20 May 2009

Ms. Chantelle Carroll
U.S. Army Corps of Engineers, Buffalo District
Regulatory Branch, Orwell Field Office
33 Grand Valley Avenue
Orwell, Ohio 44076
Phone: (440) 437-8970
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Re: *Section 404 Nationwide Permit Application,*
*Haley's Ditch Restoration Project*
*North of East Archwood Avenue and south of Triplett Boulevard,*
*Akron, Summit County, Ohio 44306*

Dear Ms. Carroll:

Enclosed please find a pdf. copy of the Haley's Ditch Stream and Wetland Restoration plan that details the restoration efforts to follow the remediation. After your review if you require additional information or have questions please contact myself (330-620-7756) or Joel Bingham (330-858-0298). A hard copy has also been sent.

Respectfully,

Jamie Krejsa
Vice President / Director of Ecological Services

enc: Haley's Ditch Stream and Wetland Restoration Plan

**CC:**
Mr. Dave Gunnarson, Lockheed Martin
File

# Haley's Ditch Restoration Plan

Prepared By:

RiverWorks
A Partnership for Stream & Wetland Restoration

GPD GROUP

ES ENVIRO SCIENCE INCORPORATED

River Reach Construction
Specializing in Stream & Wetland Restoration

EnviroScience, Inc.
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May 18, 2009

**Lockheed Martin**
**Haley's Ditch Stream and Wetland Restoration Plan**


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# 1. Introduction

## 1.1 Background

The following is a restoration plan for the Haley's Ditch remediation project in Summit County, Akron, OH. The following information is meant to provide additional detail regarding the proposed restoration for Haley's Ditch with regard to existing condition, restoration approach and design. For a more detailed background regarding the historical cause of PCB contamination refer to ARCADIS Remediation Plan section 1.1 and 1.2. In general, the remediation project will involve the excavation, removal, transportation and offsite disposal of accumulated, unconsolidated sediment deposits in Haley's Ditch, as well as adjacent soils containing PCBs at concentrations above the soil cleanup level of 1.0 mg/kg.

Remediation of Haley's Ditch will generally proceed in an upstream to downstream direction beginning at the culvert outlet from Triplett Blvd to the culvert invert at Archwood Ave. The project is roughly divided into three sections; South, Middle and North Areas. Figure 1 illustrates the project boundaries, proposed horizontal soil and sediment removal limits and depths. The following plan details the restoration activities post-remediation.

The restoration of Haley's Ditch centers on enhancing the remediation area within the limits of contaminated sediment removal. Although not required, Lockheed Martin has made a conscious decision to spend additional resources to provide a functional stream valley, floodplain and riparian corridor as a foundation for ecological recovery. Thus, the limits of remediation are largely the limits of restoration. The restoration approach is also centered on recognizing the existing impairments and limitations of channel morphology, habitat and riparian zone to mitigate for historical impacts as well as alleviate disturbance from remediation. The remediation and restoration activities within wetland areas and waters will be completed in accordance with a Nationwide 38 permit obtained by the United States Army Corps of Engineers.

## 1.2 Existing Conditions

Haley's Ditch is considered a headwater stream (1.04 sq mi drainage area) with a Warm Water Habitat (WWH) use designation by the Ohio EPA. Overall, the Haley's Ditch watershed is heavily urbanized. Prior to development, large portions of the Haley's Ditch watershed consisted of wetlands and forest. However, over the past 100 years of development, drainage, channelization, fill and other practices have altered the watershed from previous conditions. An evaluation of the existing channel morphology, habitat, local biology, vegetation and project area wetlands was performed to satisfy project permitting and facilitate restoration design.

### 1.2.1 Stream Morphology

Because the existing drainage channel will be excavated and relocated as part of the remediation efforts, limited channel morphology measurements were collected on the existing conditions. Four cross sections were performed in representative areas to assess channel characteristics and conditions. A longitudinal profile was not performed

because analysis of the channelized pattern (sinuosity 1.1) in relation to riffle-pool features would offer little information to the restored condition. However, an average slope (0.0035 ft/ft) and bankfull indicators were determined from survey and field observation. The channelized stream geometry is an obvious detriment to the existing channel function and habitat.

Cross sections were surveyed in four riffle areas to characterize channel conditions and their relationship to depositional and floodplain features and terraces (Figures 2-5). The results characterize the channel as a low width:depth ratio (ie. narrow deep) resembling a Type G or E channel. The cross sections represent a likely recovered condition (Type E) for the channelized ditch as there are indications of a small floodplain that has equilibrated within the bank levees. Nonetheless, the channelization and bank levels as they currently exist inhibit frequent flood inundation to the larger floodplain.

**Table 1. Cross Section Summary**

| Cross Section | Bankfull width | Mean Depth | Cross Sectional Area | Width:Depth | Entrenchment Ratio |
|---|---|---|---|---|---|
| **CS 1** | 8.58 | 1.56 | 13.68 | 5.4 | 2.0 |
| **CS 2** | 10.82 | 1.62 | 17.5 | 6.68 | 1.97 |
| **CS 3** | 15.4 | 1.16 | 17.95 | 13.32 | 1.68 |
| **CS 4** | 12.1 | 1.19 | 14.39 | 10.15 | 1.40 |

**Figure 2. Cross Section 1 Riffle**

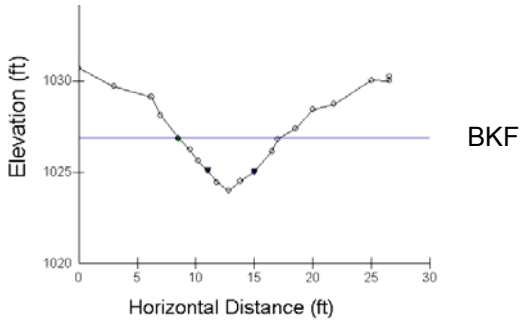



**Figure 3. Cross Section 2 riffle**

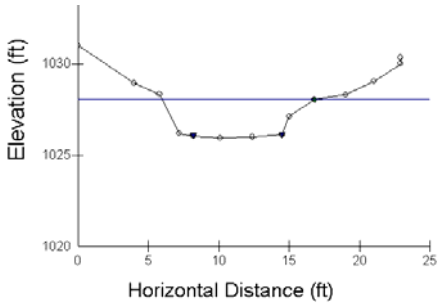



**Figure 4. Cross Section 3 Riffle**

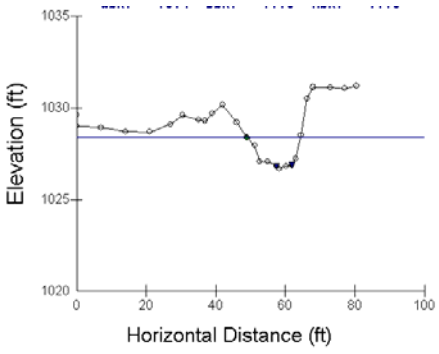
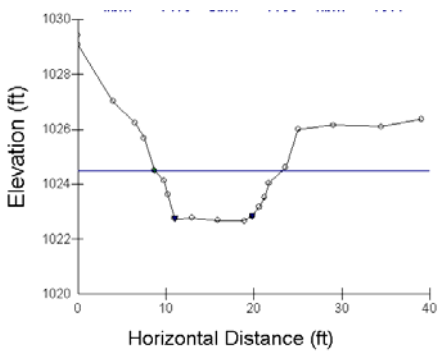



**Figure 5. Cross Section 4 riffle**

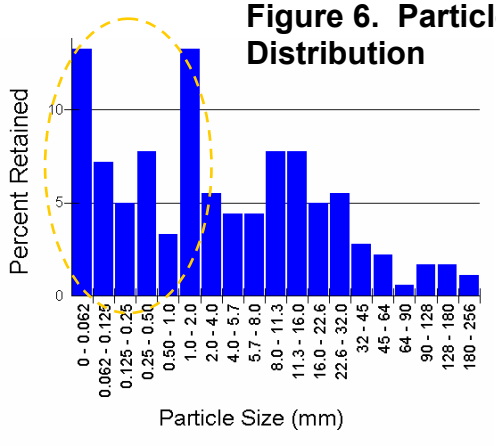


Streambed substrates were characterized using the Wolman pebble count methods. Samples were collected in riffle areas as these would represent best substrate conditions due to the depositional nature of pools. Below, Table 2 and Figure 6 summarize the particle distribution in riffle areas. Notice the high percentage of silt (13.2%) and its corresponding proportion (orange outline) in the bar chart depicting bimodal distribution. This is typical of many channelized or incised streams which do not have access to floodplains for storage of this finer material.

