



Department of Energy
Office of Legacy Management

May 22, 2008

Mr. Timothy Fischer
U.S. Environmental Protection Agency
Region V-SRF-6J
77 W. Jackson Blvd.
Chicago, IL 60604-3590

Mr. Thomas Schneider, Project Manager
Ohio Environmental Protection Agency
Southwest District Office
401 East Fifth Street
Dayton, Ohio 45402-2911

Dear Mr. Fischer and Mr. Schneider:

Subject: **Transmittal of the Fernald Preserve Visitors Center Bio-Treatment Wetland Final Design**

This letter transmits the final design drawings and specifications for the Fernald Preserve Visitors Center Bio-Treatment Wetland Project.

This final design incorporates the 90 percent design Response to Comments that were submitted to U.S. and Ohio EPA on April 21, 2008. Ohio EPA approved the Response to Comments on May 5, but expressed concern regarding the reliance on *Scirpus atrovirens* for the sub-surface flow (SSF) wetland planting approach. DOE recognizes OEPA's concern regarding stress on vegetation due to variability in flow or other factors. Note that the variability in flow will be reduced through pumping from the flow equalization and recirculation manholes. Nevertheless, DOE is prepared to revise the SSF wetland planting strategy if signs of stress are observed. Details regarding vegetation management will be provided in the Operations and Maintenance (O&M) Manual. The O&M Manual will be provided at project completion.

If you have any questions, please call me at (513) 648-3148.

Sincerely,

Jane Powell,
Fernald Site Manager
DOE-LM-20.1

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REPLY TO: Harrison Office

Mr. Timothy Fischer
Mr. Thomas Schneider
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Enclosure

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LEED Requirements

1. To the extent possible, the project will incorporate the following LEED requirements:
 - Recycle and/or salvage at least 50% of non-hazardous construction and demolition. Excavated soil and land-clearing debris do not contribute toward this credit.
 - Use salvaged, refurbished, or reused materials such that the sum of these materials contributes at least 5%, based on cost, of the total value of materials on the project. Only include materials permanently installed in the project.
 - Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of the total value of the materials in the project.
 - Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for a minimum of 10% (based on cost) of the total materials value.
 - Use rapidly renewable building materials and products (made from plants that are typically harvested within a ten-year cycle or shorter) for 2.5% of the total value of all building materials and products used in the project (based on cost).
 - Use a minimum of 50% of wood-based materials and products, which are certified in accordance with the Forest Stewardship Council's Principles and Criteria, for wood building components.

General Information

1. All work shall be completed in compliance with applicable federal, state, and local regulations.
2. All units shall be installed in accordance with the manufacturer's recommendations.
3. All units installed at grade shall provide adequate sloping to divert surface run-on from the treatment system.

Surveying

1. The work covered by this section shall include, but not be limited to, establishing survey control points, surveying existing conditions, providing survey control during construction, and providing final 'as-built' documentation.
2. An independent registered Land Surveyor licensed in the State of Ohio shall be provided.
3. The Surveyor shall provide, at a minimum, the following components:
 - (a) The initial site conditions (including existing grades, utilities, and pertinent site features).
 - (b) Areas of clearing and disturbance.
 - (c) Base of subsurface flow (SSF) and surface flow (SF) wetlands and final grades.
 - (d) Final elevations of any areas disturbed by site activities.
 - (e) Stormwater swales, berms, and other management features.
 - (f) Location, width and depth of the manhole(s).
 - (g) Location, elevation, and size of lift station, septic tanks, and equalization tank.
 - (h) All invert elevations of wastewater conveyance units.

Site Preparation

Site preparation shall include, but not be limited to, existing utility location, protection, or abandonment; installation of erosion and sediment control measures; clearing and grubbing, the demolition and removal of incidental structures and debris; installing temporary facilities, such as trailers; installing temporary fencing for protection of the site, and preparing the Site for work activities.

Clearing and grubbing shall be minimized to the extent possible. Materials to be cleared shall include trees, shrubs, grass, any other standing vegetation, and any surface debris or foreign matter that may impede the safe, effective, and efficient implementation of Site activities, including excavation, filling, or installing erosion and sediment control features.

Erosion and Sediment Control Measures

Work will be completed under the existing Erosion and Sedimentation Control Plan developed for the Fernald Preserve Visitor Center. Work shall include, but not be limited to, furnishing, installing, and maintaining temporary and permanent erosion and sediment control features during all work activities. Adequate erosion control measures shall be implemented during and after construction of the wetland treatment system construction, water conveyance trenches, and all other components of construction. All erosion and sediment control measures shall be installed prior to earthmoving activities.

Earthwork

1. Earthwork shall include, but not be limited to, the furnishing, excavating, hauling, handling, placement, and compaction of fill soil for excavation backfill, trench backfill, Treatment Wetland System construction, general site grading required by the Drawings, and the Contract Documents.
2. General fill and topsoil should be obtained from an on-site source designated by the owner's representative.
3. General fill should consist of natural on-site soils free from stones exceeding two inches in any dimension, significant organic matter, and debris. Grain size analysis and Atterberg limits will be obtained where necessary.
4. Excavations and fills shall be made to the elevations, contours, and dimensions specified in the Drawings.
5. Remove of all water entering excavation in such a manner as shall not interfere with the progress of work. Discharge of construction water will be coordinated with the owner's representative.
6. General fill for all general earthwork shall be placed in 12 inch lifts, unless otherwise designated by the owner's representative. General fill shall be placed in a uniform lift and compacted prior to the placement of succeeding lifts. A minimum of four passes per lift with an 84-in sheep foot roller (or equivalent) will be required. Acceptability of the compaction will be based on visual inspection.
7. Sufficient water will be added during the compaction effort to assure proper soil compaction where required. If the material exceeds the moisture content for satisfactory compaction due to rain or other causes, it shall be allowed to dry before compaction or filling efforts are resumed.
8. Field quality assurance shall include visual field inspection by the design engineer.
9. Soils from the excavation of the SSF and SF wetlands will be stockpiled for berm construction. Should sufficient soils not be available, additional soils will be obtained from an on-site borrow source designated by the owner's representative.
10. The SSF and SF wetland excavations, perimeter berms, separator berms, and cross berms shall be constructed as shown on the Drawings.

Geomembrane

1. A minimum 30 mil PVC, or 40 mil High Density Polyethylene (HDPE) or Low Density Polyethylene (LLDPE) geomembrane liner shall be installed at the base grade of the SSF wetland and anchored within the berm.
2. The subgrade should be free of rocks greater than 0.472-in diameter, sticks, or debris to protect the liner from punctures. An 8-ounce non-woven geotextile fabric shall be placed prior to liner installation.
3. A geotextile fabric consisting of an 8-ounce non-woven geotextile, or equivalent, will be placed over the installed liner at the inlet and outlet to protect the liner from punctures potentially caused by the stone.
4. The geomembrane liner shall be fabricated by the manufacturer and shipped to the site complete for each wetland cell and surrounding berm.
5. Installation, including inlets, outlets, and berm anchoring shall be in compliance with the liner manufacturer's specifications (Attached).
6. Liner installation methods that will not damage, stretch or crimp geomembrane and protect underlying surface from damage shall be used.
7. The liner will be installed without cuts, holes, tears, or damage that may modify the integrity of the geomembrane.
8. Test field seams as needed using non-destructive methods over their full length using a vacuum test unit, air pressure (for double-fusion seams only) or other approved methods; tests shall be completed as the seaming progresses, and not at the completion of all the field seaming. All defects shall be repaired.
9. Seam pipe penetrations using boots or other methods as approved by liner manufacturer and/or liner fabricator.

Construction of SSF Wetland

1. In general, the SSF wetland system will consist of a protective geotextile fabric, a geomembrane liner, washed pea gravel bed media, influent distribution and effluent collection components, hydraulic control structures, an organic layer, and wetland plants. The SSF wetland shall be constructed with two parallel cells.
2. Bed media consisting of washed pea gravel shall be placed as specified in the Drawings.
3. The bottom of the SSF wetland shall be level and at the elevation shown on the Drawings.
4. The protective geotextile fabric over the base of the SSF wetland in accordance with the Drawings and manufacturer's specifications.
5. The geomembrane liner shall be placed over the protective geotextile and installed in accordance with the Drawings and specifications.
6. Bed media will be placed over the geomembrane liner to the depth specified in the Drawings. Placement of the bed media shall be performed in accordance in a manner that will not damage the geomembrane.
7. Influent distribution components shall be installed in accordance with the Drawings.
8. Effluent collection components shall be installed as shown in the Drawings.
9. A three-inch layer of well-degraded mulch (peat or compost) that is free of weeds will be installed at the bed surface.
10. Mulch shall be placed in a smooth layer during dry weather, with no low, rough, or soft areas.

Construction of SF Wetland

1. In general, the SF wetland treatment system will include hydraulic control structures, inlet and outlet piping, and wetland plants. The SF wetland shall be constructed as one cell.
2. The SF wetland basin shall be level and at the elevation listed in the Drawings.
3. Hydraulic control structures and inlet and outlet piping shall be installed as specified in the Drawings.
4. Four to six inches of organic matter (well degraded weed free mulch) will be applied to the SF wetland basin. The organic matter shall be tilled eight to 10 inches deep, in order to expedite establishment of the vegetative cover.

SSF Wetland Planting

1. Rootstock shall be used for the SSF wetland.
2. All plant material shall be 100% free of weeds to the extent practical.
3. If not planted immediately after being delivered to the job site, rootstock and potted plants and rootstock shall be stored out of direct exposure to sun. Plant stock shall be kept moist through periodic watering until the time of planting.
4. SSF wetland plants will consist of the following:

Common Name	Scientific Name
Blue Flag Iris	<i>Iris versicolor</i>
Green Bulrush	<i>Scirpus atrovirens</i>
River Bulrush	<i>Scirpus fluviatilis</i>
Duck Potato	<i>Sagittaria latifolia</i>
Prairie Cordgrass	<i>Spartina pectinata</i>

5. Use at least three different species of rootstock.
6. At least 60% of rootstock shall be *Scirpus atrovirens* (Green Bulrush)
7. Plants shall be spaced 2-feet by 2-feet (4 square feet per plant).
8. Rootstock in the form of tubers shall be at least 5/8-inch in diameter. Rootstock in the form of rhizomes shall be at least 2 inches long.
9. Duck Potato rootstock will be in the form of tubers at least 5/8-inch in diameter. Blue Flag Iris rootstock in the form of rhizomes shall be at least 2 inches long. Green Bulrush, River Bulrush, and Prairie Cordgrass shall be in the form of root wads. Bodies and shoots associated with rootstock shall be rigid to the touch. The Engineer shall reject bodies and shoots that are soft, mushy and appear rotten or decomposed. Established root stock shall contain roots that are rigid to the touch. Tubers and rhizomes shall be white in appearance.
10. To plant stock, hand-dig through mulch layer and SSF wetland media. Plant stock directly into media.
11. Refer to Operation and Maintenance (O&M) Manual for vegetation establishment procedures.

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S.M. Stoller Corporation
Final Design
May 15, 2008**

12. Optimum planting date begins May 15. Acceptable planting dates are from May 15 through September 15.

SF Wetland Planting

1. Seed mix shall be used for the SF wetland.
2. Seed mix will be provided by owner.
3. Immediately before seeding, the soil should be fully or partially saturated and should not be allowed to dry after planting.
4. Seed shall be distributed evenly over footprint of surface flow wetland. Seeding shall be completed by broadcasting using rotary seeders, or by hand, and then lightly raking into the soil. Seeding rate will be provided by owner.
5. Refer to O&M Manual for vegetation establishment procedures.
6. Optimum planting dates are from June 1 through July 1. Acceptable planting dates are from May 15 through September 15.
7. Refer to the O&M Manual for Canada geese control.

Berm and Diversion Ditch Planting

1. Diversion ditches that convey surface water run-on away from the treatment system and berms surrounding the wetlands will be seeded.
2. Prepare subsoil to eliminate uneven areas and washouts. Maintain lines, levels, profiles and contours
3. Remove foreign materials, weeds and undesirable plants and their roots.
4. Loosen the soil to a minimum depth of 3 inches using disks, harrows, field diggers or other suitable equipment. Leave soil surface in a roughened condition with clods, lumps and tillage ridges approximately 3 inches high
5. Place topsoil on berms and ditches. Place topsoil during dry weather.
6. Remove vegetable matter and foreign nonorganic material from topsoil while spreading. Grade topsoil to eliminate rough, low or soft areas, to ensure positive drainage to a minimum depth of 4 inches.
7. Diversion ditches shall be seeded in accordance with ODOT Item 659, Seeding and Mulching (attached).
8. Berms shall be seeded with a tallgrass prairie seed mix emphasizing natural species.

Common Name	Scientific Name
Big Bluestem	<i>Andropogon gerardii</i>
Blue Joint Grass	<i>Calamagrostis canadensis</i>
Switch Grass	<i>Panicum virgatum</i>
Woolgrass	<i>Scirpus cyperinus</i>
Prairie Cordgrass	<i>Spartina pectinata</i>

9. At least three different grass species shall be used.
10. Prairie seed mix shall be applied at a rate of 1.0 pound per 1,000 square feet using a seed drill, such as a Truax drill, or equivalent.
11. After planting berms with native grass, plant area with a cover crop of oats or barley at a rate of 3.0 pounds per 1,000 square feet.

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12. Hay, straw or cellulose fiber mulch shall be applied on all seeded areas with a 4:1 slope or flatter. Application rate for straw or hay mulch shall be 105 pounds (air dry weight) per 1,000 square feet. Application rate for wood cellulose fiber mulch shall be 5 pounds (air dry weight) per 1,000 square feet.
13. Biodegradable erosion control blankets, such as coir mats or Agridrain Geojute® or equivalent, shall be applied on all seeded areas with a slope equal or greater than 4:1.
14. Do not sow immediately after rain or during days of high wind velocity (> 10 mph).
15. Suitable planting dates are March 15 to May 15.
16. Refer to O&M Manual for vegetation establishment procedures.
17. Canada wild rye shall be used for upland areas beyond berms (by others).

