

Danvers Pond Dam Removal and Stream Restoration Project

Great Lakes Restoration Initiative Grant Final Report

US EPA Contract Number E-00639

December, 2012



Project Partners:



Working together, restoring the river

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DANVERS POND DAM REMOVAL AND STREAM RESTORATION PROJECT



EPA Contract Number: E-00639

Grantee: Alliance of Rouge Communities

Award Amount: \$499,254

Project Location: Danvers Pond
Farmington Hills, Oakland County, Michigan 48334
Latitude: 42.5 N
Longitude: 83.32 W

Stream: Pebble Creek of the Rouge River

Property Owner: City of Farmington Hills

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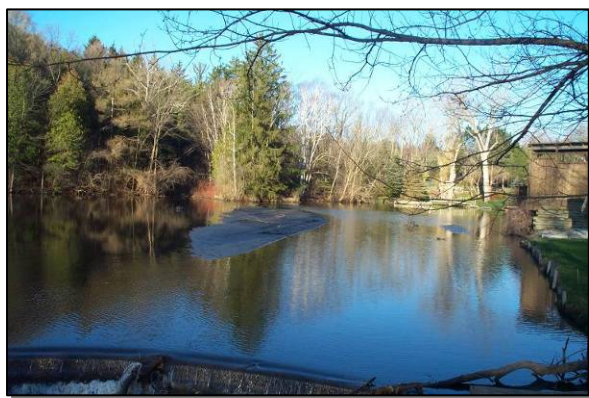
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1.0 INTRODUCTION

The Danvers Pond Dam Removal and Stream Restoration Project is located in Farmington Hills on the City owned property, on Pebble Creek, a tributary of the Main Rouge River. The project was funded by a Great Lakes Restoration Initiative (GLRI) Grant to the Alliance of Rouge Communities (ARC), in partnership with the City of Farmington Hills. This project consisted of the finalization of the design and construction contract documents, permitting, and construction of the Danvers Pond Dam removal, the construction of a naturalized water course and restoration of the floodplain.



Danvers Pond Dam prior to project implementation



Danvers Pond prior to project implementation

Prior to implementation of the project the dam acted as a barrier to fish passage as well as promoted the accumulation of sediment within the pond, which contributed to the degradation of the creek. The goals of the project were to create and improve habitat and increase water quality in the creek while making progress toward eliminating the Benthos and Fish and Wildlife Habitat Beneficial Use Impairments (BUIs) for the Rouge River Area of Concern (AOC). The project also aimed to fulfill local and sub-watershed goals by improving the quality of the



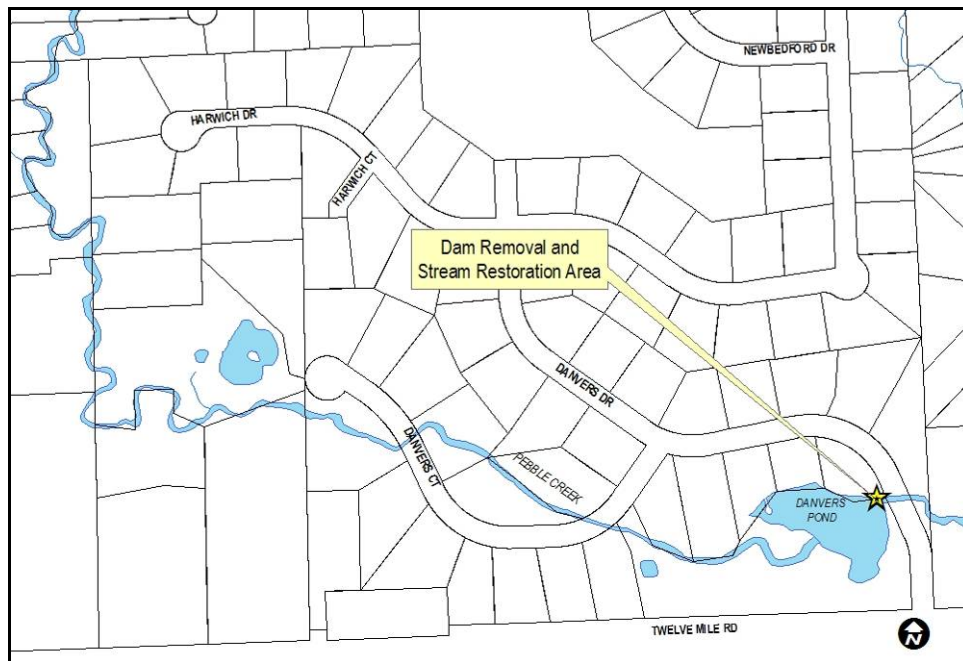
Restored Stream Channel

ecosystem and restoring approximately two acres of habitat for fish and terrestrial wildlife. With the removal of the dam, sedimentation within the creek has been reduced, two acres of woodland and wetland habitat were restored and preserved, and 283 linear feet of naturalized stream channel was created which improved habitat conditions for fish and wildlife using the Pebble Creek stream corridor. Additionally, the removal of the dam and the enhancements to Pebble Creek now allows unencumbered fish passage for Pebble Creek,

which is approximately 6.5 miles, and creates a natural buffer of native vegetation between developed private property and the stream corridor.

2.0 PROJECT BACKGROUND

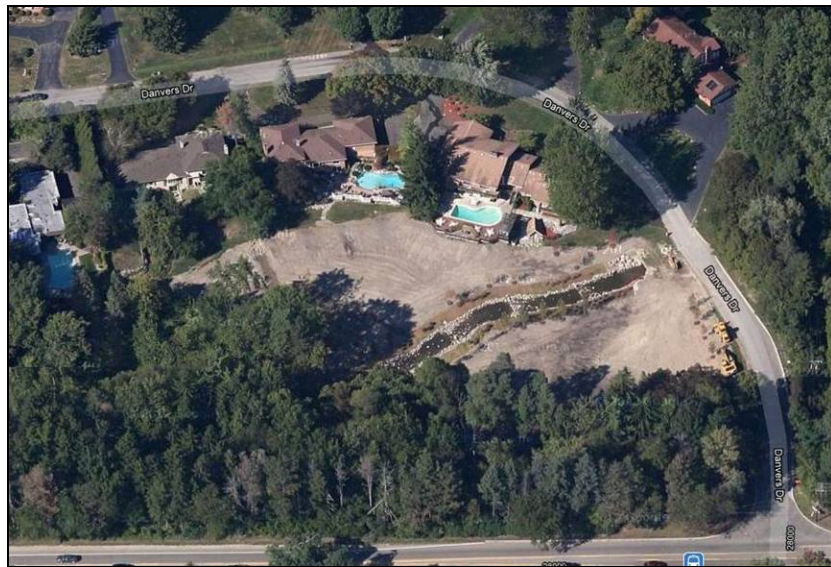
The project is located on Pebble Creek near Danvers Street in the Woodcreek Subdivision (Figure 1) of the City of Farmington Hills, Michigan. This portion is located in the Rouge River Main 1-2 Subwatershed. Prior to project implementation, the existing impoundment was in need of corrective measures to improve the water quality in Pebble Creek. The dam acted as a barrier to fish movement along the creek. Additionally, the dam was at risk of failure, which, if occurred, would have resulted in adverse impacts to downstream properties and ecosystems.



Project Location Map



Aerial of Project Vicinity Prior to Project Implementation



Aerial of Project Vicinity during Project Implementation

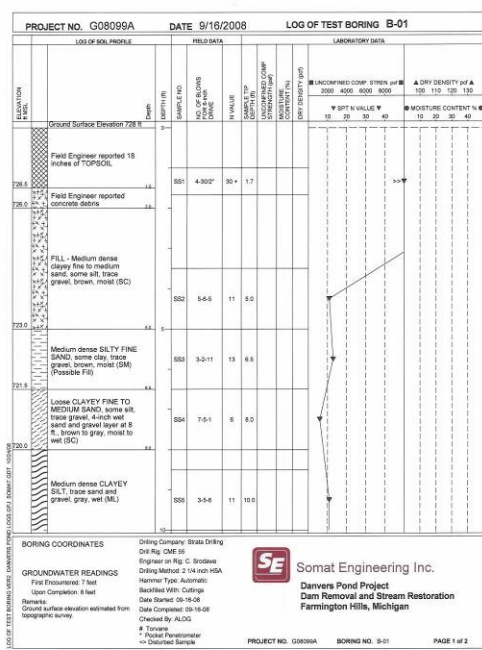
2.1 Initial Design

The initial design phase of the project, completed in 2008 prior to the GLRI award, focused on data collection, conceptual design, alternatives evaluation, and initial development of the chosen conceptual alternative. This work provided a basis for the development of the contract documents and permit application under the GLRI grant.

Existing Conditions

During the initial design phase in the late summer/ early fall of 2008, a site investigation was conducted which included a wetland delineation, tree survey, geotechnical investigation, topographic survey and a geomorphic assessment. The critical information obtained is as follows:

Wetland Delineation- One wetland was located and flagged adjacent to Pebble Creek on the western end of the pond.



Soil Boring Log

Tree Survey- Trees within the proposed project disturbance area with a DBH (Diameter at Breast Height) of 6 inches or larger were tagged and surveyed in accordance with the City's tree protection ordinance. The tree survey was used in preparing the contract documents.

Geotechnical Investigation- A total of two soil borings (near the existing dam and culvert structures) and eight hand auger probes (near the northern portion of the existing pond for a proposed berm) were conducted and samples were subjected to laboratory tests consisting of moisture content and hand penetrometer tests. The soil information was used during the design process and was also included in the Contract Documents.

Topographic Survey- A topographic survey of the property was conducted by a registered land surveyor. The spatial scope of the survey included the channel downstream of the dam, the channel immediately upstream of the dam, the impoundment, the dam, and lands immediately adjacent to the impoundment up to 50 feet beyond the property boundaries. The tagged trees and soil boring locations were also included in the survey. The topographic survey played a key role in the design of the project and the preparation of the contract documents.

Geomorphic Assessment- A geomorphic assessment was conducted to assess the geomorphology of Pebble Creek. A 500-foot reference reach upstream of Danvers Court was selected and various aspects of channel morphology were measured including the cross-

sectional area, streambed and water surface slope, pool depth, riffle slope and length, and meander bend radius of curvature. In addition, meander length, meander spacing, and floodplain widths were determined from aerial photographs. This assessment played an important role during the design of the restored stream channel.

Conceptual Design

Three elements of the proposed project were identified: Dam Removal, Stream Restoration, and Floodplain Restoration. With the data collection complete, design concept alternatives were evaluated and the chosen alternative was developed.

Dam Removal- During the site investigation the existing concrete and masonry structure was observed to be in disrepair and seepage and flow was observed at the dam, indicating deterioration and possible impending structural failure. The extent of dam removal was investigated and the initial concept alternative that was developed included the removal of the arch dam structure, wing walls and entire box culvert to the existing 84" x 120" corrugated metal pipe (CMP) culvert. In this concept, the earth fill outside the box culvert would be re-graded to a 1:3 (v:h) slope and stabilized with rip rap. The existing CMP culvert would be extended to a minimum of 12 feet in order to maintain the proposed 1:3 (v:h) slope from Danvers Road. The flow of Pebble Creek would then be restored through the existing CMP culvert. The existing culvert under Danvers Road would serve as downstream grade control for the restored stream channel.

Stream Restoration- Prior to project implementation, Pebble Creek was impounded upstream of the dam to Danvers Court. During the data collection phase of the project, it was determined that the streambed elevation at Danvers Court was 725.0 feet, while the top-of-dam elevation was 725.02 feet. This meant that removing the dam would cause the streambed of Pebble Creek upstream of the impoundment to erode downward through previously deposited sediments up to Danvers Court, unless the streambed elevation was controlled upstream of the dam and impoundment. If the streambed elevation was not controlled, bed erosion and incision between the impoundment and Danvers Court would cause instability in Pebble Creek, leading to streambank erosion, infrastructure damage, private property damage, and excessive sediment transport downstream of the dam. Therefore, the bed elevation of Pebble Creek was designed to be controlled just upstream of the impoundment at an elevation of 723.0 feet, providing some bed slope upstream of the impoundment to Danvers Court. Setting the elevation at 723.0 feet decreased the channel slope through the impoundment would create better sediment transport upstream of the impoundment.

The proposed streambed control elevation as described above would be one foot below the existing elevation. Therefore, some bed erosion was anticipated to occur upstream of the impoundment to Danvers Court. The maximum bed erosion depth was estimated to be one foot immediately upstream of the riffle. Erosion depth was anticipated to decrease linearly upstream to Danvers Court. This minor erosion depth was determined to have no impact on infrastructure or property upstream of the impoundment. The stream banks are well vegetated

and stable, streambank heights are low due to the elevated bed elevation, and stream energy was found to be relatively low. The anticipated bed erosion would help to decrease low-frequency flood elevations upstream of the impoundment slightly.

An artificial riffle was designed with a crest elevation of 723.0 feet to control the streambed elevation upstream of the impoundment at the control location described above. Artificial riffles have been widely used in urban streams to stabilize eroding streambeds and protect infrastructure. The artificial riffle was designed to be constructed with natural boulders and cobbles that were sized such that they are never transported. The riffle sill was designed to be trenched into the streambed and banks to the expected depth of scour. Artificial riffles were specified within the restored stream channel through the impoundment to control streambed gradient and to stabilize the streambed. Another benefit to the artificial riffles is that they have a natural appearance similar to that of natural riffles and provide habitat for macroinvertebrates and fish. Associated pools provide fish habitat and wading bird habitat.



Conceptual Rendering of Proposed Project

Due to the concern of erosion and private property damages upstream of the impoundment, the designed channel was is steeper through the former impoundment than that of the surveyed reference reach studied during the geomorphic assessment. Two alternative designs were evaluated for the new stream channel: a natural, deformable channel with vegetated banks and meandering riffle-pool morphology or a relatively straight, armored threshold channel. The natural, deformable channel would have unarmored

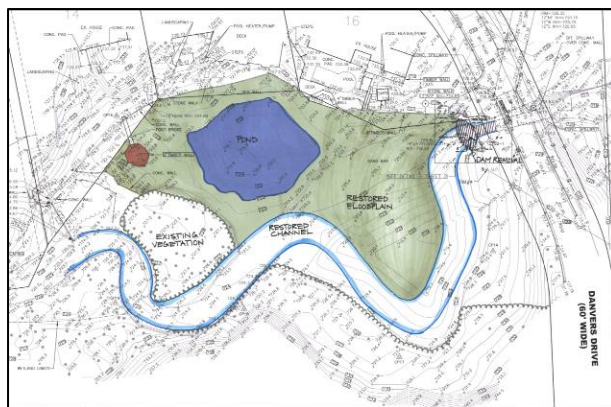
stream banks that are initially stabilized with erosion control blankets, but rely on vegetation alone for permanent, long-term stabilization. Given the disturbed watershed hydrology of Pebble Creek, the erosive nature of Pebble Creek upstream of Danvers Court would have most likely been replicated within the restored natural deformable channel. The only way to prevent future streambank erosion in the restored channel was to armor the streambanks with riprap. However, if such armoring was deemed necessary or desirable, then it would have been more prudent to pursue the armored threshold channel option. On a per-lineal-foot basis, the armored threshold channel is cheaper to construct than the natural meandering channel with bank armoring. The natural meandering stream would have had an approximate length of 400 feet, while the armored threshold channel would have had an approximate length of 250 feet. The estimated preliminary cost was the same for each option, primarily due to the difference in length of the two channels. Therefore, the armored threshold channel was chosen to be the desired alternative.

Constructed riffles were designed to provide energy dissipation, control stream bed elevation throughout the armored threshold channel, and create aquatic habitat. Along with channel

restoration, the former impoundment bottom lands were designed to be restored as floodplain connected to the stream channel so that flood flows could be dissipated and stored temporarily. Allowing flood flows to overtop the streambanks of the restored channel and onto the restored floodplain would create a more stable channel.

Floodplain Restoration- In addition to the stream restoration, the remaining impoundment area needed to be restored. It would be converted to a vegetated floodplain once the dam was removed. All of the existing sediment would be re-graded within the confines of the former impoundment area. During the initial concept development, soil balancing calculations allowed for two small, shallow depressions to remain within the restored floodplain where the two deeper basins originally existed. These depressions were intended to be shallow wetland habitats within the restored floodplain area. Additionally, the results from the soil balancing calculations at that time allowed for fill and topsoil to be imported and used to grade the former impoundment and restored floodplain. The remaining floodplain area was to be vegetated with a wet-meadow seed mix containing native grasses and flowering forbs. Trees and shrubs were proposed along both sides of the restored stream channel to help stabilize the new streambanks. An objective of the chosen design concept was for the restored floodplain to require minimal maintenance once the vegetation was established.

Three storm sewer outfalls discharge to Pebble Creek within the project area: two in the northwest corner of the impoundment and one to the stream channel approximately 225 feet upstream of the impoundment. The invert elevation of the outfall located upstream of the impoundment is 724.0 feet; therefore, there was a concern that it could be impacted by bed erosion upstream of the artificial riffle. The initial design provided that the upstream outfall be protected with riprap that would be trenched into the streambed to the depth of expected scour to protect the outfall from undermining. Riprap aprons were designed to be installed downstream of the other two outfalls that discharge to the impoundment area to dissipate energy and prevent erosion. Due to soil balancing during initial design, a small open water wetland area was proposed in the northwest corner of the impoundment. Open channels were proposed between the two outfalls and the open water wetland area. A third channel was



Conceptual Plan of Pond Alternative

proposed between the open water wetland area and the restored stream channel. These three storm water conveyance channels were intended to be self-maintaining natural features stabilized with riprap and shrubs.

Pond Establishment Alternative- During initial design, ECT investigated whether or not a viable pond could remain or could be created once the dam is removed and Pebble Creek has been restored, as the existing impoundment would no longer exist. Estimating the actual elevation of the water

table underlying the northwest corner of the impoundment after dam removal was highly uncertain given the amount of data available. The available data from the soil investigation and topographical survey was examined and hydrological conditions were studied.

The existing soil and hydraulic conditions significantly limited the ability to create a pond north of the proposed channel. The pond size would be limited by the volume of material to be excavated and the associated dollar cost. Other limitations to pond size include constructability and protection of existing slopes and structures. Periodic maintenance requirements of the proposed pond would include algae and weed control. Some sedimentation would also occur when Pebble Creek floods into the pond, resulting in the need for future periodic dredging. The frequency would depend on the frequency of flood events over time. The creation of a pond was determined not to be a viable option.

The initial design was completed in 2008 with the preparation of initial design plans.

3.0 PROJECT IMPLEMENTATION

In September of 2010, a Great Lakes Restoration Initiative grant was awarded to the Alliance of Rouge Communities (ARC) for completion of the contract Documents, permitting, and implementation. The following work was identified to be completed under the grant:

- *Dam Demolition- The proposed dam demolition consists of the removal of the arch dam structure, wing walls and entire box culvert to the existing 84" x 120" corrugated metal pipe (CMP) culvert. The earth fill outside the box culvert will be re-graded to a 1:3 (v:h) slope and stabilized with rip rap. The existing CMP culvert will be extended to a minimum of 12 feet in order to maintain the proposed 1:3 (v:h) slope from Danvers Drive. The flow of Pebble Creek will then be restored through the existing CMP culvert. The existing culvert under Danvers Road will serve as downstream grade control for the restored stream channel.*
- *Stream Restoration/Stabilization- An artificial riffle will be constructed to control the streambed elevation upstream of the impoundment. It will be constructed with natural boulders and cobbles that are sized such that they are stable and never transported downstream. The riffle sill will be trenched into the streambed and banks to the expected depth of scour. Constructed riffles will be used to dissipate energy and control the stream bed elevation in the restored channel. The design will include restoration of Pebble Creek through the pond after drawdown and dam removal, including active restoration of pattern, profile, and dimension, stream habitat, and an active vegetated floodplain with expected terrestrial wildlife value.*
- *Floodplain Restoration- The bottom lands exposed after draw down of the pond will be restored as a natural functioning floodplain capable of conveying and storing water during floods with native forbs, shrubs, and trees similar to wet-meadow communities along streams. Floodplain restoration also creates a natural vegetated buffer and wildlife habitat along the restored stream corridor.*

The following provides a summary of the grant activities, by task:

3.1 Permit Submittal

In order to submit the permit application to the Michigan Department of Environmental Quality (MDEQ), design modification and finalization was required. Based on available aerial photographs for the site, and visual observations of the site, it was evident that a substantial amount of sediment had accumulated within the existing impoundment since the time of the original topographical survey. (See aerials below.) Therefore, updated topographical information was obtained and the proposed floodplain grading was revised accordingly. The revised design plans were submitted to the City of Farmington Hills in November of 2010 for their review and comment. In December of 2010, the MDEQ/ USACE joint permit application

was submitted. After review, public comment, and a public hearing, the permit was issued in September, 2011.



