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Revision 4

P&T REMEDIATION
PROJECT T323
CONSTRUCTION PROCEDURE AND SPECIFICATIONS

I. GENERAL CONDITIONS

This specification and Olin drawings D-T323-840-0-5 thru-11, cover the materials, location, workmanship, and details necessary to construct a cover system over an existing disposal area at Pine Avenue and Tuscarora Road in Niagara Falls, N.Y. It is the purpose of these documents to produce a complete job, except where specifically noted.

II. SEQUENCE OF EVENTS

Contractor shall follow this general sequence of events with an orderly schedule and work plan. Actual construction schedule may vary from this order if approved by Olin. All variations shall be coordinated with and approved by Olin.

1) Establish construction field offices.
2) Establish erosion and sedimentation controls.
3) Clear and grub site.
4) Erect temporary fence.
5) Construct new creek channel.
6) Divert creek to new channel.
7) Install stabilization fill, cap drain system, and coarse aggregate drainage layer.
8) Fill existing channel.
9) Grade site.
10) Install slurry wall.
11) Install cap.
12) Place topsoil.
13) Install erosion protection.
14) Erect permanent fence.
15) Grassing.
16) Landscaping.

III. DEFINITIONS

Wherever used in the specifications, the following terms shall have the meanings indicated.

1. Owner - Olin

2. Contractor - The individual, partnership, firm, or corporation with whom the Owner has executed the contract agreement (including any subcontractors engaged by the contractor) to perform said work.

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3. Quality Assurance Engineer - The engineer or engineering firm representative(s) retained by the owner to provide design consultation and recommendation regarding various aspects of the project during construction and to audit the Quality Control program.

4. Quality Control Engineer - The engineer or engineering firm representative(s) retained by the owner to monitor the construction and verify that all work is performed in accordance with the design drawings, project specifications, and project QA/QC Plan.

IV. PROJECT PROCEDURE AND SPECIFICATIONS

1) Surveying and Layout

A construction surveyor shall be employed by the contractor to locate the corners, fence lines, new creek channel, construction facilities, field offices, physical cap site, etc., to use in the construction phase. He shall also set all grade stakes, elevation controls, etc., necessary for construction. Cap layer thickness will be controlled by grade stakes, and physical measurements. Grade shall be closely controlled by setting grade stakes 25' apart, maximum,, and/or taking measurements with rules, level rod, etc. 4' apart, maximum. String lines between grade stakes shall be used when required to obtain measurements where cap component layers, etc., are not readily discernible. Grade stakes in the cap area will not be allowed after the flexible membrane liner (FML) has been placed. Any measurement(s) showing thickness less than specified shall be noted. Other measurements shall be taken radially out in every direction at 1' intervals until the area of deficient thickness is identified. Material shall be placed as per specifications to bring the deficient area identified up to specified thickness.

A land surveyor licensed in the State of New York shall be employed by the Contractor to prepare an as-built plat and deed locating the fences and cap boundaries for permanent record with Olin and appropriate governmental agencies. All survey documents must be certified and stamped by the licensed land surveyor. The surveyor shall set a permanent monument, or benchmark at the capsite located outside the proposed fill areas giving coordinates and elevation. This marker shall be concrete placed a minimum of 4' in the ground. A brass plate shall be permanently affixed to the concrete monument and properly permanently inscribed giving the exact elevation and N.Y. State coordinates. This permanent marker shall be located inside the fenced area adjacent to the cap.

This licensed land surveyor may also be the same person as the construction surveyor.

2) Existing Properties

All affected properties are located at or around the area of Pine Avenue and Tuscarora Road in Niagara Falls, N. Y. The site of the new cap is the Art Batrouny property. Other surrounding properties that will be affected by the new cap and/or the construction area are generally described in this specification. Dust and noise control measures must be practiced during construction to the satisfaction of the Project Health and Safety Officer to avoid affecting adjacent properties and property owners.