**Table 2. Percent Particle Distribution**

| Type | Riffle Areas |
|---|---|
| Silt/Clay | 13.2% |
| Sand | 36.5% |
| Gravel | 45.3% |
| Cobble | 5.0% |
| Boulder | 0% |

**Figure 6. Particle Distribution**




### 1.2.2 Wetlands

The site contains three wetlands (referred to as Wetlands A, B, and C) totaling 0.84-acres of two types of wetland habitat: palustrine emergent and palustrine forested wetland habitat (Wetland Delineation, Davey Resources Group 2008). Wetlands A, B and C were assessed using the Ohio Rapid Assessment Methodology (ORAM) scoring forms (Ecological Resources Assessment and Indiana Bat Survey, EnviroScience 2008). Wetland A (0.72-acre) was determined to be a Category 2 wetland, Wetland B (0.093-acre) was determined to fall within the Category 1 or 2 gray zone, and Wetland C (0.024-acre) was determined to be a Category 1 wetland (USACE Jurisdictional Determination, 2009).

### 1.2.3 Habitat

In-stream habitat was evaluated with the Qualitative Habitat Evaluation Index (QHEI) which is a standard subjective evaluation performed by the Ohio EPA (Table 3). Haley's Ditch scored a 55.25 out of 100 possible points. Typically, scores >60 have sufficient habitat to support a WWH fish community. The results from Haley's Ditch suggest that the existing habitat has a marginal capability to meet WWH standards. Major limiting factors to the site related primarily to Metric 3 channel morphology, Metric 2 diversity of in-stream habitat and Metric 5 riffle-pool quality. Riffle quality was generally poor with shallow depths consisting of moderately embedded substrates. Pool depth was considered average but the number of quality pools was limiting.

**Table 3. QHEI Summary**

| Haley's Ditch | Metric Score |
|---|---|
| **Metric 1. Substrate** 20pts max | 12 |
| **Metric 2. In-Stream Cover** 20 pts max | 12 |
| **Metric 3. Channel Morphology** 20 pts max | 10 |
| **Metric 4. Riparian** 10 pts max | 4.75 |
| **Metric 5. Riffle Pool Quality** 20 pts max | 8.25 |
| **Metric 6. Gradient** 10 pts max | 8 |
| **Total Score** | 55.25 |

### 1.2.4 Biology

During June and August of 2008, EnviroScience conducted a supplemental biological evaluation to update biological information within the project area. The Haley's Ditch site evaluated by EnviroScience was located adjacent to the Goodyear Test track approximately 0.70 miles downstream from the project site. Overall, EnviroScience observed similar results as past Ohio EPA sampling events (Table 4). Therefore, it appears that the water quality in the reach has not improved substantially. EnviroScience, with concurrence from Ohio EPA, did not perform a biological evaluation on the Lockheed Martin reach of the Haley's Ditch for several reasons. First, the concurrent evaluation in the watershed provided a sufficient evaluation of the fishery community capable of inhabitating the area under the existing conditions. Second, EnviroScience and Lockheed wanted to avoid disturbing substrates within the project area to minimize the risk of downstream migration prior to remediation activities. Also, since there was no feasible upstream site of natural channel conditions, the downstream data was considered adequate. Additional data regarding the biological integrity of the Little Cuyahoga River watershed is available through the Ohio EPA report entitled; *Biological and Water Quality Study of the Little Cuyahoga River and Tributaries, 1996* (OEPA 1998),

**Table 4. EnviroScience Biological Summary**

| Site | June 2008 | August 2008 | Attainment Status |
|---|---|---|---|
| | IBI | Mlwb | WWH |
| **RM 0.2 Springfield Lake Outlet** | 30 | 26 | Non |
| **RM 0.2 Haleys Ditch** | 30 | N/A | Non |

### 1.2.5 Vegetation and Soils

A majority of the site is surrounded by buildings, parking lots, or residential areas. Consequently, the historical vegetative communities are either lost or severely impacted. However, information on the existing conditions suggest a potential trajectory for recovery and species that will be successful post-restoration. During an ecological investigation of the site (*EnviroScience, Inc. 2008*), three upland plant communities were identified in the project area, consisting of urban, successional forest, and scrub shrub. The northern portion of the site consists primarily of successional forest as well as scrub shrub habitat. The central portion of the site consists primarily of urban area, mowed grass with shrubs and herbaceous vegetation lining Haley's Ditch. The southern portion of the site consists primarily of successional forest as well as scrub shrub and urban habitat types.

Common species found in the successional forest and scrub shrub habitat include *Acer saccharinum* (silver maple, FACW-), *Populus deltoides* (eastern cottonwood, FAC), *Prunus serotina* (black cherry, FACU), *Robinia pseudoacacia* (black locust, FACU-), and *Acer negundo* (box-elder, FAC+) in the tree canopy layer; *Crataegus sp.* (hawthorn), *Cornus foemina* (gray dogwood, FAC), *Lonicera tatarica* (Tartarian honeysuckle, FACU), *Rosa multiflora* (multiflora rose, FACU), and *Rhamnus frangula* (glossy buckthorn, FAC) in the shrub layer; *Alliaria petiolata* (garlic mustard, FACU-), *Impatiens capensis* (spotted touch-me-not, FACW), and *Toxicodendron radicans*

(poison ivy, FAC) in the herbaceous layer; *Vitis riparia* (river-bank grape, FACW) and *Parthenocissus quinquefolia* (Virginia creeper, FACU) in the vine layer.

In summary, the vegetative communities are impacted by regular maintenance or exist in a successional state. The three described communities do not represent a climax vegetative condition, and restoration of these areas will result in better ecological condition in the long term.

The site is found in the *Soil Survey of Summit County, Ohio* (Ritchie and Steiger 1990). According to the survey, the soils within the project area are one of four types consisting of Carlise muck (Cg), Chili-Urban (CuB), Chili-Urban (CuC) or Urban (Ur). The Carlise muck is a hydric soil typical of swampy wetland areas. The remaining soil types are indicative of areas where original Chili soils have been destroyed from borrow, fill or re-grading. The surface layer of the disturbed soil has low organic matter, is droughty and seed germination is poor. Urban land (Ur), a nonhydric soil, is defined as "areas ten acres of more in size that area covered by buildings, pavement, or other manmade surfaces" (Ritchie and Steiger 1990).

### 1.3 Summary

From a morphological, biological and habitat perspective, Haley's Ditch functions marginally well. This current condition is primarily the result of human induced alteration from industry and settlement in the watershed. However, the evaluation has identified some key impairments that, if restored or addressed through restoration efforts, could increase functionality. Channelization and loss of an accessible bankful floodplain appear to be the most limiting factors. The proposed restoration plan is designed to restore these features through the creation of a restored stream pattern and excavation of an accessible floodplain.