Aerial of Project Vicinity- 2006



Aerial of Project Vicinity- 2008



Aerial of Project Vicinity- 2010

3.2 Bidding and Contractor Selection

The ARC entered into an Inter Agency Agreement (IAA) with the City of Farmington Hills (one of its members) to contract for the construction activities associated with the implementation.

After receipt of the State of Michigan permit, ECT worked with Farmington Hills (the City) to finalize the contract documents. Also during this time there was a major effort in keeping the residents of the adjacent Woodcreek neighborhood informed of the proposed project. Several meetings were held to answer their questions and discuss their concerns. With input from the City and its residents, all details and specifications were finalized for the dam removal, stream restoration, and floodplain restoration. This included the dewatering plan that contained the details and specifications for the construction of a temporary cofferdam and bypass flume. The temporary cofferdam was proposed at the upstream end of the impoundment. The bypass flume, a 36" diameter HDPE pipe was proposed from the cofferdam to the box culvert at Danvers Drive. The cofferdam and bypass flume would allow flow to pass through the construction site in a controlled manner for the duration of the construction work. The construction documents are included in the Appendix.

The project was released for bidding on March 9, 2012, with a mandatory pre-bid conference on March 22, 2012. Bids were due on April 10, 2012. After bids were received, a bid tab was developed and reviewed and the lowest bidder's references were checked. ECT then issued a contractor recommendation letter to the City. On April 23, 2012, the Farmington Hills City Council approved awarding the construction contract to Anglin Civil. The bid tab and Measurement and Payment section of the Contract Documents are included in the Appendix.

NO.	ITEM	QTY	UNIT	UNIT PRICE	AMOUNT
1.	Mobilization	1	LS	\$	\$
2.	Construction Staking	1	LS	\$	\$
3.	Traffic Control	1	LS	\$	\$
4.	Audiovisual Tape Recording	1	LS	\$	\$
5.	Soil Erosion and Sediment Control	1	LS	\$	\$
6.	Construction Fence	1300	LF	\$	\$
7.	Tree Protection	1	LS	\$	\$
8.	Clearing, Grubbing	0.3	ACRE	\$	\$
9.	Tree Removal	9	EA	\$	\$
10.	Bypass Pipe Demolition	1	LS	\$	\$
11.	Foot Bridge Demolition	15	LF	\$	\$
12.	Dam Demolition	1	LS	\$	\$
13.	General Demolition	20	TONS	\$	\$
14.	Sheet Pile Retaining Wall	95	LF	\$	\$
15.	Channel Bypass and Dewatering	1	LS	\$	\$
16.	Excavation	1	LS	\$	\$
17.	Grading	1	LS	\$	\$
18.	Clean Sand Cap (9 inches)	1,100	CY	\$	\$
19.	Riffle-Pool Construction	5	EA	\$	\$
20.	Stormwater Conveyance Channel	190	LF	\$	\$
21.	New Channel Streambank Construction	620	LF	\$	\$
22.	Topsoil Placement	600	CY	\$	\$
23.	Erosion Control Blankets	3,000	SY	\$	\$
24.	Seeding	1.5	AC	\$	\$
25.	Replacement Tree Installation	50	EA	\$	\$
26.	Potted Shrub Installation	70	EA	\$	\$
27.	Live Stake Installation	10,000	SF	\$	\$
28.	Vegetation Maintenance	6	MONTHS	\$	\$
29.	Site Restoration	1	LS	\$	\$
30.	As-Built Survey and Drawings	1	LS	\$	\$
ALLOWANCES					
31.	Owner Ordered Testing	1	LS	\$5,000.00	\$5,000.00
32.	Post-Construction In-stream adjustments	1	LS	\$10,000.00	\$10,000.00
33.	SESC Routine Inspections	1	LS	\$3,000.00	\$3,000.00
34.	Unforeseen Conditions	1	LS	\$20,000.00	\$20,000.00
TOTAL ITEMIZED BID (Items 1-34):					
ALTERNATE A1					
The following Bid Alternate may be added to the base bid dependent of project funds:					
NO.	ITEM	QTY	UNIT	UNIT PRICE	TOTAL
A1.	Culvert Restoration	1	LS	\$	\$

Bid Form

It should be noted here that the box culvert removal and corrugated metal pipe extension were included in the bid documents as an alternate. Based on costs estimates conducted before bidding, it was decided that this could be an expensive line item, which could result in bids exceeding the grant award amount. The base bid included a partial removal of the dam, which would still achieve project goals. After bids were received, the alternate was not chosen and the box culvert was not removed, due to cost.

Another item that should be noted is that when the project was bid it was contained on the floodplain property owned by the City of Farmington Hills though the floodplain in the area of the project extended onto adjacent private property. As a result, a sheet pile retaining wall was proposed along the north side of the dam and the bid item “Sheet Pile Retaining Wall” was included for this purpose. The City worked with the adjacent private property owners to gain their participation in the project by allowing for grading and restoration of the floodplain areas located on their property. This provided a cost savings by eliminating the need for the sheet pile retaining wall and the ecological benefit of being able to restore the entire floodplain.

3.3 Construction and Construction Oversight

The pre-construction meeting was held on May 30, 2012. The contractor began to mobilize on May 31, 2012. Shortly after mobilization the construction fencing and soil erosion and sediment controls were installed. The work construction and construction oversight proceeded as follows:

June, 2012- The existing bypass valve was found and opened and the impoundment water level was lowered. During design, the existing bypass valve was known to be in place, but its functionality was unknown. After the water was lowered, the existing island and deposited sediments upstream of the dam within the center of the impoundment acted as a barrier, separating the north half of the pond from the south half. The active flow of the stream continued through the north half of the pond and over the north end of the dam. Efforts were then concentrated on dewatering low-lying areas in the south half of the pond. The contractor used a well point to help with the dewatering of the sediments on the south side of the pond.



Existing bypass valve opened



Flow through north side of pond and over dam



Well point installed to help with dewatering

Concurrent with dewatering efforts, tree removal and clearing were conducted.



Clearing, view from across Danvers Drive, looking west



Clearing, view looking west

With the south half of the impoundment sufficiently dewatered, the cofferdam sheet pile was installed and bypass flume pipe was laid. The dam was the notched to allow for placement of the bypass flume.



Cofferdam and connected bypass flume



Bypass flume, view looking northwest



Notching at the dam for installation of bypass flume



Water flowing through the bypass flume

With the bypass flume in place and functioning, the rest of the dam demolition took place.



Dam spillway removed

The rest of the impoundment was allowed to dry out and site grading began.



Grading for proposed channel



Grading at north side of pond

July, 2012- Late July 4/ early July 5 an intense rain event occurred at the project site. The river flow rose considerably, the bypass flume was plugged with logs and debris and the river flowed through the site temporarily.



Water flow through site

Once onsite, the contractor isolated the flow using sandbags and started pumping from upstream of the cofferdam across the site and into the culvert at Danvers Drive. Additional sheet piling was installed at both ends of the cofferdam and the banks were restored.



Sand bags at the downstream end of the site, just upstream from the culvert



Upstream side of cofferdam, note pumping



Installation of additional sheet piles at north end of cofferdam

Due to this short duration, high intensity storm event, the contractor installed a temporary emergency overflow plastic lined channel and notched the top of the sheet pile cofferdam. The purpose of this channel was to receive any flow that overtops the cofferdam after the bypass flume is at capacity and/or plugged. Once the site was cleaned up, site grading resumed.



Temporary overflow channel



Temporary overflow channel

And site grading continued.



Site Grading at the north side of the site

As site grading continued and drying out of sediments progressed, it became apparent that the soils were consolidating and the amount of soil to be hauled off site would be less than expected. Additionally, the existing soils were observed to be rich in organics and the need for topsoil was re-evaluated. Based on this information, adjustments were made to the grading plan. Proposed topography was adjusted near the outer boundaries of the project site, to “waste” some of the existing sediment, while topsoil was eliminated from the proposed project.

August, 2012- Channel construction began in early August at riffle/pool 5 at the downstream end of the proposed stream channel. The channel was constructed from downstream to upstream and continued through most of the month of August. An access drive was maintained over riffle/ pool 2 during stream channel construction. When grading was complete on the north side of the stream channel, riffle/pool 2 was constructed. Once most of the stream channel was constructed, the stream banks were constructed by wrapping erosion control blanket behind the rock at the streambank and extending it back 10 feet from the stream channel. The bypass flume was removed, the sheet pile cofferdam was driven to final elevation and water was allowed to enter the newly constructed stream channel.



Rock placed for riffle/pool 5 and 4



Stream channel, view looking upstream (west)



Work at riffle/pool 2, view looking east, note stream bank constructed north bank

Boulders were placed near the existing walls near the culvert. Also during August rock was placed at each of the storm sewer outfalls located at the north side of the site.



Boulders at the north bank at the culvert



Rock at the north storm sewer outfall



Rock at the northwest storm sewer outfall

September, 2012- Planting began on September 6. The plant locations were staked and planting began.



Plant locations staked



Planting



Planting



Planting

Seeding occurred on September 18, 2012.



Straw mat over seed



Seed on ground

A walk through was conducted at the project site on September 26, 2012.



Completed Stream Channel

Though, substantially complete in September, miscellaneous restoration tasks were completed throughout the month of October and November, 2012.

As indicated above, the initial design included the removal of the existing concrete box culvert at Danvers Drive just downstream of the spillway. Due to cost concerns (available grant funding), this was not included in the construction cost. Therefore, the arch spillway portion of the dam was the only part of the dam that was removed and the wing walls remained. During construction and the changes that were made to the grading plan, the need for additional rock or boulders was evident near the existing wing walls at the culvert near Danvers Drive.



Shotcrete (Gunite) work

Therefore, additional boulders were placed to stabilize the slopes and the wing walls near the culvert. Additionally, due to changes in resident participation, as well as the contractor's efficiency, there was some budget remaining toward the end of the project and available for some treatment at the wing walls. Removal of the box culvert was not feasible at that point as the stream channel was already in place. So it was decided to face the wing walls with shotcrete (Gunite) to provide some

structural integrity. In October, 2012, the contractor returned to the site to complete this work. The face was molded to have a boulder like appearance and blend in the boulders next to the wing walls. This added both a structural and aesthetic value to the project.

3.4 Grant Administration and Closeout

Throughout the project, the ARC completed status reports and other documentation required by the agency. This document is the final report and was completed under this task.

4.0 PROJECT RESULTS

4.1 Results

The primary goal of this project was to improve the habitat and water quality of Pebble Creek and its receiving waters and support the delisting of the AOC's Benthos and Fish and Wildlife Habitat BUIs. This was accomplished by, removing the existing dam, restoring the naturalized stream channel and restoring the vegetative floodplain. The projected outputs were:

- Two acres of woodlands and wetlands habitat restored and preserved
- 300 linear feet of channel will be enhanced
- 6.5 miles of stream will be opened up for fish passage.

The entire extent of the floodplain within the project limits was restored and was measured at project completion to be 1.7 acres. This, in conjunction with the adjacent woodland transition area which was preserved as part of the project provided a total of two acres of habitat restored and preserved as a result of this project.

The 300 linear feet projected at the start of the project was an estimate based on existing data at that time. The length of channel that was enhanced as a result of this project was measured to be 283 linear feet at project completion.

In addition to the restored and preserved habitat and enhanced stream channel, 6.5 miles of stream was opened up for fish passage as a result of this project.

Aside from the project outputs, the implementation of the Danvers Dam Removal and Stream Restoration Project provided an outcome of making progress toward eliminating the Benthos and Fish and Wildlife BUIs for the AOC.

The project also fulfilled local and subwatershed goals by improving the quality of the ecosystem and restoring habitat for fish and terrestrial wildlife. This project also fulfilled the following Rouge River Main 1-2 Subwatershed objectives: (1) Minimize the amount of soil erosion and sedimentation; (2) Improve and maintain the river ecosystem for wildlife, and (3) Restore/maintain aesthetically appealing conditions.

Habitat restoration is identified as an action the City of Farmington Hills would like to take in the Main 1-2 Subwatershed Management Plan (pp. 5-4 & 5-5). Additionally, by removing an impediment to fish and aquatic life and the natural flow of the creek fulfills a goal of the City of Farmington Hills Storm Water Pollution Prevention Initiative (SWPPI) by protecting the designated uses of receiving waters from the effects commonly associated with urbanization.

4.2 Measuring Results

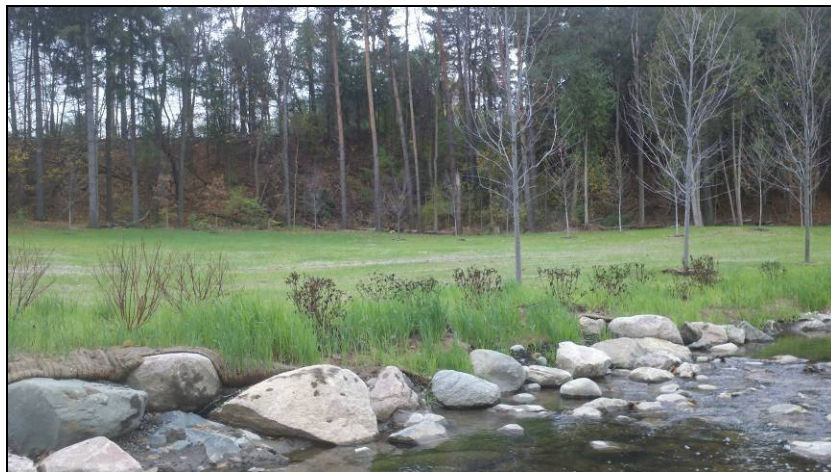
The measurement of progress as it relates to the project outputs was based on successful completion of the construction project. As discussed above, the project outputs were:

- Two acres of woodland and wetland habitat was restored and preserved
- 283 linear feet of channel will be enhanced
- 6.5 miles of stream will be opened up for fish passage.

After construction the project was periodically visited and vegetation establishment and wildlife usage was noted.

Vegetation Establishment

By mid- October, the cover crop (wild seed oats) was growing fairly consistently throughout the restored floodplain area. Living native trees, shrubs, and live stakes were planted by November 15, 2012, after the 2012 growing season. At completion of construction, the site was completely vegetated with native trees, shrubs, grasses, and forbs. All planted vegetation will continue to be monitored throughout the warranty period, which will end in the fall of 2013.



Restored floodplain south of the restored stream channel



Restored project site

Wildlife Usage

After project completion, and even during construction, wildlife usage of the project site was evident. Whitetail deer and great blue herons have been observed. Small mammal tracks have been observed. Small fish and crayfish have been observed in the pools. Wildlife usage will increase as the floodplain vegetation grows and matures. The following photographs of whitetail deer and a great blue heron document some of the wildlife use observed.

- Deer- Deer were observed at the site. Tree damage due to deer activity was observed. (See photos below.) Also, deer droppings and deer tracks were observed at multiple locations throughout the site.



Deer at the project site



Damage to Maple Tree due to Deer Activity

- Great Blue Heron - Great blue herons were observed wading in pools on multiple occasions.



Great Blue Heron at the project site

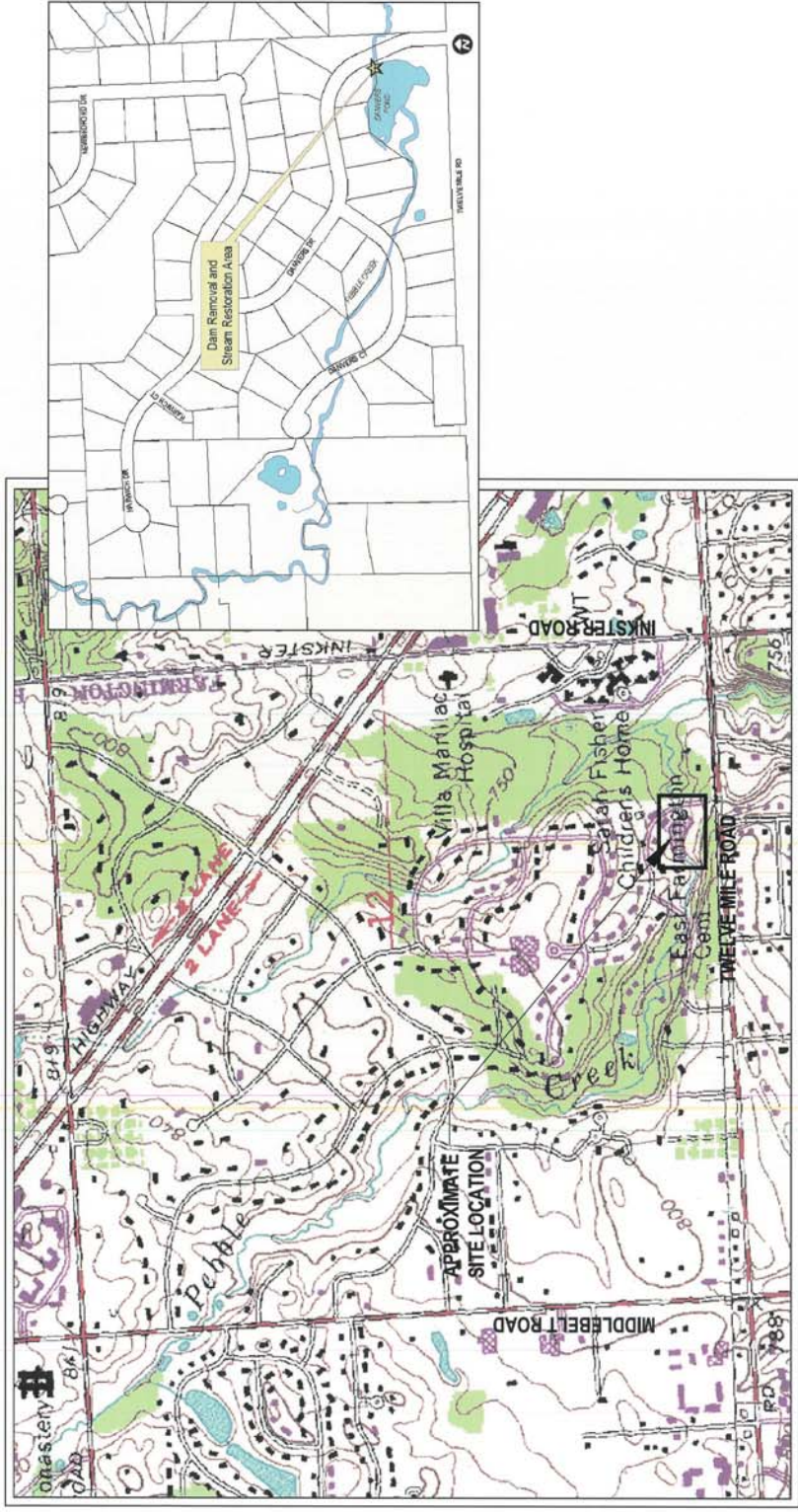
APPENDIX A: CONSTRUCTION DRAWINGS

DANVERS POND DAM REMOVAL AND STREAM RESTORATION

FOR BID - MARCH 2012



CITY OF FARMINGTON HILLS, MICHIGAN



LOCATION MAP

NOT TO SCALE

PROJECT DESIGN TEAM



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DRAWING INDEX

- 1A. EXISTING CONDITIONS POND
- 1B. EXISTING CONDITIONS AND TREE INVENTORY
- 1C. SITE PREPARATION, CLEARING AND GENERAL DEMOLITION PLAN
- 2A. EXISTING DAM CONDITIONS
- 2B. DAM DEMOLITION PLAN
- 2C. CHANNEL BYPASS AND DEWATERING PLAN
- 3A. ROUGH GRADING PLAN
- 3B. FINAL SITE GRADING & CHANNEL RESTORATION
- 3C. RIFFLE/POOL GRADING DETAILS
- 3D. RIFFLE/POOL DETAILS
- 3E. CHANNEL CROSS-SECTIONS AND PROFILES
- 3F. MISCELLANEOUS DETAILS
- 4A. REVEGETATION PLAN
- HISTORIC PLAN
- ALT-1, ALT. 1: CULVERT RESTORATION PLAN