All building permits, access permission to the various sites, etc., will be secured in advance of construction by Olin Corporation in writing from the various property owners and agencies. Copies will be given to the contractor for his use. Properties affected are:

A) Former Art Batrouny Property (now Olin Corporation)

The cap will be constructed on the back (east end) of the property. The front (west end) of the property will be disturbed as little as possible. The existing house will not be used by the contractor(s). Olin may opt to use the garage for a change room. All trees and shrubs, etc., in the yard west of the cap will be protected until completion of the job.

B) Schul Property

An access road to the north end of the new creek channel extends through this property. Contractor may/may not elect to use this as a construction road during the project construction.

If used, the existing road must be improved as follows:

1) All rubbish and trash for a 20' width (10' each side of the center) must be removed and disposed of in an approved sanitary landfill.
2) All existing limbs, brush, undergrowth, etc., must be cut and disposed of to maintain 12' clear roadway minimum.
3) The existing road-bed must be regraded as required with all potholes, etc., filled with compacted material to form a smooth even road-bed. Road-bed should be graded, if required, to facilitate drainage and tie into natural surrounding drainage to allow no standing water on access road.
4) Improved road-bed (see 1,2,3) should be initially graveled with 6" of #57 (AASHTO M-43), 1" to #4. Gravel should be added as required during the job duration to maintain a fully graveled passable roadway.
5) At the completion of the job, the road-bed should be left in first class condition as defined above. The road should be closed with a locked, impassible barricade that could be reopened in the future if necessary.

C) Niemel & Schul Property.

New Cayuga Creek channel will be located through the property as shown on the drawings. The existing creek will be filled downstream of the influx of the city storm sewers. A staging area will be provided on the property by the contractor for the borrow stock pile excavated from the new creek channel. Final staging area locations will be determined by the contractor, but must be approved by Olin before clearing for use. After construction, the staging area, filled creek channel and construction haul roads will be graded to allow positive drainage and left grassed, landscaped, or rip-rapped as required.

Other use of the property during construction is possible, but must be approved by Olin. Disturbance or altering the natural condition of the property must be kept to a minimum.

D) Zito Property.

The Zito property will be used for access to the south side of the construction site. The field offices and construction facility will be located on the Zito property. The contractor will be responsible for moving all automobiles, etc., within the Zito property site to a location directed by the owners, to provide room for field offices and access to the facilities. Upon completion, contractor shall remove all field offices and construction facilities and shall grade disturbed areas to match existing grades. No grassing shall be required.

E) Niagara Mohawk Power.

No permanent appurtenance may be added or located in the Niagara Mahawk R.O.W. except the south cap and south cap fence and piezometer #5, as shown on the construction drawings. Temporary work and conveyances, i.e. trucks, welders, etc., are permitted if approved by the Project Health and Safety Officer. Extreme caution will be required due to high voltage lines overhead and all work in the vicinity shall be in accordance with the Project Health and Safety Plan and all OSHA requirements. Any bare areas created by construction activities should be grassed.

3) Construction Field Offices

Contractor shall grade an area approximately level - large enough to locate all temporary construction facilities. Area will be located on Zito property as directed by Olin. A night security light for the construction facilities and the parking lot shall be furnished by the contractor. Temporary telephone service must be furnished by the contractor to the Olin trailer and the contractors trailer for the duration of the job. Olin will pay the monthly billing for only the Olin phones. Temporary power must be furnished by the contractor for the duration of the job. Temporary potable water must be furnished by the contractor to be used by Olin and the contractor for the duration of the job. No wells are permissible. Sanitary facilities, portable or otherwise, shall terminate in a tank or similar holding facility and be serviced regularly by a septic tank service for the duration of the job. Temporary connection to the city sewers, and/or potable water main, furnished by the contractor are permissible. All facilities shall be removed and disposed of at the end of the job by the contractor to the satisfaction of Olin.

At this area the contractor shall place two furnished trailers 12' x 50', complete with HVAC, for exclusive Olin use housing temporary field offices and Olin rest rooms and the job safety personnel. Trailer #1 shall be furnished for Olin Construction Supervisor, Olin Project Manager, Olin EAD Representative, and a small conference room for Olin visitors. Trailer #2 shall be furnished for H&S officer, CQA officer, 24 hr. security guard, and NYSDEC Construction Inspectors. Contractor shall level and tie down said trailers, and be responsible for all trailer maintenance for the duration of the job. Contractor shall provide phone service to each Olin trailer with a separate number for each. Two phones will be provided for each trailer.