### 1.4 Restoration Approach

From a morphological, habitat and biological perspective, the restoration approach will provide a substantial basis for recovery through its focus of reversing the historical impairments and the impacts to habitat and morphology caused by remediation. The restoration of the physical habitat will be addressed with channel and floodplain restoration (Figure 7). The creation of additional meander bends and stream pattern will provide a basis for more habitat diversity and deeper more varied pool depths. One of the immediate benefits from channel and floodplain restoration will be the potential reduction of fine sediment storage within the channel. The restored floodplain, wetlands and channel will be restored to an elevation and to encourage a higher level of connectivity (Figures 8). The new stream geometry will create greater channel and flow variability and facilitate riffle-pool complexes. Imported substrate for the stream bed will consist of bank run from a nearby gravel-pit, supplemented by larger gravel and cobble sized material. Bank run is unwashed material that provides natural variability synonymous with glacial till. A depth of approximately 1 foot of substrate will be placed over sub-grade within the channel and planned flood storage areas to final grade.

The remediation effort will also displace a large amount of trees and understory but the restoration effort will use most of this material on-site as wood chips added to the soil or as deadfall or in-stream habitat. A significant planting effort of trees shrubs and live cuttings to replace the lost vegetation is proposed through the restoration area (Figure 9). Proposed native species and seed mixes vary depending on location in the floodplain, upland or wetland areas. The planting strategy employs groups and clusters of vegetation to increase chance of success with patchy development rather than randomization. Similar species will be planted together particularly with regard to the shrub species. Fast growing species such as willow and dogwood are focused along the stream banks in the form of containerized and live cuttings for banks stability and habitat. The recovery potential of the site will also increase with time as stream bank vegetation will provide root mats, undercuts, overhanging vegetation and more importantly shade for the restored reach.

Biologically, a regional species pool of 22 fish species is potentially available for recruitment into the restored reach. This pool was generated based on current and historical information from the main stem of the Little Cuyahoga, Springfield Lake Outlet and Haley's Ditch between the Kelly Ave. dam and Mogadore Reservoir Outlet. This pool of species is comprised of various trophic guilds and tolerant and non-tolerant species. This community does have the capacity from a species perspective to develop into a WWH supporting community. The restoration of more habitat heterogeneity, functional morphologic features and riparian zone will greatly assist in the development of that community. While the restored site will likely not support a diversity of 22 species, the regional pool provides a larger variability of tolerances and habitat preferences for potential colonization.

The expansion of the floodway corridor and restoration of a meandering channel provide opportunity to restore riverine wetlands. Wetland restoration efforts will primarily be directed at restoring a proposed 0.84-acre wetland in the northwest corner of the site at the location of existing Wetland A. Several other small seasonally inundated depressional areas will be created in floodplains to mimic oxbow wetlands. These riverine wetlands are prevalent in the Cuyahoga watershed and along intact areas of the Little Cuyahoga River corridor and its tributaries. Riverine wetlands will provide additional habitat diversity, refuge for fish during flooding and a source of food for wildlife. Other beneficial floodplain functions include flood storage, filtration and groundwater recharge. The primary source of hydrology for the wetlands will be precipitation and over bank flooding which will likely access these areas 3-4 times during the growing season. The large 0.84-acre wetland will be restored over top existing Carlise muck (Cg) soils to provide the hydric soil component.

## 2. Property Access and Permit Approvals

Permits and approvals will be obtained prior to performing remediation and restoration activities at Haley's Ditch. The permits and approvals are as follows:

<u>Permits</u>

- Grading Permit (City of Akron);

- US Army Corp of Engineers - Nationwide 38 Permit;

Approvals

- Risk-Based Disposal Approval for PCB Remediation Waste (US EPA);
- NPDES General Permit (Ohio EPA);
- Storm Water Pollution Prevention Plan (SWPPP) (Summit Soil and Water Conservation District);

## 3. Haley's Ditch Restoration Activities

### 3.1 Mobilization

Restoration activities will commence as soon as practical following the remediation effort, thus restoration activities are anticipated to begin approximately 3-4 weeks from remediation start date. Restoration activities will utilize the base equipment staging areas used initially by the remediation effort in the support zone "clean" areas only. Restoration activities will utilize the same construction entrances as remediation activities after the remediation crew has moved into the next zone.

### 3.2 Survey Layout

The restoration site will be stationed and referenced along the centerline of the proposed bankfull channel alignment. Stationing begins at 1+00 at the downstream culvert invert at E. Archwood Ave. and continues upstream to station 21+39.45 at the culvert invert at the south end of the site coming from Triplett Blvd. Station and offsets on survey lathe shall provide the location of grading limits, channel depth, bank heights etc. in the field. Cross sections were planned at specific locations perpendicular to the centerline to provide horizontal distances of channel shape and secondarily act as an as-built "check" discussed further in construction oversight. Cross sections are spaced approximately 25-50 ft apart.

### 3.3 Erosion Sediment Controls and Bypass Pumping

Storm water management will include erosion control measures to be installed in accordance with the SWPPP reviewed and approved by the local soil and water conservation district. Scheduling of daily restoration activities will be planned in accordance with the anticipated weather conditions to minimize adverse impacts as a result of severe weather. As a general guideline, the majority of channel restoration work will be performed in the "dry" through the use of either water diversion or bypass pumping. The existing channel will be restored to a sub-grade elevation by the remediation crew using clean soil to allow base flow to bypass long distances in the North and South work zones. If bypass diversion is not feasible (ie. Middle Zone), then daily bypass pumping will minimize water contact with exposed soils. Rock check dams will be installed at specified locations in the sub-grade restored channel and diversion bypass channel as an in-channel BMP. Rock check dams will be placed specifically at riffle crest locations and ultimately incorporated into the final restoration grade. Thus,

the rock checks also become points of vertical grade control. Rock check dams will be removed from diversion bypass channels prior to backfill and grading.

If significant storm events are anticipated, the remediation and restoration crews will perform all practical measures to ensure that the project site and downstream areas will not be negatively impacted. As a general rule, the restoration construction will be completed to a point that any rainfall event can flow through the newly restored areas at the end of each day. In other words, channel diversions are installed such that overtopping can flow into the restored channel if extra capacity is needed. Also, daily bypass pumping procedures will be ceased at the end of the work day. Any continual bypass pumping will be performed solely by the remediation crew.

### 3.4 Restoration Sequence

The Haley's Ditch restoration activities will include the following tasks, generally performed in sequential order. A brief description of each activity is provided below

- Dewatering and Channel diversion- See Section 3.3
- Refine subgrade and stream banks
- Placement of substrate
- In-stream woody habitat
- Finish Grade
- Erosion fabric and topsoil placement for stream banks
- Floodplain grading
- Wood chip placement
- Topsoil placement and grading
- Woody debris deadfall placement
- Tree and plant installation
- Seed and straw mulch
- Wetland Construction

- Refine subgrade and stream banks

  Excavation of constant slope sub-grade channel to provide a refined sub-grade of the riffle and pool features. Pool areas will be excavated deeper and material placed at the downstream or upstream area thereby creating the rise and fall of the profile.

- Placement of substrate

  Once the riffle and pool sub-grade has been achieved in a feasible length of stream (i.e. 100-300 ft), a base foundation of bank run material will be added of approximately 0.5 ft (6 inches) over the pool and riffle areas. Bank run material has a high percentage of sand and small gravel that is typical of "sub-pavement" areas of stream beds. This material will be compacted into place using a machine bucket or vibrating skid.

Compaction will be performed to avoid the redistribution of the base material during initial rain events and to increase precision of final grading due to the fine tolerances of low gradient streams.

- In-stream woody habitat

  Before finish grade and bank construction, it is beneficial to install any in-stream woody habitat features. Woody debris habitat is a large component of headwater stream habitat particularly in the Cuyahoga basin. Various types of woody debris habitat will be installed within riffle and pool areas. The length and diameter of the woody material will generally range from 10-20 feet in length and a diameter of 6-18 inches. Specific woody debris locations, alignment, type and size will be at the discretion of the restoration team due to the variability of each location and source of wood.

