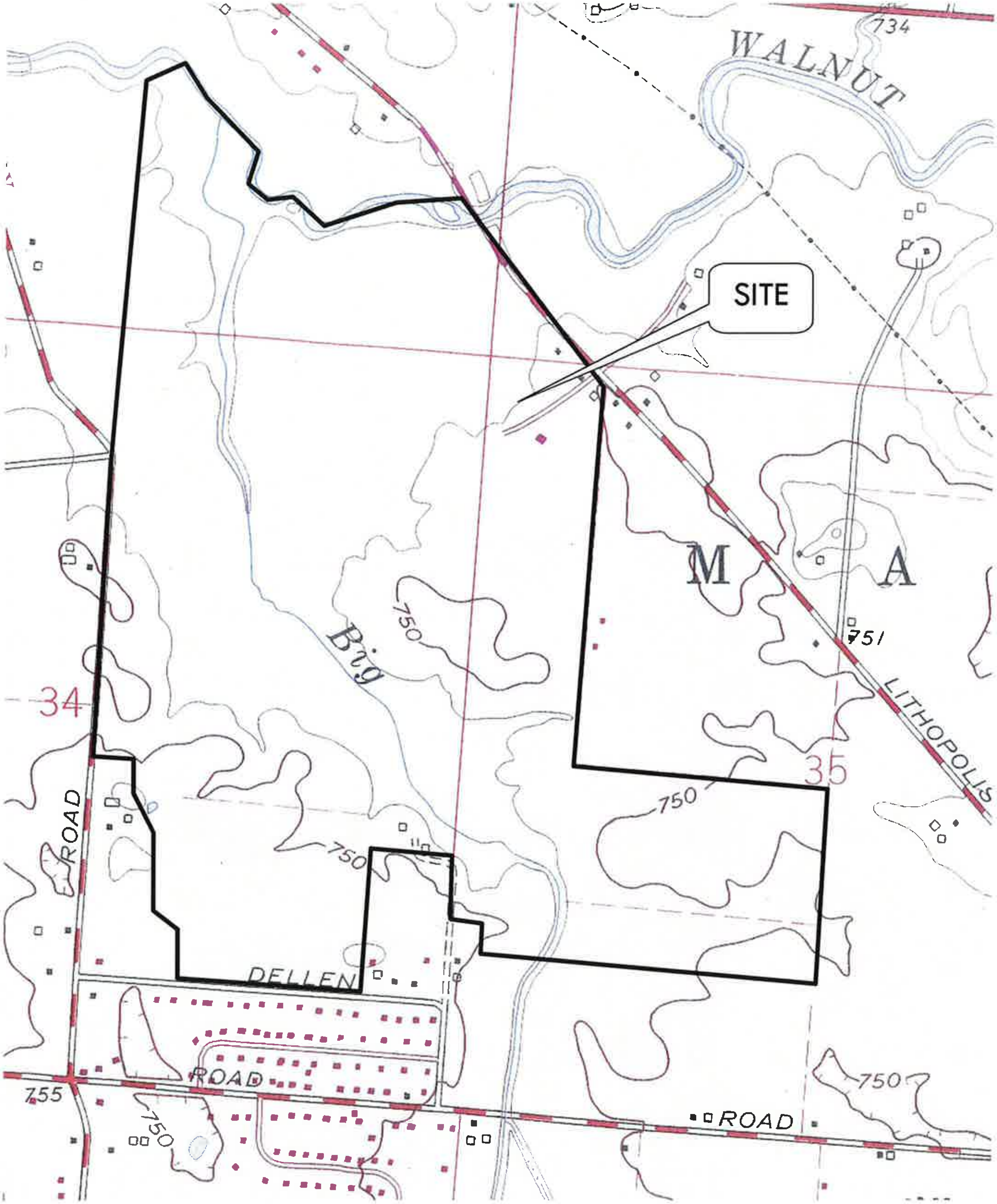
SCALE: 1"= 2000'

0 1000 2000 4000 FEET

GROVEPORT, FRANKLIN COUNTY, OHIO

EASTSIDE NURSERY SITE
AREA LOCATION MAP
EXHIBIT 1

Source:
- FRANKLIN COUNTY MAP (2007)



EMHT
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4800
M C M X X V I

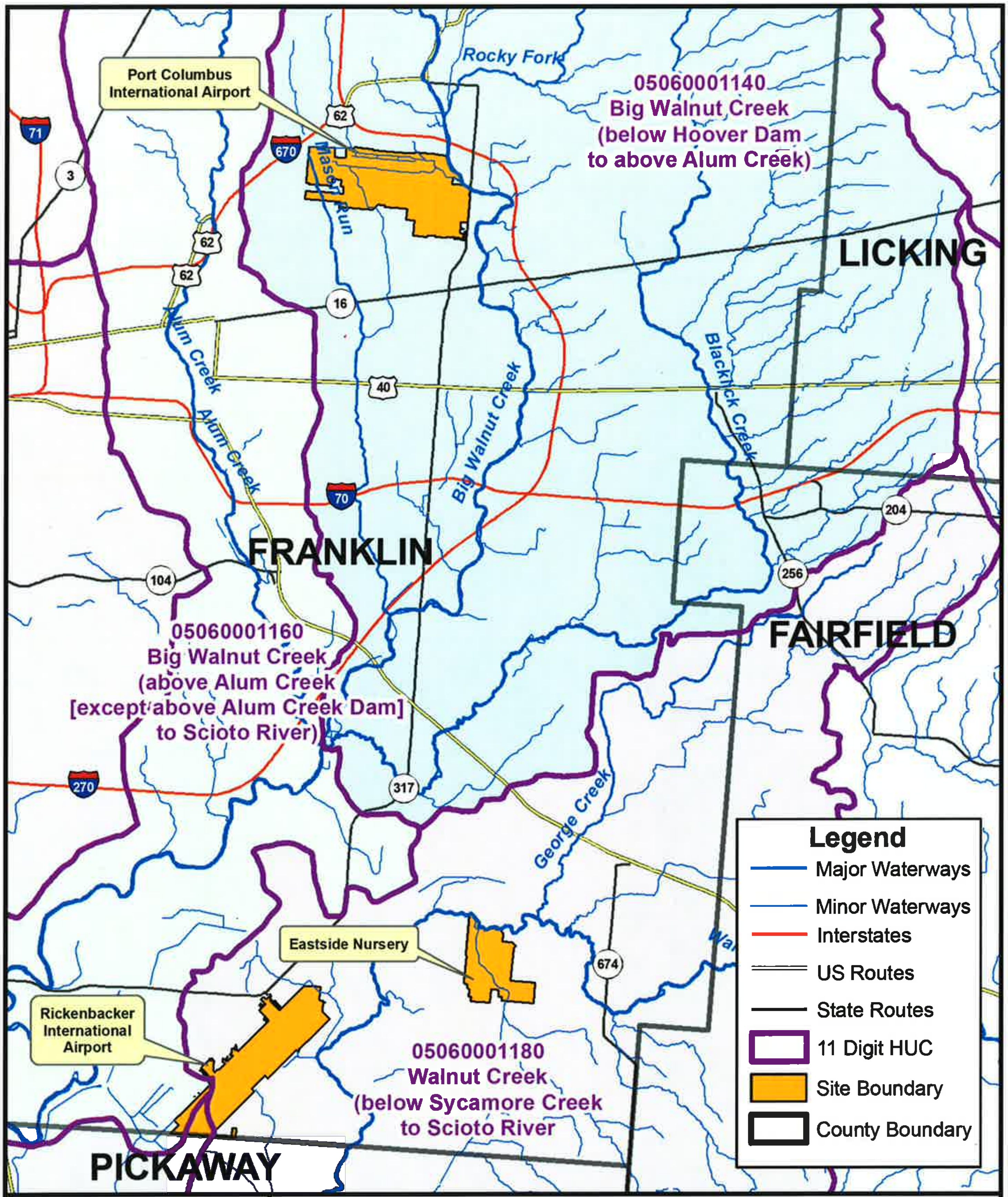
N

SCALE: 1"= 1000'

0 500 1000 2000 FEET

GROVEPORT, FRANKLIN COUNTY, OHIO
EASTSIDE NURSERY SITE
TOPOGRAPHIC MAP
EXHIBIT 2

Source:
- USGS CANAL WINCHESTER, OH QUAD (1985)



Q:\PROJECT\20081022.ENV\Shapefiles\Layouts\HUC_Exhibit.mxd - 3/19/2009 @ 10:06:05 AM

EMH&T

Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4800
M C M X X V I

FRANKLIN COUNTY, OHIO

Eastside Nursery Site
Watershed Location Map
Exhibit 3

SCALE: 1" = 10,000'

0 5,000 10,000 20,000 Feet

Source:
- Hydrologic Unit Code (HUC), NRCS

N

EMH&T

Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4800
M C M X X V I

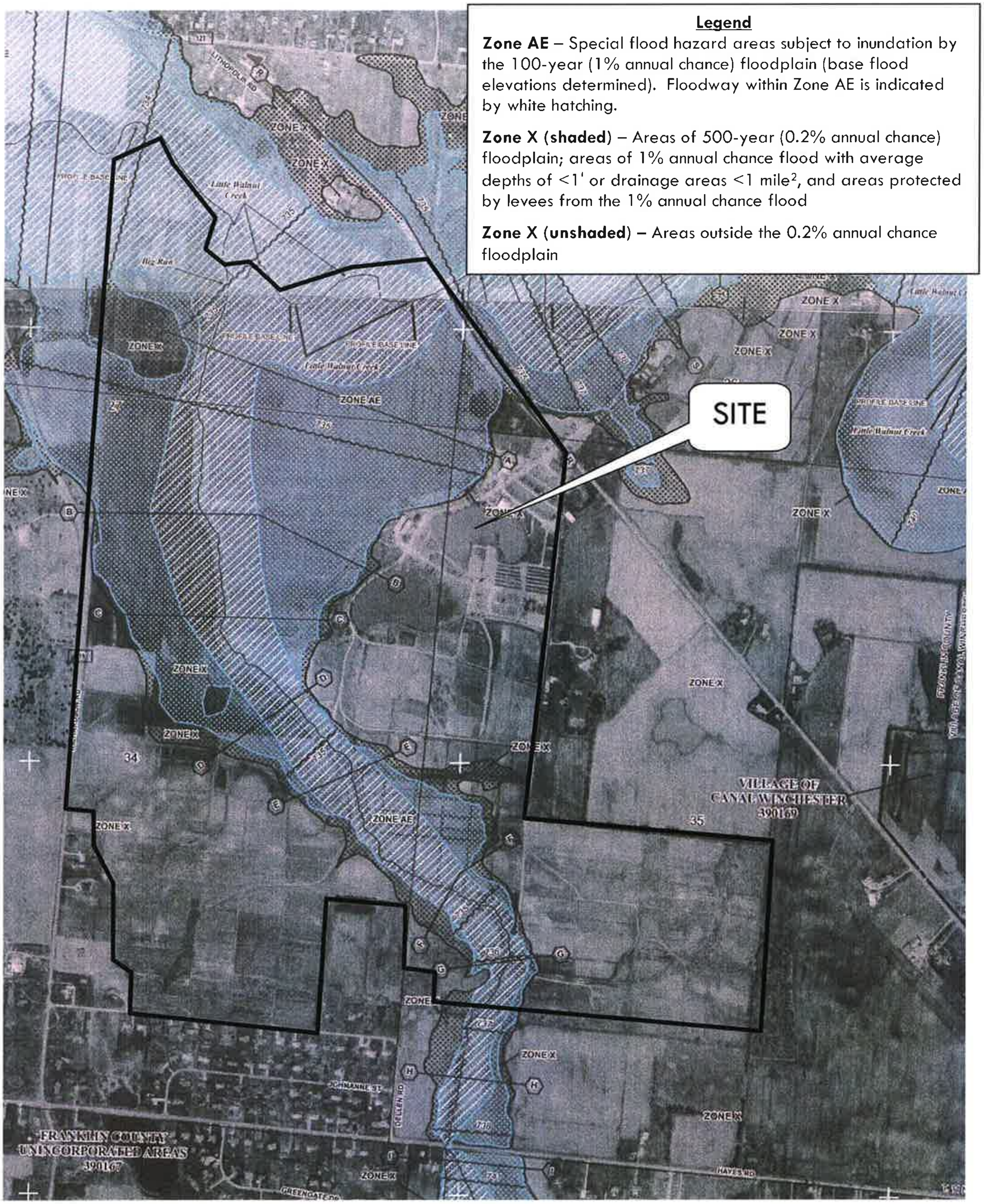
SCALE: 1"= 1000'

0 500 1000 2000 FEET

GROVEPORT, FRANKLIN COUNTY, OHIO

EASTSIDE NURSERY SITE
SOIL SURVEY MAP
EXHIBIT 4

Source:
- USDA/NRCS (2008)



Legend

Zone AE – Special flood hazard areas subject to inundation by the 100-year (1% annual chance) floodplain (base flood elevations determined). Floodway within Zone AE is indicated by white hatching.

Zone X (shaded) – Areas of 500-year (0.2% annual chance) floodplain; areas of 1% annual chance flood with average depths of <1' or drainage areas <1 mile^2, and areas protected by levees from the 1% annual chance flood

Zone X (unshaded) – Areas outside the 0.2% annual chance floodplain

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4800
M C M X X V I

SCALE: 1"= 1000'

0 500 1000 2000 FEET

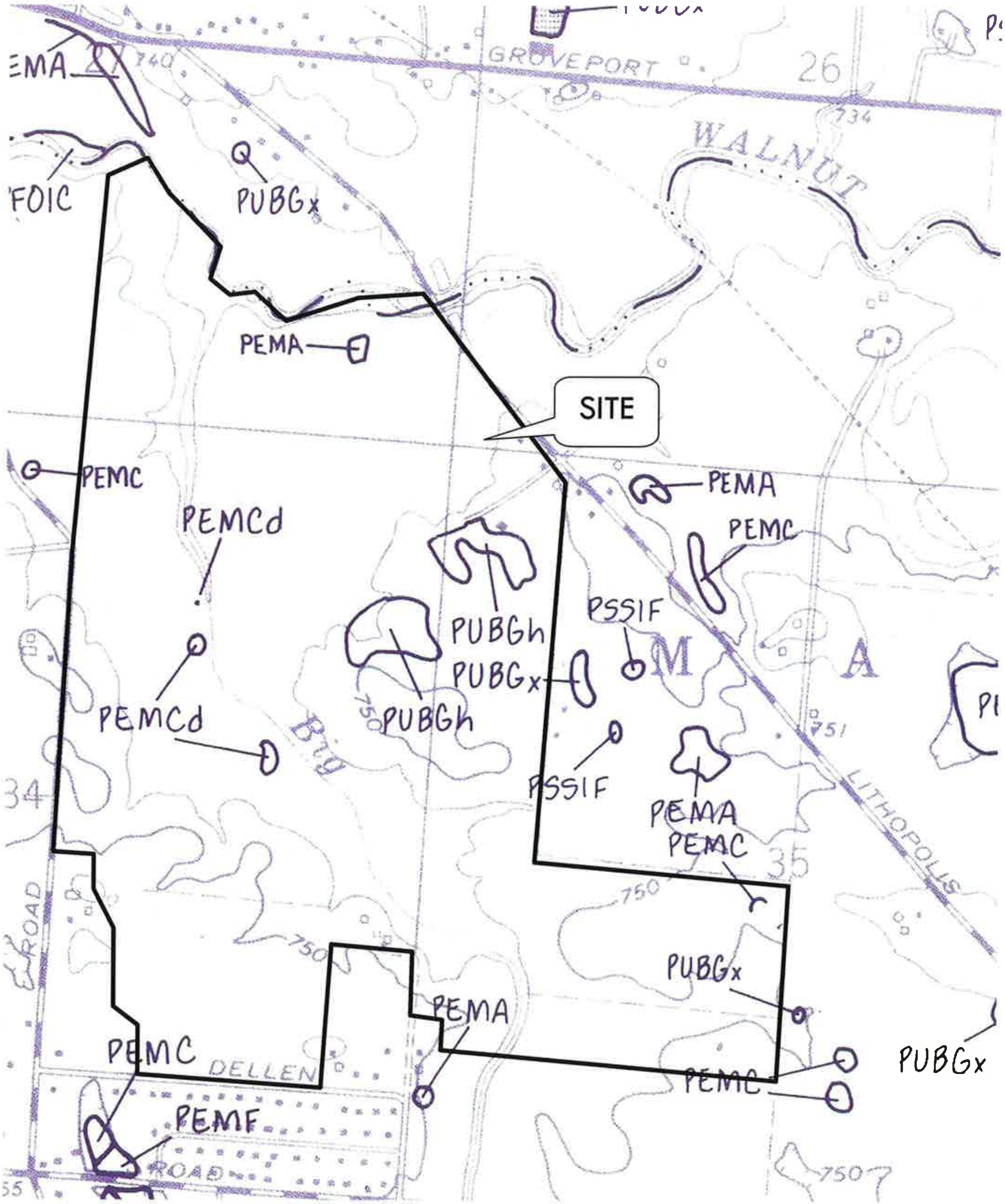
GROVEPORT, FRANKLIN COUNTY, OHIO

EASTSIDE NURSERY SITE

FLOOD INSURANCE RATE MAP

EXHIBIT 5

Source:
- FEMA (2008)



EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4800
M C M X X V I

N

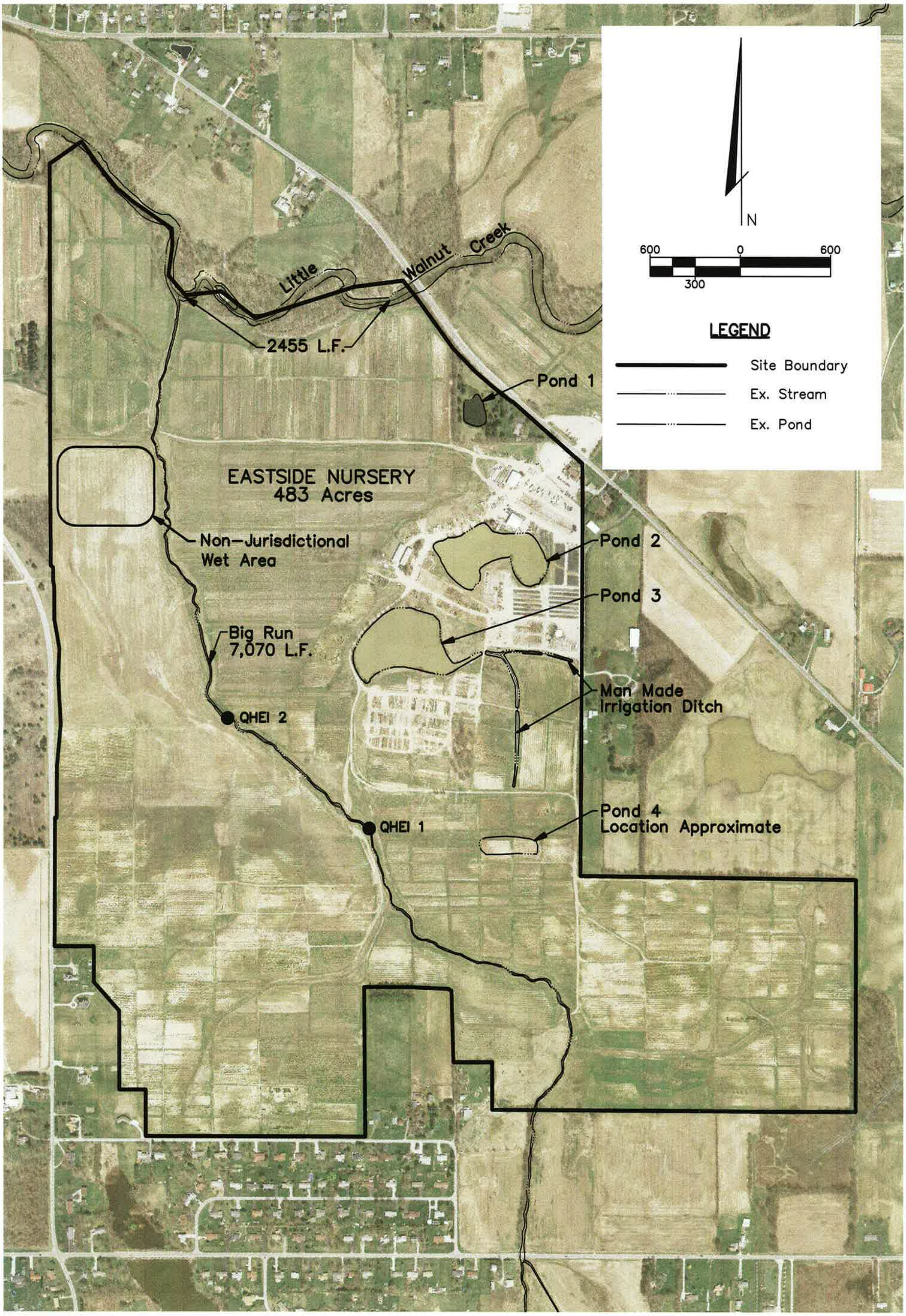
SCALE: 1"= 1000'

0 500 1000 FEET 2000

GROVEPORT, FRANKLIN COUNTY, OHIO

EASTSIDE NURSERY SITE
NATIONAL WETLAND INVENTORY MAP
EXHIBIT 6

Source:
- USFWS CANAL WINCHESTER, OH (1995)



EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4800
M C M X X V I

COLUMBUS REGIONAL
AIRPORT AUTHORITY

GROVEPORT, FRANKLIN COUNTY, OHIO

EASTSIDE NURSERY SITE

DELINEATION MAP

EXHIBIT 7

Date: March 2009

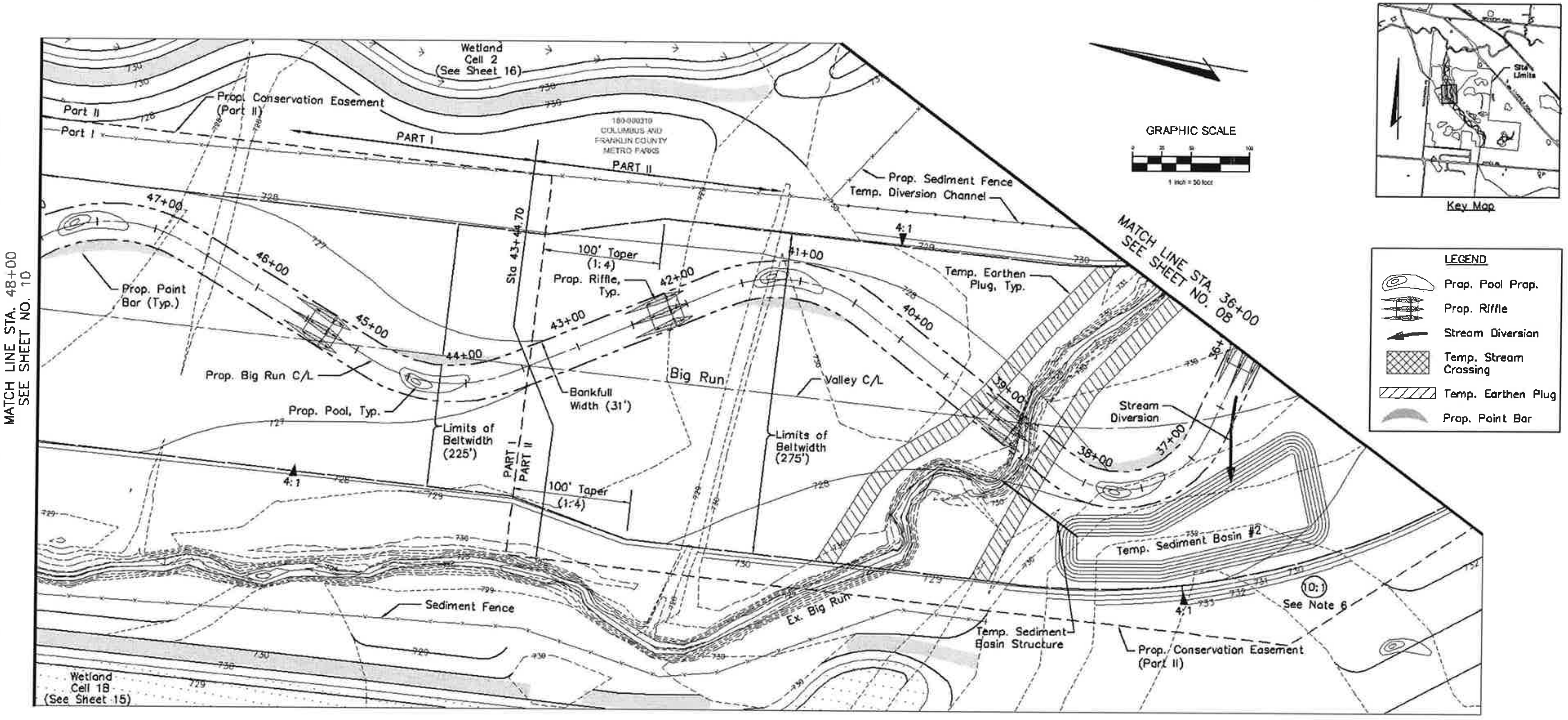
Scale: 1" = 600'

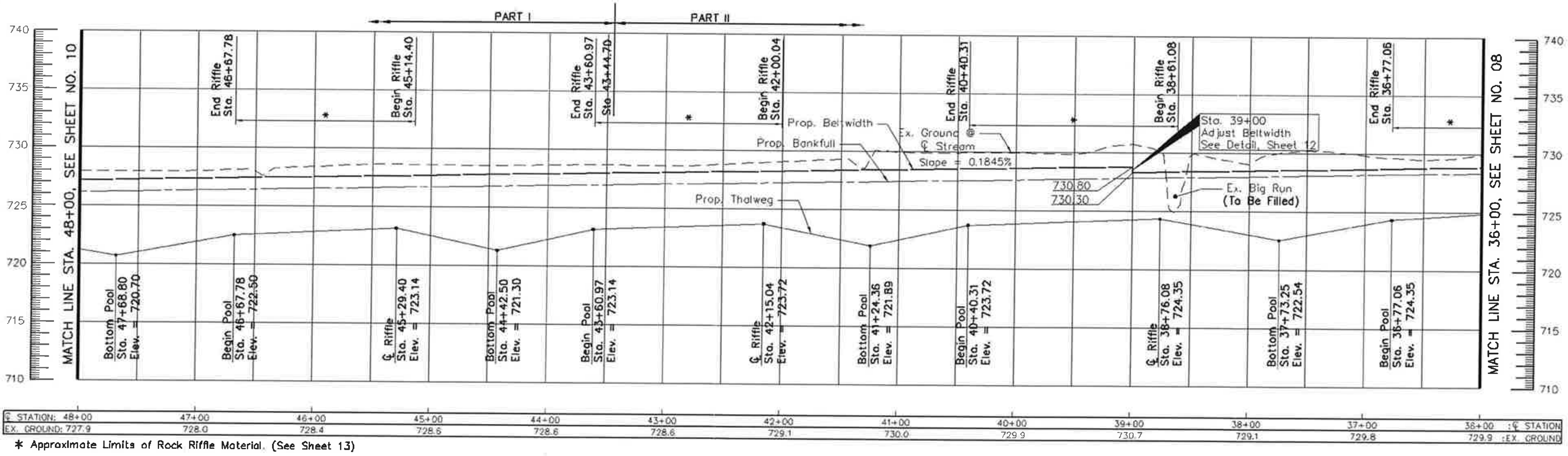
Job No: 2008-1022

\\CMHDATA2\ENVIRON\PROJECT\20081022.ENV\DWG\EXHIBITS\DELINEATION MAP.DWG<11X17> – NO XREFS – LAST SAVED BY GTHOMAS [3/19/2009 11:01:27 AM] – PLOTTED BY GTHOMAS [3/19/2009 11:01:28 AM]

Notes

1. The existing stream shall be filled in per the specifications of Item 203. Embankment. This fill shall be capped with a minimum of 1.0 ' of topsoil per Item 652, Placing Stockpiled Topsoil. The fill placed within the existing stream shall be graded consistent with the stream valley so that it drains toward the new stream channel. Outside of the stream valley, the existing stream shall be filled and graded consistent with surrounding ground elevation, so that it drains toward the new valley.
2. All profile elevations represent the finished grades for the project. The proposed thalweg represents the finished grade of pools and riffles, including the rock material placed in the riffles. The proposed bankfull and beltwidth represents the finished grade of the valley, include the placement of 1.0' of topsoil.
3. All proposed contours in the stream plan view represent the finished valley grade for the project, including the placement of 1.0' of topsoil. These contours do not show the grading required to construct the stream channel. The Valley and Channel grading shall be constructed per the stream profile (This Sheet), Stream Staking Plan (Sheet 33–37), and the stream details provided on Sheet 12 and 13.
4. See the stream planting plan for seeding and planting details. (Sheet 14)
5. See the stream detail sheet for riffle and pool typical sections and details. (Sheet 12 and 13)
6. The proposed 4:1 slope from the beltwidth up to meet existing ground shall transition to a 10:1 slope in the areas shown on the plan view, to create a natural sloping stream corridor. These transition areas shall vary in length from 50' to 200'. The Contractor shall mark the location and lengths in the field for approval by the Construction Manager prior to excavation. The cost of this work shall be included in Item 203, Excavation.
7. Profile stationing based upon ℄ of new stream channel.
8. Pool and riffle symbols are provided only as a general indication of the location of those features. The actual location and length of these features shall be constructed per the stream profile (This Sheet) and the Stream Staking Plan. (Sheet 33–37)
9. Refer to Sheets 29–32 for details and notes regarding erosion and sediment control features.





* Approximate Limits of Rock Riffle Material. (See Sheet 13)

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM RESTORATION PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITHOPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
EXHIBIT 8A :STREAM PLAN AND PROFILES

Date	January 2010	Job No.	2009-0543
Scale	As Noted	Drawn By:	RRN

EMH&T

COLUMBUS REGIONAL AIRPORT AUTHORITY
PLANNING & ENGINEERING
4600 INTERNATIONAL GATEWAY
COLUMBUS, OHIO 43219
(614) 239-4000
(614) 238-7850 FAX

REVISIONS
MARK DATE

Notes

1. The existing stream shall be filled in per the specifications of Item 203. Embankment. This fill shall be capped with a minimum of 1.0 ' of topsoil per Item 652, Placing Stockpiled Topsoil. The fill placed within the existing stream shall be graded consistent with the stream valley so that it drains toward the new stream channel. Outside of the stream valley, the existing stream shall be filled and graded consistent with surrounding ground elevation, so that it drains toward the new valley.

2. All profile elevations represent the finished grades for the project. The proposed thalweg represents the finished grade of pools and riffles, including the rock material placed in the riffles. The proposed bankfull and beltwidth represents the finished grade of the valley, include the placement of 1.0' of topsoil.

3. All proposed contours in the stream plan view represent the finished valley grade for the project, including the placement of 1.0' of topsoil. These contours do not show the grading required to construct the stream channel. The Valley and Channel grading shall be constructed per the stream profile (this sheet), Stream Staking Plan (Sheet 33-37), and the stream details provided on Sheet 12 and 13.

4. See the stream planting plan for seeding and planting details. (Sheet 14)

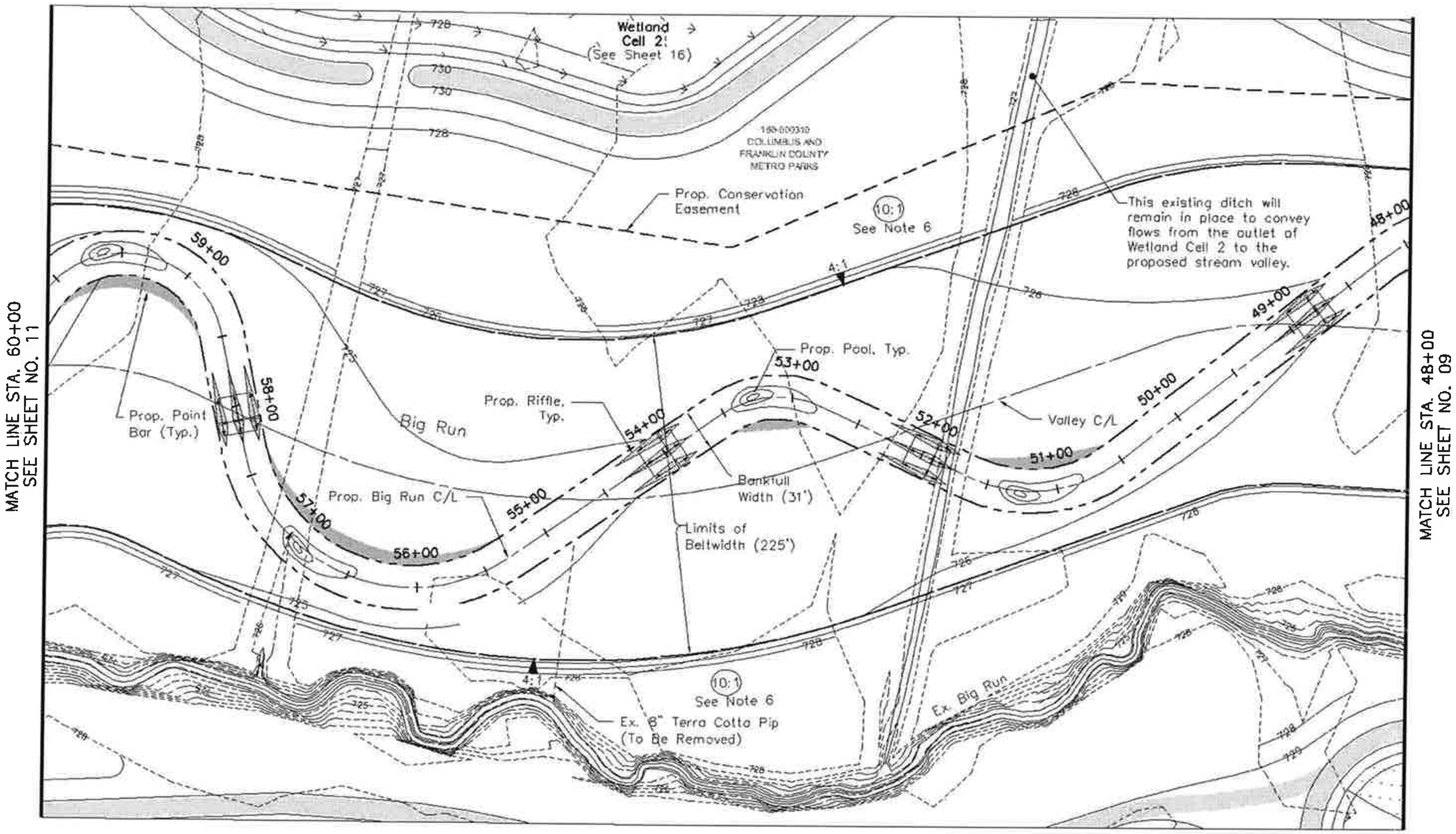
5. See the stream detail sheet for riffle and pool typical sections and details. (Sheet 12 and 13)

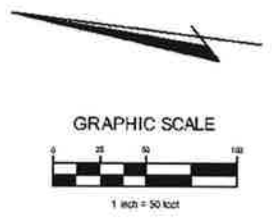
6. The proposed 4:1 slope from the beltwidth up to meet existing ground shall transition to a 10:1 slope in the areas shown on the plan view, to create a natural sloping stream corridor. These transition areas shall vary in length from 50' to 200'. The Contractor shall mark the location and lengths in the field for approval by the Construction Manager prior to excavation. The cost of this work shall be included in Item 203, Excavation.

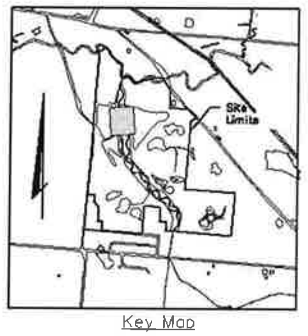
7. Profile stationing based upon ℄ of new stream channel.

8. Pool and riffle symbols are provided only as a general indication of the location of those features. The actual location and length of these features shall be constructed per the stream profile (This Sheet) and the Stream Staking Plan (Sheet 33-37)

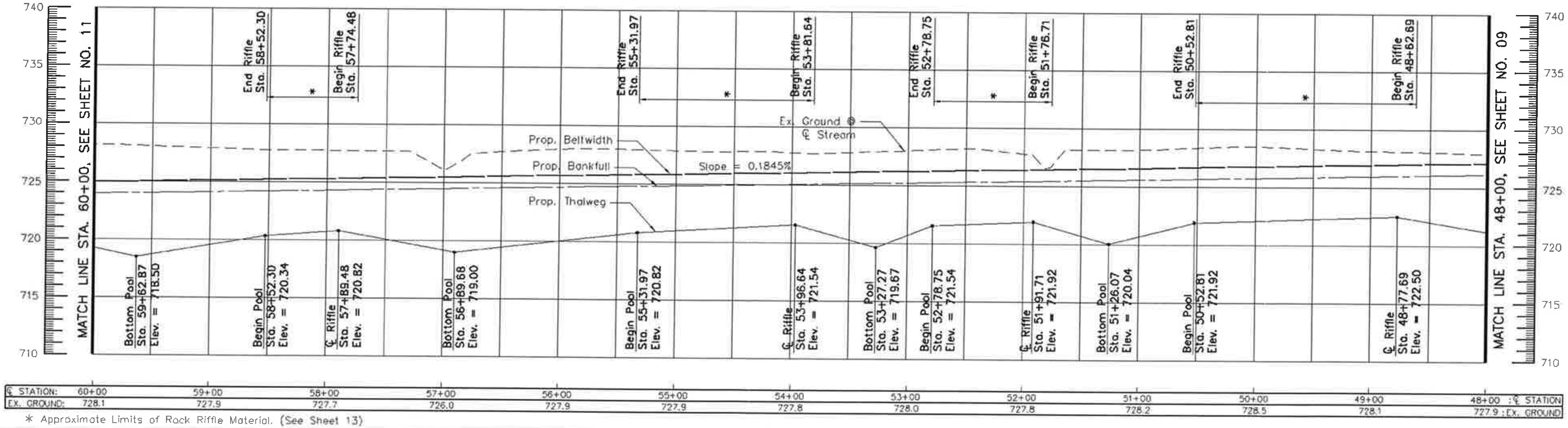
9. Refer to Sheets 29-32 for details and notes regarding erosion and sediment control features.







Key Map



* Approximate Limits of Rock Riffle Material. (See Sheet 13)

REVISIONS

MARK	DATE

COLUMBUS REGIONAL AIRPORT AUTHORITY
PLANNING & ENGINEERING
4600 INTERNATIONAL GATEWAY
COLUMBUS, OHIO 43219
(614) 239-4000
(614) 238-7850 FAX

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone 614 775 4500 Toll Free 888 775 3648
emht.com

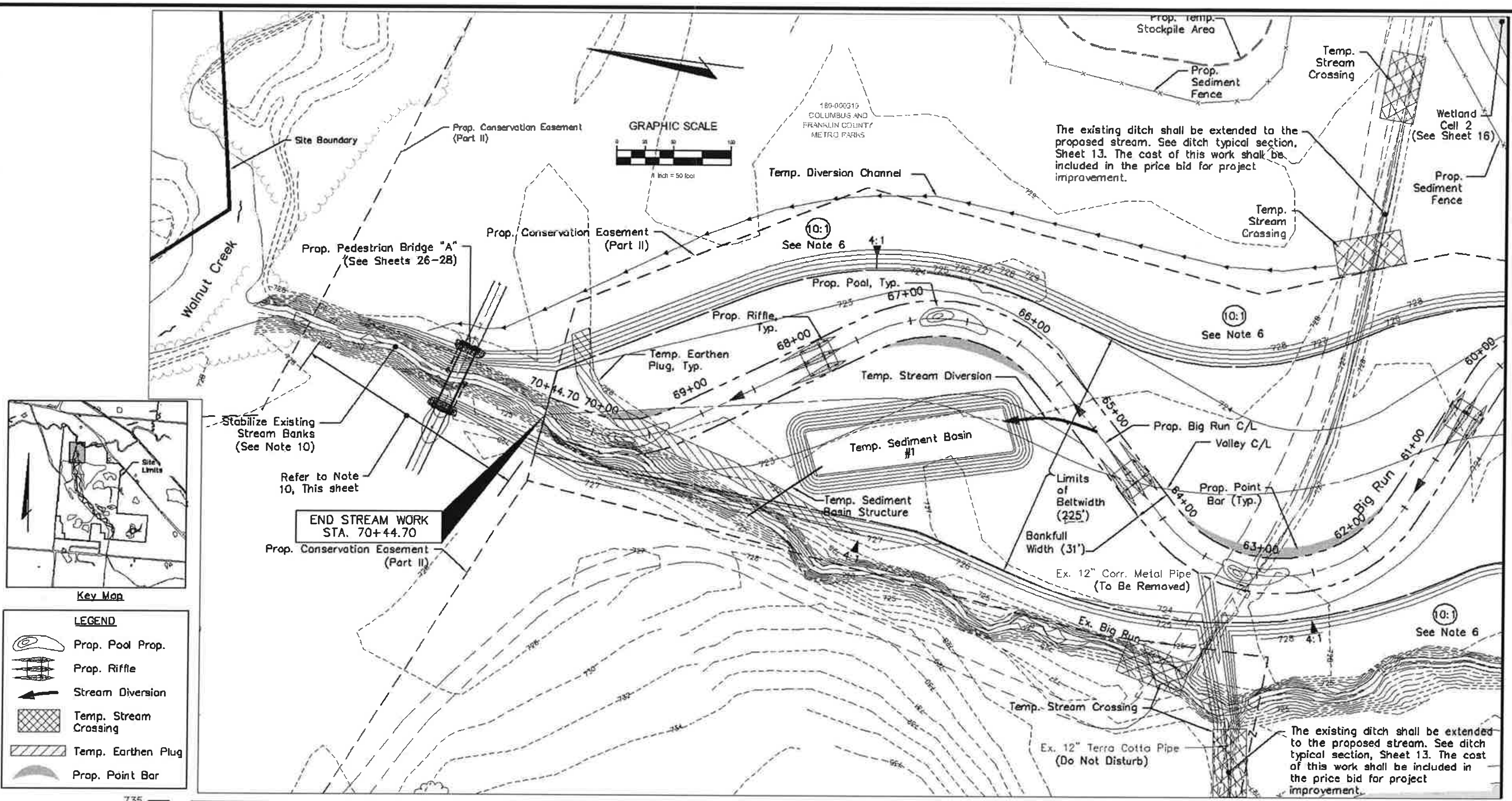
COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM RESTORATION PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITOHPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
EXHIBIT 8B: STREAM PLAN AND PROFILES

Date	Job No.
January, 2010	2009-0543
Scale	Drawn By:
Horiz: 1" = 50' Vert: 1" = 5'	RRN

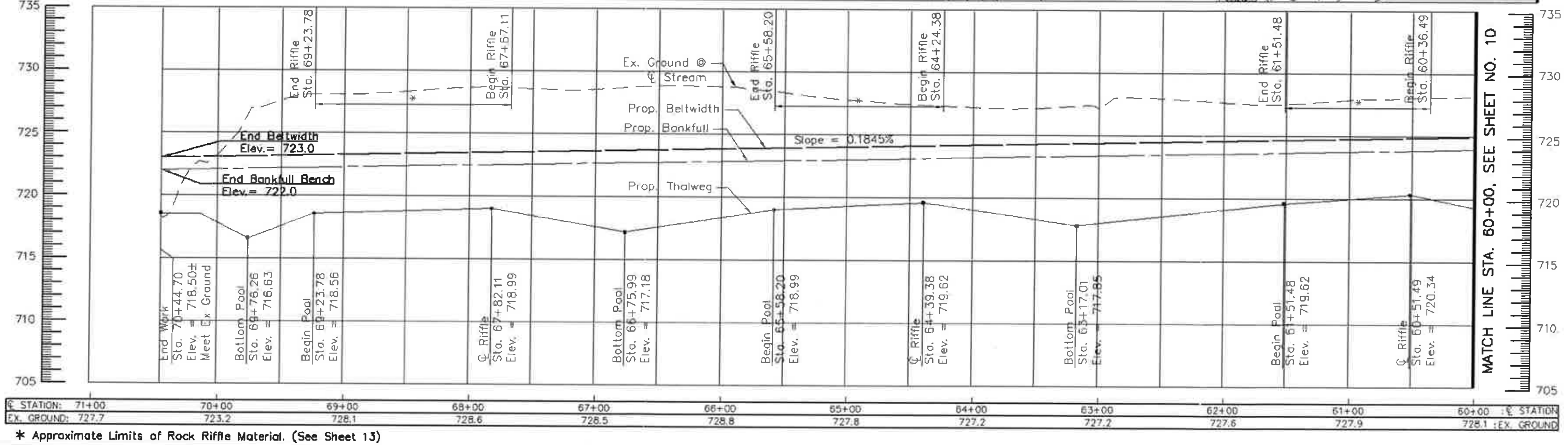
\\CMHDATA01\Project01\20090543\20090543env\Dwg\Sheets\Exhibits\CRAA Permit 11-17-09(11x17)\Exhibit 8B.dwg<10 Stream Plan and Profiles> - 2 Xrefs: [\\CMHDATA01\Project01\20090543\20090543env\Dwg\Xrefs\90543XBS-2009.dwg, Auditors-2009 NEW.dwg] - No Images - SavedBy: JCRAMER [2/1/2010 4:01:43 PM] - PlottedBy: JCRAMER [2/3/2010 1:57:04 PM]

Notes

1. The existing stream shall be filled in per the specifications of Item 203, Embankment. This fill shall be capped with a minimum of 1.0 ' of topsoil per Item 652, Placing Stockpiled Topsoil. The fill placed within the existing stream shall be graded consistent with the stream valley so that it drains toward the new stream channel. Outside of the stream valley, the existing stream shall be filled and graded consistent with surrounding ground elevation, so that it drains toward the new valley.
2. All profile elevations represent the finished grades for the project. The proposed thalweg represents the finished grade of pools and riffles, including the rock material placed in the riffles. The proposed bankfull and beltwidth represents the finished grade of the valley, include the placement of 1.0' of topsoil.
3. All proposed contours in the stream plan view represent the finished valley grade for the project, including the placement of 1.0' of topsoil. These contours do not show the grading required to construct the stream channel. The Valley and Channel grading shall be constructed per the stream profile (This Sheet), Stream Staking Plan (Sheet 33–37), and the stream details provided on Sheet 12 and 13.
4. See the stream planting plan for seeding and planting details. (Sheet 14)
5. See the stream detail sheet for riffle and pool typical sections and details. (Sheet 12 and 13)
6. The proposed 4:1 slope from the beltwidth up to meet existing ground shall transition to a 10:1 slope in the areas shown on the plan view, to create a natural sloping stream corridor. These transition areas shall vary in length from 50' to 200'. The Contractor shall mark the location and lengths in the field for approval by the Construction Manager prior to excavation. The cost of this work shall be included in Item 203, Excavation.
7. Profile stationing based upon ℄ of new stream channel.
8. Pool and riffle symbols are provided only as a general indication of the location of those features. The actual location and length of these features shall be constructed per the stream profile (This Sheet) and the Stream Staking Plan. (Sheet 33–37)
9. Refer to Sheets 29–32 for details and notes regarding erosion and sediment control features.
10. The existing eroded stream banks between the end of the proposed stream restoration and Walnut Creek shall be laid back and stabilized. Any existing stream bank that has a slope greater than a 2:1 shall be laid back to a finished slope less than 2:1. The disturbed areas shall be stabilized with the Native Grass Seeding and Mulching within 24 hours of completing the final grade on the stream bank. See sheet 14 for the Native Grass Custom Seed mix and specifications. The cost of this work has been included in Item 203, Excavation and Item SPEC, Native Grass Seeding and Mulching.



MATCH LINE STA. 60+00
SEE SHEET NO. 10



* Approximate Limits of Rock Riffle Material. (See Sheet 13)

MARK	DATE	REVISIONS

COLUMBUS REGIONAL AIRPORT AUTHORITY
PLANNING & ENGINEERING
4600 INTERNATIONAL GATEWAY
COLUMBUS, OHIO 43219
(614) 239-4000
(614) 238-7850 FAX:

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
emht.com

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM RESTORATION PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITHOPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
EXHIBIT 8C: STREAM PLAN AND PROFILES

Date	Job No.
January, 2010	2009-0543
Scale Horiz: 1" = 50' Vert: 1" = 5'	Drawn By: RRN

ROCK RIFFLES:

Only imbedded (not visible) support and crest stone may be quarried limestone material. No construction rubble is permissible. All other material used to construct the rock riffle (all visible rock) shall be river rock, consisting of rounded stone with natural hues. The Contractor shall review samples of this material with the Construction Manager for approval prior to installation. See Riffle Materials Table for descriptions and sizes of materials.

1.0 CREST STONE

The crest stone shall be placed to the elevation shown and labeled on the stream profile. The crest elevation must pool water back to the base of the upstream riffle/run.

Installation:
The crest elevation must be determined and the center weir stone installed first. Trench into the stream bed approximately 1.5 feet and place the stone(s) so that the center weir stone reaches the crest elevation. Trench and install the remaining crest stones across the stream, elevating them into the banks the specified distance. Finished elevations of the crest stone must concentrate flows through the center of the riffle.

2.0 SUPPORT STONE

Installation:
Support stone must be placed tightly on both sides of the crest stone paying close attention to fit on the downstream side. Proper elevation of the support stone must be maintained and must be as high as the crest stone. Ten (10) feet downstream of the crest stone the support stone will be laid more loosely to create turbulence of flow across the riffle. At this point, the stone should start to become trenched into the streambed. At the end of the riffle, the support stone will be trenched fully into the stream bed to a depth of approximately 1.5 feet. Finished elevations of the support stone must concentrate flows across the center of the riffle and create non-laminar (turbulent) flow. Support stones will continue up the banks to the final elevation. Support stone will be trenched into the banks to support the crest stone.

3.0 FILL STONE

Installation:
After the installation of the larger crest and support stones, fill all voids with Fill Stone and compact with an excavator bucket. Final grading and transition with the upper bank area can be accomplished using this stone size.

4.0 PAYMENT

The cost of all labor and materials associated with the construction of rock riffles as shown on this plan, including crest, support and fill stone, shall be included in the price bid for Item Spec., Rock Riffle, As Per Plan.

BOULDER TOE:

1.0 Material:
The boulder toe material may consist of quarried limestone (no construction rubble is permissible). The Contractor shall review samples of this material with the Construction Manager for approval prior to installation. The size of this material shall be consistent with the gradation of Type 'C' Rock Channel Protection, per ODOT Item 601.

2.0 Installation:
The boulder toe material shall be imbedded into the channel bottom and channel bank to the minimum depths shown on Detail 'C'. Filter fabric material per ODOT Item 712.09, Type B, shall be included in the construction of the boulder toe reinforcement, as demonstrated on Detail 'C'. Over-excavation of the channel bank to install the boulder toe reinforcement shall be backfilled with compactable material that is placed in lifts and graded to conform to the designed channel bank, and reinforced with the geotextile material specified by this plan.

3.0 Payment:
The cost of all labor and materials associated with the placement of Boulder Toe, shall be included in the price bid for Item Spec., Boulder Toe, As Per Plan.

COIR ROLL:

1.0 Material:
Rolls shall consist of biodegradable material 16 inches in diameter with a density of 7 lbs./cu.ft. The coir roll outer netting shall consist of a bristle coir twine with a breaking strength of 90 lbs. Hardwood stakes to anchor the coir rolls shall be 2"x2"x36" in size. The specified length is a minimum and may need to be adjusted to allow for sufficient anchoring.

The Contractor may use coir rolls manufactured by RoLanka Products (800) 760-3215, or approved equal.

2.0 Installation:
Refer to Detail 'A' for a schematic of the location of the coir roll material along the channel and Detail 'C' for a schematic of the location of the coir rolls with respect to the other bank reinforcement materials.

The coir rolls shall be installed after the boulder toe material is in place. The upstream and downstream ends of the coir roll shall be bent back into the channel bank to prevent stream flow from cutting behind the Rolls. The ends of abutting coir rolls shall be tied together with twine. Hardwood stakes shall be driven into the native, undisturbed soil behind the Rolls. The Rolls shall be tied to the stakes with twine. Stakes shall be placed at the beginning and end of each Roll and at a maximum spacing of 2 feet.

3.0 Payment:
The cost of all labor and materials associated with the installation of the coir rolls and stakes shall be included in the price bid for Item Spec., Coir Roll, As Per Plan.