Contractor facilities at the site will consist of items such as construction office trailer(s), job security quarters, construction rest rooms, construction lunch room, etc. Sufficient construction facilities must be provided to comply with OSHA requirements and the Project Health and Safety Plan, minimum. Contractor shall provide for all housekeeping, cleaning, etc., required, on a daily basis, to keep all Olin and OSHA required facilities in a satisfactory and sanitary condition.

Contractor shall provide a parking lot for all construction contractor parking and five Olin spaces and three visitor spaces. The parking lot and walk areas between trailers, etc., will be graveled by the contractor. Gravel used shall be AASHTO M-43, size 57, well graded 1" to #4 thickness as required, minimum thickness 4". Contractor to provide construction radios for communication between contractor, Olin construction supervisor, construction field offices, the CQA representative, the Health and Safety Officer, and on-site security personnel.

4) Clearing and Grubbing

Clearing and grubbing will be handled at different times and in different manners. No site burning will be permitted. All brush disposal shall be handled by the contractor in accordance with local ordinances.

A) Cap Site.

All trees, shrubs, brushes, etc., in the area to be capped will be cut and removed from the site. This brush will go to an approved sanitary landfill authorized by Olin. All stumps must be cleared of as much dirt as possible and disposed of in an Olin approved hazardous waste landfill, unless instructed otherwise.

All grass shall be cut as closely as practical, but it is not necessary to grub this area. The contractor shall apply Hyvar X Herbicide to the lawn area to be capped, mixed and applied in accordance with the manufacturer's specifications (applying the herbicide at a rate equivalent to 7 pounds per acre using at least 200 gallons of spray per acre to ensure uniform coverage). The area shall be covered with a minimum of 6 inches of clean fill after herbicide treatment.

B) New Cayuga Creek Channel.

All trees, shrubs, brush, grass, etc., shall be cut and removed from the site. This includes the channel proper and the banks. Clearing and grubbing shall be held to the minimum required to accomplish the work.

This area shall be grubbed of all roots, trash, organic material, and this material disposed of in the approved sanitary landfill. Stockpile all top soil as directed by the Owner's representative for reuse later. All stumps shall be cleaned and hauled to the approved sanitary landfill.

C) Old Cayuga Creek Channel.

Trees and stumps shall be cut flush with the channel bed and the bank. Clear all shrubs and bushes and roots and haul to approved sanitary landfill. Grass and surface vegetation should be cut as closely as possible before construction of fill area but do not need to be grubbed out. After clearing trees and brush from the existing channel slopes, the contractor shall treat the channel slopes with Hyvar X Herbicide in accordance with the manufacturer's specifications. This slope treatment is to be performed after the creek has been diverted to the new channel and just prior to filling the old creek channel area. Application shall be made with a handgun sprayer at a rate equivalent to 15 pounds Hyvar X per acre. Continuous mechanical or hydraulic agitation in the spray tank shall be performed to keep the material in suspension. Extreme care shall be exercised to avoid potential contamination of the creek with the herbicide. Appropriate measures indicated in the Project Health and Safety Plan shall be followed by those applying the spray.

D) Miscellaneous.

Rubbish, primarily located at the SE corner of the cap site shall be removed to an approved sanitary landfill. Chunks of solid concrete can be placed in the bottom of the existing Cayuga Creek channel and used as a fill after the creek has been diverted to the new channel provided they are scattered and spread to preclude nesting and the creation of voids which could result in future soil migration and resulting subsidence.

The top 18" of ground adjacent to/at the SE corner shall be scraped up and deposited in the area to be capped, to remove surface contamination. Limits of scraped area shall be monitored and determined by Olin Environmental in the field.