- Finish Grade

  The finish grading is the stage where the channel begins to take shape with regard to its fine details, bars and microfeatures typical of natural channels. Finish grade will be accomplished using a coarser mixture of medium-large gravel and small cobble substrate. Material will be compacted into place using machine bucket or vibrating skid. During finish grading, water may be diverted into the channel to facilitate minor adjustments to elevations of riffle crests and shaping of base flow channel areas.

- Erosion fabric and topsoil placement for stream banks

  Erosion fabric will provide both short and long-term protection for stream banks as native grasses and live stakes grow through the blanket. A North American Green C125 coconut fiber erosion fabric, Rolanka jute fabric, or equivalent will be applied along both banks. A section of channel that has reached finish grade will undergo topsoil placement and erosion fabric installation to meet final floodplain grade (ie. bankfull elevation). Erosion fabric will be initially laid out along the bank within the channel, so that the left edge is within the channel while the right edge is overlapping the sub-grade bank 1-2 ft (looking downstream). The right edge will be fastened with wooden stakes at regular intervals to lock in the bottom edge of the fabric. Topsoil will be placed at the designated bank edge, compacted in lifts to final elevation. Prior to rolling the left edge of the fabric, the bank will be seeded with native seed mix. Once the fabric has been overlaid and the bank edge is formed, wooden stakes will fasten the fabric in place according to manufacturer specifications.

- Floodplain grading

  Adjustments to the sub-grade floodplain will be made at this time to prepare the area for topsoil and finish floodplain grade. Identified areas of compaction from hauling or vehicle traffic will be ripped to a depth of 0.5-1.0 ft to loosen soils.

- Wood chip placement

A percentage of the cleared trees will be chipped and stockpiled. This is an effort not only to reduce material handling but also to keep carbon on-site as a soil additive. The wood chips will help increase the coarse woody organic layer and detritus to potentially increase successional recovery and establish a micro soil fauna similar to wooded or successional areas. Only trees greater than 4 in. dbh will be used to produce woody chips in order to avoid invasive species recruitment from the shrub layer. Wood chip mulch will be spread on the sub-grade in a relatively even layer of 1-3 inches.

- Topsoil placement and grading

  Clean topsoil free of PCB's (i.e., PCB concentration less than 0.1 mg/kg) from a local source will be imported and spread over the sub-grade to meet final floodplain and upland elevations. A soil test shall be performed to identify soil characteristics. A composite sample of the imported material will be used from the source location. A standard soil test provides an indication of levels of phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), pH, cation exchange capacity, lime requirement index and base saturation. An important soil characteristic is a soil pH around 6.5. At this level, most soil nutrients are readily available. Based on the results of the soil test(s) fertilizers or additional constituents can be added to the soil to provide an adequate balance for vegetation.

- Woody debris deadfall placement

  Following topsoil placement, woody debris and logs will be placed at locations specified by the restoration biologist. This deadfall will provide additional habitat for wildlife and mimic the natural conditions of a wooded corridor and floodplain. Logs will be slightly buried at one end or along its length in effort to help anchor the wood in case of a large flood event.

- Tree and plant installation

  The restored vegetation is an important component to the project as it provides the foundation for the community and sets the trajectory for recovery. The restored plantings will consist primarily of tree, shrub and live cuttings of varying sizes and species. A list of proposed species for each of the distinct areas (floodplain and stream banks, uplands, wetlands) for the project are included in Table 5. Depending on the weather conditions and timing of when areas are ready for plantings, installation may be delayed until early fall to increase chance of survivability. This would save time and effort on watering through hot summer months as the site will be devoid of most natural shade. Planting of containerized or ball and burlap (B&B) trees and shrubs shall be performed according to ODOT CMS 661. Spacing of the plant depends on the species but will generally be 10-15 ft centers for B&B trees and 6-8 ft for containerized plants. Tree guards may be installed at later date depending on deer activity following project completion. Wood chips or wood mulch will be placed around installed trees and shrubs to help

prevent weed competition in the drip line. Live stakes will be installed during March and April 2010 while species are still dormant.

- Seed and straw mulch

  Seeding of temporary and native seed will occur as soon as possible in disturbed areas. A table of the proposed seed mix species for each of the distinct areas (floodplain and stream banks, uplands, wetlands) is attached. The objective of seeding is to ensure good seed-to-soil contact at a depth of no more than ½ inch. Areas to be seeded will be properly prepared and seeded at a rate of 15 lbs per acre. All seeded areas shall be covered with straw mulch. Straw mulch will be applied by hand or straw blower at a rate of 2 tons per acre. Immediately after straw is laid, material will be crimped by tracked vehicle running against the slope as to not encourage rill erosion.

- Wetland Construction

  *Emergent Riverine Wetlands*

  Proposed emergent wetlands will be planted with a wide variety of native herbaceous vegetation, including grasses, sedges and forbs that generally grow 1-3 ft in height. Species were selected based on common species in northeast Ohio and those identified in reference wetland areas upstream. Emergent marshes will provide excellent fish refugia during flood events and possible spawning grounds for amphibians and wildlife habitat. Wetland restoration will entail the following bulleted activities below. Refer to the corresponding descriptions above for general guidelines on activities in addition to any particular notes provided.

- Refine Wetland sub-grade
  Grading depressions, swales and berms to create microtopography in accordance with the design plan will be performed at this stage
- Wetland finish grade
- Wetland wood chip placement
- Wetland topsoil placement and grading
- Wetland woody debris deadfall placement
- Wetlant tree and plant installation
- Wetland seed and straw mulch

### 3.5 Construction Inspection and Oversight

The restoration of Haley's Ditch stream and wetland features will be performed as a design build construction project. The restoration biologist, engineers and construction managers encompassing the restoration team that conceptualized and designed the project will implement the final product. The restoration biologist will be on-site daily for a majority of the restoration construction. In addition to directing operators and assisting in layout, part of this oversight is the periodic checking of the as-built condition utilizing the design plan sections, profile and plan view. Natural channel construction

provides flexibility from the design detail as simplified 2-D sections and profiles cannot represent the intricacies, details and variability of natural channels. However, critical elevations such as riffle crests, floodplain elevations and cross sectional areas provide the basis and range of tolerances. Ultimately, the restoration goal is to construct a stream and valley that functions ecologically and morphologically and provides a foundation that can evolve and adapt over time.