LIVE STAKES:

1.0 Material:
Live stake material shall be dormant and gathered locally (within or in proximity to the project site) or purchased from a reputable commercial supplier. The Contractor may use live stakes supplied by Ernst Conservation Seeds (800) 873-3321, or approved equal. This material shall be planted only during its natural dormancy period, extending from late fall through early spring. Stakes shall be 1/2 to 2 inches in diameter, 2 to 3 feet in length, and living based on the presence of young buds and green bark. Prior to installation, the stakes shall be cut so that they are angled on the bottom and flush on the top.

All harvested or purchased live stake material shall be preserved in a cool, moist environment until installation. Plant material that has been allowed to dry out or is not preserved in a dormant state prior to installation shall be discarded.

See Stream Planting Plan for Material List.

2.0 Installation:
Refer to Detail 'A' for a schematic of the location of the live stakes along the channel and Detail 'C' for a schematic of the location of the live stakes with respect to the other bank reinforcement materials.

Live stakes shall be installed in two (2) rows, with 2.0-foot spacing between the stakes. Three-fourths of the stake is to be imbedded within the channel bank. The angle of the imbedded stake to the channel bank shall be between 30 and 60 degrees. When installed, at least two (2) buds should remain above the ground surface and those buds shall be oriented upwards.

Live stakes that split or become bent or broken during installation shall be removed from the channel bank and discarded.

3.0 Payment:
The cost of all labor and materials associated with the installation of live stakes shall be included in the price bid for Item Spec., Stream Planting, As Per Plan.

STOCKPILE COBBLE MATERIAL:

Remove and stockpile any available cobble stream bed material through the reach of the existing stream channel to be excavated/relocated. Stockpiled material shall be replaced within the excavated/relocated stream bed upon completion. Cost of this work to be included in the price bid for the various related items.

GEOTEXTILES:

The specified geotextile shall meet the specifications identified on this plan, unless otherwise approved by the Construction Manager.

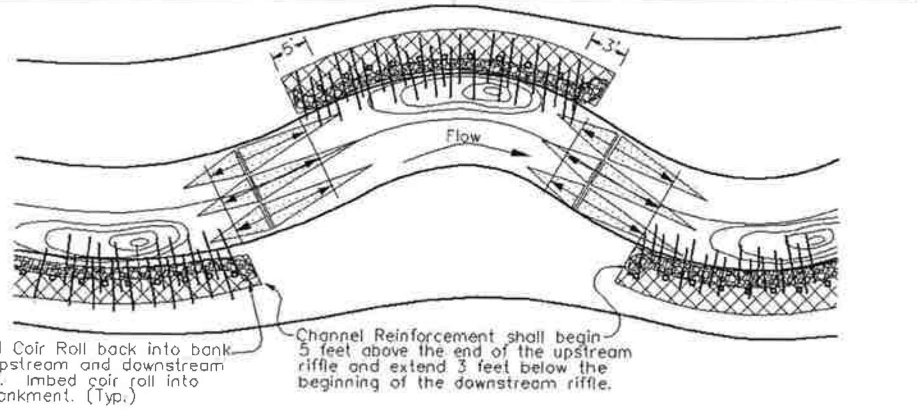
Geotextile shall be placed in accordance with ODOT CMS Item 671, and manufacturer's recommendations.

The geotextile Rolls shall be furnished with suitable wrapping for protection against moisture and extended ultraviolet exposure prior to placement. Each Roll shall be labeled or tagged to provide product identification sufficient for field inventory and quality control purposes. Rolls shall be stored in a manner which provides identification, as well as protection from the elements. If stored outdoors, the Rolls shall be elevated and protected with a waterproof cover.

INSTALLATION:

- Over-excavation of the channel bank may be necessary to accomplish the installation of the boulder toe protection. The boulder toe protection shall be imbedded into the bottom of the channel to the depth specified on Detail C, this sheet.
- The live stakes shall be placed on top of the imbedded boulder toe material protruding into the native, undisturbed soil of the channel bank.
- Soil material, including the specified topsoil, shall be placed to backfill the over-excavated channel bank.
- The specified seeding shall be applied to the disturbed/restored soil material.
- The first (lowest) row of the geotextile material shall be anchored to the restored soil material.
- The coir roll material shall be installed and secured with the hardwood stakes protruding into the native, undisturbed soil of the channel bank.
- Any remaining rows of geotextile material shall be installed and anchored to the channel bank, with the last (highest) row "trenched" into the bank.

RIFFLE MATERIAL TABLE			
I.D.	DESCRIPTION	SIZE	% OF RIFFLE VOLUME
Crest Stone	Stone to establish the crest and footing of the Riffle	Rock Channel Protection, Type C Type C shall consist of sizes such that at least 85 percent of the total material by weight shall be larger than 6 inches but less than an 18-inch square opening. At least 50 percent of the total material by weight shall be larger than 12-inch square opening.	30%
Support Stone	Stone to transition upstream and down stream of the crest	Rock Channel Protection, Type D Support Stone shall have a gradation of sizes such that at least 85% of the material by weight shall be between 4" and 8" in diameter, 50% of which shall be larger than 6" in diameter.	50%
Fill Stone	Stone that fills the voids between the larger stone; Cobble- rounded river rock	Fill stone shall have a gradation of sizes such that at least 85% of the material by weight shall be between 1" and 6" in diameter, 50% of which shall be larger than 3" in diameter.	20%

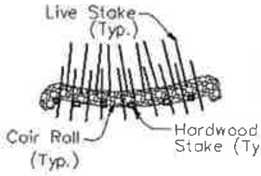


TYPICAL GEOTEXTILE LOCATION PLAN- DETAIL 'A'

Not to Scale

LEGEND

▦	Limits of boulder toe, coir roll, and geotextile reinforcement**; refer to Detail "C". (This Sheet).
⋙	Riffle-Run Complex
⬭	Pool

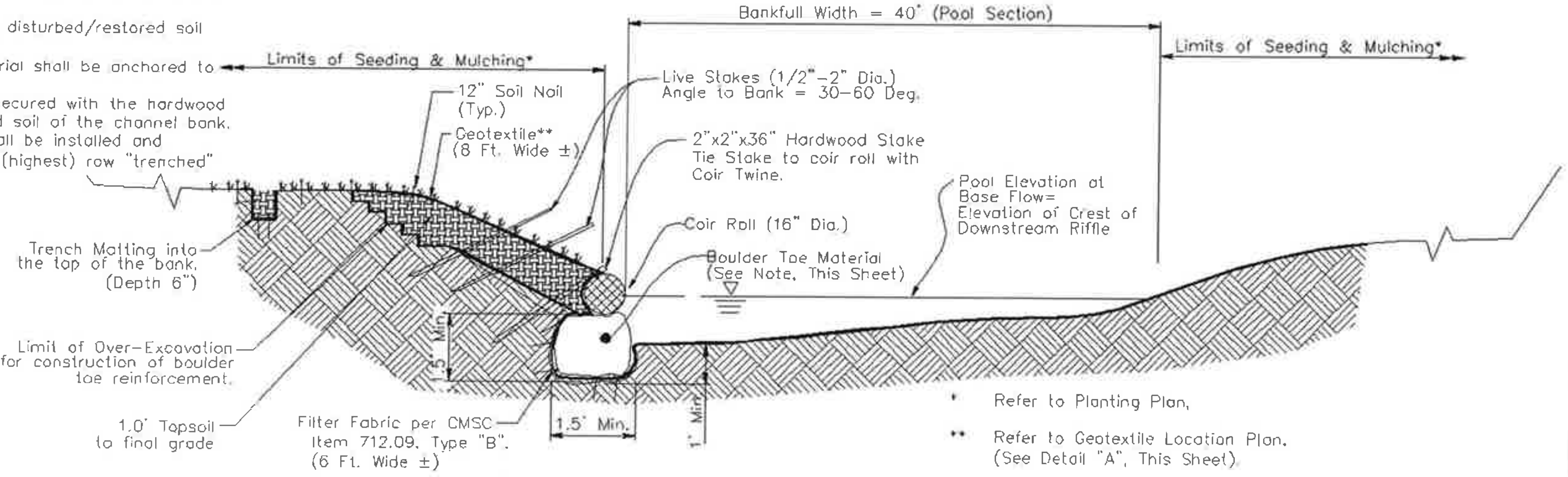


Limits of boulder toe, coir roll & live stakes.

NOTES

** Geotextile shall be an Erosion Control Mat, Type C per 712.11 or approved equivalent:

- 70% Straw/30% Coconut Fiber
- Photodegradable Polypropylene Netting



* Refer to Planting Plan.

** Refer to Geotextile Location Plan. (See Detail "A", This Sheet).

CHANNEL REINFORCEMENT DETAIL - DETAIL 'C'

Not to Scale

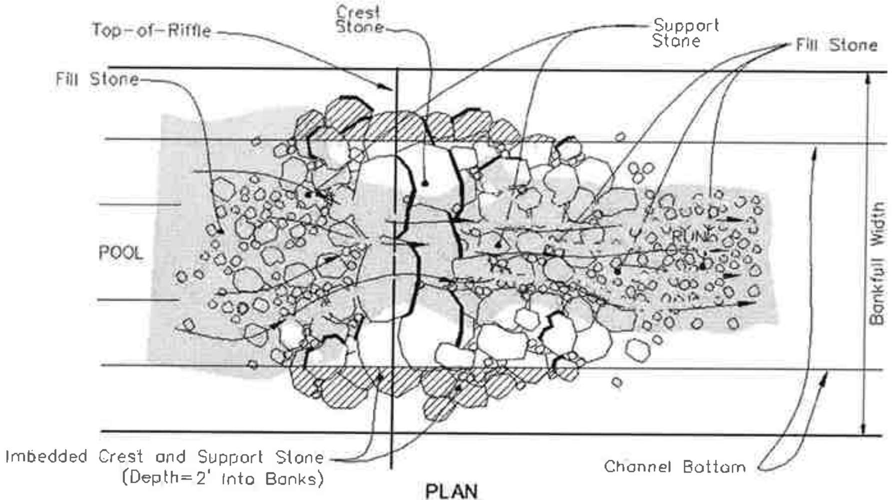
MARK	DATE	REVISIONS

COLUMBUS REGIONAL AIRPORT AUTHORITY
PLANNING & ENGINEERING
4600 INTERNATIONAL GATEWAY
COLUMBUS, OHIO 43219
(614) 239-4000
(614) 238-7850 FAX

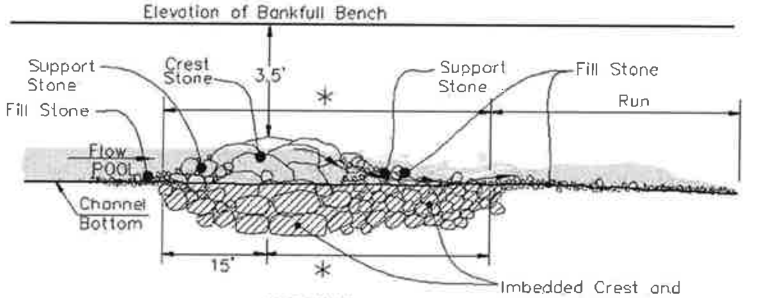
EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
emht.com

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM RESTORATION PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITHOPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
EXHIBIT 9A: STREAM ENGINEERING DETAILS

Date January, 2010	Job No. 2009-0543
Scale Not to Scale	Drawn By GDT

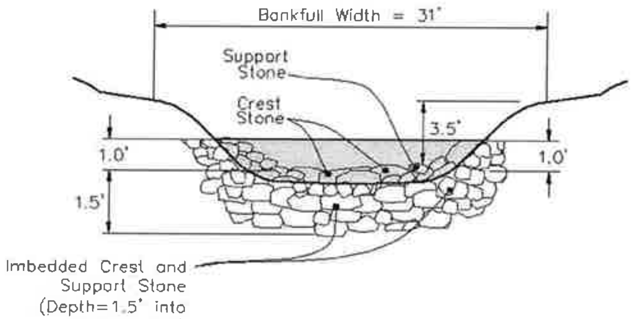


PLAN



PROFILE

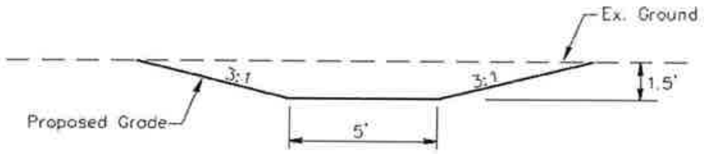
* See Stream Profile for Riffle Lengths



SECTION

ROCK RIFFLE DETAIL - DETAIL 'B'

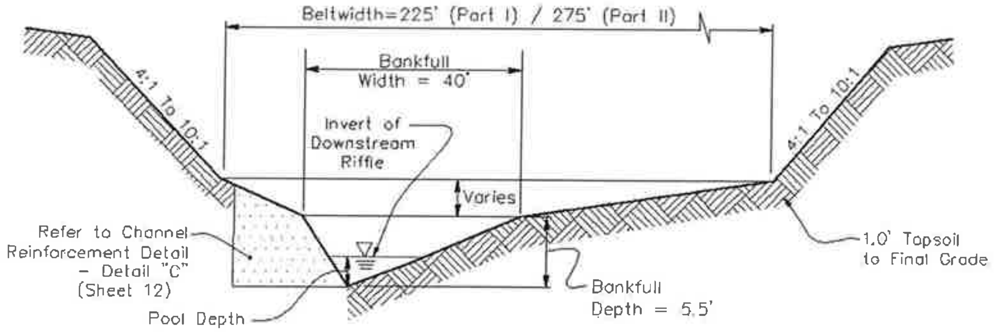
Not to Scale



DITCH TYPICAL SECTION

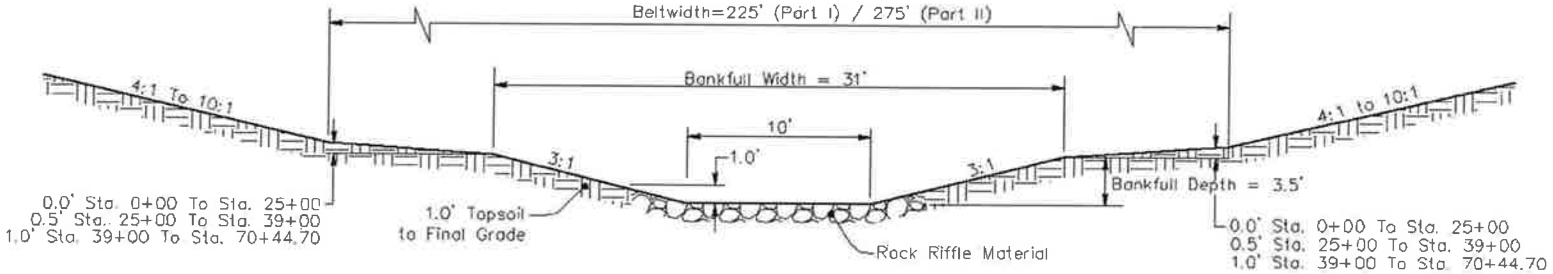
Not To Scale

NOTE:
The proposed ditch shall be stabilized with Native Grass Seeding and Mulching immediately after construction. See Native Grass Seeding specifications on sheet 2 and seeding table on sheet 14.



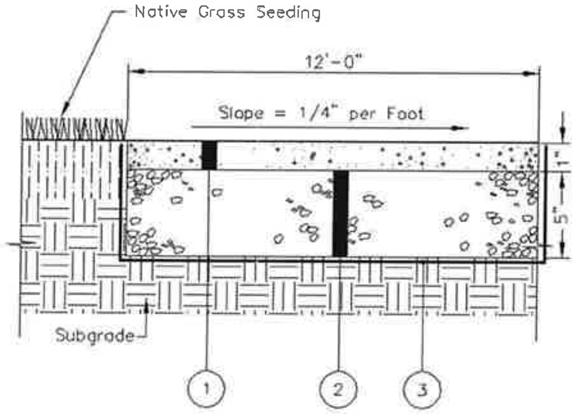
TYPICAL POOL SECTION (See Detail 'C', Sheet 12)

Not to Scale



TYPICAL RIFFLE SECTION (See Detail 'B')

Scale: 1"=5'



① #10 Limestone Screenings with Dust Surface Course

② No. 57 Limestone Compacted

③ Filter Fabric, Type B

PEDESTRIAN PATH DETAIL

Not To Scale

REVISIONS

MARK	DATE	

COLUMBUS REGIONAL AIRPORT AUTHORITY
PLANNING & ENGINEERING
4600 INTERNATIONAL GATEWAY
COLUMBUS, OHIO 43219
(614) 239-4000
(614) 238-7850 FAX

EMH&T
emht.com

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM RESTORATION PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITOHPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
EXHIBIT 9B: STREAM ENGINEERING DETAILS

Date: January, 2010
Job No.: 2009-0543
Scale: As Noted
Drawn By: GDT

STREAM PLANTING ZONES

■ – Zone 1 – Outside Meander

Live Stakes

Common Name	Scientific Name
Silky dogwood	*Cornus amomum*
Red-osier dogwood	*Cornus sericea*
Peachleaved willow	*Salix amygdaloides*
Pussy willow	*Salix discolor*
Sandbar willow	*Salix interior*
Black willow	*Salix nigra*
Silky Willow	*Salix sericea*
Ninebark	*Physocarpus opulifolius*

▨ – Zone 2 – Streamside Shrubs & Trees

Shrubs

Common Name	Scientific Name
Black chokeberry	*Aronia melanocarpa*
Rough leaf dogwood	*Cornus drummondii*
Gray dogwood	*Cornus racemosa*
Red-osier dogwood	*Cornus sericea*
Smooth alder	*Alnus serrulata*
Southern arrowwood	*Viburnum dentatum*
Blackhaw	*Viburnum prunifoluim*
Elderberry	*Sambucas canadensis*
American hazelnut	*Corylus americana*

Trees

Common Name	Scientific Name
Cockspur hawthorne	*Crataegus crus-galli*
Shellbark hickory	*Carya laciniosa*
Swamp white oak	*Quercus bicolor*
Slippery elm	*Ulmus rubra*
Tulip tree	*Liriodendron tulipifera*
Sycamore	*Platanus occidentalis*
Eastern cottonwood	*Populus deltoides*
Black cherry	*Prunus serotina*
Swamp white oak	*Quercus bicolor*
Pin oak	*Quercus palustris*

○ =Balled and burlap trees

* Balled and burlap trees to be minimum 1" caliper diameter. #10 or #15 containerized trees may be substituted. Park grade trees may be used.

Balled and burlap trees to be planted at pools, 2 trees per pool, 5' from edge of bank, 1 tree per side (see plan view locations). Contractor to mark planting locations after construction of pools for approval by Construction Manager.

Remaining portion of Zone planted with 3-gallon trees as specified in stream planting table.

░ – Zone 3 – Floodprone Area/Buffer

Trees

Common Name	Scientific Name
Red maple	*Acer rubrum*
Sugar maple	*Acer saccharum*
Common hackberry	*Celtis occidentalis*
Eastern redbud	*Cercis canadensis*
Cockspur hawthorne	*Crataegus crus-galli*
Tulip tree	*Liriodendron tulipifera*
Black cherry	*Prunus serotina*
Shagbark hickory	*Carya ovata*
Red oak	*Quercus rubra*
Bur oak	*Quercus macrocarpa*
Pin oak	*Quercus palustris*
Slippery elm	*Ulmus rubra*
Beech	*Fagus gandifolia*
Black walnut	*Juglans nigra*
Black gum	*Nyssa sylvatica*
Pignut hickory	*Carya glabra*
White oak	*Quercus alba*

STREAM PLANTING TABLE

ZONE	MATERIAL	DENSITY	SPECIES	QUANTITY	
				PART I	PART II
Zone 1	Live Stakes	2 rows with 2' spacing	7	3,380	5,260
Zone 2	3 Gallon Shrubs 3 Gallon Trees Balled & Burlap Trees*	20'x20' Centers 20'x20' Centers 2 per pool as indicated	7 7 7	1,268 1,268 18	2,247 2,247 30
Zone 3	3 Gallon Trees	16'x16' Centers	10	442	837

The species column designates the minimum number of species that shall be selected from each planting list.

NATIVE GRASS SEEDING TABLE

TYPE			APPLICATION RATES	APPLICATION DATES
OVER SEED:				
Annual Rye (Grain) or	*(Lolium multiflorum)*		40 lbs/acre	March – October
Winter Rye (Grain) or	*(Secale cereale)*		40 lbs/acre	October – February
Oats (Grain)	*(Avena sativa)*		15 lbs/acre	March – October
PERMANENT SEED: Native Grass Custom Seed Mix:				
Common Name	Scientific Name	Percentage	7 lbs/acre	October 1st – May 15th
Little bluestem	*Andropogon scoparius*	15		
Big bluestem	*Angropogon gerardii*	10		
Riverbank wild rye	*Elymus riparius*	10		
Silky wild rye	*Elymus villosus*	10		
Virginia wild rye	*Elymus virginicus*	10		
Indian grass	*Sorghastrum nutans*	10		
Switchgrass	*Panicum virgatum*	7		
Black-eyed susan	*Rudbeckia hirta*	7		
Ox-eye sunflower	*Heliopsis helianthoides*	6		
Gray-headed coneflower	*Ratibida pinnata*	4		
Cup plant	*Silphium perfoliatum*	4		
Tall white bread tongue	*Penstemon digitalis*	3		
Ohio spiderwort	*Tradescantia ohioensis*	2		
Joe pye weed	*Eupatorium fistulosum*	1		
Wild bergamot	*Monarda fistulosa*	1		

Over seed shall be applied with the permanent seed to quickly stabilize the site. This is required because the permanent seed takes much longer to germinate than the over seed.

LANDSCAPING WARRANTY

Landscaper shall warranty at least an 80% survivability of all #3 containerized shrub and tree materials for one (1) year from planting date. Any dead, dying, or diseased material shall be replaced with like material.

Landscaper shall warranty 100% of all balled and burlap and #10 and larger containerized tree materials for one (1) year from planting date. Any dead, dying, or diseased plants shall be replaced with like species.

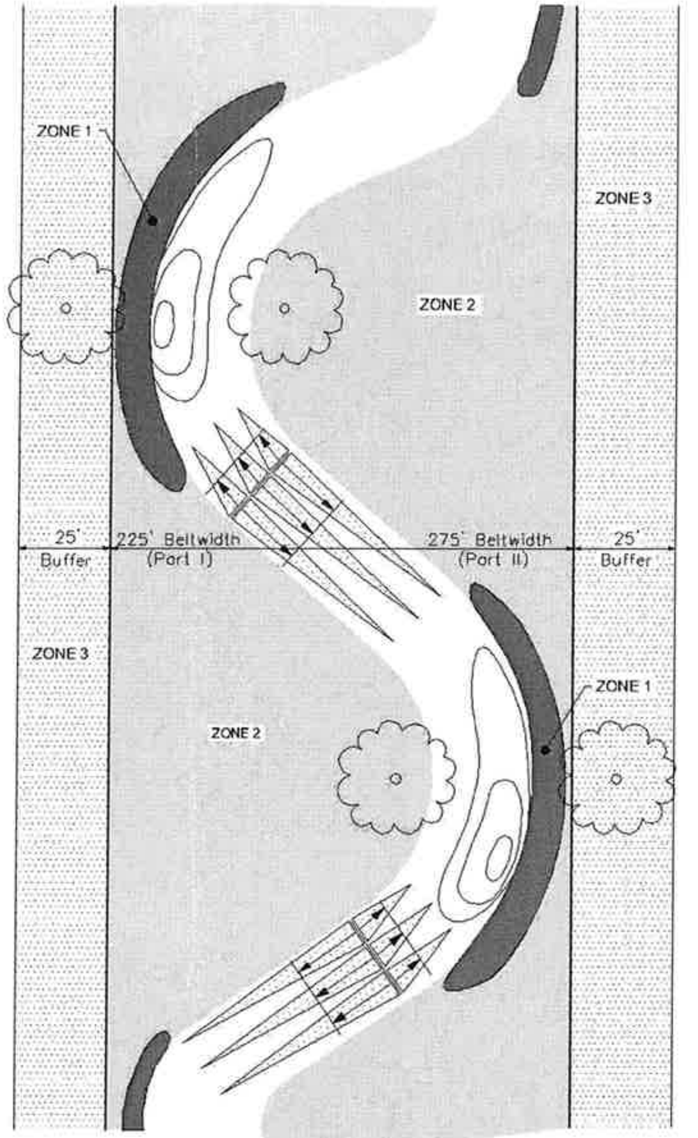
WATERING

Contractor shall insure that all material is thoroughly watered at time of planting, and once every week during the period of establishment. Sprinklers, gator bags or other such methods shall be used if rainfall is inadequate.

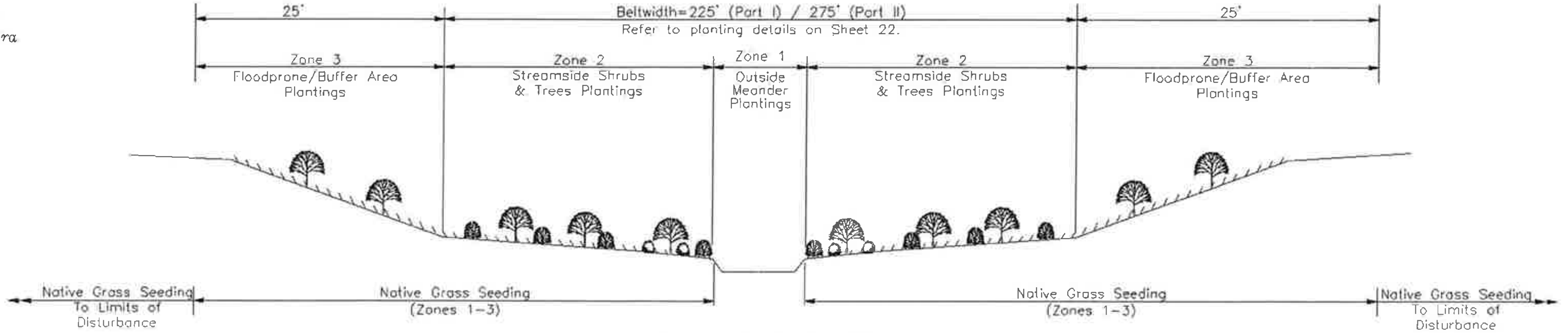
NOTES:

Final species selection will be based upon availability shall be approved in writing by the Construction Manager prior to ordering the plant material.

Permanent Seed and Over Seed to occur in Zones 1, 2, & 3 - See Table above.



PLANTING ZONES
Not to Scale



TYPICAL PLANTING SECTION
Not to Scale

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM RESTORATION PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITOHPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
EXHIBIT 10: STREAM PLANTING PLAN

Date	Job No.
January, 2010	2009-0543
Scale	Drawn By:
As Noted	GDT

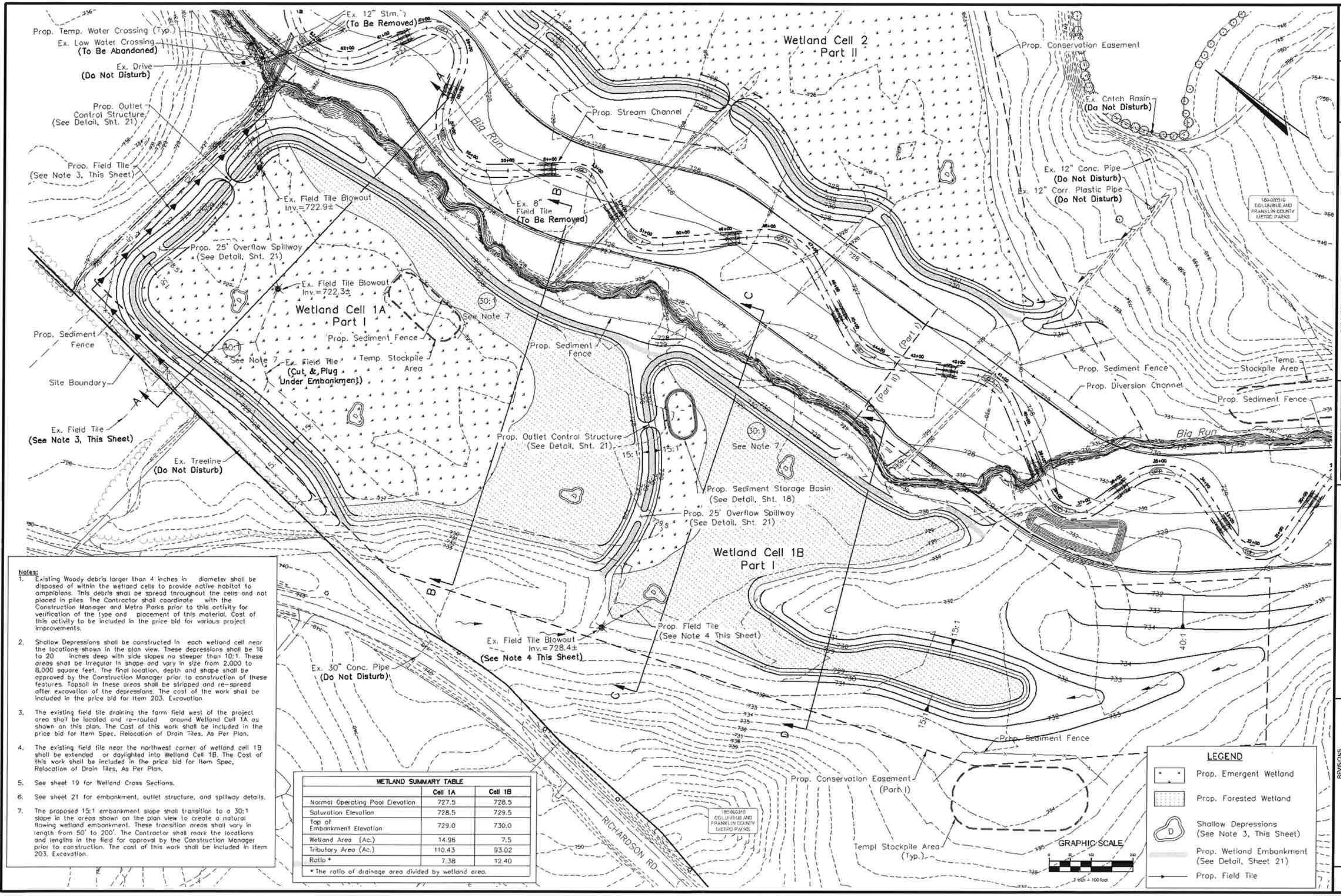
EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, Ohio 43054
Phone 614.775.4500 Toll Free 888.775.3648
emht.com

COLUMBUS REGIONAL AIRPORT AUTHORITY
PLANNING & ENGINEERING
4600 INTERNATIONAL GATEWAY
COLUMBUS, OHIO 43219
(614) 239-4000
(614) 238-7850 FAX

REVISIONS

MARK	DATE	

\\OHDATA01\Projects\2009\20090543\20090543\[illegible]\Exhibits\CRAA Permit 11-17-09\11x17\Exhibit 10.dwg<14 Stream Planting Plan> - No Xrefs - No Images - SavedBy: JCRAMER [2/3/2010 4:36:24 PM] - PlottedBy: JCRAMER [2/3/2010 5:01:44 PM]



Notes:

1. Existing Woody debris larger than 4 inches in diameter shall be disposed of within the wetland cells to provide native habitat to amphibians. This debris shall be spread throughout the cells and not placed in piles. The Contractor shall coordinate with the Construction Manager and Metro Parks prior to this activity for verification of the type and placement of this material. Cost of this activity to be included in the price bid for various project improvements.
2. Shallow Depressions shall be constructed in each wetland cell near the locations shown in the plan view. These depressions shall be 16 to 20 inches deep with side slopes no steeper than 10:1. These areas shall be irregular in shape and vary in size from 2,000 to 8,000 square feet. The final location, depth and shape shall be approved by the Construction Manager prior to construction of these features. Topsoil in these areas shall be stripped and re-spread after excavation of the depressions. The cost of the work shall be included in the price bid for Item 203, Excavation
3. The existing field tile draining the farm field west of the project area shall be located and re-routed around Wetland Cell 1A as shown on this plan. The Cost of this work shall be included in the price bid for Item Spec. Relocation of Drain Tiles, As Per Plan.
4. The existing field tile near the northwest corner of wetland cell 1B shall be extended or daylighted into Wetland Cell 1B. The Cost of this work shall be included in the price bid for Item Spec. Relocation of Drain Tiles, As Per Plan.
5. See sheet 19 for Wetland Cross Sections.
6. See sheet 21 for embankment, outlet structure, and spillway details.
7. The proposed 15:1 embankment slope shall transition to a 30:1 slope in the areas shown on the plan view to create a natural flowing wetland embankment. These transition areas shall vary in length from 50' to 200'. The Contractor shall mark the locations and lengths in the field for approval by the Construction Manager prior to construction. The cost of this work shall be included in Item 203, Excavation.

WETLAND SUMMARY TABLE

	Cell 1A	Cell 1B
Normal Operating Pool Elevation	727.5	728.5
Saturation Elevation	728.5	729.5
Top of Embankment Elevation	729.0	730.0
Wetland Area (Ac.)	14.96	7.5
Tributary Area (Ac.)	110.43	93.02
Ratio *	7.38	12.40

* The ratio of drainage area divided by wetland area.

LEGEND

∗	Prop. Emergent Wetland
▨	Prop. Forested Wetland
D	Shallow Depressions (See Note 3, This Sheet)
▬	Prop. Wetland Embankment (See Detail, Sheet 21)
→	Prop. Field Tile

MARK	DATE	REVISIONS

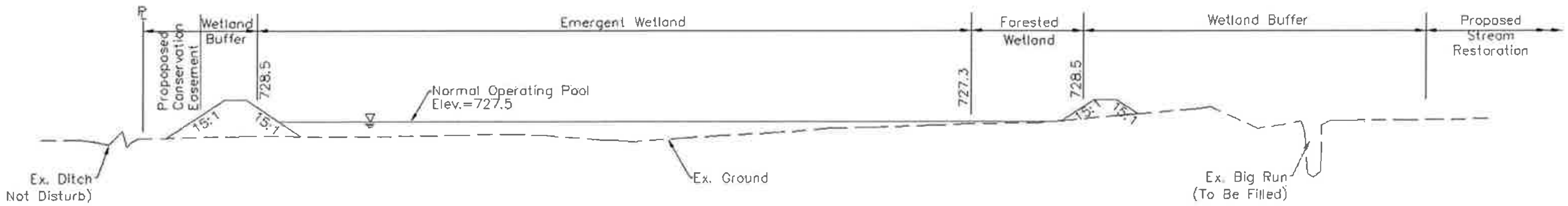
COLUMBUS REGIONAL AIRPORT AUTHORITY
PLANNING & ENGINEERING
4600 INTERNATIONAL GATEWAY
COLUMBUS, OHIO 43219
(614) 239-4000
(614) 238-7850 FAX

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
emht.com

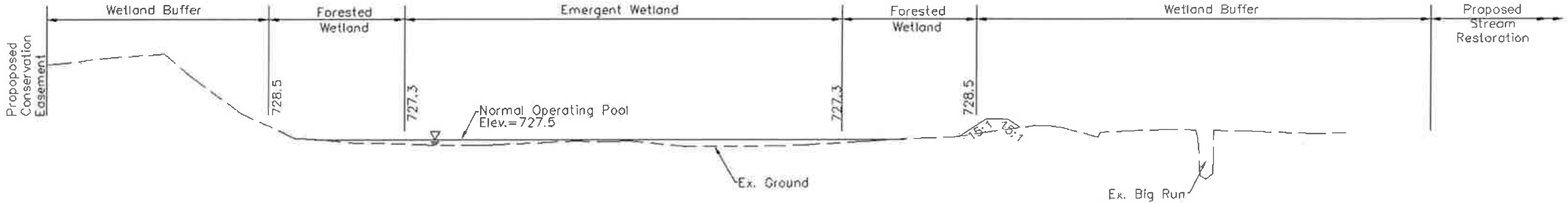
COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM RESTORATION PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITHOPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
EXHIBIT 11A: WETLAND PLAN VIEW

Date: January 2010
Job No.: 2009-0543
Scale: 1" = 100'
Drawn By: GDT

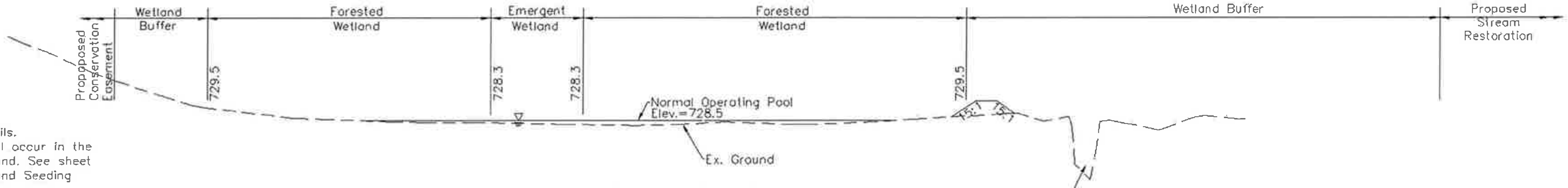
PlottedBy: JCRAMER [2/3/2010 2:02:14 PM]



Cross Section A-A Wetland Cell 1A - PART I
Scale: Horz: 1"=50'
Vert: 1"=5'

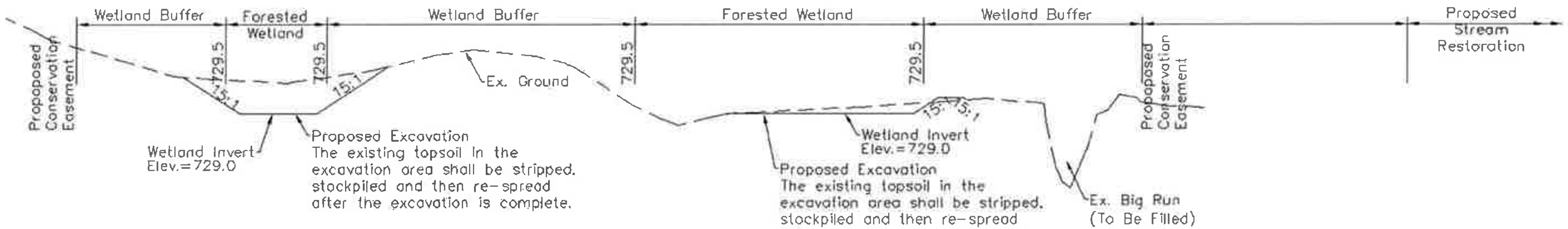


Cross Section B-B Wetland Cell 1A - PART I
Scale: Horz: 1"=50'
Vert: 1"=5'

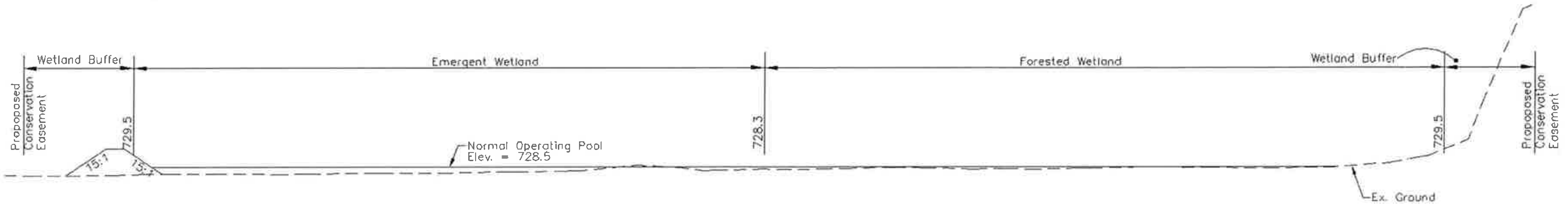


Ex. Big Run
(To Be Filled)

Cross Section C-C Wetland Cell 1B - PART I
Scale: Horz: 1"=50'
Vert: 1"=5'



Cross Section D-D Wetland Cell 1B - PART I
Scale: Horz: 1"=50'
Vert: 1"=5'



Cross Section E-E Wetland Cell 2 - PART II
Scale: Horz: 1"=50'
Vert: 1"=5'

NOTES

1. See sheet 21 for wetland embankment details.
2. Emergent Wetland Planting and Seeding shall occur in the areas shown and labeled as Emergent Wetland. See sheet 22 and 23 for Emergent Wetland Planting and Seeding specifications.
2. Forested Wetland Planting and Seeding shall occur in the areas shown and labeled Forested Wetland. See sheet 22 and 23 for Forested Wetland Planting and Seeding specifications.
3. The Emergent Wetland Buffer Planting shall occur in a 25' wide areas adjacent each of the emergent areas within wetland cells 2-7. See sheet 22 for Emergent Wetland Buffer Planting specifications.
4. The Forested Wetland Buffer Planting shall occur within a 25 foot wide buffer adjacent to the forested areas within wetland cells 1-4, and 8-9. The forested wetland buffer planting shall also occur within a 25' wide buffer area adjacent to the emergent portions of wetland cells 1A and 1B. See sheet 22 for Forested Wetland Buffer Planting specifications.
5. The Forested and Emergent Wetland Buffers shall be seeded with the Native Grass Custom Seed Mix listed on sheet 23. This seeding shall extend out to the limits of disturbance.
6. The excavated area within wetland cell 1B shall be over-excavated by approximately one foot and capped with topsoil to meet final grade.
7. The fill areas within wetland cells 8 and 9 shall be capped with one foot of topsoil to meet final grade.

Job No.	2009-0543
Date	January, 2010
Drawn By	GDT
Scale	Horiz: 1" = 50' Vert: 1" = 5'

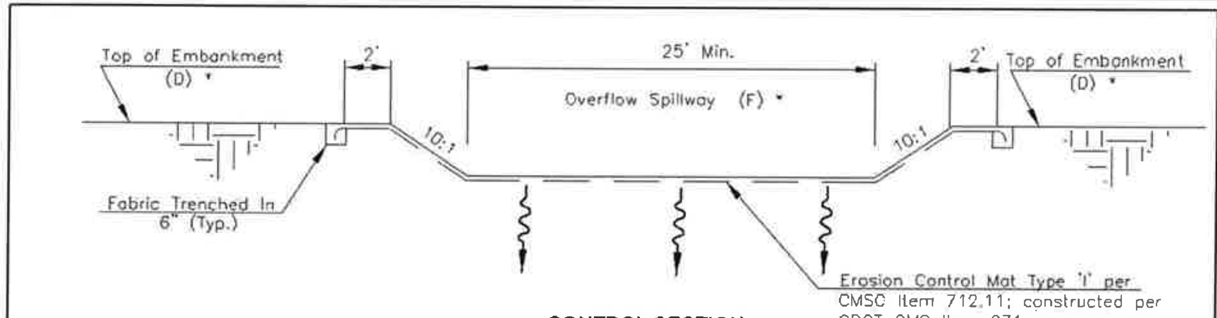
COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM RESTORATION PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITOHPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
EXHIBIT 11B: WETLAND CROSS SECTIONS

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
emht.com

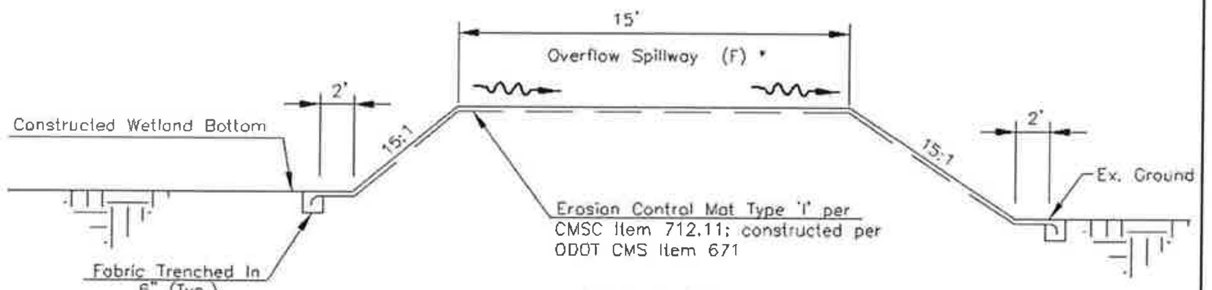
COLUMBUS REGIONAL AIRPORT AUTHORITY
PLANNING & ENGINEERING
4600 INTERNATIONAL GATEWAY
COLUMBUS, OHIO 43219
(614) 239-4000
(614) 238-7850 FAX:

REVISIONS		
MARK	DATE	

\\CMHDATA01\Project01\20090543\20090543env\Dwg\Sheets\Exhibits\CRAA Permit 11-17-09\11x17\Exhibit 11B.dwg<19 Wetland Cross Sections> - 1 Xref: [\\CMHDATA01\Project01\20090543\20090543env\Dwg\Xrefs\90543XBS-2009.dwg] - No Images - SavedBy: JCRAMER [2/3/2010 11:53:42 AM] - PlottedBy: JCRAMER [2/3/2010 2:03:45 PM]



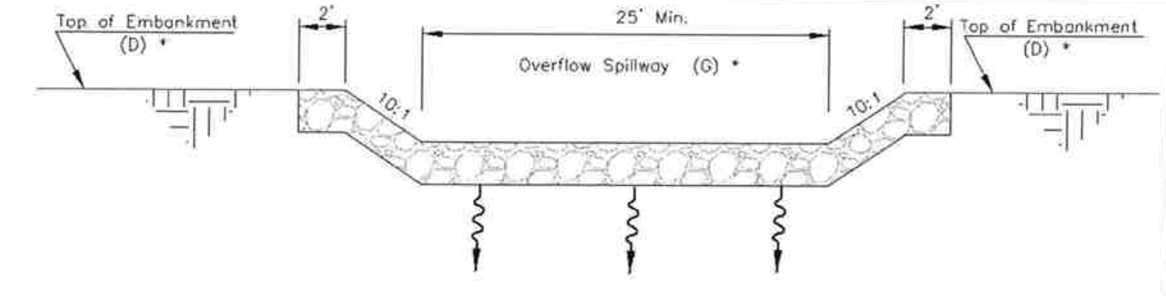
CONTROL SECTION
Not to Scale



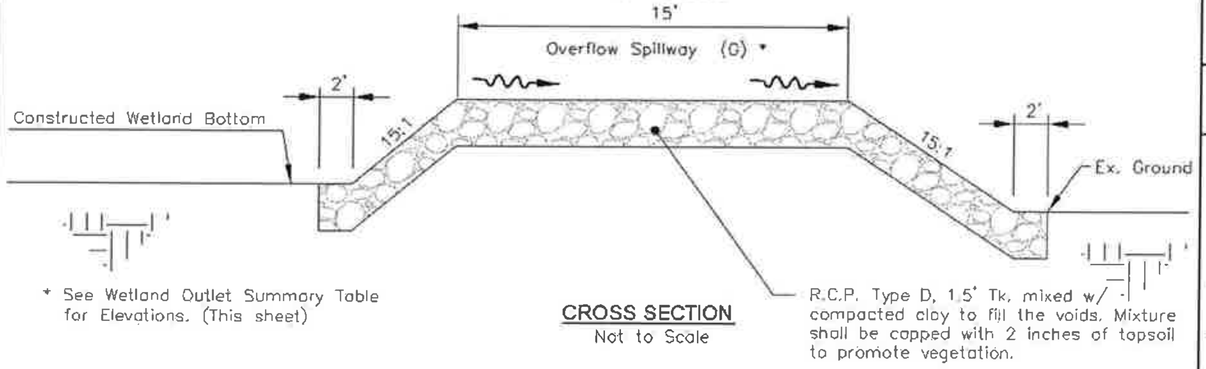
CROSS SECTION
Not to Scale

OVERFLOW SPILLWAY DETAIL
Not to Scale

* See Wetland Outlet Summary Table This Sheet for Elevations.



CONTROL SECTION
Not to Scale



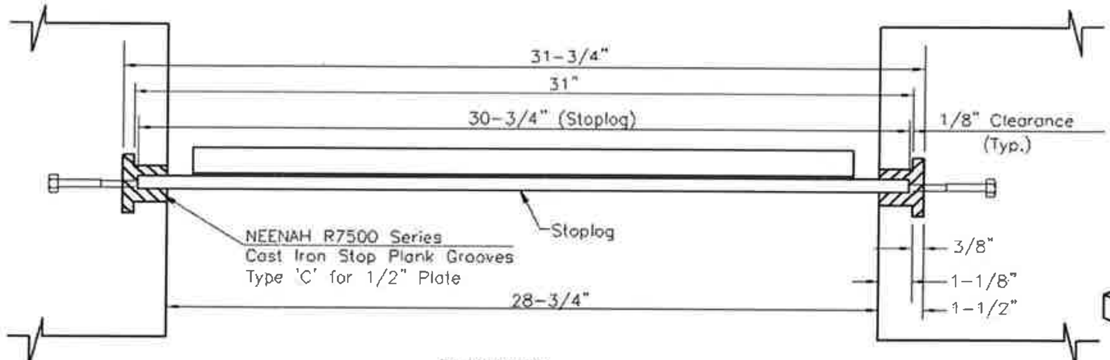
* See Wetland Outlet Summary Table for Elevations. (This sheet)

CROSS SECTION
Not to Scale

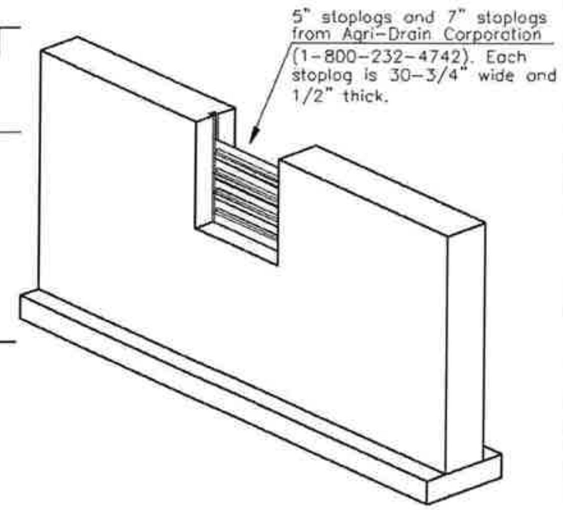
PRIMARY SPILLWAY DETAIL
Not to Scale

WETLAND OUTLET SUMMARY TABLE

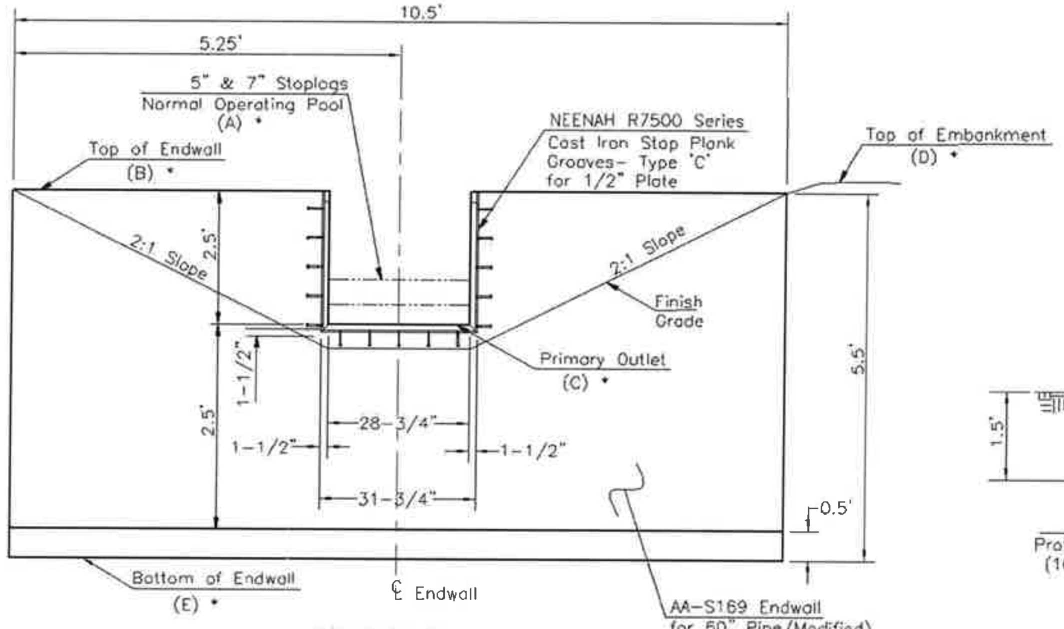
	Cell 1A	Cell 1B	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6	Cell 7	Cell 8	Cell 9
Normal Operating Pool Elev. (A)	727.5	728.5	728.5	732.5	–	–	–	–	743.5	–
Top of Endwall Elev. (B)	728.0	729.0	729.0	734.0	–	–	–	–	745.0	–
Primary Outlet Elev. (C)	726.5	727.5	727.5	731.5	–	–	–	–	742.5	–
Top of Embankment Elev. (D)	729.0	730.0	730.0	734.0	737.0	747.0	747.0	746.0	745.0	746.0
Bottom of Endwall (E)	722.5	723.5	723.5	728.5	–	–	–	–	739.5	–
Overflow Spillway Elev. (F)	728.5	729.5	729.5	733.5	736.5	746.5	746.5	745.5	744.5	745.5
Primary Spillway Elev. (G)	–	–	–	–	735.5	745.5	745.5	744.5	–	744.5



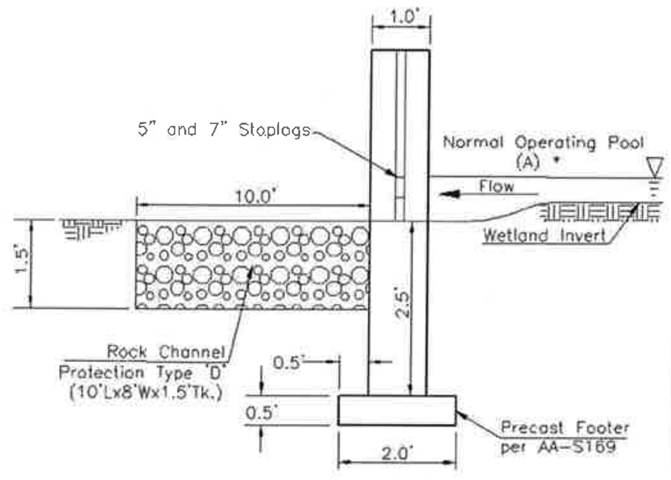
PLAN VIEW



OBLIQUE VIEW



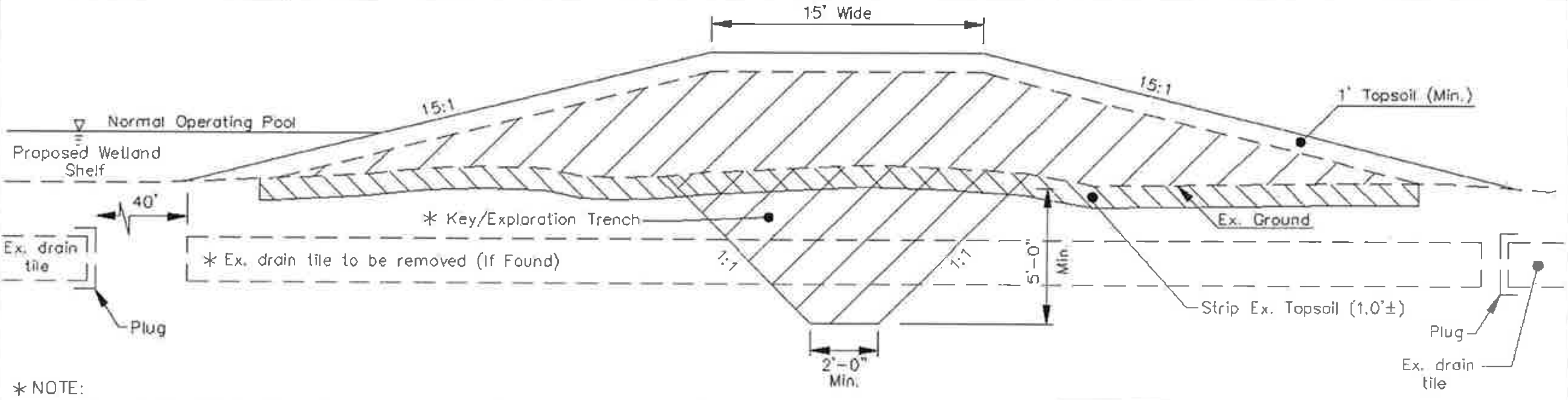
PROFILE VIEW



END VIEW

OUTLET CONTROL STRUCTURE WITH STOPLOGS DETAIL
Not To Scale

* See Wetland Outlet Summary Table This Sheet for Elevations.