**DANVERS POND
DAM REMOVAL
AND
STREAM
RESTORATION**

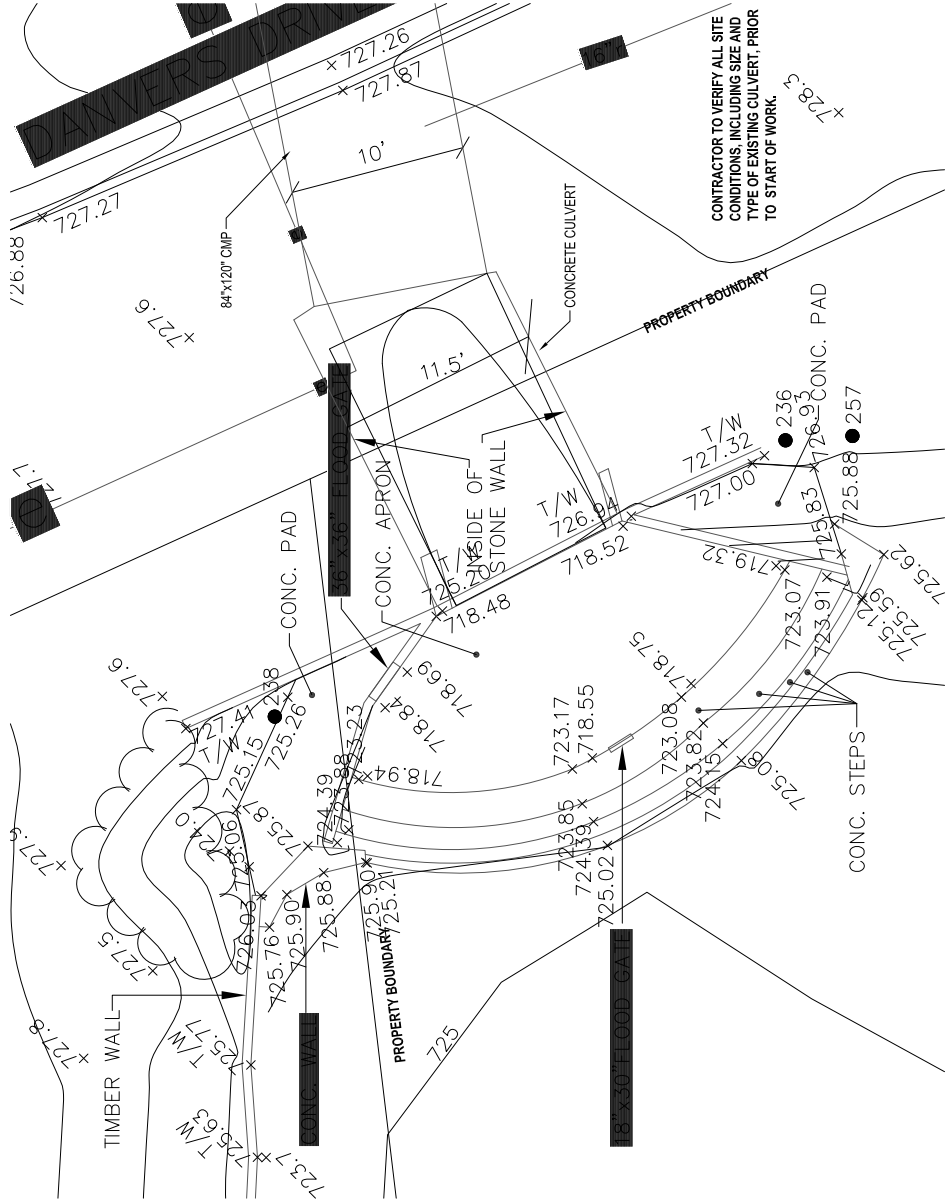
**CITY OF
FARMINGTON HILLS**

	03-2012
FOR BID	03-18-11
REVISED PER CITY'S COMMENTS	12-01-10
PERMIT APPLICATION	12-19-08
CLIENT REVIEW	

ECT PROJECT NUMBER	
MB	MB
DESIGNED BY	CHECKED BY
TH	MB
DRAWN BY	APPROVED BY

SHEET NAME	EXISTING CONDITIONS AND TREE INVENTORY	SCALE: AS SHOWN	NORTH	1B
				

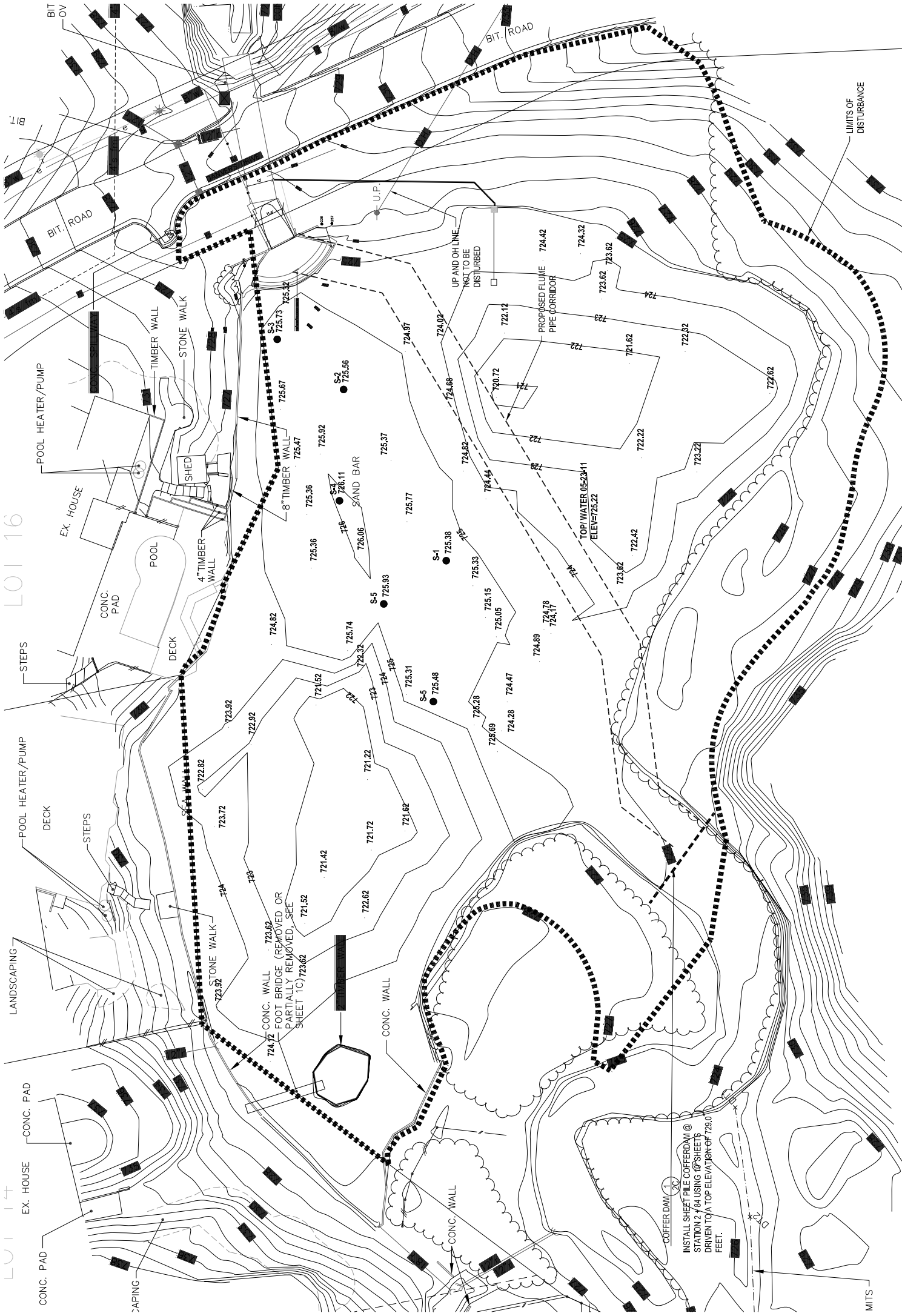
Tag #	Scientific Name	Common Name	DBH (%)	Condition	Canopy Dom. (ft.)	158	Thupa deliquentia	Yellow birch	6	9	7	15	
1	Populus deltoides	Eastern cottonwood	23	Poor	30	159	Thupa deliquentia	American elm	Northern white-cedar	10	10	Poor	20
2	Thuja occidentalis	Eastern white-cedar	10	Good	15	160	Thuja occidentalis	American elm	American elm	23	Good	30	10
3	Juniperus virginiana	Eastern redcedar	10	Fair	15	161	Platanus occidentalis	Sycamore	American elm	23	Good	30	10
4	Mauia spp.	Ornamental crabapple	8	Poor	10	162	Picea abies	Norway spruce	Norway spruce	14	Poor	15	15
5	Sorbus aucuparia	European mountainash	6	Fair	8	163	Pinus nigra	Black pine	Black pine	18	Poor	20	20
6	Thuja occidentalis	Eastern white-cedar	10	Good	15	164	Thuja occidentalis	American elm	American elm	17	Good	30	10
7	Mauia abba	White mulberry	9	Good	30	165	Prunus pennsylvanica	Red ash	Red ash	13	Fair	20	20
8	Platanus occidentalis	Sycamore	31	Good	50	166	Ulmus americana	American elm	American elm	16	Fair	20	20
9	Ulmus americana	American elm	15	Fair	20	167	Betula papyrifera	Paper birch	Paper birch	10	Fair	20	20
10	Ulmus americana	American elm	15	Good	30	168	Betula papyrifera	Paper birch	Paper birch	10	Fair	20	20
11	Mauia abba	White mulberry	15	Good	30	169	Ulmus americana	American elm	American elm	10	Fair	20	20
12	Ulmus americana	American elm	7	Fair	25	170	Populus deltoides	Eastern cottonwood	Eastern cottonwood	24	Fair	30	30
13	Ulmus americana	American elm	17	Fair	35	171	Populus deltoides	American elm	American elm	14	Good	30	30
14	Populus deltoides	Eastern cottonwood	17	Fair	35	172	Ulmus americana	American elm	American elm	16	Good	30	30
15	Salix nigra	Black willow	15	Poor	20	173	Ulmus americana	American elm	American elm	12	Good	30	30
16	Ulmus americana	American elm	9	Fair	20	174	Ulmus americana	American elm	American elm	12	Good	30	30
17	Ulmus americana	American elm	17	Fair	35	175	Ulmus americana	American elm	American elm	12	Good	30	30
18	Populus deltoides	Eastern cottonwood	14	Good	30	176	Populus deltoides	Eastern cottonwood	Eastern cottonwood	13	Fair	20	20
19	Populus deltoides	Eastern cottonwood	21	Good	45	177	Picea spp.	Unknown spruce	Unknown spruce	11	Good	30	30
20	Ulmus americana	American elm	15	Good	30	178	Betula papyrifera	Paper birch	Paper birch	10	Fair	20	20
21	Ulmus americana	American elm	15	Good	30	179	Ulmus americana	American elm	American elm	11	Fair	20	20
22	Mauia abba	White mulberry	7	Good	20	180	Tilia americana	Red ash	Red ash	11	Fair	20	20
23	Mauia abba	White mulberry	10,11	Poor	20	181	Ulmus americana	American elm	American elm	11	Fair	20	20
24	Ulmus americana	American elm	10,11	Good	30	182	Betula papyrifera	Paper birch	Paper birch	12, 13, 10	Good	30	30
25	Ulmus americana	American elm	10,11	Good	30	183	Betula papyrifera	Paper birch	Paper birch	12, 13, 10	Good	30	30
26	Populus deltoides	Eastern cottonwood	17	Good	45	184	Betula papyrifera	Paper birch	Paper birch	12, 13, 10	Good	30	30
27	Populus deltoides	Eastern cottonwood	17	Fair	30	185	Picea abies	Norway spruce	Norway spruce	24, 6	Fair	30	30
28	Ulmus americana	American elm	19	Good	30	186	Ulmus americana	American elm	American elm	10	Fair	20	20
29	Ulmus americana	American elm	19	Poor	25	187	Ulmus americana	American elm	American elm	10	Poor	15	15
30	Populus deltoides	Eastern cottonwood	19	Poor	30	188	Platanus occidentalis	Sycamore	Sycamore	16	Fair	15	15
31	Populus deltoides	Eastern cottonwood	14	Poor	30	189	Ulmus americana	American elm	American elm	15	Good	25	25
32	Populus deltoides	Eastern cottonwood	14	Poor	30	190	Ulmus americana	American elm	American elm	15	Good	25	25
33	Ulmus americana	American elm	6	Fair	20	191	Betula papyrifera	Paper birch	Paper birch	12, 16	Good	30	30
34	Populus deltoides	Eastern cottonwood	29	Fair	45	192	Ulmus americana	American elm	American elm	10	Good	20	20
35	Platanus occidentalis	Sycamore	11	Fair	25	193	Pinus nigra	Black pine	Black pine	12	Poor	20	20
36	Platanus occidentalis	Sycamore	11	Fair	25	194	Pinus nigra	Black pine	Black pine	12	Poor	20	20
37	Ulmus americana	American elm	8	Fair	30	195	Pinus strobus	White pine	White pine	22	Poor	20	20
38	Platanus occidentalis	Sycamore	8	Fair	30	196	Pinus strobus	White pine	White pine	22	Poor	20	20
39	Populus deltoides	Eastern cottonwood	19	Good	30	197	Ulmus americana	American elm	American elm	10	Fair	20	20
40	Populus deltoides	Eastern cottonwood	19	Fair	35	198	Ulmus americana	American elm	American elm	10	Fair	20	20
41	Salix babingtonia	Weeping willow	45	Fair	50	199	Carpa ovalis	Shagbark hickory	Shagbark hickory	6	Good	25	25
42	Salix babingtonia	Weeping willow	35	Poor	45	200	Tilia americana	Red ash	Red ash	11	Good	25	25
43	Ulmus americana	American elm	17	Fair	35	201	Ulmus americana	American elm	American elm	12	Good	30	30
44	Ulmus americana	American elm	17	Fair	35	202	Platanus occidentalis	Sycamore	Sycamore	16	Fair	20	20
45	Populus deltoides	Eastern cottonwood	13	Fair	30	203	Thupa occidentalis	Northern white-cedar	Northern white-cedar	17, 14	Good	30	30
46	Ulmus americana	American elm	8	Good	30	204	Ulmus americana	American elm	American elm	19	Good	30	30
47	Ulmus americana	American elm	8	Good	30	205	Ulmus americana	American elm	American elm	19	Good	30	30
48	Tilia americana	Red ash	10	Fair	30	206	Prunus pennsylvanica	Red ash	Red ash	8	Poor	15	15
49	Ulmus americana	American elm	7	Good	30	207	Larix laricina	Japanese larch	Japanese larch	23	Good	30	30
50	Fraxinus pennsylvanica	Red ash	11	Good	30	208	Larix laricina	Japanese larch	Japanese larch	23	Good	30	30
51	Populus deltoides	Eastern cottonwood	14	Good	30	209	Ulmus americana	American elm	American elm	10	Good	30	30
52	Populus deltoides	Eastern cottonwood	11	Fair	35	210	Thupa occidentalis	Northern white-cedar	Northern white-cedar	9, 10, 8	Poor	20	20
53	Fagus grandifolia	American beech	9	Good	40	211	Thupa occidentalis	Northern white-cedar	Northern white-cedar	16	Fair	20	20
54	Ulmus americana	American elm	15	Good	30	212	Ulmus americana	American elm	American elm	10	Fair	20	20
55	Mauia abba	White mulberry	7	Fair	20	213	Thupa occidentalis	Northern white-cedar	Northern white-cedar	9, 14, 10	Fair	30	30
56	Mauia abba	White mulberry	8	Poor	20	214	Ulmus americana	American elm	American elm	8	Good	30	30
57	Ulmus americana	American elm	6	Poor	20	215	Thupa occidentalis	Northern white-cedar	Northern white-cedar	7, 6, 6	Fair	30	30
58	Ulmus americana	American elm	10	Poor	20	216	Ulmus americana	American elm	American elm	8	Good	30	30
59	Mauia abba	White mulberry	12, 13	Fair	30	217	Ulmus americana	American elm	American elm	9	Good	30	30
60	Ulmus americana	American elm	26	Poor	25	218	Ulmus americana	American elm	American elm	9	Good	30	30
61	Mauia abba	White mulberry	13	Fair	30	219	Ulmus americana	American elm	American elm	10	Good	30	30
62	Mauia abba	White mulberry	6	Poor	15	220	Ulmus americana	American elm	American elm	10	Good	30	30
63	Mauia abba	White mulberry	14	Fair	20	221	Fraxinus pennsylvanica	Red ash	Red ash	10	Good	30	30
64	Mauia abba	White mulberry	14	Good	20	222	Acer platanoides	Norway maple	Norway maple	20	Good	40	40
65	Quercus rubra	Red oak	14	Good	30	223	Betula papyrifera	Paper birch	Paper birch	14, 12	Good	30	30
66	Mauia abba	White mulberry	9	Good	20	224	Betula papyrifera	Paper birch	Paper birch	14, 12	Good	30	30
67	Mauia abba	White mulberry	9	Fair	20	225	Picea abies	Norway spruce	Norway spruce	30	Fair	20	20
68	Mauia abba	White mulberry	9	Fair	20	226	Acer platanoides	Norway maple	Norway maple	11	Good	25	25
69	Mauia abba	White mulberry	15	Poor	15	227	Acer platanoides	Norway maple	Norway maple	36	Good	60	60
70	Mauia abba	White mulberry	15	Fair	20	228	Acer platanoides	Norway maple	Norway maple	40	Good	75	75
71	Juglans cinerea	Black walnut	15	Fair	40	229	Acer platanoides	Norway maple	Norway maple	40	Good	75	75
72	Ulmus americana	American elm	10	Poor	20	230	Mauia spp.	Unknown crabapple	Unknown crabapple	<8	Fair	30	30
73	Ulmus americana	American elm	10	Poor	20	231	Mauia spp.	Unknown crabapple	Unknown crabapple	<8	Fair	30	30
74	Ulmus americana	American elm	11	Poor	25	232	Mauia spp.	Unknown crabapple	Unknown crabapple	<8	Fair	30	30
75	Mauia abba	White mulberry	10	Good	30	233	Platanus occidentalis	Sycamore	Sycamore	21, 19	Good	35	35
76	Fraxinus pennsylvanica	Red ash	16	Good	30	234	Ulmus americana	American elm	American elm	7	Good	30	30
77	Ulmus americana	American elm	10	Good	30	235	Ulmus americana	American elm	American elm	13	Poor	30	30
78	Ulmus americana	American elm	8	Good	35	236	Ulmus americana	American elm	American elm	13	Poor	30	30
79	Ulmus americana	American elm	7	Good	30	237	Acer negundo	Boxelder	Boxelder	16	Fair	30	30
80	Ulmus americana	American elm	10	Good	30	238	Ulmus americana	American elm	American elm	8, 7, 7	Good	30	30
81	Populus deltoides	Eastern cottonwood	16	Fair	35	239	Carpa caroliniana	Muscadine	Muscadine	8, 7, 7	Good	30	30
82	Platanus occidentalis	Sycamore	8	Good	35	240	Carpa caroliniana	Muscadine	Muscadine	8, 7, 7	Good	30	30
83	Populus deltoides	Eastern cottonwood	9	Poor	15	241	Prunus serotina	Black cherry	Black cherry	16	Good	40	40
84	Populus deltoides	Eastern cottonwood	9	Poor	15	242	Prunus serotina	Black cherry	Black cherry	16	Good	40	40
85	Populus deltoides	Eastern cottonwood	14	Good	30	243	Ostrya virginiana	Ironwood	Ironwood	11	Good	30	30
86	Populus deltoides	Eastern cottonwood	13	Good	30	244	Quercus rubra	Northern red oak	Northern red oak	24	Good	40	40
87	Populus deltoides	Eastern cottonwood	12	Fair	20	245	Quercus rubra	Northern red oak	Northern red oak	22	Good	40	40
88	Ulmus americana	American elm	15	Good	30	246	Ulmus americana	American elm	American elm	10	Good	30	30
89	Ulmus americana	American elm	6	Poor	15	247	Thupa serotina	Black cherry	Black cherry	16	Good	30	30
90	Populus deltoides	Eastern cottonwood	11	Fair	20	248	Quercus rubra	Northern red oak	Northern red oak	10	Good	30	30
91	Populus deltoides	Eastern cottonwood	10	Good	30	249	Quercus rubra	Northern red oak	Northern red oak	10	Good	30	30
92	Populus deltoides	Eastern cottonwood	7	Poor	10	250	Fagus grandifolia	American beech	American beech	10	Good	20	20
93	Populus deltoides	Eastern cottonwood	10	Fair	15	251	Fagus grandifolia	American beech	American beech	6	Fair	20	20
94	Populus deltoides	Eastern cottonwood	10	Fair	15	252	Fagus grandifolia	American beech	American beech	6	Fair	20	20
95	Ulmus americana	American elm	11	Good	30	253	Acer saccharum	Sugar maple	Sugar maple	8	Poor	5	5
96	Ostrya virginiana	Ironwood	30	Good	30	254	Acer saccharum	Sugar maple	Sugar maple	8	Poor	5	5
97	Ulmus americana	American elm	8	Fair	20	255	Ulmus americana	American elm	American elm	8	Good	30	30
98	Populus deltoides	Eastern cottonwood	22	Fair	25	256	Ostrya virginiana	Ironwood	Ironwood	8	Good	30	30
99	Ulmus americana	American elm	8	Good	30	257	Ostrya virginiana	Ironwood	Ironwood	11	Good	30	30
100	Ulmus americana	American elm	8	Poor	15	258	Acer saccharum	Sugar maple	Sugar maple	10	Good	30	30
101	Populus deltoides	Eastern cottonwood	21	Good	25	259	Acer saccharum	Sugar maple	Sugar maple	19	Poor	30	30
102	Ulmus americana	American elm	9	Poor	20	260	Acer rubrum	Red maple	Red maple	9	Fair	20	20
103	Ulmus americana	American elm	9	Poor	20	261	Quercus rubra	Northern red oak	Northern red oak	16	Fair	20	20
104	Tilia americana	Red ash	8	Good	25	262	Quercus rubra	Northern red oak	Northern red oak	16	Fair	20	20
105	Ulmus americana	American elm	13	Poor	8	263	Tilia americana	Red ash	Red ash	15	Good	35	35
106	Ulmus americana	American elm	13	Poor	8	264	Tilia americana	Red ash	Red ash	15	Good	35	35
107	Fraxinus pennsylvanica	Red ash	18	Good	30	265	Tilia americana	Red ash	Red ash	15	Good	35	35
108	Fraxinus pennsylvanica	Red ash	18	Good	30	266	Ulmus americana	American elm	American elm	6	Fair	20	20
109	Larix laricina	Japanese larch	16	Poor	20	267	Prunus serotina	Black cherry	Black cherry	11	Poor	20	20
110	Larix laricina	Japanese larch	16	Good	20	268	Prunus serotina	Black cherry	Black cherry	11	Poor	20	20
111	Larix laricina	Japanese larch	16	Good	20	269	Ulmus americana	American elm	American elm	10	Fair	20	20
112	Larix laricina	Japanese larch	12	Poor	20	270	Ulmus americana	American elm	American elm	7	Good	30	30
113	Populus deltoides	Eastern cottonwood	12	Good	30	271	Ulmus americana	American elm	American elm	15	Good	30	30
114	Populus deltoides	Eastern cottonwood	12	Good	30	272	Ulmus americana	American elm	American elm				