## 4. Schedule

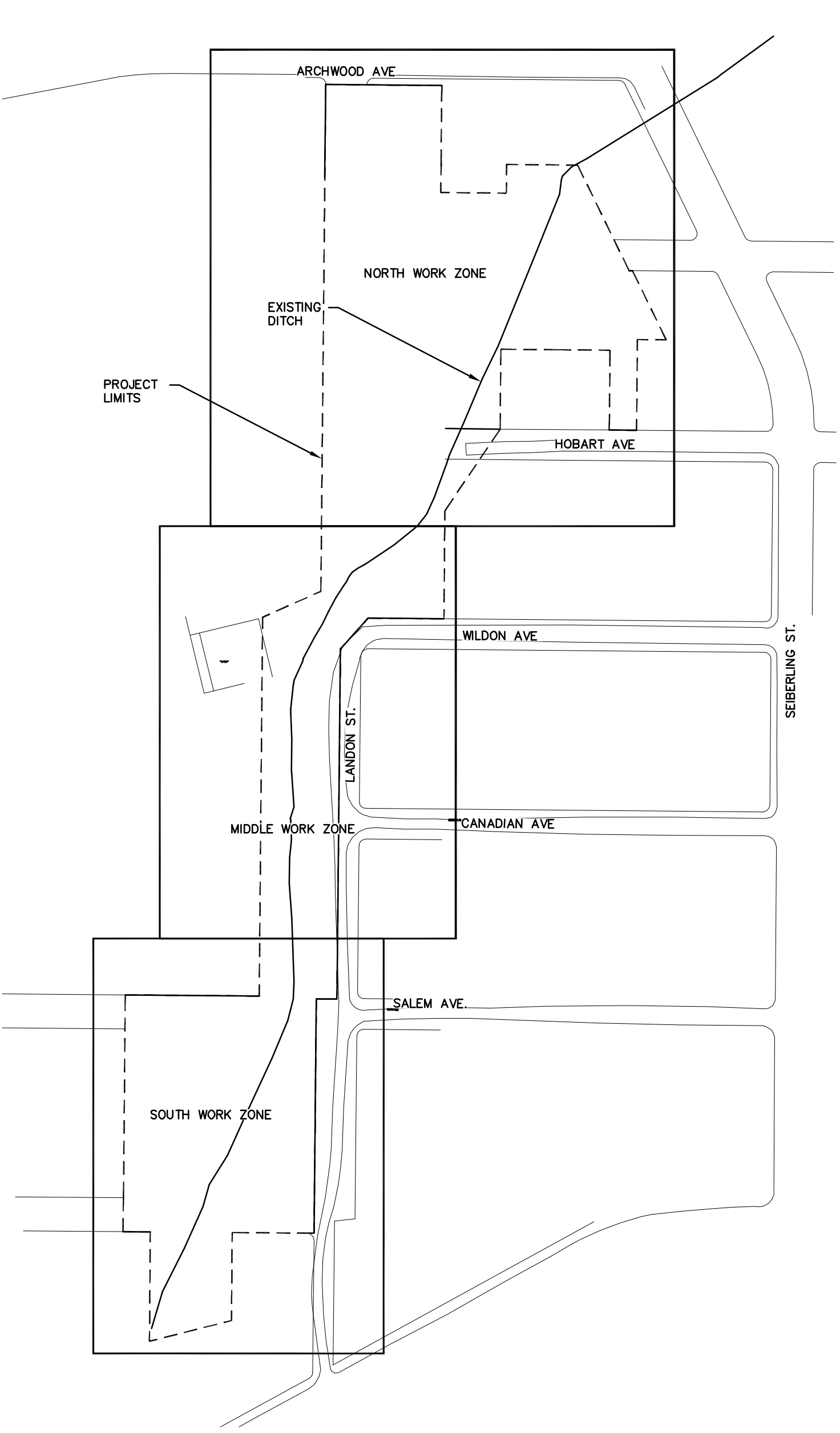
Lockheed Martin plans to perform the Haley's Ditch remediation activities during the summer of 2009. ARCADIS plans to mobilize to the site in early May 2009 and complete the remediation work in early September 2009. Restoration work is scheduled to be complete by mid October, 2009 with supplemental plantings in spring 2010.

## Table 5. Restoration Proposed Species

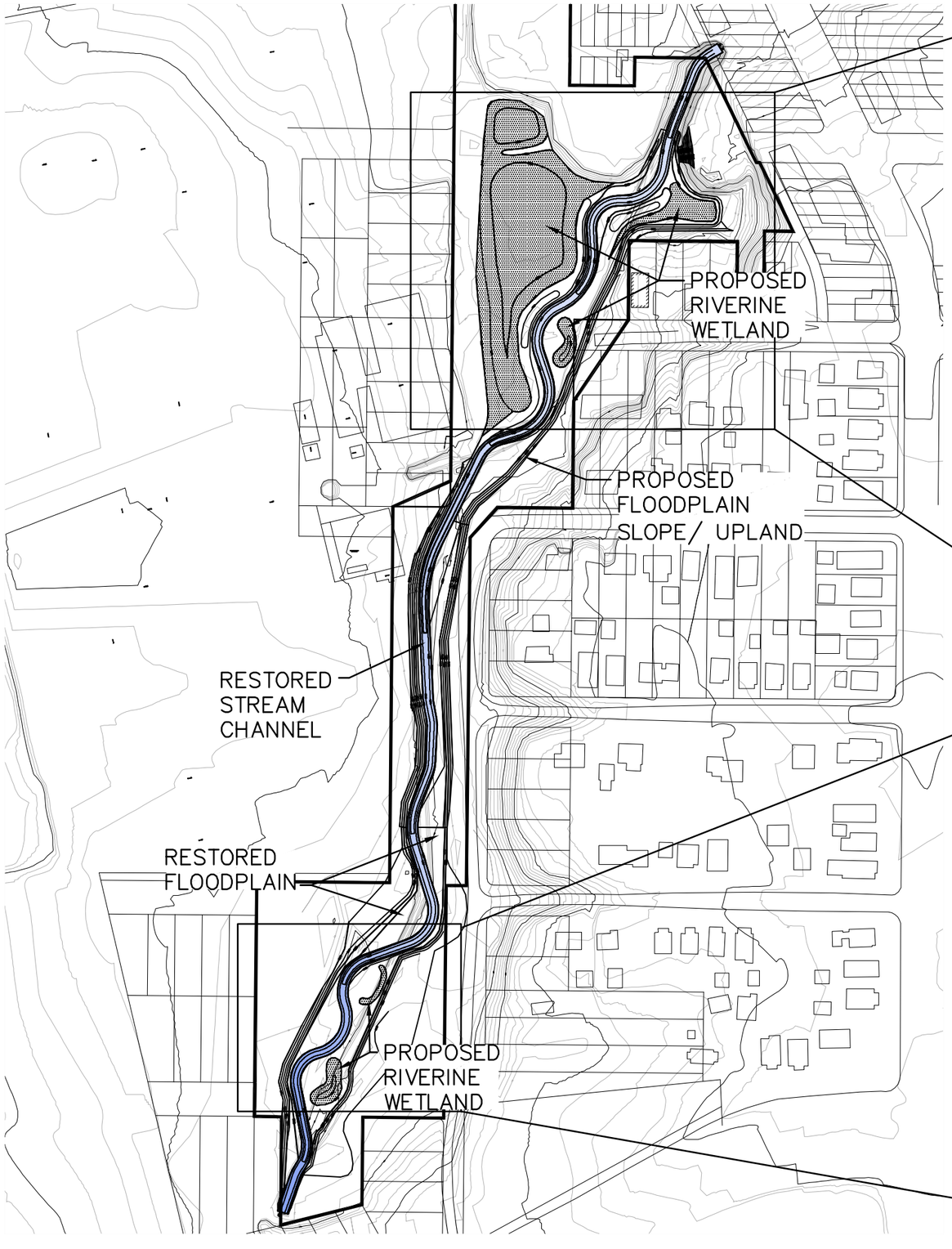
| Floodplain / Riparian | Areas |
|---|---|
| **Herbs** | |
| ***Genus/Species*** | ***Common Name*** |
| *Agrimonia parviflora* | Small-flowered agrimony |
| *Carex crinita* | Fringed sedge |
| *Carex grayi* | Asa gray's sedge |
| *Carex lurida* | Lurid sedge |
| *Carex vulpinoidea* | Fox sedge |
| *Cinna arundinacea* | Wood reed grass |
| *Elymus riparius* | Riverbank wild rye |
| *Elymus virginicus* | (Virginia Wild Rye) |
| *Eupatorium fistulosum* | (Joe Pye Weed) |
| *Eupatorium maculatum* | (Spotted Joe Pye Weed) |
| *Glyceria striata* | Fowl manna grass |
| *Impatiens capensis* | Jewelweed |
| *Juncus effusus* | Soft rush |
| *Leersia virginica* | Whitegrass |
| *Monarda fistulosa* | Wild bergamot |
| *Panicum clandestinum* | Deertongue |
| *Penstemon digitalis* | Tall White Beard tongue) |
| *Rudbeckia hirta* | Black Eyed Susan |
| *Senecio aureus* | Golden ragwort |
| *Verbesina alternifolia* | wingstem |
| | |
| | |
| **Shrubs/Trees** | |
| ***Genus/Species*** | ***Common Name*** |
| *Acer negundo* | Box elder |
| *Alnus rugosa* | Speckled alder |
| *Cornus amomum* | Silky Dogwood |
| *Cornus sericea* | red osier dogwood |
| *Lindera benzoin* | Spicebush |
| *Platanus occidentalis* | American sycamore |
| *Quercus bicolor* | Swamp white oak |
| *Spiraea alba* | Meadow sweet |
| *Ulmus americana* | American elm |