Black Willow Planting

1. All plant material shall comply with American Standard for Nursery Stock ANSI Z60.1. Suitable planting time is Spring, when ground is not frozen.

2. Bare root seedling willow trees shall be planted in the locations indicated in the Drawings. Spacing shall be 10 feet by 10 feet.

3. Seedlings must be at least one year old and no more than two years old.

4. Seedling source must be of the same latitude as Project Site, \pm 200 miles.

5. Tree seedlings require water and cool temperatures to survive until planted. If planting will be delayed longer than a week, roots and packing materials must be damp, sealed, and store the package in a cool place, periodically checking the condition of the tree's roots. Planting delays will affect survival rate.

6. To plant, insert dibble bar at angle and push forward to upright position. The dibble bar must be longer than root depth to prevent root bending or twisting. A sturdy spade may be substituted for a planting bar using this technique. Mechanical planting techniques may also be utilized.

7. Place seedling to depth grown at nursery. Make sure root is straight. ***Roots must not be bent or twisted.***

8. Insert dibble two inches from seedling, then pull back to pack the soil around roots.

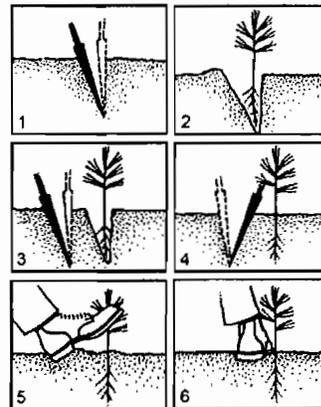
9. Push handle toward the seedling to finish packing soil at top of roots.

10. Fill in second hole by stomping with heel.

11. Pack soil around seedling with feet.

12. If cuttings are used, at least 60% of the cutting should be below ground.

13. Refer to O&M Manual for vegetation establishment procedures.



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Final Design
May 15, 2008**



FIELD INSTALLATION

QUALITY ASSURANCE MANUAL

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1.1.0 INTRODUCTION

1.1.1. Purpose

Quality assurance refers to means and actions employed by In-Line Plastics, LC (ILP) to assure conformity of the lining system installation with the Quality Assurance Plan, drawings and specifications.

This manual addresses the quality assurance of the installation of flexible membrane liners and other geosynthetic products used by ILP in waste disposal landfills, surface impoundments or other installations as specified by the owner and/or Engineer. This manual therefore delineates the In-Line's quality procedures and standards for installation.

The typical use of geosynthetic components of a lining system are discussed in this manual. This includes polyethylene geomembranes, geotextiles, geonets and geocomposites. This manual can be a useful guide in delineating the quality assurance procedures and requirements for the installation of all the above geosynthetic products. The site specific QA depends on job specifications and site conditions.

This manual does not address the quality assurance of soils, except in cases where soil placement may have an influence on the geosynthetics.

1.1.2. Scope of Quality Assurance

The scope of this manual includes the quality assurance applicable to shipment, handling, and installation of all geosynthetics. In particular, full time quality assurance of the installation of geomembranes and the installation of other geosynthetics is essential. (See exhibit A for QA Chart)

This manual does not address design guidelines, installation specifications, or selection of geomembranes or other geosynthetics (which includes compatibility between geosynthetic and contained material).

1.2.0 Construction Meetings

1.2.1 Progress Meetings

It is recommended an informal daily installation Progress Meeting be held among appropriate parties to discuss current progress.

1.3.0 Delivery, Storage, and handling

Membrane delivered to the site shall be unloaded prior to In-Line crew arrival and stored with a minimum of handling. Each roll will be uniquely labeled.

Inventory shall be taken at the time of delivery. As the membrane is unloaded, it shall be inspected for damage. Any damage will be noted and repaired per specification. The "inventory Report" form will be used as material is delivered. Any shortages shall be noted as missing items ordered.

Membrane material shall be handled with equipment that will not damage the membrane. The storage area required shall be reasonably flat and well drained. The surface shall be free of sharp rocks or other objects that may damage the membrane.

The storage area must be as close as practical to the work area in order to minimize on site handling. The storage area must also be secure to prevent vandalism and theft and must be such that the membrane is not likely to be damaged by passing vehicles.

1.4.0 Equipment

1.4.1 Welding Equipment

Two practical types of welding equipment can be utilized: Wedge, and Extrusion.

A. Wedge Welding

For panel seaming with varying subgrade, the contractor shall provide automated welding equipment. The equipment shall be capable of measuring the temperature at the wedge and monitoring the automated equipment to assure it maintains a consistent pressure to achieve a passing field weld.

The power source shall be capable of providing constant voltage under a combined-line load.

B. Extrusion Welding

For extrusion welding, the contractor shall provide a field extrusion welder capable of adhering a continuous bead between the panels with a nominal width of one inch. Extrusion welders shall have a fixed preheat nozzle attached to the front of the extrusion welder.

1.4.2 Generators

Typically, a 6.5 kw or larger generator will be used at the work area and electrical extension cords will be used to power the welding equipment.

1.4.3 Miscellaneous Equipment

Small tools will include hook blade utility knives, scissors with rounded points, hand leister, grinders, and silicone or rubber rollers.

2.1.0 GEOMEMBRANE INSTALLATION

2.1.1 Earthwork

A. Surface Preparation

The Earthwork Contractor shall be responsible for preparing the subgrade according to the project specifications and the following minimum industry subgrade standard necessary to properly install the liner.

A.1 The surface to be lined has been prepared so as to be free of irregularities, protrusions, vegetation, excessive water, loose soil or abrupt changes in grade.

A.2 The supporting surface does not contain stones or other matter of such composition, shape or size which may be damaging to the geomembrane and

A.3 There are no excessively soft surface areas

Under no circumstances shall the installer deploy any geomembrane in areas not acceptable within these guidelines. A completed surface acceptance form shall be provided to the customer specifically indicating the areas accepted for geomembrane

The daily progress report form shall be provided after installation activities within that area. If at any time during the installation of the geosynthetic lining system the prepared subgrade deteriorates, becomes damaged, or in any way is determine unacceptable by the

Site Supervisor, all liner installation work shall stop in those areas and the condition of those areas brought to the attention of the appropriate party.

B. Anchor Trench

The anchor trenches shall be constructed by the Earthwork Contractor to the lines, widths and depths as shown on the drawings and specifications. This task should be performed prior to the geomembrane deployment.

Pile excavated dirt away from the area to be lined.

The edges where the geosynthetics enter the trench should be free of irregularities, protrusions, etc. to avoid potential damage to the material. Backfilling of the anchor trench shall be the responsibility of the Earthwork Contractor in accordance with specifications. Backfilling should occur when the geosynthetic material is at its most contracted state to avoid potential bridging problems. Care must be taken to avoid damaging the geosynthetics during backfilling.

2.2.0 Geomembrane Deployment

The site supervisor, in conjunction with the customer shall agree upon the following issues. If any adverse situation or disagreement exists, the site supervisor shall delay deployment until issues are resolved.

2.2.1 Installation

The Site Supervisor shall proceed with deployment provided that:

- Deployment equipment does not damage the subgrade
- Personnel who are in contact with the liner do not smoke, wear damaging (non-soft sole) shoes or engage in other activities which risk damage to the liner

2.2.2 Use of a low ground pressure, rubber-tired all terrain vehicle (i.e. ATV) is allowed on the geosynthetic surface, provided proper care is taken to avoid damage and excessive traffic

2.2.3 Field panel placement installation sequence should take into account site drainage, wind direction, subgrade surface, access to the site, and production schedule of the project. Field panels should be seamed as soon as possible after deployment and all deployed material shall be marked with appropriate identification.

2.2.4 Visual Inspection

The Site Supervisor and/or the QA Technician and the designated Independent Inspector shall visually inspect each panel, as soon as possible after deployment, for damage or areas needing repair. Areas shall be marked for repair.

2.3.0 Field Seaming

Field seaming involves the bonding of adjacent panels using thermal methods.

2.3.1 Seam Layout

In general, seams shall be oriented parallel to the direction of maximum slope, i.e. oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of seams should be minimized. No horizontal seams should occur on a panel less than five lineal feet from the toe of the slope. On slopes of less than 10% (6L: 1H), this rule shall not apply. A cross slope seam may be utilized provided the panel ends are cut at an angle of approximately 45%.

A seam is considered a separate entity if it is the principal attachment that joins two or more panels. Repairs are not considered seams in this context.

A numbering system using adjacent panel numbers shall identify each seam.

2.3.2 Seaming Equipment and Products

Approved processes for field seaming and repairing are extrusion welding and fusion welding. All welding equipment shall have accurate temperature monitoring devices to insure proper measurement of the welder temperatures.

A. Fusion Process

This process shall be used for seaming panels together and is not generally used for patching or detailed work. The apparatus shall be of hot wedge type and is commonly equipped with a "split wedge" to allow air pressure seam testing.

Fusion welding equipment shall be self propelled devices and shall be equipped with functioning wedge temperature and seaming speed controllers to assure proper control by the Welding Technician.

B. Extrusion Process

This process shall be used primarily for repairs, patching, and special detail fabrication. This method is also useful to connect new panels to previously installed liner that does not have an exposed edge capable of being fusion welded.

The extrusion welding apparatus (hand welder) shall be equipped with temperature monitoring devices.

2.3.3 Seam Preparation

Seaming shall be performed in ambient temperature between 35F and 104 F. Ambient temperature is to be measured at least 6" from surface of liner. The Welding Technician shall verify that prior to seaming the seam area is free of moisture, dust, sand, or debris of any nature; the seam is properly heat tacked and abraded when extrusion welding; and seams are performed to minimize "fish-mouths".

2.3.4 Trial Seams (Trial Welds)

Prior to production seaming, trial seams shall be made and accepted using project specified criteria. Trial seams shall be made on appropriate sized pieces of identical or equivalent geomembrane material to verify that seaming conditions and procedures are adequate. Five (5) one in wide specimens will be cut for the trial weld sample. Each trial seam sample shall be assigned a number and the test results recorded in the appropriate log.

- Trial seams shall be performed for each welder to be used and by each operator of extrusion welders, and by the primary operator of each fusion welder.
- A passing trial seam shall be made prior to the beginning of each seaming period. Typically this is at the start of the day and after lunch break.
- Fusion welded trial seam samples shall be approximately six feet long by one foot wide with the seam centered lengthwise. For extrusion welding, the trial seam sample size shall be approximately five feet long by one foot wide with the seam centered lengthwise.
- All specimens shall meet FTB.

2.3.5 Panel Seams (Production Seaming)

Upon Acceptance of the trial seams, work may begin on deployed panels. All seams shall be non-destructively tested. Each completed seam shall be labeled with pertinent information. Seam panels on the same day panels are deployed.

2.3.6 Non-Destructively Seam Testing.

ILP will only non-destructively test field seams for their full length using an air pressure test or a vacuum test, if required by Engineer's specifications. The purpose of non-destructively tests is to demonstrate the leak resistance of the seam.

The Site Supervisor shall schedule all non-destructively testing operations in order to ensure prompt demonstration of weld quality and the orderly progress of the project.

The QA Technician shall instruct the testing personnel regarding marking of repairs needed, leaks and sign-off marks on seam and repairs.

a) Vacuum Testing

Vacuum testing is routinely performed on extrusion welds and can be performed on the fusion welds. The equipment shall consist of a vacuum box assembly with a vacuum gauge, a pumping device, and a soap solution.

The following procedure shall be followed:

- Wet a section of the seam with the soap solution. The seam section must be longer than the vacuum box.
- Place the vacuum box over the wetted area and apply body weight to form a seal between the gasket and the liner.

2.3.7 Evacuate air to create a negative pressure of approximately 5 psig.

2.3.8 Observe, for not less than 10 sec, the seam through the viewing window for presence of soap bubbles emitting from the seam.

- If no bubbles are observed, reposition the box on the next wetted area for testing with slight overlap.
- If bubbles are detected, this indicates a leak in the seam, mark the area of the leak for repair and retest.

b) Air Pressure Testing

Air pressure testing is performed on seams made by a double-seam fusion welding apparatus.

The equipment shall be comprised of the following:

- An air pump, or air tank, capable of producing a minimum air pressure of 30 psig in the seam channel
- A sharp hollow needle to insert air into the air channel of the seam
- A hot air gun or other heating device to seal the ends of the air channel

The following procedures shall be followed:

- Seal both ends of the air channel of the seam to be tested.
- Insert the needle into the air chamber at either end of the seam to be tested.
- Pressurize the air channel to minimum of 30 psig. Allow the pressure to stabilize, and if necessary, re-pressurize to 30 psig and note the pressure.
- With a minimum pressure of 30 psig stabilized in the air channel, the time of day should be noted.
- After approximately 5 minutes, the air pressure should be read again.

- If the difference between the two readings is more than 2 psig, the seam needs to be retested
- Upon completion of the air pressure test, the seam shall be marked and points requiring repair identified.

c) **Procedures for Air Pressure Test Failure**

Should the seam fail the air pressure test, the following procedure shall be followed:

- Reposition the apparatus and retest the same section
- While the seam air-channel is under pressure, traverse the length of the seam and listen for the leak
- While the seam air-channel is under pressure, apply a soapy solution to the seam edge (do not trim excess material from edge of seam) and observe for bubbles formed by escaping air
- Re-test the seam in progressively smaller increments, until the area of leakage is identified
- Repair the identified leak area by extrusion welding the excess material at the edge of the seam and then vacuum test
- In areas where the air channel is closed and the integrity of the weld is not suspect, vacuum testing is acceptable

2.3.7 **Destructive Seam Testing**

Destructive seam testing will only be performed at selected locations, if required by Engineer's specifications. The purpose of these tests is to evaluate bonded seam strength testing shall be performed as work progresses.

a) **Location and Frequency**

The frequency of sample removal is commonly no more than one sample per 500 lineal feet of seam.

b) **Size of Samples**

A sample segment twelve inches by twelve inches shall be cut with the seam centered lengthwise. Additional segment of 12"x18" shall be cut for independent lab testing, 12"x12" segment for archival retain or other uses.

c) **Sample Identification**

The segment shall be marked with the appropriate destructive sample (D/S) number.

d) **Field Testing**

Sample shall be tested in peel and in shear using the following procedure:

- Ten specimens of one inch width shall be cut with a coupon cutter from the segment with a machine press and die.
- Five specimens shall be tested for peel. Fusion welds shall be tested from both sides.
- Five Specimens shall be tested for shear.
- If specified, a field tensiometer will be supplied. Testing will occur at a rate of two inches per minute.

e) **Pass/Fail Criteria**

Seam shall exhibit a film tear bond (FTB) (see Exhibits B & C). For projects which utilize a tensiometer, the following table provides minimum acceptable values.