E) Erosion and Sedimentation Control

This work shall consist of measures to control soil erosion and sedimentation at the site. After clearing and/or grubbing an area, silt barriers shall be installed to intercept and filter sediments from stormwater drainage flows to minimize erosion and subsequent siltation of Cauyga Creek and properties abutting the site. These flows shall be controlled, as necessary, by diversion ditches, benches, berms, and other earth-formed shaping so that siltation is minimized. Field determine the number and length of the silt barriers, as required. Silt barrier shall consist of steel or wooden posts approximately 6 feet on center with an approximately 36-inch-wide geotextile attached to the posts. The barriers will be installed by driving the posts on the downstream side of the geotextile and anchoring the lower portion of the geotextile in a shallow, hand-excavated trench, backfilled and tamped to secure the geotextile. The silt barrier geotextile material should satisfy the requirements of the Federal Highway Administration Joint AASHTO-AGC-ARTBA Task Force 25 Specification Guide, "Temporary Silt Fence." A preassembled silt fence is allowable also, such as AMOCO Silt Stop, Mirafi Envirofence, or equivalent. Hay or straw bales anchored by staking (2 per bale) can be used as a temporary barrier until installation of the specified silt fence. All silt barriers shall be checked periodically, especially after rainfall events, to verify their integrity. Excessive build-ups of sediments and other accumulated debris shall be removed so that the silt barriers can continue to function as intended.

The contractor shall design and install a silt barrier similar to the above, extending full anticipated depth and through Cayuga Creek immediately downstream of the construction site. The creek silt barrier shall meet all requirements of the Fish and Wildlife Department. The creek silt barrier shall be maintained clean of silt pluggage and debris build-up to prevent creek backup and flooding.

F) Dust Control

Dust control measures must be followed during the course of the job, including all construction operations. A water truck/trailer and/or hoses must be used on a regular basis to saturate the ground surface sufficiently to prevent dust. This shall be done as many times as required per day on all days where dust is created by construction activities. The Health and Safety Officer shall have the final jurisdiction.

G) Noise Control

As much as practical, all power equipment shall be equipped with mufflers and similar noise control devices. Power equipment, trucks, and similar vehicles shall be operated in a manner to minimize noise.

5) Clean Fill

As soon as practical after the cap area is cleared and after all contaminated scrapings from the SE corner have been placed in the cap area, the cap area shall be covered with 6" minimum of clean (uncontaminated) clay. This clay shall be the first 6" layer of the 24" minimum bottom clay layer of the cap. Compact, before covering with another layer, to 90% maximum Standard Proctor Density, ASTM D698 (see requirements for compacted fill).

More clay will be added later, compacted, and graded to slopes conforming to the design drawings.

6) Temporary Fence

A temporary fence (hereby referred to as existing) will already be erected before construction begins and contractor arrives on the job site. The contractor is responsible for maintenance of this existing fence during the duration of the job. The contractor is responsible for alterations, modifications, or extensions of this fence as required to execute the project. Finally, the contractor shall be responsible for removal and disposal of all temporary fence upon completion of the job, unless redirected by Olin at that time. This first temporary fence is shown on Olin drawing D-T323-TF-5.

A second temporary fence, with three gates, around the work area must be erected by the contractor before actual work begins on the creek or the cap. Some of this fence will already be in place as is and some will be modifications and/or extensions of the existing fence. Location of the fence shall be as follows:

North - 40' north of creek - end at creek for N.E. corner.

West - 40' west of creek where possible, immediately adjacent to Tuscarora Road the fence line shall be the existing utility pole line - Extend south along Tuscarora Road to Zito property.

South - The boundary between Niagara Mohawk Power and the Zito property extended east to creek with an extension southward to encompass the construction field offices located on the Zito property.

East - On the east side of Cayuga Creek stay 40' east of new creek channel-terminate N & S end at existing creek.

Locate three gates in field with Olin approval - one at the construction field offices, one at or near the driveway to the Batrouny property, and one at the access road across the Schul property. The fence shall form a positive barrier, easily recognized and noted, at least 4' high (±) - yet one that can be easily taken down in specific areas as work may require. Four signs saying "KEEP OUT - NO TRESPASSING" shall be furnished, with one installed on each side -- N,S,E, & W. The fence type and construction shall be by contractor but subject to Olin approval. Fence shall be sturdy enough to prevent personnel from damaging it barehanded without equipment. Use types such as hogwire, heavy gauge chicken wire, snow fence, etc. Contractor shall remove and dispose of temporary fence after permanent fence is erected.