| Wetland Areas | |
|---|---|
| **Herbs** | |
| ***Genus/Species*** | ***Common Name*** |
| *Alisma subcordatum* | Water plantain |
| *Asclepias incarnata* | Swamp milkweed |
| *Carex crinita* | Fringed sedge |
| *Carex cristatella* | Crested sedge |
| *Carex lurida* | Lurid sedge |
| *Carex scoparia* | Broom sedge |
| *Carex tribuloides* | Blunt broom sedge |
| *Carex vulpinoidea* | Fox sedge |
| *Eleocharis obtusa* | Blunt spike-rush |
| *Eupatorium fistulosum* | Joe Pye Weed |
| *Eupatorium maculatum* | Spotted Joe Pye Weed |
| *Eupatorium perfoliatum* | boneset |
| *Glyceria striata* | Fowl manna grass |
| *Hibiscus moscheutus* | Rose mallow |
| *Iris versicolor* | Blue flag |
| *Juncus canadensis* | Canada rush |
| *Juncus effusus* | Soft rush |
| *Leersia oryzoides* | Rice cutgrass |
| *Lobelia cardinalis* | Cardinal flower |
| *Lycopus americanus* | Water horehound |
| *Mimulus ringens* | Monkey flower |
| *Onoclea sensibilis* | Sensitive fern |
| *Polygonum arifolium* | halberdleaf tearthumb |
| *Scirpus cyperinus* | Woolgrass |
| *Sisyrinchium angustifolium* | Blue-eyed grass |
| *Spiraea tomentosa* | steeplebush |
| *Verbena hastata* | Blue vervain |
| **Shrubs** | |
| ***Genus/Species*** | ***Common Name*** |
| *Cephalanthus occidentalis* | buttonbush |
| *Cornus amomum* | Silky Dogwood |
| *Cornus sericea* | red osier dogwood |
| *Sambucus canadensis* | Common elderberry |

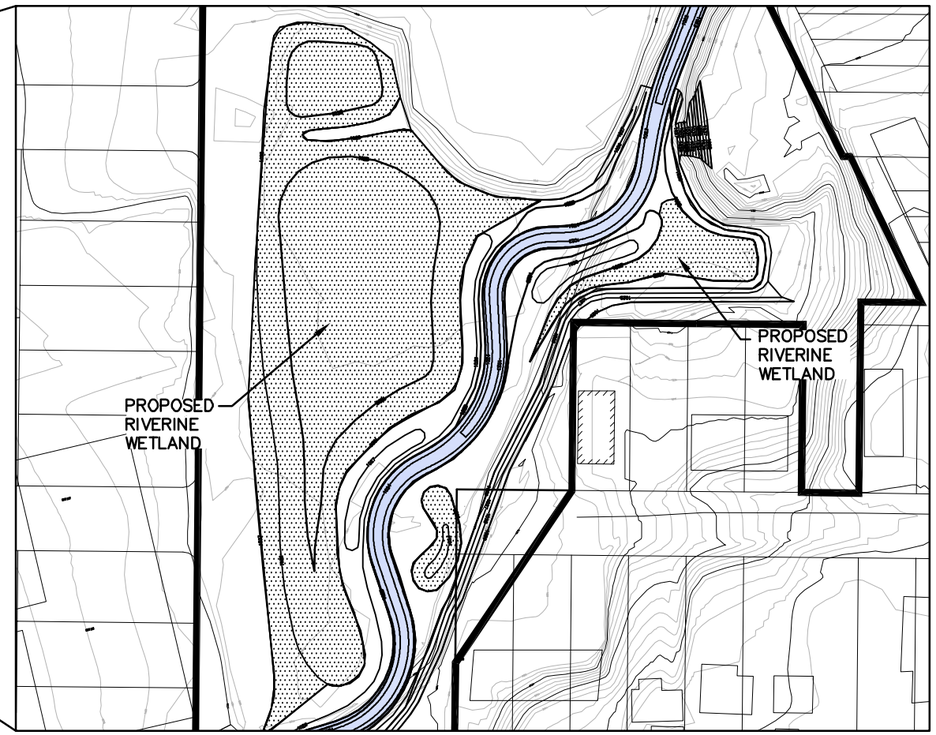
| Upland Areas | |
|---|---|
| **Herbs** | |
| ***Genus/Species*** | ***Common Name*** |
| *Aster dumosus* | Rice button aster |
| *Aster laevis* | Smooth blue aster |
| *Aster novae-angliae* | New England aster |
| *Elymus riparius* | Riverbank Wild Rye |
| *Elymus virginicus* | Virginia Wild Rye |
| *Schizachyrium scoparium* | little Bluestem |
| *Solidago altissima* | Tall goldenrod |
| *Sorghastrum nutans* | Indian grass |
| **Shrubs/Trees** | |
| *Acer saccharinum* | Silver maple |
| *Carpinus caroliniana* | American hornbeam |
| *Cornus racemosa* | Gray dogwood |
| *Liquidambar styraciflua* | Sweetgum |
| *Liriodendron tulipifera* | Tulip poplar |
| *Nyssa sylvatica* | Sour gum |
| *Quercus rubra* | Red oak |
| *Rhus glabra* | Smooth sumac |
| *Rhus typhina* | Staghorn sumac |
| **Area** | **Acres** |
| Floodplain/Riparian | |
| Emergent Wetland | |
| Upland | |
| **Total** | |



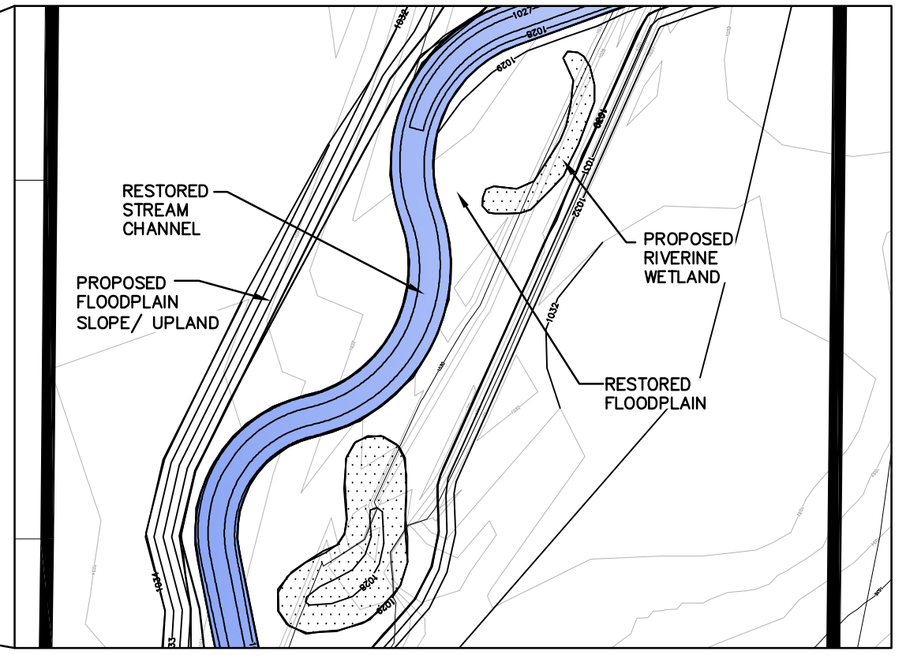

| | | | | |
|---|---|---|---|---|
| I | HALEY'S DITCH<br>RESTORATION PROJECT | FIGURE 1 – PROJECT AREA | CALCULATED –<br>CHECKED – | NOT TO SCALE<br>HORIZONTAL SCALE IN FEET |