NOTE: THERE ARE CONDUITS EXTENDING THROUGH THE EXISTING STRUCTURE. IT IS UNKNOWN IF THESE CONDUITS ARE LIVE. LIVE CONDUITS, IF ANY, NEED TO BE PROTECTED AND RELOCATED. DEAD LINES NEED TO BE PROPERLY ABANDONED.

FOR ADDITIONAL EXISTING DAM INFORMATION,
SEE SHEET 2A

1B EXISTING DAM SURVEY DETAIL
SCALE = 1" = 5'



NOTES:

1. CONTRACTOR TO INSTALL 40" OF STEEL SHEET PILE COFFERDAM AT STATION 2+84 USING 10' SHEETS DRIVEN TO AN ELEVATION OF 729.00'.
2. CONTRACTOR TO PROVIDE A 36" STEEL OR DUCTILE IRON PIPE STUB WELDED INTO THE STEEL SHEET PILE WITH UPSTREAM AND DOWNSTREAM INVERT ELEVATIONS OF 724.0 FEET. WELD PIPE TO SHEET PILING USING $\frac{3}{8}$ " BEAD WELD BOTH SIDES OF PILING. STEEL PIPE STUB SHALL FORM A WATER-TIGHT SEAL WITH SHEET PILING. PIPE STUB SHALL HAVE A MINIMUM LENGTH OF 12" UPSTREAM AND DOWNSTREAM OF SHEET PILING FACE.
3. STEEL SHEET PILE COFFER DAM WILL BE TEMPORARY DURING DEWATERING, BYPASS, AND CONSTRUCTION. STEEL SHEET PILE WILL BE DRIVEN TO A PERMANENT TOP ELEVATION OF 723.0 FEET ONCE THE COFFER DAM IS NO LONGER NECESSARY. PIPE STUB TO BE CUT OFF AS NECESSARY PRIOR TO DRIVING SHEETS TO PERMANENT ELEVATION.
4. CONTRACTOR TO LOCATE 36" SMOOTH-CORE DOUBLE WALL FLUME PIPE IN A TRENCH WITHIN CORRIDOR. ACTUAL LOCATION CAN BE DETERMINED BY CONTRACTOR. ALTERNATE LOCATIONS OUTSIDE OF CORRIDOR MUST BE APPROVED BY ENGINEER.
5. FLUME PIPE TRENCH SHALL BE GRADED AT A CONSTANT SLOPE FROM AN ELEVATION OF 724.0 AT THE STEEL SHEET PILE COFFER DAM TO AN ELEVATION OF 718.5 AT THE ENTRANCE OF THE EXISTING CONCRETE BOX CULVERT EAST OF THE DAM.
6. CONTRACTOR TO USE MINIMUM 7,000 GPM PUMPS TO PUMP - BYPASS STREAM THROUGH IMPOUNDMENT AND PUMP WATER FROM IMPOUNDMENT. ALL PUMPS SHALL DISCHARGE INTO THE EXISTING CULVERT AT A POINT UPSTREAM OF DANVERS DRIVE. MAINTAIN A MINIMUM DISTANCE OF 12' ABOVE SEDIMENTS FROM PUMP INTAKES TO AVOID ENTRAINMENT OF SEDIMENTS OR BURY PUMP INTAKE IN 6A FILTER STONE.
7. ALL WATER CARRYING SUSPENDED SEDIMENTS SHALL DISCHARGE INTO A GEOSYNTHETIC FILTER PRIOR TO DISCHARGE TO PEBBLE CREEK.
8. LOW AREAS IN IMPOUNDMENT NORTH AND SOUTH OF PROPOSED NEW CHANNEL SHALL BE MAINTAINED AS LONG AS POSSIBLE FOR RUNOFF COLLECTION AND SEDIMENTATION AREAS DURING CONSTRUCTION. OTHERWISE, CONTRACTOR SHALL PROVIDE OTHER MEANS OF FILTERING RUNOFF PRIOR TO DISCHARGE TO PEBBLE CREEK.
9. GENERAL SEQUENCING AS FOLLOWS:
 - PUMP BYPASS STREAM FLOWS AROUND/ THROUGH POND.
 - INSTALL STEEL SHEET PILE COFFERDAM AND 36" STEEL PIPE STUB.
 - DEWATER POND VIA PUMPING
 - INSTALL 36" HDPE BYPASS FLUME PIPE
 - BREACH SOUTH SIDE OF DAM TO AN EL OF 718.5 TO ALLOW FOR INSTALLATION OF 36" HDPE PIPE THROUGH DAM STRUCTURE
 - ESTABLISH FLOW THROUGH 36" BYPASS FLUME
 - COMPLETE DEWATERING OF POND AND MAINTAIN DEWATERED CONDITION VIA PUMPING AS NECESSARY
 - REMOVE REMAINDER OF DAM, AS REQUIRED.
 - INSTALL NEW CULTIVAT. AS NECESSARY.
 - CONSTRUCT NEW STREAM CHANNEL AND ROUGH GRADE FLOODPLAIN
 - ROUTE FLOW THROUGH NEW CHANNEL
 - REMOVE FLUME PIPE AND DRIVE STEEL SHEET PILE COFFERDAM TO FINAL DESIGN ELEVATION
 - COMPLETE FINAL GRADING
 - LANDSCAPING
 - RESTORATION
 - DEMOBILIZATION

INSTALLING PIPE THROUGH SHEET PILE SEQUENCE:

- 1.) WELD PAIR OF SHEET PILES TOGETHER IF PIPE LOCATION IS AT 2 SHEET PILES.
- 2.) CUT, INSTALL, WELD PIPE STUB ON BOTH SIDES OF SHEET PILE.
 - 3.) DRIVE SHEET PILE TO PROPOSED ELEVATION AS PRESENTED ON PROFILE VIEWS
 - 4.) MAKE 36" HOPE FLUME PIPE CONNECTION TO PER INSTALLED PIPE STUB USING A WATER TIGHT COUPLER

36" DIA. STEEL PIPE STUB

1/4"

12 MIN.

12 MIN.

36" DIA. STEEL PIPE STUB

10' LONG SHEET PILE WALL, 5" MAX. STICK UP WITH 5' MIN. EMBEDMENT. USE PZ-22 SHEET PILING, GRADE 50 STEEL.

SHEET PILE

NOTE: MINIMUM WELD SIZE SHOWN. WELD SHALL BE A SIZE TO ASSURE A WATERTIGHT SEAL.

1 TEMPORARY STEEL SHEET PILE COFFERDAM ELEVATION

2C) SCALE = 1" = 4'

2 36" PIPE STUB AT SHEET PILE COFFERDAM (PLAN VIEW)

2C) NOT TO SCALE

ECT
Environmental Consulting & Technology, Inc.

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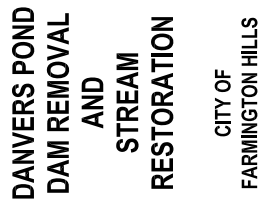
DANVERS POND DAM REMOVAL AND STREAM RESTORATION

CITY OF
FARMINGTON HILLS

SHEET NAME
**CHANNEL BYPASS
AND DEWATERING
PLAN**

SCALE: 1" = 20' @ 24x36

 NORTH	SHEET NUMBER 2C
---	---------------------------



FOR BID	03-2012
REVISED	8-29-11
RESUBMIT TO MDNRE	2-21-11
PERMIT APPLICATION	12-01-10
CLIENT REVIEW	12-19-09

060732-0100
ECT PROJECT NUMBER

MB DESIGNED BY MB CHECKED BY

TH DRAWN BY MB APPROVED BY

FINAL SITE GRADING AND CHANNEL RESTORATION



NORTH  3B
SHEET NUMBER



1. SEE SHEET 3C FOR RIFFLE/POOL GRADING DETAILS
2. SEE SHEET 3D FOR RIFFLE/POOL CONSTRUCTION DETAILS
3. SEE SHEET 3E FOR TYPICAL POOL CROSS SECTION
4. SEE SHEET 3E FOR CHANNEL CROSS-SECTIONS

- LEGEND**
- LIMITS OF DISTURBANCE
- 7/2 PROPOSED CONTOUR
- EXISTING CONTOUR
- R1 RIFLE #
- P1 POOL #

2200 COMMONWEALTH BLVD
SUITE 300
ANN ARBOR, MI 48105
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FAX: 734-769-3164
www.ectinc.com

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660 Woodward Ave, Ste. 2430
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Tel: 313-963-2731
Fax: 313-963-2736
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DANVERS POND DAM REMOVAL AND STREAM RESTORATION

CITY OF
FARMINGTON HILLS

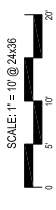
FOR BID	03-2012
REVISED	8-29-11
RESUBMIT TO MDNRE	2-21-11
PERMIT APPLICATION	12-01-10
CLIENT REVIEW	12-19-08

080732-0100
ECT PROJECT NUMBER

MB MB
DESIGNED BY CHECKED BY

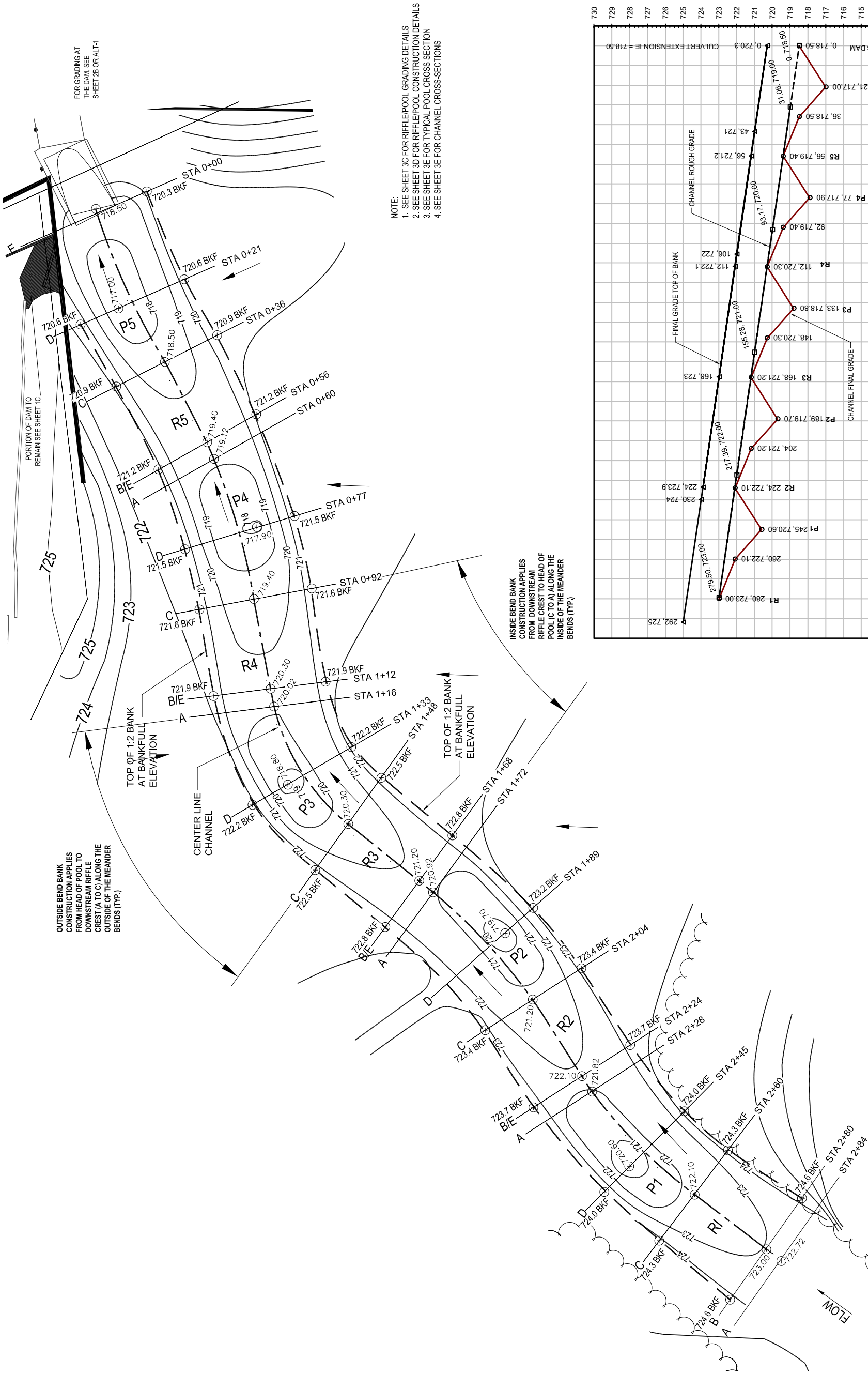
TH MB
DRAWN BY APPROVED BY

RIFLE/POOL GRADING DETAILS



NORTH	SHEET NUMBER
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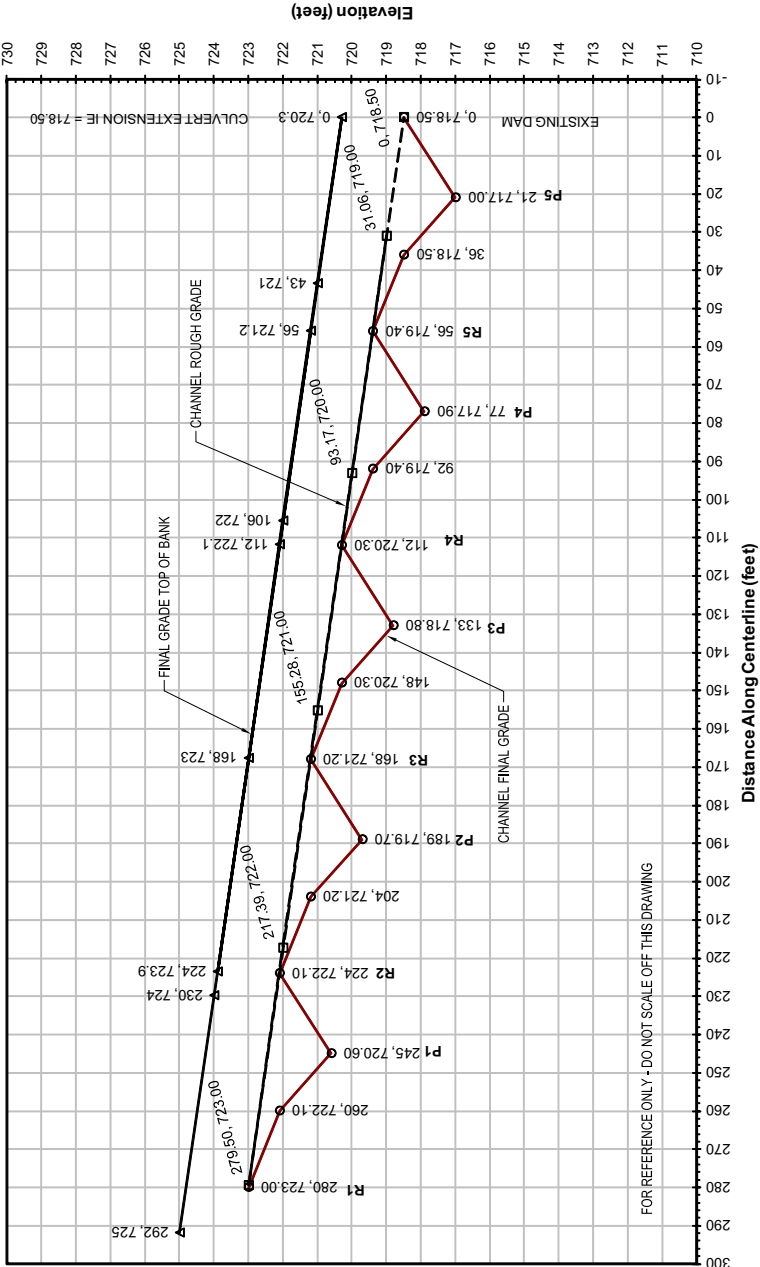
30