* NOTE:
If a drain tile is found during construction of the Key/Exploration trench it shall be removed under the limits of the embankment and 40' into the proposed wetland. Both ends of the exposed field tile shall be plugged with suitable cohesive embankment material. Backfill remaining voids with cohesive material that is compacted to the embankment specification (Item 203).

▨ Cohesive Clay Backfill (Compacted per Embankment Specification)

EMBANKMENT AND KEY/EXPLORATION TRENCH DETAIL
Not to Scale

MARK	DATE	REVISIONS

COLUMBUS REGIONAL AIRPORT AUTHORITY
PLANNING & ENGINEERING
4600 INTERNATIONAL GATEWAY
COLUMBUS, OHIO 43219
(614) 239-4000
(614) 238-7860 FAX:

EMHT
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Toll Free: 888.775.3648
emht.com

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM RESTORATION PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITOHPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
EXHIBIT 12: WETLAND DETAILS

Date: January, 2010
Job No.: 2009-0643
Scale: As Noted
Drawn By: GDT

WETLAND PLANTING

Forested/Emergent Wetland Buffer Area

Trees (3 gal.)

Common Name	Scientific Name
Red maple	*Acer rubrum*
Sugar maple	*Acer saccharum*
Ohio buckeye	*Aesculus glabra*
Shagbark hickory	*Carya ovata*
American beech	*Fagus grandifolia*
Tulip tree	*Liriodendron tulipifera*
Black cherry	*Prunus serotina*
White oak	*Quercus alba*
Bur oak	*Quercus macrocarpa*

Shrubs (3 gal.)

Common Name	Scientific Name
Gray dogwood	*Cornus racemosa*
Spicebush	*Lindera benzoin*
Smooth rose	*Rosa blanda*
Pasture rose	*Rosa carolina*
Southern arrowwood	*Viburnum dentatum*
Rough leaf dogwood	*Cornus drummondii*
Black chokeberry	*Aronia melanocarpa*
American hazelnut	*Corylus americana*

Emergent Wetland Area ⁘

Herbs (Plugs)

Common Name	Scientific Name
American sweet flag	*Acorus americanus*
Broad-leaf water plantain	*Alisma subcordatum*
Swamp milkweed	*Asclepias incarnata*
Panicled aster	*Aster lanceolatus*
New England aster	*Aster novae-angliae*
Swamp aster	*Aster puniceus*
River bulrush	*Bolboschoenus fluviatilis*
Marsh marigold	*Caltha palustris*
Water sedge	*Carex aquatilis*
Emory's sedge	*Carex emoryi*
Stalk-grain sedge	*Carex stipata*
Lesser spikerush	*Eleocharis acicularis*
Creeping spikerush	*Eleocharis palustris*
Small spikerush	*Eleocharis parvula*
Boneset	*Eupatorium perfoliatum*
Fowl manna grass	*Glyceria striata*
Swamp rose-mallow	*Hibiscus moscheutos*
Blue flag iris	*Iris versicolor*
Canada rush	*Juncus canadensis*
Torrey's rush	*Juncus torreyi*
Great blue lobelia	*Lobelia siphilitica*
Virginia bugleweed	*Lycopus virginicus*
Arrow arum	*Peltandra virginica*
Water smartweed	*Polygonum amphibium*
Mild water pepper	*Polygonum hydropiperoides*
Pickerelweed	*Pontederia cordata*
Soft stem bulrush	*Schoenoplectus tabernaemontani*
Blue vervain	*Verbena hastata*
American water horehound	*Lycopus americanus*

Shrubs (3 Gal.)

Common Name	Scientific Name
Buttonbush	*Cephalanthus occidentalis*
Red osier dogwood	*Cornus sericea*
Silky dogwood	*Cornus amomum*
Winterberry	*Ilex verticillata*
Pussy willow	*Salix discolor*
Witherod	*Viburnum cassinoides*
Southern arrowwood	*Viburnum dentatum*
Gray dogwood	*Cornus racemosa*
Rough leaf dogwood	*Cornus drummondii*
Elderberry	*Sambucus canadensis*

Live Stakes

Common Name	Scientific Name
Buttonbush	*Cephalanthus occidentalis*
Red osier dogwood	*Cornus sericea*
Silky dogwood	*Cornus amomum*
Pussy willow	*Salix discolor*
Silky willow	*Salix sericea*
Shining willow	*Salix lucide*
Black willow	*Salix nigra*
Elderberry	*Sambucus canadensis*
Sandbar willow	*Salix interior*
Ninebark	*Physocarpus opulifolius*

Forested Wetland Area ▨

Trees (3 gal.)

Common Name	Scientific Name
Silver maple	*Acer saccharinum*
Blue beech	*Carpinus caroliniana*
Black gum	*Nyssa sylvatica*
Swamp white oak	*Quercus bicolor*
Bur oak	*Quercus macrocarpa*
Pin oak	*Quercus palustris*
Red maple	*Acer rubrum*
Eastern cottonwood	*Populus deltoides*
Black willow	*Salix nigra*
Peachleaf willow	*Salix amygdaloides*

Shrubs (1 and 3 gal.)

Common Name	Scientific Name
Speckled alder	*Alnus incana*
Hazel alder	*Alnus serrulata*
Black chokeberry	*Aronia melanocarpa*
Buttonbush	*Cephalanthus occidentalis*
Red-osier dogwood	*Cornus sericea*
Winterberry	*Ilex verticillata*
Spicebush	*Lindera benzoin*
Ninebark	*Physocarpos opulifolius*
Pussywillow	*Salix discolor*
Elderberry	*Sambucus canadensis*
Withe rod	*Viburnum cassinoides*
Nannyberry	*Viburnum lentago*
Silky dogwood	*Cornus amomum*
Gray dogwood	*Cornus racemosa*
Rough leaf dogwood	*Cornus drummondii*
American cranberry bush	*Viburnum opulus var. Americana*

Live Stakes

Common Name	Scientific Name
Buttonbush	*Cephalanthus occidentalis*
Silky dogwood	*Cornus amomum*
Red osier dogwood	*Cornus sericea*
Black willow	*Salix nigra*
Pussy willow	*Salix discolor*
Silky willow	*Salix sericea*
Shining willow	*Salix lucide*
Elderberry	*Sambucus canadensis*
Sandbar willow	*Salix interior*
Ninebark	*Physocarpus opulifolius*

Herbs (Plugs)

Common Name	Scientific Name
Lizard's tail	*Saururus cernuus*
Hop sedge	*Carex lupulina*
Bottlebrush sedge	*Carex lurida*
Pointed broom sedge	*Carex scoparia*
Canada wild rye	*Elymus canadensis*
Riverbank wild rye	*Elymus riparius*
Virginia wild rye	*Elymus virginicus*
Crested sedge	*Carex cristatella*
Porcupine sedge	*Carex hystericina*
Tussock sedge	*Carex stricta*
American water horehound	*Lycopus americana*
Great blue lobelia	*Lobelia siphilitica*
Seedbox	*Penthorum sedoides*
Fringed Sedge	*Carex crinita*
Bristly cattail Sedge	*Carex frankii*
Fox Sedge	*Carex vulpinoid*

WETLAND PLANTING TABLE

ZONE	MATERIAL	DENSITY	SPECIES	QUANTITY	
				PART I	PART II
Forested Wetland Area	3 Gallon Trees 3 Gallon Shrubs 1 Gallon Shrubs Herbaceous Plugs Live Stakes	18'x18' Centers 30'x30' Centers 30'x30' Centers 15'x15' Centers 25'x25' Centers	7 10 10 10 7	1.525 0 549 2,195 790	2,684 966 0 3,864 1,391
Emergent Wetland Area	Herbacious Plug 3 Gallon Shrubs Live Stakes	6'x6' Centers 30'x30' Centers 20'x20' Centers	20 7 7	13,455 538 1,211	33,190 1,328 2,987
Forested Wetland Buffer Area	3 Gallon Trees 3 Gallon Shrubs	20'x20' Centers 30'x30' Centers	7 7	454 202	807 359
Emergent Wetland Buffer Area	3 Gallon Shrubs	16'x16' Centers	7	0	579

The species column designates the minimum number of species that shall be selected from each planting list.

LANDSCAPING WARRANTY

Landscaper shall warranty at least an 80% survivability of all #1 and #3 containerized shrub and tree materials for one (1) year from planting date. Any dead, dying, or diseased material shall be replaced with like material.

WATERING

Contractor shall insure that all material is thoroughly watered at time of planting, and once every week during the period of establishment. Sprinklers, gator bags or other such methods shall be used if rainfall is inadequate.

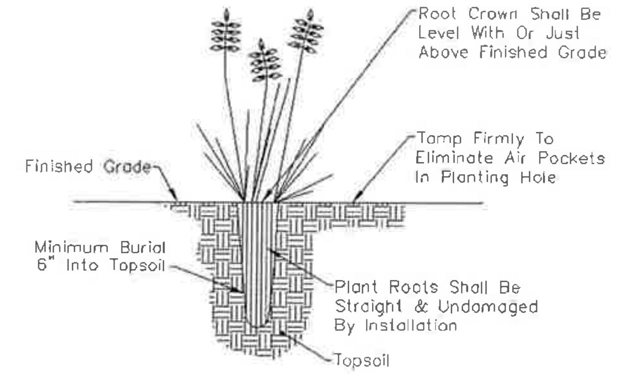
Notes:

All plantings shall be selected from the species lists provided and approved in writing by the Construction Manager prior to ordering the plants.

Herbaceous Material shall not be installed until water reaches the wetland normal pool elevation and the basin area in fully stabilized. Under no circumstance should wetland plants be installed while the basin is being used for temporary sediment storage during site construction.

Herbaceous Material shall be planted between May 1 and July 1. Planting beyond these dates shall be approved in writing by the Owner and Construction Manager.

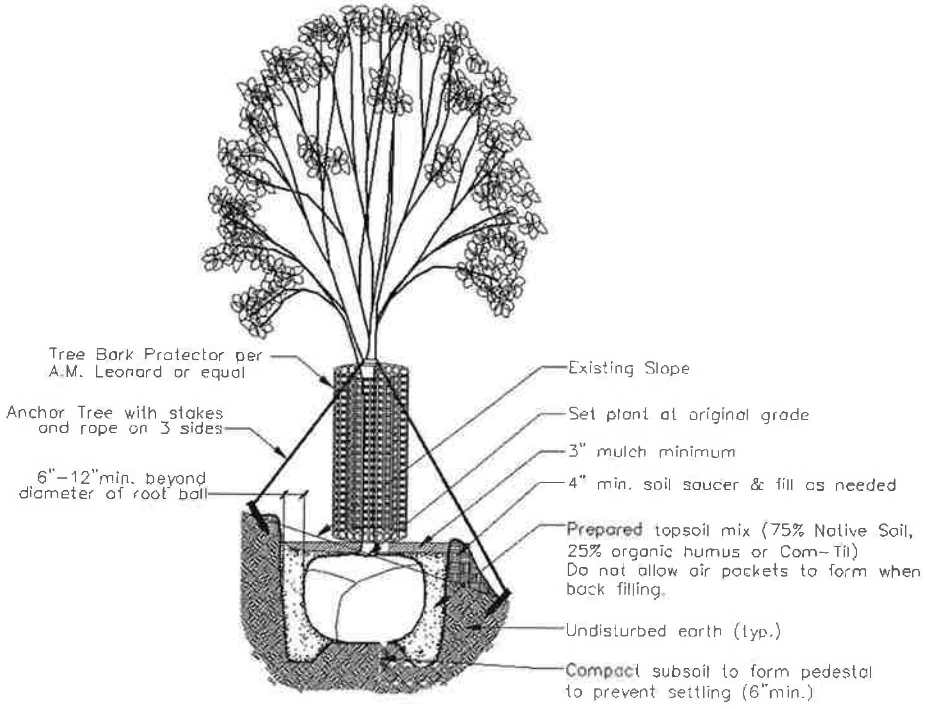
Under no circumstance should herbaceous material be planted such that the entire plant is below the water surface.



Notes:
Leaves & Root Crown Shall Remain Undamaged During Planting

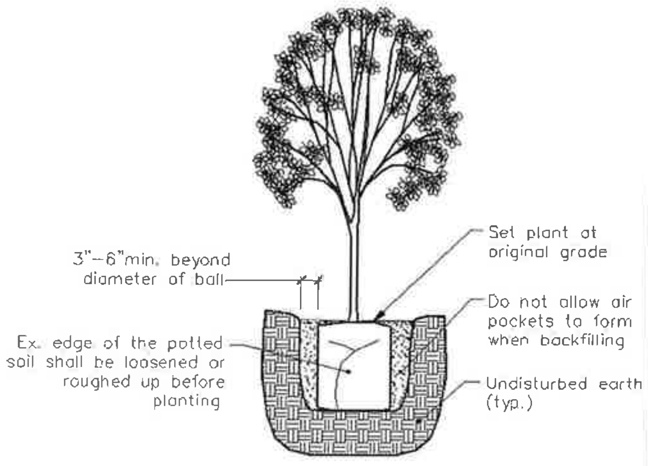
PLUG PLANTING DETAIL

Not To Scale



TREE PLANTING DETAIL

Not to Scale



POTTED PLANTING DETAIL

Not to Scale

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM RESTORATION PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITOHPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
EXHIBIT 13A: WETLAND PLANTING PLAN

Job No. 2009-0543	Drawn By GDT
Date January 2010	Scale As Noted

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
emht.com

COLUMBUS REGIONAL AIRPORT AUTHORITY
PLANNING & ENGINEERING
4600 INTERNATIONAL GATEWAY
COLUMBUS, OHIO 43219
(614) 239-4000
(614) 239-7850 FAX

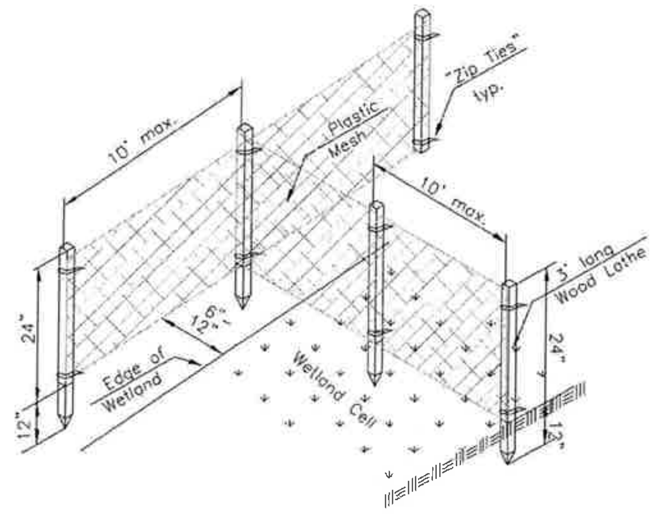
REVISIONS

MARK	DATE	

WETLAND SEEDING TABLE

TYPE			APPLICATION RATES	APPLICATION DATES
OVER SEED:				
Annual Ryegrass or	*(Lolium multiflorum)*		40 Lbs./Acre	March to October
Oats (Grain) or	*(Secale cereale)*		15 Lbs./Acre	March to October
Winter Rye (Grain)	*(Avena sativa)*		40 Lbs./Acre	October to February
(Forested/Emergent Wetland Buffer) PERMANENT SEED: Native Grass Custom Seed Mix				
Common Name	Scientific Name	Percentage	11 lbs/acre	October 1st – May 15th
Little bluestem	*Andropogon scoparius*			
Big bluestem	*Angropogon gerardii*	15		
Riverbank wild rye	*Elymus riparius*	10		
Silky wild rye	*Elymus villosus*	10		
Virginia wild rye	*Elymus virginicus*	10		
Indian grass	*Sorghastrum nutans*	10		
Switchgrass	*Panicum virgatum*	10		
Black-eyed susan	*Rudbeckia hirta*	7		
Ox-eye sunflower	*Heliopsis helianthoides*	7		
Gray-headed coneflower	*Ratibida pinnata*	6		
Cup plant	*Silphium perfoliatum*	4		
Tall white bread tongue	*Penstemon digitalis*	4		
Ohio spiderwort	*Tradescantia ohioensis*	3		
Joe pye weed	*Eupatorium fistulosum*	2		
Wild bergamot	*Monarda fistulosa*	1		
		1		
▨ (Forested Wetland Area) PERMANENT SEED: Ernst Seeds ERNMX-127 or approved equal				
Common Name	Scientific Name	Percentage	15 Lbs./Acre	Oct. 1st to May 15th
Fowl Bluegrass	*Pao palustris*	25		
Virginia Wild Rye	*Elymus virginicus*	25		
Fox Sedge	*Carex vulpinoidea*	25		
Ticklegrass (Rough Bentgrass)	*Agrostis scabra*	6		
Giant Bur Reed	*Sparganium eutycarpum*	3		
Blue Vervain	*Verbena hastata*	3		
Soft Rush	*Juncus effusus*	2		
Green Bulrush	*Scirpus atrovirens*	2		
Wool Grass	*Scirpus cyperinus*	2		
Many Leaved Bulrush	*Scirpus polyphyllus*	2		
Blunt Broom Sedge	*Carex scoparia*	1		
Common Sneezeweed	*Helenium autumnale*	1		
Blue Flag	*Iris versicolor*	1		
Path Rush	*Juncus tenuis*	1		
Square Stemmed Monkey Flower	*Mimulus ringens*	1		
⁘ (Emergent Wetland Area) PERMANENT SEED: Ernst Seeds ERNMX-120 or approved equal				
Common Name	Scientific Name	Percentage	15 Lbs./Acre	Oct. 1st to May 15th
Virginia Wild Rye	*Elymus virginicus*	20		
Fox Sedge	*Carex vulpinoidea*	15		
Soft Rush	*Juncus effusus*	10		
Giant Bur Reed	*Sparganium eurycarpum*	8		
Blue Vervain	*Verbena hastata*	8		
Wool Grass	*Scirpus cyperinus*	6		
New England Aster	*Aster novae-angliae*	5		
American Mannagrass	*Glyceria grandis*	5		
Eastern Bur Reed	*Sparganium americanum*	5		
Green Bulrush	*Scirpus atrovirens*	4		
Cosmos (Bristly) Sedge	*Carex comosa*	3.5		
Lurid (Shallow) Sedge	*Carex lurida*	3.5		
Rattlesnake Grass	*Glyceria candensis*	2		
Hop Sedge	*Carex lupulina*	2		
Nodding Sedge	*Carex gynandra*	2		
Wild Brome Grass	*Bromus latiglumis*	1		

- Over seed shall be applied with the permanent seed to quickly stabilize the site. This is required because the permanent seed takes much longer to germinate than the over seed.



GOOSE FENCE DETAIL

Not to Scale

Goose Fence:
Goose Fence material shall be black or green plastic mesh with 0.75 – 1.00 inch square openings (Cintoflex, Type "D", or approved equal).

Embed 3' long Wooden Lath into soil. Lath shall be 1 1/2" wide (Min.) x 3/8" Thk. (Min.)

Tie Plastic Mesh (Goose Fencing) to Wooden Lath at top and bottom of mesh.

Goose Fencing shall remain installed for a minimum of one (1) year. Removal of Goose Fencing after the one (1) year period is at the Owners discretion.

Goose Fence shall only be installed in Wetland Cell 1A and 1B. See Specification on Sheet 2.

Job No. 2009-0643
Drawn By: RRN
Date January, 2010
Scale As Noted

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM RESTORATION PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITOHPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
EXHIBIT 13B: WETLAND PLANTING PLAN

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Toll Free: 888.775.3648
emht.com

COLUMBUS REGIONAL AIRPORT AUTHORITY
PLANNING & ENGINEERING
4600 INTERNATIONAL GATEWAY
COLUMBUS, OHIO 43219
(614) 239-4000
(614) 238-7850 FAX:

REVISIONS

MARK	DATE

PHOTOGRAPHS

PHOTOGRAPH 1
Big Run – Mid-Channel Sand Bar (EMH&T, 8/11/08)

PHOTOGRAPH 2
Big Run – Bank Erosion and Slumping (EMH&T, 8/11/08)

PHOTOGRAPH 3
Big Run – Undercut Banks (EMH&T, 8/28/08)

PHOTOGRAPH 4
Sand/Silt Substrate Typical of Big Run Restoration Reach (EMH&T, 11/6/08)

PHOTOGRAPH 5
Big Run Facing South (EMH&T, 11/6/08)

PHOTOGRAPH 6
Walnut Creek, Located to the North of the Proposed Mitigation Area (EMH&T, 11/6/08)

PHOTOGRAPH 7
Area to be Developed for Wetland Restoration West of Big Run (EMH&T, 8/28/08)

PHOTOGRAPH 8
Nursery Orchards East of Big Run (EMH&T, 8/28/08)

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
502 EIGHTH STREET
HUNTINGTON, WEST VIRGINIA 25701-2070

REPLY TO
ATTENTION OF

JUN 23 2011

Operations and Readiness Division
Regulatory Branch
2003-270-1-SCR-Mason Run

Ms. Elaine Roberts
Columbus Regional Airport Authority
4600 International Gateway
Columbus, Ohio 43219

Dear Ms. Roberts:

Enclosed are one original and one copy of validated Department of the Army Permit Number 2003-270-1-SCR-Mason Run, authorizing you to discharge of dredged/fill material into approximately 592 linear feet of stream channel (Mason Run) and 0.14 acre of wetland (Turkey Run Wetland 14B) in conjunction with the construction of the replacement Runway 10R/28L. The project site is located (latitude 39.992N and longitude -82.9007W) within the Mason Run watershed at the existing Port Columbus International Airport within the City of Columbus, in Franklin County, Ohio.

The original copy of this permit is for your records. The enclosed copy of the authorization must be supplied to the project engineers responsible for the construction activities.

If any changes in the location and plans of the work are found necessary, revised plans must be submitted to this office for approval as required by law, before work is initiated. It is imperative that this office be notified two weeks prior to the commencement of construction, and again upon completion of activities.

Upon completion of the work, the attached certification must be signed and returned to this office. If you have any questions, please contact Teresa Spagna of the North Regulatory Section at 304-399-5210.

Sincerely,

Rebecca Rutherford
Chief, North Regulatory Section

Enclosures

Copies Furnished:

Mr. Jeromy Applegate
U.S. Fish and Wildlife Service
4625 Morse Road, Suite 104
Columbus, Ohio 43230
With enclosures

Mr. Brian Mitch
ODNR-Environmental Policy Coordinator
2045 Morse Rd., Building C-4
Columbus, Ohio 43229-6693
With enclosures

Ms. Wendy Melgin
US EPA, Region V, WW-16-J
77 West Jackson St.
Chicago, Illinois 60604-3590
With enclosures

Mr. Jeff Boyles
Ohio EPA
Lazarus Government Building
Post Office Box 1049
Columbus, Ohio 43216-3669
With enclosures

Mr. Mark Epstein
Ohio Historic Preservation Office
OHPO Serial No. 2008-RIC-1024/1020355
1982 Velma Ave
Columbus, Ohio 43211-1030
With enclosures

[illegible]

Applicant COLUMBUS REGIONAL AIRPORT AUTHORITY	File Number: 2003-270-1-SCR-Mason Run	Date: June 23, 2011

Attached is:		See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A
X	PROFFERED PERMIT (Standard Permit or Letter of permission)	B
	PERMIT DENIAL	C
	APPROVED JURISDICTIONAL DETERMINATION	D
	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://usace.army.mil/inet/functions/cw/cecwo/reg or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact: Ginger Mullins, Chief, Regulatory Branch, 304-399-5710 Rebecca Rutherford, Ch. North Regulatory Section, 304-399-5210 Mark Taylor, Chief, Energy Resource Section, 304 399-5610 LuAnne Conley, Chief, South Regulatory Section, 304-399-5710 Address: U.S. Army Corps of Engineers Regulatory Branch 502 8th Street Huntington, WV 25701	If you only have questions regarding the appeal process you may also contact: US Army Corps of Engineers Great Lakes & Ohio River Division Attn: Pauline Thorndike, Review Officer 550 Main Street RM 10-524 Cincinnati, OH 45202-3222 Phone: (513) 684-6212 Fax: (513) 684-2460

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

Signature of appellant or agent.	Date:	Telephone number:

Permit Number: 2003-270-1-SCR-Mason Run

Name of Permittee: Columbus Regional Airport Authority

Date of Issuance: June 23, 2011

Upon completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

Huntington District
U. S. Army Corps of Engineers
502 8th Street
Huntington, West Virginia 25701-2070
Attn: OR-FN

Please note that your permitted activity is subject to a compliance inspection by an U. S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation was completed in accordance with the permit conditions.

Signature of Permittee Date

PM: Teresa Spagna

DEPARTMENT OF THE ARMY PERMIT

Permittee Columbus Regional Airport Authority

Permit No 2003-270-1-SCR

Issuing Office Huntington District

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description: You are authorized to discharge dredged and fill material into 592 linear feet of stream channel (Mason Run) and 0.14 acre of wetland (Turkey Run Wetland 14B) in conjunction with the construction of the replacement Runway 10R/28L in accordance with the drawings attached hereto.

Project Location: The project site is located (latitude 39.992N and longitude -82.9007W) within the Mason Run watershed at the existing Port Columbus International Airport within the City of Columbus, in Franklin County, Ohio. Construction of the project will take place within Mason Run and wetlands adjacent to Turkey Run.

Permit Conditions:

General Conditions:

1. The time limit for completing the work authorized ends on December 31, 2015. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

Special Conditions:

Special conditions are found on the attached sheet titled "SPECIAL CONDITIONS FOR THE DEPARTMENT OF THE ARMY SECTION 404 CLEAN WATER ACT PERMIT 2003-270-1-SCR ISSUED TO COLUMBUS REGIONAL AIRPORT AUTHORITY FOR CONSTRUCTION OF THE REPLACEMENT RUNWAY 10R/28L AT THE PORT COLUMBUS REGIONAL AIRPORT"

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

   ( ) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).

   (X) Section 404 of the Clean Water Act (33 U.S.C. 1344).

   ( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

2. Limits of this authorization:

   a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.

   b. This permit does not grant any property rights or exclusive privileges.

   c. This permit does not authorize any injury to the property or rights of others.

   d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability: In issuing this permit, the Federal Government does not assume any liability for the following:

   a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.
   b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

   c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

   d. Design or construction deficiencies associated with the permitted work.

   e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision: This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

   a. You fail to comply with the terms and conditions of this permit.

   b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).
   c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

Elaine Roberts — 6-17-11

(PERMITTEE) — (DATE)

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

June 23, 2011

(DISTRICT ENGINEER) — (DATE)

ROBERT D. PETERSON
Colonel, Corps of Engineers

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

(TRANSFEREE) — (DATE)

SPECIAL CONDITIONS FOR THE DEPARTMENT OF THE ARMY SECTION 404 CLEAN WATER ACT PERMIT 2003-270-1-SCR ISSUED TO COLUMBUS REGIONAL AIRPORT AUTHORITY FOR CONSTRUCTION OF THE REPLACEMENT RUNWAY 10R/28L AT THE PORT COLUMBUS REGIONAL AIRPORT

1. The permittee is hereby authorized to discharge dredged and/or fill material into 592 linear feet of stream channel and 0.14 acre of wetland in conjunction with the construction of the replacement Runway 10R/28L. This Department of the Army (DA) Section 404 Clean Water Act permit remains contingent upon and must be constructed in accordance with drawings attached hereto.

2. The water quality certification issued by the Ohio Environmental Protection Agency (OEPA) dated January 19, 2011 respectively are attached hereto and made a part of this permit. All conditions attached to or contained therein are hereby incorporated by reference as being special conditions of the DA permit.

3. The permittee shall display a copy of this DA permit at the site and ensure all contractors are aware of its terms and conditions.

4. The permittee is required to apply for and secure all necessary permits, certifications or other approvals from federal, state or local regulatory agencies, prior to commencing construction activity. These other federal, state or local approvals and all conditions attached to or contained therein are hereby incorporated by reference as being special conditions of this DA permit.

5. Construction activities will be performed during low flow conditions. Appropriate site specific best management practices (BMP) for sediment and erosion control will be fully implemented during construction activities at the site. The BMPs include, but are not limited to, the utilization of silt fences, check dams, mulching and seeding. No area for which grading has been completed will be unseeded or unmulched for longer than 14 days. All disturbed areas will be seeded and/or revegetated with native species and approved seed mixes that preclude hazardous wildlife and the establishment of non-native invasive species. Specifically, any un-vegetated riparian corridor will be re-established with species native to Ohio.

6. As-built drawings, certified by a professional engineer, shall be furnished to this office within 60 days of completion of construction showing the location and configuration, as well as all pertinent dimensions and elevations of each project component authorized under this DA permit.

7. Should new information regarding the scope and/or impacts of the project become available that was not submitted to this office during our review of the proposal, the permittee shall submit written information concerning proposed modification(s) to this office for review and evaluation, as soon as practicable.

8. Representatives from the United States Army Corps of Engineers (USACE) shall be allowed to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of this DA permit.

Compensatory Mitigation

9. The USACE-Huntington District has determined the use of compensatory mitigation credits accrued at the "Eastside Nursery Site" and described in the "Eastside Nursery Final Mitigation Plan..." and dated February 9, 2010 is acceptable to offset the unavoidable impacts to waters of the United States. This mitigation site is a single user pooled mitigation site constructed to locally accommodate the mitigation needs for various projects undertaken by the Columbus Regional Airport Authority. According to the final approved "Eastside Nursery Final Mitigation Plan...," this pooled mitigation site provides 11.3 acres of forested wetlands, 11.2 acres of emergent wetlands and 2,700 linear feet of stream at this composite mitigation site. To compensate for unavoidable adverse impacts to waters of the United States, the permittee will ensure the following mitigation measures are successfully implemented and monitored as described in the compensatory mitigation plan (CMP) and as stipulated in this DA Permit:

a. restore and permanently protect 0.21 acre of non-forested Category 2 wetlands and 888 linear feet of Big Run at the "Eastside Nursery Site."

The permittee shall implement the mitigation work plan and complete the initial construction and plantings in accordance with the timeframes specified in the final CMP. Completion of all elements of this CMP is a requirement of this DA permit.

10. The permittee shall dedicate in perpetuity by an appropriate real estate instrument or other long-term protection mechanism 0.21 acre of non-forested Category 2 wetlands and 888 linear feet of Big Run restored at the "Eastside Nursery Site." The permittee shall survey the mitigation areas, develop appropriate restrictive instruments for the surveyed areas, and submit the appropriate real estate instrument or other long-term protection mechanism to the USACE-Huntington District for approval prior to the initiation of construction on the mitigation site.

a. The protective real estate instrument or other long-term protection mechanism must stipulate that the mitigation areas shall be properly marked and shall not be disturbed, except by those activities that will not adversely affect the intended extent, condition and function of the mitigation areas. The real estate instrument must, to the extent appropriate and practicable, prohibit incompatible uses (e.g., clear cutting) that might otherwise jeopardize the objectives of the compensatory mitigation project. Livestock grazing, and similar activities are not allowed unless written permission is granted by the USACE-Huntington District.
b. The instrument or mechanism must also include a map depicting the boundary of the preservation sites.
c. Upon notification in writing by this office of approval of the protective real estate instrument or long-term protection mechanism, it shall be filed and recorded with the Franklin County Auditor within 60 days of this written notification.

d. The restriction shall not be removed from the deed or modified without written approval of the USACE-Huntington District and conveyance of any interest in the property must be subject to the recorded instrument or mechanism. Any proposed activities, including transfer of title to, or establishment of any other legal claims over, the compensatory mitigation sites within the protected easement areas must be coordinated through this office 60 days in advance.

Natural Stream Design

11. The permittee must use natural stream design techniques and concepts, based on reference stream pattern, profile and dimensions using sound geomorphology techniques, to determine the appropriate hydrogeomorphic configuration of the off-site mitigation stream channel (888 linear feet of Big Run). The constructed in-stream habitat within the off-site restored channel of Big Run will be installed in a manner to correct or ameliorate some of the noted physical impairments along Big Run with the goals of restoring stability and promoting aquatic habitat within the channel while also helping to preserve water quality within the Walnut Creek mainstem . The new channel configuration will conform to the restored watershed size and shape and be capable of transporting the corresponding stream flow and bedload. The use of grout is prohibited to prevent the loss of hydrology in the created stream channel. The permittee shall immediately notify the USACE-Huntington District to discuss other alternative methods.

Planting

12. A minimum of a 50-foot vegetated buffer zone (25 feet on each stream side), consisting of native non-invasive grasses, shrubs and trees will be planted along 888 linear feet of restored Big Run. Woody stems shall be irregularly placed along the corridor and low growing shrubs will be planted between trees. All grasses, shrubs and trees shall be selected based upon their hydrologic and edaphic tolerances, and shall be native to the project area. Loosely graded non-compacted topsoil or topsoil substitutes that include, when possible, woody debris and native seeds shall be used in the riparian area. Selection of ground cover shall be based on soil pH and the growth habit of the species. Slow growing ground cover species insures soil stabilization while allowing tree seedlings to emerge above the ground cover, ensuring their survival.

As Built Submittal

13. Within 6 weeks of completion of mitigation construction (i.e. site preparation and planting), a report must be submitted to the USACE-Huntington District describing the as-built status of the off-site stream restoration and off-site wetland restoration projects. If mitigation construction is initiated in, or continues throughout the year, but is not completed by December 31 of any given year, the permittee will provide the USACE-Huntington District, a letter providing the date mitigation work began and the work completed as of December 31. The letter will be sent no later than January 31 of the next year.

a. As-built channel surveys will be conducted to document the dimension, pattern and profile of the 888 linear feet restored segment of Big Run. Permanent cross-sections will be established during this survey for use during future monitoring surveys. At a minimum, two permanent cross-sections will be established in each mitigation area. The locations will be selected to represent approximately 50 percent of the pool habitat and 50 percent of the riffle habitat. The as-built surveys will include photographic documentation at cross-sections and structures, a plan view diagram and vegetation information for at least two sites along the restored channel. The location of plantings and other installations or structures shall be indicated on mapping.

b. As-built surveys will be conducted to document the topography, any inlet/outlet structures and the location and extent of the designed plant community types at the restored 0.21 acre of non-forested wetlands at the "Eastside Nursery Site." Within each community type the plan will show the species planted. There will also be a soil profile description and the actual measured organic content of the topsoil. This will be included in the first monitoring report unless there are grading and/or soil modifications and/or additional plantings of different species in subsequent years. Representative photographs of the wetland mitigation site must be taken from the same locations for each monitoring event. Photographs must be dated and clearly labeled with the direction from which the photograph was taken. The photograph sites must also be identified on mapping.

Performance Standards

14. Implementation of the CMP must ensure the mitigation stream segments, surrounding riparian areas and established wetlands meet the performance standards outlined below. If the mitigation efforts do not meet the performance standards outlined in the CMP, Section 401 Water Quality Certification dated January 19, 2011 and special conditions of this individual permit authorization, corrective measures and/or additional mitigation will be required.

Waters of the United States and Surrounding Buffer and Riparian Zones for Off-Site Mitigation

- The restored stream channel of Big Run must develop and maintain definable bed and bank with an ordinary high water mark and exhibit a surface hydrological connection to navigable waters of the United States in order to meet the definition of waters of the United States under the Regulatory Program regulations.
- Restored wetlands at the "Eastside Nursery Site" must develop and maintain wetland characteristics consistent with the USACE Midwest Regional Supplement in order to meet the definition of waters of the United States under the Regulatory Program regulations.
- Waters of the United States must function at the level of ecological performance prescribed in the mitigation plan.

- Buffer and riparian zones and other areas integral to the enhancement of the aquatic ecosystem must function as the intended type of ecosystem component and at the level of ecological performance prescribed in the mitigation plan.

Off-Site Stream Mitigation

- A minimum of 888 linear feet of restored segment of Big Run at the "Eastside Nursery Site" and 1.02 acres of riparian buffer habitat must be present and be functioning as the intended type of waters of the United States and at the level of ecological performance prescribed in the mitigation plan.
- The restored segment of Big Run off-site must attain a minimum Qualitative Habitat Evaluation Index (QHEI) of 60 and meet criteria for the warmwater habitat aquatic life use designation.
- A total of 80% of the restored channel's riparian zone shall be covered by native shrub and herbaceous species.
- The restored channel's riparian zone shall contain no more than 5 percent relative cover of any invasive species.

Off-Site Wetland Mitigation

- A total of 0.21 acre of restored non-forested Category 2 wetlands as determined by an investigation of waters completed in accordance with the USACE Midwest Regional Supplement or successor document must be functioning as the intended type of waters of the United States and at the level of ecological performance prescribed in the mitigation plan.
- The off-site mitigation wetlands must attain a Vegetation Index of Biotic Integrity score of 51 or higher for each plant community type.
- The .0.21 acre of the off-site mitigation wetlands must attain an Ohio Rapid Assessment Method (ORAM) score equivalent to a Category 2 non-forested wetland.
- The mitigation wetland must have less than 10% of its total area as unvegetated open water.
- A minimum of 75% of all dominant plant species within the restored wetlands must have an indicator status of obligate, facultative wetland or facultative.
- A total of 80% of the total area of the mitigation wetland shall be covered by native tree, shrub and herbaceous species.
- The restored wetlands and their upland buffer shall contain no more than 5 percent relative cover of any invasive species.
- A minimum of 50% of the perimeter shall have slopes no greater than 15:1.
- The restored wetlands must exhibit a surface water connection to navigable waters of the United States.

Monitoring

15. The off-site restored channel of Big Run shall be monitored annually for 5 years while the off-site restored wetlands shall be monitored every other year for 10 years following completion of the applicant's proposed compensatory mitigation efforts. Annual report containing the data listed in this DA permit as well as the OEPA Section 401 Water Quality Certification dated January 19, 2011 shall be submitted to the USACE by December 31 for each of the five consecutive years (1, 2, 3, 4 and 5) for off-site stream restoration and every other year of the ten years (1, 3, 5, 7 and 10) for the off-site wetland restoration. The first report must contain as-built drawings of all mitigation areas and their surrounding riparian and/or upland buffer areas. All reports must provide a status of the off-site restored stream segment and off-site restored wetlands, including photographs and narrative descriptions of channel and wetland development. The District Engineer may extend the monitoring past the minimum period based upon a determination that performance standards stated herein, in the CMP have not been met or the compensatory mitigation project(s) is not on track to meet them (e.g. high mortality rate of vegetation, absence of an ordinary high water mark, lack of habitat diversity, lack of hydrology, lack of surface hydrological connection to the tributary system). The District Engineer may also revise the monitoring requirements when remediation is required. The District Engineer may require monitoring of the mitigation sites more often than annually during the early stages of development to quickly address problems and/or concerns associated with the mitigation site.

16. Evaluations, as outlined in Special Condition 17, shall be performed to determine whether the mitigation efforts are on track to meet performance standards identified under Special Condition 14 above to allow for mid-course adjustments and to report on any unanticipated benefits or problems as a result of the monitoring program. The information accumulated through this process will be used to adjust strategy periodically on the basis of what has been learned. If the mitigation site(s) are generally progressing as expected or if progress is slower than expected but would probably meet mitigation goals and objectives within a reasonable amount of time, no action would be necessary. However, physical actions might be required to maintain aquatic resource development on course toward its goals or significant changes in parts of the implemented mitigation plan could be required.

17. In order to provide a comparison of restored stream and riparian area development throughout the years of required monitoring, the scores of the QHEI, Invertebrate Community Index, Index of Biotic Integrity, and Native and Invasive Plant Species Monitoring will be provided with each submitted monitoring report. In order to provide a comparison of wetland area development throughout the years of required monitoring, the scores of the ORAM and Invasive Plant Species Monitoring will be provided with each submitted monitoring report.

18. To ensure coordination with resource agencies one original and five copies of the monitoring report must be submitted for review. Failure to submit monitoring reports constitutes permit non-compliance.

19. Annual monitoring reports must include details sufficient for an inspector to determine compliance with performance standards and to identify any required remedial actions. At a minimum, information outlined in the enclosed USACE Regulatory Guidance Letter (RGL) No. 08-03 and titled "Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Creation, Restoration, and/or Enhancement of Aquatic Resources" as well as the Ohio Environmental Protection Agency Section 401 Water Quality Certification dated January 19, 2011 must be provided. Combined 401/404 monitoring reports are preferred.

20. Monitoring reports are required by December 31 of each monitoring year even if no work is conducted during the reporting period.

Remedial Actions

21. Remedial actions taken during the monitoring period shall be described. These actions may include, but are not limited to, removing debris, replanting, controlling invasive species, regrading the site, applying additional topsoil or soil amendments, adjusting site hydrology, etc. Remedial measures may be necessary to achieve or maintain achievement of the success criteria and otherwise improve the extent to which the mitigation site(s) replace the functions and values lost due to project impacts.

22. If an annual performance criterion is not met for all or any portion of the mitigation project(s) in any year, or if the final performance standards are not met, the applicant shall prepare an analysis of the cause(s) of failure, if determined necessary by the USACE-Huntington District, and propose remedial actions for approval. The applicant's Contingency Plan or other corrective measures will be required to be performed by the permittee as directed by the District Engineer.

23. If performance standards are not met, a brief explanation of the difficulties and potential remedial actions or additional compensatory mitigation proposed by the permittee, including a timetable, must be provided. The District Engineer will ultimately determine if the mitigation site is successful for a given monitoring period.

Monitoring Inspections

24. The permittee shall arrange an on-site meeting with the USACE-Huntington District during the growing season following submittal of the first, third and fifth year reports for the stream restoration site and first, third, fifth, seventh and tenth reports for the wetland restoration site. The purpose of the meeting is to determine if the stream and wetland mitigation sites have been constructed in accordance with the mitigation plan and are functioning as expected. A current jurisdictional determination documenting the limits of all waters of the United States shall be provided for verification with the fifth year report for the off-site stream restoration site and with the fifth and tenth year reports for the off-site wetland restoration site.

25. Problems at the mitigation areas shall be addressed and potential solutions must be incorporated into actions the permittee would take to allow the mitigation areas to reach their proposed functional status. The permittee is responsible for implementing reasonable corrective measures recommended by the USACE-Huntington District.

Release

26. The permittee's responsibility to complete the required compensatory mitigation as set forth in Special Condition 9 will not be considered fulfilled until the permittee has demonstrated a sustainable level of mitigation success and has received written verification from the USACE-Huntington District that areas within the mitigation areas meet the success criteria established under Special Condition 14.

27. Following submittal of the fifth year monitoring report for the stream restoration site and tenth year monitoring report for the wetland restoration site, a determination of the mitigation success will be made by the USACE-Huntington District. If the performance standards have been achieved, the applicant would be released from future monitoring requirements. However, if success criteria have not been adequately met, the applicant may be required to implement contingency measure(s), including additional mitigation, to ensure compensation adequately offsets the loss of waters in association with the proposal as determined in the sole discretion of the District Engineer. Monitoring may be extended for a longer period if completed mitigation is not functioning as predicted in the CMP. Additionally, the permittee will purchase credits from an approved mitigation bank and/or preserve aquatic resources or other alternative mitigation as determined by the USACE-Huntington District in the event the District Engineer determines that additional mitigation and monitoring would not ensure adequate compensation for impacts to waters of the United States.

Endangered Species Act Coordination

28. The Replacement Runway 10R/28L project site and off-site "Eastside Nursery Site" lie within the range of the Indiana bat (*Myotis sodalis*), a Federally-listed endangered species. Since first listed as endangered in 1967, their population has declined by nearly 60%. Several factors have contributed to the decline of the Indiana bat including the loss and degradation of suitable hibernacula, human disturbance during hibernation, pesticides, and the loss and degradation of forested habitat, particularly stands of large, mature trees. Fragmentation of forest habitat may also contribute to declines. Summer habitat requirements for the species are not well defined but the following are considered important:

a. Dead or live trees and snags with peeling or exfoliating bark, split tree trunk and/or branches, or cavities, which may be used as maternity roost areas.
b. Live trees (such as shagbark hickory and oaks) which have exfoliating bark.
c. Stream corridors, riparian areas, and upland woodlots which provide forage sites.

If it is determined that suitable habitat for the Indiana bat may be located within the wooded areas of the impact and/or off-site mitigation site, the permittee shall preserve trees and associated habitats exhibiting any of the characteristics listed above wherever possible. Should suitable habitat be present that cannot be saved during construction activities, these trees shall be cut prior to April 1 and after September 30.

29. The permittee is reminded this DA Permit authorization does not authorize the "take" of a threatened or endangered species as defined under the Endangered Species Act. In the absence of separate authorization (e.g. Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the United States Fish and Wildlife Service (USFWS), both lethal and non-lethal "takes" of protected species are in violation of the Endangered Species Act. Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the USFWS or their World Wide Web page at http://www.fws.gov/r9endspp/endspp.html.

30. Section 7 obligations under Endangered Species Act must be reconsidered if new information reveals impacts that may affect federally listed species or critical habitat in a manner not previously considered, the proposed project is subsequently modified to include activities which were not considered during Section 7 consultation with the USFWS, or new species are listed or critical habitat designated that might be affected by the subject Replacement Runway 10R/28L project site and off-site "Eastside Nursery Site."

Cultural Resources

31. In the event any previously unknown historic or archaeological sites or human remains are uncovered while accomplishing the activity authorized by this DA permit, the permittee must cease all work immediately and contact local, state and county law enforcement offices (only contact law enforcement on findings of human remains), the USACE-Huntington District Regulatory Branch and Ohio State Historic Preservation Office. The USACE-Huntington District Regulatory Branch will initiate the Federal, state and tribal coordination required to comply with the National Historic Preservation Act and applicable state and local laws and regulations. Federally recognized tribes are afforded a government-to-government status as sovereign nations and consultation is required under Executive Order 13175 and 36 CFR Part 800.

Project Compliance

32. If it is determined the permittee's authorized discharges of dredged/fill material associated with the Replacement Runway 10R/28L project site and off-site "Eastside Nursery Site" are in non-compliance with the permit terms and conditions, the permittee must immediately take necessary actions to bring its project into compliance with the terms and conditions of this DA permit. Failure to do so can result in the modification, suspension or revocation pursuant to 33 CFR 325.7 or enforcement procedures pursuant to 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring permittees to comply with the terms and conditions of their permit and for the initiation of legal action where appropriate.

Other Requirements

33. The culvert base or invert at the location of the substrate of the 592 linear feet of Mason Run will be installed below the sediment to allow natural channel bottom to develop and to be retained. The channel bottom substrate would be similar to and contiguous with the immediate upstream and downstream reaches of the stream.

34. The permittee shall maintain a detailed accounting of the stream and wetland mitigation credits at the "Eastside Nursery Site." The accounting shall include the total acres of wetlands and linear feet of streams as initially built and approved under a Nationwide Permit 27 verification dated March 19, 2010. Additionally, the wetland acreage and/or linear footage of streams debited shall be included for each Section 401 Water Quality Certification, isolated OEPA wetland permit, or USACE DA permit. The balance of available wetland acreage and linear footage of streams for use shall also be noted for use as future mitigation.

Ohio | **Environmental Protection Agency**
John R. Kasich, Governor
Mary Taylor, Lt. Governor
Scott J. Nally, Director

Certified Mail

2011 JAN 19 A 10: 25

I certify this to be a true and accurate copy of the official documents as filed in the records of the Ohio Environmental Protection Agency.

Dana Lassiter Date 1-19-11

January 19, 2011

Ms. Elaine Roberts
Columbus Regional Airport Authority
4600 International Gateway
Columbus, Ohio 43219

Re: Columbus Regional Airport Authority - Runway 10R/28L Replacement Project
Franklin/Columbus/Mifflin Township
Grant of Section 401 Water Quality Certification and Level Two Isolated Wetlands Permit: Preferred Design Alternative, Minimal Degradation Alternative
ACOE Permit No. 200300270-1 (jurisdictional waters only)
Ohio EPA ID No. 103655 (jurisdictional waters) and 103683 (isolated wetlands)

Ladies and Gentlemen:

The director of Ohio Environmental Protection Agency hereby authorizes the above referenced project under one or both of the following authorities and is subject to the following modifications and/or conditions:

Section 401 Water Quality Certification
Pursuant to Section 401 of the Federal Water Pollution Control Act, Public Law 95-217, the director of Ohio Environmental Protection Agency hereby certifies that the above referenced project will comply with the applicable provisions of Sections 301, 302, 303, 306, and 307 of the Federal Water Pollution Control Act.

Ohio Isolated Wetland Permit
Pursuant to Ohio Revised Code Chapter 6111 and Ohio Administrative Code Chapter 3745-1, and other applicable provisions of state law, the director of Ohio Environmental Protection Agency hereby concludes that the above-referenced project will comply with the applicable provisions of Sections 6111.03 and 6111.04 of the Ohio Revised Code.

This authorization is specifically limited to a Section 401 Water Quality Certification and/or Ohio Isolated Wetlands Permit with respect to water pollution and does not relieve the applicant of further Certifications or Permits as may be necessary under the law. I have determined that a lowering of water quality within the Big Walnut Creek watershed 05060001-140 as authorized by this Section 401 Water Quality Certification/Ohio Isolated Wetlands Permit is necessary. I have made this determination based upon the consideration of all public comments, and including the technical, social, and economic considerations concerning this application and its impact on waters of the state.