7) New Creek Channel

A new creek channel shall be excavated at the location and depth shown on the drawings. The excavation shall be sloped as indicated on the drawings. Temporary sumps shall be used the entire time of construction and pumped as necessary to prevent water from accumulating in the excavation. Water pumped shall be discharged into the existing creek.

A temporary "plug" shall be left at each end of the new channel. The plug shall be unexcavated soil approximately 20' wide minimum to allow vehicle traffic to cross. This plug shall slope at 2:1 toward the bottom of the excavation.

All excavated soil shall be inspected by the Quality Control Engineer and determined to be usable/unusable as compacted fill. Usable excavation shall be stock-piled in a staging area approved by Olin for use later as creek fill. Contractor shall have a Standard Proctor Density curve (ASTM D698) run on excavation to be used as fill. One Proctor curve shall be run for each different type of soil to be used. Excavation deemed unsuitable for compacted fill shall be spoiled and disposed of by the contractor as approved by Olin.

After excavation, the bottom and sides shall be graded in accordance with the design drawings; leveled, and raked smooth to provide a uniform grade.

Ground stabilization fabric shall be placed over the compacted excavation as per manufacturer instructions. Laps, splices, hold down, etc. shall conform to the Project QA/QC Plan. Fabric shall be a non-woven needle punched geotextile meeting the requirements listed in Table 2, placed on bottom and on side slopes to proper elevations as shown on drawings. If soil particle size analysis so indicates it to be permissible, then the alternate choice of woven fabric, Mirafi 700X, may be used. Fabric shall be anchored at the top in an anchor trench as shown. Lap and secure fabric in accordance with the Project QA/QC Plan. Place riprap on bottom 1st and work up slopes.

TABLE 2

PHYSICAL REQUIREMENTS* OF GROUND STABILIZATION FABRIC

AOS (U.S. Standard Sieve Size)	Puncture ASTM D 4833 (lb)	Mullen Burst ASTM D 3786 (psi)	Trapezoid Tear Strength ASTM D 4533-85 (lb)	Grab Tensile ASTM D 4632-86 (lb)
100	200	670	160	375

*All values are minimum average roll values.

Riprap shall be fitted and placed where shown on Olin drawings to prevent erosion of the new creek channel. Riprap shall be placed in an approximately uniform layer. Riprap shall be placed from the bottom up and in a manner to not damage the ground stabilization fabric. Alternate placement will be considered only if the contractor first demonstrates his ability to do so without fabric damage and advance approval from Olin is obtained. Stone shall be blocky and predominantly angular in shape.

A) Light riprap shall be used on the south and west banks of the new creek channel and shall have a uniform thickness, of 18" minimum.

B) Light riprap shall be used on the creek bottom and the north and east banks. Light riprap shall have a uniform thickness, 12" minimum.

All riprap shall be graded in accordance with New York State, Department of Transportation, Standard Specifications, Section 620.

All areas to be riprapped shall be protected by embankment ground stabilization fabric applied as per the Project QA/QC Plan under the riprap and keyed into a trench at the riprap perimeter.

After completion of the new channel, the end plugs shall be removed. The south end plug shall be removed first followed by the north end plug. All plug removal shall be in compliance with the sedimentation control requirements of the Fish and Wildlife Department. After the soil has been excavated and shaped to the correct cross section, the bottom and sides of all new excavation must be riprapped the same as the typical channel. Ground stabilization fabric and riprap will be carefully placed under water in these sections or placed "in the dry" after installing temporary sand bag dikes and silt barriers, as necessary, during favorable weather periods. Grades will be shot at plug excavations to provide a smooth transition and leave no high spots. Grade will be shot on the finish riprap also.

8) Existing Creek Channel

After completion of the new creek channel, the existing channel shall be plugged to divert the creek flow into the new channel. Temporary plugs shall be placed at each end of the new channel, immediately adjacent to the upstream and downstream tie-ins using earth excavated from the plugs at the ends of the new channel. These plugs shall be placed in compliance with the sedimentation control requirements stipulated by the Fish and Wildlife Department. Plugs shall be placed by dumping and walking in fill lifts with a bulldozer. Temporary plug widths shall be constructed to the minimum width necessary to retain all water flow. Plug height shall be two feet higher than water flow elevation at time of construction. Height may be adjusted up as required to adjust to creek flows and prevent flooding old channel. The temporary plug at the north (upstream) end shall be placed first.