ELEVATION SCHEDULE: RIFFLE

	1	2	3	4	5
A	722.72	721.82	720.92	720.02	719.12
B	723.00	722.10	721.20	720.30	719.40
C	722.10	721.20	720.30	719.40	718.50
D	720.60	719.70	718.80	717.90	717.00
E	725.00	723.90	723.00	722.10	721.20

NOTE:
1. SEE SHEET 3D FOR RIFFLE DETAILS



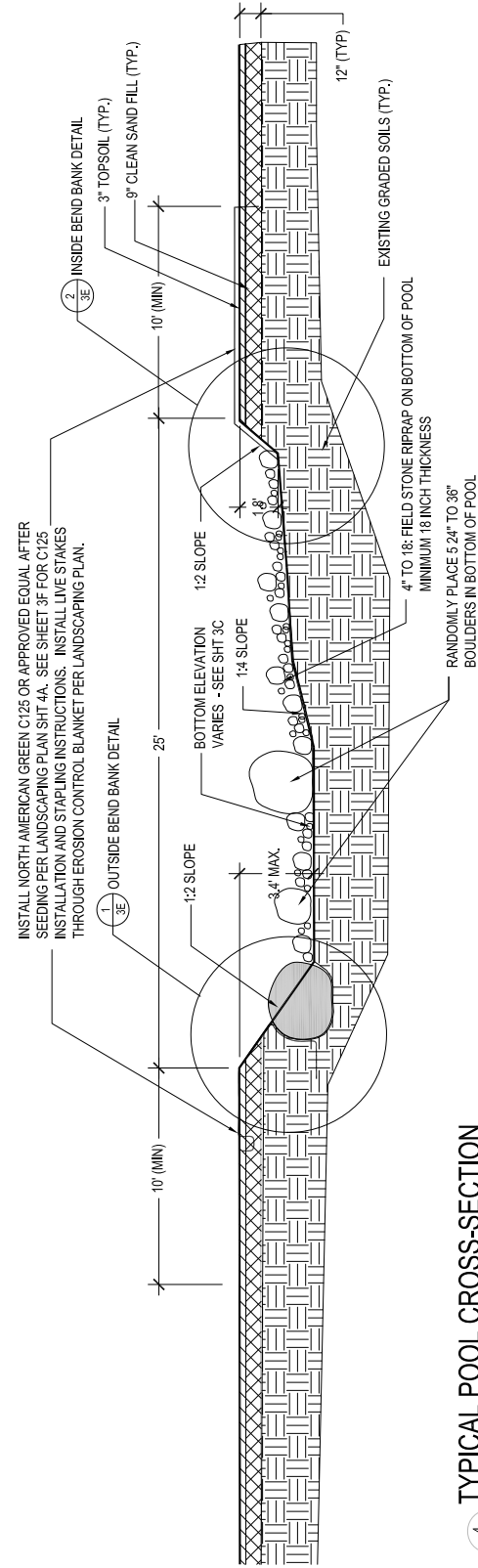
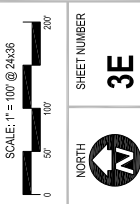
ELEVATIONS ARE FINAL GRADES TOP OF RIPRAP.

**DANVERS POND
DAM REMOVAL
AND
STREAM
RESTORATION**

**CITY OF
FARMINGTON HILLS**

[illegible]

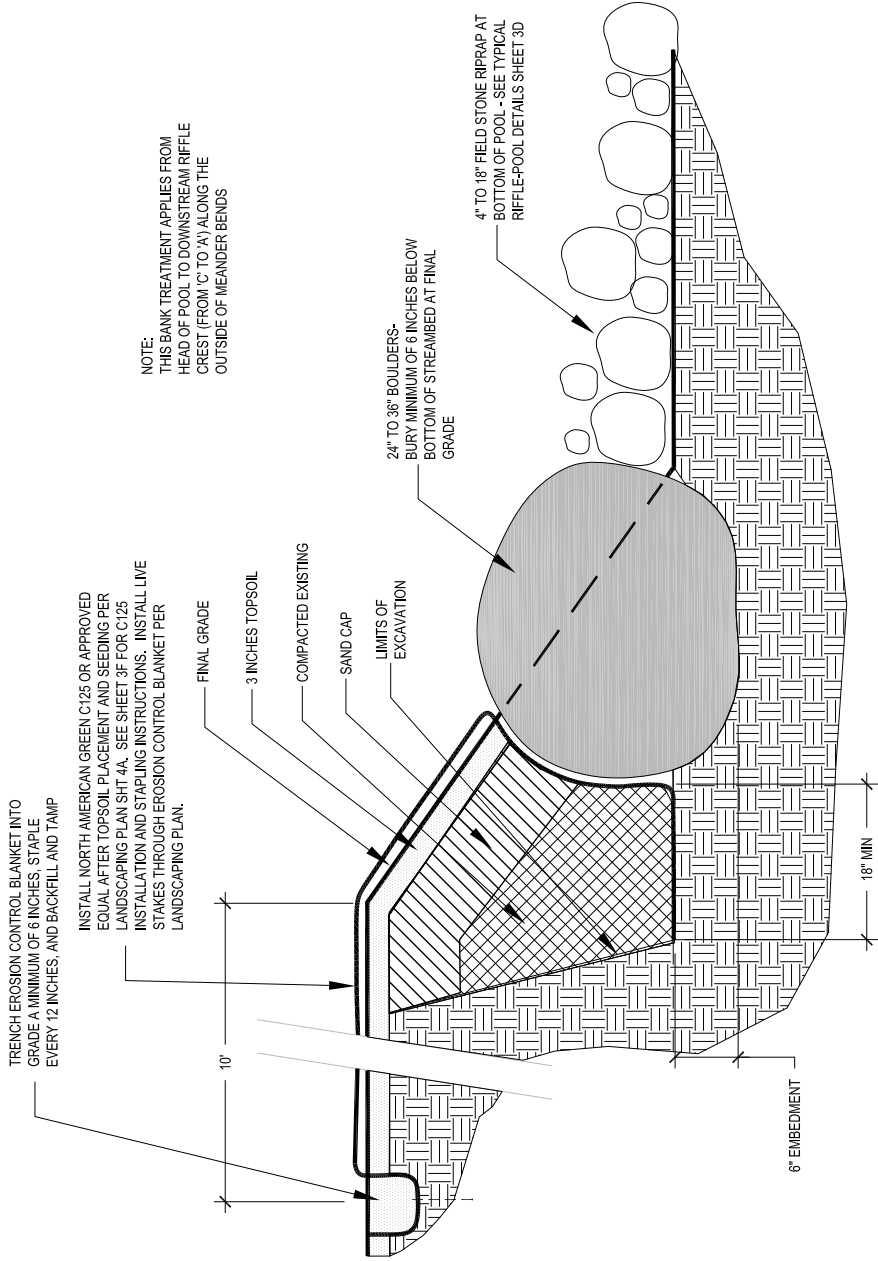
SHEET NAME



TYPICAL POOL CROSS-SECTION

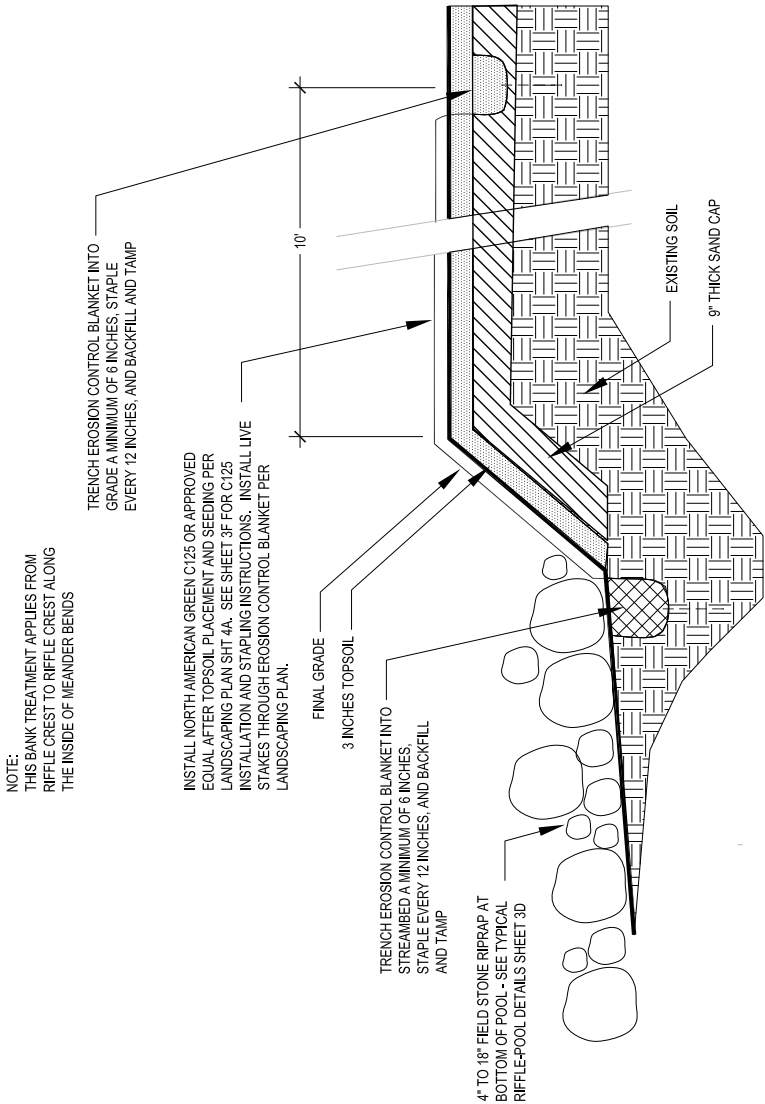
SCALE: 1" = 4'

NOTE: OVER EXCAVATE AS NECESSARY FOR RIPRAP PLACEMENT TO ACHIEVE FINAL GRADES.

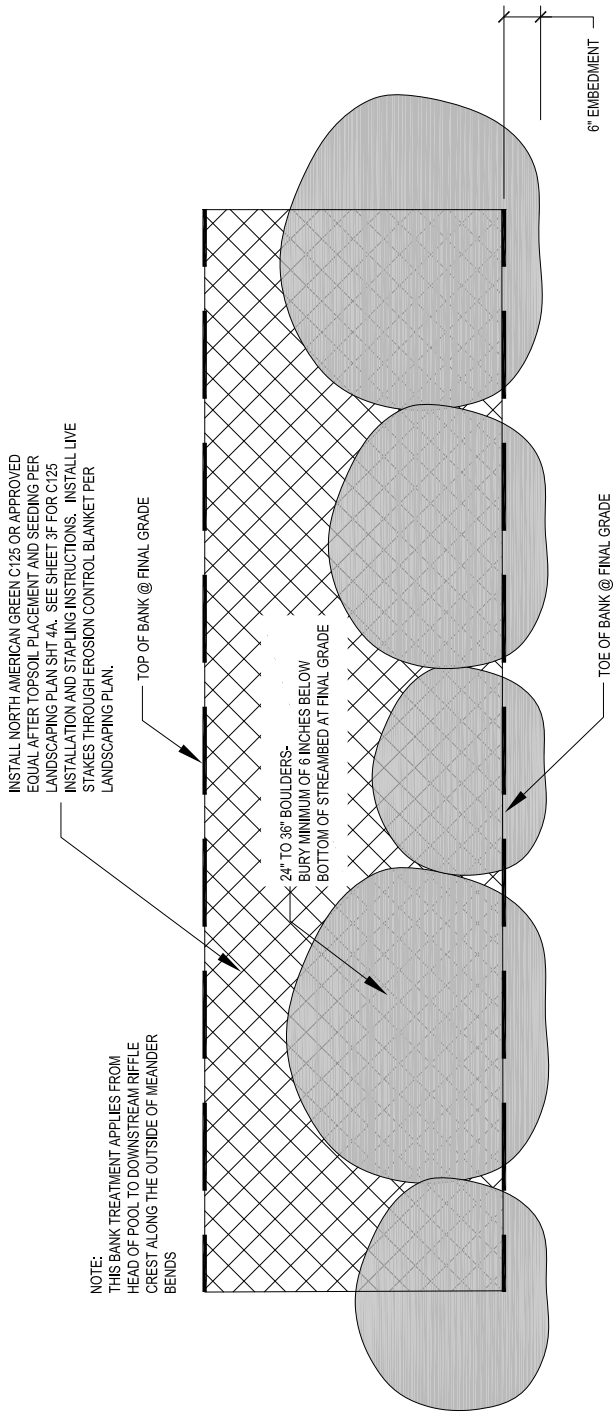


TYPICAL OUTSIDE BEND BANK CONSTRUCTION

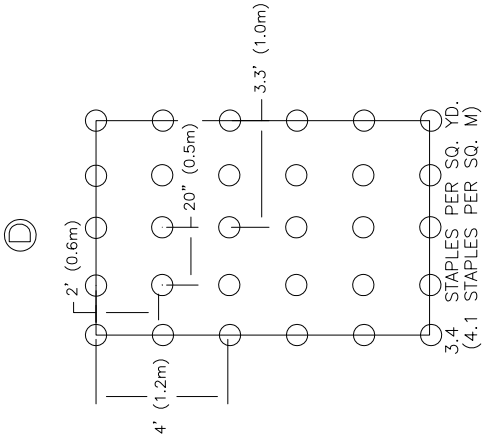
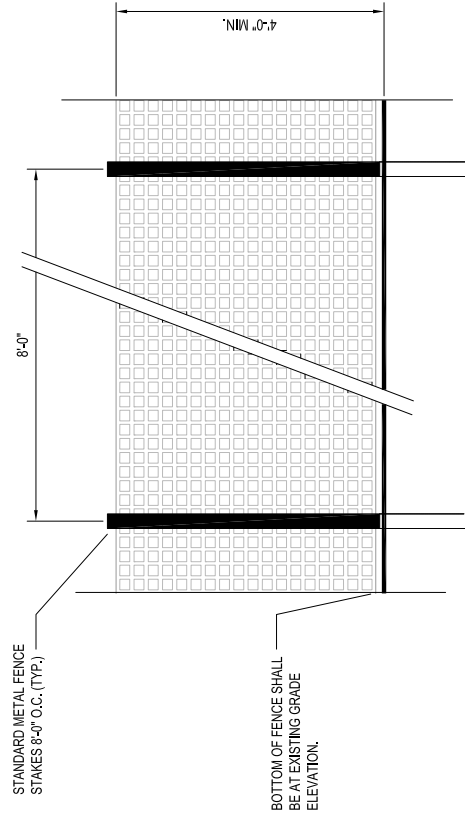
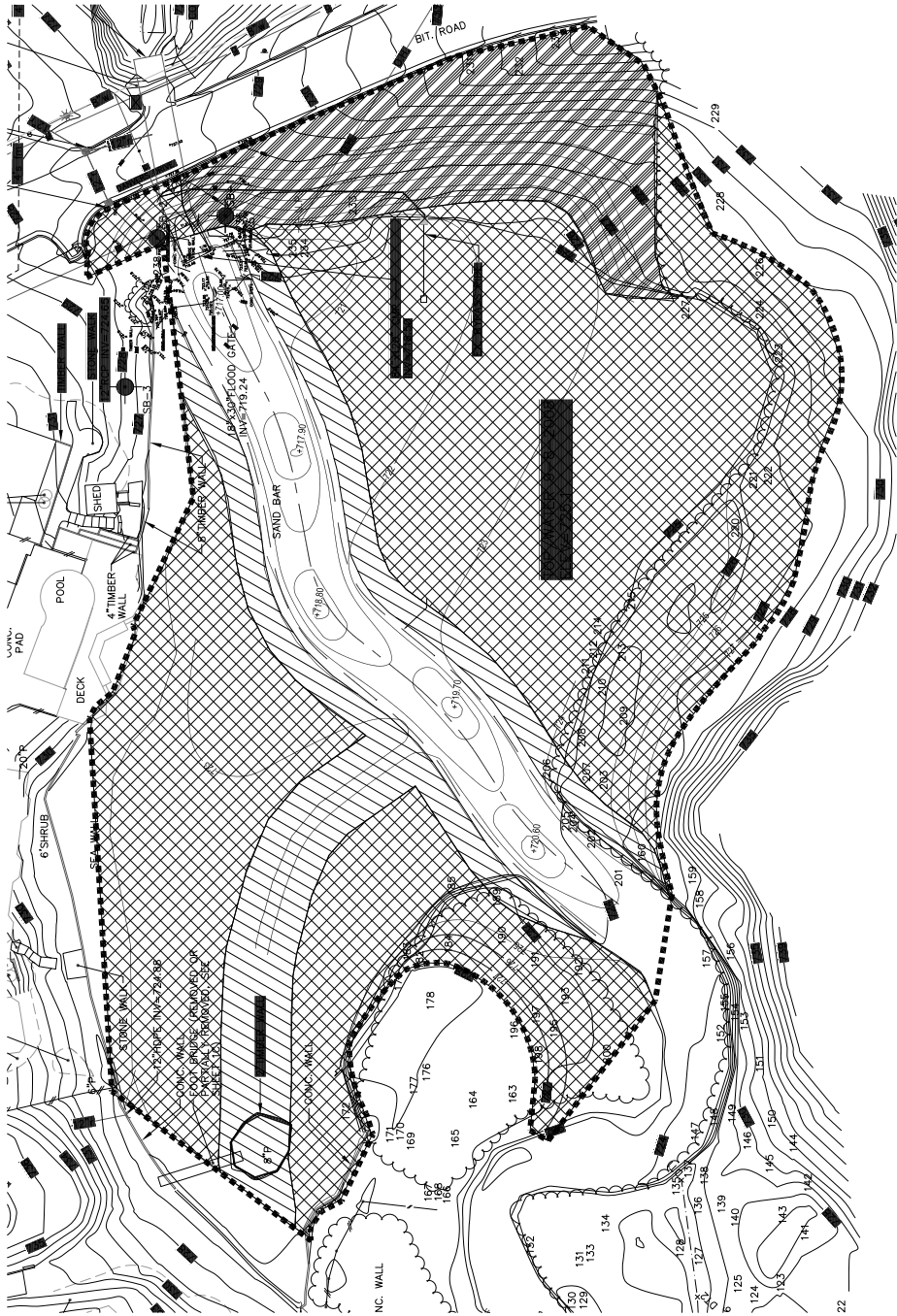
SCALE: 1" = 1'



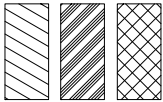
2
3E
TYPICAL INSIDE BEND BANK CONSTRUCTION
SCALE: 1" = 1'



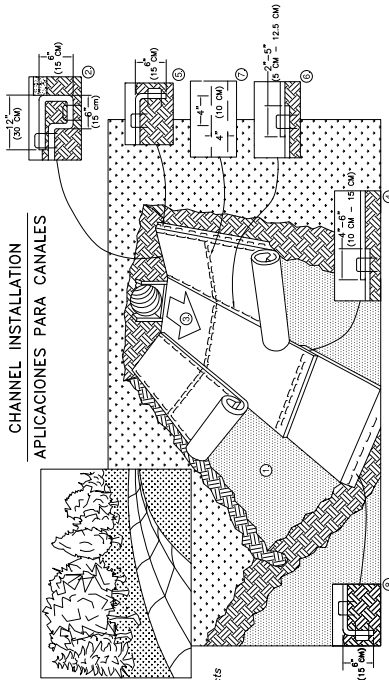
3
TYPICAL OUTSIDE BEND BANK ELEVATION
3E
SCALE: 1" = 1'