50 West Town Street, Suite 700
P.O. Box 1049
Columbus, OH 43216-1049

614 | 644 3020
614 | 644 3184 (fax)
www.epa.ohio.gov

ON-SITE WATER RESOURCES AND IMPACTS

A. Site Setting

Site Location: Franklin/Columbus/Mifflin Township
HUC 14-Digit and Drainage Name: 05060001-140-040, Mason Run; 05060001-140-030, Big Walnut Cr. below Rocky Fork Cr. to above Blacklick Cr. [except Mason Run]
Parcel Size: The project would replace existing runway 10R/28L and relocate it to the south. The project includes ancillary improvements including taxiway, lighting, drainage, roadway, and landing zone improvements. The total area of the project is approximately 735 acres.

B. Streams

Stream ID	Type* E, I, or P	QHEI/HHEI Score*	Total Length on Site (lf)	Total Length Impacted (lf)	Impact Type	% Avoided
Mason Run	perennial	-/36	8,229	592	culvert	93.6
			8,229	592		93.6

* As modified by Ohio EPA

C. Wetlands

Wetland ID	Iso or JD	Forested or Non?	ORAM/ Cat	Total Acreage on Site	Total Acreage Impacted	% Avoided	Mitigation Ratio	Mitigation Acreage
1	ISO	F	45/2	0.11	0	100	0	0
2	ISO	F	48/2	0.84	0	100	0	0
3	ISO	F	39/2	0.06	0.06	0	2.5	0.15
4	ISO	F	39/2	0.07	0.07	0	2.5	0.175
5	ISO	F	39/2	0.05	0.05	0	2.5	0.125
6	ISO	F	41/2	0.03	0.03	0	2.5	0.075
7	ISO	F	42/2	0.14	0.14	0	2.5	0.35
8	ISO	F	49/2	0.39	0.39	0	2.5	0.975
9	ISO	F	47/2	0.05	0.05	0	2.5	0.125
10	ISO	F	48/2	0.21	0	100	0	0
11A-Z	ISO	NF	27.5/1	6.19	0	100	0	0
Turkey Run	JD	NF		1.81	0.14	0	1.5	0.21
Totals				10.09	0.93	90.8		2.185

*ORAM/Category scores based upon OEPA revisions dated May 11, 2009.

D. Lakes

No lake impacts are authorized by this water quality certification/isolated wetlands permit.

II. GENERAL CONDITIONS

A. All water resources and their buffers which are to be avoided shall be clearly indicated on site drawings and demarcated in the field with suitable materials, prior to site disturbance. These materials shall remain in place and be maintained throughout the construction process.

B. Best Management Practices (BMPs) must be employed throughout the course of this project to avoid the creation of unnecessary turbidity which may degrade water quality or adversely affect aquatic life outside of the project area.

C. Temporary fill shall consist of suitable non-erodible material or shall be stabilized to prevent erosion.

D. Procedures shall be developed and implemented to eliminate the possibility of spills and to control dust that may enter the waterway by runoff or point discharge.

E. Unpermitted impacts to surface water resources and/or their buffers occurring as a result of this project will be reported within 24 hours of occurrence to Ohio EPA for further evaluation.

F. In temporary impact areas where trees have been removed to facilitate construction, they shall be replaced with appropriate native tree species.

G. Stormwater basins on the site which have Extended Detention or Permanent Pool water quality features shall meet the design specifications in Ohio EPA Permit OHC000003 effective April 21, 2008. Storm water basins on site which have water quality features (Forebay, Aquatic Benches and Wetlands, Optimum Flow Length, Reverse Flow Pipe, Optimum Pool Depth, Shading and Buffer Plants, and Runoff Reuse) shall meet the design specifications contained in the Ohio Department of Natural Resources Rainwater and Land Development document, second edition, 1996, or successor document.

H. Stormwater management measures shall be inspected immediately after each rainfall and at least daily during periods of prolonged rainfall. Specifications for any necessary repairs and removal of sediment deposition shall be developed as needed in the Stormwater Pollution Prevention Plan for the site.

I. In the event that there is a conflict between the Section 401 and/or Isolated Wetlands permit application and the conditions within this water quality certification and/or isolated wetlands permit, the condition shall prevail unless Ohio EPA agrees, in writing, that the Section 401 and/or Isolated Wetlands permit application or other provision prevails.

J. Representatives from the Ohio EPA, Division of Surface Water will be allowed to inspect the authorized activity at any time deemed necessary to insure that it is being or has been accomplished in accordance with the terms and conditions of this water quality certification.

K. This proposal may require other permits from Ohio EPA. For information concerning application procedures, contact the Ohio EPA District Office at the following address:

Central District Office, 3232 Alum Creek Drive, Columbus, Ohio 43207.

L. This water quality certification shall be effective for a period of five years from the date of issuance of the Section 404 Permit. However, stream and wetland mitigation obligations described in Section III below will remain in force should the performance criteria specified in Section III.D have not been meet within the prescribed time frames.

III. MITIGATION

A. Description of Required Mitigation

The applicant is authorized to conduct stream and wetland mitigation at the proposed Eastside Nursery site located in Madison Township, Franklin County, southwest of Lithopolis Road, east of Richardson Road, and north of Dellen Road. The Eastside Nursery mitigation site is to be a single user pooled mitigation site to locally accommodate the mitigation needs for various projects undertaken by the Columbus Regional Airport Authority. The Eastside Nursery mitigation site will provide 2,700 linear feet of stream mitigation credits and at total of 22.5 acres of wetland mitigation credit. The requirements described in Section III. A. 1 and 2 below shall be conducted at the Eastside Nursery site to satisfy stream and wetland mitigation requirements for the Runway 10R/28L Replacement project covered by this Section 401 Water Quality Certification (103655 JD, 103683 – Iso).

1. Wetlands

    a. Restore 1.975 acres of forested wetlands that meet criteria for Category 2 wetlands or greater at the Eastside Nursery site.

    b. Restore 0.21 acres of non-forested wetlands that meet criteria for Category 2 wetlands or greater at the Eastside Nursery site.

2. Streams

    Restore 888 linear feet of Big Run at the Eastside Nursery Site to meet a minimum Qualitative Habitat Evaluation Index (QHEI) score of 60 and meet criteria for the warmwater habitat aquatic life use designation.

B. Timing of Mitigation Requirements

1. Within thirty (30) days from the date of the authorized Section 404 Permit, the applicant shall submit a Final Stream and Wetland Mitigation Plan to Ohio EPA for review and approval. The Final Stream and Wetland Mitigation Plan shall contain a schedule of implementation.

2. The mitigation monitoring period shall commence after the 1st growing season following completion of mitigation construction and shall continue through a five-year monitoring period for the stream restoration and a ten year period for wetland mitigation, unless otherwise agreed upon by Ohio EPA.

3. For mitigation with a preservation component, the applicant shall submit to Ohio EPA an either acceptable, notarized, recorded, and filed conservation easement or environmental covenant held by an organization meeting the requirements of section 5301.68 of the Ohio Revised Code. The conservation easement or environmental covenant shall protect, in perpetuity, all wetlands associated with the Eastside Nursery Wetland Mitigation site utilized by the CRAA.

C. General Monitoring and Reporting Requirements

1. <u>Monitoring Reports</u>: Annual reports containing the data listed in the appropriate subsections below shall be submitted to Ohio EPA for each of five consecutive years (1, 2, 3, 4 and 5) for stream restoration and every other year of the ten years (1, 3, 5, 7 and 10) for wetland mitigation following completion of mitigation construction. The first annual report is due to Ohio EPA by December 31 of the first full year

following completion of mitigation construction. All subsequent reports shall be submitted by December 31st of each of the subsequent monitoring years. The applicant may include any additional information that it believes relevant for Ohio EPA's consideration. Monitoring reports for past and future certifications utilizing the Eastside Nursery shall be combined into a single report. The Monitoring Report shall clearly list the project and SWIMS numbers for every certification included in the report.

2. As-built Drawings: As- built drawings shall be submitted within 180 days following completion of construction for both stream and wetland mitigation sites. The drawings shall be no larger than 11" by 17" for each of the mitigation streams and wetlands.

3. Photographs: A representative observation point shall be selected in each plant community type in distinct mitigation area. This shall be a point which best represents the characteristics of the entire plant community. The observation points shall be marked on the base map.

   Applicant shall take photographs from these points during all five years for five years in the case of streams and bi-annually for 10 years in the case of wetlands. Each color photo point shall be photo documented from the same position and angle during July of each monitoring year.

4. Credit/Debit Accounting: The applicant shall maintain a detailed accounting of the stream and wetland mitigation credits at the Eastside Nursery mitigation site. The accounting shall include a) the total acres of wetlands and linear feet of streams as initially built and approved, b) the wetland acreage and/or linear footage of streams debited for each 401 water quality certification, isolated wetland permit, or nationwide permit, and c) the balance of available wetland acreage and linear footage of streams available for use as mitigation and the US permit number and/or OEPA ID number. The applicant shall submit items a through c above in writing, for every 401 water quality or isolated wetland permit mitigated at the Eastside Nursery site by the CRAA.

D. Wetland Mitigation Monitoring and Reporting Requirements

1. Monitoring Reports: Cells 1A and 1B of the Eastside Nursery Wetland Mitigation Site shall be monitored for a period of not less than 10 years. Reports that contain the data listed in the appropriate subsections below, shall be submitted to Ohio EPA for the 1st, 3rd, 5th, 7th and 10th years starting after the 1st full growing season following completion of

mitigation construction. The first annual report is due to Ohio EPA by December 31 of the first full year following completion of mitigation construction. All subsequent reports shall be submitted by December 31st of each of the subsequent monitoring years.

The applicant may include any additional information that it believes relevant for Ohio EPA's consideration.

2. As-built Drawings: An as-built drawing shall be submitted to Ohio EPA within 180 days of construction completion.

3. Physical Measurements: A plan view and at least one cross-section through the short axis and another through the long axis is required for each mitigated wetland. This information will be collected as part of the as-built survey completed for each mitigated wetland.

4. Water Chemistry Monitoring: A representative grab sample(s) shall be collected in May of each monitoring year in each wetland mitigation area where standing water is present. The samples shall be analyzed for ammonia, nitrates, nitrite, carbon, total sulfates, total iron, total manganese, specific conductivity, pH, turbidity, total suspended solids, heavy metals and biochemical oxygen demand.

5. Hydrology Monitoring: Water level data shall be collected in May and late August or September of each monitoring year. Ground water levels shall be measured in the absence of inundated conditions.

6. Soils Monitoring: A soil sample shall be collected and analyzed from each VIBI plot and each focus plot for each year that monitoring reports are required. The analysis should provide a brief description (including the presence or lack of hydric soil indicators) of the soil as well as the soil color, matrix and chroma as per the Munsell Soil Color chart. This data, along with the name of the soil map unit name (soil series and phase) shall be included in each monitoring report in a tabular format.

7. Vegetation Monitoring: The location and name of each plant community type within the mitigation area and buffer area shall be marked on a scaled drawing or scaled aerial photograph (base map) and named.

   A representative observation point shall be selected in each plant community type in each distinct wetland mitigation area. This shall be a point which best represents the characteristics of the entire plant community. The observation points shall be marked on the base map.

The dominant plant species shall be visually determined in each vegetation layer of each community type, and the scientific names of these species shall be included in the report. Dominant species are those species which have the greatest relative basal area (woody overstory), greatest height (woody overstory), greatest percentage of aerial coverage (herbaceous understory), and/or greatest number of stems (woody vines).

8. Vegetation Index of Biotic Integrity (VIBI): The applicant shall assess the mitigation wetlands to obtain a VIBI score according to methods approved by Ohio EPA (http://www.epa.state.oh.us/dsw/401/401.html) during the growing season of the 1st, 3rd, 5th, 7th and 10th years after completion of construction of the mitigation wetlands.

9. Wetland Delineation: The applicant shall conduct a delineation of the restored mitigation wetlands during the growing seasons of the 5th and 10th years after completion of construction of the mitigation wetlands using the United States Army Corps of Engineers 1987 Wetland Delineation Manual (or successor document). The delineation shall be submitted with the 5th and 10 year reports.

10. Fourth Year Site Review: The applicant shall arrange an on-site mitigation meeting with Ohio EPA during the growing season after the 3rd year report has been submitted. The purpose of this inspection is to determine if the mitigation project has been constructed in accordance with the agreement between the applicant and Ohio EPA. If necessary, Ohio EPA may make recommendations to improve the wetland. The applicant is responsible for undertaking any reasonable modifications identified by Ohio EPA.

11. Eighth-Year Site Review: The applicant shall arrange an on-site mitigation meeting with Ohio EPA during the growing season after the 7th year report has been submitted. The purpose of this inspection is to determine if the mitigation project has been constructed in accordance with the agreement between the applicant and Ohio EPA. If necessary, Ohio EPA may make recommendations to improve the wetland. The applicant is responsible for undertaking any reasonable modifications identified by Ohio EPA.

12. Additional site visits may be performed at the request of Ohio EPA or the Applicant.

E. Stream Mitigation Monitoring and Reporting Requirements

The restored segment of Big Run shall be monitored annually for five years. Monitoring for QHEI, IBI, and ICI shall be conducted at two sites within the restored channel reach on the Eastside Nursery site. These two sites will be mutually agreed upon by the applicant and the Ohio EPA. Monitoring utilizing QHEI, IBI and ICI shall be conducted and reported in years 1, 3 and 5 of monitoring. The applicant may include any additional information that it believes relevant for Ohio EPA's consideration.

1. Qualitative Habitat Evaluation Index (QHEI): QHEI values for Big Run shall be calculated according to methods approved by Ohio EPA based on sampling conducted and included in the monitoring report for years one, three and five.

2. Index of Biotic Integrity (IBI): IBI values for Big Run shall be calculated according to methods approved by Ohio EPA based on sampling conducted and included in the monitoring report for years one, three and five.

3. Invertebrate Community Index (ICI): ICI values for the former Big Run shall be calculated according to methods approved by Ohio EPA based on sampling conducted and included in the monitoring report for years one, three and five.

4. Invasive Plant Species: Vegetative monitoring shall be conducted within the constructed belt-width of Big Run during years one, three, and five. A diagram depicting the scientific and common name and location for each invasive plant species and its relative abundance shall be included in the monitoring report for each year that sampling is required.

5. Physical Measurements: A plan view, longitudinal profile along the thalweg, and at least one cross-section through a pool area and another through a riffle area is required for the restored stream. Additional cross sections may be required if necessary to accommodate significant variations in slope, entrenchment or other key morphological parameters.

   Plan view measurements shall be those measurements necessary to determine sinuosity, meander length, belt width, radius of curvature, and meander arc length.

Longitudinal profile measurements shall be those measurements necessary to determine average water surface slope, riffle slope, pool slope, and riffle/pool or step/pool sequences.

Cross-sectional measurements shall include those measurements necessary to determine bankfull width, bankfull mean depth, bankfull maximum depth, flood prone area width, entrenchment ratio, and bankfull cross-sectional area.

F. Performance Criteria

1. Wetlands:

Within ten years after completion of construction, mitigation wetlands 1A and 1B of the Eastside Nursery Wetland Mitigation Site shall meet the following performance criteria:

a. Develop a minimum of 22.5 acres of forested wetlands as determined by United States Army Corps of Engineers 1987 Wetland Delineation Manual (or successor document including regional supplements as appropriate).

b. Attain a Vegetative Index of Biotic Integrity (VIBI) score of 51 for each plant community type.

c. Contain no more than 5 % invasive species.

d. Contain no less than 75% areal coverage of native perennial hydrophytes (FAC+, FACW, OBL).

e. Contain less than 10% of its total area as "unvegetated open water" defined as inundated areas where there is no or minimal emergent, rooted aquatic bed, (e.g. *Nuphar advena*, *Nymphaeae odorata*, *Potamogeton spp.*), or submersed or floating non-rooted aquatic bed (e.g. *Utricularia spp.*, *Ceratophyllum spp.* excluding species in the *Lemnaceae*) vegetation growing in the area of inundation.

f. A minimum 50%of the perimeter shall have slopes no greater than 15:1.

g. Forested components of the mitigation wetlands shall be demonstrated by graphing standard forest measures (frequency, density, dominance, and importance values) against time, to be on a trajectory towards becoming forested wetlands.

2. Streams

Within five years after completion of construction, the restored 2,700 linear feet of Big Run on the Eastside Nursery site shall meet the following performance criteria:

a. Attain a Qualitative Habitat Evaluation Index (QHEI) score of 60.

b. Meet criteria for the warmwater habitat aquatic life use designation.

G. Contingency Plans

1. If the mitigation areas are not performing as proposed by the end of the fifth year of post construction monitoring for the stream restoration and tenth year of post construction for the wetland restoration, the monitoring period may be extended and/or the applicant may be required to revise the existing mitigation or seek out new or additional mitigation areas. However, if after the required post construction monitoring is completed, the stream and wetland mitigation areas are demonstrated, by graphing measurements against time, to be on a trajectory toward the stated performance criteria, the applicant may request that Ohio EPA consider the mitigation areas deemed successful and that no additional monitoring be required.

2. For the stream restoration, specifically, if the monitoring data demonstrates a lack of sufficient hydrology that would be necessary to meet the criteria of WWH, the applicant may request Ohio EPA consider the mitigation areas deemed successful and that no additional monitoring is to be required.

3. The applicant may provide any other information it wishes Ohio EPA to consider when determining whether the stream or wetland mitigation sites are meeting, or have met, the performance criteria required above. Ohio EPA may reduce or increase the number of years for which monitoring is required to be conducted based on the effectiveness of the mitigation.

4. Any deviations from the monitoring period described in this water quality certification must be approved by Ohio EPA in writing.

IV. NOTIFICATIONS TO OHIO EPA

All notifications, correspondence, and reports regarding this Section 401 Water Quality Certification and/or Isolated Wetlands Permit shall reference the following information:

Applicant: Columbus Regional Airport Authority
Project: Runway 10R/28L Replacement Project
Ohio EPA ID#: 103655 (JD waters) and 103683 (isolated wetlands)

and shall be sent to:

Ohio EPA, Division of Surface Water, 401 Unit
Lazarus Government Center
50 West Town Street
P.O. Box 1049
Columbus, Ohio 43216-1049

You are hereby notified that this action of the director is final and may be appealed to the Environmental Review Appeals Commission pursuant to Section 3745.04 of the Ohio Revised Code. The appeal must be in writing and set forth the action complained of and the grounds upon which the appeal is based. The appeal must be filed with the Commission within thirty (30) days after notice of the director's action. The appeal must be accompanied by a filing fee of $70.00 which the Commission, in its discretion, may reduce if by affidavit you demonstrate that payment of the full amount of the fee would cause extreme hardship. Notice of the filing of the appeal shall be filed with the director within three (3) days of filing with the Commission. Ohio EPA requests that a copy of the appeal be served upon the Ohio Attorney General's Office, Environmental Enforcement Section. An appeal may be filed with the Environmental Review Appeals Commission at the following address:

Environmental Review Appeals Commission
309 South Fourth Street, Room 222
Columbus, OH 43215

Sincerely,

Scott J. Nally
Director

cc: Susan Fields, U.S. Army Corps of Engineers, Huntington District
Tim Mentel, CRAA, 4600 International Gateway, Columbus,OH 43219
John Watts, Columbus Metroparks, 1069 West Main Street, Westerville, Ohio 43081-1181
Kevin Pierard, U.S. EPA, Region 5
Mary Knapp, U.S. Fish & Wildlife Service
Brian Mitch, ODNR, Division of Real Estate & Land Management
Jeff Bohne, Ohio EPA, Central District Office
Susan Applegate, OEPA, DEFA
Dave Snyder, Ohio Historical Preservation Office, 1982 Velma, Columbus, OH 43211
Tom Harcarik, Ohio EPA, DSW, 401 Reviewer
Jeff Boyles, Ohio EPA, DSW, Mitigation Coordinator

Appendix I
Stream and Wetland Mitigation Report Submission Schedule
OEPA ID No. 103655 and 103683

Streams Mitigation Reporting

	Year 1	Year 2	Year 3	Year 4	Year 5
Submit Report	X	X	X	X	X
As Built Drawings	180 days				
Photos	X	X	X	X	X
QHEI	X	X	X	X	X
IBI/ICI Data	X		X		X
Physical Measurements	X		X		X
Regulatory Site Visit			X		

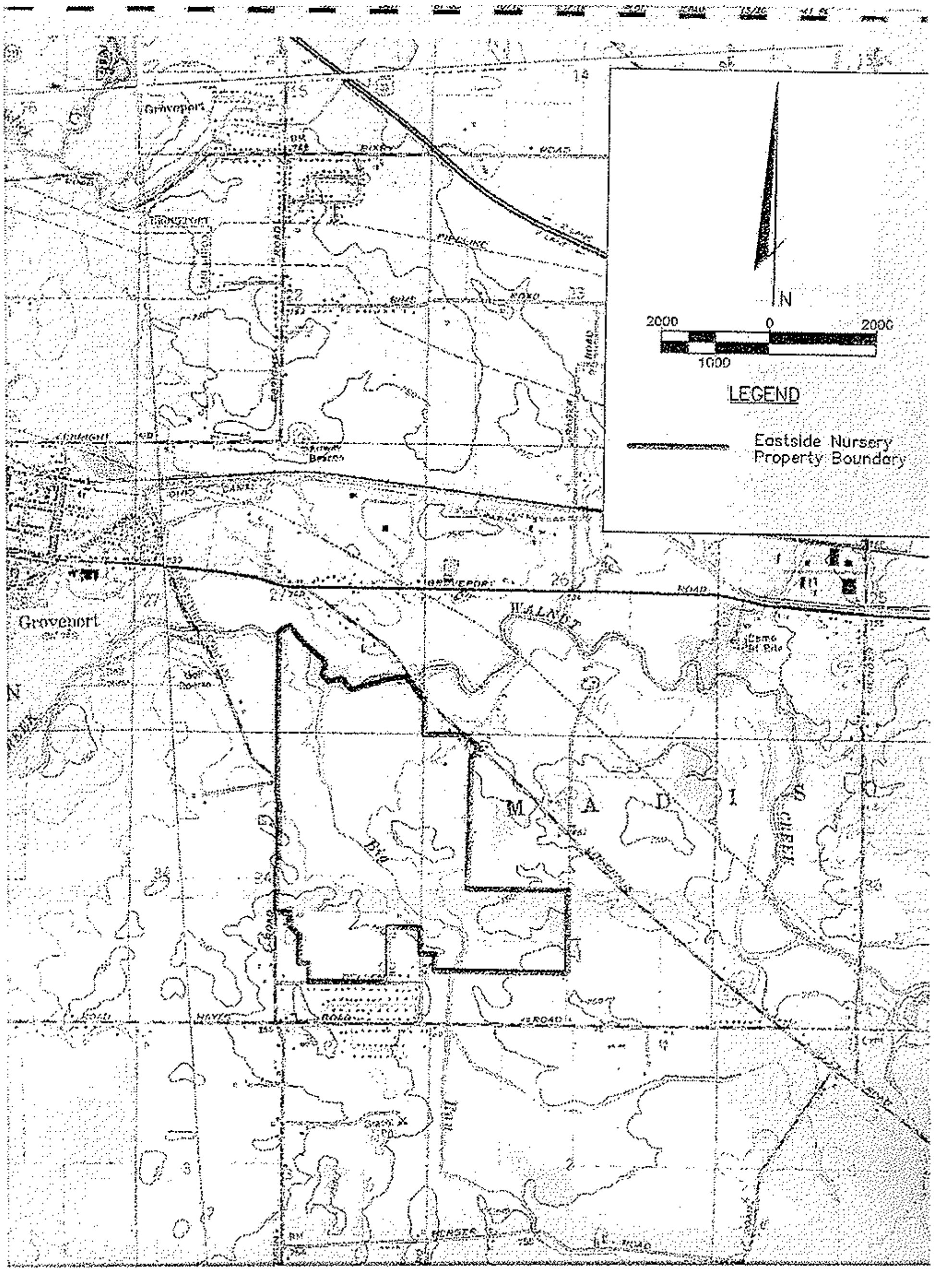
Wetlands Mitigation Reporting

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10
Submit Report	X		X		X		X			X
As Built Drawings (days after construction)	180									
Photos	X		X		X		X			X
Physical Measurements	X		X		X		X			X
Water Chemistry	X		X		X		X			X
Hydrology Monitoring	X		X		X		X			X
Soils Monitoring	X		X		X		X			X
Vegetation Monitoring	X		X		X		X			X
VIBI	X		X		X		X			X
Wetland Delineation					X					X
Regulatory Site Visit				X				X		

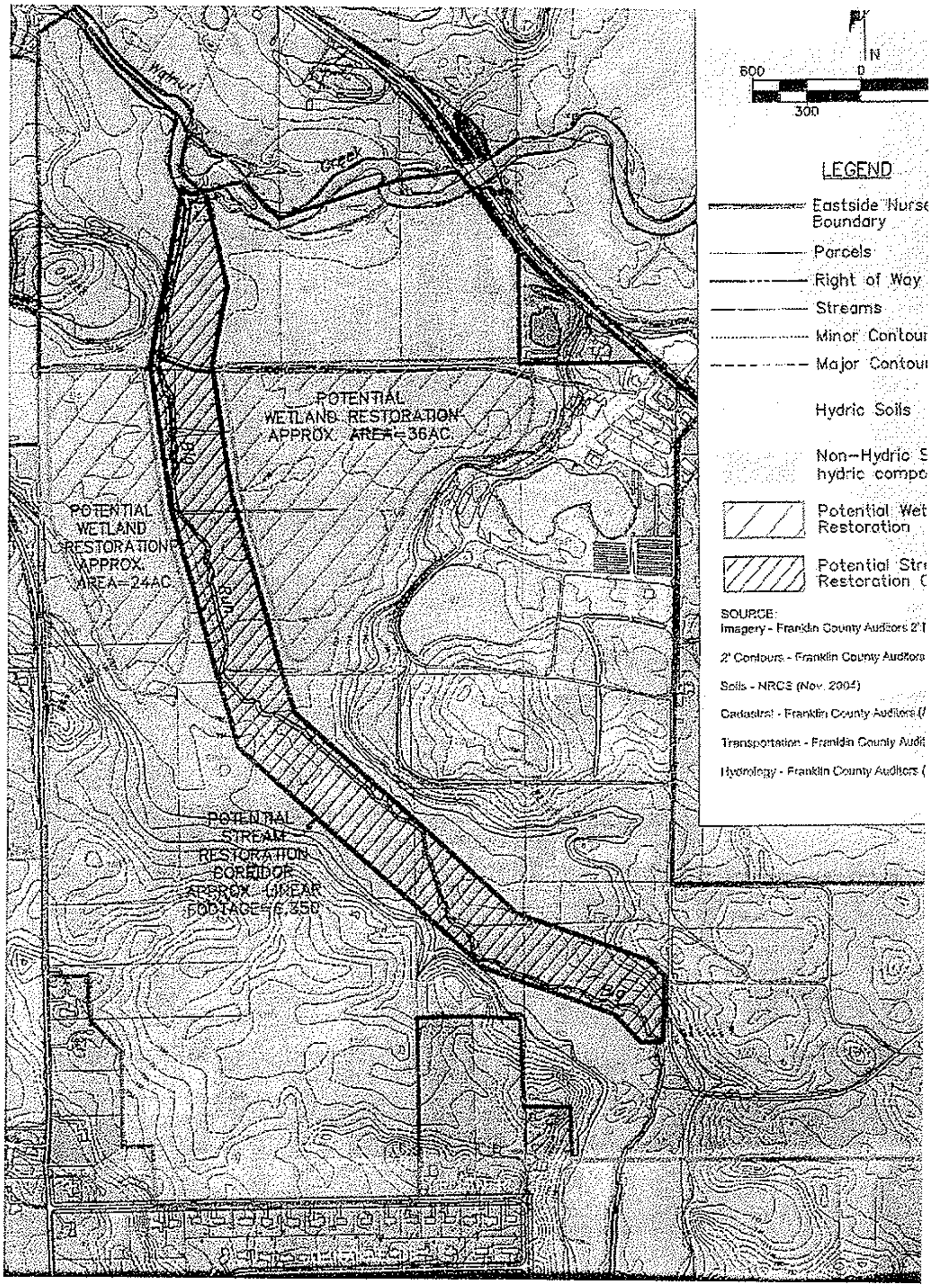
Appendix II

Eastside Nursery – General Location Map

OEPA ID No. 103655 and 103683



Appendix III
Eastside Nursery Potential Mitigation Areas
OEPA ID No. 103655 and 103683



Appendix IV
Runway Relocation Project Location
OEPA ID No. 103655 and 10368

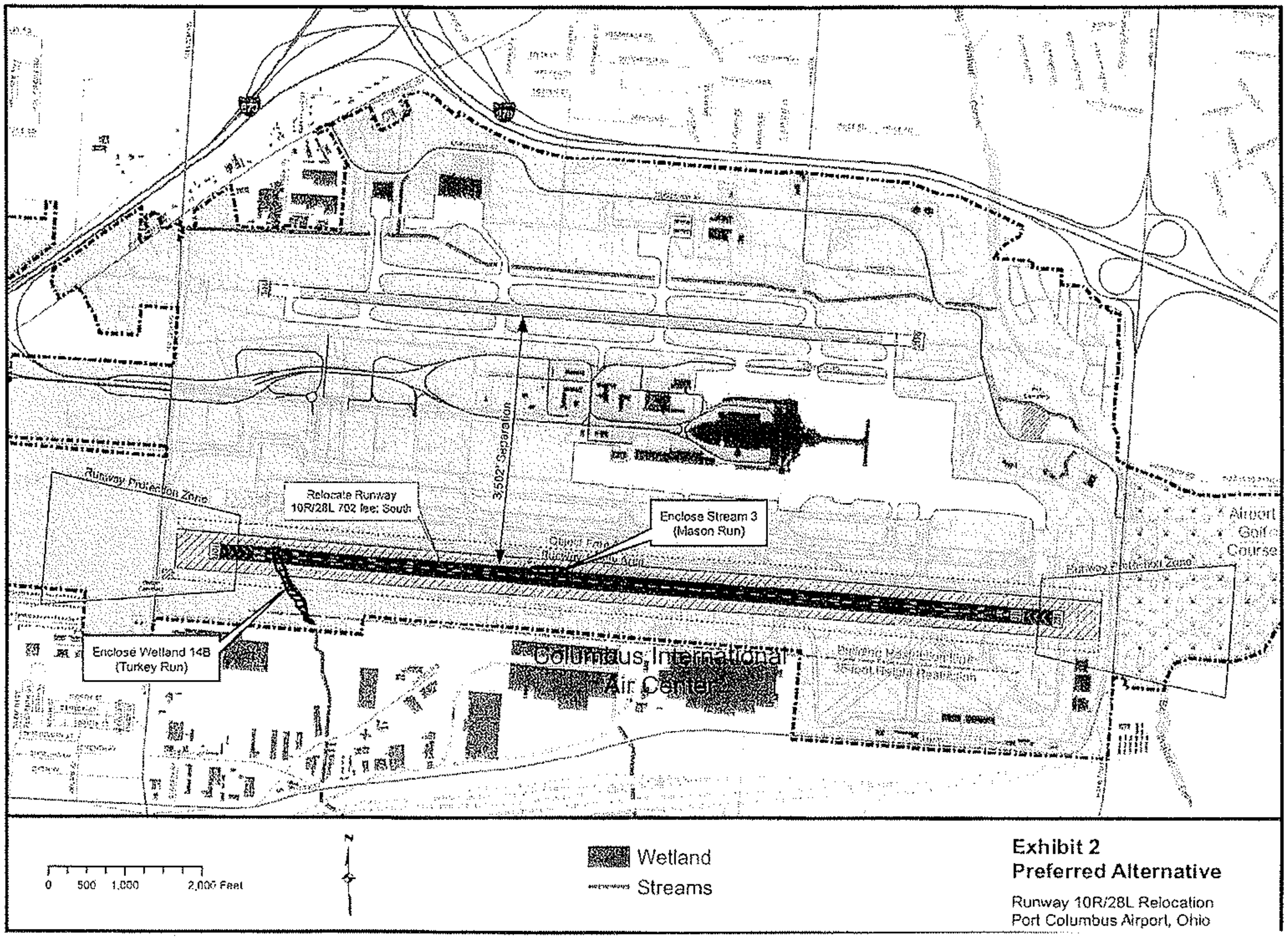


Exhibit 2
Preferred Alternative

Runway 10R/28L Relocation
Port Columbus Airport, Ohio

APPENDIX B:

Environmental Covenant

ENVIRONMENTAL COVENANT
60.100 ACRES

Situated in the State of Ohio, County of Franklin, Township of Madison, lying in Sections 27 and 34, Township 11, Range 21, Matthew's Survey of Congress Lands, being on, over, and across those 29.6483 and 151.834 acre tracts conveyed to Eastside Nursery, Inc. by deed of record in Official Record 20730D05, that 44.33 acre tract conveyed to Eastside Nursery, Inc. by deed of record in Deed Volume 2716, Page 332, and that 117.657 acre tract conveyed to Eastside Nursery, Inc. by deed of record in Instrument Number 200705040078337 (all references refer to the records of the Recorder's Office, Franklin County, Ohio), and described as follows:

Beginning, for reference, at the southeasterly corner of said 44.33 acre tract, at the southwesterly corner of that 13.71 acre tract conveyed to Eastside Nursery, Inc. by deed of record in Official Record 12726C06, being on the northerly line of said 117.657 acre tract, and the line common to Sections 27 and 34;

thence North 85° 07' 08" West, with the line common to said 29.6483 and 44.33 acre tracts, a distance of 306.29 feet to the TRUE POINT OF BEGINNING;

thence across said 117.657, 151.834, 29.6483, and 44.33acre tracts, the following courses and distances:

South 19° 19' 33" East, a distance of 122.82 feet to a point;

South 01° 09' 57" West, a distance of 518.91 feet to a point;

South 30° 38' 43" East, a distance of 293.37 feet to a point;

South 03° 48' 54" East, a distance of 634.93 feet to a point;

South 86° 11' 06" West, a distance of 325.00 feet to a point;

South 03° 48' 54" East, a distance of 673.51 feet to a point;

South 42° 59' 40" East, a distance of 441.36 feet to a point;

South 51° 08' 35" West, a distance of 394.51 feet to a point;

North 44° 22' 25" West, a distance of 691.02 feet to a point;

North 21° 35' 53" West, a distance of 1456.48 feet to a point;

North 04° 16' 33" East, a distance of 985.01 feet to a point;

South 86° 03' 22" East, a distance of 679.98 feet to a point;

North 00° 09' 31" East, a distance of 149.68 feet to a point;

North 07° 48' 16" East, a distance of 521.70 feet to a point;

South 82° 11' 44" East, a distance of 161.89 feet to a point;

South 28° 45' 25" East, a distance of 273.81 feet to a point;

South 07° 48' 16" West, a distance of 359.07 feet to a point;

South 19° 19' 33" East, a distance of 50.69 feet to the TRUE POINT OF BEGINNING and containing 60.100 acres of land, more or less.

HEATHER L. KING
S-8307

EVANS, MECHWART, HAMBLETON & TILTON, INC.

Heather L King 1/19/20

Heather L. King Date
Registered Surveyor No. 8307

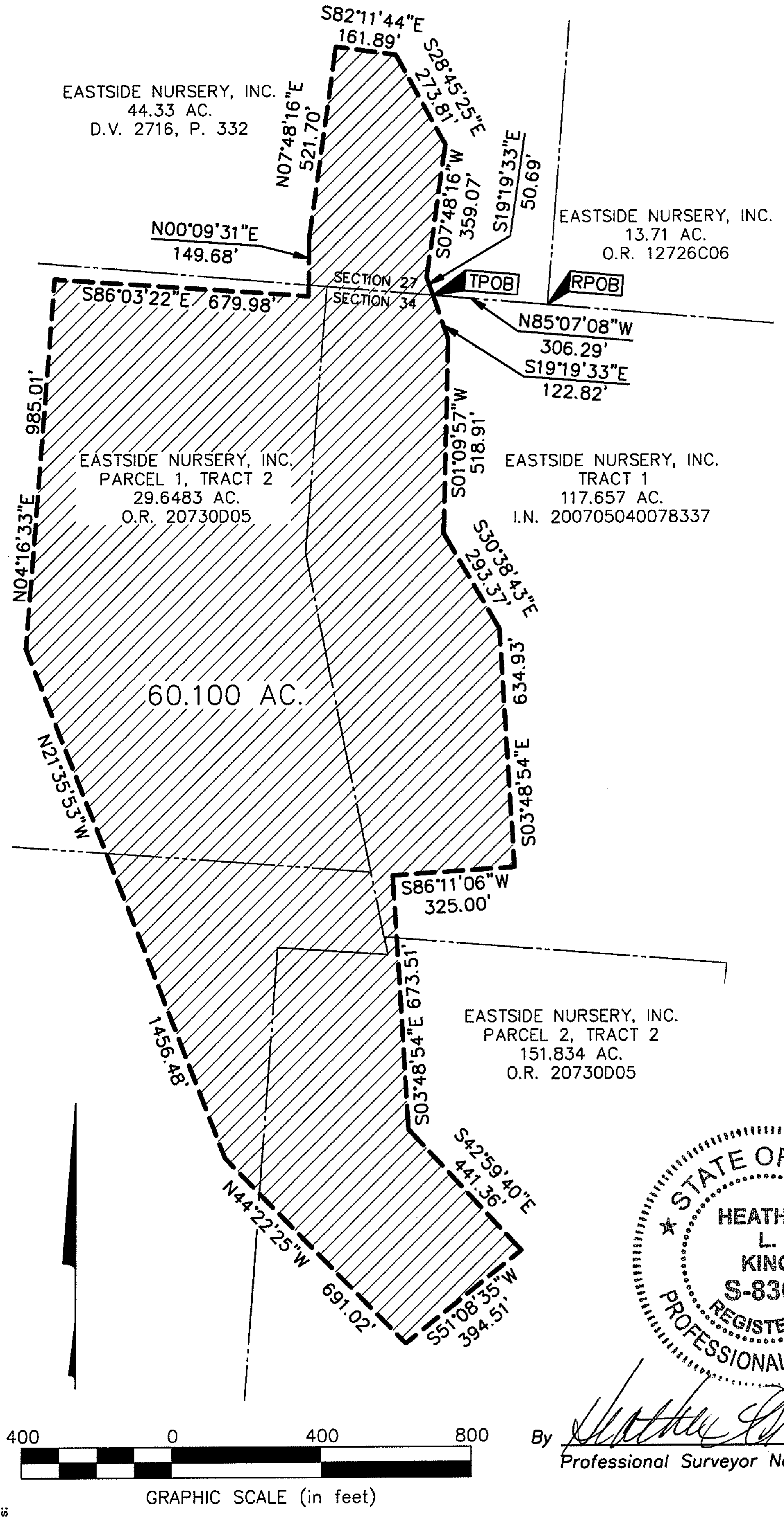
HLK: mr / November 23, 2009
60_100 ac esmt 90543ce.doc

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Toll Free: 888.775.3648
emht.com

ENVIRONMENTAL COVENANT

SECTIONS 27 & 34, TOWNSHIP 11, RANGE 21
MATTHEW'S SURVEY OF CONGRESS LANDS
TOWNSHIP OF MADISON, COUNTY OF FRANKLIN, STATE OF OHIO

Date: January 19, 2010	Job No. 2009-0543	Scale: 1" = 400'



HEATHER L. KING S-8307

By 1/19/10
Professional Surveyor No. 8250

J:\20090543\20090543SV\90543CE.DWG plotted by RISSLER, MICHAEL on 1/19/2010 2:37:57 PM last saved by MRISSLER on 1/19/2010 2:37:24 PM
Xrefs:

APPENDIX C:

Stream Data forms

EMH&T
Stream Monitoring Data Form

Project Site: Big Run/ Walnut Woods

Date of Sampling: 10/11/16

Transect Number: 1(pool)

Total Native Vegetation Cover: 99%

Dominant Species Include:
Shrub/tree stratum: *Salix nigra*
Forb stratum: *Polygonum persicaria, Polygonum lapathifolium, Echinochloa muricata*

Species Present	Stratum	Cover Class	% Cover*
Polygonum persicaria (Spotted Lady's thumb)	HERB	7	37.5
Polygonum lapathifolium (Curlytop knotweed)	HERB	6	17.5
Echinochloa muricata (Rough barnyard grass)	HERB	6	17.5
Salix nigra (Black willow)	TREE	5	7.5
Xanthium strumarium (Rough cocklebur)	HERB	5	7.5
Symphyotrichum ericoides (White heath aster)	HERB	5	7.5

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Invasive plant percentage: <2%

Other woody plants present:
Acer rubrum, Salix ericoides, Quercus bicolor, Platanus occidentalis

Other herbaceous plants present:
Solidago canadensis, Silphium perfoliatum, Poa sp., Ambrosia sp., Rumex crispus, Pilea pumila, Eragrostis spectabilis, Phalaris arundinacea

EMH&T
Stream Monitoring Data Form

Project Site: Big Run/ Walnut Woods **Date of Sampling:** 10/11/16

Transect Number: 2 (riffle) **Total Native Vegetation Cover:** 99 %

Dominant Species Include:
Shrub/tree stratum: *n/a*
Forb stratum: *Symphyotrichum ericoides*, *Leersia oryzoides*

Species Present	Stratum	Cover Class	% Cover*
Symphyotrichum ericoides (White heath aster)	HERB	7	37.5
Leersia oryzoides (Rice cutgrass)	HERB	7	37.5
Polygonum persicaria (Spotted Lady's thumb)	HERB	5	7.5
Polygonum lapathifolium (Curlytop knotweed)	HERB	5	7.5
Echinochloa muricata (Rough barnyard grass)	HERB	5	7.5
Pilea pumila (Clearweed)	HERB	4	3.25
Xanthium strumarium (Rough cocklebur)	HERB	4	3.25

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Invasive plant percentage: <2%

Other woody plants present:
Salix nigra, Salix ericoides, Quercus bicolor, Populus deltoides

Other herbaceous plants present:
Solidago canadensis, Silphium perfoliatum, Epilobium coloratum, Sorghastrum nutans, Eragrostis sp., Phalaris arundinacea, Schoenoplectus pungens

EMH&T
Stream Monitoring Data Form

Project Site: Big Run/ Walnut Woods **Date of Sampling:** 10/11/16

Transect Number: 3 (pool) **Total Native Vegetation Cover:** 98%

Dominant Species Include:
Shrub/tree stratum: *Salix nigra,*
Forb stratum: *Solidago canadensis, Impatiens capensis*

Species Present	Stratum	Cover Class	% Cover*
Salix nigra (Black willow)	TREE	9	82.5
Solidago canadensis (Canada goldenrod)	HERB	4	3.25
Cephalanthus occidentalis (Buttonbush)	TREE	4	3.25
Impatiens capensis (Jewelweed)	HERB	4	3.25

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Invasive plant percentage: 0%

Other woody plants present: n/a

Other herbaceous plants present: *Silphium perfoliatum, Eragrostis sp., Pilea pumila, Symphyotrichum ericoides*

EMH&T
Stream Monitoring Data Form

Project Site: Big Run/ Walnut Woods **Date of Sampling:** 10/11/16

Transect Number: 4 (riffle) **Total Native Vegetation Cover:** 85%

*Bare ground and dead invasive plants comprise 15%

Dominant Species Include:

Shrub/tree stratum: *Salix nigra, Platanus occidentalis, Salix exigua*

Forb stratum: *Symphyotrichum ericoides*, *Solidago canadensis, Elymus virginicus, Silphium perfoliatum*

Species Present	Stratum	Cover Class	% Cover*
Symphyotrichum ericoides (White heath aster)	HERB	7	37.5
Solidago canadensis (Canada goldenrod)	HERB	6	17.5
Elymus virginicus (Virginia wildrye)	HERB	6	17.5
Silphium perfoliatum (Cup plant)	HERB	6	17.5
Salix nigra (Black willow)	TREE	5	7.5
Platanus occidentalis (American sycamore)	TREE	4	3.25
Salix exigua (Sandbar willow)	TREE	4	3.25
Xanthium strumarium (Rough cocklebur)	HERB	4	3.25
Cirsium sp. (Thistle)	HERB	4	3.25

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Invasive plant percentage: <1%; Recent treatment of *Phalaris arundinacea* present

Other woody plants present: Quercus bicolor, Juglans nigra

Other herbaceous plants present: *Sorghastrum nutans, Eragrostis sp.,*

EMH&T
Stream Monitoring Data Form

Project Site: Big Run/ Walnut Woods **Date of Sampling:** 10/11/16

Transect Number: 5 (pool) **Total Native Vegetation Cover:** 90%

*Bare ground and dead invasive plants comprise 10%

Dominant Species Include:
Shrub/tree stratum: *Salix nigra,*
Forb stratum: *Symphyotrichum ericoides*, *Solidago canadensis*

Species Present	Stratum	Cover Class	% Cover*
Salix nigra (Black willow)	TREE	7	37.5
Solidago canadensis (Canada goldenrod)	HERB	7	37.5
Symphyotrichum ericoides (White heath aster)	HERB	7	37.5
Salix amygdaloides (Peachleaf willow)	TREE	5	7.5
Cephalanthus occidentalis (Buttonbush)	TREE	4	3.25

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Invasive plant percentage: <1%; Recent treatment of *Phalaris arundinacea* present

Other woody plants present: n/a

Other herbaceous plants present: *Elymus virginicus, Eragrostis sp., Asclepias incarnata, Silphium perfoliatum*

EMH&T
Stream Monitoring Data Form

Project Site: Big Run/ Walnut Woods **Date of Sampling:** 10/11/16

Transect Number: 6 (riffle) **Total Native Vegetation Cover:** 90%
*Bare ground and dead invasive plants comprise 10%

Dominant Species Include:
Shrub/tree stratum: *Salix nigra, Platanus occidentalis*
Forb stratum: *Symphyotrichum ericoides*, *Eragrostis sp.*

Species Present	Stratum	Cover Class	% Cover*
Solidago canadensis (Canada goldenrod)	HERB	7	37.5
Eragrostis sp. (Lovegrass)	HERB	6	17.5
Salix nigra (Black willow)	TREE	5	7.5
Silphium perfoliatum (Cup plant)	HERB	5	7.5
Lysimachia nummularia (moneywort)	HERB	5	7.5
Platanus occidentalis (American sycamore)	TREE	4	3.25
Rumex crispus (Curly dock)	HERB	4	3.25

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Invasive plant percentage: <1%; Recent treatment of *Phalaris arundinacea* present

Other woody plants present: Acer rubrum, Morus sp.