Seam Strength ASTM D 4437					
		Shear		Peel	
Product Name	Thickness ASTM D 5199 Mm (mils)	Extrusion kN/m (lb/in)	Fusion kN/m (lb/in)	Extrusion kN/m (lb/in)	Fusion kN/m (lb/in)
HDPE Smooth	0.75 (30)	9.4 (54)	9.4 (54)	6.3 (36)	7.3 (42)
HDPE Smooth	1.0 (40)	13.3 (76)	13.3 (76)	8.7 (50)	10.3 (59)
HDPE Smooth	1.5 (60)	20.4 (117)	20.4 (117)	12.7 (78)	15.9 (91)
HDPE Smooth	2.0 (80)	27.1 (155)	27.1 (155)	18.2 (104)	21.1 (121)
LLDPE Smooth	0.75 (30)	7.3 (42)	7.3 (42)	6.1 (35)	6.1 (35)
LLDPE Smooth	1.0 (40)	9.8 (56)	9.8 (56)	8.4 (48)	8.4 (48)
LLDPE Smooth	1.5 (60)	14.7 (84)	14.7 (84)	12.6 (72)	12.6 (72)
LLDPE Smooth	2.0 (80)	19.6 (112)	19.6 (112)	16.8 (96)	16.8 (96)

Seam Strength ASTM D 4437					
		Shear		Peel	
Product Name	Thickness ASTM D 5199 Mm (mils)	Extrusion kN/m (lb/in)	Fusion kN/m (lb/in)	Extrusion kN/m (lb/in)	Fusion kN/m (lb/in)
HDPE Textured	0.75 (30)	9.4 (54)	9.4 (54)	6.3 (36)	7.3 (42)
HDPE Textured	1.0 (40)	13.3 (76)	13.3 (76)	8.7 (50)	10.3 (59)
HDPE Textured	1.5 (60)	20.4 (117)	20.4 (117)	12.7 (78)	15.9 (91)
HDPE Textured	2.0 (80)	27.1 (155)	27.1 (155)	18.2 (104)	21.1 (121)
LLDPE Textured	0.75 (30)	5.9 (34)	5.9 (34)	5.0 (29)	5.0 (29)
LLDPE Textured	1.0 (40)	8.4 (48)	8.4 (48)	7.0 (40)	7.0 (40)
LLDPE Textured	1.5 (60)	13.0 (70)	13.0 (70)	11.0 (60)	11.0 (60)
LLDPE Textured	2.0 (80)	16.8 (96)	16.8 (96)	14.0 (80)	14.0 (80)

In addition to these values, the sample shall not fail within the seam area. Four out of five specimens meeting the above criteria will constitute a passing test.

If the seam fails the test, the following procedure shall be followed. Additional sample segments of the same size shall be removed approximately 10 lineal feet in each direction from the failed seam. Both of these sample segments shall be tested in accordance with the criteria listed above and each segment must pass. This procedure is repeated until a passing result is obtained. In lieu of taking an excessive number of samples, the entire seam may be repaired as outlined in Section 2.3.8.a.

2.3.8 Defects and Repairs

All seams and non-seam areas of the polyethylene lining system shall be examined for identification of defects. Identification of defects or repair may be made by marking on the sheet/seam with an appropriate marking device.

a) Repair Procedures

Any portion of the polyethylene lining system exhibiting a defect which has been marked for repair shall be repaired with any one or combination of the following methods:

- Patching: used to repair holes, tears
- Grind and re weld: used to repair small sections of extruded seams

- Spot welding: used to repair small minor, localized flaws
- Flap welding: used to extrusion weld the flap of a fusion weld in lieu of a full cap
- Capping: used to repair failed seams
- Topping: application of extrudate bead directly to exist

The suspected defect shall be demonstrated as out of specification and detrimental to the performance of the liner.

The following conditions shall apply to all the above methods:

- Surfaces of the polyethylene which are to be repaired shall be lightly abraded to assure cleanliness
- All surfaces intended to receive extrudate must be clean and dry at the time of the repair
- All patches and caps shall extend at least four inches beyond the edge of the defect, and all patches shall have rounded corners.

- b) **Verification of Repairs**
Repairs shall be non-destructively tested according to the criteria established in Section 2.3.6.e.

Repairs which pass the non-destructive test will be taken as an indication of an adequate repair. Failed tests indicate that the repair must be re-done and re-tested until a passing test result.

2.4.0 Lining System Acceptance

After work is complete, the Site Supervisor and/or QA Technician shall conduct a final inspection (walk-down) of the area for confirmation that all repairs have been appropriately performed, all test results are acceptable and the area has all scrap, trash and debris removed. Only after careful evaluation by the Site Supervisor and acceptance by the Customer shall any material be placed upon the lining system.

The geosynthetic lining system will be accepted by the customer when:

- Installation of materials is completed.
- Verification of the adequacy of all seams and repairs, including associated testing and documentation is completed

Acceptance will be indicated by all parties involved by signing a Certificate of Acceptance (see Attached). Partial area of the installation may be accepted in order to allow further construction of the project.

3.1.0 Handling

All geotextile, geonets, and geocomposites shall be handled in such a manner as to ensure they are not damaged.

- On Slopes, the geosynthetics shall be securely anchored in the anchor trench and then rolled down the slope in such a manner as to keep the material in tension.
- Sandbags shall be used to secure the edges of the material when the potential wind damage is significant.
- Cutting the material shall be done in such a manner as to prevent damage to any underlying or adjacent geomembrane.

- Care should be taken when deploying geosynthetic materials that stones, debris or other material is not trapped by the geonet, geocomposites, geotextile or geosynthetic clay liner and which might damage the geosynthetic or geomembrane.

3.2.0 Deployment and Installation

- 3.2.1 **Geonet – Drainage Net**
Geonet shall be overlapped approximately four inches and fastened together with plastic cable ties.
- 3.2.2 **Geotextile/ Geonet Geocomposite**
The geonet component shall be overlapped approximately four inches and fastened together with plastic cable ties. The un-bonded edge of the geotextile component shall remain overlapped.
- 3.2.3 **Geotextile**
Geotextile may be installed by overlapping, by heat bonding (spot or continual basis) or by sewing as indicated in the specifications.
- 3.2.4 **Geosynthetic Clay Liner**
Seaming of GCLs is achieved by overlap the GCL panels approximately six inches. End-of-roll seams shall be overlapped a minimum of 12". Supplemental granular bentonite is required for reinforced GCL. The granular bentonite shall be applied at a rate of one quarter pound per lineal foot between the overlapping panels and at end-of-roll.

3.3.0 Geosynthetic Repair

- 3.3.1 **Geonet – Drainage Net**
Any tear larger than twelve inches shall be repaired. Patches shall extend at least six inches from all sides of the tear and shall be fastened with plastic cable ties.
- 3.3.2 **Geotextile/ Geonet Geocomposite**
Holes and tears in the composite material shall be repaired with a patch of identical or similar material extending at least 6" from all sides of the hole or tear and fastened with plastic cable ties.
- 3.3.3 **Geotextile**
Holes in geotextile material shall be repaired using a patch of identical or similar materials extending approximately six inches on all sides from the hole or tear and heat bonded to parent material.
- 3.3.4 **Geosynthetic Clay Liner**
The area to be repaired (patched) must be free of contamination by foreign matter. Patches should have approximately twelve inches overlaps around the damaged area. For fabric-encased GCLs, the patch is to be tucked into place with excess bentonite poured over the overlap. However, temporary attachment of patches is required to ensure that the patch is not dislodged by covering with geomembrane or soil.

4.1.0 Exhibits

- A. QA Chart
- B. Pass / Fail Criteria – Hot Wedge Weld
- C. Pass / Fail Criteria – Extrusion Weld

4.2.0 In-Line Plastic's Installation Forms

- D. Subgrade Acceptance

- E. Pre-weld Qualification
- F. Daily Progress Report Master
- G. Destructive Sample Report
- H. Certificate of Acceptance

ITEM 659 SEEDING AND MULCHING

659.01 Description

659.02 Agricultural Liming Materials

659.03 Commercial Fertilizer

659.04 Seeds

659.05 Inoculating Bacteria

659.06 Mulching Material

659.07 Inoculating Legumes

659.08 Fertilizing

659.09 Seeding and Mulching

659.10 Wildlife Seeding

659.11 Method of Measurement

659.12 Basis of Payment

659.01 Description. This item shall consist of furnishing all seed, agricultural liming materials, commercial fertilizer, mulching material, and water and placing and incorporating as specified; and mowing the resulting cover as directed. Seeding and mulching shall be performed in stages, per 108.04 and 207.

The areas to be seeded and paid for under this item shall include all areas designated by the Engineer within the right-of-way line and as described on the plans. All areas outside of specified limits where the vegetative growth has been injuriously disturbed or destroyed by the Contractor including those areas defined in 104.06 shall be restored and seeded in accordance with these specifications by the Contractor at no additional cost to the Department.

When the proposal contains an estimated quantity of "659 Repair Seeding and Mulching," such work shall be performed on damaged or eroded areas of seeding and mulching which have previously been acceptably completed, at the times and locations ordered by the Engineer.

A second application of commercial fertilizer at three quarters of the specified rate shall be applied to selected grass areas when and as ordered by the Engineer.

Commercial fertilizers and agricultural liming materials shall be obtained by the Contractor from a dealer or manufacturer whose brands and grades are registered or licensed by the State of Ohio, Department of Agriculture.

659.02 Agricultural Liming Materials. For the basis of quality control agricultural ground limestone, with a minimum total neutralizing power (TNP) of 90 percent and at least 40 percent passing a 150 μm (No. 100) sieve, and at least 95 percent passing a 2.35 mm (No. 8) sieve, and with a 100 percent application rate of 256 kg/1000 m^2 (46 pounds per 1000 square feet) shall be standard grade. Other grades of agricultural liming materials will be applied at rates which are dependent on the total neutralizing power and fineness of the sample. These rates are determined from the table "Equivalent Amounts of Liming Materials" found in Bulletin 472, "Agronomy Guide", published by the Cooperative Extension Service, The Ohio State University.

No payment adjustment shall be made for the equivalent quantity required by the Agronomy Guide. The payment rate shall be based on the percentage of the standard in 659.08 or the rate stated in the plans.

659.03 Commercial Fertilizer. Commercial fertilizer may be dry or liquid in analysis specified or in the same ratio as specified.

659.04 Seeds. All seeds specified shall meet the current specifications on file with the Department as to percentage purity, weed seed and germination.

All seeds proposed to be used under this item shall be on an approved list on file at the Laboratory, and shall meet the requirements of these specifications.

The Department reserves the right to test, reject or approve all seed after delivery on the project.

All seeds are to be furnished in separate varieties, separately packaged or bagged, and shall be labeled, tagged or marked in accordance with 907.03, ORC.

659.05 Inoculating Bacteria. The inoculant for treating leguminous seeds shall be a pure culture of nitrogen-fixing bacteria selected for maximum vitality, not more than one year old. All cultures shall be subject to the approval of the Engineer.

659.06 Mulching Material. Materials used for mulching shall be straw, hay or wood fiber. The material shall be reasonably free of weed seed and such foreign materials as may detract from their effectiveness as a mulch or injurious to desired plant growth.

659.07 Inoculating Legumes. All leguminous seeds shall be inoculated or treated with the proper amount of approved culture mixed with sufficient water to thoroughly wet the seed with the solution. When seed is sown hydraulically, four times the amount of inoculant required above shall be placed directly into the slurry and thoroughly mixed immediately before seeding. Seed shall be sown within 24 hours after treatment with the inoculant.

659.08 Fertilizing and Liming. The standard application of fertilizer shall be at the rate of 0.1 kg/m^2 (20 pounds per 1000 square feet) of 12-12-12. Another analysis, in the same ratio, may be used by varying the application rate to produce the same values specified. Either dry or liquid fertilizer may be used and shall be distributed in an even pattern over the specified area, then thoroughly disked, harrowed or raked into the soil to a depth of not less than 50 mm (2 inches) unless otherwise directed by the Engineer.

When agricultural liming material is required, it shall be applied on the surface at 220 percent of the standard rate stated in 659.02, and thoroughly disked, harrowed or raked into the soil to a depth of not less than 50 mm (2 inches) unless otherwise directed by the Engineer.

Other agricultural liming materials may be used and the rate of application shall be varied according to the percent required of the standard rate of application specified under 659.02.

Fertilizer and liming materials when required shall be applied separately but can be disked or otherwise incorporated into the soil in the same operation. If the seed bed becomes compacted prior to seeding, it shall be redisked or loosened to a friable condition before seeding. If the fertilizer or lime has been washed or otherwise lost from the seed bed, the areas so depleted shall be retreated as directed by the Engineer at no cost to the project.

Areas of the project which were seeded and mulched during preceding seasons (three months or more) shall be refertilized. The fertilizer shall be applied to the surface without incorporation into soil at one half the normal rate. This operation shall be performed after repair seeding and mulching operations have been completed.