Permanent dikes should be placed immediately after the temporary plugs are placed and all water that does not flow out has been pumped out of the old channel. The old channel must be kept "continuously" pumped free of water during the entire construction period. All pumped water shall be discharged into Cayuga Creek. The permanent dike(s) shall be constructed in 8" lifts and compacted to 90% maximum Standard Proctor Density.

The remainder of the existing creek channel shall be filled as follows:

A) Cut flush and remove rubbish and trash. If required, place shot rock over the existing creek bottom sediments to stabilize these materials. Excavate for and install trench drain along the southern edge of the shot rock layer in accordance with the design drawings.

B) Install cap drain system and manholes as shown on drawings adjacent to new cap area. Carefully survey and document the locations and drain alignments to prevent interference with later slurry wall installation.

C) Extend the ground stabilization fabric envelope of the trench drain over the shot rock stabilization layer and the southernmost bank of the existing creek channel as indicated on the design drawings and construct the coarse aggregate drainage layer (graded in accordance with New York State Department of Transportation, Standard Specifications, Section 703-02, Type 4A) within a ground stabilization fabric envelope.

D) Fill in 8" uncompacted lifts using cut from new channel. Initial two lifts to be compacted to 85% maximum Standard Proctor density (ASTM D698). Supplement as required using select structural fill (CL or SC). Compact subsequent lift to 90% maximum Standard Proctor Density, ASTM D698.

E) Grade to drain as shown on drawings.

9) Grading & Fill

Contractor shall locate borrow source of good structural fill and pay for testing. Fill shall be classified CL or SC according to the Unified Soil Classification. Grain size, Atterberg Limits, Material Properties, and a Standard Proctor Curve tests shall be performed on the proposed fill and submitted to Olin for approval. Written certification shall be provided by the contractor indicating that the fill material is uncontaminated.

Borrow fill shall be used to supplement the new creek channel cut to fill the existing creek channel. Borrow fill shall be used for the top 18" layer of the cap placed over the FML. All structural fill placed under the cap shall be placed in 8" (maximum) layers and compacted to 90% maximum Standard Proctor Density near the optimum water content.

The cap and the filled existing creek channel must be graded as shown on the drawings to allow proper drainage. Grade tolerance is ±2". Grade in the cap area must be to final grade elevations shown on design drawings minus 6". Additional compacted clean offsite clay must be added as required to obtain the proper rough grade elevations under the cap. Rough grade over the filled channel to the final grades shown on drawings minus 4" - 18". The difference between rough and final grade is the allowance for topsoil or riprap, as noted on drawings.

10) Slurry Trench Cutoff Wall

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1.00 - GENERAL

1.01 Description

Work under this Section consists of furnishing all labor, equipment, materials, and supervision for constructing a soil-bentonite slurry trench cutoff wall, hereafter referred to as the slurry wall. The slurry wall shall be constructed around the perimeter of the Batrouny Property as shown on Drawing D-T323-840-0-10 to the alignment and depths shown on the Drawings. The slurry wall shall consist of a mixture of bentonite-water slurry and select materials excavated from the trench and/or from designated borrow areas. The slurry wall shall have a design long term in-site permeability of 1×10^{-7} cm/sec or less and physical properties within the tolerances stated herein. The work shall include, but not necessarily be limited to the following:

1. Providing bentonite-water slurry, including all materials, equipment (e.g. mixing, storage, pumping, and testing equipment) and maintenance of required physical properties.

2. Excavation of a slurry trench, maintenance of trench stability and bentonite-water slurry levels.

3. Providing soil-bentonite backfill, including mixing and placing of the soil-bentonite backfill.

4. Cleanup and restoration of the site and facilities, including disposal of spoil and slurry on-site in areas designated by the Owner.