Other herbaceous plants present: *Ambrosia sp., Cirsium sp., Symphyotrichum ericoides, Vernonia gigantea, Convolvulus sp., Polygonum sp.*

EMH&T
Stream Monitoring Data Form

Project Site: Big Run/ Walnut Woods **Date of Sampling:** 10/11/16

Transect Number: 7 (pool) **Total Native Vegetation Cover:** 95%
*Bare ground and dead invasive plants comprise 5%

Dominant Species Include:
Shrub/tree stratum: *Salix exigua, Salix nigra,*
Forb stratum: *Solidago canadensis, Silphium perfoliatum, Eragrostis sp.*

Species Present	Stratum	Cover Class	% Cover*
Salix exigua (Sandbar willow)	TREE	7	37.5
Salix nigra (Black willow)	TREE	6	17.5
Solidago canadensis (Canada goldenrod)	HERB	6	17.5
Salix amygdaloides (Peachleaf willow)	TREE	5	7.5
Silphium perfoliatum (Cup plant)	HERB	5	7.5
Eragrostis sp. (Lovegrass)	HERB	5	7.5
Pilea pumila (Clearweed)	HERB	4	3.25

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Invasive plant percentage: <1%; Recent treatment of *Phalaris arundinacea* present

Other woody plants present: *Cephalanthus occidentalis, Cornus sericea*

Other herbaceous plants present: *Vernonia gigantea, Convolvulus sp., Potamogeton nodosus, Leersia oryzoides*

EMH&T
Stream Monitoring Data Form

Project Site: Big Run/ Walnut Woods

Date of Sampling: 10/11/16

Transect Number: 8 (riffle)

Total Native Vegetation Cover: 90%
*Bare ground and dead invasive plants comprise 10%

Dominant Species Include:
Shrub/tree stratum: *Salix nigra*
Forb stratum: *Solidago canadensis, Leersia oryzoides, Elymus virginicus, Symphyotrichum ericoides*

Species Present	Stratum	Cover Class	% Cover*
Solidago canadensis (Canada goldenrod)	HERB	6	17.5
Leersia oryzoides (Rice cutgrass)	HERB	5	7.5
Salix nigra (Black willow)	TREE	5	7.5
Elymus virginicus (Virginia wildrye)	HERB	5	7.5
Symphyotrichum ericoides (White heath aster)	HERB	5	7.5
Echinochloa muricata (Rough barnyard grass)	HERB	4	3.25
Polygonum lapathifolium (Curlytop knotweed)	HERB	4	3.25
Silphium perfoliatum (Cup plant)	HERB	4	3.25
Xanthium strumarium (Rough cocklebur)	HERB	5	7.5

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Invasive plant percentage: <1%; Recent treatment of *Phalaris arundinacea* present

Other woody plants present: *Acer rubrum, Salix amygdaloides*

Other herbaceous plants present: *Eragrostis sp.*

APPENDIX D:

Big Run QHEI Forms

OhioEPA

Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 65

Stream & Location: Big Run Section 1, Walnut Woods Stream Relocation ***RM:*** _ _ _._ ***Date:*** 10 / 11 / 16

Scorers Full Name & Affiliation: Stephen Bailey/ EMH&T

River Code: _ _ _- _ _ _- _ _ _ ***STORET #:*** _ _ _ _ _ _ ***Lat./ Long.:*** (NAD 83 - decimal °) _ _ . _ _ _ _ /8_ . _ _ _ _ ***Office verified location*** ☐

1] *SUBSTRATE*

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

		BEST TYPES	POOL	RIFFLE			OTHER TYPES	POOL	RIFFLE
☐	☐	**BLDR /SLABS [10]**			☐	☐	**HARDPAN [4]**		10
☐	☐	**BOULDER [9]**			☐	☐	**DETRITUS [3]**	10	
☐	☐	**COBBLE [8]**		15	☐	☐	**MUCK [2]**		
☐	▣	**GRAVEL [7]**	10	50	☐	☐	**SILT [2]**	20	10
▣	☐	**SAND [6]**	60	15	☐	☐	**ARTIFICIAL [0]**		
☐	☐	**BEDROCK [5]**							

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ **4 or more [2]** ☑ **3 or less [0]**

Comments

Excellent natural substrate. Some concrete and brick

Check ONE (*Or 2 & average*)

ORIGIN
- ☐ **LIMESTONE [1]**
- ☐ **TILLS [1]**
- ☐ **WETLANDS [0]**
- ☐ **HARDPAN [0]**
- ☑ **SANDSTONE [0]**
- ☐ **RIP/RAP [0]**
- ☐ **LACUSTRINE [0]**
- ☐ **SHALE [-1]**
- ☐ **COAL FINES [-2]**

QUALITY

SILT
- ☐ **HEAVY [-2]**
- ☑ **MODERATE [-1]**
- ☐ **NORMAL [0]**
- ☐ **FREE [1]**

EMBEDDEDNESS
- ☐ **EXTENSIVE [-2]**
- ☑ **MODERATE [-1]**
- ☐ **NORMAL [0]**
- ☐ **NONE [1]**

Substrate 11 *Maximum 20*

2] *INSTREAM COVER*

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

	UNDERCUT BANKS [1]	1	**POOLS > 70cm [2]**		**OXBOWS, BACKWATERS [1]**
2	**OVERHANGING VEGETATION [1]**		**ROOTWADS [1]**	1	**AQUATIC MACROPHYTES [1]**
	SHALLOWS (IN SLOW WATER) [1]		**BOULDERS [1]**	1	**LOGS OR WOODY DEBRIS [1]**
1	**ROOTMATS [1]**				

AMOUNT

Check ONE (*Or 2 & average*)
- ☐ **EXTENSIVE >75% [11]**
- ☑ **MODERATE 25-75% [7]**
- ☐ **SPARSE 5-<25% [3]**
- ☐ **NEARLY ABSENT <5% [1]**

Comments

Cover *Maximum 20* 13

3] *CHANNEL MORPHOLOGY*

Check ONE in each category (*Or 2 & average*)

SINUOSITY
- ☐ **HIGH [4]**
- ☑ **MODERATE [3]**
- ☐ **LOW [2]**
- ☐ **NONE [1]**

DEVELOPMENT
- ☐ **EXCELLENT [7]**
- ☐ **GOOD [5]**
- ☑ **FAIR [3]**
- ☐ **POOR [1]**

CHANNELIZATION
- ☑ **NONE [6]**
- ☐ **RECOVERED [4]**
- ☐ **RECOVERING [3]**
- ☐ **RECENT OR NO RECOVERY [1]**

STABILITY
- ☑ **HIGH [3]**
- ☐ **MODERATE [2]**
- ☐ **LOW [1]**

Comments

Channel *Maximum 20* 15

4] *BANK EROSION AND RIPARIAN ZONE*

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ☑ ☑ **NONE / LITTLE [3]**
- ☐ ☐ **MODERATE [2]**
- ☐ ☐ **HEAVY / SEVERE [1]**

RIPARIAN WIDTH (L R)
- ☑ ☑ **WIDE > 50m [4]**
- ☐ ☐ **MODERATE 10-50m [3]**
- ☐ ☐ **NARROW 5-10m [2]**
- ☐ ☐ **VERY NARROW < 5m [1]**
- ☐ ☐ **NONE [0]**

FLOOD PLAIN QUALITY (L R)
- ☐ ☐ **FOREST, SWAMP [3]**
- ☑ ☑ **SHRUB OR OLD FIELD [2]**
- ☐ ☐ **RESIDENTIAL, PARK, NEW FIELD [1]**
- ☐ ☐ **FENCED PASTURE [1]**
- ☐ ☐ **OPEN PASTURE, ROWCROP [0]**

(L R)
- ☐ ☐ **CONSERVATION TILLAGE [1]**
- ☐ ☐ **URBAN OR INDUSTRIAL [0]**
- ☐ ☐ **MINING / CONSTRUCTION [0]**

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian *Maximum 10* 9

5] *POOL / GLIDE AND RIFFLE / RUN QUALITY*

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ☐ **> 1m [6]**
- ☑ **0.7-<1m [4]**
- ☐ **0.4-<0.7m [2]**
- ☐ **0.2-<0.4m [1]**
- ☐ **< 0.2m [0]**

CHANNEL WIDTH

Check ONE (*Or 2 & average*)
- ☑ **POOL WIDTH > RIFFLE WIDTH [2]**
- ☐ **POOL WIDTH = RIFFLE WIDTH [1]**
- ☐ **POOL WIDTH < RIFFLE WIDTH [0]**

CURRENT VELOCITY

Check ALL that apply
- ☐ **TORRENTIAL [-1]**
- ☐ **VERY FAST [1]**
- ☐ **FAST [1]**
- ☐ **MODERATE [1]**
- ☑ **SLOW [1]**
- ☐ **INTERSTITIAL [-1]**
- ☐ **INTERMITTENT [-2]**
- ☐ **EDDIES [1]**

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current *Maximum 12* 7

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (*Or 2 & average*). ☐**NO RIFFLE [metric=0]**

RIFFLE DEPTH
- ☑ **BEST AREAS > 10cm [2]**
- ☐ **BEST AREAS 5-10cm [1]**
- ☐ **BEST AREAS < 5cm [metric=0]**

RUN DEPTH
- ☐ **MAXIMUM > 50cm [2]**
- ☑ **MAXIMUM < 50cm [1]**

RIFFLE / RUN SUBSTRATE
- ☐ **STABLE (e.g., Cobble, Boulder) [2]**
- ☑ **MOD. STABLE (e.g., Large Gravel) [1]**
- ☐ **UNSTABLE (e.g., Fine Gravel, Sand) [0]**

RIFFLE / RUN EMBEDDEDNESS
- ☐ **NONE [2]**
- ☐ **LOW [1]**
- ☑ **MODERATE [0]**
- ☐ **EXTENSIVE [-1]**

Comments

Riffle / Run *Maximum 8* 4

6] *GRADIENT* (9.74 ft/mi)

DRAINAGE AREA (8.5 mi²)

- ☐ **VERY LOW - LOW [2-4]**
- ☑ **MODERATE [6-10]**
- ☐ **HIGH - VERY HIGH [10-6]**

%POOL: 20 **%GLIDE:** 50

%RUN: 20 **%RIFFLE:** 10

Gradient *Maximum 10* 6

A] SAMPLED REACH
Check ALL that apply

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.
Reach is typical of stream

METHOD
☐ BOAT
☒ WADE
☐ L. LINE
☐ OTHER

STAGE
1st -sample pass- 2nd
☐ HIGH ☐
☐ UP ☐
☒ NORMAL ☒
☐ LOW ☐
☐ DRY ☐

DISTANCE
☐ 0.5 Km
☐ 0.2 Km
☒ 0.15 Km
☐ 0.12 Km
☐ OTHER
200
meters

CLARITY
1st --sample pass-- 2nd
☐ < 20 cm ☐
☐ 20-<40 cm ☐
☐ 40-70 cm ☐
☒ > 70 cm/ CTB ☒
☐ SECCHI DEPTH ☐
1st_________ cm
pass
2nd_________ cm

CANOPY
☒ > 85%- OPEN
☐ 55%-<85%
☐ 30%-<55%
☐ 10%-<30%
☐ <10%- CLOSED

B] AESTHETICS
☒ NUISANCE ALGAE
☐ INVASIVE MACROPHYTES
☐ EXCESS TURBIDITY
☐ DISCOLORATION
☐ FOAM / SCUM
☐ OIL SHEEN
☐ TRASH / LITTER
☐ NUISANCE ODOR
☐ SLUDGE DEPOSITS
☐ CSOs/SSOs/OUTFALLS

C] RECREATION
AREA DEPTH
POOL: ☐ >100ft² ☐ >3ft

D] MAINTENANCE
Circle some & *COMMENT*
PUBLIC / PRIVATE / BOTH / NA
ACTIVE / HISTORIC / BOTH / NA
YOUNG-SUCCESSION-OLD
SPRAY / SNAG / REMOVED
MODIFIED / DIPPED OUT / NA
LEVEED / ONE SIDED
RELOCATED / CUTOFFS
MOVING-BEDLOAD-STABLE
ARMOURED / SLUMPS
ISLANDS / SCOURED
IMPOUNDED / DESICCATED
FLOOD CONTROL / DRAINAGE

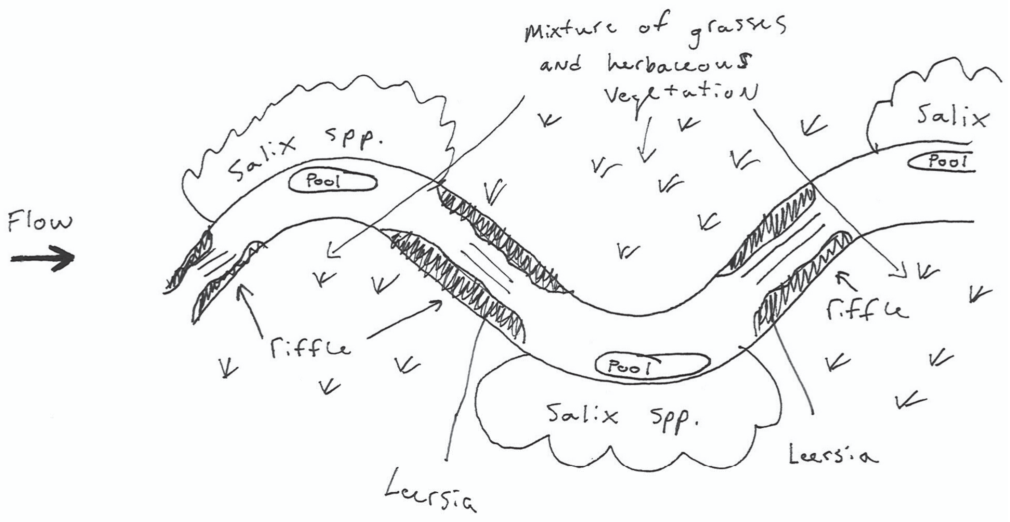
D.) Private. Relocated

E] ISSUES
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

F] MEASUREMENTS
$\bar{x}$ width
$\bar{x}$ depth
max. depth
$\bar{x}$ bankfull width
bankfull $\bar{x}$ depth
W/D ratio
bankfull max. depth
floodprone x^2 width
entrench. ratio

Legacy Tree:

Stream Drawing:



Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 65

Stream & Location: Big Run Section 2 Walnut Woods Stream Relocation **RM:** _ _ _._ **Date:** 10 / 11 / 16

Scorers Full Name & Affiliation: Stephen Bailey/ EMH&T

River Code: _ _ _-_ _ _-_ _ _ **STORET #:** _ _ _ _ _ _ **Lat./ Long.:** (NAD 83 - decimal °) _ _ . _ _ _ _ /8_ . _ _ _ _ Office verified location ☐

1] SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

		BEST TYPES	POOL	RIFFLE			OTHER TYPES	POOL	RIFFLE
☐	☐	BLDR /SLABS [10]			☐	☐	HARDPAN [4]		15
☐	☐	BOULDER [9]			☐	☐	DETRITUS [3]	10	
☐	☐	COBBLE [8]		10	☐	☐	MUCK [2]		
☐	▣	GRAVEL [7]	10	50	☐	☐	SILT [2]	20	15
▣	☐	SAND [6]	60	10	☐	☐	ARTIFICIAL [0]		
☐	☐	BEDROCK [5]							

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☑ 3 or less [0]

Check ONE (*Or 2 & average*)

ORIGIN
- ☐ LIMESTONE [1]
- ☐ TILLS [1]
- ☐ WETLANDS [0]
- ☐ HARDPAN [0]
- ☑ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTURINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILT
- ☐ HEAVY [-2]
- ☑ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

EMBEDDEDNESS
- ☐ EXTENSIVE [-2]
- ☑ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Comments

Excellent natural substrate. Some concrete and brick

Substrate 11 *Maximum 20*

2] INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

	UNDERCUT BANKS [1]	1	POOLS > 70cm [2]		OXBOWS, BACKWATERS [1]
1	OVERHANGING VEGETATION [1]	1	ROOTWADS [1]	1	AQUATIC MACROPHYTES [1]
	SHALLOWS (IN SLOW WATER) [1]		BOULDERS [1]		LOGS OR WOODY DEBRIS [1]
	ROOTMATS [1]				

AMOUNT

Check ONE (*Or 2 & average*)
- ☐ EXTENSIVE >75% [11]
- ☑ MODERATE 25-75% [7]
- ☐ SPARSE 5-<25% [3]
- ☐ NEARLY ABSENT <5% [1]

Comments

Cover 12 *Maximum 20*

3] CHANNEL MORPHOLOGY

Check ONE in each category (*Or 2 & average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☑ NONE [6]	☑ HIGH [3]
☑ MODERATE [3]	☑ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel 17 *Maximum 20*

4] BANK EROSION AND RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

L	R	EROSION	L	R	RIPARIAN WIDTH	L	R	FLOOD PLAIN QUALITY	L	R	
☑	☑	NONE / LITTLE [3]	☑	☑	WIDE > 50m [4]	☐	☐	FOREST, SWAMP [3]	☐	☐	CONSERVATION TILLAGE [1]
☐	☐	MODERATE [2]	☐	☐	MODERATE 10-50m [3]	☑	☑	SHRUB OR OLD FIELD [2]	☐	☐	URBAN OR INDUSTRIAL [0]
☐	☐	HEAVY / SEVERE [1]	☐	☐	NARROW 5-10m [2]	☐	☐	RESIDENTIAL, PARK, NEW FIELD [1]	☐	☐	MINING / CONSTRUCTION [0]
			☐	☐	VERY NARROW < 5m [1]	☐	☐	FENCED PASTURE [1]			
			☐	☐	NONE [0]	☐	☐	OPEN PASTURE, ROWCROP [0]			

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian 9 *Maximum 10*

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH Check **ONE** (*ONLY!*)	CHANNEL WIDTH Check ONE (*Or 2 & average*)	CURRENT VELOCITY Check ALL that apply	
☐ > 1m [6]	☑ POOL WIDTH > RIFFLE WIDTH [2]	☐ TORRENTIAL [-1]	☑ SLOW [1]
☑ 0.7-<1m [4]	☐ POOL WIDTH = RIFFLE WIDTH [1]	☐ VERY FAST [1]	☐ INTERSTITIAL [-1]
☐ 0.4-<0.7m [2]	☐ POOL WIDTH < RIFFLE WIDTH [0]	☐ FAST [1]	☐ INTERMITTENT [-2]
☐ 0.2-<0.4m [1]		☐ MODERATE [1]	☐ EDDIES [1]
☐ < 0.2m [0]			

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current 7 *Maximum 12*

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (*Or 2 & average*). ☐ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☑ BEST AREAS 5-10cm [1]	☑ MAXIMUM < 50cm [1]	☑ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☑ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run 3 *Maximum 8*

6] GRADIENT (9.74 ft/mi)

DRAINAGE AREA (8.5 mi²)

- ☐ VERY LOW - LOW [2-4]
- ☑ MODERATE [6-10]
- ☐ HIGH - VERY HIGH [10-6]

%POOL: 30 %GLIDE: 20

%RUN: 20 %RIFFLE: 30

Gradient 6 *Maximum 10*

EPA 4520 06/16/06

A] SAMPLED REACH

Check ALL that apply

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Reach is typical of stream

METHOD

☐ **BOAT**
☒ **WADE**
☐ **L. LINE**
☐ **OTHER**

STAGE

1st -sample pass- 2nd

☐ **HIGH** ☐
☐ **UP** ☐
☒ **NORMAL** ☒
☐ **LOW** ☐
☐ **DRY** ☐

DISTANCE

☐ **0.5 Km**
☐ **0.2 Km**
☒ **0.15 Km**
☐ **0.12 Km**
☐ **OTHER**

200
meters

CLARITY

1st --sample pass-- 2nd

☐ **< 20 cm** ☐
☒ **20-<40 cm** ☐
☐ **40-70 cm** ☐
☐ **> 70 cm/ CTB** ☐
☐ **SECCHI DEPTH** ☐

1st pass ________ cm
2nd pass ________ cm

CANOPY

☒ **> 85%- OPEN**
☐ **55%-<85%**
☐ **30%-<55%**
☐ **10%-<30%**
☐ **<10%- CLOSED**

B] AESTHETICS

☒ **NUISANCE ALGAE**
☐ **INVASIVE MACROPHYTES**
☐ **EXCESS TURBIDITY**
☐ **DISCOLORATION**
☐ **FOAM / SCUM**
☐ **OIL SHEEN**
☐ **TRASH / LITTER**
☐ **NUISANCE ODOR**
☐ **SLUDGE DEPOSITS**
☐ **CSOs/SSOs/OUTFALLS**

C] RECREATION

POOL: AREA ☐ **>100ft²** DEPTH ☐ **>3ft**

D] MAINTENANCE

Circle some & *COMMENT*

PUBLIC / PRIVATE / BOTH / NA
ACTIVE / HISTORIC / BOTH / NA
YOUNG-SUCCESSION-OLD
SPRAY / SNAG / REMOVED
MODIFIED / DIPPED OUT / NA
LEVEED / ONE SIDED
RELOCATED / CUTOFFS
MOVING-BEDLOAD-STABLE
ARMOURED / SLUMPS
ISLANDS / SCOURED
IMPOUNDED / DESICCATED
FLOOD CONTROL / DRAINAGE

D) Private, Relocated

E] ISSUES

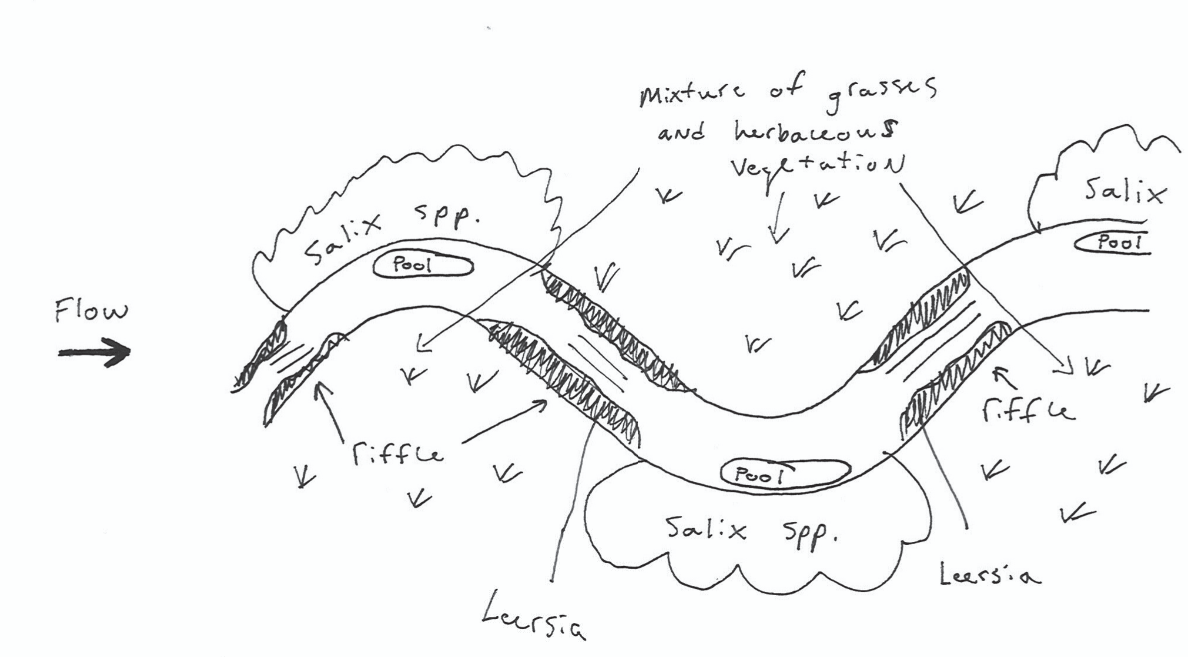
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

F] MEASUREMENTS

$\bar{x}$ width
$\bar{x}$ depth
max. depth
$\bar{x}$ bankfull width
bankfull $\bar{x}$ depth
W/D ratio
bankfull max. depth
floodprone x^2 width
entrench. ratio

Legacy Tree:

Stream Drawing:



APPENDIX E:

Big Run IBI Data Forms

IBI Section 1
Walnut Woods

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME Big Run	LOCATION Canal Winchester, Franklin County, OH
STATION #________ RIVERMILE ~4.5	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN Scioto River
STORET #	AGENCY
INVESTIGATORS Stephen Bailey	
FORM COMPLETED BY Stephen Bailey	DATE 7/13/16 TIME 930 [✓ AM] PM REASON FOR SURVEY IBI Calculation

WEATHER CONDITIONS
81°F
clear/sunny
Wind 6mph

Now		Past 24 hours
☐	storm (heavy rain)	☒
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
____%☐	%cloud cover	☐ ✓ %
☑	clear/sunny	☑

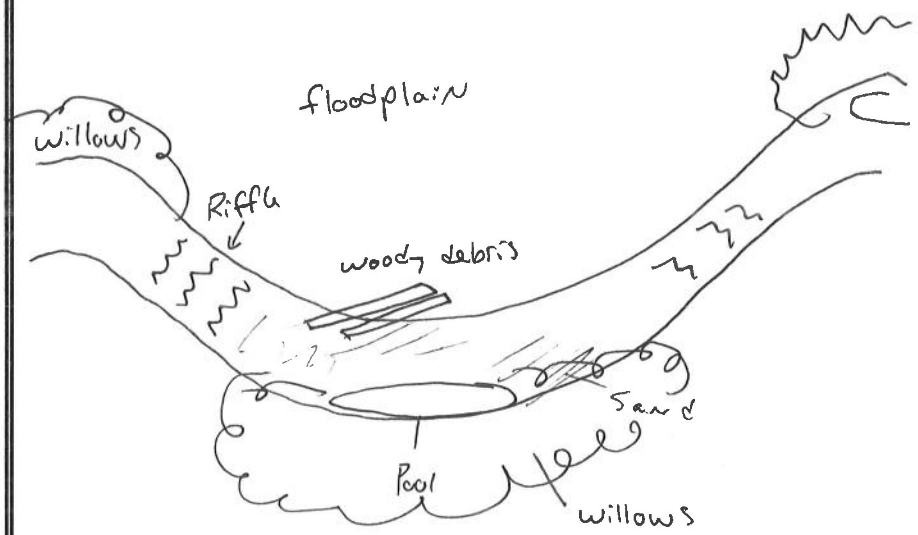
Has there been a heavy rain in the last 7 days?
☐ Yes ☑ No

Air Temperature 81°F

Other____________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☒ Mixture of origins
☐ Other__________

Stream Type
☐ Coldwater ☒ Warmwater

Catchment Area 8.5 mi^2

IBI Section 1

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☐ Commercial
☑ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______
☑ Residential

Local Watershed NPS Pollution
☐ No evidence ☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☑ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☑ Shrubs ☑ Grasses ☑ Herbaceous

dominant species present See riparian vegetation data forms

INSTREAM FEATURES

Estimated Reach Length 100 m
Estimated Stream Width 3.5 m
Sampling Reach Area 350 m^2
Area in km² (m^2x1000) .35 km^2
Estimated Stream Depth 0.5 m
Surface Velocity (at thalweg) Neg. m/sec

Canopy Cover
☑ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark ~4.0 m +

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 10 % ☐ ~~Run~~ 80 %
☐ Pool 10 % Glide

Channelized ☐ Yes ☑ No
Dam Present ☐ Yes ☑ No

LARGE WOODY DEBRIS

~~**LWD** ______ m^2~~
~~**Density of LWD** ______ m^2/km^2 **(LWD/ reach area)**~~

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☑ Rooted emergent ☐ Rooted submergent ☑ Rooted floating ☐ Free floating
☑ Floating Algae ☑ Attached Algae

dominant species present L. oryzoides, C. palustris, S. tabernaemontani, Potamogeton sp.

Portion of the reach with aquatic vegetation 20 %

WATER QUALITY

~~**Temperature** ______ °C~~
~~**Specific Conductance** ______~~
~~**Dissolved Oxygen** ______~~
~~**pH** ______~~
~~**Turbidity** ______~~
~~**WQ Instrument Used** ______~~

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ______

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☑ Flecks
☐ None ☐ Other ______

Turbidity (if not measured)
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other ______

SEDIMENT/ SUBSTRATE

Odors
☐ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☑ Anaerobic ☐ None
☐ Other ______

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☑ Sand
☐ Relict shells ☑ Other silt

Looking at stones which are not deeply embedded, are the undersides black in color?
☑ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	10
Gravel	2-64 mm (0.1"-2.5")	10
Sand	0.06-2mm (gritty)	60
Silt	0.004-0.06 mm	20
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Characteristic**	**% Composition in Sampling Area**
Detritus	sticks, wood, coarse plant materials (CPOM)	10
Muck-Mud	black, very fine organic (FPOM)	10
Marl	grey, shell fragments	0

IBI Section 1
Walnut Woods

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Big Run
LOCATION Canal Winchester, OH
STATION # ________ RIVERMILE ~4.5
STREAM CLASS
LAT ________ LONG ________
RIVER BASIN Scioto River
STORET #
AGENCY
INVESTIGATORS Stephen Bailey
FORM COMPLETED BY Stephen Bailey
DATE 7/13/16
TIME 9^{30} [✓ AM] PM
REASON FOR SURVEY IBI calculation

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 11	20 19 18 17 16	15 14 13 12 [✓ 11]	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 12	20 19 18 17 16	15 14 13 [✓ 12] 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 17	20 19 18 [✓ 17] 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

IBI Section 1

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 17	20 19 18 [✓ 17] 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 10 (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0

Total Score 163

IBI Section 1

Walnut Woods

FISH SAMPLING FIELD DATA SHEET (FRONT)

page ____ of ____

STREAM NAME Big Run	LOCATION Canal Winchester, OH
STATION # ________ RIVERMILE ~4.5	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN Scioto River
STORET #	AGENCY
GEAR	INVESTIGATORS Stephen Bailey Nick D'Eramo
FORM COMPLETED BY Stephen Bailey	DATE 7/13/16 8/31 TIME 9^{30} [✓ AM] PM REASON FOR SURVEY IBI Calculation

SAMPLE COLLECTION	**How were the fish captured?** ☐ back pack ☐ tote barge ☑ other Sein **Block nets used?** ☐ YES ☑ NO **Sampling Duration** Start time 9^{30} End time 12^{00} Duration 2.5 **Stream width (in meters)** Max 4.5 Mean 3.5
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☑ Riffles 10 % ☑ Pools 10 % ☑ Runs 80 % ☐ Snags ____ % ☑ Submerged Macrophytes 5 % ☐ Other ( ) ____ %
GENERAL COMMENTS	Reach is representative of stream

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMEN MAX SUBSAMPLE)					ANOMALIES*							
							D	E	F	L	M	S	T	Z
Catostomus com.	31													
S. atromaculatus	25													
E. nigrum	24													
E. blennoides	1													

IBI Section 1

FISH SAMPLING FIELD DATA SHEET (BACK)

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMEN MAX SUBSAMPLE)					ANOMALIES*							
							D	E	F	L	M	S	T	Z
E. caeruleum	8													
L. cyanellus	39													
H. nigricans	1													
M. dolomieux	5													
F. notatus	44													
C. spiloptera	8													
C. anomalum	15													

* **ANOMALY CODES:** D = deformities; E = eroded fins; F = fungus; L = lesions; M = multiple DELT anomalies; S = emaciated; Z = other

IBI Section 2
Walnut Woods

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Big Run	LOCATION Canal Winchester, Franklin County, OH	
STATION #________ RIVERMILE ~ 4.5	STREAM CLASS	
LAT __________ LONG __________	RIVER BASIN Scioto River	
STORET #	AGENCY	
INVESTIGATORS Stephen Bailey		
FORM COMPLETED BY Stephen Bailey	DATE 7/13/16 TIME 100 AM [✓ PM]	REASON FOR SURVEY IBI Calculation

WEATHER CONDITIONS
83 °F
clear/sunny
wind 4 mph

Now		Past 24 hours
☐	storm (heavy rain)	☑
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
____%☐	%cloud cover	☐ / %
☑	clear/sunny	☑

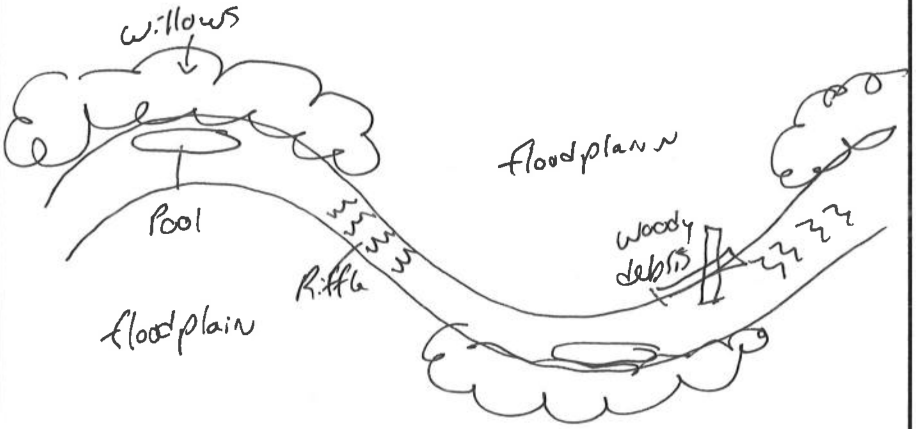
Has there been a heavy rain in the last 7 days?
☐ Yes ☑ No

Air Temperature 83 °F

Other ____________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☑ Mixture of origins
☐ Other__________

Stream Type
☐ Coldwater ☑ Warmwater

Catchment Area 8.5 ~~km²~~ mi²

IBI Section 2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☐ Commercial
☑ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______
☑ Residential

Local Watershed NPS Pollution
☐ No evidence ☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☑ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☑ Shrubs ☑ Grasses ☑ Herbaceous

dominant species present See Riparian Vegetation data Forms

INSTREAM FEATURES

Estimated Reach Length 100 m
Estimated Stream Width 3.6 m
Sampling Reach Area 360 m^2
Area in km^2 (m^2x1000) .36 km^2
Estimated Stream Depth 0.3 m
Surface Velocity (at thalweg) Neg. m/sec

Canopy Cover
☑ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark ~4+ m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 10 % ☐ ~~Run~~ 80 %
☐ Pool 10 % glide

Channelized ☐ Yes ☑ No

Dam Present ☐ Yes ☑ No

LARGE WOODY DEBRIS

LWD ______ m^2
Density of LWD ______ m^2/km^2 **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☑ Rooted emergent ☐ Rooted submergent ☑ Rooted floating ☐ Free floating
☑ Floating Algae ☑ Attached Algae

dominant species present C. oryzoides, C. palustris, S. tabernaemontani Potamogeton sp.

Portion of the reach with aquatic vegetation 10 %

WATER QUALITY

Temperature ______ °C
Specific Conductance ______
Dissolved Oxygen ______
pH ______
Turbidity ______
WQ Instrument Used ______

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ______

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☑ Flecks
☐ None ☐ Other ______

Turbidity (if not measured)
☑ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other ______

SEDIMENT/ SUBSTRATE

Odors
☐ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☑ Anaerobic ☐ None
☐ Other ______

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☑ Sand
☐ Relict shells ☑ Other silt

Looking at stones which are not deeply embedded, are the undersides black in color?
☑ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	10
Gravel	2-64 mm (0.1"-2.5")	10
Sand	0.06-2mm (gritty)	60
Silt	0.004-0.06 mm	20
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	10
Muck-Mud	black, very fine organic (FPOM)	10
Marl	grey, shell fragments	0

IBI Section 2
Walnut Woods

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Big Run	LOCATION Canal Winchester, OH
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ________ LONG ________	RIVER BASIN Scioto River
STORET #	AGENCY
INVESTIGATORS Stephen Bailey	
FORM COMPLETED BY Stephen Bailey	DATE 7/13/16 TIME 1:00 AM [✓ PM]
	REASON FOR SURVEY IBI Calculation

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 11	20 19 18 17 16	15 14 13 12 [✓ 11]	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 12	20 19 18 17 16	15 14 13 [✓ 12] 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 17	20 19 18 [✓ 17] 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

IBI Section 2

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 17	20 19 18 [✓ 17] 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 10 (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0

Total Score 163

IBI Section 2

FISH SAMPLING FIELD DATA SHEET (FRONT)

page 1 of 2

STREAM NAME Big Run	LOCATION Canal Winchester, OH
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN Scioto River
STORET #	AGENCY
GEAR Sein	INVESTIGATORS Stephen Bailey, Nick D'Eramo
FORM COMPLETED BY Stephen Bailey	DATE 7/13 8/31 TIME 1:00 AM [✓ PM] — REASON FOR SURVEY IBI calculation

SAMPLE COLLECTION	**How were the fish captured?** ☐ back pack ☐ tote barge ☒ other Sein **Block nets used?** ☐ YES ☒ NO **Sampling Duration** Start time 1:00 End time 5:00 Duration 4 **Stream width (in meters)** Max 4 m Mean 3.3 m
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Riffles 10 % ☐ Pools 10 % ☐ Runs 80 % ☐ Snags ____ % ☐ Submerged Macrophytes 5 % ☐ Other ( ) ____ %
GENERAL COMMENTS	reach is representative of stream

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMEN MAX SUBSAMPLE)					ANOMALIES*							
							D	E	F	L	M	S	T	Z
C. commersonii	57													
S. atromaculatus	60													
M. dolomieux	6													
E. caeruleum	14													

IBI Section 2

FISH SAMPLING FIELD DATA SHEET (BACK)

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMEN MAX SUBSAMPLE)					ANOMALIES*							
							D	E	F	L	M	S	T	Z
E. Nigrum	23													
C. cyanellus	16													
F. Notatus	80													
N. buccata	3													
N. straMiNeus	3													
A. Natalis	1													
C. aNomalum	7													

* **ANOMALY CODES:** D = deformities; E = eroded fins; F = fungus; L = lesions; M = multiple DELT anomalies; S = emaciated; Z = other

Walnut Woods IBI - 2016

Section	Code	Species		Count	Species Group	Feeding Guild	TOL	IBI Group	River Size	Breeding Guild	Habitat Pref	Family
1	40-016	White sucker	Catostomus commersonii	31	Round bodied su	Omnivor	Tolerant	White sucker		Simple Lithophil	Both	Catostomidae
1	43-013	Creek chub	Semotilus atromaculatus	25	Minnows	Generalized insectivore	Tolerant	Cyprinidae	Pioneering sp	Complex, no parental care	Both	Cyprinidae
1	80-014	Johnny darter	Etheostoma nigrum	24	Darters	Insectivore	n/a	Darter	Pioneering sp	Complex, parental care	Both	Percidae
1	80-015	Greenside darter	Etheostoma blennoides	1	Darters	Insectivore	Moderately intolerant	Darter		Simple Lithophil	Riffles	Percidae
1	80-022	Rainbow darter	Etheostoma caeruleum	8	Darters	Insectivore	Moderately intolerant	Darter		Simple Lithophil	Riffles	Percidae
1	77-008	Green sunfish	Lepomis cyanellus	39	Sunfish	Insectivore	Tolerant	Sunfish	Pioneering sp	Complex, parental care	Pools	Centrarchidae
1	40-015	Northern hogsucker	Hypentelium migricans	1	Round bodied su	Insectivore	Moderately intolerant	Round bodied sucker		Simple Lithophil	Riffles	Catostomidae
1	77-004	Smallmouth bass	Micropterus dolomieux	5	Blackbass, crapp	Carnivore	Moderately intolerant	Sport fish		Complex, parental care	Pools	Centrarchidae
1	54-002	Blackstripe topminnow	Fundulus notatus	44		Insectivore				Simple, Miscellaneous	Pools	Cyprinodontidae
1	43-032	Spotfin shiner	Cyprinella spiloptera	8	Shiners	Insectivore		Cyprinidae		Simple, Miscellaneous	Both	Cyprinidae
1	43-044	Central stoneroller	Campostoma anomalum	15	Minnows	Herbivoire		Cyprinidae		Complex, no parental care	Both	Cyprinidae
2	40-016	White sucker	Catostomus commersonii	57	Round bodied su	Omnivor	Tolerant	White sucker		Simple Lithophil	Both	
2	43-013	Creek chub	Semotilus atromaculatus	60	Minnows	Generalized insectivore	Tolerant	Cyprinidae	Pioneering sp	Complex, no parental care	Both	
2	77-004	Smallmouth bass	Micropterus dolomieux	6	Blackbass, crapp	Carnivore	Moderately intolerant	Sport fish		Complex, parental care	Pools	Centrarchidae
2	80-022	Rainbow darter	Etheostoma caeruleum	14	Darters	Insectivore	Moderately intolerant	Darter		Simple Lithophil	Riffles	
2	80-014	Johnny darter	Etheostoma nigrum	23	Darters	Insectivore	n/a	Darter	Pioneering sp	Complex, parental care	Both	
2	77-008	Green sunfish	Lepomis cyanellus	16	Sunfish	Insectivore	Tolerant	Sunfish	Pioneering sp	Complex, parental care	Pools	Centrarchidae
2	54-002	Blackstripe topminnow	Fundulus notatus	80		Insectivore				Simple, Miscellaneous	Pools	Cyprinodontidae
2	43-039	Silverjaw minnow	Notropis buccata	3	Minnows	Insectivore		Cyprinidae	Pioneering sp	Simple, Miscellaneous	Both	Cyprinidae
2	43-034	Sand shiner	Notropis stramineus	3	Shiners	Insectivore	Moderately intolerant	Cyprinidae		Simple, Miscellaneous	Both	Cyprinidae
2	47-004	Yellow bullhead	Ameiurus natalis	1	Catfish, drum	Insectivore	Tolerant			Complex, parental care	Pools	Ictaluridae
2	43-044	Central stoneroller	Campostoma anomalum	7	Minnows	Herbivoire		Cyprinidae		Complex, no parental care	Both	Cyprinidae
Combine	40-016	White sucker	Catostomus commersonii	88	Round bodied su	Omnivor	Tolerant	White sucker		Simple Lithophil	Both	Catostomidae
Combine	43-013	Creek chub	Semotilus atromaculatus	85	Minnows	Generalized insectivore	Tolerant	Cyprinidae	Pioneering sp	Complex, no parental care	Both	Cyprinidae
Combine	80-014	Johnny darter	Etheostoma nigrum	47	Darters	Insectivore	n/a	Darter	Pioneering sp	Complex, parental care	Both	Percidae
Combine	80-015	Greenside darter	Etheostoma blennoides	1	Darters	Insectivore	Moderately intolerant	Darter		Simple Lithophil	Riffles	Percidae
Combine	80-022	Rainbow darter	Etheostoma caeruleum	22	Darters	Insectivore	Moderately intolerant	Darter		Simple Lithophil	Riffles	Percidae
Combine	77-008	Green sunfish	Lepomis cyanellus	55	Sunfish	Insectivore	Tolerant	Sunfish	Pioneering sp	Complex, parental care	Pools	Centrarchidae
Combine	40-015	Northern hogsucker	Hypentelium migricans	1	Round bodied su	Insectivore	Moderately intolerant	Round bodied sucker		Simple Lithophil	Riffles	Catostomidae
Combine	77-004	Smallmouth bass	Micropterus dolomieux	11	Blackbass, crapp	Carnivore	Moderately intolerant	Sport fish		Complex, parental care	Pools	Centrarchidae
Combine	54-002	Blackstripe topminnow	Fundulus notatus	124		Insectivore				Simple, Miscellaneous	Pools	Cyprinodontidae
Combine	43-032	Spotfin shiner	Cyprinella spiloptera	8	Minnows	Insectivore		Cyprinidae		Simple, Miscellaneous	Both	Cyprinidae
Combine	43-044	Central stoneroller	Campostoma anomalum	22	Minnows	Herbivoire		Cyprinidae		Complex, no parental care	Both	Cyprinidae
Combine	43-039	Silverjaw minnow	Notropis buccata	3	Minnows	Insectivore		Cyprinidae	Pioneering sp	Simple, Miscellaneous	Both	Cyprinidae
Combine	43-034	Sand shiner	Notropis stramineus	3	Minnows	Insectivore	Moderately intolerant	Cyprinidae		Simple, Miscellaneous	Both	Cyprinidae
Combine	47-004	Yellow bullhead	Ameiurus natalis	1	Catfish, drum	Insectivore	Tolerant			Complex, parental care	Pools	Ictaluridae

Section	Category	Metric	Actual number	Score
1	Species compostition	Total species	11	3
1		Darters & sculpins	3	3
1		Headwater species	0	0
1		Minnow species	3	1
1		Sensitive species [A]	4	3
1		% Tolerant (no.) <= 10	0.47	3
1	Trophic compostition	% Pioneering species	0.43	3
1		% Omnivores	0.15	5
1		% Insectivores	0.62	5
1	Fish condition	Simple Lithophils	4	3
1		% DELT anomalies	0	5
1		Fish numbers [D] >8 sq.mi.	201	3
			TOTAL - 37	

Section	Category	Metric	Actual number	Score
2	Species compostition	Total species	11	3
2		Darters & sculpins	2	3
2		Headwater species	0	0
2		Minnow species	4	3
2		Sensitive species [A]	3	3
2		% Tolerant (no.) <= 10	49.00%	3
2	Trophic compostition	% Pioneering species	37.00%	3
2		% Omnivores	21.00%	3
2		% Insectivores	51.00%	5
2	Fish condition	Simple Lithophils	2	1
2		% DELT anomalies	0.00%	5
2		Fish numbers [D] >8 sq.mi.	270	3
			TOTAL - 35	

Section	Category	Metric	Actual number	Score
Combined	Species compostition	Total species	14	5
Combined		Darters & sculpins	3	3
Combined		Headwater species	0	0
Combined		Minnow species	5	3
Combined		Sensitive species [A]	5	5
Combined		% Tolerant (no.) <= 10	48.60%	3
Combined	Trophic compostition	% Pioneering species	40.00%	3
Combined		% Omnivores	18.00%	3
Combined		% Insectivores	56.00%	5
Combined	Fish condition	Simple Lithophils	4	3
Combined		% DELT anomalies	0.00%	3
Combined		Fish numbers [D] >8 sq.mi.	471	3
			TOTAL - 41	

FISH SHANNON DIVERSITY INDEX

Section	Code	Species	Ni	Pi	ln Pi	(-) Pi * ln Pi
1	40-016	White sucker	31	0.15422886	-1.86932	0.28830273
1	43-013	Creek chub	25	0.12437811	-2.08443	0.259257349
1	80-014	Johnny darter	24	0.11940299	-2.12525	0.253761323
1	80-015	Greenside darter	1	0.00497512	-5.3033	0.026384602
1	80-022	Rainbow darter	8	0.039801	-3.22386	0.12831297
1	77-008	Green sunfish	39	0.19402985	-1.63974	0.31815914
1	40-015	Northern hogsucker	1	0.00497512	-5.3033	0.026384602
1	77-004	Smallmouth bass	5	0.02487562	-3.69387	0.091887239
1	54-002	Blackstripe topminnow	44	0.21890547	-1.51912	0.332542647
1	43-032	Spotfin shiner	8	0.039801	-3.22386	0.12831297
1	43-044	Central stoneroller	15	0.07462687	-2.59525	0.193675724
		Total =	**201**		**H=**	**2.046981295**

Section	Code	Species	Ni	Pi	ln Pi	(-) Pi * ln Pi
2	40-016	White sucker	57	0.21111111	-1.55537	0.328356035
2	43-013	Creek chub	60	0.22222222	-1.50408	0.334239422
2	77-004	Smallmouth bass	6	0.02222222	-3.80666	0.0845925
2	80-022	Rainbow darter	14	0.05185185	-2.95936	0.153448536
2	80-014	Johnny darter	23	0.08518519	-2.46293	0.209804956
2	77-008	Green sunfish	16	0.05925926	-2.82583	0.167456784
2	54-002	Blackstripe topminnow	80	0.2962963	-1.2164	0.360413429
2	43-039	Silverjaw minnow	3	0.01111111	-4.49981	0.049997885
2	43-034	Sand shiner	3	0.01111111	-4.49981	0.049997885
2	47-004	Yellow bullhead	1	0.0037037	-5.59842	0.020734896
2	43-044	Central stoneroller	7	0.02592593	-3.65251	0.094694751
		Total =	**270**		**H=**	**1.853737079**

Section	Code	Species	Ni	Pi	ln Pi	(-) Pi * ln Pi
Combo	43-011	White sucker	88	0.18683652	-1.67752	0.313422235
Combo	54-001	Creek chub	85	0.18046709	-1.71221	0.308996988
Combo	77-009	Johnny darter	47	0.09978769	-2.30471	0.229981726
Combo	43-043	Greenside darter	1	0.00212314	-6.15486	0.013067639
Combo	43-044	Rainbow darter	22	0.04670913	-3.06382	0.143108162
Combo	43-001	Green sunfish	55	0.11677282	-2.14752	0.250772548
Combo	80-014	Northern hogsucker	1	0.00212314	-6.15486	0.013067639
Combo	77-006	Smallmouth bass	11	0.02335456	-3.75696	0.087742231
Combo	43-035	Blackstripe topminnow	124	0.26326964	-1.33458	0.351353481
Combo	80-022	Spotfin shiner	8	0.01698514	-4.07542	0.069221513
Combo	77-003	Central stoneroller	22	0.04670913	-3.06382	0.143108162
Combo	43-034	Silverjaw minnow	3	0.00636943	-5.05625	0.032205387
Combo	43-021	Sand shiner	3	0.00636943	-5.05625	0.032205387
Combo	43-032	Yellow bullhead	1	0.00212314	-6.15486	0.013067639
		Total=	**471**		**H=**	**2.001320737**

FISH MEASURE OF EVENNESS

Section	Number of Species (N)	Shannon Index (H)	E= H/ln(N)
1	11	1.94487005	0.81107381
2	11	2.195662097	0.91566222
Combo	14	2.104494149	0.79744162

APPENDIX F:

Summary of Recent Management Activities

COLUMBUS
REGIONAL AIRPORT AUTHORITY

November 16, 2015

Ms. Teresa Spagna
US Army Corps of Engineers
502 Eighth Street
Huntington, WV 25701-2070

Subject: LHR-2006-2164-2-SCR (Walnut Woods)

Dear Teresa:

The Columbus Regional Airport Authority (CRAA) would like to provide an update on maintenance measures at the Walnut Woods Metro Park mitigation site. CRAA installed 22.5 acres of wetlands and 2,700 feet of stream. As you know there have been challenges with vegetation due to hydrology in the wetland cells, and periodic beaver dams in the stream. CRAA has taken several actions to correct these deficiencies and I thought it would be helpful to review what we've done and what we plan in the future:

- December 2012. Flooding from Walnut Creek was creating erosion at the wetland outlet structure. We felt the erosion was part of the hydrology concern, and so the structure was removed and replaced with a stone spillway.
- September 2013. Suspicion about loss of water was not only about the outlet structure, but possibly from old field tiles. Several field tiles were destroyed. (exhibit attached)
- January 2015. With progress being made on hydrology corrections, we felt it was appropriate to move forward with installation of woody materials in the wetland cells. 2,000 live stakes were installed.
- September 2015. A final measure was taken to address the potential that the excavated pools were losing water. Three pools were over-excavated, lined with clay, and compacted. The original pool sediment was then replaced on top of the clay. (photo attached)
- September 2015. During the pool repairs, we had the contractors use equipment to remove several beaver dams to ensure normal flow.
- November 2015. We will be planting 6,400 bare root seedlings within the wetland cells to aid in the trajectory of vegetation success.

- 2016 +. With our hydrology corrections complete, we will allow the site to reach a new balance. Additional plantings across the entire site – including buffer areas – will be made and the regular schedule of monitoring will continue. 2016 will be the final monitoring event for the stream, and will be the 3rd monitoring event for the wetland.

We look forward to working with you and Ohio EPA during the future site visits and monitoring. Please contact me with any questions.

Sincerely,

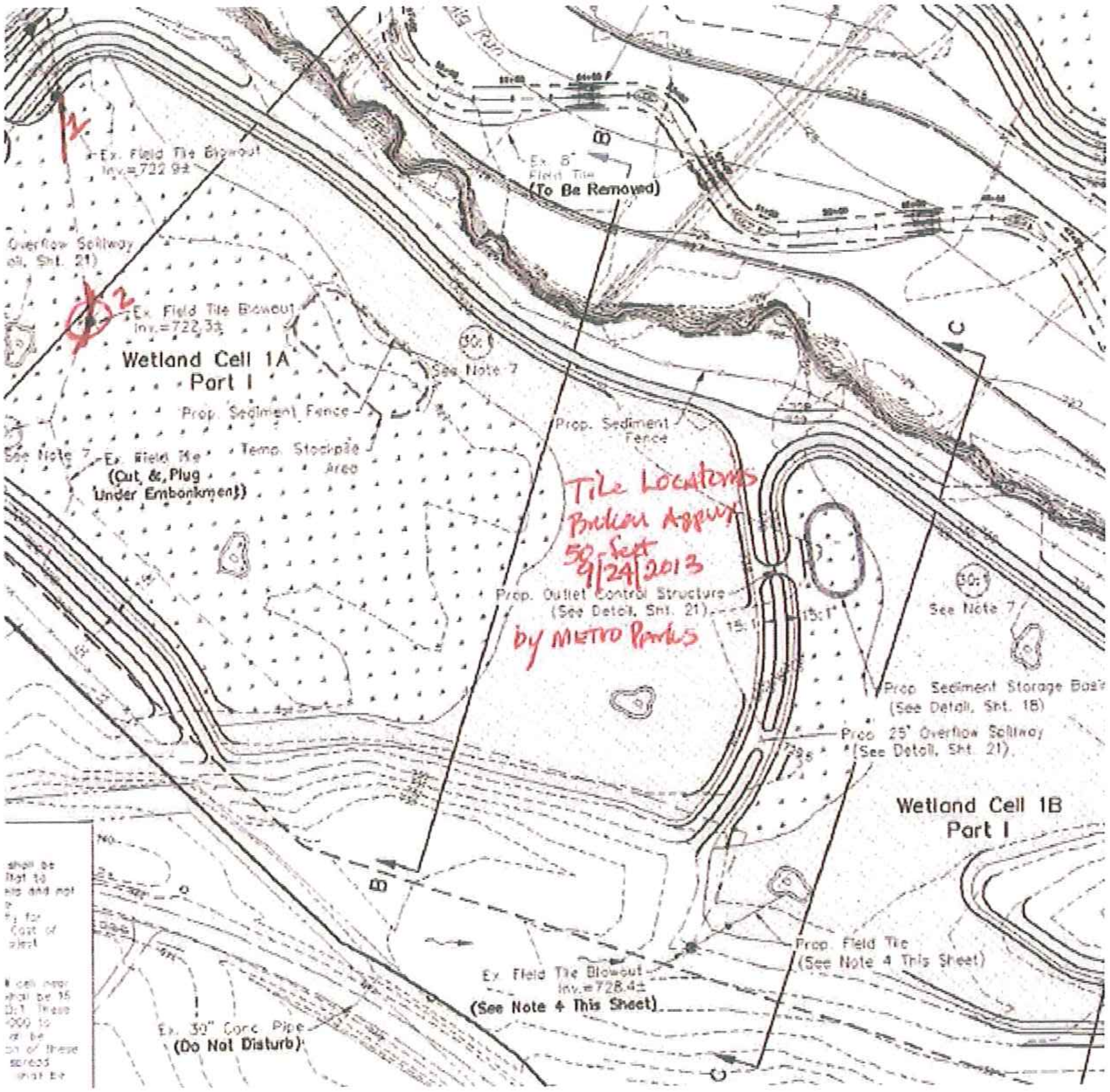
COLUMBUS REGIONAL AIRPORT AUTHORITY
by

Paul D Kennedy

Paul D. Kennedy, AAE
Manager, Energy and Environment

pkennedy@columbusairports.com

cc: Andrea Kilbourne, Ohio EPA
Robert Milligan, EMH&T
File



Field Tiles Cut

Excavated Pools to be Repaired

Working on Excavated Pools

APPENDIX G:

Wetland Data Forms

EMH&T

Wetland Monitoring Data Form

Transect Number: Plot 1 - Forested

Date of Sampling: 10/11/16

Percent Cover of Native Perennial Hydrophytes: 66.5%

Open Water Extent: 0%

Invasive plant cover: 0%

Tree density: 485 trees/acre

Dominant Species Include:

Shrub/tree stratum: *Quercus palustris*

Forb stratum: *Symphyotrichum laterifolium, Bidens sp., Elymus virginicus*

Species Present	Cover Class	% Cover*	Native Wetland Status
Symphyotrichum laterifolium (Calico aster)	6	17.5	PE - FACW
Bidens sp. (Beggar tick)	6	17.5	A- FACW
Elymus virginicus (Virginia wild rye)	6	17.5	PE - FACW
Carex lurida (Bottlebrush sedge)	6	17.5	PE- OBL
Hibiscus moscheutos (Swamo rose mallow)	5	7.5	PE- OBL
Echinochloa sp. (Barnyard grass)	5	7.5	A- FACW
Asclepias incarnata (Swamp milkweed)	4	3.25	PE- OBL
Carex sp. (Sedge)	4	3.25	PE- FACW
Seteria glauca (Yellow foxtail grass)	4	3.25	A- FAC
Rumex crispus	3	1.5	PE- FACU

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Hydrology:

Spring: saturated Summer: moist, not saturated

EMH&T
Wetland Monitoring Data Form

Forestry Measurements

Plot size: 100m^2

Species **Height (cm)**	**0-20**	**20-40**	**40-60**	**60-80**	**80-100**	**100+**
Quercus palustris (Pin oak)	2	4				
Fraxinus pennsylvanica (Green ash)			1	1		
Quercus bicolor (Swamp white oak)	2	2				

Tree Density: 485 Trees per acre
Average Height: 28.3cm

EMH&T
Wetland Monitoring Data Form

Transect Number: Plot 2 - Forested

Date of Sampling: 10/11/16

Percent Cover of Native Perennial Hydrophytes: 100%

Open Water Extent: 0%

Invasive plant cover: 0%

Tree density: 405 trees/acre

Dominant Species Include:
Shrub/tree stratum: *Quercus bicolor*
Forb stratum: *Symphyotrichum laterifolium*

Species Present	Cover Class	% Cover*	Native Wetland Status
Symphyotrichum laterifolium (Calico aster)	9	82.5	PE - FACW
Carex vulpinoidea	6	17.5	PE - FACW

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Hydrology:
Spring: saturated Summer: moist, not saturated

EMH&T

Wetland Monitoring Data Form

Forestry Measurements

Plot size: 100m^2

Species	**Height (cm)**	**0-20**	**20-40**	**40-60**	**60-80**	**80-100**	**100-150**	**150-200**
Quercus palustris (Pin oak)		1	2					
Fraxinus pennsylvanica (Green ash)			1					
Quercus bicolor (Swamp white oak)		1	1			1	1	1
Quercus macrocarpa (Bur oak)			1					

Tree Density: 405 Trees per acre
Average Height: 56.0cm

EMH&T
Wetland Monitoring Data Form

Transect Number: Plot 3 - Forested **Date of Sampling:** 10/11/16

Percent Cover of Native Perennial Hydrophytes: 52.5% **Open Water Extent:** 0%

Invasive plant cover: 0% **Tree density:** 647 trees/acre

Dominant Species Include:
Shrub/tree stratum: Quercus bicolor
Forb stratum: *Echinochloa muricata, Juncus effusus, Polygonum sp.*

Species Present	Cover Class	% Cover*	Native Wetland Status
Echinochloa muricata (Rough barnyard grass)	7	37.5	A- FACW
Juncus effusus (Soft rush)	7	37.5	PE- FACW
Polygonum sp. (Smartweed)	7	37.5	N/A- FACW
Hibiscus moscheutos (Swamp rose mallow)	5	7.5	PE- FACW
Carex sp. (Sedge)	5	7.5	PE- FACW

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Hydrology:
Spring: saturated Summer: moist, not saturated

EMH&T
Wetland Monitoring Data Form

Forestry Measurements

Plot size: 100m^2

Species **Height (cm)**	**0-20**	**20-40**	**40-60**	**60-80**	**80-100**	**100-150**	**150-200**
Quercus palustris (Pin oak)	1	3					
Fraxinus pennsylvanica (Green ash)				1	1		
Quercus bicolor (Swamp white oak)	4	2					
Quercus macrocarpa (Bur oak)		1					
Acer saccharinum (Silver Maple)	1	2					

<u>Tree Density:</u> 647 Trees per acre
<u>Average Height:</u> 28.75cm

EMH&T
Wetland Monitoring Data Form

Transect Number: Plot 4 - Forested **Date of Sampling:** 10/11/16

Percent Cover of Native Perennial Hydrophytes: 97.5% **Open Water Extent:** 0%

Invasive plant cover: 0% **Tree density:** 9,915 trees/acre

Dominant Species Include:
Shrub/tree stratum: Fraxinus pennsylvanica
Forb stratum: Poa sp.