## NORTH ZONE




## SOUTH ZONE



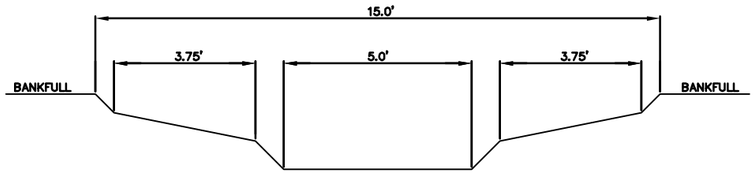

HORIZONTAL SCALE IN FEET

CALCULATED –
CHECKED –

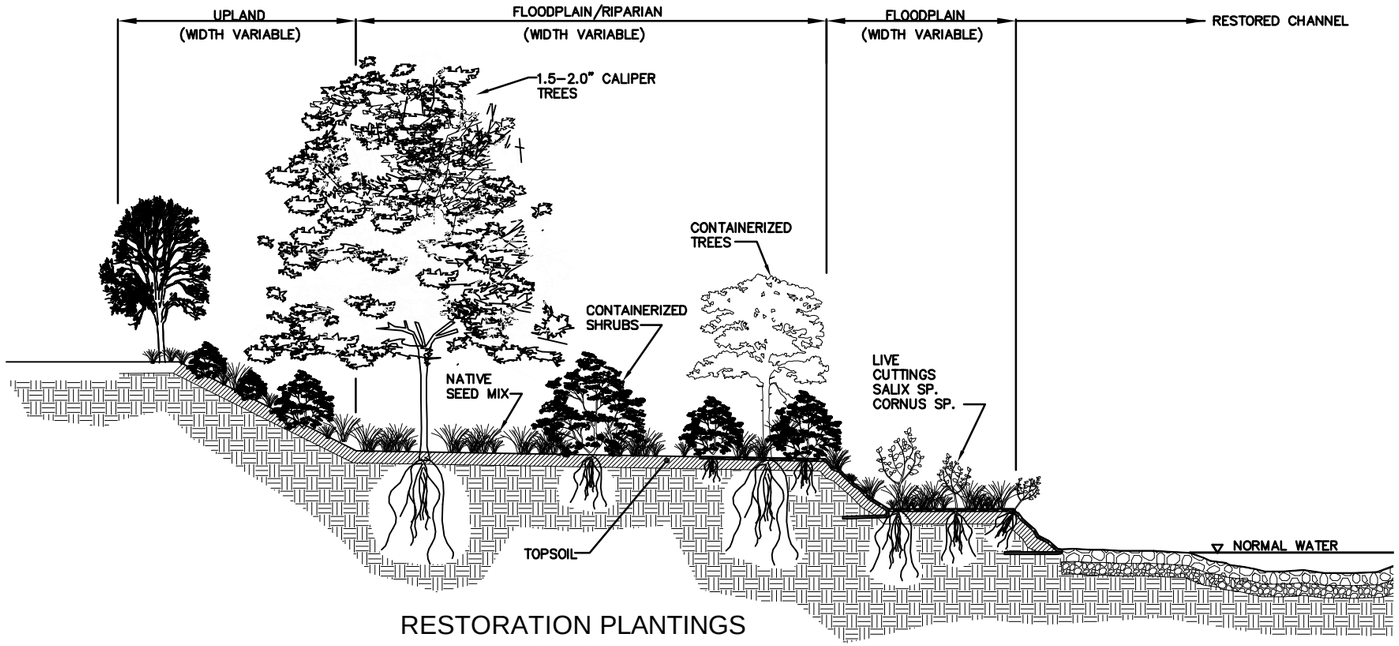
FIGURE 7 – RESTORATION PLAN

HALEY'S DITCH
RESTORATION PROJECT

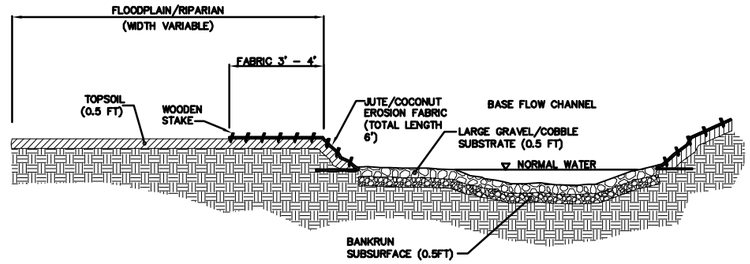
1



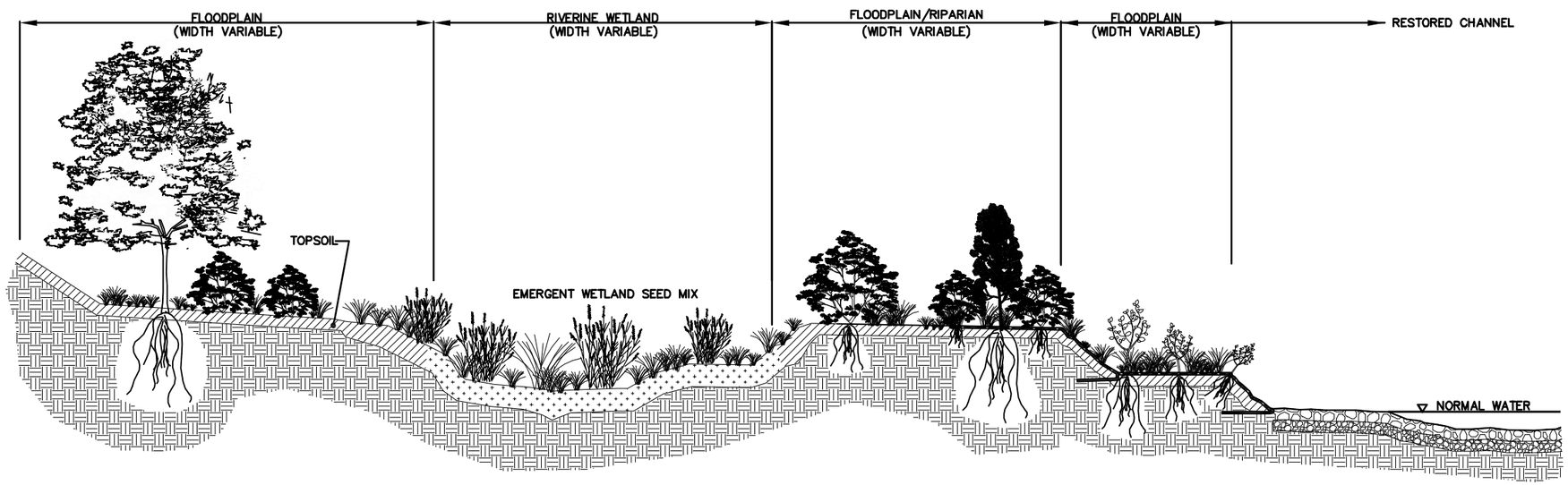

TYPICAL DESIGN SECTION
(N.T.S.)




RESTORATION PLANTINGS
(N.T.S.)




STREAMBANK AND
SUBSTRATE TYPICAL
(N.T.S.)




RIVERINE WETLANDS TYPICAL
(N.T.S.)