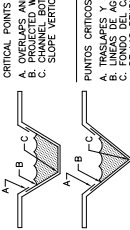
LEGEND:



14649 HIGHWAY 41 NORTH
EVANSVILLE, IN 47725
800-772-2040
www.nagreen.com



1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (REC'S), INCLUDING ANY NECESSARY APPLICATION OF FERTILIZER, AND SEED. WHEN USING CELL-O-SOIL, THE REC'S MUST BE INSTALLED WITH PAPER SIDE DOWN.
 2. PREPARE THE TRENCH, BACKFILL AND COMPACT THE TRENCH, AND/OR THE REC'S TO A DEPTH OF APPROXIMATELY 12" (30 CM) OF REC'S EXTENDING BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE REC'S WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH, AFTER STAPLING, APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30 CM) PORTION OF REC'S BACK TO THE TRENCH. REPEAT STEPS 2 AND 3 UNTIL THE ENTIRE SLOPE IS COVERED WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30 CM) ACROSS THE WIDTH OF THE REC'S.
 3. ROLL CENTER REC'S IN THE DIRECTION OF WATER FLOW IN BOTTOM OF CHANNEL. REC'S WILL UNROLL WITH APPROPRIATE SLIDE AGAINST THE SOIL SURFACE. ALL REC'S MUST BE STAPLED TO THE TRENCH, BACKFILL AND COMPACTED TRENCH, AND/OR THE REC'S TO A DEPTH OF APPROXIMATELY 12" (30 CM) APART IN THE BOTTOM OF THE TRENCH. WHEN USING THE TRENCH SYSTEM, STAPLES/STAKES SHOULD BE PLACED THROUGH ONE OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
 4. PLACE CONSECUTIVE REC'S END OVER END (SHINGLE STYLE) WITH A 4" - 6" (10 CM - 15 CM) OVERLAP. USE A DOUBLE ROW OF STAPLES STAGGERED 4" (10 CM) APART AND 4" (10 CM) ON CENTER TO SECURE REC'S.
 5. SECURE REC'S WITH A DOUBLE ROW OF STAPLES/STAKES. STAPLES MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN A 6" (15 CM) DEEP 6" (15 CM) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
 6. ADJUNCT REC'S MUST BE OVERLAPPED APPROXIMATELY 2" - 5" (5 CM - 12.5 CM) (DEPENDENT ON REC'S TYPE) AND STAPLED.
 7. IN HIGH FLOW CHANNEL APPLICATIONS, A STAPLE CHAIN SLOT IS RECOMMENDED AT 30 TO 40 FOOT (9 M - 12 M) INTERVALS. USE A DOUBLE ROW OF STAPLES STAGGERED 4" (10 CM) APART AND 4" (10 CM) ON CENTER OVER ENTIRE WIDTH OF THE CHANNEL.
 8. THE TERMINAL END OF THE REC'S MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN A 6" (15 CM) DEEP 6" (15 CM) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
- NOTE: IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" (15 CM) MAY BE NECESSARY TO PROPERLY ANCHOR THE REC'S.



- [illegible]

C-125 STAPLING PATTERN
NOT TO SCALE

C-125 INSTALLATION INSTRUCTIONS
NOT TO SCALE

ECI
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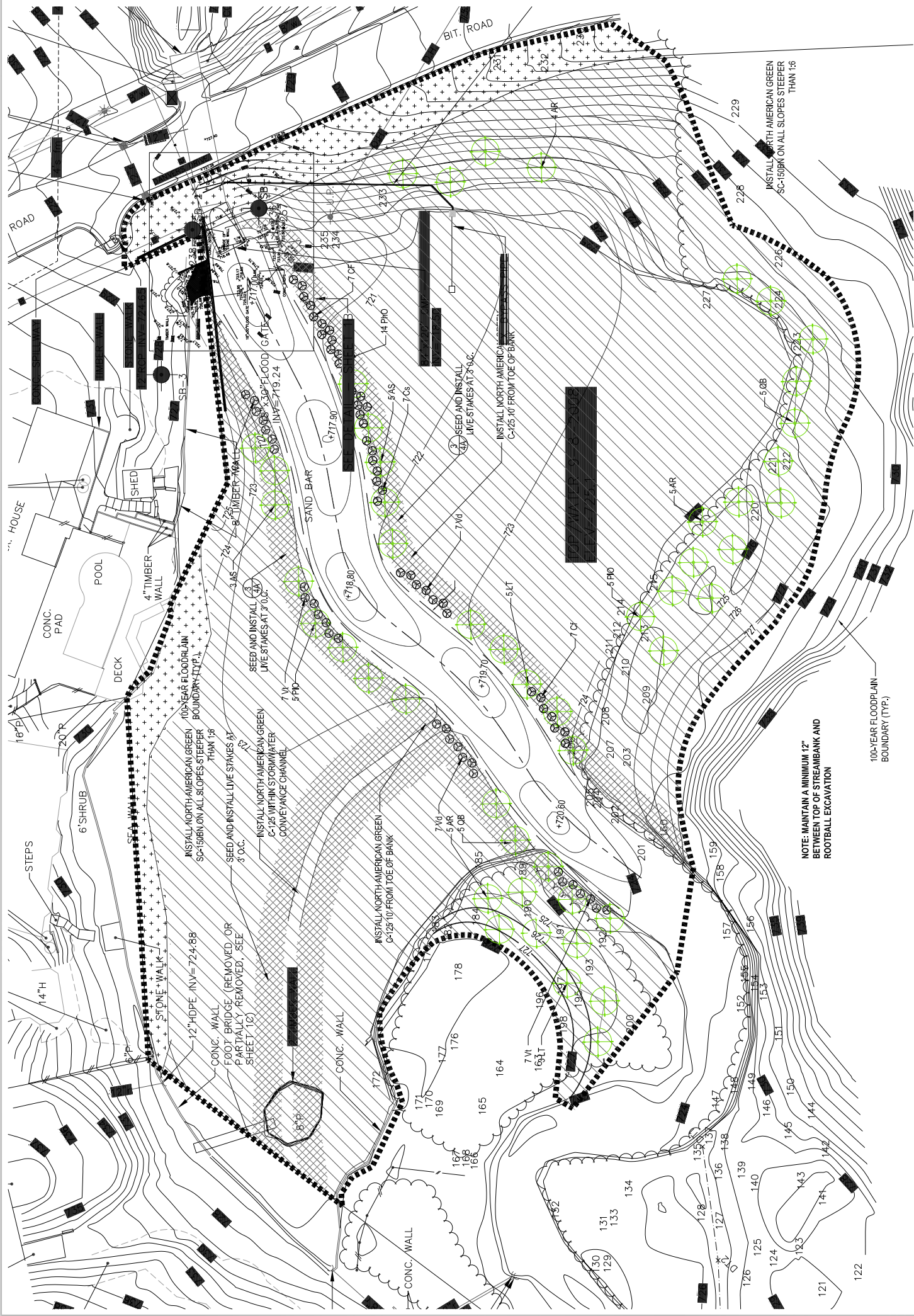
**DANVERS POND
DAM REMOVAL
AND
STREAM
RESTORATION**

**CITY OF
FARMINGTON HILLS**

MISCELLANEOUS DETAILS

SCALE: AS SHOWN

NORTH  3F
SHEET NUMBER



PLANT LIST:				
SYM	QTY	SCIENTIFIC NAME	COMMON NAME	SPACING SIZE
AR	14	ACER RUBRUM	RED MAPLE	AS SHOWN 3' CAL.
AS	8	ACER SACCHARINUM	SILVER MAPLE	AS SHOWN 3' CAL.
LT	8	LIRIODENDRON TULIPIFERA	TULIP TREE	AS SHOWN 3' CAL.
PRO	10	PLATANUS OCCIDENTALIS	SYCAMORE	AS SHOWN 3' CAL.
OB	10	QUERCUS BICOLOR	SWAMP WHITE OAK	AS SHOWN 3' CAL.
CB	14	CORNUS AMOMUM	SILKY DOGWOOD	AS SHOWN 3' CAL.
CS	14	CORNUS SERICEA	RED OSIER DOGWOOD	AS SHOWN 3' CAL.
VB	14	VIBURNUM DENTATUM	ARROWOOD VIBURNUM	AS SHOWN 3' CAL.
VI	14	VIBURNUM TRILOBUM	HIGHBUSH CRANBERRY	AS SHOWN 3' CAL.
PHO	14	PHYSCARPUS OPULIFOLIUS	NINEBARK	AS SHOWN 3' CAL.

INSTALL 1030 TOTAL LIVE STAKES (300 ON EACH SIDE OF RESTORED CHANNEL AND 215 ON EACH SIDE OF STORMWATER CONVEYANCE CHANNEL), AN EQUAL NUMBER OF AT LEAST FIVE OF THE FOLLOWING SPECIES SHALL BE INSTALLED ON 3' CENTERS.

SCIENTIFIC NAME	COMMON NAME
CORNUS SERICEA	RED-OSIER DOGWOOD
CORNUS AMOMUM	SILKY DOGWOOD
PHYSCARPUS OPULIFOLIUS	NINEBARK
SALIX EXIGUA	SANDBAR WILLOW
SALIX DISCOLOR	PUSSY WILLOW
SALIX SERICEA	SILKY WILLOW
SALIX NIGRA	BLACK WILLOW
SALIX AMYGDALOIDES	PEACH-LEAF WILLOW

NOTES:

TREE SHALL BE PLANTED WITH TOP OF ROOT BALL AT OR SLIGHTLY ABOVE FINISH GRADE - NEVER LOWER.

PRUNE ONLY AS DIRECTED EXCEPT FOR REMOVING DEAD OR BROKEN BRANCHES; RETAIN NATURAL FORM. DO NOT CUT LEADER.

4" MULCH TO COVER ENTIRE PLANTING HOLE. TAPER MULCH TO TRUNK. CREATE CONTINUOUS 6" EARTH SAUCER.

SPECIFIED BACKFILL SOIL

REMOVE TOP 1/3 OF BURLAP OR ENTIRE BAP IF NON-Biodegradable AFTER PLACING TREE IN PIT

SCARIFY BOTTOM AND SIDEWALLS OF PLANTING PIT.

6" EARTH PEDESTAL OF UNDISTURBED OR COMPACTED SOIL.

1 DECIDUOUS TREE PLANTING

4A NOT TO SCALE

PLANT ALL SHRUBS VERTICAL.

PRUNE ALL DEAD OR DAMAGED BRANCHES

4" BARK MULCH TO COVER ENTIRE PLANTING HOLE. TAPER MULCH TO BASE OF PLANT.

REMOVE ROPE & TOP 1/3 OF BURLAP PRIOR TO BACKFILLING.

PROVIDE 3" SOIL SAUCER AROUND EACH PLANT BACKFILL WITH MIX OF 50% IMPORTED TOPSOIL AND 50% EXCAVATED SITE SOIL & TAMP LIGHTLY WITHIN 8 HOURS OF PLANTING

IF CONTAINER STOCK IS ROOT BOUND, MAKE 4 VERTICAL CUTS IN EACH ROOT BALL WITH SHARP BLADE

SCARIFY BOTTOM AND SIDEWALLS OF PLANTING PIT.

2 SHRUB PLANTING

4A NOT TO SCALE

MDOOT TUF MIX (0.25 ACRES)		
SCIENTIFIC NAME	COMMON NAME	%
FESTUCA RUBRA	CREeping RED FESCUE	40%
LOLIUM PERENNE	PERENNIAL RYEGRASS	20%
FESTUCA OVINA VAR. DURUSCULA	HARD FESCUE	20%
POA PRATENSIS	KENTUCKY BLUEGRASS	10%
PUCCELLINIA DISTANS	FULTS SALT GRASS	10%

WET TO MESIC SEED MIX (1.5 ACRES)		
SCIENTIFIC NAME	COMMON NAME	LEBAC
AVENA SATIVA	SEED OATS	30.00
ANDROPOGON GERARDII	BIG BLUESTEM GRASS	3.000
ASCLEPIAS INCARNATA	SWAMP MILKWEED	0.063
ASTER LAEVIS	SMOOTH BLUE ASTER	0.016
ASTER NOVA-ANGIAE	NEW ENGLAND ASTER	0.031
CALAMAGROSTIS CANADENSIS	BLUE JOINT GRASS	0.063
CAREX ANNETENS	YELLOW-FRUITED SEDGE	0.063
CAREX BEBBII	BERB'S SEDGE	0.063
CAREX NORMALIS	NORMAL SEDGE	0.063
CAREX VULPINODEA	FOX SEDGE	0.125
CASSIA FASCICULATA	PARTIDGE PEA	0.250
ELYMUS CANADENSIS	CANADA WILD RYE	1.000
EUPATORIUM COLORATUM	CINNAMON WILLOW HERB	0.015
EUPATORIUM PYRAMIDATUM	BONESET	0.015
IRIS VIRGINICA	GREAT ST. JOHN'S WORT	0.063
LIATRIS SPICATA	BLUE FLAG IRIS	0.125
LOBELIA SIPHILITICA	SPIKED BLAZING STAR	0.188
MINULUS RINGENS	GREAT BLUE LOBELIA	0.031
MONARDA FISTULOSA	MONKEY FLOWER	0.031
PANICUM VIRGATUM	SWITCH GRASS	0.063
PHYSTOSTEGIA VIRGINIANA	SHOWY DRAGONHEAD	0.250
PTYCNANTHEUM VIRGINIANUM	MT. MINT	0.063
RATIBIDA PINNATA	YELLOW CONEFLOWER	0.063
RUDEBECKIA HIRTA	BLACK EYED SUSAN	0.250
SCIRPUS AETIOBENS	DARK GREEN RUSH	0.500
SOLIDAGO RIDDELLI	RIDDELL'S GOLDENROD	0.063
SOLIDAGO RIGIDA	RIGID GOLDENROD	0.125
SORGHASTRUM NUTANS	INDIAN GRASS	4.000
SPARTINA PECTINATA	PRAIRIE CORD GRASS	0.188
VERONICA FASCICULATA	COMMON IRONWEED	0.031
VERONICASTRUM VIRGINICUM	CULVER'S PHYSIC	0.063
ZIZIA AUREA	GOLDEN ALEXANDER	0.031
TOTAL		41.145

LEGEND

LIMITS OF DISTURBANCE

PROPOSED CONTOUR

EXISTING CONTOUR

MDOOT TUF MIX

WET-TO-MESIC SEED MIX

WET-TO-MESIC SEED MIX AND LIVE STAKING

PROPOSED SHRUBS

PROPOSED TREES

GROUND SURFACE W/ EXISTING VEGETATION

LIVE CUTTING (1/2 INCH TO 1-1/2 INCH IN DIAMETER)

NOTES:

1. INSTALL IN MUD/LAT/TILL ZONE AS DIRECTED BY LANDSCAPE ECOLOGIST, DURING FIRST DORMANT SEASON FOLLOWING SEEDING

2. ROOTED/LEAFED CONDITION OF THE LIVING PLANT MATERIAL IS NOT REPRESENTED AT THE TIME OF INSTALLATION.

3. INSTALL LIVE STAKES AT RIGHT ANGLES, PUSH INTO THE GROUND BY HAND. USE DEAD BLOW HAMMER AS NEEDED.

4. BURY FOURFIFTHS OF THE STAKE IN THE GROUND, AND FIRMLY PACK SOIL AROUND IT. ORIENT THE BUDS UP.

5. INSTALL STAKES 2 TO 3 FEET APART IN TRIANGULAR SPACING PATTERN.

3 LIVE STAKE INSTALLATION

4A NO SCALE

ECT
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**DANVERS POND
DAM REMOVAL
AND
STREAM
RESTORATION**

CITY OF
FARMINGTON HILLS

FOR BID	05-2012
REVISED PER CITY'S COMMENT	05-15-11
PERMIT APPLICATION	12-41-10
CLIENT REVIEW	12-15-08
ECT PROJECT NUMBER	080724400
DESIGNED BY	MB
CHECKED BY	MB
APPROVED BY	TH