Species Present	Cover Class	% Cover*	Native Wetland Status
Poa sp. (grass)	9	82.5	PE- FACW
Scirpus cyperinus (Wool grass)	5	7.5	PE- FACW
Populus deltoides (Eastern cottonwood)	5	7.5	PE- FACW

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Hydrology:
Spring: 4 inches Summer: moist, not saturated

EMH&T
Wetland Monitoring Data Form

Forestry Measurements

Plot size: 100m^2

Species	Height (cm)	20-40	40-60	60-80	80-100	100-150	150-200	200+
Fraxinus pennsylvanica (Green ash)						8	14	217
Populus deltoides (Eastern cottonwood)								5
Acer saccharinum (Silver Maple)								1

Tree Density: 9,915 Trees per acre
Average Height: 196.1cm

EMH&T

Wetland Monitoring Data Form

Transect Number: Plot 5 – Non-forested

Date of Sampling: 10/11/16

Percent Cover of Native Perennial Hydrophytes: 90%

Open Water Extent: 0%

Invasive plant cover: 0%

Tree density: n/a

Dominant Species Include:
Shrub/tree stratum: *Cephalanthus occidentalis*
Forb stratum: *Echinochloa muricata, Hibiscus moscheutos*

Species Present	Cover Class	% Cover*	Native Wetland Status
Echinochloa muricata (Rough barnyard grass)	7	37.5	A- FACW
Hibiscus moscheutos (Swamp rose mallow)	7	37.5	PE- FACW
Cephalanthus occidentalis (Buttonbush)	7	37.5	PE- OBL
Penthorum sedoides (Ditch stone crop)	5	7.5	PE- OBL
Asclepias incarnata (Swamp milkweed)	5	7.5	PE- OBL
Xanthium strumarium (Common cocklebur)	4	3.25	A- FAC
Cirsium sp. (Thistle)	4	3.25	PE- FACU
Setaria sp. (Foxtail grass)	4	3.25	N/A

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Hydrology:
Spring: saturated   Summer: moist, not saturated

EMH&T
Wetland Monitoring Data Form

Transect Number: Plot 6 – Non-forested **Date of Sampling:** 10/17/16

Percent Cover of Native Perennial Hydrophytes: 108% **Open Water Extent:** 0%

Invasive plant cover: 0% **Tree density:** n/a

Dominant Species Include:
Shrub/tree stratum: *n/a*
Forb stratum: *Scirpus cyperinus, Carex lurida*

Species Present	Cover Class	% Cover*	Native Wetland Status
Scirpus cyperinus (Wool grass)	7	37.5	PE- FACW
Carex lurida (Bottlebrush sedge)	7	37.5	PE- FACW
Juncus effusus (Soft rush)	6	17.5	PE- FACW
Verbena hastata (Blue vervain)	5	7.5	PE- FACW
Solidago sp. (Goldenrod)	5	7.5	N/A
Epilobium coloratum (Purple leaf willow herb)	4	3.25	PE- OBL
Mimulus ringens (Monkey flower)	4	3.25	PE- OBL
Symphyotrichum laterifolium (Calico aster)	3	1.5	PE - FACW
Juncus tenuis (Path rush)	3	1.5	PE-FAC

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Hydrology:
Spring: 2 inches Summer: moist, not saturated

EMH&T

Wetland Monitoring Data Form

Transect Number: Plot 7 – Forested

Date of Sampling: 10/17/16

Percent Cover of Native Perennial Hydrophytes: 62.5%

Open Water Extent: 0%

Invasive plant cover: 0%

Tree density: 850 per acre

Dominant Species Include:
Shrub/tree stratum:
Forb stratum: *Symphyotrichum laterifolium, Bidens sp.*

Species Present	Cover Class	% Cover*	Native Wetland Status
Symphyotrichum laterifolium (Calico aster)	7	37.5	PE - FACW
Bidens sp. (Beggar's tick)	7	37.5	A- FACW
Carex frankii (Frank's sedge)	6	17.5	PE - FACW
Carex sp. (Sedge)	5	7.5	PE - FACW
Seteria sp. (Foxtail grass)	5	7.5	N/A

* % cover calculated using cover classes and cover class midpoints from Ohio EPA Vegetation Index of Biotic Integrity.

Hydrology:
Spring: 2 inches Summer: moist, not saturated

EMH&T
Wetland Monitoring Data Form

Forestry Measurements

Plot size: $100m^2$

Species **Height (cm)**	**0-20**	**20-40**	**40-60**	**60-80**	**80-100**	**100-150**	**150-200**	**200+**
Populus deltoides (Eastern cottonwood)				1	1	1	1	3
Quercus palustris (Pin oak)	1	2						
Quercus bicolor (Swamp white oak)	2							
Quercus macrocarpa (Bur oak)	4							
Acer saccharinum (Silver Maple)	3		2					

Tree Density: 850 Trees per acre
Average Height: 62.8cm

APPENDIX H:

Forested VIBI Data Forms

Walnut Woods Forested VIBI Plot

Site Information

Site Name:	Walnut Woods Plot 2	**Site Code:**	
County:	Franklin	**Sampling date(s):**	7/20/2016
Collector(s):	Stephen Bailey, Melissa Benoit, Christine Rahtz	**Affiliation:**	EMH&T
			Create Summary Report
Phone number:	614-775-4522	**email address:**	sbailey@emht.com

Plot Information

General Plot Information	
Monitor Event	**2nd**
Total Modules	**10**
Intensive Modules	**4**
Plot Congituration	**VIBI-Std (2x5)**
Area (ha)	**0.10**
Latitude	
Longitude	
Centerline	
Army Corp Region	**MW**
Plant Community Information	
VEG Class	**EMERGENT**
1st Plant Community	
Veg. Group	**Wet meadow**
Veg. Modifier	
Other	
2nd Plant Community	
VEG Class	
Veg. Group	
Veg. Modifier	
Other	
HGM Information	
Primary HGM Class	**DEPRESSION**
Sub class	**Suface water**
Secondary HGM Class	
Sub class	
Sub or Super Sample	**NO**
% Sub or Super Sample	**100%**
Total plot canopy closure %	
Total plot herbaceous cover %	

VIBI Calculation Summary Information

Metric	**Value**		**VIBI - Metric Score**		**VIBI FQ**
	Statewide	**ACOE Region**	**Statewide**	**ACOE Region**	**Metric Score**
Carex	**6**	**6**	**10**	**10**	***NA***
Cyperaceae	**11**	**11**	***NA***	***NA***	***NA***
Dicot	**26**	**26**	**10**	**10**	***NA***
Shade	**5**	**5**	***NA***	***NA***	***NA***
Shrub	**2**	**2**	**3**	**3**	***NA***
Hydrophyte	**39**	**39**	**10**	**10**	***NA***
Seedless Vascular Plant	**0**	**0**	***NA***	***NA***	***NA***
Annual/Perennial ratio	**0.48**	**0.48**	**0**	**0**	***NA***
FQAI	**17.39**	**17.39**	**7**	**7**	**18.49**
Weighted C of C	**2.94**	**2.94**	***NA***	***NA***	**24.47**
%bryophyte	**0.11%**	**0.11%**	***NA***	***NA***	***NA***
%hydrophyte	**94.52%**	**94.52%**	***NA***	***NA***	***NA***
%sensitive	**1.39%**	**1.39%**	**0**	**0**	***NA***
%tolerant	**35.57%**	**35.57%**	**7**	**7**	***NA***
%invasive graminoids	**0.43%**	**0.43%**	**10**	**10**	***NA***
Pole timber (small tree)	**0.00**	**0.00**	***NA***	***NA***	***NA***
Subcanopy IV	**0.00**	**0.00**	***NA***	***NA***	***NA***
Canopy IV	**0.80**	**0.80**	***NA***	***NA***	***NA***
Biomass	**244**	**244**	**7**	**7**	***NA***
%unvegetated	**NA**	**NA**	***NA***	***NA***	***NA***

Informational Parameters

stems/ha wetland trees	**5370.00**	**5370.00**
stems/ha wetland shrubs	**80.00**	**80.00**
%buttonbush	**1.18%**	**1.18%**
%perennial native hydrophytes	**89.76%**	**89.81%**
%perennial native	**89.81%**	**89.81%**
%perennial	**91.86%**	**91.86%**
%adventives	**1.30%**	**1.30%**
%open water	**0.00%**	**0.00%**
%unvegetated open water	**0.00%**	**0.00%**
%bare ground	**2.83%**	**2.83%**
Wetness Index	**0.90**	**0.90**

VIBI Total Score:	**64**	**64**	**43**
Average %Cover of Plot:	**233.87%**		

*** If Average %Cover is < 75% then Weight CofC VIBI FQ Metric Score is proportioned.**

Walnut Woods Forested VIBI Plot

Species	Common Name	CofC	Tolerance	Nativity	Form	Shade	Type	Habit	Relative Cover	Weighted CofC
Abutilon theophrasti	VELVETLEAF	0	tolerant	adventive	forb	advent	UPL	AN	0.0005	0
Acer negundo	BOX ELDER	3	midrange	native	tree	tree	FAC+	W	0.0005	0.001603489
Acer saccharinum	SILVER MAPLE	3	midrange	native	tree	tree	FACW	W	0.0000	9.62094E-05
Alisma subcordatum	SOUTHERN WATER-PLANTAIN	2	tolerant	native	forb	full	OBL	PE	0.1229	0.245868343
Ammannia coccinea	LONG-LEAVED TOOTH-CUP	7	sensitive	native	forb	full	OBL	AN	0.0016	0.011224424
Apocynum cannabinum	INDIAN HEMP	1	tolerant	native	forb	full	FACU	PE	0.0005	0.000534496
Asclepias incarnata	SWAMP MILKWEED	4	midrange	native	forb	full	OBL	PE	0.0000	4.27597E-05
Aster lateriflorus	CALICO ASTER	2	tolerant	native	forb	shade	FACW-	PE	0.0534	0.106899279
Aster sp.	ASTER	-1	tolerant	0	forb	ND	ND	PE	0.0118	
Bidens frondosa	DEVIL'S BEGGAR'S-TICK	2	tolerant	native	forb	full	FACW	AN	0.0000	2.13799E-05
Carex annectens	YELLOW FOX SEDGE	3	midrange	native	sedge	full	FACW	PE	0.0016	0.004810468
Carex comosa	BEARDED SEDGE	2	tolerant	native	sedge	full	OBL	PE	0.0203	0.040621726
Carex lupulina	HOP SEDGE	3	midrange	native	sedge	full	OBL	PE	0.1149	0.344750176
Carex lurida	BOTTLEBRUSH SEDGE	3	midrange	native	sedge	full	OBL	PE	0.0005	0.001635559
Carex scoparia	POINTED BROOM SEDGE	3	midrange	native	sedge	full	FACW	PE	0.0005	0.001603489
Carex sp.	SEDGE	-1	tolerant	0	sedge	ND	ND	PE	0.0005	
Carex tribuloides	BLUNT BROOM SEDGE	4	midrange	native	sedge	partial	FACW+	PE	0.0037	0.014965899
Cephalanthus occidentalis	BUTTONBUSH	6	sensitive	native	shrub	full	OBL	W	0.0118	0.070553524
Chenopodium album	LAMB'S-QUARTERS	0	tolerant	adventive	forb	advent	FACU+	AN	0.0005	0
Cirsium arvense	CANADA THISTLE	0	tolerant	adventive	forb	advent	FACU	PE	0.0000	0
Convolvulus arvensis	FIELD BINDWEED	0	tolerant	adventive	forb	advent	(UPL)	PE	0.0000	0
Cornus amomum	SILKY DOGWOOD	2	tolerant	native	shrub	full	FACW	W	0.0021	0.004275971
Echinochloa muricata	ROUGH BARNYARD GRASS	3	midrange	native	grass	full	FACW+	AN	0.0412	0.123500738
Eleocharis obtusa	BLUNT SPIKE-RUSH	1	tolerant	native	sedge	full	OBL	AN	0.0139	0.013896906
Eleocharis palustris	SMALL'S SPIKE-RUSH	5	midrange	native	sedge	full	OBL	PE	0.0401	0.200436149
Euphorbia maculata	SPOTTED SPURGE	0	tolerant	native	forb	full	FACU-	AN	0.0000	0
Euphorbia sp.	SPURGE	-1	tolerant	0	forb	ND	ND	ND	0.0000	
Fraxinus pennsylvanica	GREEN ASH	3	midrange	native	tree	tree	FACW	W	0.1791	0.537168879
Fraxinus pennsylvanica	GREEN ASH	3	midrange	native	tree	tree	FACW	W	0.0000	0
Fraxinus sp.	ASH	-1	tolerant	0	tree	tree	ND	W	0.0000	
Helenium autumnale	COMMON SNEEZEWEED	4	midrange	native	forb	full	FACW+	PE	0.0005	0.002137986
Hibiscus moscheutos	SWAMP ROSE-MALLOW	4	midrange	native	forb	full	OBL	PE	0.0000	8.55194E-05
Hibiscus trionum	FLOWER-OF-AN-HOUR	0	tolerant	adventive	forb	advent	(UPL)	AN	0.0005	0
Iris versicolor	NORTHERN BLUE FLAG	6	sensitive	native	forb	partial	OBL	PE	0.0005	0.003206978
Juncus effusus	SOFT RUSH	1	tolerant	native	forb	full	FACW+	PE	0.0160	0.016034892
Lactuca canadensis	WILD LETTUCE	1	tolerant	native	forb	partial	FACU-	BI	0.0000	1.06899E-05
Lindernia dubia	FALSE PIMPERNEL	2	tolerant	native	forb	full	OBL	AN	0.0005	0.001068993
Ludwigia palustris	WATER-PURSLANE	3	midrange	native	forb	full	OBL	AN	0.0054	0.016099031
Moss sp.	ND	-1	tolerant	adventive	bryo	bryo	ND	BR	0.0011	
Penthorum sedoides	DITCH-STONECROP	2	tolerant	native	forb	full	OBL	PE	0.0321	0.064139568
Phalaris arundinacea	REED CANARY GRASS	0	tolerant	native	grass	full	FACW+	PE	0.0005	0
Polygonum pensylvanicum	PINKWEED	0	tolerant	native	forb	full	FACW	AN	0.0080	0
Polygonum persicaria	LADY'S THUMB	0	tolerant	adventive	forb	advent	FACW	AN	0.0021	0
Polygonum sp.	KNOTWEED	-1	tolerant	0	ND	ND	ND	ND	0.0016	
Populus deltoides	EASTERN COTTONWOOD	3	midrange	native	tree	tree	FAC	W	0.0225	0.067378616
Portulaca oleracea	COMMON PURSLANE	0	tolerant	adventive	forb	advent	FAC	AN	0.0000	0

Potamogeton nodosus	LONG-LEAVED PONDWEED	3	midrange	native	forb	full	OBL	PE	0.0005	0.001603489
Quercus bicolor	SWAMP WHITE OAK	7	sensitive	native	tree	tree	FACW+	W	0.0000	0.000149659
Quercus palustris	PIN OAK	5	midrange	native	tree	tree	FACW	W	0.0000	0.000213799
Rorippa palustris	YELLOW CRESS	2	tolerant	native	forb	full	OBL	AN	0.0000	4.27597E-05
Rumex crispus	CURLY DOCK	0	tolerant	adventive	forb	advent	FACU	PE	0.0000	0
Salix nigra	BLACK WILLOW	2	tolerant	native	tree	tree	FACW+	W	0.0016	0.003206978
Schoenoplectus mucronatus	RICEFIELD BULRUSH	0	tolerant	adventive	sedge	advent	OBL	PE	0.0000	0
Schoenoplectus pungens	THREE-SQUARE	5	midrange	native	sedge	full	FACW+	PE	0.1037	0.518514955
Schoenoplectus tabernaemontani	SOFT-STEMMED BULRUSH	2	tolerant	native	sedge	full	OBL	PE	0.0043	0.008551942
Scirpus cyperinus	WOOL-GRASS	1	tolerant	native	sedge	full	FACW+	PE	0.0481	0.048104676
Scirpus sp.	ND	-1	tolerant	0	sedge	ND	ND	PE	0.0043	
Sparganium eurycarpum	GIANT BUR-REED	4	midrange	native	forb	full	OBL	PE	0.1155	0.461804887
Typha x glauca	HYBRID CAT-TAIL	0	tolerant	adventive	forb	advent	OBL	PE	0.0038	0
Ulmus sp.	ND	-1	tolerant	0	ND	ND	ND	W	0.0000	
Verbena hastata	BLUE VERVAIN	4	midrange	native	forb	full	FACW+	PE	0.0000	4.27597E-05
Vitis riparia	RIVERBANK GRAPE	3	midrange	native	vine	partial	FACW	W	0.0000	3.20698E-05
Xanthium strumarium	COMMON COCKLEBUR	0	tolerant	adventive	forb	advent	FAC	AN	0.0043	0

Walnut Woods Forested VIBI Plot

	Module			Module			Module			Module			Module			Residual
	2			3			8			9						
	Corner	Corner		Corner	Corner		Corner	Corner		Corner	Corner		Corner	Corner		
	2	4		2	4		2	4		2	4					
species	Level	Level	Cover Class	Level	Level	Cover Class	Level	Level	Cover Class	Level	Level	Cover Class	Level	Level	Cover Class	Cover Class
%open water	1		0	1		0	1		0	1		0	1			
%unvegetated open water	1		0	1		0	1		0	1		0	1			
%bare ground	1		3	1		0	1		4	1		4	1			
%litter cover	1		2	1		2	1		2	1		3	1			
Carex lupulina	4	4	4		1	4	4		10		1	4				
Fraxinus pennsylvanica	4	2	5	2	4	7	3		9	3	2	7				
Aster lateriflorus	4	2	7	2	3	3	3		4	3	2	5				
Echinochloa muricata	4	4	6	4	4	4		4	1	4	2	6				
Aster sp.	4		5		4	1				4	1	4				
Rorippa palustris	4		1	1	2	1										
Alisma subcordatum	3	3	7	4	2	8	4	3	5	2	2	5				
Polygonum pensylvanicum	3	4	4	3	1	2				4		4				
Ludwigia palustris	3	3	4	3	3	1		4	1		2	3				
Eleocharis obtusa	4	4	3	4		5	3	3	2		2	4				
Penthorum sedoides	2	3	3	3	3	6	4		4	4	2	5				
Asclepias incarnata	2		1													
Hibiscus trionum	1	2	1							2		2				
Portulaca oleracea	2	3	1	3		1										
Hibiscus moscheutos		3	1		2	1										
Juncus effusus		2	4	2		5		1	2		2	4				
Xanthium strumarium		2	2	2	2	1	2	2	1	4		4				
Quercus palustris		2	1	3		1		1	1		1	1				
Euphorbia sp.		2	1								1	1				
Scirpus sp.		1	2		3	1				4		4				
Abutilon theophrasti		1	2	2		1				3	4					
Cirsium arvense		1	1													
Scirpus cyperinus		1	5							3	2	7				
Populus deltoides		1	4					2	1		4	6				
Acer saccharinum		1	1		1	1					2	1				
Carex tribuloides		1	3		1	2					1	3				
Phalaris arundinacea		1	2		2	1										
Cornus amomum		1	3					1	2							
Polygonum persicaria		1	2					1	1	4		3				
Acer negundo		1	2													
Carex lurida		1	1								1	2				
Rumex crispus		1	1								1	1				
Quercus bicolor		1	1								1	1				
Moss sp.		1	2	2	4	2										
Schoenoplectus pungens				3		1		4	10							
Sparganium eurycarpum				2		4	2	1	5		4	10				
Carex sp.				2		2										
Polygonum sp.					4	1		3	1		2	3				
Carex comosa							2		3		1	6				
Potamogeton nodosus								3	2							
Ammannia coccinea								2	3							
Bidens frondosa								2	1							
Lindernia dubia								2	2							
Eleocharis palustris							2		7							
Schoenoplectus tabernaemontani								1	2		2	4				
Cephalanthus occidentalis								1	5		1	4				
Typha x glauca								1	1		1	4				
Chenopodium album										2		2				
Salix nigra											1	3				
Ulmus sp.											1	1				
Apocynum cannabinum											1	2				
Carex annectens											1	3				
Schoenoplectus mucronatus											1	1				
Carex scoparia											1	2				
Iris versicolor																2
Vitis riparia																1
Helenium autumnale																2
Convolvulus arvensis																1
Verbena hastata																1
Lactuca canadensis																1
Euphorbia maculata																1

Walnut Woods Forested VIBI Plot

			size class (cm) woody stems >1m tall																				
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
mod #	Veg Species	%sub	clump	0-<1	1-<2.5	2.5-<5	5-<10	10 - <15	15 - <20	20 - <25	25 - <30	30 - <35	35 - <40	>40-1	>40-2	>40-3	>40-4	>40-5	>40-6	>40-7	>40-8	>40-9	>40-10
1	Fraxinus pennsylvanica	1.00		3																			
1	Cephalanthus occidentalis	1.00	1																				
2	Fraxinus pennsylvanica	1.00		17	3																		
2	Populus deltoides	1.00		2																			
2	Cornus amomum	1.00	1																				
2	Acer negundo	1.00		1																			
3	Acer saccharinum	1.00		2																			
3	Fraxinus pennsylvanica	1.00		100	100																		
4	Fraxinus pennsylvanica	1.00		59																			
4	Acer negundo	1.00		1																			
4	Cephalanthus occidentalis	1.00	2																				
4	Populus deltoides	1.00		4																			
5	Fraxinus pennsylvanica	1.00		4																			
5	Cephalanthus occidentalis	1.00	1																				
6	Fraxinus pennsylvanica	1.00		1																			
7	Cephalanthus occidentalis	1.00	1																				
7	Fraxinus pennsylvanica	1.00		52	5																		
8	Cephalanthus occidentalis	1.00	1																				
8	Populus deltoides	1.00		27																			
8	Fraxinus pennsylvanica	1.00		100	11																		
9	Populus deltoides	1.00		2																			
9	Cephalanthus occidentalis	1.00	1																				
9	Fraxinus pennsylvanica	1.00		42																			
10	Fraxinus pennsylvanica	1.00		1																			
		1.00																					

Walnut Woods Forested VIBI Plot

Bio Mass Collected	**YES**

Sample Area (m^2)	**0.1**

Module	Corner	Sample Number	Area Sample (m2)	Weight w/bag (g)	Bag Weight (g)	Actual or Derived	Net Weight (g)	g/m2
2	1	1	0.1	23	8	A	15.0	150
2	3	2	0.1	21	8	A	13.0	130
3	1	3	0.1	36	8	A	28.0	280
3	3	4	0.1	14	8	A	6.0	60
8	1	5	0.1	44	8	A	36.0	360
8	3	6	0.1	31	8	A	23.0	230
9	1	7	0.1	20	8	A	12.0	120
9	3	8	0.1	70	8	A	62.0	620
		9	0.1			A	0.0	ND
		10	0.1			A	0.0	ND

APPENDIX I:

Non-forested VIBI Data Forms

Walnut Woods Non-forested VIBI Plot

Site Information

Site Name:	Walnut Woods- Plot 1		**Site Code:**	
County:	Franklin	**Sampling date(s):**	7/20/2016	
Collector(s):	Stephen Bailey, Melissa Benoit, Christine Rahtz		**Affiliation:**	EMH&T
				Create Summary Report
Phone number:	614-775-4522	**email address:**	sbailey@emht.com	

Plot Information

General Plot Information	
Monitor Event	2nd
Total Modules	10
Intensive Modules	4
Plot Congituration	VIBI-Std (2x5)
Area (ha)	0.10
Latitude	
Longitude	
Centerline	
Army Corp Region	MW
Plant Community Information	
VEG Class	EMERGENT
1st Plant Community	
Veg. Group	Wet meadow
Veg. Modifier	
Other	
2nd Plant Community	
VEG Class	
Veg. Group	
Veg. Modifier	
Other	
HGM Information	
Primary HGM Class	DEPRESSION
Sub class	Suface water
Secondary HGM Class	
Sub class	
Sub or Super Sample	NO
% Sub or Super Sample	100%
Total plot canopy closure %	
Total plot herbaceous cover %	

VIBI Calculation Summary Information

Metric	Value		VIBI - Metric Score		VIBI FQ
	Statewide	ACOE Region	Statewide	ACOE Region	Metric Score
Carex	6	6	10	10	NA
Cyperaceae	11	11	NA	NA	NA
Dicot	28	28	10	10	NA
Shade	4	4	NA	NA	NA
Shrub	6	6	10	10	NA
Hydrophyte	43	44	10	10	NA
Seedless Vascular Plant	0	0	NA	NA	NA
Annual/Perennial ratio	0.26	0.26	7	7	NA
FQAI	20.18	20.18	7	7	25.45
Weighted C of C	2.63	2.63	NA	NA	21.90
%bryophyte	0.00%	0.00%	NA	NA	NA
%hydrophyte	86.65%	86.73%	NA	NA	NA
%sensitive	1.78%	1.78%	0	0	NA
%tolerant	38.22%	38.22%	7	7	NA
%invasive graminoids	0.00%	0.00%	10	10	NA
Pole timber (small tree)	0.00	0.00	NA	NA	NA
Subcanopy IV	0.00	0.00	NA	NA	NA
Canopy IV	0.17	0.17	NA	NA	NA
Biomass	299	299	7	7	NA
%unvegetated	NA	NA	NA	NA	NA
Informational Parameters					
stems/ha wetland trees	40.00	40.00			
stems/ha wetland shrubs	630.00	630.00			
%buttonbush	0.54%	0.54%			
%perennial native hydrophytes	68.75%	69.53%			
%perennial native	69.53%	69.53%			
%perennial	75.12%	75.12%			
%adventives	3.89%	3.89%			
%open water	0.00%	0.00%			
%unvegetated open water	0.00%	0.00%			
%bare ground	2.00%	2.00%			
Wetness Index	0.84	0.84			
		VIBI Total Score:	78	78	47
Average %Cover of Plot:	161.35%				

* If Average %Cover is < 75% then Weight CofC VIBI FQ Metric Score is proportioned.

Walnut Woods Non-forested VIBI Plot

	Module			Module			Module			Module			Module			Residual
	2			3			8			9						
	Corner	Corner		Corner	Corner		Corner	Corner		Corner	Corner		Corner	Corner		
	2	4		2	4		2	4		2	4					
species	Level	Level	Cover Class	Level	Level	Cover Class	Level	Level	Cover Class	Level	Level	Cover Class	Level	Level	Cover Class	Cover Class
%open water	1		0	1		0	1		0	1		0	1			
%unvegetated open water	1		0	1		0	1		0	1		0	1			
%bare ground	1		3	1		4	1		3	1		3	1			
%litter cover	1		3	1		3	1		3	1		3	1			
Echinochloa muricata	4		7	4	1	7	4	4	6	4		3				
Penthorum sedoides	4	4	6		1	3	4	2	3	4	3	4				
Asclepias incarnata	4	4	5	4	4	4	4	2	8	4	4	9				
Eleocharis obtusa	4		4	4	1	3	2		4	3	4	4				
Scirpus sp.	4	3	3	3		4	4		4		4	5				
Aster lateriflorus	4	4	4	4	4	3	3	3	5	3	4	6				
Bidens frondosa	3	4	2	3	1	3	3	4	3	4	4	5				
Phyla lanceolata	3		4		1	5	3		4		1	2				
Alisma subcordatum	3	4	4	3	2	2	3	2	3	4	3	6				
Scirpus cyperinus	2		4	3		5		1	2	2	1	4				
Eleocharis palustris	2		3													
Leersia oryzoides	2	3	5	3	2	2	3	4	4	2	3	3				
Helenium autumnale	2	2	2		4	3	2		5	2		3				
Rumex crispus	2		2	2	3	1	2		6	2	2	3				
Euphorbia sp.	2		1				4		1							
Carex scoparia	2	4	3	2	4	5	2	4	5		4	6				
Carex tribuloides	2	4	4	2	3	5	2	2	4		4	6				
Lycopus americanus	2		2	3	1	1					2	1				
Salix exigua		4	5					2	6							
Juncus effusus		3	4	3	3	4					2	2				
Carex annectens		3	4	3	4	2	2	3	5		2	2				
Carex lupulina		2	6								1	2				
Hibiscus moscheutos		1	1	3	3	2		2	2		1	1				
Cornus sericea		1	1		1	1										
Cephalanthus occidentalis		1	4													
Iris versicolor		1	4					1	4							
Xanthium strumarium		1	1		1	1					2	1				
Polygonum hydropiperoides		1	2													
Mimulus ringens		1	2								1	1				
Carex lurida		1	2					3	3		1	3				
Quercus bicolor		1	1					1	1							
Carex frankii		1	1				2	1	2							
Abutilon theophrasti		1	1		1	2	4		2	2	1	2				
Verbena hastata		1	1		1	1										
Polygonum sp.				4		7	4	4	2							
Acer saccharinum				2		1	2	2	1							
Convolvulus arvensis				2		1		1	2							
Elymus virginicus					3	1	2	1	1							
Quercus palustris					2	1		2	1							
Ludwigia palustris					1	1				4		1				
Typha sp.					1	1										
Morus alba								2	1							
Setaria glauca								2	1							
Polygonum persicaria								2	1	4	1	4				
Eclipta prostrata								2	2							
Apocynum cannabinum								1	3		1	4				
Salix sericea								1	2							
Cornus amomum								1	1							
Viburnum dentatum								1	3							
Eupatorium maculatum								1	2							
Salix amygdaloides										2		4				
Juncus torreyi																1
Schoenoplectus tabernaemontani																1
Typha x glauca																1
Salix discolor																1
Solanum dulcamara																1
Schoenoplectus pungens																2
Sparganium eurycarpum																2
Fraxinus pennsylvanica																1
Populus deltoides																1

Walnut Woods Non-forested VIBI Plot

OhioEPA			size class (cm) woody stems >1m tall																				
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
mod #	**Veg Species**	**%sub**	**clump**	**0-<1**	**1-<2.5**	**2.5-<5**	**5-<10**	**10 - <15**	**15 - <20**	**20 - <25**	**25 - <30**	**30 - <35**	**35 - <40**	**>40-1**	**>40-2**	**>40-3**	**>40-4**	**>40-5**	**>40-6**	**>40-7**	**>40-8**	**>40-9**	**>40-10**
1	Salix discolor	1.00		1																			
2	Salix exigua	1.00		5																			
4	Cephalanthus occidentalis	1.00	1																				
4	Populus deltoides	1.00			1																		
5	Cornus amomum	1.00	1																				
5	Salix discolor	1.00	1																				
5	Cephalanthus occidentalis	1.00	1																				
6	Populus deltoides	1.00			1																		
7	Fraxinus pennsylvanica	1.00		1																			
7	Salix exigua	1.00	1																				
8	Salix exigua	1.00		51																			
8	Viburnum dentatum	1.00	1																				
9	Salix amygdaloides	1.00		1																			

Walnut Woods Non-forested VIBI Plot

Bio Mass Collected	**YES**

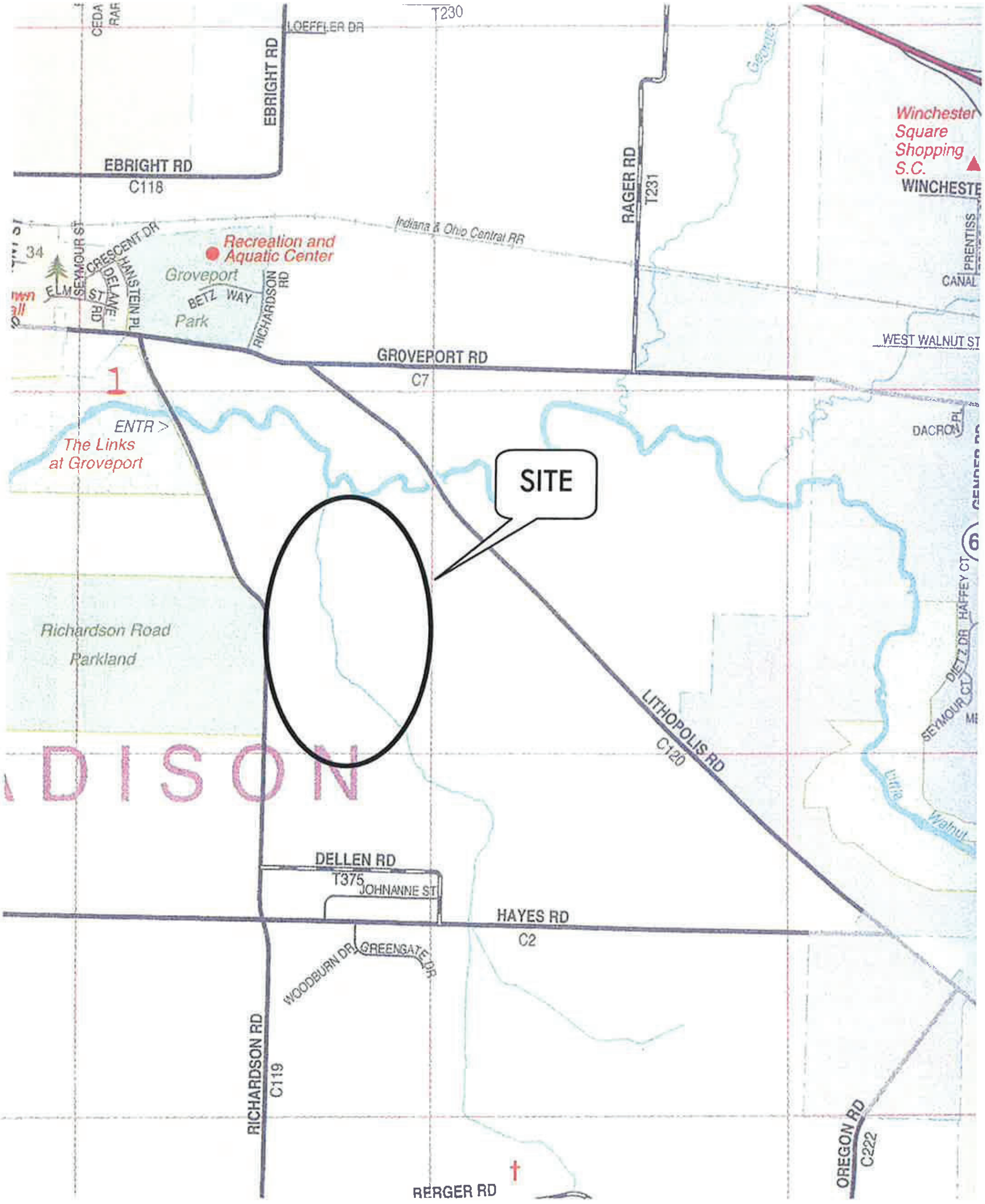
Sample Area (m^2)	**0.1**

Module	Corner	Sample Number	Area Sample (m2)	Weight w/bag (g)	Bag Weight (g)	Actual or Derived	Net Weight (g)	g/m2
2	1	1	0.1	24	8	A	16.0	160
2	3	2	0.1	74	8	A	66.0	660
3	1	3	0.1	44	8	A	36.0	360
3	3	4	0.1	23	8	A	15.0	150
8	1	5	0.1	19	8	A	11.0	110
8	3	6	0.1	43	8	A	35.0	350
9	1	7	0.1	25	8	A	17.0	170
9	3	8	0.1	51	8	A	43.0	430
		9	0.1			A	0.0	ND
		10	0.1			A	0.0	ND

Walnut Woods Non-forested VIBI Plot

Species	Common Name	CofC	Tolerance	Nativity	Form	Shade	Type	Habit	Relative Cover	Weighted CofC
Abutilon theophrasti	VELVETLEAF	0	tolerant	adventive	forb	advent	UPL	AN	0.0023	0
Acer saccharinum	SILVER MAPLE	3	midrange	native	tree	tree	FACW	W	0.0000	9.29656E-05
Alisma subcordatum	SOUTHERN WATER-PLANTAIN	2	tolerant	native	forb	full	OBL	PE	0.0356	0.071273629
Apocynum cannabinum	INDIAN HEMP	1	tolerant	native	forb	full	FACU	PE	0.0077	0.007747134
Asclepias incarnata	SWAMP MILKWEED	4	midrange	native	forb	full	OBL	PE	0.2456	0.982336535
Aster lateriflorus	CALICO ASTER	2	tolerant	native	forb	shade	FACW-	PE	0.0465	0.092965603
Bidens frondosa	DEVIL'S BEGGAR'S-TICK	2	tolerant	native	forb	full	FACW	AN	0.0170	0.034087388
Carex annectens	YELLOW FOX SEDGE	3	midrange	native	sedge	full	FACW	PE	0.0186	0.055779362
Carex frankii	FRANK'S SEDGE	2	tolerant	native	sedge	full	OBL	PE	0.0008	0.001580415
Carex lupulina	HOP SEDGE	3	midrange	native	sedge	full	OBL	PE	0.0279	0.083669042
Carex lurida	BOTTLEBRUSH SEDGE	3	midrange	native	sedge	full	OBL	PE	0.0054	0.01626898
Carex scoparia	POINTED BROOM SEDGE	3	midrange	native	sedge	full	FACW	PE	0.0527	0.158041525
Carex tribuloides	BLUNT BROOM SEDGE	4	midrange	native	sedge	partial	FACW+	PE	0.0496	0.198326619
Cephalanthus occidentalis	BUTTONBUSH	6	sensitive	native	shrub	full	OBL	W	0.0054	0.032537961
Convolvulus arvensis	FIELD BINDWEED	0	tolerant	adventive	forb	advent	(UPL)	PE	0.0008	0
Cornus amomum	SILKY DOGWOOD	2	tolerant	native	shrub	full	FACW	W	0.0000	3.09885E-05
Cornus sericea	RED-OSIER DOGWOOD	3	midrange	native	shrub	full	FACW+	W	0.0000	9.29656E-05
Echinochloa muricata	ROUGH BARNYARD GRASS	3	midrange	native	grass	full	FACW+	AN	0.1456	0.436938333
Eclipta prostrata	YERBA-DE-TAJO	3	midrange	native	forb	full	FAC	AN	0.0008	0.00232414
Eleocharis obtusa	BLUNT SPIKE-RUSH	1	tolerant	native	sedge	full	OBL	AN	0.0186	0.018593121
Eleocharis palustris	SMALL'S SPIKE-RUSH	5	midrange	native	sedge	full	OBL	PE	0.0023	0.0116207
Elymus virginicus	VIRGINIA WILD RYE	3	midrange	native	grass	partial	FACW-	PE	0.0000	9.29656E-05
Eupatorium maculatum	SPOTTED JOE-PYE WEED	6	sensitive	native	forb	full	FACW	PE	0.0008	0.00464828
Euphorbia sp.	SPURGE	-1	tolerant	0	forb	ND	ND	ND	0.0000	
Fraxinus pennsylvanica	GREEN ASH	3	midrange	native	tree	tree	FACW	W	0.0000	4.64828E-05
Helenium autumnale	COMMON SNEEZEWEED	4	midrange	native	forb	full	FACW+	PE	0.0170	0.068174775
Hibiscus moscheutos	SWAMP ROSE-MALLOW	4	midrange	native	forb	full	OBL	PE	0.0016	0.006321661
Iris versicolor	NORTHERN BLUE FLAG	6	sensitive	native	forb	partial	OBL	PE	0.0108	0.065075922
Juncus effusus	SOFT RUSH	1	tolerant	native	forb	full	FACW+	PE	0.0116	0.0116207
Juncus torreyi	TORREY'S RUSH	3	midrange	native	forb	full	FACW	PE	0.0000	4.64828E-05
Leersia oryzoides	RICE CUT GRASS	1	tolerant	native	grass	full	OBL	PE	0.0201	0.020142547
Ludwigia palustris	WATER-PURSLANE	3	midrange	native	forb	full	OBL	AN	0.0000	9.29656E-05
Lycopus americanus	AMERICAN WATER-HOREHOUND	3	midrange	native	forb	full	OBL	PE	0.0008	0.002417106
Mimulus ringens	COMMON MONKEY-FLOWER	4	midrange	native	forb	full	OBL	PE	0.0008	0.00316083
Morus alba	WHITE MULBERRY	0	tolerant	adventive	tree	advent	UPL	W	0.0000	0
Penthorum sedoides	DITCH-STONECROP	2	tolerant	native	forb	full	OBL	PE	0.0372	0.074372482
Phyla lanceolata	FOG-FRUIT	3	midrange	native	forb	full	OBL	PE	0.0232	0.069724202
Polygonum hydropiperoides	MILD WATER-PEPPER	6	sensitive	native	forb	full	OBL	PE	0.0008	0.00464828
Polygonum persicaria	LADY'S THUMB	0	tolerant	adventive	forb	advent	FACW	AN	0.0054	0
Polygonum sp.	KNOTWEED	-1	tolerant	0	ND	ND	ND	ND	0.0589	
Populus deltoides	EASTERN COTTONWOOD	3	midrange	native	tree	tree	FAC	W	0.0000	4.64828E-05
Quercus bicolor	SWAMP WHITE OAK	7	sensitive	native	tree	tree	FACW+	W	0.0000	0.00021692
Quercus palustris	PIN OAK	5	midrange	native	tree	tree	FACW	W	0.0000	0.000154943
Rumex crispus	CURLY DOCK	0	tolerant	adventive	forb	advent	FACU	PE	0.0302	0
Salix amygdaloides	PEACH-LEAF WILLOW	3	midrange	native	tree	full	FACW	W	0.0054	0.01626898
Salix discolor	PUSSY WILLOW	3	midrange	native	shrub	full	FACW	W	0.0000	4.64828E-05
Salix exigua	SANDBAR WILLOW	1	tolerant	native	shrub	full	OBL	W	0.0387	0.038735668
Salix sericea	SILKY WILLOW	4	midrange	native	shrub	full	OBL	W	0.0008	0.003098853
Schoenoplectus pungens	THREE-SQUARE	5	midrange	native	sedge	full	FACW+	PE	0.0008	0.003873567
Schoenoplectus tabernaemontani	SOFT-STEMMED BULRUSH	2	tolerant	native	sedge	full	OBL	PE	0.0000	3.09885E-05
Scirpus cyperinus	WOOL-GRASS	1	tolerant	native	sedge	full	FACW+	PE	0.0232	0.023241401
Scirpus sp.	ND	-1	tolerant	0	sedge	ND	ND	PE	0.0248	
Setaria glauca	YELLOW FOXTAIL GRASS	0	tolerant	adventive	grass	advent	FAC	AN	0.0000	0
Solanum dulcamara	BITTERSWEET NIGHTSHADE	0	tolerant	adventive	vine	advent	FAC-	PE	0.0000	0
Sparganium eurycarpum	GIANT BUR-REED	4	midrange	native	forb	full	OBL	PE	0.0008	0.003098853
Typha sp.	ND	-1	tolerant	0	forb	ND	OBL	PE	0.0000	
Typha x glauca	HYBRID CAT-TAIL	0	tolerant	adventive	forb	advent	OBL	PE	0.0000	0
Verbena hastata	BLUE VERVAIN	4	midrange	native	forb	full	FACW+	PE	0.0000	0.000123954
Viburnum dentatum	ARROW-WOOD	2	tolerant	native	shrub	full	FAC	W	0.0023	0.00464828
Xanthium strumarium	COMMON COCKLEBUR	0	tolerant	adventive	forb	advent	FAC	AN	0.0000	0

EXHIBITS



EMH&T

Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4800

M C M X X V I

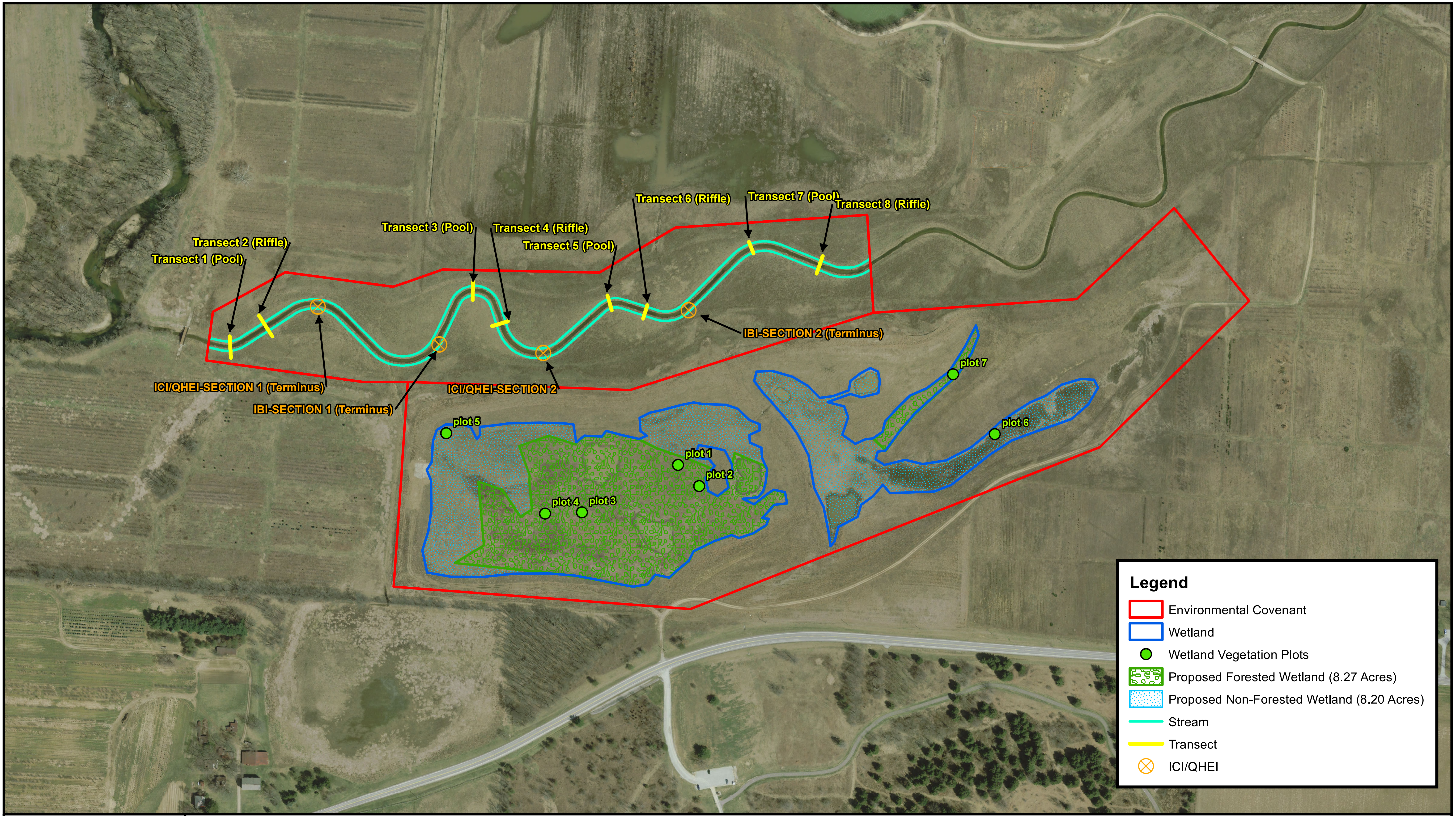
SCALE: 1"= 2000'

0 1000 2000 4000 FEET

GROVEPORT, FRANKLIN COUNTY, OHIO

WALNUT WOODS SITE
AREA LOCATION MAP
EXHIBIT 1

Source:
- FRANKLIN COUNTY MAP (2007)



EMH&T
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Toll Free: 888.775.3648
emht.com

SCALE: 1" = 300'

0 150 300 600 Feet

SOMERSET TOWNSHIP, BELMONT COUNTY, OHIO

Walnut Woods
Mitigation Overview Map
Exhibit 2

Aerial - OSIP, 2013

Path: J:\20110496\GIS\Exhibit 2 - Mitigation Overview Map.mxd

COLUMBUS AND FRANKLIN COUNTY METRO PARKS

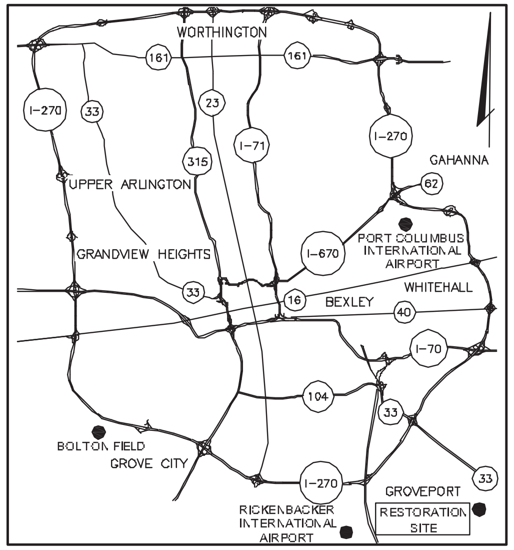
WETLAND AND STREAM AS-BUILT PLAN

AT

THE FORMER EASTSIDE NURSERY SITE

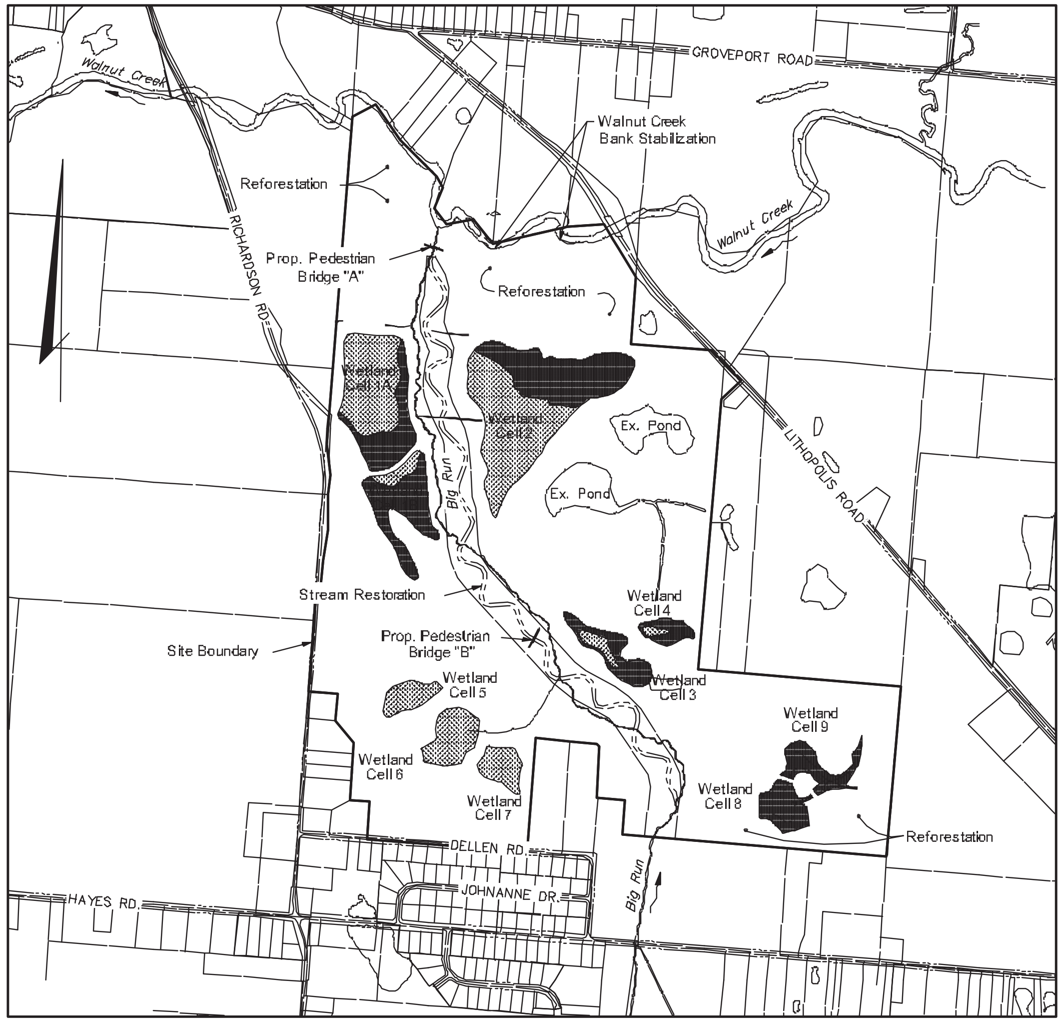
6723 LITHOPOLIS ROAD, CANAL WINCHESTER, OHIO 43110