659.09 Seeding and Mulching. All areas with slopes less than 2 to 1 that are to be seeded shall be free of rock and other foreign material 75 mm (3 inches) or greater in any dimension and shall be satisfactorily shaped and finished as provided in 203. All areas with 2 to 1 slopes or steeper that are to be seeded shall be free of rock and foreign material 75 mm (3 inches) or greater in any dimension but shall not be fine graded. Areas in front of residences, between curb and sidewalks, and other areas indicated on the plans, shall be free of all stones 25 mm (1 inch) or greater in any dimension and shall have a smooth surface. In such areas, hand raking will be required if inaccessible to machines, and may be required if machines do not provide results equivalent to hand raking. Payment for the work necessary for

proper preparation of the seed bed shall be included in the unit price for 203.

The seed shall be thoroughly mixed and then evenly sown over the prepared areas at the rate of 25 g/m² (5 pounds per 1000 square feet). Seed shall be sown dry or hydraulically.

All areas to be seeded which are considered to be urban in character, and any area immediately in front of a residence, shall be seeded with the following mixture: (Percentages are by weight).

30 percent Kentucky Bluegrass (*Poa pratensis*)
30 percent Creeping Red Fescue (*Festuca rubra*)
20 percent Annual Ryegrass (*Lolium multiflorum*)
20 percent Perennial Ryegrass

All areas not urban in nature with slopes less than or equal to 3 to 1 shall be seeded with the following mixture:

30 percent Kentucky Bluegrass (*Poa pratensis*)
40 percent Kentucky 31 Fescue (*Festuca arundinacea* var. Ky. 31)
30 percent Perennial Ryegrass (*Lolium perenne*)

All areas with slopes greater than 3 to 1 to be seeded with Crown Vetch shall be seeded at a rate of 15 g/m² (3 pounds per 1000 square feet) with the following mixture:

30 percent Crown Vetch (*Coronilla varia*)
60 percent Perennial Ryegrass (*Lolium perenne*)
10 percent Annual Ryegrass

Immediately after sowing, the area shall be raked, dragged or otherwise treated so as to cover the seed to a depth of approximately 6 mm (1/4 inch).

The operation of seed sowing shall not be performed when the ground is frozen or muddy, or when the soil or weather conditions would prevent the proper soil preparation and subsequent operations as specified. All seeding performed between October 15 and March 15 shall be temporary seeding in accordance with 207. However, for projects which will be completed in the same calendar year, permanent seeding may be performed with permission of the Engineer. Sowing of Crown Vetch shall not be permitted during September or October.

Seeding shall be done prior to or concurrently with 660, 667, 668 or 670.

Within 48 hours after any given area is seeded, vegetative mulch material conforming to 659.06 shall be evenly placed over all seeded areas at the rate of approximately 0.5 t/1000 m² (2 tons per acre) for straw, or 0.7 t/1000 m² (3 tons per acre) for hay, when seeding is performed between the dates of March 15 and October 15, and at the approximate rate of 0.7 t/1000 m² (3 tons per acre) for straw, or 1.0 t/1000 m² (4 1/2 tons per acre) for hay, when seeding is performed between the dates of October 15 and March 15 of the succeeding year.

Mulching materials shall be kept in place with asphalt emulsion applied at a minimum rate of 250 L/t (60 gallons per ton) of mulch or by methods approved by the Engineer with tackifiers as approved by the Laboratory. An additional application at a rate of 125 L/t (30 gallons per ton) of mulch shall be applied to the shoulder area, starting at the berm edge and extending out for a distance of 3 m (10 feet). Asphalt emulsion for vegetative mulch shall conform to 702.04. Emulsion shall be nontoxic to plants and shall be so prepared that it will not change in transportation or storage. Mulching which is displaced shall be replaced at once but only after the seeding or other work which preceded the

mulching and which work was damaged as a result of displacement of mulching material has been acceptably repaired.

The Contractor shall maintain all seeded and mulched areas until final inspection. Maintenance shall also include repairing any areas damaged following the seeding or mulching operation due to wind, water, fire or other causes. Such damaged areas shall be repaired to re-establish the condition and grade of the area prior to seeding and shall then be refertilized, reseeded and remulched as directed by the Engineer.

When an estimated quantity of "659 Repair Seeding and Mulching" is listed in the proposal, it is to provide for repair of damages or erosion where the regular seeding and mulching operations have been acceptably performed in stages on significant portions of the project. Such repairs of these areas shall be made at the direction of the Engineer when the damage or erosion is not due to fault or negligence of the Contractor. The repairs shall be made prior to completion of the project by reworking or reshaping to grade and then refertilizing, reseeding and mulching. Reworking or reshaping of slope shall include bringing in additional material, if necessary, and using whatever equipment is necessary to restore slopes to grade. Such work will be measured and paid for as "Repair Seeding and Mulching." When damage or erosion of these areas occurs as a result of the fault or negligence of the Contractor, the areas shall be satisfactorily repaired and refertilized, reseeded, and mulched at no additional cost to the State.

Unless otherwise directed by the Engineer, the seed bed shall be thoroughly watered, as soon as the seed is covered, at the rate of $5 \text{ m}^3/1000 \text{ m}^2$ (120 gallons per 1000 square feet). The water shall be applied by means of a hydro-seeder or a water tank under pressure with a nozzle that will produce a spray that will not dislodge the mulching material. A second water application shall be made no sooner than 7 days or later than 10 days after the first application, providing significant rainfall has not occurred within 7 days after the first application. When significant rainfall occurs within 7 days after the first application, the Engineer may delay or omit entirely the second application, depending on weather conditions. The rate of the second application shall be $5 \text{ m}^3/1000 \text{ m}^2$ (120 gallons per 1000 square feet). Water shall be measured and paid for separately.

Mowing of excess growth on seeded areas shall be performed when and as directed by the Engineer. The vegetation shall be cut to approximately 150 mm (6 inches) in height by acceptable methods.

659.10 Wildlife Seeding. When areas of the project are designated to be seeded for wildlife, the following mixture shall be used at the rate of 10 g/m^2 (2 pounds per 1000 square feet):

- 60 percent Brome grass (*Bromus inermis*).
- 18 percent Red Clover (*Trifolium pratense*).
- 22 percent Perennial Ryegrass (*Lolium perenne*).

659.11 Method of Measurement. Commercial fertilizer and agricultural liming to be paid for shall be the number of kilograms (tons) of each calculated to standard, furnished, spread and incorporated.

Seeding and mulching to be paid for shall be the number of square meters (square yards) of the area seeded and mulched in accordance with these specifications. In the measurement of seeding and mulching, no adjustment of the plan quantities or recalculation of the areas of seeding and mulching shall be made for any areas found different by less than five percent from the plan quantity. The Contractor shall accept the plan quantity with authorized changes as payment in full unless revised by the Engineer. The burden of proof of a plan discrepancy greater than five percent is on the Contractor. The Contractor shall submit supporting documentation concerning the possible changes.

Repair seeding and mulching to be paid for shall be the number of square meters (square yards) of damaged or eroded areas reshaped, seeded, and mulched at the direction of the Engineer on portions of the project where seeding and mulching had previously been acceptably completed and where the damage was due to no fault or negligence of the Contractor. The quantity of water shall be the amount in cubic meters (thousands of gallons) applied in accordance with

the requirements of this item and measured in tanks, tank wagons or trucks of predetermined capacity, or by means of meters of a type satisfactory to the Engineer and furnished and installed by the Contractor at his own expense, or determined by weight conversion.

Mowing satisfactorily performed at the direction of the Engineer will be measured in square meters (1000 square foot units).

659.12 Basis of Payment . Payment for accepted quantities will be made at contract prices for:

Item	Unit	Description
659	Kilogram (ton)	Commercial fertilizer
659	Kilogram (ton)	Agricultural liming
659	Square meter (square yard)	Seeding and mulching
659	Square meter (square yard)	Seeding and mulching for wildlife
659	Square meter (square yard)	Repair seeding and mulching
659	Cubic meter (M gallons)	Water
659	Square meter (M square feet)	Mowing

S.M. Stoller
2008

S.M. Stoller Corporation
FERNALD PRESERVE VISITORS CENTER
 Crosby Township, Hamilton County, Ohio

BIO-TREATMENT WETLAND DESIGN



ISSUED FOR BIDDING		
ADDENDUM NO.	ADDENDUM DATE	BY

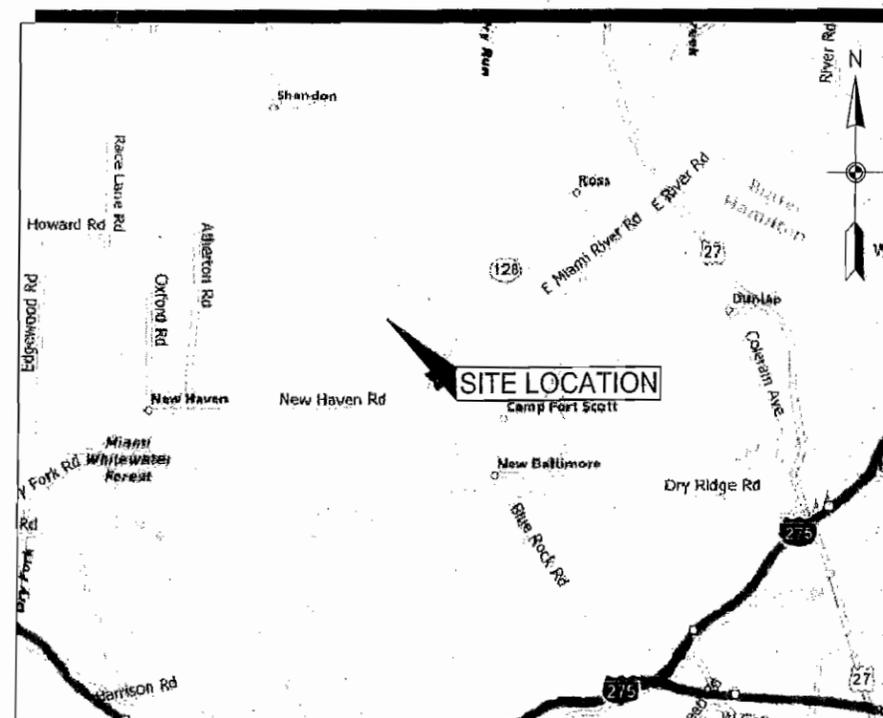
ISSUED FOR CONSTRUCTION		
NO.	DESCRIPTION	DATE BY

RECORD DRAWINGS		
NO.	DESCRIPTION	DATE BY

INDEX OF DRAWINGS:

- C000 TITLE SHEET
- C100 BIO-TREATMENT WETLAND SYSTEM LAYOUT
- C101 BIO-TREATMENT WETLAND SYSTEM SURVEY
- C200 PLAN AND PROFILE STA. 4+06.38 TO 7+11.42
- C201 PLAN AND PROFILE STA. 0+00 TO 4+06.38
- C301 SSF WETLAND SECTIONS AND DETAILS
- C302 SF WETLAND SECTION
- C303 MANHOLE DETAILS
- C304 MISCELLANEOUS DETAILS
- C305 MISCELLANEOUS DETAILS
- C400 BIO-TREATMENT SYSTEM PLANTING PLAN

DRAWING INDEX



VICINITY MAP

Not to Scale

FINAL DESIGN

By:



May 15, 2008

Prepared for:

S.M. STOLLER CORPORATION
 10995 HAMILTON-CLEVES HWY.
 HARRISON, OH 45030



1375 EUCLID AVENUE, SUITE 600
 CLEVELAND, OH 44115
 PHONE: 216-622-2400 FAX: 216-622-2428

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 DRAWN BY: BTS CHECKED BY: NES
 JOB NO 41785932.10000
 SCALE NONE

GRAPHIC SCALE

TITLE SHEET

FERNALD PRESERVE
 VISITORS CENTER
 BIO-TREATMENT
 WETLAND DESIGN

C000

BAR IS ONE-INCH ON ORIGINAL DRAWING
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ISSUED FOR BIDDING DATE BY

ADDENDUM REVISIONS

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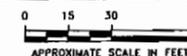
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SCALE 1"=30'