REVEGETATION PLAN

SHEET NAME

SCALE: 1" = 20' @ 24x36

NORTH

SHEET NUMBER

4A

APPENDIX B: BID TAB

ITEM	ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL COST	TSP	TSP	Anglin	Anglin	VIL	VIL	Inland	Inland
1	Mobilization	1	LS	\$ 20,000.00	\$ 20,000.00	\$ 24,117.00	\$ 24,117.00	\$ 20,000.00	\$ 20,000.00	\$ 20,000.00	\$ 20,000.00	\$ 23,196.26	\$ 23,196.26
2	Construction Staking	1	LS	\$ 15,000.00	\$ 15,000.00	\$ 4,224.00	\$ 4,224.00	\$ 5,750.00	\$ 5,750.00	\$ 4,000.00	\$ 4,000.00	\$ 3,888.00	\$ 3,888.00
3	Traffic Control	1	LS	\$ 2,000.00	\$ 2,000.00	\$ 2,989.00	\$ 2,989.00	\$ 2,875.00	\$ 2,875.00	\$ 2,000.00	\$ 2,000.00	\$ 5,415.00	\$ 5,415.00
4	Audiovisual Tape Recording	1	LS	\$ 1,500.00	\$ 1,500.00	\$ 1,418.00	\$ 1,418.00	\$ 2,625.00	\$ 2,625.00	\$ 2,200.00	\$ 2,200.00	\$ 1,500.00	\$ 1,500.00
5	Soil Erosion and Sediment control	1	LS	\$ 1,000.00	\$ 1,000.00	\$ 1,998.00	\$ 1,998.00	\$ 5,175.00	\$ 5,175.00	\$ 4,500.00	\$ 4,500.00	\$ 3,833.80	\$ 3,833.80
6	Construction Fence	1300	LF	\$ 5.00	\$ 6,500.00	\$ 1.58	\$ 2,054.00	\$ 5.00	\$ 6,500.00	\$ 5.00	\$ 6,500.00	\$ 3.25	\$ 4,225.00
7	Tree Protection	1	LS	\$ 1,000.00	\$ 1,000.00	\$ 537.00	\$ 537.00	\$ 2,875.00	\$ 2,875.00	\$ 3,000.00	\$ 3,000.00	\$ 1,300.00	\$ 1,300.00
8	Clearing, Grubbing	0.3	AC	\$ 10,000.00	\$ 3,000.00	\$ 19,223.00	\$ 5,766.90	\$ 17,250.00	\$ 5,175.00	\$ 40,000.00	\$ 12,000.00	\$ 23,133.00	\$ 6,939.90
9	Tree Removal	9	EA	\$ 300.00	\$ 2,700.00	\$ 723.00	\$ 6,507.00	\$ 460.00	\$ 4,140.00	\$ 250.00	\$ 2,250.00	\$ 542.00	\$ 4,878.00
10	Bypass Pipe Demolition	1	LS	\$ 750.00	\$ 750.00	\$ 4,078.00	\$ 4,078.00	\$ 4,025.00	\$ 4,025.00	\$ 6,000.00	\$ 6,000.00	\$ 3,249.00	\$ 3,249.00
11	Foot Bridge Demolition	15	LF	\$ 100.00	\$ 1,500.00	\$ 96.00	\$ 1,440.00	\$ 155.00	\$ 2,325.00	\$ 100.00	\$ 1,500.00	\$ 32.50	\$ 487.50
12	Dam Demolition	1	LS	\$ 15,000.00	\$ 15,000.00	\$ 14,228.00	\$ 14,228.00	\$ 11,500.00	\$ 11,500.00	\$ 31,000.00	\$ 31,000.00	\$ 24,457.00	\$ 24,457.00
13	General Demolition	20	Tons	\$ 300.00	\$ 6,000.00	\$ 115.00	\$ 2,300.00	\$ 575.00	\$ 11,500.00	\$ 250.00	\$ 5,000.00	\$ 81.25	\$ 1,625.00
14	Sheet Pile Retaining Wall	95	LF	\$ 250.00	\$ 23,750.00	\$ 372.00	\$ 35,340.00	\$ 683.00	\$ 64,885.00	\$ 400.00	\$ 38,000.00	\$ 577.63	\$ 54,874.85
15	Channel Bypass and Dewatering	1	LS	\$ 40,000.00	\$ 40,000.00	\$ 25,368.00	\$ 25,368.00	\$ 32,025.00	\$ 32,025.00	\$ 90,000.00	\$ 90,000.00	\$ 49,720.00	\$ 49,720.00
16	Excavation	1	LS	\$ 7,500.00	\$ 7,500.00	\$ 16,000.00	\$ 16,000.00	\$ 5,175.00	\$ 5,175.00	\$ 13,500.00	\$ 13,500.00	\$ 56,600.00	\$ 56,600.00
17	Grading	1	LS	\$ 45,000.00	\$ 45,000.00	\$ 7,655.00	\$ 7,655.00	\$ 17,250.00	\$ 17,250.00	\$ 20,000.00	\$ 20,000.00	\$ 10,000.00	\$ 10,000.00
18	Clean Sand Cap (9 inches)	1,100	CY	\$ 10.00	\$ 11,000.00	\$ 21.57	\$ 23,727.00	\$ 25.00	\$ 27,500.00	\$ 25.00	\$ 27,500.00	\$ 24.90	\$ 27,390.00
19	Riffle- Pool Construction	5	Each	\$ 8,000.00	\$ 40,000.00	\$ 22,000.00	\$ 110,000.00	\$ 5,750.00	\$ 28,750.00	\$ 9,000.00	\$ 45,000.00	\$ 12,905.00	\$ 64,525.00
20	Stormwater Conveyance Channel	190	LF	\$ 20.00	\$ 3,800.00	\$ 119.00	\$ 22,610.00	\$ 46.00	\$ 8,740.00	\$ 25.00	\$ 4,750.00	\$ 32.00	\$ 6,080.00
21	New Channel Streambank Construction	620	LF	\$ 100.00	\$ 62,000.00	\$ 12.89	\$ 7,991.80	\$ 63.00	\$ 39,060.00	\$ 30.00	\$ 18,600.00	\$ 15.15	\$ 9,393.00
22	Topsoil Placement	600	CY	\$ 18.00	\$ 10,800.00	\$ 29.11	\$ 17,466.00	\$ 25.00	\$ 15,000.00	\$ 25.00	\$ 15,000.00	\$ 19.50	\$ 11,700.00
23	Erosion Control Blankets	6,200	SY	\$ 4.00	\$ 24,800.00	\$ 2.34	\$ 14,508.00	\$ 2.00	\$ 12,400.00	\$ 1.50	\$ 9,300.00	\$ 1.10	\$ 6,820.00
24	Seeding	1.5	AC	\$ 2,000.00	\$ 3,000.00	\$ 1,120.00	\$ 1,680.00	\$ 4,725.00	\$ 7,087.50	\$ 5,000.00	\$ 7,500.00	\$ 3,140.00	\$ 4,710.00
25	Replacement Tree Installation	50	EA	\$ 400.00	\$ 20,000.00	\$ 250.00	\$ 12,500.00	\$ 341.00	\$ 17,050.00	\$ 375.00	\$ 18,750.00	\$ 290.44	\$ 14,522.00
26	Potted Shrub Installation	70	EA	\$ 50.00	\$ 3,500.00	\$ 76.00	\$ 5,320.00	\$ 47.00	\$ 3,290.00	\$ 50.00	\$ 3,500.00	\$ 41.15	\$ 2,880.50
27	Live Stake Installation	10,000	SF	\$ 0.60	\$ 6,000.00	\$ 0.59	\$ 5,900.00	\$ 0.47	\$ 4,700.00	\$ 0.70	\$ 7,000.00	\$ 0.30	\$ 3,000.00
28	Vegetation Maintenance	6	Mos	\$ 1,000.00	\$ 6,000.00	\$ 1,800.00	\$ 10,800.00	\$ 2,100.00	\$ 12,600.00	\$ 600.00	\$ 3,600.00	\$ 812.00	\$ 4,872.00
29	Site Restoration	1	LS	\$ 3,000.00	\$ 3,000.00	\$ 2,418.00	\$ 2,418.00	\$ 5,750.00	\$ 5,750.00	\$ 7,500.00	\$ 7,500.00	\$ 8,500.00	\$ 8,500.00
30	As-Built Survey and Drawings	1	LS	\$ 5,000.00	\$ 5,000.00	\$ 5,966.00	\$ 5,966.00	\$ 6,325.00	\$ 6,325.00	\$ 3,000.00	\$ 3,000.00	\$ 2,678.00	\$ 2,678.00
Allowances													
27	Owner Ordered Testing	1	LS	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00
28	Post Construction In Stream Adjustments	1	LS	\$ 10,000.00	\$ 10,000.00	\$ 10,000.00	\$ 10,000.00	\$ 10,000.00	\$ 10,000.00	\$ 10,000.00	\$ 10,000.00	\$ 10,000.00	\$ 10,000.00
29	SESC Routine Inspections	1	LS	\$ 3,000.00	\$ 3,000.00	\$ 3,000.00	\$ 3,000.00	\$ 3,000.00	\$ 3,000.00	\$ 3,000.00	\$ 3,000.00	\$ 3,000.00	\$ 3,000.00
30	Unforeseen Conditions	1	LS	\$ 20,000.00	\$ 20,000.00	\$ 20,000.00	\$ 20,000.00	\$ 20,000.00	\$ 20,000.00	\$ 20,000.00	\$ 20,000.00	\$ 20,000.00	\$ 20,000.00
Total				\$ 429,100.00		\$ 434,906.70		\$ 430,052.50		\$ 470,450.00		\$ 461,259.81	

APPENDIX C: SECTION 01025- MEASUREMENT AND PAYMENT

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

This section describes the method of measurement and basis of payment for all items of work included in the Contract and listed in the Bid Form. The CONTRACTOR shall provide all labor, material, tools, equipment and services required to complete the Work as specified and as indicated on the Drawings. THE OWNER ONLY WILL PAY FOR ITEMS ON THE BID FORM, AND WILL MAKE NO PAYMENT FOR ITEMS NOT INCLUDED ON THE BID FORM.

1.02 RELATED WORK

- A. Bid Form.
- B. Section 01010, Summary of Work.
- C. Section 01240, Value Engineering Incentive.
- D. Section 01310, Work Plan.

1.03 PAYMENT ITEMS

ITEM NO. 1 – Mobilization

Mobilization will be paid for at the Contract lump sum (LS) amount (not to exceed 5% of the total Contract Price). Price paid shall be payment in full for all labor, material, and equipment necessary for all preparatory work and operations, including but not limited to, the movement of personnel, equipment, supplies, and incidentals to the project site. Mobilization shall also include preconstruction costs, including permit fees and premiums for insurance and bonds, exclusive of bidding costs, which are necessary direct costs to the project and are of a generalized nature rather than directly attributable to other pay items under this Contract. This pay item shall also include all costs associated with De-Mobilization. This pay item shall include:

- the establishment of staging/storage areas;
- the establishment of construction facilities and temporary controls;
- furnish and installation of GLRI Sign;
- preparation of work schedules and schedule-of-values, and preparation of submittals ;
- other work and operations which must be performed or for expenses incurred, prior to beginning work;
- All costs associated with De-Mobilization.

Payment for mobilization will be based upon the following schedule:

Partial Payment Schedule

<u>Percentage of Total Contract Price Earned</u>	<u>Percentage of Bid Price for Mobilization Allowed</u>
5	50
10	75
25	100

ITEM NO. 2- Construction Staking

Construction Staking will be paid for at the Contract lump sum (L.S.) amount. Price paid shall be payment in full for all labor, material and equipment required for establishing staking and maintaining staking in the project area as required to control grades and lines per Drawings. All other staking required shall be considered incidental, and shall be included in the unit price.

ITEM NO. 3- Traffic Control

Traffic Control will be paid for at the Contract lump sum (L.S.) amount. Price paid shall be payment in full for all labor, material and equipment for the traffic control required to complete work. Price paid shall include but is not limited to:

- labor, material and equipment for the traffic control on Danvers Drive as required to complete work (no staging, loading, unloading, lane closures etc. allowed on 12 Mile Road);
- preparation and submission of traffic control plan for approval prior to start of work in accordance with the Michigan Department of Transportation Manual on Uniform Traffic Control Devices;
- coordination with City of Farmington Hills;
- abiding by any City or County requirements;
- all other items required to complete work.

ITEM NO. 4 – Audiovisual Tape Recording

Audiovisual Tape Recording will be paid for at the Contract lump sum (L.S.) amount. Price paid shall be payment in full for all labor, material and equipment required for the audiovisual tape recording of the project area prior to the start of Work.

ITEM NO. 5- Soil Erosion and Sediment Control

Soil erosion and sediment control will be paid for at the Contract lump sum (L.S.) amount. Price paid shall be payment in full for all labor, material and equipment required for the installation, maintenance, and removal of soil erosion and sediment control for the project.

ITEM NO. 6- Construction Fence

Construction fence will be paid for at the Contract unit price basis. Price paid shall be payment in full for all labor, material, and equipment required to install, maintain and remove construction fence as indicated on the Drawings.

ITEM NO. 7- Tree Protection

Tree protection will be paid for at the Contract lump sum (L.S.) amount. Price paid shall be payment in full for all labor, material and equipment required for the installation, maintenance, and removal of tree protection required for this project.

ITEM NO. 8- Clearing and Grubbing

Clearing and grubbing will be paid for at the Contract unit price amount. Price paid shall be payment in full for all labor, material and equipment required for clearing, grubbing, chipping, hauling, and disposal. The cost of removing and for hauling and disposal of trees, brush and woody vegetation removed shall be included in the price.

ITEM NO. 9- Tree Removal

Tree removal will be paid for at the Contract unit price amount. Price paid shall be payment in full for all labor, material and equipment required for removal, hauling and disposal of those trees that are included in the clearing and grubbing areas.

ITEM NO. 10- Bypass Demolition

Bypass demolition activities will be paid for at the Contract lump sum (L.S.) amount. Price paid shall be payment in full for all labor, material and equipment required to perform demolition activities at the bypass pipe. Price paid shall include, but is not limited to:

- removal of bypass valve and structure;
- removal of piping;
- abandonment of pipe with flowable fill;
- excavating and removal of demolition materials;
- hauling and legal disposal of demolition materials;
- rough grading of area after demolition including clean sand fill for backfill of excavation as necessary; and
- all other items necessary to complete the work.

ITEM NO. 11- Foot Bridge Demolition

Foot bridge demolition activities will be paid for at the contract unit price amount. Price paid shall be payment in full for all labor, material and equipment required to perform demolition activities at the existing food bridge. Price paid shall include but is not limited to:

- removal of foot bridge structure to 3" (min) below proposed grade;
- excavating and removal of demolition materials;
- hauling and legal disposal of demolition materials;
- rough grading of area after demolition including clean sand fill for backfill of excavation as necessary; and
- all other items necessary to complete the work.

ITEM NO. 12- Dam Demolition

Demolition activities will be paid for at the Contract lump sum (L.S.) amount. Price paid shall be payment in full for all labor, material and equipment required to perform dam demolition activities to the extent shown on the Drawings or as directed by the ENGINEER and shall include but is not limited to:

- demolition of the existing masonry and concrete dam;
- demolition of the existing masonry and concrete wing walls;
- demolition of the existing masonry and concrete parapet wall;
- any saw cutting or other techniques used for removal of materials to elevations shown on the plans;
- excavating and removal of demolition materials;
- hauling and legal disposal of demolition materials
- hauling and legal disposal or recycling of metals;
- rough grading of area after demolition including clean sand fill for backfill of excavation as necessary; and
- all other items necessary to complete the work.

ITEM NO. 13- General Demolition

General demolition activities will be paid for at the Contract unit price amount. Price paid shall be payment in full for all labor, material and equipment required to perform demolition activities as required for the removal of unforeseen items, concrete, within the project area and debris or as directed by the ENGINEER and shall include but is not limited to:

- demolition of additional unearthed concrete;
- excavating and removal of demolition materials;

- hauling and legal disposal of demolition materials
- hauling and legal disposal or recycling of metals;
- rough grading of area after demolition including clean sand fill for backfill of excavation as necessary;
- a unit price per ton provided for on the bid sheet shall be used for any additional demolition required; and
- all other items necessary to complete the work.

ITEM NO. 14- Sheet Pile Retaining Wall

Sheet pile retaining wall will be paid for at the Contract unit price amount. Price paid shall include but is not limited to:

- performing engineering for sheet pile;
- providing of signed and sealed sheet pile design by a licensed professional engineer;
- all labor material and equipment required to install a permanent steel sheet pile retaining wall as determined by approved design;
- installation of steel sheet pile;
- furnish and install fencing;
- all other items necessary to complete the work.

ITEM NO. 15- Channel Bypass and Dewatering

Channel bypass and dewatering activities will be paid for at the Contract lump sum (L.S.) amount. Price paid shall be payment in full for all labor, material and equipment required to bypass the existing pond with a steel sheet pile cofferdam and 36-inch HDPE pipe flume, and to dewater the pond and maintaining it in a dewatered state throughout construction as shown on the Drawings or as directed by the ENGINEER and shall include but is not limited to:

- installation of approximately 400 square feet of steel sheet pile cofferdam with a 36" steel pipe stub;
- installation of approximately 300 feet of 36" HDPE pipe;
- installation and operation of pumps to dewater the stream channel and pond and to maintain a dewatered condition;
- treatment of sediment-laden construction water during dewatering to prevent discharge of sediment to Pebble Creek;
- bypass pumping as needed throughout the work and
- all other items necessary to complete the work.

ITEM NO. 16- Excavation

Excavation will be paid for at the Contract lump sum (L.S.) basis. Price paid shall be payment in full for all labor, material and equipment required for excavation required to perform the work and shall include but is not limited to:

- excavation to unearth the concrete and masonry box culvert;
- excavation to facilitate dam demolition;
- excavation to facilitate general demolition;
- excavation of the new stream channel to rough and final grades; and
- all other items necessary to complete the work.

ITEM NO. 17- Grading

Grading will be paid for at the Contract lump sum (L.S.) amount. Price paid shall be payment in full for all labor, material and equipment required for establishing grades shown on Drawings and shall include but is not limited to:

- grading in areas outside existing pond limits to grades shown on Drawings;
- grading of soil excavated from new channel;
- grading of excess soil generated during excavation for demolition;
- grading of excess fill generated from grading – soil balancing;
- grading of new channel bottom and streambanks; and
- all other items necessary to complete the work.

ITEM NO. 18- Clean Sand Cap

Clean Sand Cap will be paid for at the Contract unit price basis. Measurement shall be based on load tickets in tonnage equivalent and depths verified by ENGINEER. Depths in excess of 9 inches shall not result in an increase in the Contract quantity. Price paid shall be payment in full for all labor, material and equipment required for placing and grading the clean sand cap to the limits shown on Drawings and shall include but is not limited to:

- acquiring and hauling fill to the site;
- placing and grading fill along existing sea walls, compaction of fill to specifications, and compaction testing;
- placing and grading a 9-inch cap over impoundment bottom to extents shown on Drawings, roller compacting, and verification of cap depth;
- grading of all fill to establish final grades; and
- all other items necessary to complete the work.

ITEM NO. 19- Riffle-Pool Construction

Riffle-Pool construction will be paid for at the Contract unit price basis. Measurement shall be based on actual number riffle-pools completed and approved by ENGINEER. Price paid shall be payment in full for all labor, material and equipment required for constructing five (5) rock riffle-pools to lines, grades, and dimensions shown on Drawings and shall include but is not limited to:

- acquiring and hauling riprap and boulders to the site;
- excavation for placement of boulders and riprap;
- placement of riprap and boulders;
- riprap and boulder adjustments as directed by ENGINEER; and
- all other items necessary to complete the work.

ITEM NO. 20- Storm Water Conveyance Channel

Storm Water Conveyance Channel will be paid for at the Contract unit price basis. Measurement shall be based on the actual field measured length from the existing 18" HDPE storm sewer invert to the junction with the new stream channel. Price paid shall be payment in full for all labor, material and equipment required for constructing approximately 240 lineal feet of channel to the lines, grades, and dimensions shown on Drawings and shall include but is not limited to:

- excavation of subgrade and Clean Fill Cap to lines, grades, and dimensions shown on Drawings;
- acquire and deliver riprap and boulders to the site;
- placements of boulders;
- placement of riprap at dissipation pool at existing 18" HPDE storm sewer;
- adjustments to boulders at direction of ENGINEER; and

- all other items necessary to complete the work.

ITEM NO. 21- New Channel Streambank Construction

New Channel Streambank Construction shall be paid for at the Contract unit price basis. Measurement shall be based on in-place measured length. Price paid shall be payment in full for all labor, material and equipment required to construct approximately 600 lineal feet of streambank along both sides of the new channel as shown on the Drawings or as directed by the ENGINEER and shall include, but is not limited to:

- fine grading;
- placement of fabric and soil erosion blankets;
- compaction;
- all other items necessary to complete the work.

ITEM NO. 22- Topsoil Placement

Topsoil Placement shall be paid for at the Contract unit price basis. Price paid shall be payment in full for all labor, material and equipment required to place and grade 3 inches of topsoil. Measurement shall be based on load tickets in tonnage equivalent and field verification by ENGINEER of placed topsoil depths. Placed topsoil depths in excess of 3 inches will not result in an increase of Contract quantity.

ITEM NO. 23- Erosion Control Blankets

Erosion Control Blankets shall be paid for at the Contract unit price basis. Price paid shall be payment in full for all labor, material and equipment required to install erosion control blankets to the extent shown on the Drawings and shall include, but is not limited to:

- acquire and deliver materials to the site;
- installation of C-125, SC-150, S75 according to the manufacturer's instructions including appropriate overlaps and grade tie-ins;
- providing and installing stapling according to manufacturer's instructions; and
- all other items necessary to complete the work.

ITEM NO. 24- Seeding

Seeding will be paid for at the Contract unit price basis. Price paid shall be payment in full for all labor, material and equipment required to seed to the extent shown on the Drawings and using specified seed mixes and shall include, but is not limited to:

- acquiring and delivering seed mix to the site;
- use of acceptable hydro-mulch applied at the specified rate;
- application of specified seed mixes within the correct zones;
- application of specified seed mixes at the specified seeding rates;
- coordination with grading, topsoil placement, and erosion control blanket installation; and
- all other items necessary to complete the work.

ITEM NO. 25- Replacement Trees

Replacement Trees will be paid for at the Contract unit price basis. Measurement shall be based on count of installed trees and installation approved by ENGINEER. Price paid shall be payment in full for all labor, material and equipment required to install replacement trees as shown on the Drawings and shall include, but is not limited to:

- acquiring and delivering trees to the site;

- acquiring approval of delivered stock from ENGINEER prior to installation;
- acquiring approval for alternate species from ENGINEER prior to installation;
- installing trees at approximate locations shown on Drawings
- installing trees using commonly accepted horticultural practices;
- watering, maintenance, and guarantee for one full growing season following installation;
- coordination with grading, topsoil placement, and erosion control blanket installation; and
- all other items necessary to complete the work.

ITEM NO. 26- Potted Shrubs

Potted Shrubs will be paid for at the Contract unit price basis. Measurement shall be based on count of installed shrubs and installation approved by ENGINEER. Price paid shall be payment in full for all labor, material and equipment required to install shrubs as shown on the Drawings and shall include, but is not limited to:

- acquiring and delivering shrubs to the site;
- acquiring approval of delivered stock from ENGINEER prior to installation;
- acquiring approval for alternate species from ENGINEER prior to installation;
- installing shrubs at approximate locations shown on Drawings
- installing shrubs using commonly accepted horticultural practices;
- watering, maintenance, and guarantee for one full growing season following installation;
- coordination with grading, topsoil placement, and erosion control blanket installation; and
- all other items necessary to complete the work.