5. Maintenance of the site during construction.

6. A) Use backfill mix developed by Woodward-Clyde (Design Report for Slurry Wall, dated May 1988) for slurry wall backfill, or

   B) Developing a backfill design mix, prior to the start of construction that includes performing laboratory permeability tests on the backfill design mix to demonstrate that it will meet the requirements of this Specification.

   C) Contractor shall be solely responsible for the performance of the backfill.

7. Developing a written Quality Control Program prior to the start of construction which will include the types and frequency of tests and measurements that the Contractor will use to verify that the work is in accordance with this Specification, and implementation\ documentation of the Quality Control Program during construction of the slurry wall.

8. Preparing a written Health and Safety Work Plan for use by the Contractor's employees and all other involved personnel, and implementation of the plan during construction.

1.02 Objective

The objective of the work is to provide a low-permeability barrier that will minimize both the quantity of groundwater that leaves the site and the quantity of groundwater that enters the site. The objective will be accomplished by construction of a slurry wall down to and keyed into the specified keying stratum layer as shown on the Drawings.

1.03 Definitions

The following terms shall have the meaning set forth hereafter:

A. Slurry Trench Cutoff Wall

A slurry trench cutoff wall is a wall of specified width, excavated in the existing soils by the slurry method of excavation, and backfilled with a specified material to form a seepage barrier with a design long-term in-situ permeability equal to or less than 1×10^{-7} cm/sec; referred to herein as the slurry wall.

B. Slurry Method of Excavation

The slurry method of excavation consists of excavating a trench in the existing soils while at the same time keeping the trench filled with bentonite-water slurry; the basic purpose of the slurry is to provide support for the walls of the trench until the slurry is displaced by the backfill.

C. Slurry

Slurry is a stable colloidal thixotropic suspension of powdered bentonite in water.

D. Bentonite

Bentonite is a natural clay whose principal mineral constituent is sodium montmorillonite.

E. Surface Water

Surface water is all water that enters the work area above the ground surface from either natural or artificial sources.

F. Work Area

The limits of the work as shown on the Drawings.

G. Groundwater

Groundwater denotes all water below the existing ground surface within the work area.

H. Working Pad

The working pad is the surface on which the equipment shall operate to excavate the slurry wall. The elevation of this surface along the alignment of the trench shall be such that it does not cause slurry in any part of the open trench to be more than 2 ft. below the top of the trench, unless specifically approved in writing by the Owner or the Engineer.

I. Backfill

The thoroughly blended mixture of bentonite-water slurry, select materials excavated from the trench and/or supplied from borrow areas, and powdered bentonite (if necessary) having a permeability equal to or less than 5×10^{-8} cm/sec as determined in a laboratory flexible-wall permeameter at an effective confining stress of 0.35 t/ft^2 and having physical properties within the tolerances stated in Section 3.04. The required laboratory permeability of the backfill (i.e., 5×10^{-8} cm/sec) is one half the design long-term in-situ permeability of the slurry wall (i.e., $\leq 1 \times 10^{-7}$ cm/sec).

J. Select Materials

Materials excavated from the trench at the locations shown on the Drawings and/or obtained from on-site or off-site borrow sources suitable for use in the backfill to achieve the required gradation and permeability of the slurry wall.

K. Mixing Area

The area in which all mixing and blending of soil and bentonite-water slurry (and dry bentonite, if necessary) shall take place. This mixing area may be along the side of the trench or elsewhere on-site. After mixing, blended materials will be transported to the slurry trench in such a manner as to preclude the loss of backfill material.

L. Keying Stratum

The red-brown clay stratum into which the slurry wall shall terminate.

M. Owner - Olin Corporation

N. Quality Assurance Engineer - Owner's representative responsible for Geotechnical Quality Assurance.

O. Quality Control Engineer - Owner's or Contractor's representative responsible for Quality Control.

1.04 References

Materials requirements and tests performed on the specified materials shall conform to the most recent issue of the following standards. In the event of a conflict between this Specification and the referenced standards, this Specification shall govern.