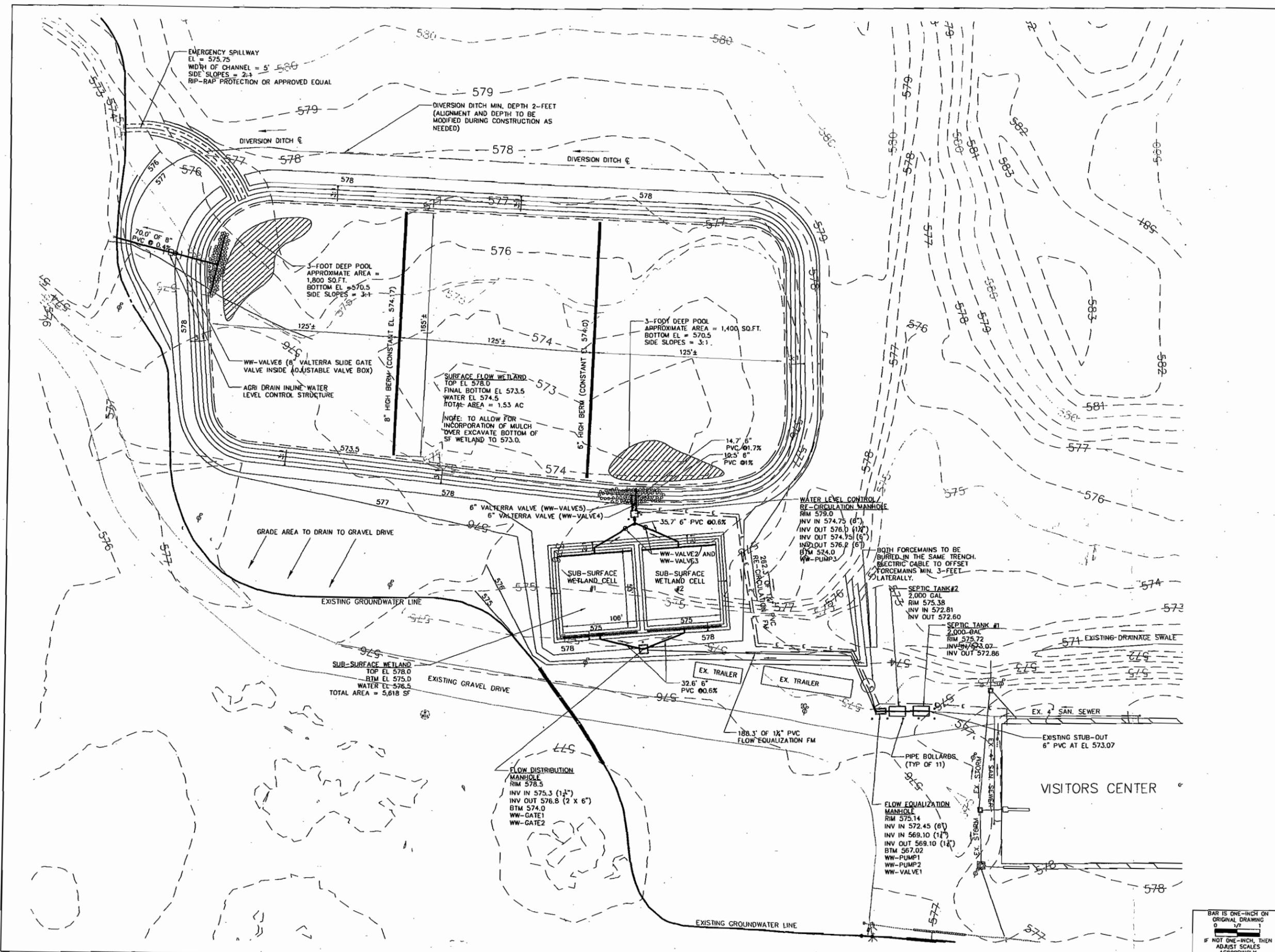


GRAPHIC SCALE

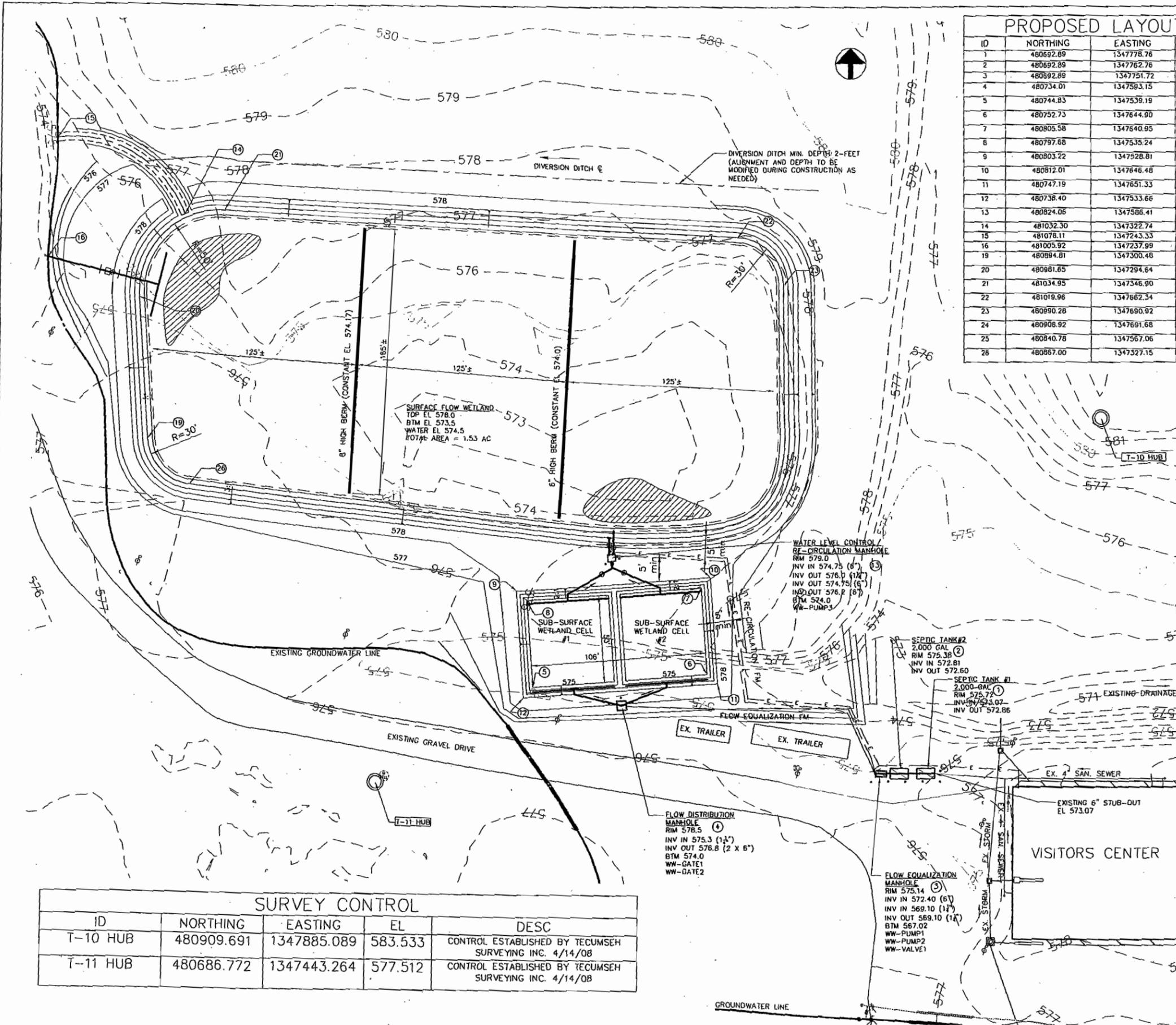
BIO-TREATMENT WETLAND SYSTEM LAYOUT

FERNALD PRESERVE VISITORS CENTER BIO-TREATMENT WETLAND DESIGN

C100



BAR IS ONE-INCH ON ORIGINAL DRAWING
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IF NOT ONE-INCH, THEN ADJUST SCALES ACCORDINGLY



PROPOSED LAYOUT SURVEY POINTS				
ID	NORTHING	EASTING	EL.	DESC
1	480692.89	134778.76	575.72	SEPTIC1 (NOTE 1)
2	480692.89	1347762.76	575.38	SEPTIC2 (NOTE 1)
3	480692.89	1347751.72	575.14	FL_EQ_MH (NOTE 2)
4	480734.01	1347593.15	578.50	FL_DIST_MH
5	480744.83	1347539.19	575.00	SSFW_SW_BTM
6	480752.73	1347644.80	575.00	SSFW_SE_BTM
7	480805.58	1347640.95	575.00	SSFW_NE_BTM
8	480797.68	1347535.24	575.00	SSFW_NW_BTM
9	480803.22	1347528.81	578.00	SSFW_NW_TOP
10	480812.01	1347646.48	578.00	SSFW_NE_TOP
11	480747.19	1347651.33	578.00	SSFW_SE_TOP
12	480738.40	1347533.66	578.00	SSFW_SW_TOP
13	480824.06	1347586.41	579.00	RECIRC_MH
14	481032.30	1347322.74	575.75	SFW_SPILLWAY
15	481078.11	1347243.33	575.00	SFW_SPILLWAY
16	481005.92	1347237.99	573.22	SFW_OUTLET
19	480894.81	1347300.48	575.00	SFW_575 (NOTE 3)
20	480981.65	1347294.64	575.00	SFW_575 (NOTE 3)
21	481034.95	1347346.90	575.00	SFW_575 (NOTE 3)
22	481019.96	1347662.54	575.00	SFW_575 (NOTE 3)
23	480990.28	1347690.92	575.00	SFW_575 (NOTE 3)
24	480908.92	1347691.68	575.00	SFW_575 (NOTE 3)
25	480840.78	1347567.06	575.00	SFW_575 (NOTE 3)
26	480867.00	1347327.15	575.00	SFW_575 (NOTE 3)

- NOTES:
- SEPTIC TANKS POINTS IS MID POINT OF STRUCTURE.
 - ALL MANHOLES POINTS ARE CENTER OF STRUCTURE.
 - SURFACE FLOW WETLAND (SFW CONTOUR 575 OUTLINE).

SURVEY CONTROL				
ID	NORTHING	EASTING	EL	DESC
T-10 HUB	480909.691	1347885.089	583.533	CONTROL ESTABLISHED BY TECUMSEH SURVEYING INC. 4/14/08
T-11 HUB	480686.772	1347443.264	577.512	CONTROL ESTABLISHED BY TECUMSEH SURVEYING INC. 4/14/08

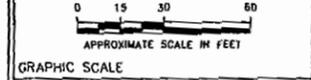


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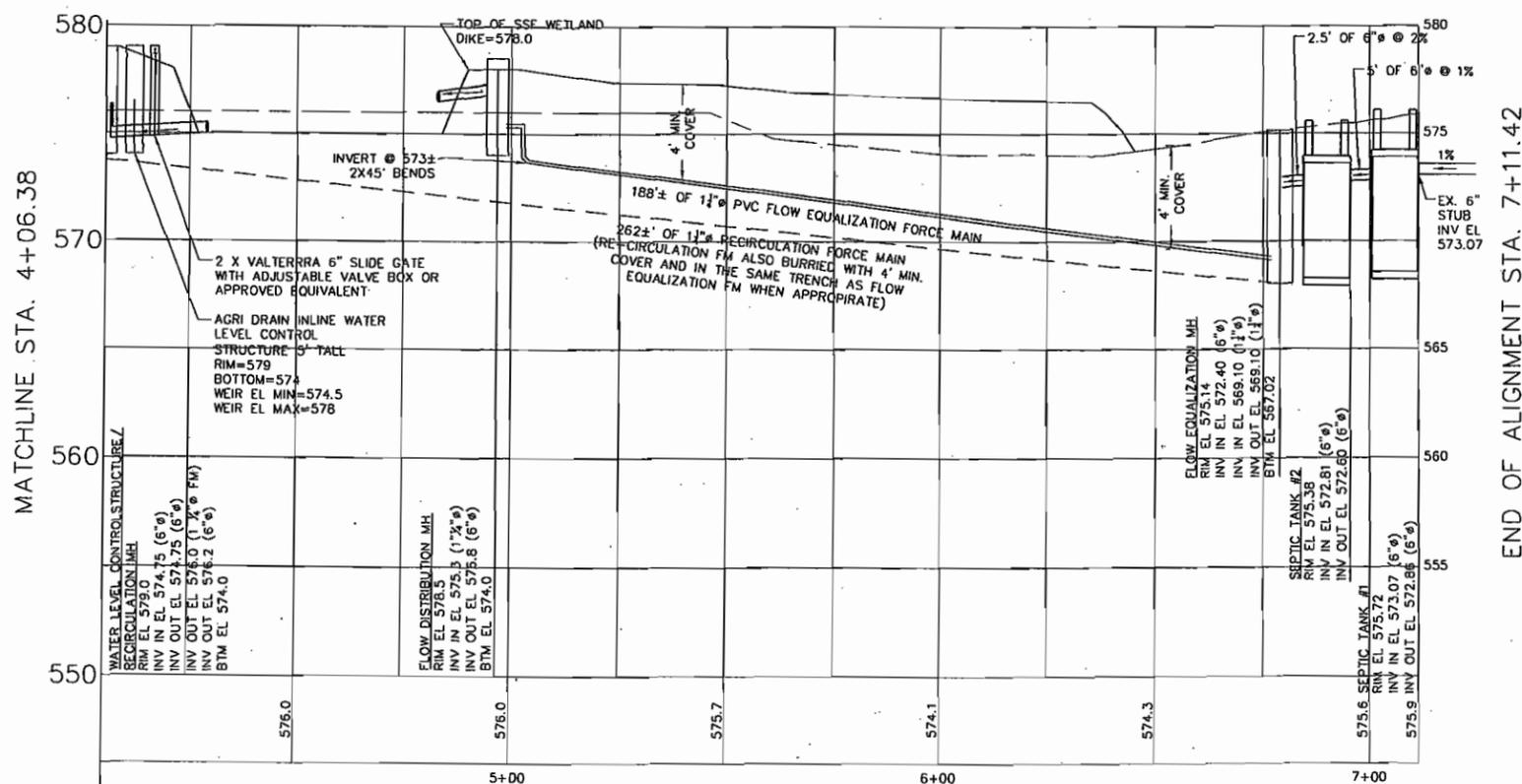
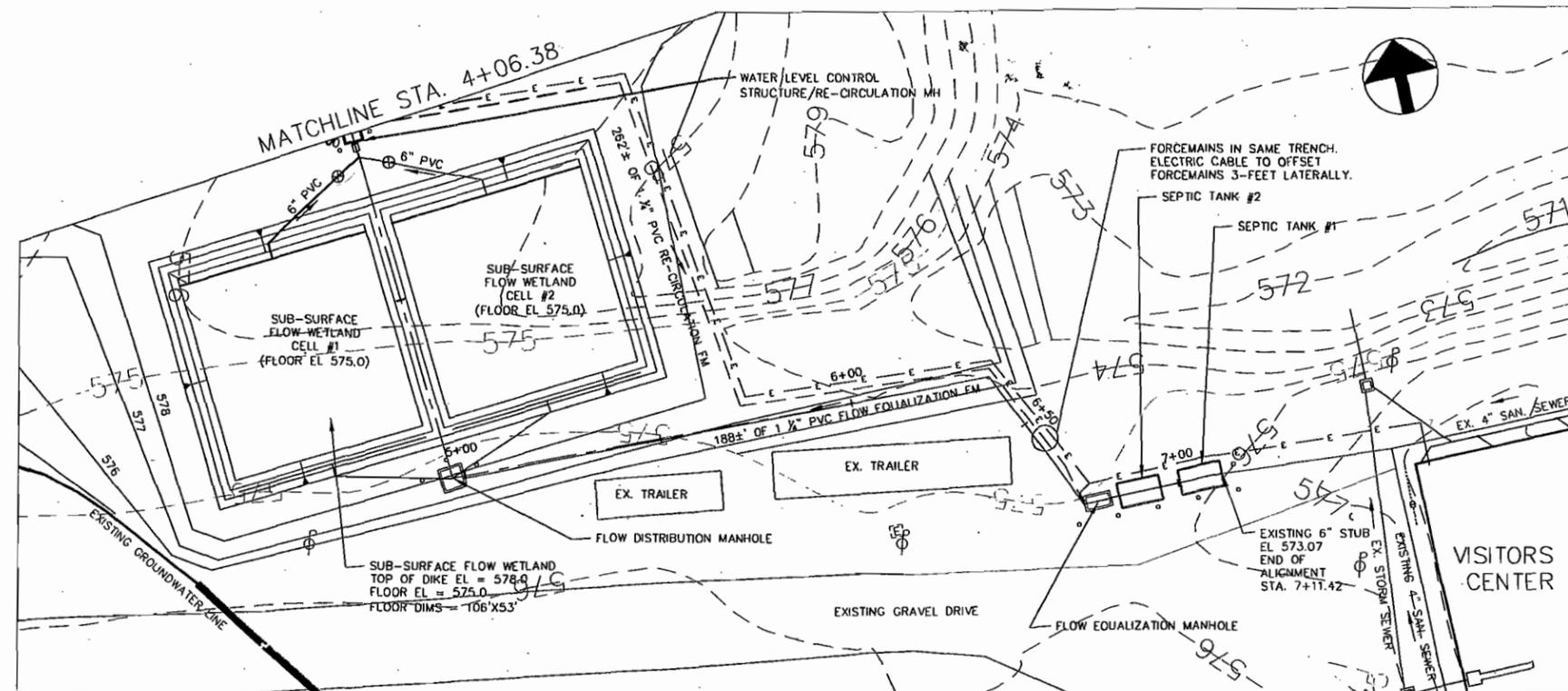
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 JOB NO 41785932.10000
 SCALE 1"=30'