2011



VICINITY MAP
NO SCALE

INDEX OF SHEETS



LOCATION MAP
SCALE: 1"=800'

PLAN PREPARED BY:

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4800
M C M X X V I

OWNER

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
1069 WEST MAIN STREET, WESTERVILLE, OH 43081
PHONE: (614) 891-0700 FAX: (614) 895-6208

WORK

PART I:
WETLAND CELLS 1A AND 1B
STREAM RESTORATION STA. 43+44.70 TO 70+44.70

PART II:
WETLAND CELLS 2-9
STREAM RESTORATION STA. 0+00 TO 43+44.70
WALNUT CREEK BANK STABILIZATION
REFORESTATION

PART III:
PEDESTRIAN BRIDGES

STANDARD DRAWINGS

COLUMBUS AA-S169 (MODIFIED)
ODOT TC-41.20

BIG RUN STREAM DESIGN STATISTICS

WATERSHED AREA AT DOWNSTREAM END	APPROX. 8.5 SQ. MILES
AVERAGE SINUOSITY	1.22
BANKFULL WIDTH	31.0 FEET
BANKFULL MEAN DEPTH	2.71 FEET
BANKFULL MAX DEPTH	3.5 FEET
W/D RATIO	11.44
BELTWIDTH	275 FEET
ENTRENCHMENT RATIO	9.52
BANKFULL DISCHARGE AT DOWNSTEAM END	APPROX. 337 cfs
BANKFULL VELOCITY AT DOWNSTREAM END	APPROX. 4.0 ft/s

WETLAND SUMMARY TABLE

	CELL 1A	CELL 1B	CELL 2	CELL 3	CELL 4	CELL 5	CELL 6	CELL 7	CELL 8	CELL 9
NORMAL OPERATING POOL ELEV. (A)	727.5	728.5	728.5	732.5	735.5	745.5	745.5	744.5	743.5	744.5
SATURATION ELEV.	728.5	729.5	729.5	733.5	736.5	746.5	746.5	745.5	744.5	745.5
EMERGENT WETLAND AREA (AC.)	9.98	1.14	14.64	3.10	0.37	2.43	4.27	2.62	–	–
FORESTED WETLAND AREA (AC.)	4.98	6.36	10.80	0.98	1.53	–	–	–	3.42	3.23
TOTAL WETLAND AREA (AC.)	14.96	7.50	25.44	4.08	1.90	2.43	4.27	2.62	3.42	3.23
TRIBUTARY AREA (AC.)	110.43	93.02	114.95	204.02	178.11	13.19	21.57	14.10	10.92	54.59
RATIO (TRIB. AREA/WETLAND AREA)	7.38	12.40	4.52	50.00	93.74	5.42	5.05	5.38	3.19	16.90

Job No.	2011-0496
Drawn By	JAC
Date	December, 2011
Scale	As Noted

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM AS-BUILT PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITHOPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
TITLE SHEET

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Toll Free: 888.775.3648
emht.com

COLUMBUS AND FRANKLIN
COUNTY METRO PARKS
1069 WEST MAIN STREET,
WESTERVILLE, OH 43081
(614) 891-0700
(614) 895-6208 FAX

REVISIONS

MARK	DATE	

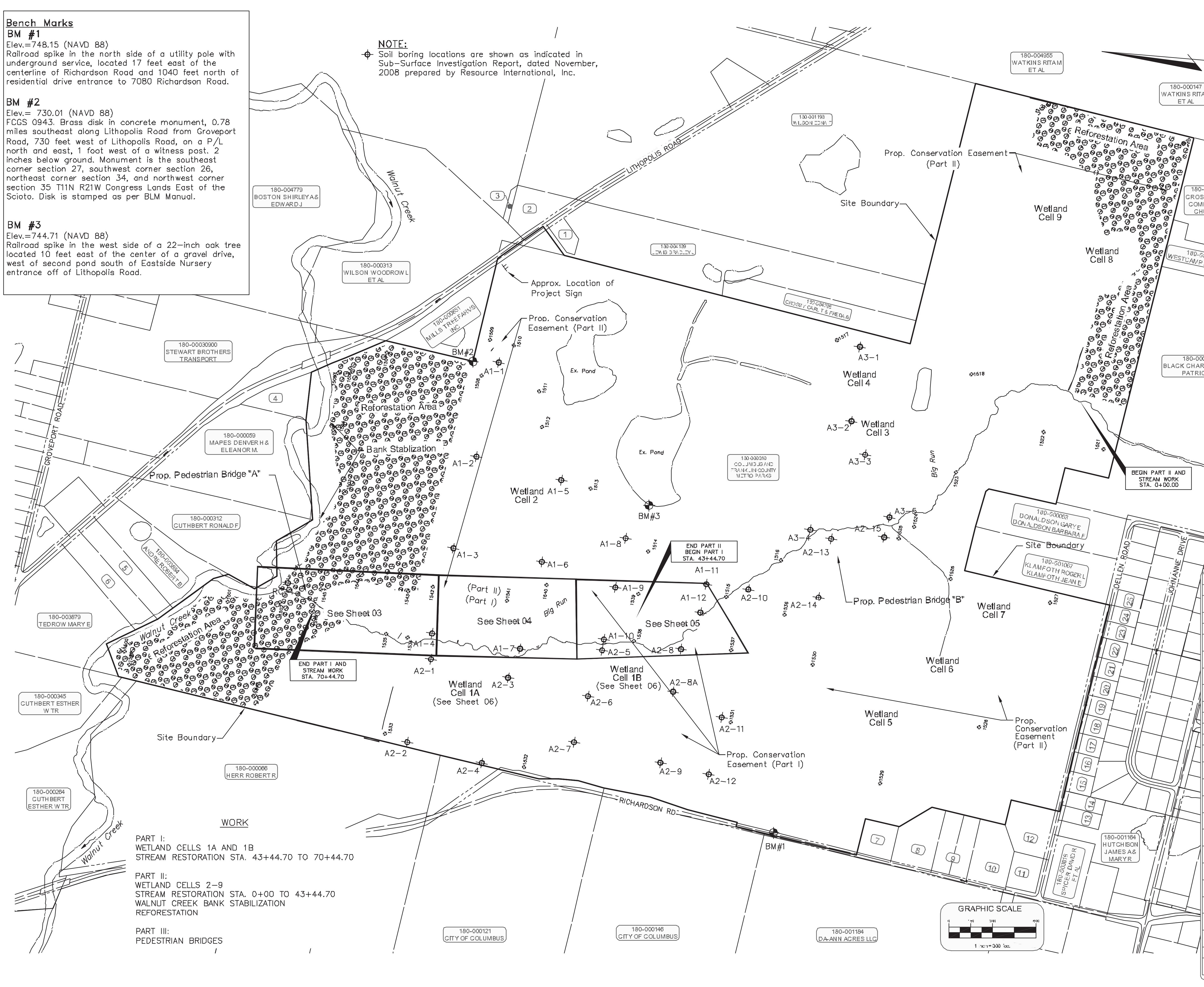
Bench Marks

BM #1
Elev.=748.15 (NAVD 88)
Railroad spike in the north side of a utility pole with underground service, located 17 feet east of the centerline of Richardson Road and 1040 feet north of residential drive entrance to 7080 Richardson Road.

BM #2
Elev.= 730.01 (NAVD 88)
FCGS 0943. Brass disk in concrete monument, 0.78 miles southeast along Lithopolis Road from Groveport Road, 730 feet west of Lithopolis Road, on a P/L north and east, 1 foot west of a witness post. 2 inches below ground. Monument is the southeast corner section 27, southwest corner section 26, northeast corner section 34, and northwest corner section 35 T11N R21W Congress Lands East of the Scioto. Disk is stamped as per BLM Manual.

BM #3
Elev.=744.71 (NAVD 88)
Railroad spike in the west side of a 22-inch oak tree located 10 feet east of the center of a gravel drive, west of second pond south of Eastside Nursery entrance off of Lithopolis Road.

NOTE:
Soil boring locations are shown as indicated in Sub-Surface Investigation Report, dated November, 2008 prepared by Resource International, Inc.



WORK

PART I:
WETLAND CELLS 1A AND 1B
STREAM RESTORATION STA. 43+44.70 TO 70+44.70

PART II:
WETLAND CELLS 2-9
STREAM RESTORATION STA. 0+00 TO 43+44.70
WALNUT CREEK BANK STABILIZATION
REFORESTATION

PART III:
PEDESTRIAN BRIDGES

CONSERVATION EASEMENT STAKING TABLE

Pnt Number	Northing	Easting
1500	672811.7573	1865483.0158
1501	672165.8178	1865934.7228
1502	671809.8575	1865990.4840
1503	671501.3147	1866813.7115
1504	671639.5126	1867219.1833
1505	671672.0085	1867611.9236
1506	671594.2256	1867658.6269
1507	671361.7659	1867804.6071
1508	670692.0413	1867754.8520
1509	670673.9870	1868007.3583
1510	670506.9982	1867995.4185
1511	670282.9599	1867711.7992
1512	670224.0390	1867473.0188
1513	669825.8510	1867108.3623
1514	669364.4024	1866745.1404
1515	668782.3796	1866524.3373
1516	668451.8797	1866832.4730
1517	668315.6458	1868391.7948
1518	667364.2667	1868308.6752
1519	667209.3988	1870172.2531
1520	666203.7370	1870089.8277
1521	666382.4340	1867946.4596
1522	666809.5502	1867996.4282
1523	667359.7142	1867625.8438
1524	667583.6203	1867208.8044
1525	667675.7328	1867111.7587
1526	667278.2191	1866894.8098
1527	666575.3701	1866843.9069
1528	666919.0162	1865918.3411
1529	667529.4232	1865427.4140
1530	668119.6026	1866159.9602
1531	668613.5389	1865676.7072
1532	669967.7536	1865140.5881
1533	670950.0172	1865214.0263
1534	670903.2477	1865892.3970
1535	671052.9243	1865892.8116
1536	668367.1066	1866467.1687
1537	668689.9236	1866166.1962
1538	669361.9419	1866121.3839
1539	669383.5659	1866445.6637
1540	670017.0843	1866403.4187
1541	670269.4794	1866253.8827
1542	670788.2858	1866264.4410
1543	670952.0189	1866207.0199
1544	671307.7593	1866255.7780
1545	671547.8034	1866124.0475
1546	671569.7872	1865963.6533
1547	671872.7131	1865330.3020
1548	672764.4296	1865399.0557

OWNER INFORMATION

NUMBER	PID:	OWNER NAME
1	180-003914	LANGOND LORITAS; LANGDON H ROBERT
2	180-000307	ROHRIG NEAL C
3	180-003873	EASTSIDE NURSERY INC.
4	180-00030900	STEWART BROTHERS TRANSPORTATION
5	180-000089	SMITH MARK W, SMITH TERESA M
6	180-003881	HENKEL GARY A, HENKEL JEANNIE L
7	180-000196	LUCAS WAYNE A & PAMELA E
8	180-005342	MAY RANDALL W
9	180-005360	MAY RANDALL W
10	180-005346	GIBSON STEPHANIE L
11	180-000373	GERARDI PAMELA S
12	180-0053341	COOK KAREN, COOK ROBERT L
13	180-000107	HUGHES BARRY A & LINDA B
14	180-000117	MACKEY ROBERT L & MARGARET L
15	180-001732	HEDGES STEVEN T & MARCIE A
16	180-001733	MOUSER EUGENE A & JANET L
17	180-001734	DAVIS DONNA G & JESSE W
18	180-001735	LEADING WAYNE R & CONNIE M
19	180-001736	RUTTER WOODROW W JR & SHIRLEY
20	180-001737	THOMPSON ELEANOR H AFDT
21	180-001738	NORMAN JEFFREY L & LORI L
22	180-001739	RECOB DAVID L, RECOB JUDY A
23	180-004738	BUTLER CRAIG W & TAMMI S
24	180-004740	COOPER KIM P & CONNIE
25	180-004739	WADDELL JAMES P & ANNA M

Job No. 2011-0496
Drawn By: JAC
Date December, 2011
Scale As Noted

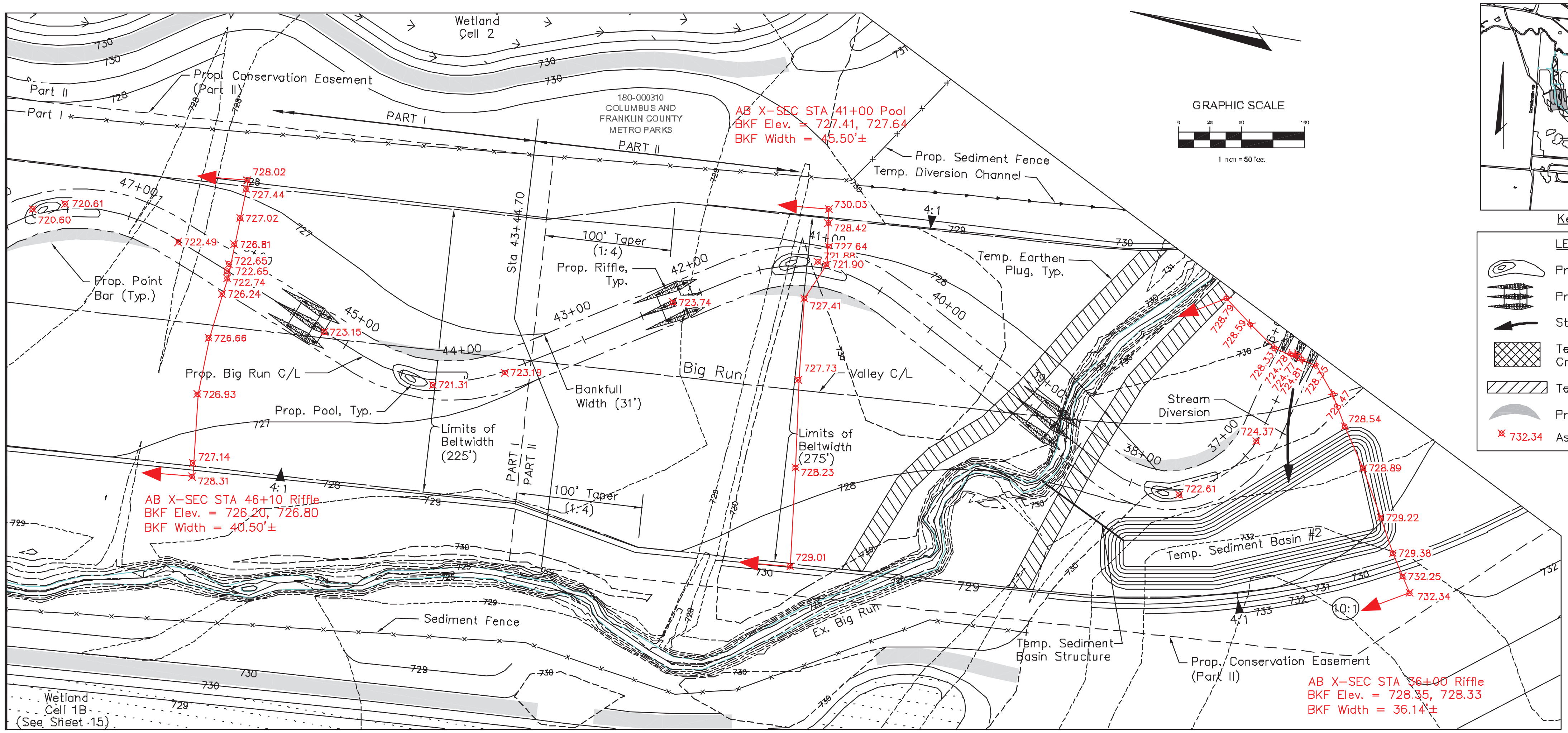
COLUMBUS AND FRANKLIN COUNTY METROPARKS
WETLAND AND STREAM AS-BUILT PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITHOPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
INDEX SHEET

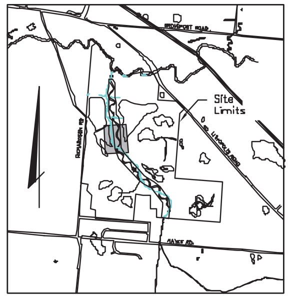
EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone 614 775 4500 Toll Free 888 775 3648
emht.com

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
1069 WEST MAIN STREET,
WESTERVILLE, OH 43081-1181
(614) 891-0700
(614) 895-6208 FAX:

REVISIONS
MARK DATE

Sheet
02/08

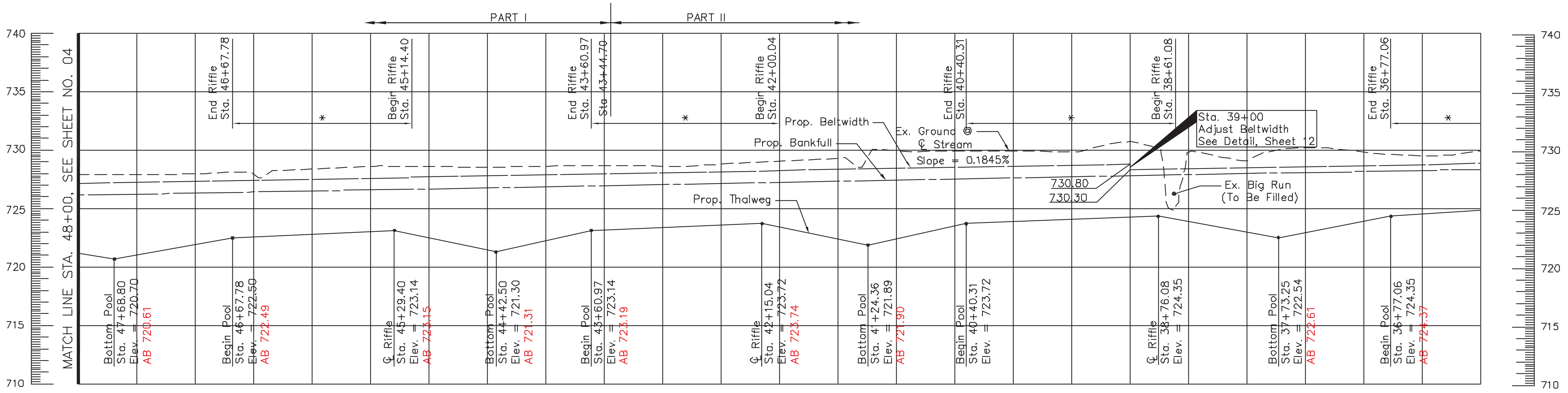




Key Map

LEGEND

- Prop. Pool Prop.
- Prop. Riffle
- Stream Diversion
- ▨ Temp. Stream Crossing
- ▨ Temp. Earthen Plug
- Prop. Point Bar
- ☒ 732.34 As Built Shot



℄ STATION: 48+00	47+00	46+00	45+00	44+00	43+00	42+00	41+00	40+00	39+00	38+00	37+00	36+00	:℄ STATION
EX. GROUND: 727.9	728.0	728.4	728.6	728.6	728.6	729.1	730.0	729.9	730.7	729.1	729.8	729.9	:EX. GROUND

Job No. 2011-0496
Drawn By JAC
Date December, 2011
Scale As Noted

COLUMBUS AND FRANKLIN COUNTY METROPARKS
WETLAND AND STREAM AS-BUILT PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITHOPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
STREAM PLAN AND PROFILES

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Toll Free: 888.775.3648
emht.com

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
1069 WEST MAIN STREET,
WESTERVILLE, OH 43081-1181
(614) 891-0700
(614) 895-6208 FAX

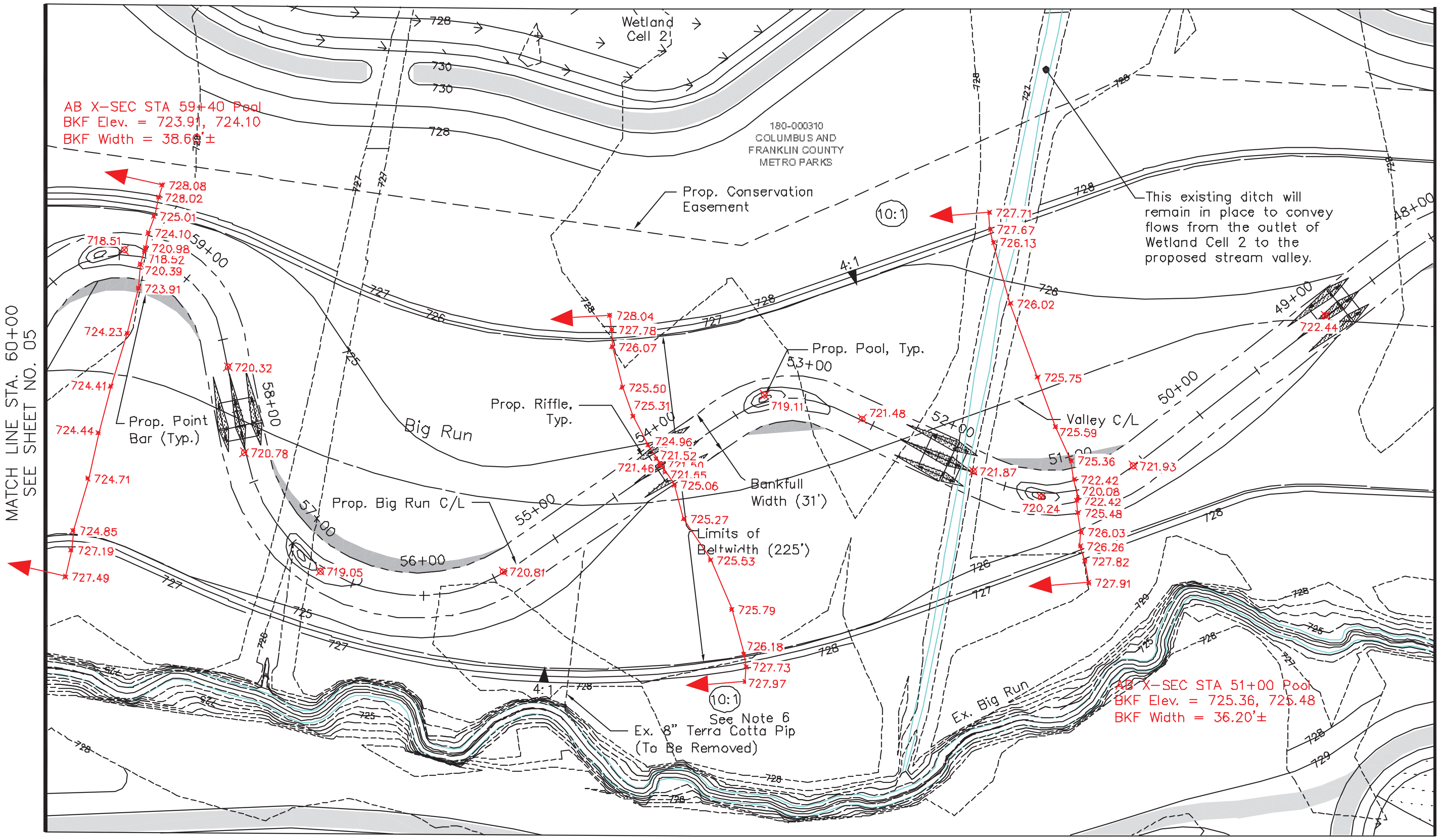
REVISIONS

MARK	DATE	

Sheet
03/08

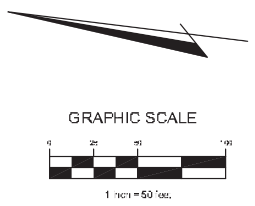
\\cmhdata01\project01\20110496\Dwg\04Sheets\Asbuilt\Sheet 4.dwg<04 Stream Plan and Profiles> – 2 Xrefs: [\\cmharc1\archiveo\2009\20090543\20090543env\Dwg\Xrefs\90543XBS-2009.dwg, Auditors-2009 NEW.dwg] – 1 Image: [\\cmharc1\archiveo\2009\20090543\20090543env\BidDocuments\OEPA-ARRA information\ARRA Logo.JPG] –
SavedBy: JCRAMER [12/20/2011 3:11:06 PM] – PlottedBy: JCRAMER [3/27/2012 1:41:49 PM]

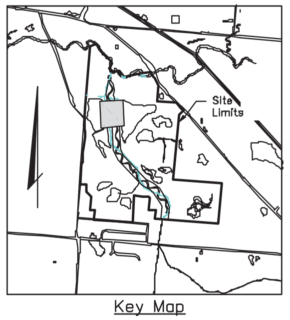
MATCH LINE STA. 60+00
SEE SHEET NO. 05



MATCH LINE STA. 48+00
SEE SHEET NO. 03

AB X–SEC STA 54+00 Riffle
BKF Elev. = 725.06, 724.96
BKF Width = 32.65'±

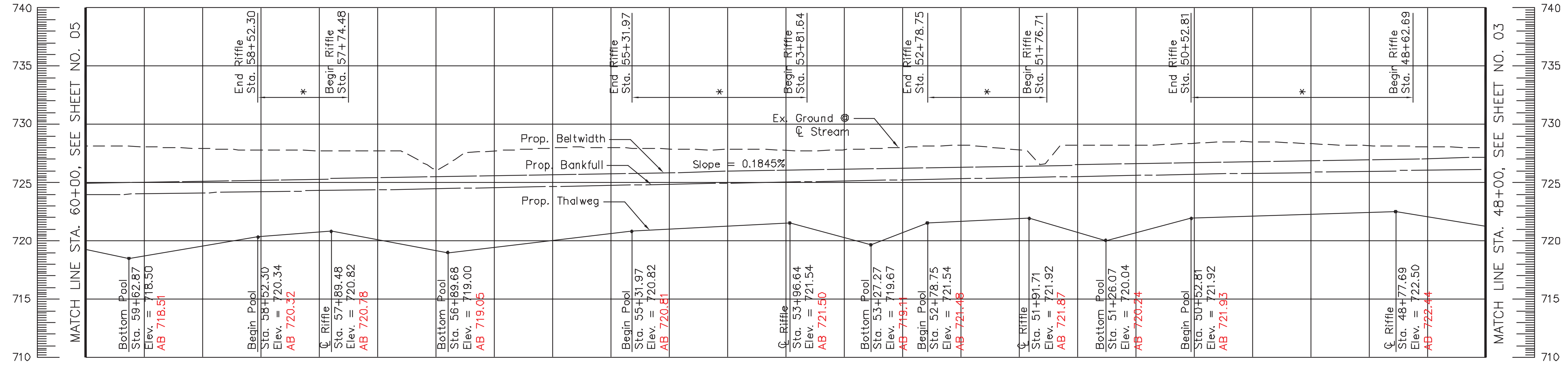




Key Map

LEGEND

⬭	Prop. Pool Prop.
▦	Prop. Riffle
←	Stream Diversion
▩	Temp. Stream Crossing
▨	Temp. Earthen Plug
◗	Prop. Point Bar
×731.77	As Built Shot



℄ STATION:	60+00	59+00	58+00	57+00	56+00	55+00	54+00	53+00	52+00	51+00	50+00	49+00	48+00 :℄ STATION
EX. GROUND:	728.1	727.9	727.7	726.0	727.9	727.9	727.8	728.0	727.8	728.2	728.5	728.1	727.9 :EX. GROUND

Date
December, 2011

Job No.
2011-0496

Scale
Horiz: 1" = 50'
Vert: 1" = 5'

Drawn By:
JAC

COLUMBUS AND FRANKLIN COUNTY METROPARKS
WETLAND AND STREAM AS-BUILT PLAN
AT
THE FORMER EAST SIDE NURSERY SITE
6723 LITHOPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
STREAM PLAN AND PROFILES

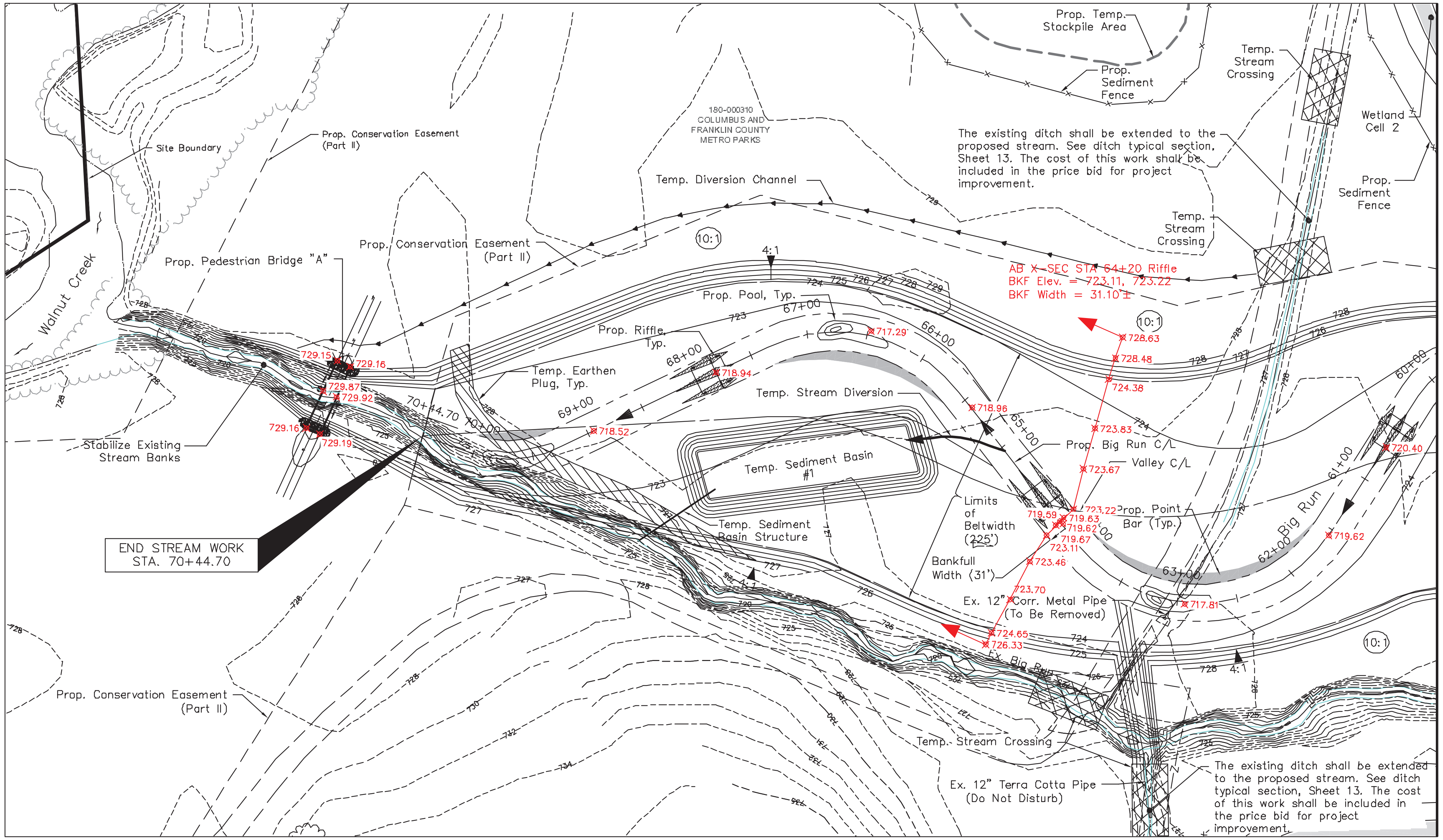
EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone 614 775 4500 Toll Free 888 775 3648
emht.com

COLUMBUS AND FRANKLIN
COUNTY METRO PARKS
1069 WEST MAIN STREET,
WESTERVILLE, OH 43081-1181
(614)891-0700
(614)895-6208 FAX

REVISIONS

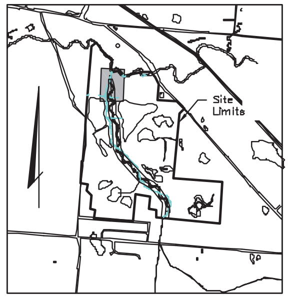
MARK	DATE	

Sheet
04/08



GRAPHIC SCALE

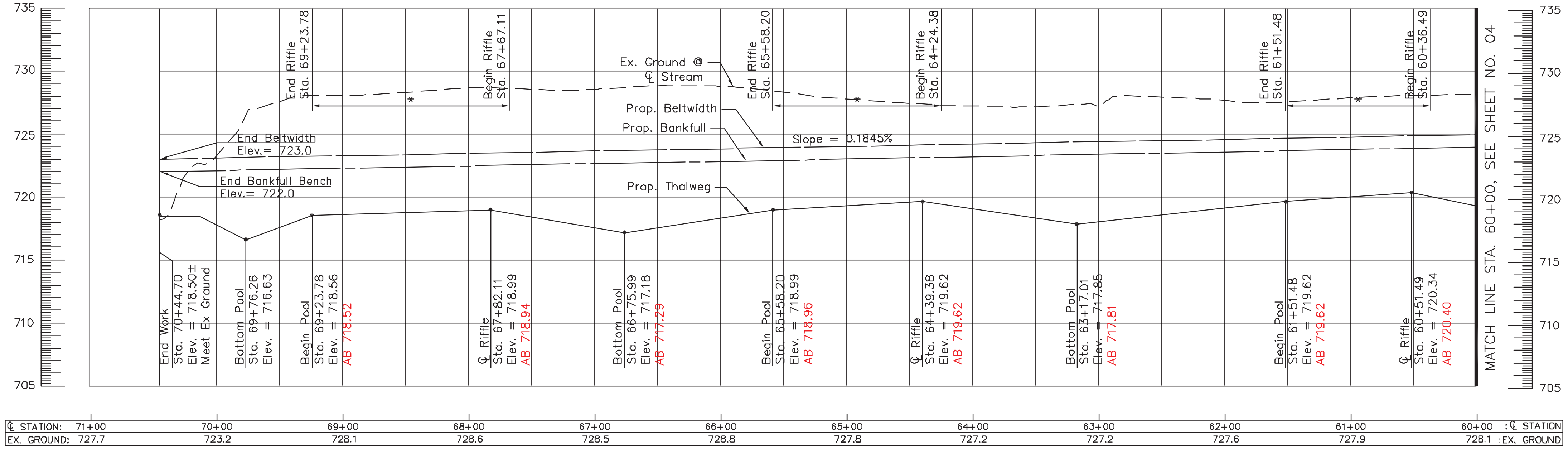
1 inch = 50 feet



Key Map

LEGEND

- Prop. Pool Prop.
- Prop. Riffle
- Stream Diversion
- ▨ Temp. Stream Crossing
- ▨ Temp. Earthen Plug
- Prop. Point Bar
- ×731.77 As Built Shot



℄ STATION:	71+00	70+00	69+00	68+00	67+00	66+00	65+00	64+00	63+00	62+00	61+00	60+00	:℄ STATION
EX. GROUND:	727.7	723.2	728.1	728.6	728.5	728.8	727.8	727.2	727.2	727.6	727.9	728.1	:EX. GROUND

Job No. 2011-0496
Drawn By: JAC
Date December, 2011
Scale Horiz: 1" = 50' Vert: 1" = 5'

COLUMBUS AND FRANKLIN COUNTY METROPARKS
WETLAND AND STREAM AS-BUILT PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITHOPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
STREAM PLAN AND PROFILES

EMHT
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Toll Free: 888.775.3648
emht.com

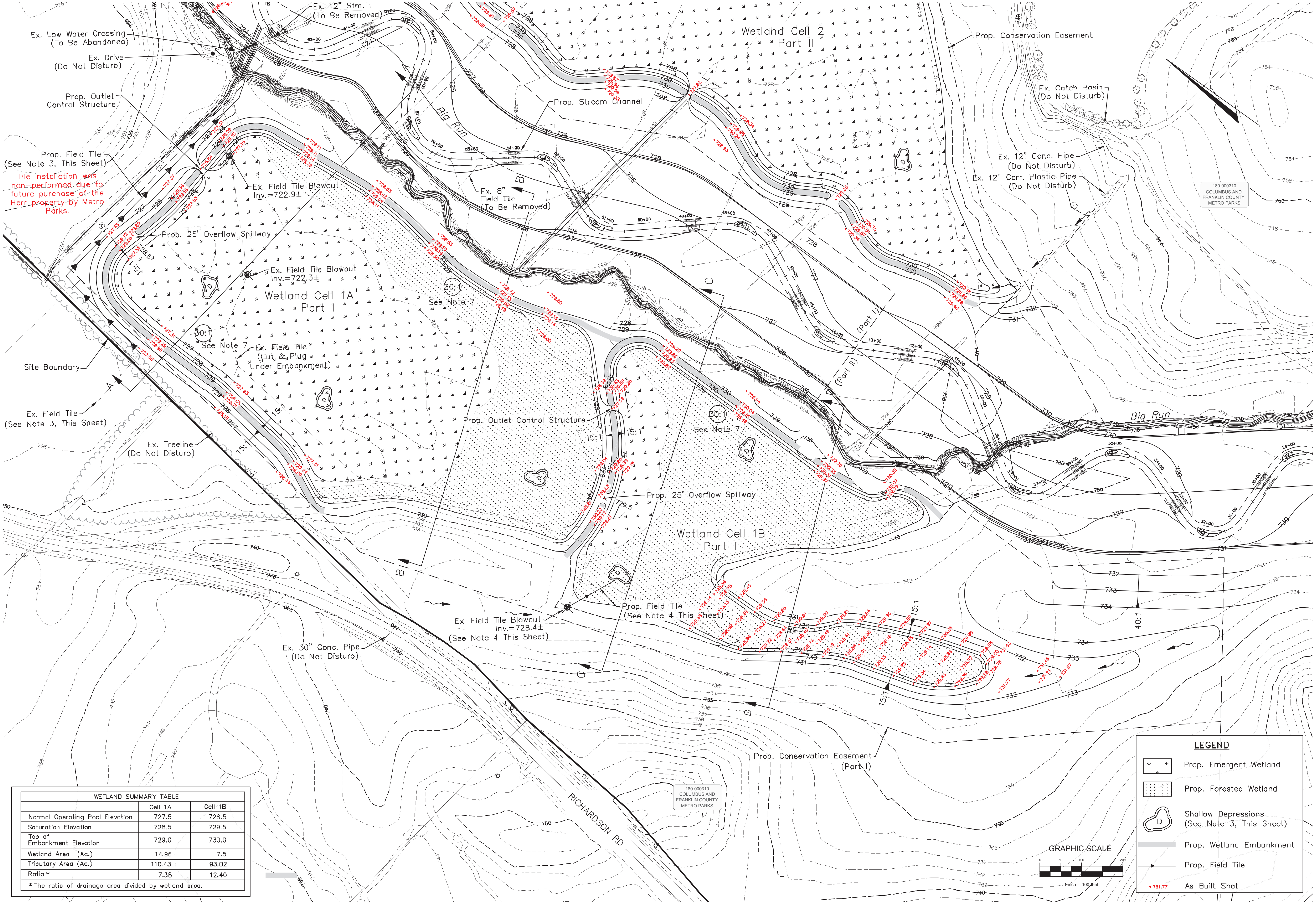
COLUMBUS AND FRANKLIN COUNTY METRO PARKS
1069 WEST MAIN STREET,
WESTERVILLE, OH 43081-1181
(614) 891-0700
(614) 895-6208 FAX

REVISIONS

MARK	DATE	

Sheet 05/08

\\cmhdata01\project01\20110496\Dwg\04Sheets\Asbuilt\Sheet 5.dwg<05 Stream Plan and Profiles> – 2 Xrefs: [\\cmharc1\archives\2009\20090543\20090543env\Dwg\Xrefs\90543XBS-2009.dwg, Auditors-2009 NEW.dwg] – 1 Image: [\\cmharc1\archives\2009\20090543\20090543env\BidDocuments\OEPA-ARRA information\ARRA Logo.JPG] –
SavedBy: JCRAMER [12/20/2011 3:11:16 PM] – PlottedBy: JCRAMER [3/27/2012 1:42:43 PM]



WETLAND SUMMARY TABLE		
	Cell 1A	Cell 1B
Normal Operating Pool Elevation	727.5	728.5
Saturation Elevation	728.5	729.5
Top of Embankment Elevation	729.0	730.0
Wetland Area (Ac.)	14.96	7.5
Tributary Area (Ac.)	110.43	93.02
Ratio *	7.38	12.40

* The ratio of drainage area divided by wetland area.

LEGEND

⌄ ⌄	Prop. Emergent Wetland
⋯	Prop. Forested Wetland
D	Shallow Depressions (See Note 3, This Sheet)
▬	Prop. Wetland Embankment
→	Prop. Field Tile
• 731.77	As Built Shot

GRAPHIC SCALE
0 50 100 200
1 inch = 100 feet

J:\20110496\Dwg\04Sheets\Asbuilt\Sheet 6.dwg Last Saved By: jcramer, 12/20/2011 3:11 PM Last Printed By: Cramer, James, 3/28/2012 10:44 AM
2 Xrefs: Auditors-2009 NEW.dwg, 90543XBS-2009.dwg

Job No. 2011-0496
Drawn By: JAC
Date December, 2011
Scale 1" = 100'

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM AS-BUILT PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITOHPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
WETLAND PLAN VIEW

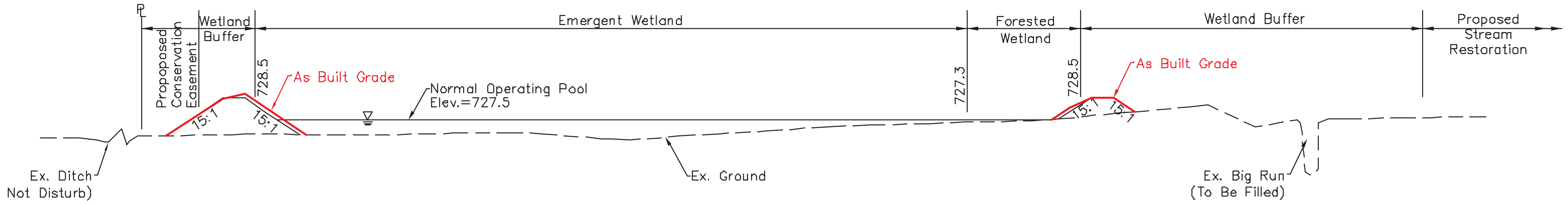
EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone 614.775.4500 Toll Free 888.775.3648
emht.com

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
1069 WEST MAIN STREET,
WESTERVILLE, OH 43081-1181
(614) 891-0700
(614) 895-6208 FAX:

REVISIONS

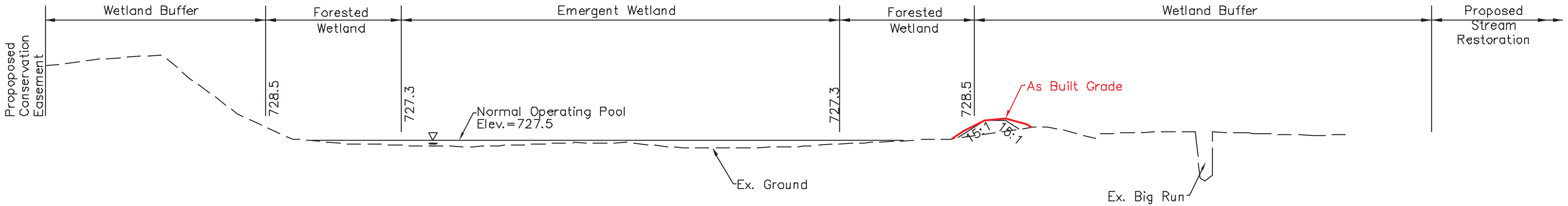
MARK	DATE	

Sheet
06/08



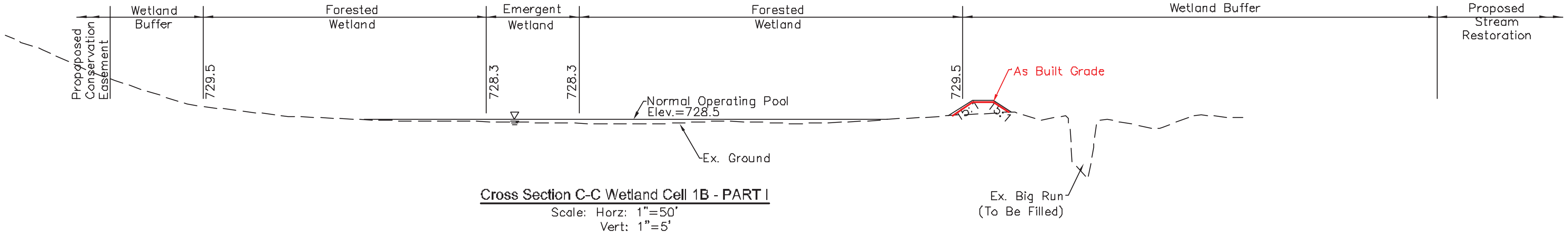
Cross Section A-A Wetland Cell 1A - PART I

Scale: Horz: 1"=50'
Vert: 1"=5'



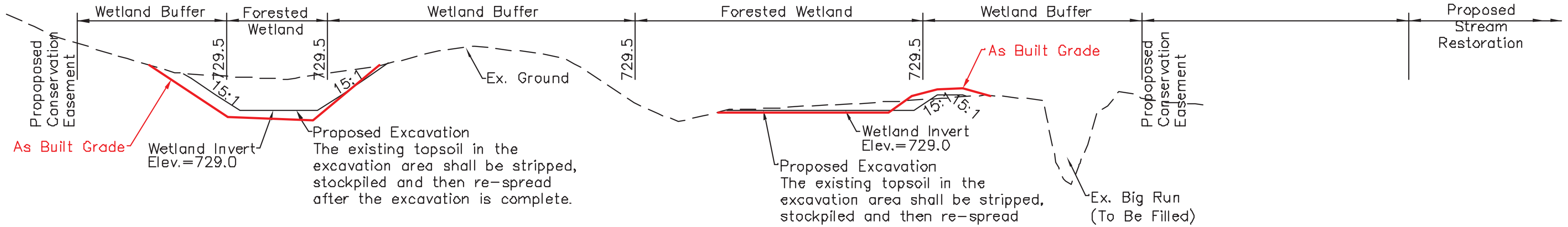
Cross Section B-B Wetland Cell 1A - PART I

Scale: Horz: 1"=50'
Vert: 1"=5'



Cross Section C-C Wetland Cell 1B - PART I

Scale: Horz: 1"=50'
Vert: 1"=5'



Proposed Excavation
The existing topsoil in the excavation area shall be stripped, stockpiled and then re-spread after the excavation is complete.

Proposed Excavation
The existing topsoil in the excavation area shall be stripped, stockpiled and then re-spread after the excavation is complete.

Cross Section D-D Wetland Cell 1B - PART I

Scale: Horz: 1"=50'
Vert: 1"=5'

REVISIONS

MARK	DATE	

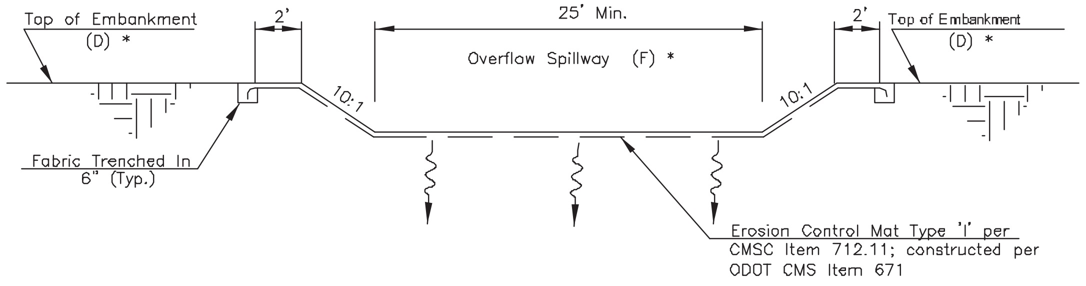
COLUMBUS AND FRANKLIN
COUNTY METRO PARKS
1069 WEST MAIN STREET,
WESTERVILLE, OH 43081-1181
(614) 891 0700
(614)895-6208 FAX:

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone 614 775 4500 Toll Free 888 775 3648
emht.com

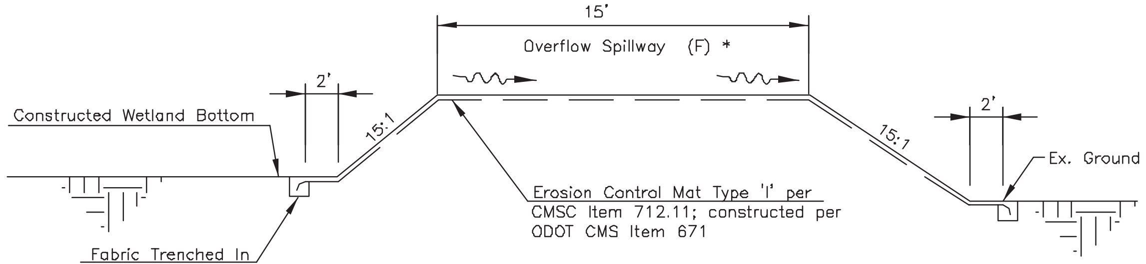
COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM AS-BUILT PLAN
AT
THE FORMER EAST SIDE NURSERY SITE
6723 LITOHPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
WETLAND CROSS SECTIONS

Date: December, 2011
Job No. 2011-0496
Scale: Horiz: 1" = 50' Vert: 1" = 5'
Drawn By: JAC

Sheet



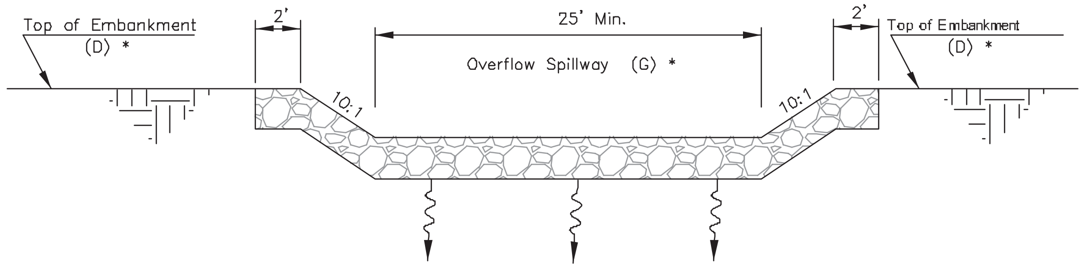
CONTROL SECTION
Not to Scale



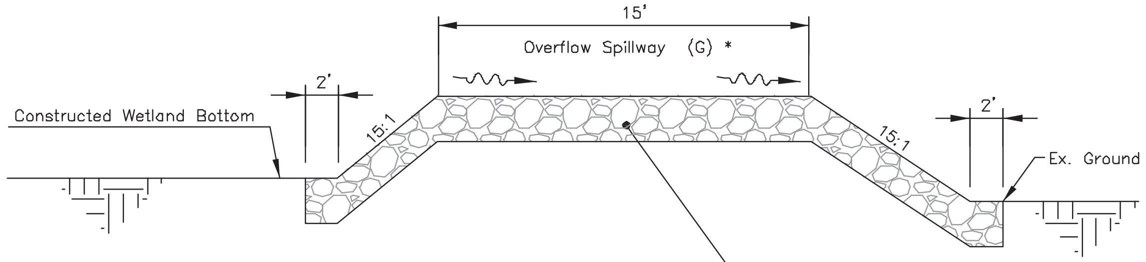
CROSS SECTION
Not to Scale

OVERFLOW SPILLWAY DETAIL
Not to Scale

* See Wetland Outlet Summary Table This Sheet for Elevations.