ITEM NO. 27- Live Stake Installation

Live Stake Installation will be paid for at the Contract unit price basis. Measurement shall be based on Contract Drawings and installation approved by ENGINEER. Price paid shall be payment in full for all labor, material and equipment required to install live stakes at the spacing and to the extents shown on the Drawings and shall include, but is not limited to:

- acquiring and delivering live stakes to the site;
- acquiring approval of delivered stock from ENGINEER prior to installation;
- acquiring approval for alternate species from ENGINEER prior to installation;
- installing live stakes at approximate spacing and locations shown on Drawings;
- installing live stakes using commonly accepted practices; and
- all other items necessary to complete the work.

ITEM NO. 28 - Vegetation Maintenance

Vegetation Maintenance will be paid for at the Contract unit price amount. Price paid shall be payment in full for all labor, material, and equipment required for remedying conditions during the growing season and shall include, but is not limited to:

- watering as required by site conditions and specifications and maintenance required for re-vegetation during extent of project;
- weeding and maintenance at a minimum once a month during growing seasons;
- invasive species removal;
- other items necessary to complete the work

ITEM NO. 29- Site Restoration

Site Restoration shall be paid for on a Contract lump sum (L.S.) amount. Price paid shall be payment in full for all labor, material and equipment required to perform completion of site restoration within the Limits of

Work/Disturbance shown on the Drawings or as directed by the ENGINEER and shall include, but is not limited to:

- restoration of existing pavement;
- restoration of existing curb and gutter;
- restoration of damaged utilities;
- restoration of any other structures;
- restoration of vegetated areas to original grade and existing vegetation types;
- all other items necessary to complete the work.

ITEM NO. 30- As-Built Surveys and Drawings

As-Built Surveys and Drawings will be paid for at the Contract lump sum (L.S.) amount. Price paid shall be payment in full for all labor, material and equipment required for the providing an as-built survey and certified as-built documents of the project following the completion of Work. As-built documents shall include 1 copy of marked up field drawings, 3 copies of certified as-built drawings by a professional surveyor, and 1 copy digital AutoCAD file containing as-built survey data. The base survey will be provided to the Contractor by the ENGINEER.

ALLOWANCES

ITEM NO. 31 – Allowance for Owner Ordered Testing

Construction testing services will be paid for at the actual cost as invoiced by the testing companies plus 5%. Price paid shall be payment for all labor, material, and equipment required to perform the required project testing.

ITEM NO. 32 - Allowance for Post-Construction In-stream Structure Adjustment

Pos-Construction In-Stream Structure Adjustment will be paid for at the negotiated price (lump sum or unit price) after Work has been authorized by the ENGINEER. This price shall include all labor, materials, and equipment necessary to complete the work. This may include one individual work item or a collection of items at a negotiated price. This may include one individual occurrence or multiple occurrences. Adjustments to installed features (including, but not limited to engineered riffle, stone toe and vegetation) may be required post construction. Post-Construction Structure Adjustments shall be authorized if adjustments are required due to an Act of God and shall not cover any Work required as a result of Contractor error during construction. One adjustment shall not necessarily be justification for the full allowance lump sum and will be negotiated per incident.

ITEM NO. 33 – Allowance for SESC Routine Inspections

The CONTRACTOR shall apply for and obtain all City and County permits required for soil erosion and sedimentation control, supply inspection deposit, and other work as required. The CONTRACTOR will be reimbursed at cost for the actual inspection deposit charged plus 5%. Price paid shall be for the inspection deposit and will be applied to routine inspections made by the City's representative. Routine inspections are scheduled by the City's representative at regular intervals and/or after a rain event. Any inspections required to follow up on corrective action shall be paid for by the contractor.

ITEM NO. 34 - Allowance for Unforeseen Conditions

Unforeseen Conditions will be paid for at the negotiated price (lump sum or unit price) after the Work has been authorized by the ENGINEER. This may include one individual work item or a collection of items at a negotiated price. This may include one individual occurrence or multiple occurrences. Price paid shall be payment in full for all labor, material, and equipment required for remedying the conditions and shall be

based upon an agreement negotiated and approved price prior to beginning this Work. One adjustment shall not necessarily be justification for the full allowance lump sum and will be negotiated per incident.

ALTERNATE A1

ITEM NO. A1- Culvert Restoration

Culvert Rehabilitation shall be paid at the Contract lump sum (L.S.) amount. Price paid shall be payment in full for all labor, material and equipment required to provide and install culvert extension as shown on Drawings and shall include but is not limited to:

- demolition of the existing masonry and concrete abutments and ceiling of the box culvert;
- relocation of live conduits, as necessary;
- abandonment of dead conduits, as necessary;
- excavating and removal of demolition materials;
- off-site disposal of concrete and masonry within the existing pond;
- hauling and legal disposal or recycling of metals;
- rough grading of area after demolition including clean sand fill for backfill of excavation as necessary;
- performing engineering for culvert restoration, including culvert end section, associated connections, reinforced collar, bedding, stabilization and construction methods;
- providing of signed and sealed culvert restoration design by a licensed professional engineer;
- acquiring and delivering culvert materials to the site, per approved design;
- assembling and installing culvert extension;
- matching existing culvert upstream invert elevation;
- all associated bedding, grading, soil and water tight connections, reinforced concrete collar; and
- providing of signed and sealed sheet pile design by a licensed professional engineer;
- removal and resurface of 50 Lf of Danvers Drive;
- all other items necessary to complete work.

PART 2 PRODUCTS (NOT USED)
PART 3 EXECUTION (NOT USED)

APPENDIX D: PHOTOGRAPHS



June 5, 2012:
Clearing, view looking south



June 5, 2012:
Stumps and logs in clearing area



June 5, 2012:
Stumps and logs in clearing area



June 5, 2012:
Turbidity Barrier



June 5, 2012:
Swirling caused by turbidity barrier



June 5, 2012:
West side of pond, looking southwest



June 5, 2012:
Water from west side of pond flowing northeast towards dam



June 5, 2012:
Looking southwest over dam



June 5, 2012:
Water flowing from pond



June 5, 2012:
Looking south across pond; cleared and dredged area



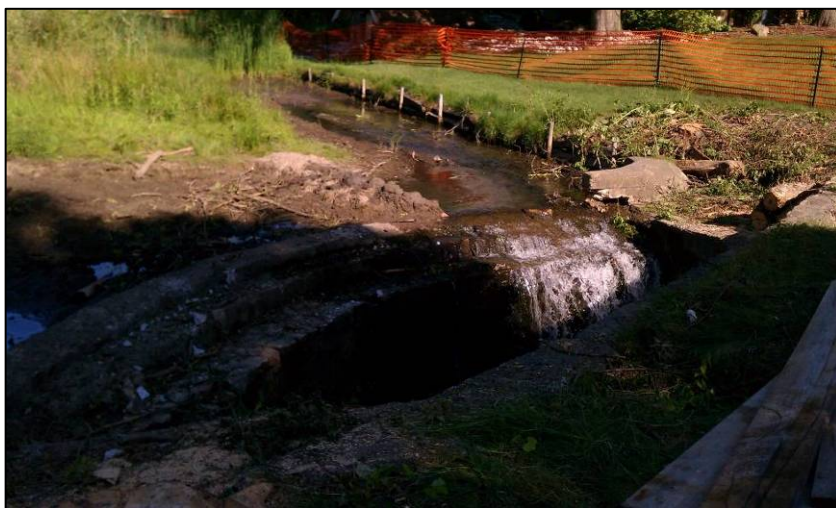
June 5, 2012:
Small rapids immediately downstream of dam



June 7, 2012:
South side of site, equipment staged



June 7, 2012:
View looking west, from road
embankment



June 7, 2012:
Dam, note water running over north
part of dam



June 14, 2012:
Demolishing dam to make room for bypass pipe



June 14, 2012:

Dam appears to have been constructed from manhole structures turned on their sides



June 14, 2012:

View south across pond. The bypass pipe has been placed



June 14, 2012:

The pond bottom is extremely soft



June 14, 2012:
Temporary dam with tap for bypass pipe



June 14, 2012:
Temporary dam with erosion fence



June 14, 2012:
Temporary dam



June 14, 2012:
Groundwater surfacing



June 14, 2012:
Groundwater surfacing



June 14, 2012:
Bypass pipe with drainage along either side



June 14, 2012:
Cutting concrete



June 14, 2012:
Site work, view looking north



June 14, 2012:
Equipment near culvert



June 14, 2012:
Excavator



June 14, 2012:
Sheet pile cofferdam with pipe stub.



June 14, 2012:
Installation of bypass flume



June 14, 2012:
Pipe onsite for bypass flume



June 14, 2012:
Chipper onsite



June 14, 2012:
Site, view looking north



June 18, 2012:
Site, view looking west, after a rain event



June 18, 2012:
Site, view looking northwest, after a rain event



June 18, 2012:
Site, view looking west, after a rain event



June 20, 2012:
Excavation of proposed channel



June 14, 2012:
Excavation of proposed channel



June 14, 2012:
Plugging leaks in temporary dam



June 20, 2012:
Plugging leaks in temporary dam – close up



June 20, 2012:
West side of pond – completely dredged



June 20, 2012:
Demolished dam



June 20, 2012:
Water pumped from west side of pond to upstream of temporary dam



June 20, 2012:
Water exiting bypass pipe



June 20, 2012:
Groundwater surfacing on west side of former pond



June 20, 2012:
Groundwater surfacing as channel is being excavated



June 20, 2012:
Grading the proposed streambank



June 20, 2012:
Checking grades of proposed streambank



July 11, 2012:
Temporary emergency spillway
channel



July 11, 2012:
Excavating/grading at the north end
of site



July 11, 2012:
Access Road over temporary
emergency overflow



July 30, 2012:
North end of site, placing rock
aprons



August 6, 2012:
Riffle pools 4 & 5, view looking upstream (west)



August 6, 2012:
Concrete walls at end of culvert



August 6, 2012:
Rock apron at north storm sewer outfall



August 6, 2012:
Rock Apron at west storm outfall



August 6, 2012:
Crew working on Riffle crest 4



August 15, 2012:
North boulder wall



August 15, 2012:
North side of stream near boulder wall



August 15, 2012:
Concrete walls at culvert with boulder wall



August 15, 2012:
North boulder wall



August 20, 2012:
Stream channel looking upstream



August 20, 2012:
Riffle 2 construction



August 20, 2012:
Coffer dam



August 20, 2012:
Rock apron at north sewer outfall



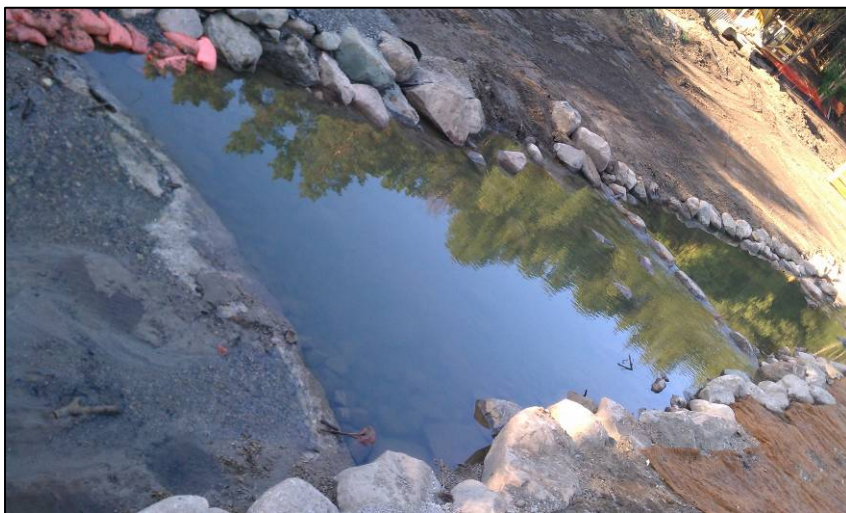
August 20, 2012:
North end of site, looking
northeast



August 20, 2012:
North end of site, looking
northwest



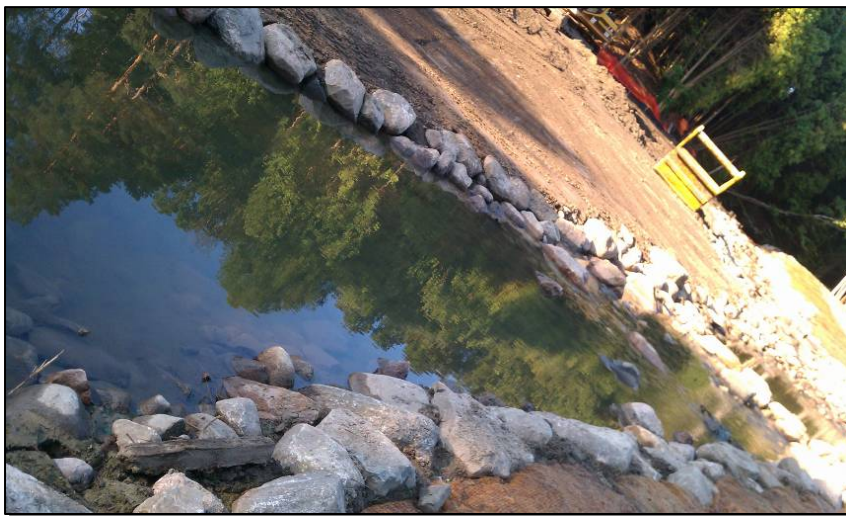
August 20, 2012:
Stream channel, looking upstream
(west)



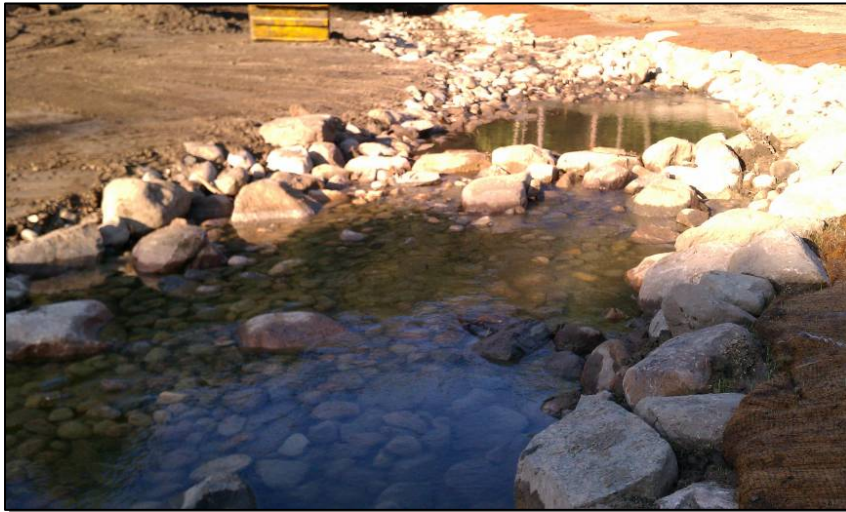
August 22, 2012:
Riffle/pool 5



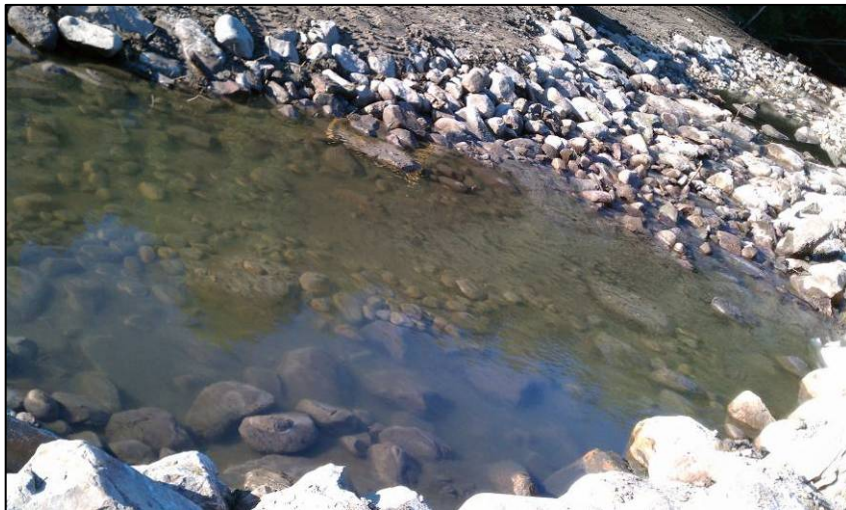
August 22, 2012:
Stream channel looking upstream (west)



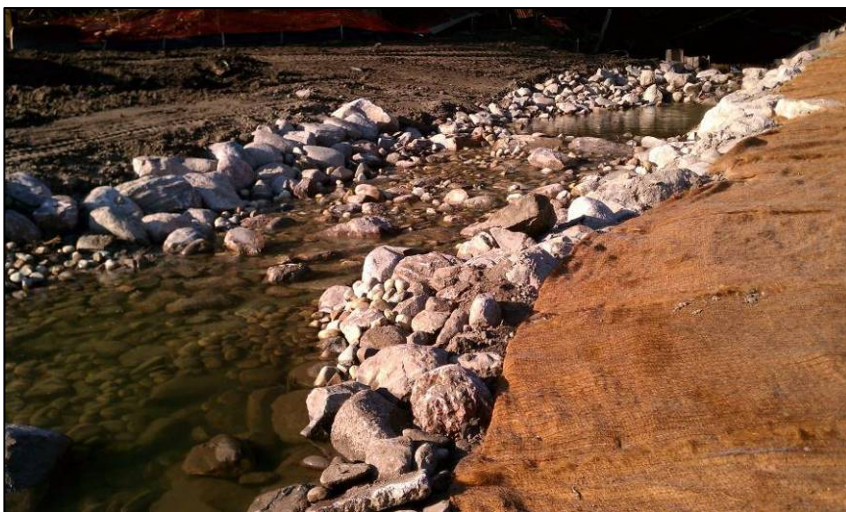
August 22, 2012:
Pool 4



August 22, 2012:
Riffle 4



August 22, 2012:
Pool 3



August 22, 2012:
Riffle 3



August 22, 2012:
Swale near north storm water
outfall



August 23, 2012:
Stream channel looking upstream



August 23, 2012:
Drainage pipe outlet from east
property



September 6, 2012:
Tree and shrub delivery



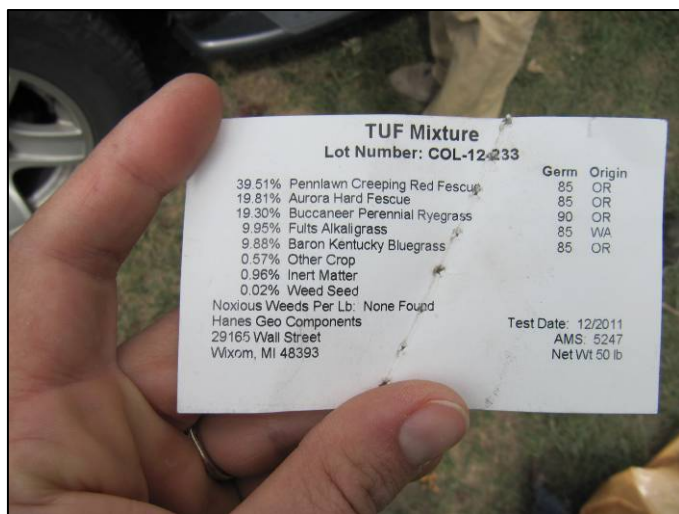
September 6, 2012:
Unloading Trees



September 6, 2012:
Installation of trees shrubs



September 18, 2012:
Seed mix label



September 18, 2012:
Turf mix label



September 18, 2012:
Coconut fiber mat label



September 18, 2012:
Straw mat label



September 18, 2012:
Erosion control matting



September 18, 2012:
Seed installation



September 18, 2012:
Erosion control delivery



September 18, 2012:
Corners covered



September 18, 2012:
Soil pile left for homeowner



September 18, 2012:
Erosion Control Blanket



September 26, 2012:
Restored Site



October 26, 2012:
Restored Site



October 31, 2012:
Shotcrete (Gunitite) work



November 19, 2012:
Restored Site