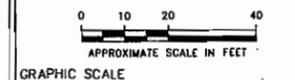
BIO-TREATMENT WETLAND SYSTEM SURVEY
 FERNALD PRESERVE VISITORS CENTER BIO-TREATMENT WETLAND DESIGN

BAR IS ONE-INCH ON ORIGINAL DRAWING
 IF NOT ONE-INCH, THEN ADJUST SCALES ACCORDINGLY



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 JOB NO 41785932.10000
 SCALE 1"=20' HORIZ. 1"=4' VERT.

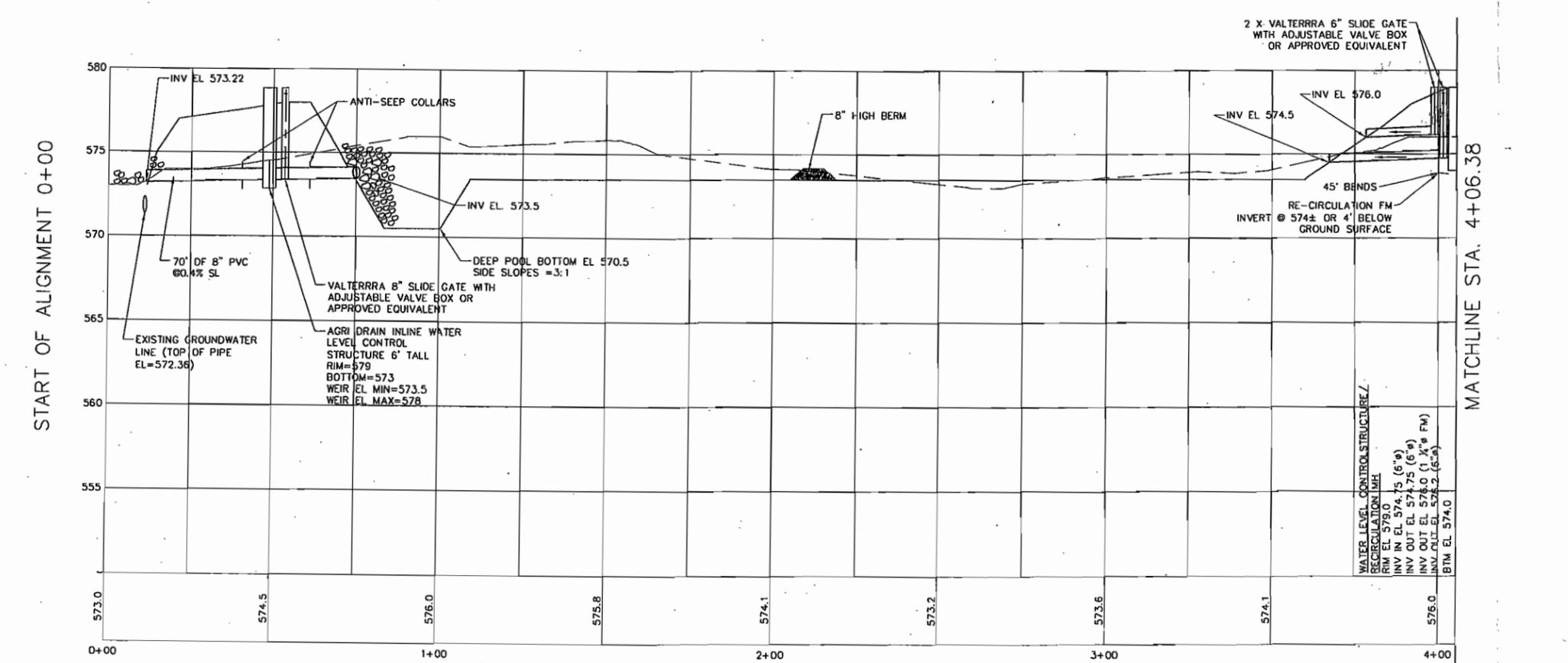
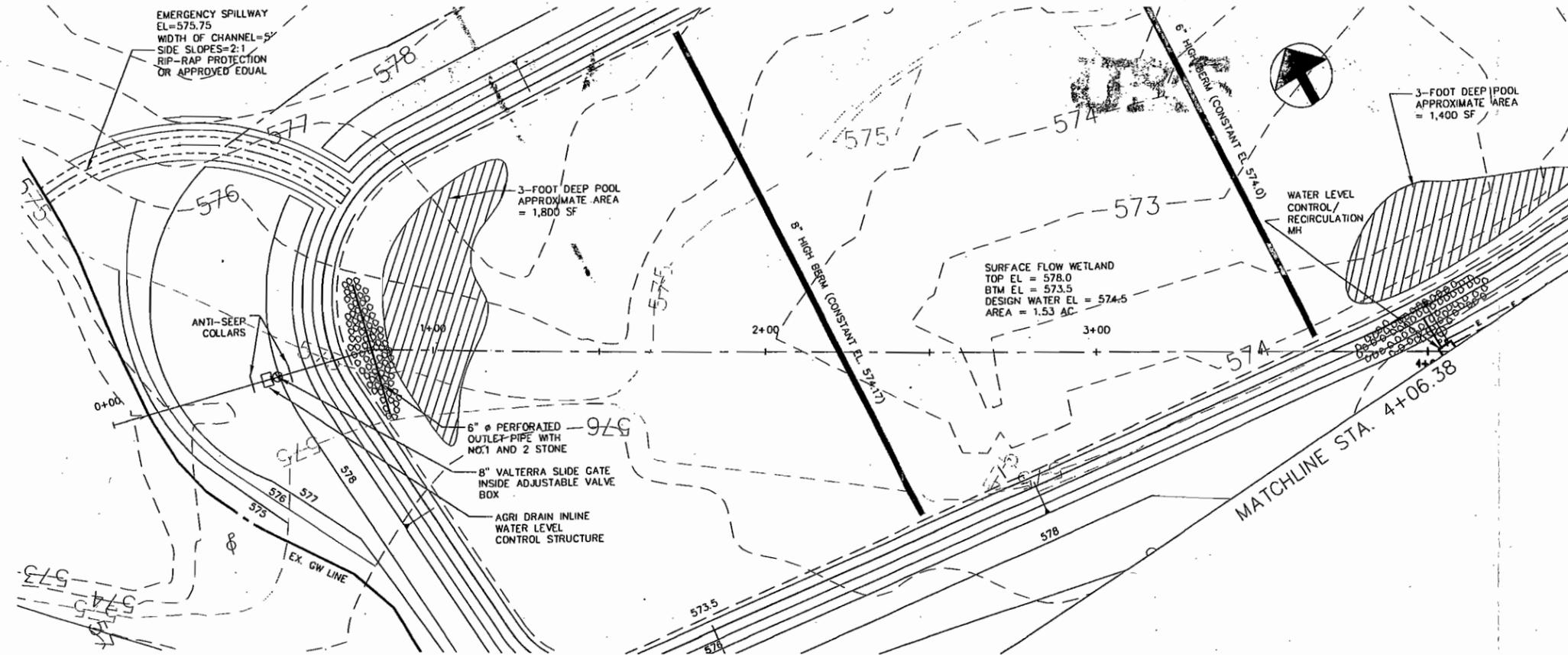


PLAN AND PROFILE
 STA. 4+06.38 TO
 STA. 7+11.42

FERNALD PRESERVE
 VISITORS CENTER
 BIO-TREATMENT
 WETLAND DESIGN

C200

BAR IS ONE-INCH ON ORIGINAL DRAWING
 0 1/2 1
 IF NOT ONE-INCH, THEN ADJUST SCALES ACCORDINGLY



ISSUED FOR BIDDING DATE BY
ADDENDUM REVISIONS

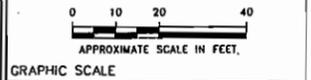
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SCALE 1"=20' HORIZ. 1"=4' VERT.



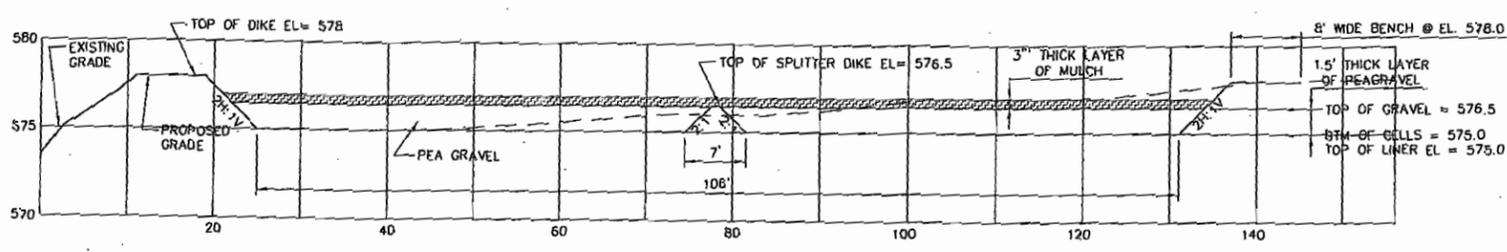
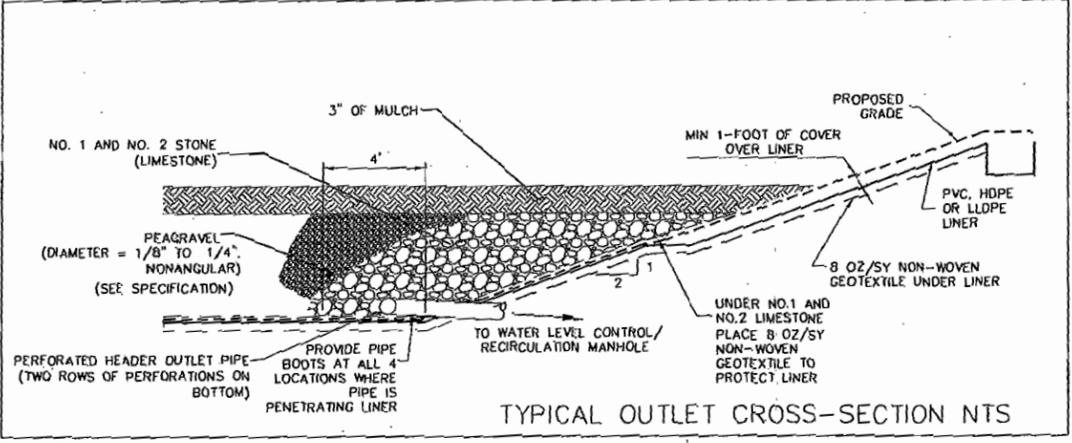
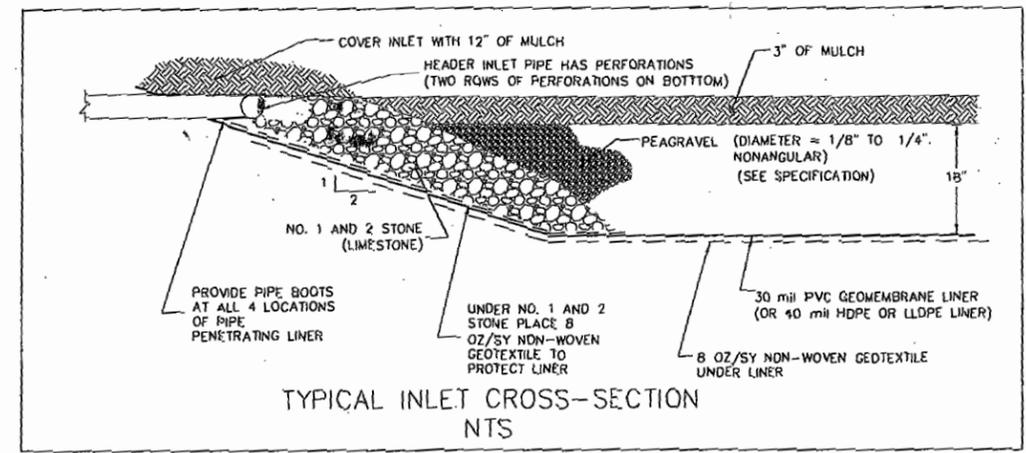
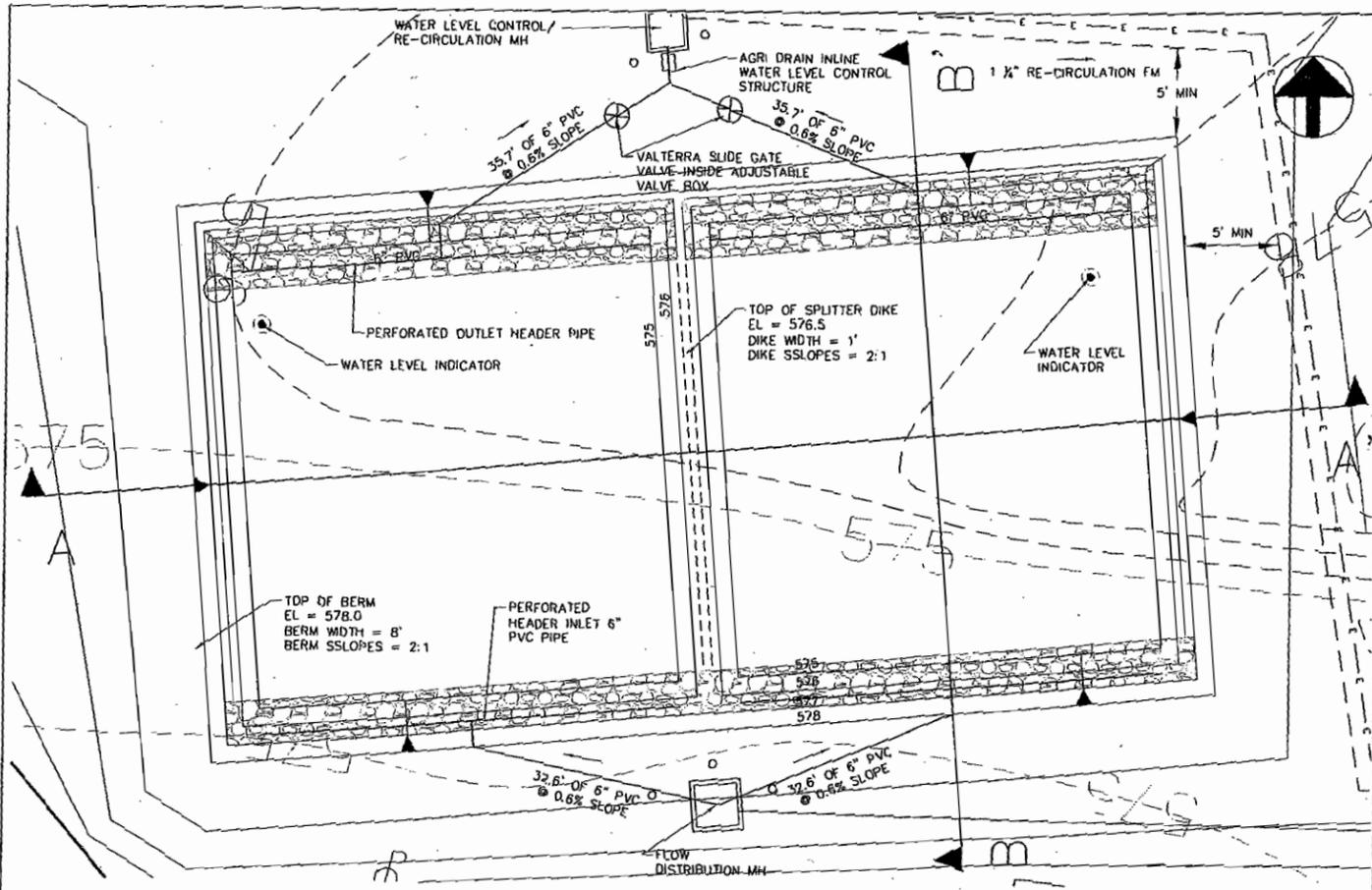
PLAN AND PROFILE
STA. 0+00 TO STA. 4+06.38