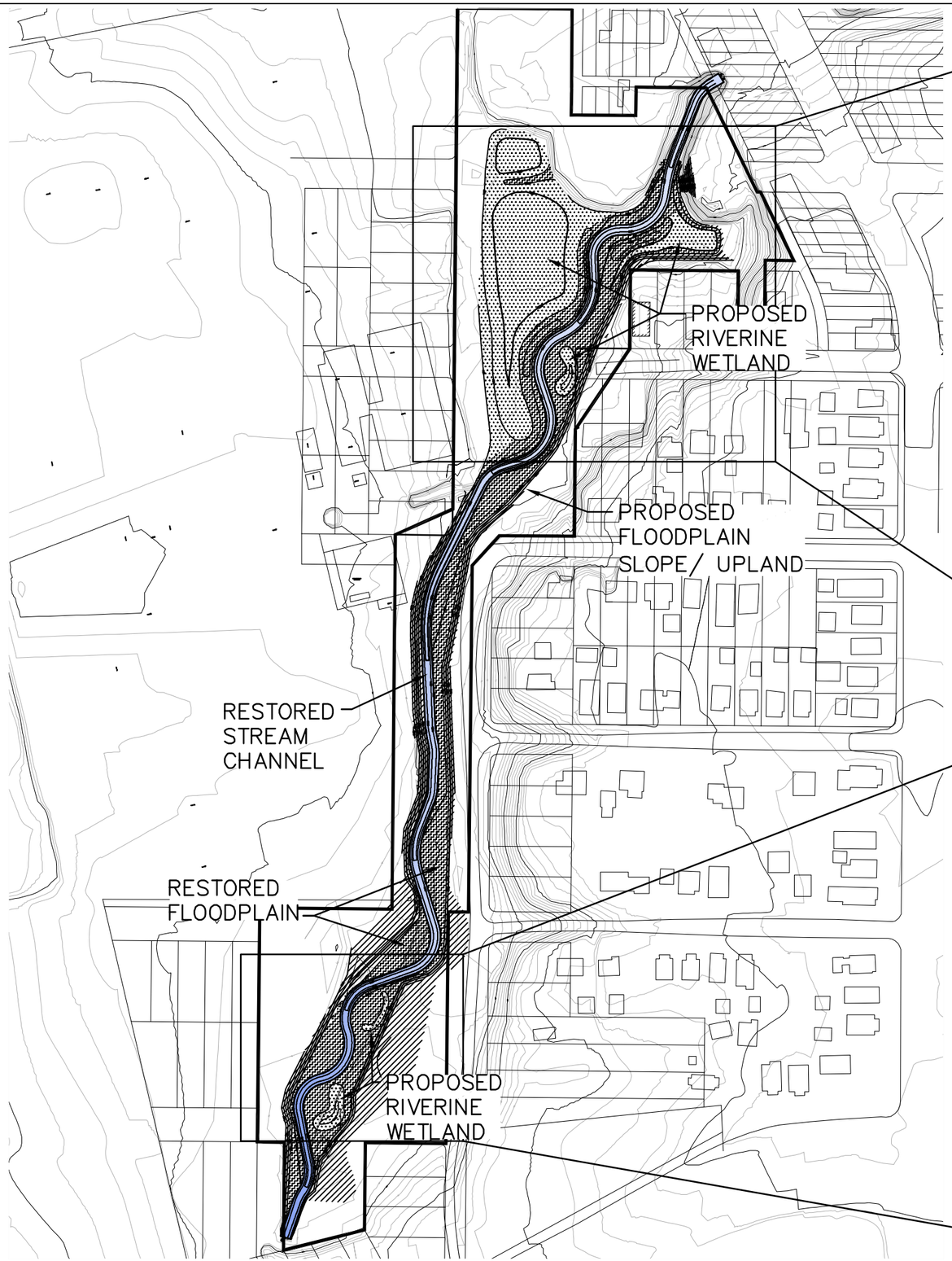
HORIZONTAL SCALE IN FEET

CALCULATED – CHECKED –

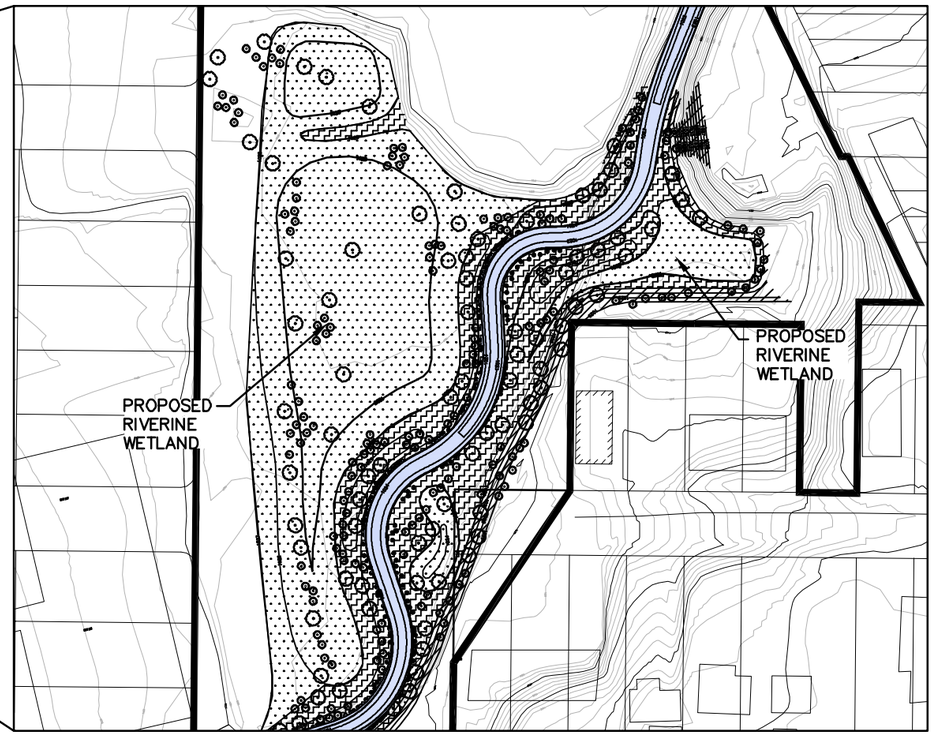
FIGURE 8 – TYPICAL SECTIONS

HALEY'S DITCH
RESTORATION PROJECT

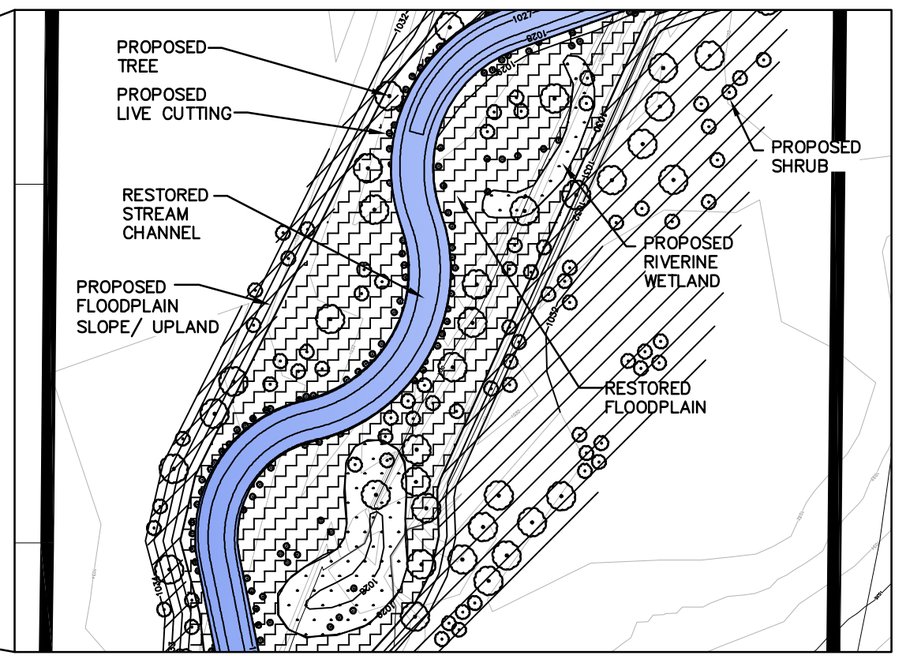
1




NORTH ZONE




SOUTH ZONE




HORIZONTAL SCALE IN FEET

CALCULATED –
CHECKED –

FIGURE 9 – RESTORATION PLANTINGS

HALEY'S DITCH
RESTORATION PROJECT

1