CONTROL SECTION
Not to Scale



* See Wetland Outlet Summary Table for Elevations. (This sheet)

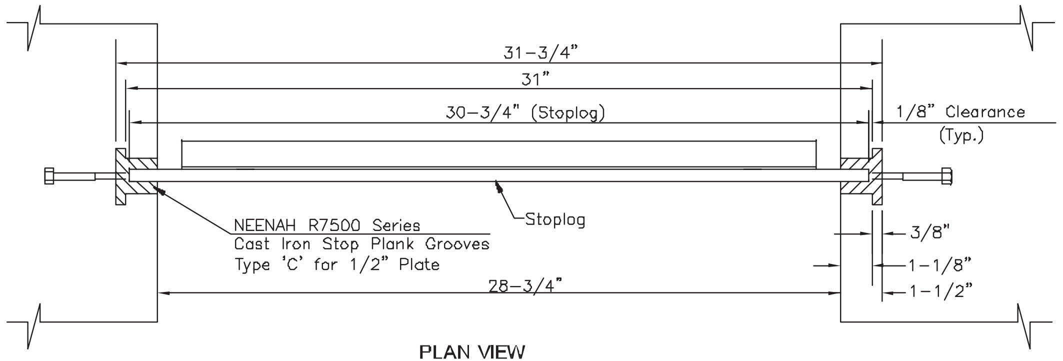
R.C.P. Type D, 1.5' Tk. mixed w/ compacted clay to fill the voids. Mixture shall be capped with 2 inches of topsoil to promote vegetation.

CROSS SECTION
Not to Scale

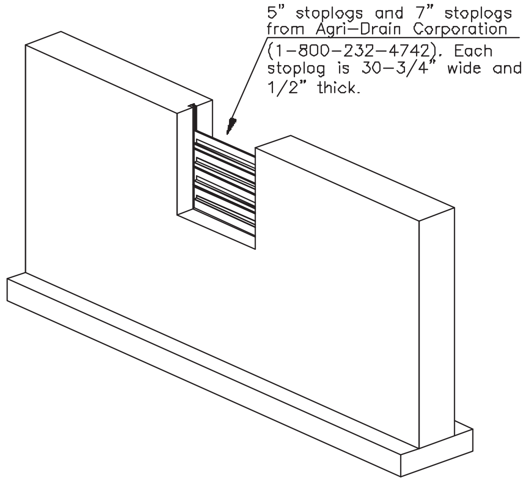
PRIMARY SPILLWAY DETAIL
Not to Scale

WETLAND OUTLET SUMMARY TABLE

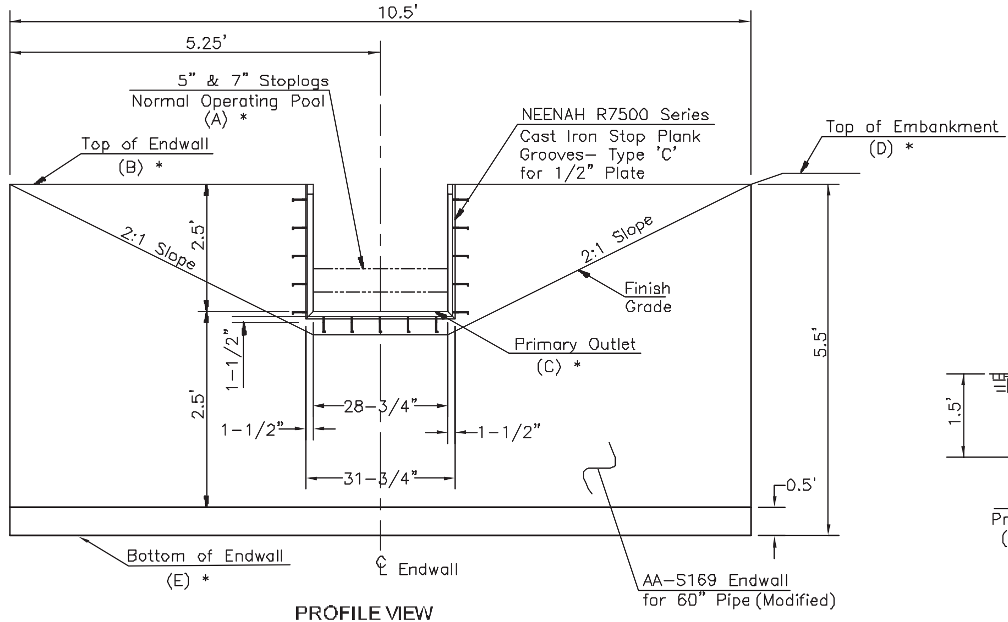
	Cell 1A	Cell 1B	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6	Cell 7	Cell 8	Cell 9
Normal Operating Pool Elev. (A)	727.5	728.5	728.5	732.0 ~~732.5~~	–	–	–	–	743.5	–
Top of Endwall Elev. (B)	728.0	729.0	729.0	734.0	–	–	–	–	745.0	–
Primary Outlet Elev. (C)	726.5 726.64	727.5 727.58	727.5 727.62	731.5 731.49	–	–	–	–	741.5 ~~742.5~~ 741.44	–
Top of Embankment Elev. (D)	729.0	730.0	730.0	734.0	737.0	747.0	747.0	746.0	745.0	746.0
Bottom of Endwall (E)	722.5	723.5	723.5	728.5	–	–	–	–	739.5	–
Overflow Spillway Elev. (F)	728.5 728.69	729.5 729.53	729.5 729.57	733.5 733.54	736.5	746.5 746.46	746.5 746.50	745.5	743.5 ~~744.5~~ 743.32	745.5 745.40
Primary Spillway Elev. (G)	–	–	–	–	734.7 ~~735.5~~ 734.76	745.5 745.54	745.5 745.33	744.5 744.47	–	744.0 ~~744.5~~ 743.96



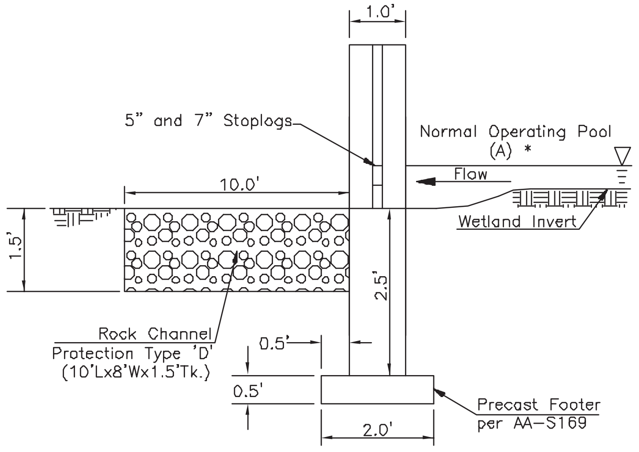
PLAN VIEW



OBLIQUE VIEW



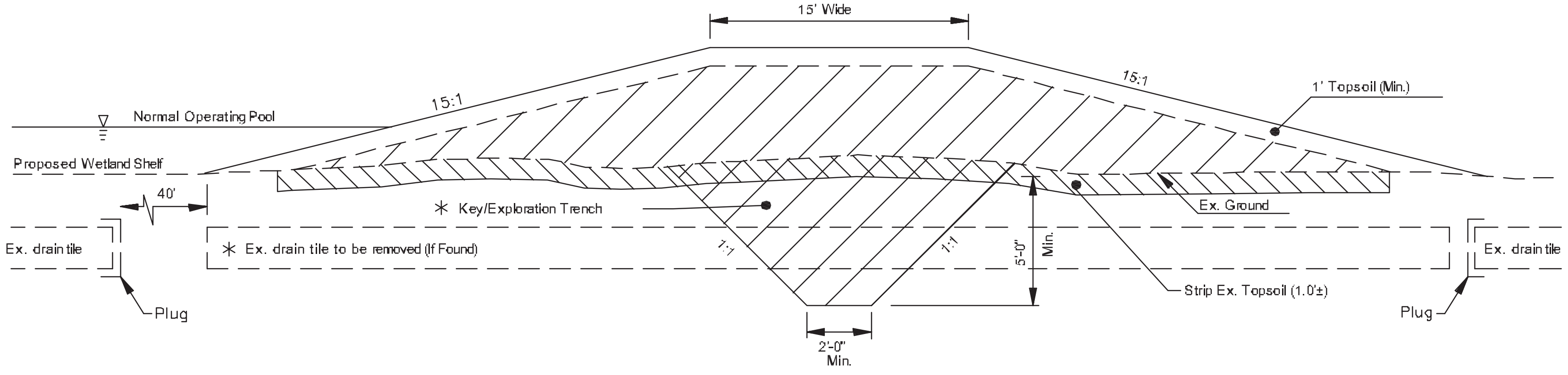
PROFILE VIEW



END VIEW

OUTLET CONTROL STRUCTURE WITH STOPLOGS DETAIL
Not To Scale

* See Wetland Outlet Summary Table This Sheet for Elevations.



✱ NOTE:
If a drain tile is found during construction of the Key/Exploration trench it shall be removed under the limits of the embankment and 40' into the proposed wetland. Both ends of the exposed field tile shall be plugged with suitable cohesive embankment material. Backfill remaining voids with cohesive material that is compacted to the embankment specification (Item 203).

▨ Cohesive Clay Backfill (Compacted per Embankment Specification)

EMBANKMENT AND KEY/EXPLORATION TRENCH DETAIL
Not to Scale

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM AS-BUILT PLAN
AT
THE FORMER EAST SIDE NURSERY SITE
6723 LITHOPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
WETLAND DETAILS

Job No. 2011-0496	Drawn By JAC
Date December, 2011	Scale As Noted

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Toll Free: 888.775.3648
emht.com

COLUMBUS AND FRANKLIN
COUNTY METRO PARKS
1069 WEST MAIN STREET,
WESTERVILLE, OH 43081-1181
(614)891-0700
(614)895-6208 FAX

REVISIONS

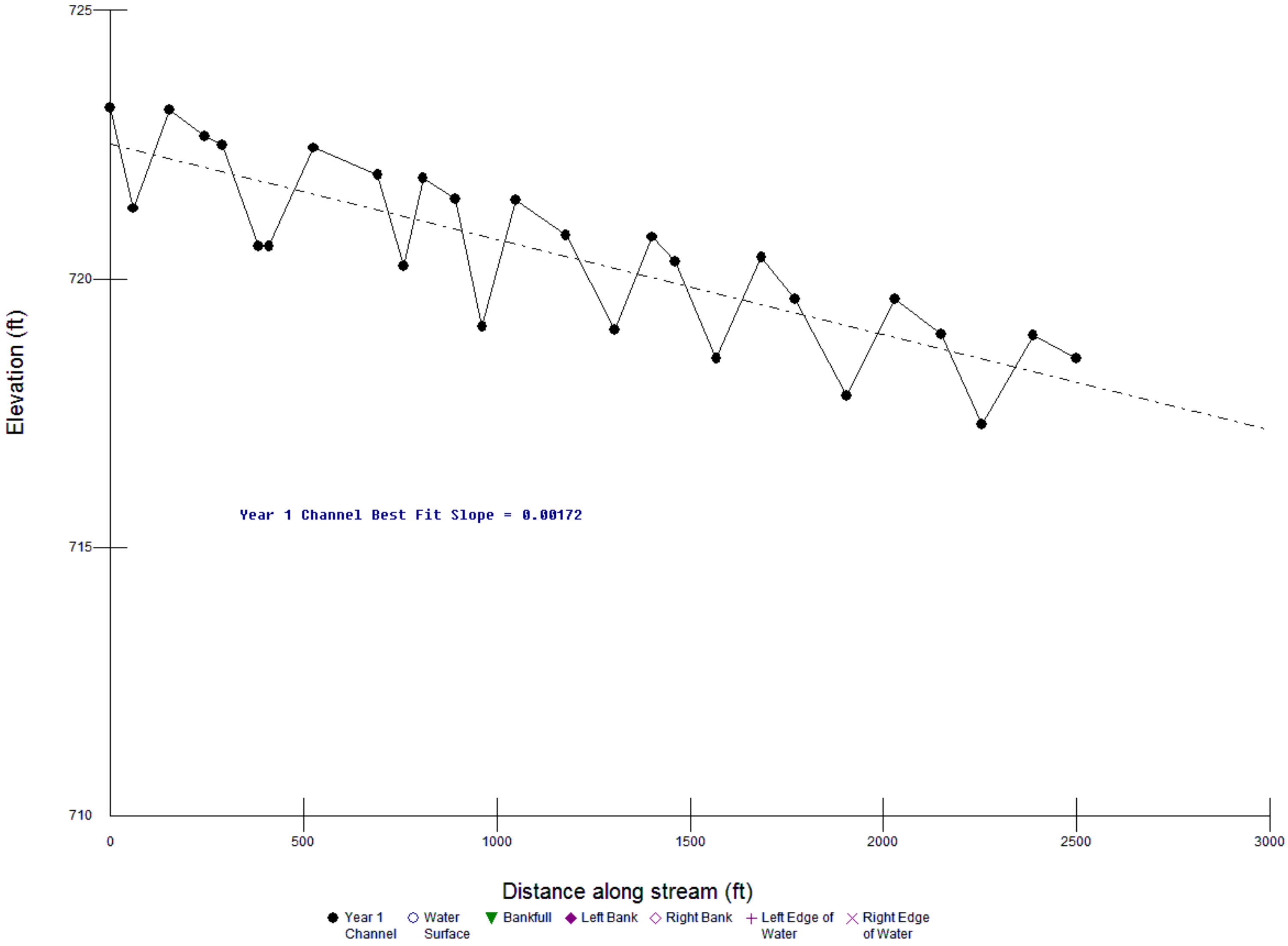
MARK	DATE	

Sheet
08/08

\\cmhdata01\project01\20110496\Dwg\04Sheets\Asbuilt\Sheet 8.dwg<08 Wetland Details> – No Xrefs – 1 Image: \\cmhsrc1\archives\2009\20090543\env\BidDocuments\OEPA-ARRA Information\ARRA Logo.JPG – SavedBy: JCRAMER [12/20/2011 3:11:26 PM] – PlottedBy: JCRAMER [1/27/2012 1:45:12 PM]

Exhibit 3b

Big Run Stream Profile - As-Built



Year 1 Channel Best Fit Slope = 0.00172

Exhibit 4 (c)

Geomorphic Summary

Big Run Stream Restoration

Profile Station 43+44.70 to 70+44.70 (2700 linear feet)

Parameter	Design	As-Built*
Dimension		
BF Width (ft)	31.00	34.75
Floodprone Width (ft)	295	295
BF Cross Sectional Area (ft^2)	71.75	84.88
BF Mean Depth (ft)	2.71	2.44
BF Max Depth (ft)	3.50	3.50
Width/Depth Ratio	11.44	14.23
Entrenchment Ratio	9.52	8.49
Plan/Pattern		
Valley Length (ft)	2213	2213
Channel Length (ft)	2700	2700
Sinuosity	1.22	1.22
Channel Beltwidth (ft)	275	275
Radius of Curvature (ft)	88	88
Meander Wavelength (ft)	372	372
Profile		
Channel Slope (ft/ft)	0.0018	0.0017
Riffle Length (ft)	127.0	115.1
Riffle Slope (ft/ft)	0.0052	0.0055
Pool Length (ft)	188.0	206.4
Pool Spacing (ft)	298.0	310.6
Substrate		
d50 (mm)	76.0	15.5
d84 (mm)	114.0	21.2

Notes:

* Dimension measurements are the average of 3 as-built riffle cross sections

WETLAND PLANTING

Forested/Emergent Wetland Buffer Area

Trees (3 gal.)

Common Name	Scientific Name
Red maple	*Acer rubrum*
Sugar maple	*Acer saccharum*
Ohio buckeye	*Aesculus glabra*
Shagbark hickory	*Carya ovata*
American beech	*Fagus grandifolia*
Tulip tree	*Liriodendron tulipifera*
Black cherry	*Prunus serotina*
White oak	*Quercus alba*
Bur oak	*Quercus macrocarpa*

Shrubs (3 gal.)

Common Name	Scientific Name
Gray dogwood	*Cornus racemosa*
Spicebush	*Lindera benzoin*
Smooth rose	*Rosa blanda*
Pasture rose	*Rosa carolina*
Southern arrowwood	*Viburnum dentatum*
Rough leaf dogwood	*Cornus drummondii*
Black chokeberry	*Aronia melanocarpa*
American hazelnut	*Corylus americana*

Emergent Wetland Area

Herbs (Plugs)

Common Name	Scientific Name
American sweet flag	*Acorus americanus*
Broad-leaf water plantain	*Alisma subcordatum*
Swamp milkweed	*Asclepias incarnata*
Panicled aster	*Aster lanceolatus*
New England aster	*Aster novae-angliae*
Swamp aster	*Aster puniceus*
River bulrush	*Bolboschoenus fluviatilis*
Marsh marigold	*Caltha palustris*
Water sedge	*Carex aquatilis*
Emory's sedge	*Carex emoryi*
Stalk-grain sedge	*Carex stipata*
Lesser spikerush	*Eleocharis acicularis*
Creeping spikerush	*Eleocharis palustris*
Small spikerush	*Eleocharis parvula*
Boneset	*Eupatorium perfoliatum*
Fowl manna grass	*Glyceria striata*
Swamp rose-mallow	*Hibiscus moscheutos*
Blue flag iris	*Iris versicolor*
Canada rush	*Juncus canadensis*
Torrey's rush	*Juncus torreyi*
Great blue lobelia	*Lobelia siphilitica*
Virginia bugleweed	*Lycopus virginicus*
Arrow arum	*Peltandra virginica*
Water smartweed	*Polygonum amphibium*
Mild water pepper	*Polygonum hydropiperoides*
Pickerelweed	*Pontederia cordata*
Soft stem bulrush	*Schoenoplectus tabernaemontani*
Blue vervain	*Verbena hastata*
American water horehound	*Lycopus americanus*

Shrubs (3 Gal.)

Common Name	Scientific Name
Buttonbush	*Cephalanthus occidentalis*
Red osier dogwood	*Cornus sericea*
Silky dogwood	*Cornus amomum*
Winterberry	*Ilex verticillata*
Pussy willow	*Salix discolor*
Witherod	*Viburnum cassinoides*
Southern arrowwood	*Viburnum dentatum*
Gray dogwood	*Cornus racemosa*
Rough leaf dogwood	*Cornus drummondii*
Elderberry	*Sambucus canadensis*

Live Stakes

Common Name	Scientific Name
Buttonbush	*Cephalanthus occidentalis*
Red osier dogwood	*Cornus sericea*
Silky dogwood	*Cornus amomum*
Pussy willow	*Salix discolor*
Silky willow	*Salix sericea*
Shining willow	*Salix lucide*
Black willow	*Salix nigra*
Elderberry	*Sambucus canadensis*
Sandbar willow	*Salix interior*
Ninebark	*Physocarpus opulifolius*

Forested Wetland Area

Trees (3 gal.)

Common Name	Scientific Name
Silver maple	*Acer saccharinum*
Blue beech	*Carpinus caroliniana*
Black gum	*Nyssa sylvatica*
Swamp white oak	*Quercus bicolor*
Bur oak	*Quercus macrocarpa*
Pin oak	*Quercus palustris*
Red maple	*Acer rubrum*
Eastern cottonwood	*Populus deltoides*
Black willow	*Salix nigra*
Peachleaf willow	*Salix amygdaloides*

Shrubs (1 and 3 gal.)

Common Name	Scientific Name
Speckled alder	*Alnus incana*
Hazel alder	*Alnus serrulata*
Black chokeberry	*Aronia melanocarpa*
Buttonbush	*Cephalanthus occidentalis*
Red-osier dogwood	*Cornus sericea*
Winterberry	*Ilex verticillata*
Spicebush	*Lindera benzoin*
Ninebark	*Physocarpos opulifolius*
Pussywillow	*Salix discolor*
Elderberry	*Sambucus canadensis*
Withe rod	*Viburnum cassinoides*
Nannyberry	*Viburnum lentago*
Silky dogwood	*Cornus amomum*
Gray dogwood	*Cornus racemosa*
Rough leaf dogwood	*Cornus drummondii*
American cranberry bush	*Viburnum opulus var. Americana*

Live Stakes

Common Name	Scientific Name
Buttonbush	*Cephalanthus occidentalis*
Silky dogwood	*Cornus amomum*
Red osier dogwood	*Cornus sericea*
Black willow	*Salix nigra*
Pussy willow	*Salix discolor*
Silky willow	*Salix sericea*
Shining willow	*Salix lucide*
Elderberry	*Sambucus canadensis*
Sandbar willow	*Salix interior*
Ninebark	*Physocarpus opulifolius*

Herbs (Plugs)

Common Name	Scientific Name
Lizard's tail	*Saururus cernuus*
Hop sedge	*Carex lupulina*
Bottlebrush sedge	*Carex lurida*
Pointed broom sedge	*Carex scoparia*
Canada wild rye	*Elymus canadensis*
Riverbank wild rye	*Elymus riparius*
Virginia wild rye	*Elymus virginicus*
Crested sedge	*Carex cristatella*
Porcupine sedge	*Carex hystericina*
Tussock sedge	*Carex stricta*
American water horehound	*Lycopus americana*
Great blue lobelia	*Lobelia siphilitica*
Seedbox	*Penthorum sedoides*
Fringed Sedge	*Carex crinita*
Bristly cattail Sedge	*Carex frankii*
Fox Sedge	*Carex vulpinoid*

WETLAND PLANTING TABLE

ZONE	MATERIAL	DENSITY	SPECIES	QUANTITY	
				PART I	PART II
Forested Wetland Area	3 Gallon Trees 3 Gallon Shrubs 1 Gallon Shrubs Herbaceous Plugs Live Stakes	18'x18' Centers 30'x30' Centers 30'x30' Centers 15'x15' Centers 25'x25' Centers	7 10 10 10 7	1.525 0 549 2,195 790	2,684 966 0 3,864 1,391
Emergent Wetland Area	Herbacious Plug 3 Gallon Shrubs Live Stakes	6'x6' Centers 30'x30' Centers 20'x20' Centers	20 7 7	13,455 538 1,211	33,190 1,328 2,987
Forested Wetland Buffer Area	3 Gallon Trees 3 Gallon Shrubs	20'x20' Centers 30'x30' Centers	7 7	454 202	807 359
Emergent Wetland Buffer Area	3 Gallon Shrubs	16'x16' Centers	7	0	579

The species column designates the minimum number of species that shall be selected from each planting list.

LANDSCAPING WARRANTY

Landscaper shall warranty at least an 80% survivability of all #1 and #3 containerized shrub and tree materials for one (1) year from planting date. Any dead, dying, or diseased material shall be replaced with like material.

WATERING

Contractor shall insure that all material is thoroughly watered at time of planting, and once every week during the period of establishment. Sprinklers, gator bags or other such methods shall be used if rainfall is inadequate.

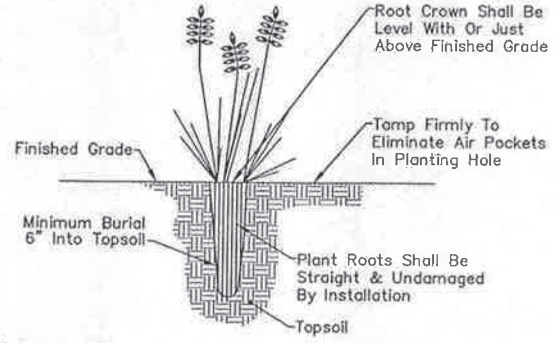
Notes:

All plantings shall be selected from the species lists provided and approved in writing by the Construction Manager prior to ordering the plants.

Herbaceous Material shall not be installed until water reaches the wetland normal pool elevation and the basin area in fully stabilized. Under no circumstance should wetland plants be installed while the basin is being used for temporary sediment storage during site construction.

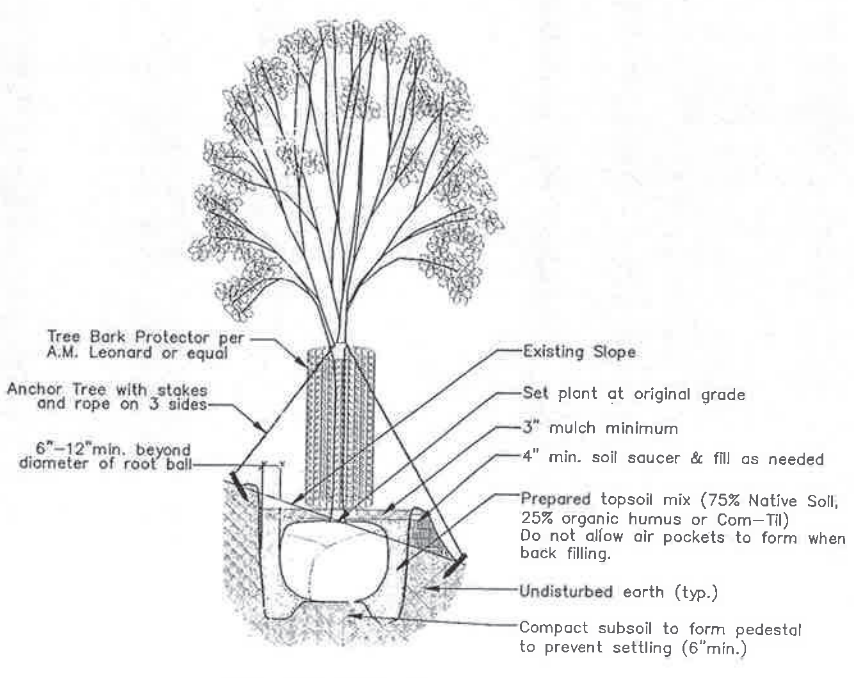
Herbaceous Material shall be planted between May 1 and July 1. Planting beyond these dates shall be approved in writing by the Owner and Construction Manager.

Under no circumstance should herbaceous material be planted such that the entire plant is below the water surface.

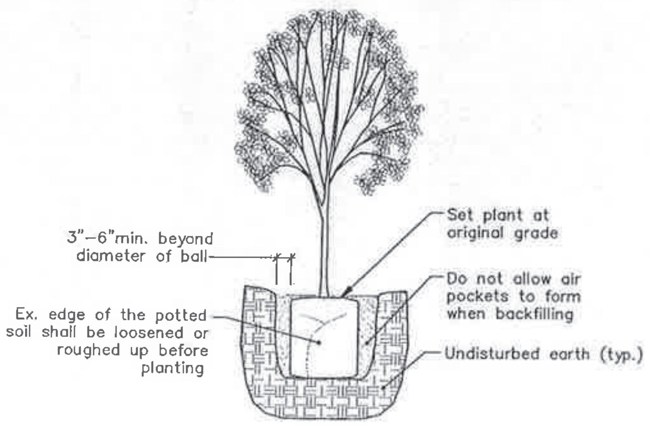


Notes:
Leaves & Root Crown Shall Remain Undamaged During Planting

PLUG PLANTING DETAIL
Not To Scale



TREE PLANTING DETAIL
Not to Scale



POTTED PLANTING DETAIL
Not to Scale

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM AS-BUILT PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITOHPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
WETLAND PLANTING PLAN

Job No. 2009-0543
Date January, 2011
Drawn By GDT
Scale As Noted

Exhibit 5(a)

EMHT
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Toll Free: 888.775.3648
emht.com

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
1069 WEST MAIN STREET,
WESTERVILLE, OH 43081-1181
(614) 891-0700
(614) 895-6208 FAX

REVISIONS

MARK	DATE	

Sheet
22/39

WETLAND PLANTING

Forested/Emergent Wetland Buffer Area

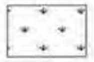
Trees (3 gal)

Common Name	Scientific Name
Red maple	*Acer rubrum*
Sugar maple	*Acer saccharum*
Ohio buckeye	*Aesculus glabra*
Shagbark hickory	*Carya ovata*
American beech	*Fagus grandifolia*
Tulip tree	*Liriodendron tulipifera*
Black cherry	*Prunus serotina*
White oak	*Quercus alba*
Bur oak	*Quercus macrocarpa*

Shrubs (3 gal.)

Common Name	Scientific Name
Gray dogwood	*Cornus racemosa*
Spicebush	*Lindera benzoin*
Smooth rose	*Rosa blanda*
Pasture rose	*Rosa carolina*
Southern arrowwood	*Viburnum dentatum*
Rough leaf dogwood	*Cornus drummondii*
Black chokeberry	*Aronia melanocarpa*
American hazelnut	*Corylus americana*

Emergent Wetland Area



Herbs (Plugs)

Common Name	Scientific Name
American sweet flag	*Acorus americanus*
Broad-leaf water plantain	*Alisma subcordatum*
Swamp milkweed	*Asclepias incarnata*
Panicled aster	*Aster lanceolatus*
New England aster	*Aster novae-angliae*
Swamp aster	*Aster puniceus*
River bulrush	*Bolboschoenus fluviatilis*
Marsh marigold	*Caltha palustris*
Water sedge	*Carex aquatilis*
Emory's sedge	*Carex emoryi*
Stalk-grain sedge	*Carex stipata*
Lesser spikerush	*Eleocharis acicularis*
Creeping spikerush	*Eleocharis palustris*
Small spikerush	*Eleocharis parvula*
Boneset	*Eupatorium perfoliatum*
Fowl manna grass	*Glyceria striata*
Swamp rose-mallow	*Hibiscus moscheutos*
Blue flag iris	*Iris versicolor*
Canada rush	*Juncus canadensis*
Torrey's rush	*Juncus torreyi*
Great blue lobelia	*Lobelia siphilitica*
Virginia bugleweed	*Lycopus virginicus*
Arrow arum	*Peltandra virginica*
Water smartweed	*Polygonum amphibium*
Mild water pepper	*Polygonum hydropiperoides*
Pickerelweed	*Pontederia cordata*
Soft stem bulrush	*Schoenoplectus tabernaemontani*
Blue vervain	*Verbena hastata*
American water horehound	*Lycopus americanus*

Shrubs (3 Gal.)

Common Name	Scientific Name
Buttonbush	*Cephalanthus occidentalis*
Red osier dogwood	*Cornus sericea*
Silky dogwood	*Cornus amomum*
Winterberry	*Ilex verticillata*
Pussy willow	*Salix discolor*
Witherod	*Viburnum cassinoides*
Southern arrowwood	*Viburnum dentatum*
Gray dogwood	*Cornus racemosa*
Rough leaf dogwood	*Cornus drummondii*
Elderberry	*Sambucus canadensis*

Live Stakes

Common Name	Scientific Name
Buttonbush	*Cephalanthus occidentalis*
Red osier dogwood	*Cornus sericea*
Silky dogwood	*Cornus amomum*
Pussy willow	*Salix discolor*
Silky willow	*Salix sericea*
Shining willow	*Salix lucide*
Black willow	*Salix nigra*
Elderberry	*Sambucus canadensis*
Sandbar willow	*Salix interior*
Ninebark	*Physocarpus opulifolius*

Forested Wetland Area

Trees (3 gal.)

Common Name	Scientific Name
Silver maple	*Acer saccharinum*
Blue beech	*Carpinus caroliniana*
Black gum	*Nyssa sylvatica*
Swamp white oak	*Quercus bicolor*
Bur oak	*Quercus macrocarpa*
Pin oak	*Quercus palustris*
Red maple	*Acer rubrum*
Eastern cottonwood	*Populus deltoides*
Black willow	*Salix nigra*
Peachleaf willow	*Salix amygdaloides*

Shrubs (1 and 3 gal.)

Common Name	Scientific Name
Speckled alder	*Alnus incana*
Hazel alder	*Alnus serrulata*
Black chokeberry	*Aronia melanocarpa*
Buttonbush	*Cephalanthus occidentalis*
Red-osier dogwood	*Cornus sericea*
Winterberry	*Ilex verticillata*
Spicebush	*Lindera benzoin*
Ninebark	*Physocarpos opulifolius*
Pussywillow	*Salix discolor*
Elderberry	*Sambucus canadensis*
Withe rod	*Viburnum cassinoides*
Nannyberry	*Viburnum lentago*
Silky dogwood	*Cornus amomum*
Gray dogwood	*Cornus racemosa*
Rough leaf dogwood	*Cornus drummondii*
American cranberry bush	*Viburnum opulus var. Americana*

Live Stakes

Common Name	Scientific Name
Buttonbush	*Cephalanthus occidentalis*
Silky dogwood	*Cornus amomum*
Red osier dogwood	*Cornus sericea*
Black willow	*Salix nigra*
Pussy willow	*Salix discolor*
Silky willow	*Salix sericea*
Shining willow	*Salix lucide*
Elderberry	*Sambucus canadensis*
Sandbar willow	*Salix interior*
Ninebark	*Physocarpus opulifolius*

Herbs (Plugs)

Common Name	Scientific Name
Lizard's tail	*Saururus cernuus*
Hop sedge	*Carex lupulina*
Bottlebrush sedge	*Carex lurida*
Pointed broom sedge	*Carex scoparia*
Canada wild rye	*Elymus canadensis*
Riverbank wild rye	*Elymus riparius*
Virginia wild rye	*Elymus virginicus*
Crested sedge	*Carex cristatella*
Porcupine sedge	*Carex hystericina*
Tussock sedge	*Carex stricta*
American water horehound	*Lycopus americana*
Great blue lobelia	*Lobelia siphilitica*
Seedbox	*Penthorum sedoides*
Fringed Sedge	*Carex crinita*
Bristly cattail Sedge	*Carex frankii*
Fox Sedge	*Carex vulpinoid*

WETLAND PLANTING TABLE

ZONE	MATERIAL	DENSITY	SPECIES	QUANTITY	
				PART I	PART II
Forested Wetland Area	3 Gallon Trees 3 Gallon Shrubs 1 Gallon Shrubs Herbaceous Plugs Live Stakes	18'x18' Centers 30'x30' Centers 30'x30' Centers 15'x15' Centers 25'x25' Centers	7 10 10 10 7	1.525 0 549 2,195 790	2,684 966 0 3,864 1,391
Emergent Wetland Area	Herbacious Plug 3 Gallon Shrubs Live Stakes	6'x6' Centers 30'x30' Centers 20'x20' Centers	20 7 7	13,455 538 1,211	33,190 1,328 2,987
Forested Wetland Buffer Area	3 Gallon Trees 3 Gallon Shrubs	20'x20' Centers 30'x30' Centers	7 7	454 202	807 359
Emergent Wetland Buffer Area	3 Gallon Shrubs	16'x16' Centers	7	0	579

The species column designates the minimum number of species that shall be selected from each planting list.

LANDSCAPING WARRANTY

Landscaper shall warranty at least an 80% survivability of all #1 and #3 containerized shrub and tree materials for one (1) year from planting date. Any dead, dying, or diseased material shall be replaced with like material.

WATERING

Contractor shall insure that all material is thoroughly watered at time of planting, and once every week during the period of establishment. Sprinklers, gator bags or other such methods shall be used if rainfall is inadequate.

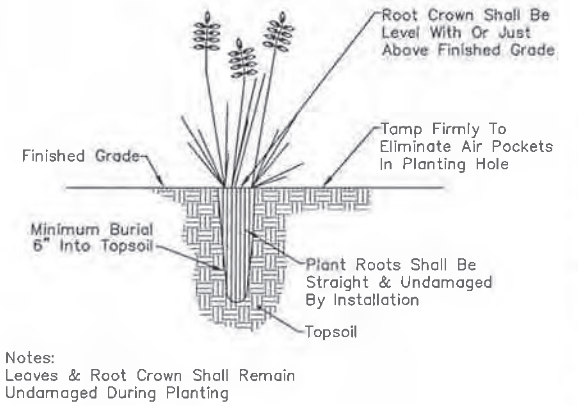
Notes:

All plantings shall be selected from the species lists provided and approved in writing by the Construction Manager prior to ordering the plants.

Herbaceous Material shall not be installed until water reaches the wetland normal pool elevation and the basin area in fully stabilized. Under no circumstance should wetland plants be installed while the basin is being used for temporary sediment storage during site construction.

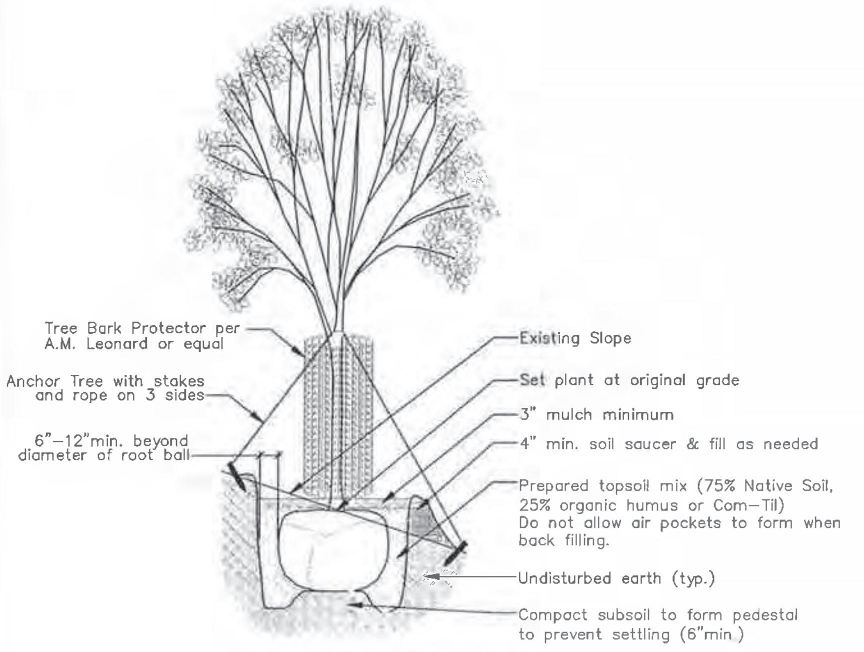
Herbaceous Material shall be planted between May 1 and July 1. Planting beyond these dates shall be approved in writing by the Owner and Construction Manager.

Under no circumstance should herbaceous material be planted such that the entire plant is below the water surface.

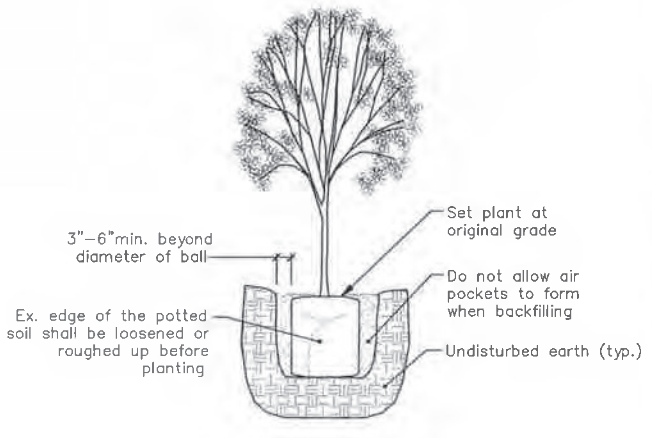


Notes:
Leaves & Root Crown Shall Remain Undamaged During Planting

PLUG PLANTING DETAIL
Not To Scale



TREE PLANTING DETAIL
Not to Scale



POTTED PLANTING DETAIL
Not to Scale

Job No. 2009-0543
Date January, 2011
Drawn By GDT
Scale As Noted

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM AS-BUILT PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITOHPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
WETLAND PLANTING PLAN

Exhibit 5(a)

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Toll Free: 888.775.3648
emht.com

COLUMBUS AND FRANKLIN
COUNTY METRO PARKS
1069 WEST MAIN STREET,
WESTERVILLE, OH 43081-1181
(614) 891-0700
(614) 895-6208 FAX:

REVISIONS

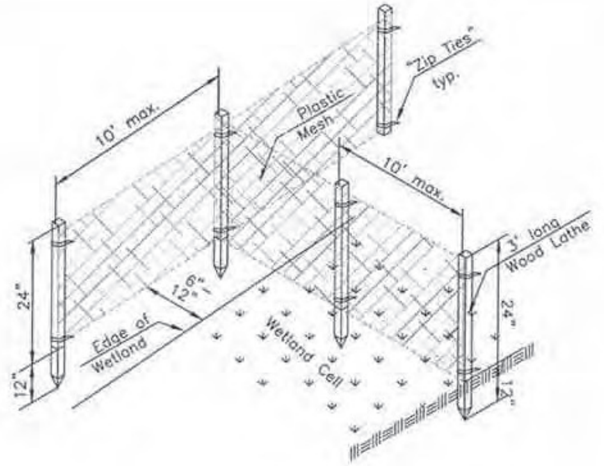
MARK	DATE	

Sheet
22/39

WETLAND SEEDING TABLE

TYPE			APPLICATION RATES	APPLICATION DATES
OVER SEED:				
Annual Ryegrass or	*(Lolium multiflorum)*		40 Lbs./Acre	March to October
Oats (Grain) or	*(Secale cereale)*		15 Lbs./Acre	March to October
Winter Rye (Grain)	*(Avena sativa)*		40 Lbs./Acre	October to February
(Forested/Emergent Wetland Buffer) PERMANENT SEED: Native Grass Custom Seed Mix				
Common Name	Scientific Name	Percentage	7 lbs/acre	October 1st – May 15th
Little bluestem	*Andropogon scoparius*			
Big bluestem	*Angropogon gerardii*	15		
Riverbank wild rye	*Elymus riparius*	10		
Silky wild rye	*Elymus villosus*	10		
Virginia wild rye	*Elymus virginicus*	10		
Indian grass	*Sorghastrum nutans*	10		
Switchgrass	*Panicum virgatum*	10		
Black–eyed susan	*Rudbeckia hirta*	7		
Ox–eye sunflower	*Heliopsis helianthoides*	7		
Gray–headed coneflower	*Ratibida pinnata*	6		
Cup plant	*Silphium perfoliatum*	4		
Tall white bread tongue	*Penstemon digitalis*	4		
Ohio spiderwort	*Tradescantia ohioensis*	3		
Joe pye weed	*Eupatorium fistulosum*	2		
Wild bergamot	*Monarda fistulosa*	1		
		1		
▨ (Forested Wetland Area) PERMANENT SEED: Ernst Seeds ERNMX–127 or approved equal				
Common Name	Scientific Name	Percentage	7 Lbs./Acre	Oct. 1st to May 15th
Fowl Bluegrass	*Pao palustris*	25		
Virginia Wild Rye	*Elymus virginicus*	25		
Fox Sedge	*Carex vulpinoidea*	25		
Ticklegrass (Rough Bentgrass)	*Agrostis scabra*	6		
Giant Bur Reed	*Sparganium eutycarpum*	3		
Blue Vervain	*Verbena hastata*	3		
Soft Rush	*Juncus effusus*	2		
Green Bulrush	*Scirpus atrovirens*	2		
Wool Grass	*Scirpus cyperinus*	2		
Many Leaved Bulrush	*Scirpus polyphyllus*	2		
Blunt Broom Sedge	*Carex scoparia*	1		
Common Sneezeweed	*Helenium autumnale*	1		
Blue Flag	*Iris versicolor*	1		
Path Rush	*Juncus tenuis*	1		
Square Stemmed Monkey Flower	*Mimulus ringens*	1		
⁘ (Emergent Wetland Area) PERMANENT SEED: Ernst Seeds ERNMX–120 or approved equal				
Common Name	Scientific Name	Percentage	15 Lbs./Acre	Oct. 1st to May 15th
Virginia Wild Rye	*Elymus virginicus*	20		
Fox Sedge	*Carex vulpinoidea*	15		
Soft Rush	*Juncus effusus*	10		
Giant Bur Reed	*Sparganium eurycarpum*	8		
Blue Vervain	*Verbena hastata*	8		
Wool Grass	*Scirpus cyperinus*	6		
New England Aster	*Aster novae–angliae*	5		
American Mannagrass	*Glyceria grandis*	5		
Eastern Bur Reed	*Sparganium americanum*	5		
Green Bulrush	*Scirpus atrovirens*	4		
Cosmos (Bristly) Sedge	*Carex comosa*	3.5		
Lurid (Shallow) Sedge	*Carex lurida*	3.5		
Rattlesnake Grass	*Glyceria candensis*	2		
Hop Sedge	*Carex lupulina*	2		
Nodding Sedge	*Carex gynandra*	2		
Wild Brome Grass	*Bromus latiglumis*	1		

– Over seed shall be applied with the permanent seed to quickly stabilize the site. This is required because the permanent seed takes much longer to germinate than the over seed.



GOOSE FENCE DETAIL

Not to Scale

Goose Fence:
Goose Fence material shall be black or green plastic mesh with 0.75 – 1.00 inch square openings (Cintoflex, Type "D", or approved equal).

Embed 3' long Wooden Lath into soil. Lath shall be 1 1/2" wide (Min.) x 3/8" Thk. (Min.)

Tie Plastic Mesh (Goose Fencing) to Wooden Lath at top and bottom of mesh.

Goose Fencing shall remain installed for a minimum of one (1) year. Removal of Goose Fencing after the one (1) year period is at the Owners discretion.

Goose Fence shall only be installed in Wetland Cell 1A and 1B. See Specification an Sheet 2.

Job No. 2009-0543
Date January, 2011
Drawn By: RRN
Scale As Noted

COLUMBUS AND FRANKLIN COUNTY METRO PARKS
WETLAND AND STREAM AS-BUILT PLAN
AT
THE FORMER EASTSIDE NURSERY SITE
6723 LITOHPOLIS ROAD, CANAL WINCHESTER, OHIO 43110
WETLAND PLANTING PLAN

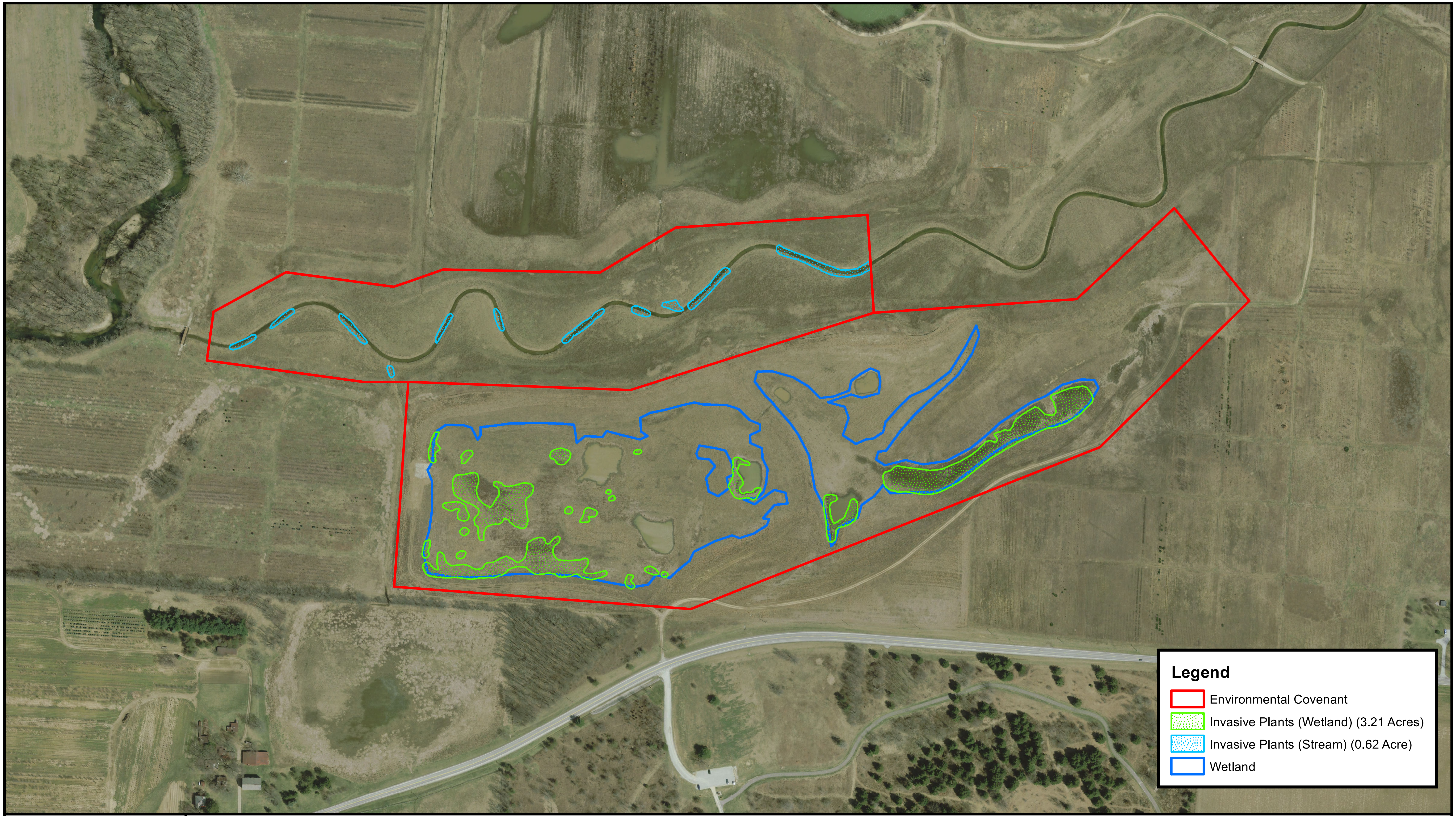
Exhibit 5(b)

EMHT
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Toll Free: 888.775.3648
emht.com

COLUMBUS AND FRANKLIN
COUNTY METRO PARKS
1069 WEST MAIN STREET,
WESTERVILLE, OH 43081-1181
(614) 891-0700
(614) 895-6208 FAX:

REVISIONS

MARK	DATE	



SOMERSET TOWNSHIP, BELMONT COUNTY, OHIO

Walnut Woods
Invasive Plant Distribution
Exhibit 6

EMH&T
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Toll Free: 888.775.3648
emht.com

SCALE: 1" = 300'

0 165 330 660 Feet

Aerial - OSIP, 2013

Path: J:\20110496\GIS\Exhibit 6 - Invasive Plant Distribution.mxd

FIXED STATION PHOTOGRAPHS

Photographs 1 and 2

Comparing downstream terminus in Years 2 and 5 of stream restoration, facing south along riparian corridor.

(EMH&T, 8/15/12)

(EMH&T, 9/28/16)

Photographs 3 and 4

Comparing riparian corridor in Years 2 and 5 of relocated stream, facing north.

(EMH&T, 8/15/12)

(EMH&T, 9/28/16)

Photographs 5 and 6

Comparing upstream terminus of stream restoration in Years 2 and 5, facing north along riparian corridor. Picture taken at the tie-in with MetroParks stream restoration project

(EMH&T, 8/15/12)

(EMH&T, 7/31/16)

Photographs 7 and 8

Tie-in of CRAA and MetroParks stream restoration projects comparing views of Years 2 and 5. Picture taken facing south toward the Metroparks restoration stream and corridor.

(EMH&T, 8/15/12)

(EMH&T, 10/11/16)

Photograph 9
View of treated reed canary grass within stream corridor
(EMH&T, 7/31/16)

Photograph 10
View of typical downstream reach
(EMH&T, 7/31/16)

Photograph 11
View of beaver dam prior to removal
(EMH&T, 12/14/15)

Photograph 12
View of beaver dam immediately after dam removal
(EMH&T, 12/14/15)

Photograph 13
View of dramatically reduced water level in stream following dam removal
(EMH&T, 12/14/15)

Photograph 14
View of submerged hester dendy substrates in running water
(EMH&T, 6/8/16)

Photograph 15
View of exposed hester dendy substrates in standing water
(EMH&T, 7/31/16)

Photograph 16
View of emergent VIBI plot
(EMH&T, 7/20/16)

Photograph 17
View of forested VIBI plot
(EMH&T, 7/20/16)

Photograph 18
View of treated reed canary grass in northern wetland cell
(EMH&T, 9/01/16)

Photograph 19
View of treated cattail in southern wetland cell
(EMH&T, 9/01/16)

Photograph 20
Typical view of wetland in northern cell
(EMH&T, 9/01/16)

Photograph 21
Typical view of wetland in northern cell
(EMH&T, 9/01/16)

Photograph 22
Typical view of wetland in southern cell
(EMH&T, 9/01/16)

Photograph 23
View of uncovered tile during hydrology investigation
(EMH&T, 9/24/13)

Photograph 24
View of repacked tile line after tile was destroyed and backfilled
(EMH&T, 9/24/13)

Photographs 25-26

Comparing pool in southern wetland cell facing north in 2015 vs 2016

(EMH&T, 5/15/2015)

(EMH&T, 5/12/2016)

Photographs 27-28

Comparing the outlet control structure between the two wetland cells in 2015 vs 2016.

(EMH&T, 5/15/2015)

(EMH&T, 5/12/2016)