FERNALD PRESERVE
VISITORS CENTER
BIO-TREATMENT
WETLAND DESIGN

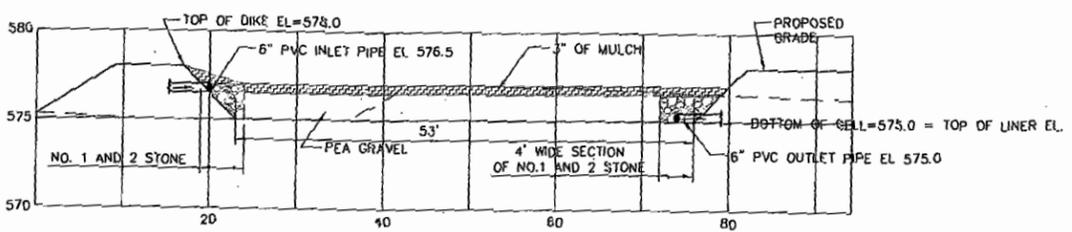
C201

BAR IS ONE-INCH ON ORIGINAL DRAWING
IF NOT ONE-INCH, THEN ADJUST SCALES ACCORDINGLY

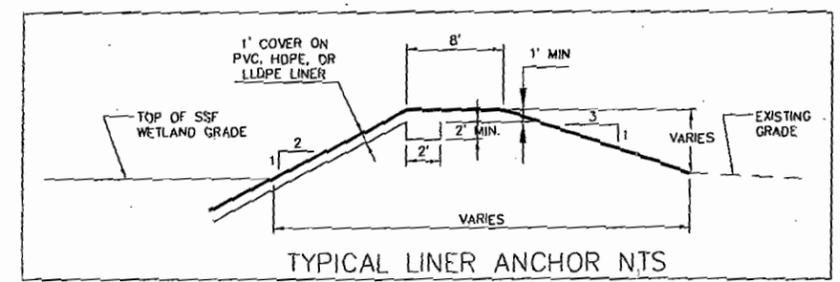
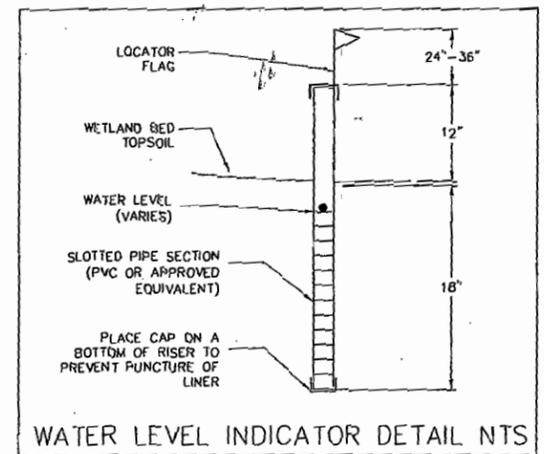
URS



SECTION A-A'

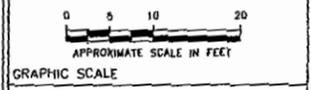


SECTION B-B'



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 SCALE 1"=10' HORIZ. 1"=5' VERT.

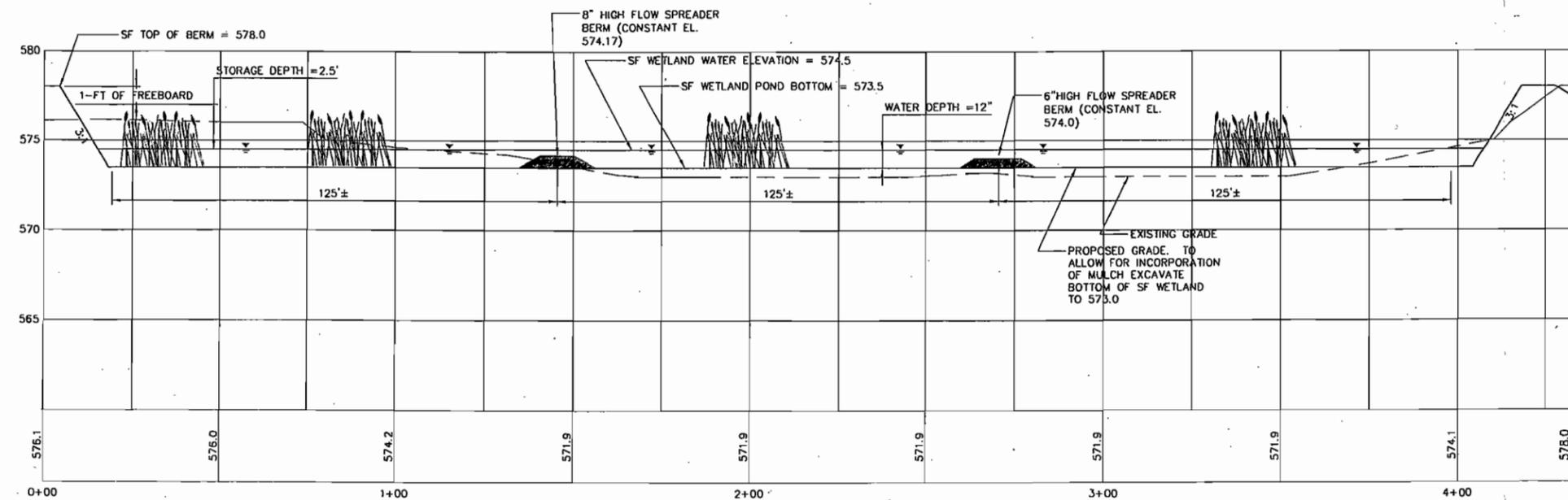
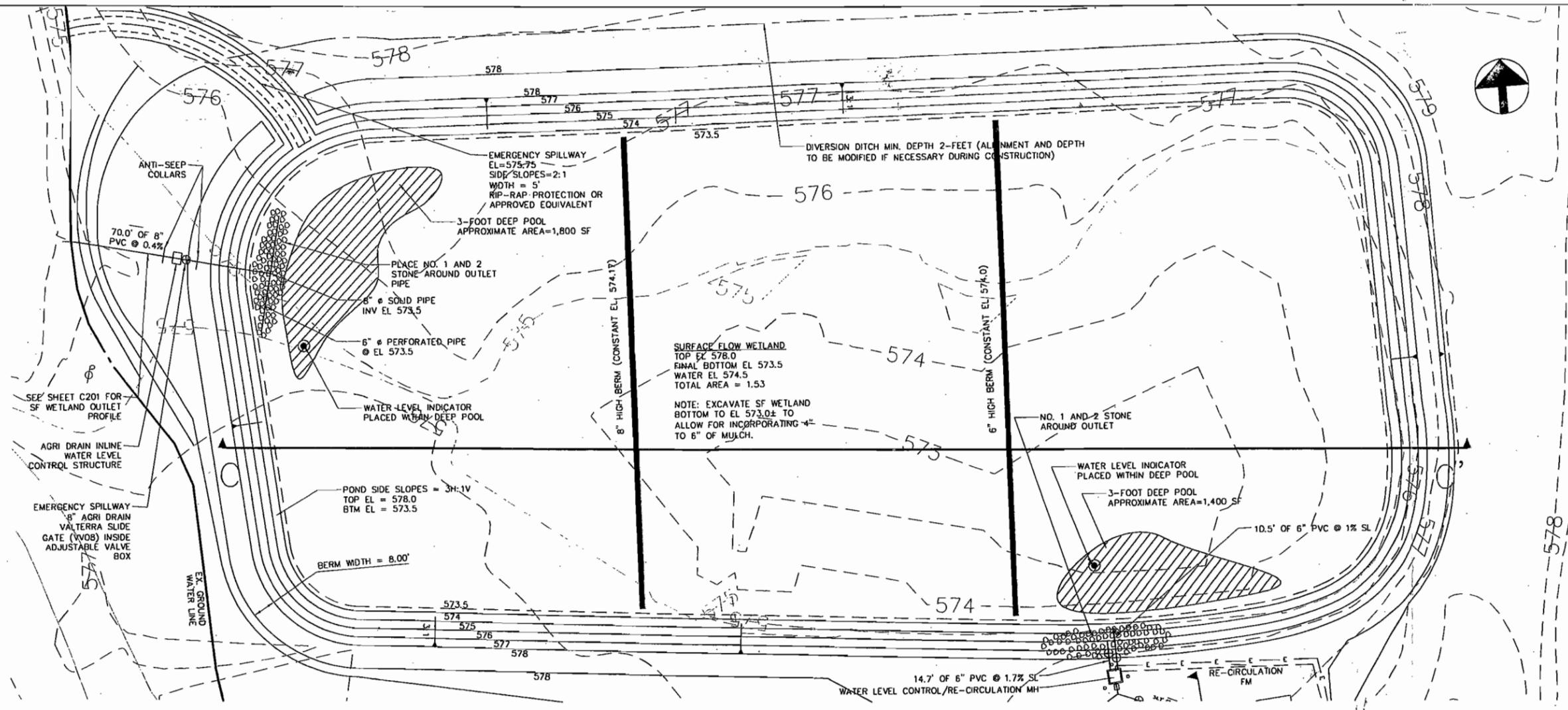


SUB-SURFACE WETLAND SECTIONS AND DETAILS

FERNALD PRESERVE VISITORS CENTER BIO-TREATMENT WETLAND DESIGN

C301

BAR IS ONE-INCH ON ORIGINAL DRAWING
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SECTION C-C'

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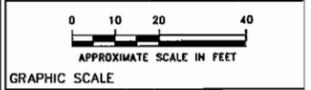
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RECORD DRAWINGS

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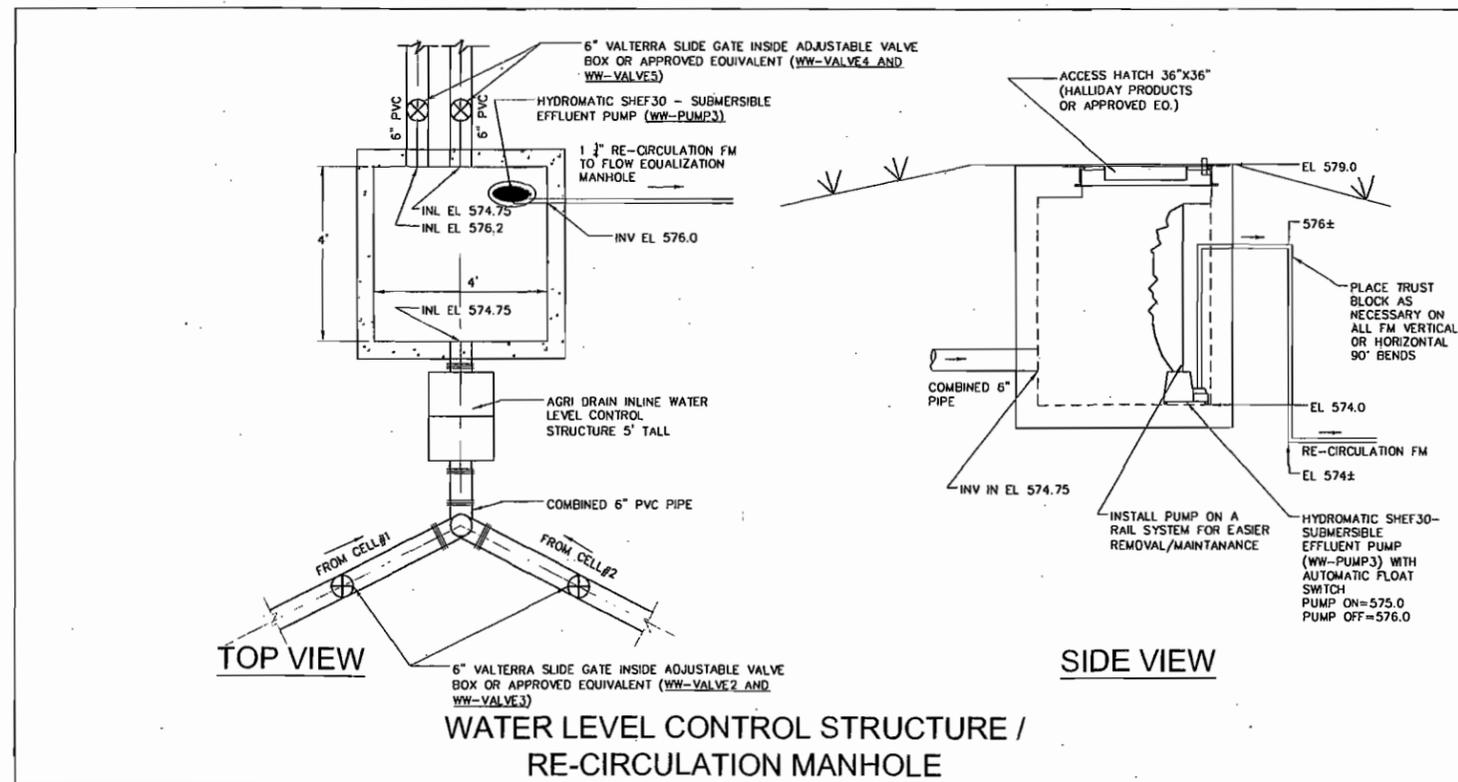
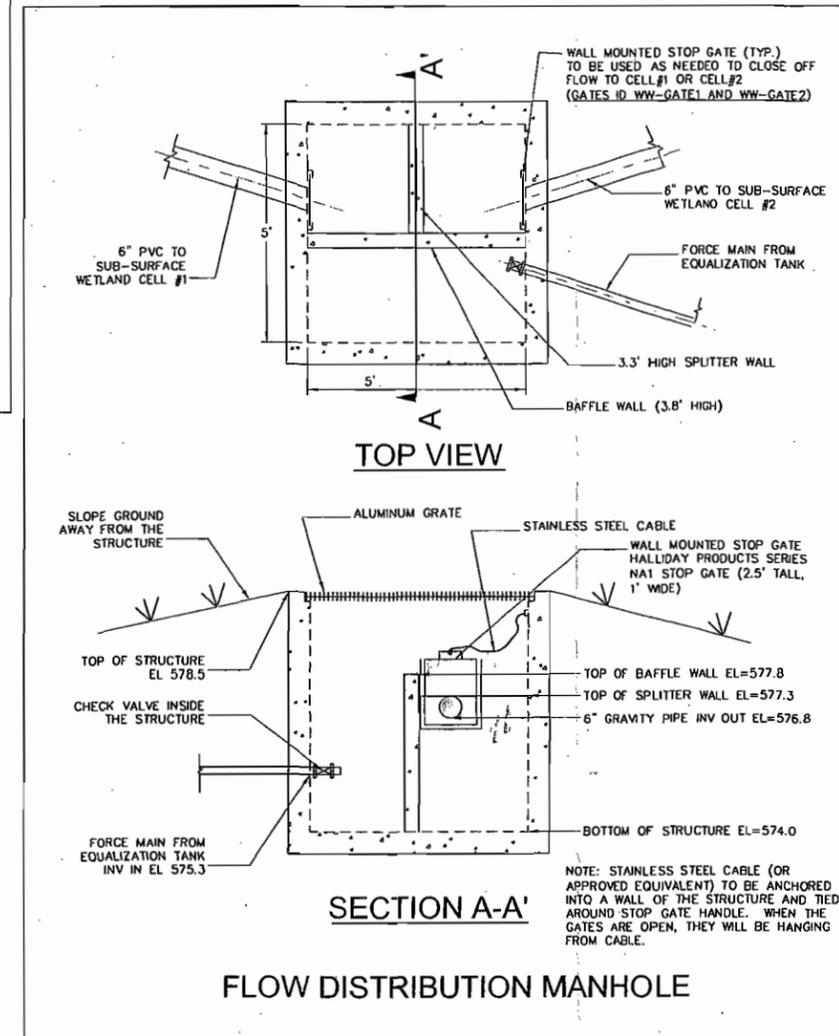
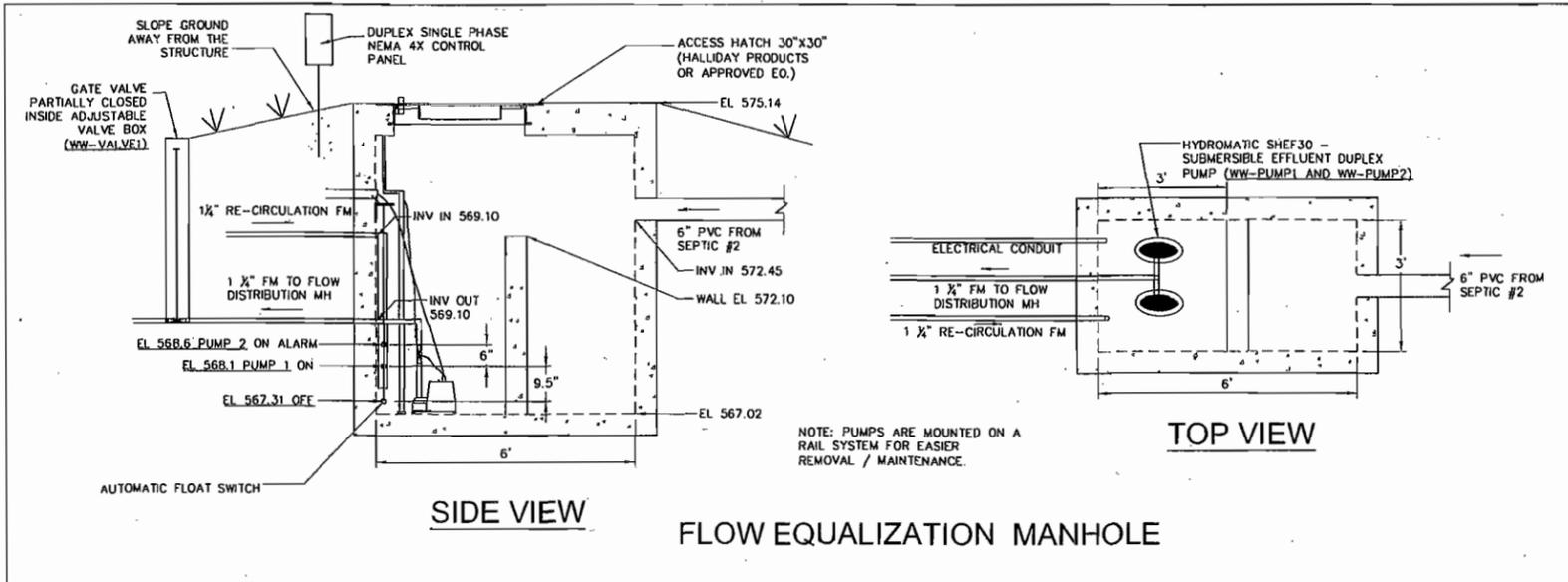


SURFACE FLOW WETLAND SECTION

FERNALD PRESERVE VISITORS CENTER BIO-TREATMENT WETLAND DESIGN

C302

BAR IS ONE-INCH ON ORIGINAL DRAWING
 IF NOT ONE-INCH, THEN ADJUST SCALES ACCORDINGLY



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SCALE NONE

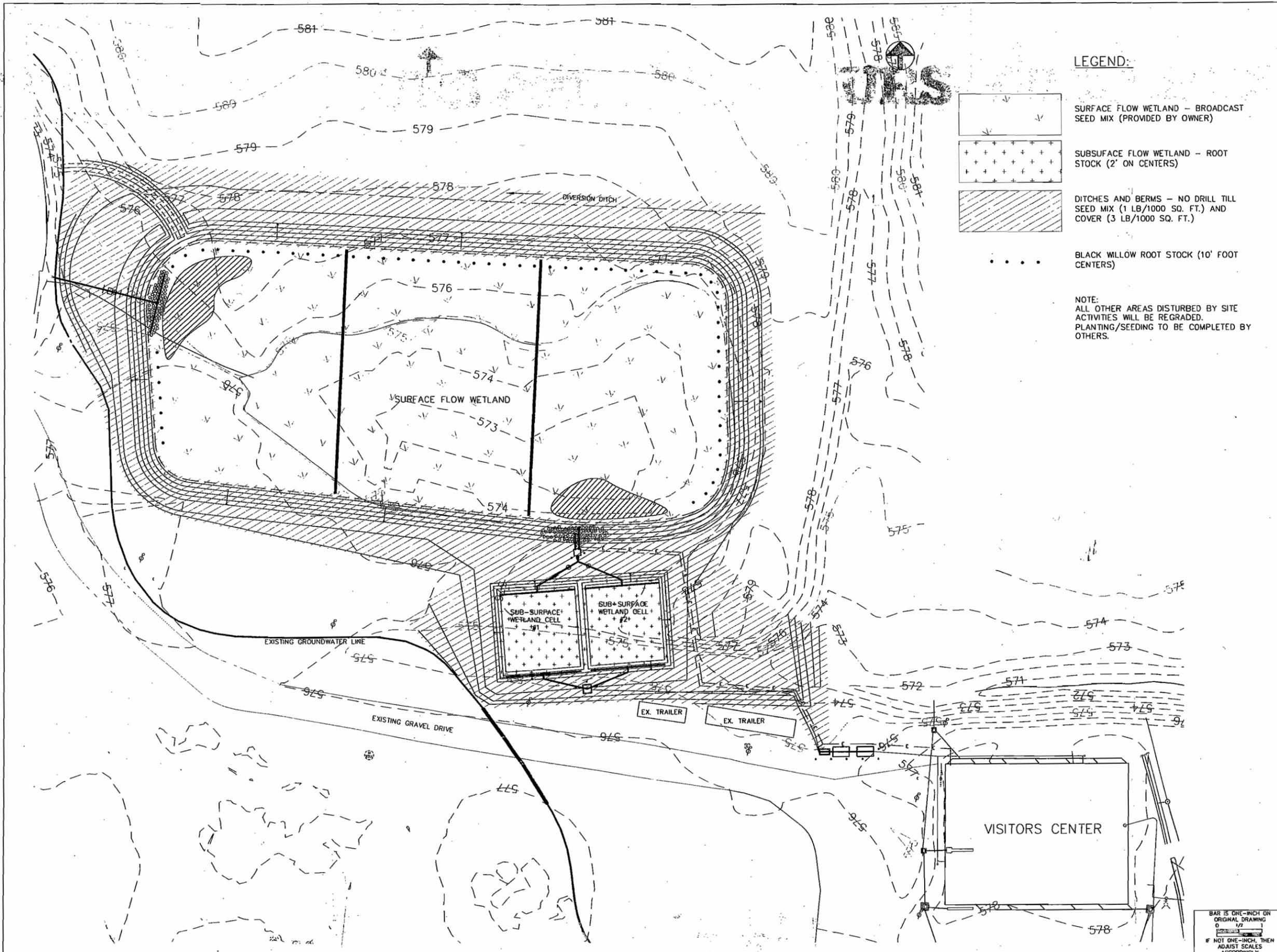
GRAPHIC SCALE

MANHOLE DETAILS

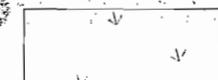
FERNALD PRESERVE VISITORS CENTER BIO-TREATMENT WETLAND DESIGN

C303

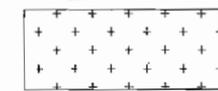
BAR IS ONE-INCH ON ORIGINAL DRAWING
IF NOT ONE-INCH, THEN ADJUST SCALES ACCORDINGLY



LEGEND:



SURFACE FLOW WETLAND - BROADCAST SEED MIX (PROVIDED BY OWNER)



SUBSURFACE FLOW WETLAND - ROOT STOCK (2' ON CENTERS)



DITCHES AND BERMS - NO DRILL TILL SEED MIX (1 LB/1000 SQ. FT.) AND COVER (3 LB/1000 SQ. FT.)



BLACK WILLOW ROOT STOCK (10' FOOT CENTERS)

NOTE:
ALL OTHER AREAS DISTURBED BY SITE ACTIVITIES WILL BE REGRADED. PLANTING/SEEDING TO BE COMPLETED BY OTHERS.



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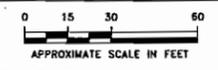
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SCALE 1"=30'



APPROXIMATE SCALE IN FEET

BIO-TREATMENT WETLAND SYSTEM PLANTING PLAN

FERNALD PRESERVE VISITORS CENTER BIO-TREATMENT WETLAND DESIGN

C400

BAR IS ONE-INCH ON ORIGINAL DRAWING
0 1/2 1
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