A. American Petroleum Institute (API)

1. API Specification 13A: "Specification for Oil Well Drilling Fluid Materials", 12th Edition, October 1988.

2. API, Recommended Practice 13B: "Standard Procedure for Testing Drilling Fluids", 12th Edition, Sept. 1988.

B. American Society for Testing and Materials (ASTM)

1. ASTM C-143: "Test for Slump of Portland Cement Concrete"

2. ASTM D-422: "Particle-Size Analysis of Soils"

3. ASTM D-1140: "Amount of Material Finer than No. 200 Sieve"

4. ASTM C-117: "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing"

5. ASTM D-4318: "Liquid Limit, Plastic Limit, and Plasticity Index of Soils"

C. U.S. Army Corps of Engineers, Engineering Manual EM 1110-2-1906, Laboratory Soils Testing, Appendix Vll, "Permeability Tests". Falling or constant head test using a pressure chamber (flexible wall permeameter) with back-pressure saturation and an effective confining stress of 0.35 $t/ft.^2$.

1.05 Qualifications

The Contractor shall submit with his bid, written evidence of experience and competence of himself or his specialty Subcontractor in soil-bentonite slurry wall construction as herein described. The evidence shall demonstrate the following:

1. A minimum of three years experience in soil-bentonite slurry wall construction, including a list of three recently completed projects with the names and addresses of the Owner and Engineer and responsible person to contact for verification of the information. The listed projects shall indicate experience in constructing slurry walls to the depths and widths required by this Specification.

2. Sufficient appropriate equipment and experienced personnel to carry out the work.

3. The name and resume of the person considered for assignment as the project Superintendent. The Superintendent shall be experienced in the type of work specified herein. If, in the opinion of the Engineer, the safety, quality, or progress of the slurry wall work is being impaired by a shortage of Contractor's qualified personnel, the Contractor shall assign additional qualified personnel to the work that are acceptable to the Engineer, and approved by the Owner.

1.06 SUBMITTALS

The Contractor shall submit, for review and comment by the Engineer, the following items four (4) weeks prior to starting the work:

1. Work Procedures: A complete description of the procedures he intends to use to perform the work, including:

   a. Materials handling, transport, and storage.

   b. Slurry wall excavation and sequencing.

   c. Slurry mixing, storing, and transporting.

   d. Backfill mixing and placement.

   e. Disposal of excess slurry and backfill on-site, including methods to stabilize the slurry before disposal.

2. Quality Control Program: A proposed quality control program for the work in conformance with the requirements of this Specification, including proposed test procedures, testing frequencies, testing equipment, and the name of the laboratory the Contractor intends to use to perform the laboratory tests required in the accepted Quality Control Program. The program shall at a minimum, meet the requirements of section 3.07 of this Specification.

3. Equipment Schedule: A list of equipment, by size, type and capacity/capability which he proposes to use for the work. The list shall include excavation equipment, slurry mixing, storing, transporting and cleaning equipment, trench bottom cleaning equipment, backfill mixing and placing equipment, and other tools and appurtenances required to complete the work.

4. Materials:

   Documents certifying the properties of bentonite, mixing water, and other materials that the Contractor proposes to use for the work. At the Engineer's request, the Contractor shall furnish samples of any materials in sufficient amount for independent testing.

   A) Use the backfill mix developed by Woodward-Clyde or

   B) Develop a new backfill mix conforming to this Specification.

5. Backfill Design Mix:

   A. Use the backfill mix developed by Woodward-Clyde (Design Report for Slurry Wall, dated May 1988) or

   B. Develop a new backfill mix conforming to this specification.

   Results of laboratory gradation analyses and permeability test results on the design mix(es) the Contractor proposes to use for the work. The design mix(es) shall use the same bentonite-water additives (if any) that the Contractor is planning to use in the field.

   If the type of backfill soil selected by the Contractor is different than that used for the backfill mix developed by Woodward Clyde, a leachate compatibility permeability test may be required. Ground water from the site shall be used as the permeant to demonstrate that the ground water will not cause the permeability of the design backfill mix to increase above the design long-term in-situ permeability of the slurry wall (i.e., 1×10^{-7} cm/sec). A minimum of two pore volumes of leachate would be passed through the sample during the leachate compatibility test. The need for a leachate compatibility permeability test would be decided by the Engineer after reviewing the Contractor's test results on the design mix(es). The compatibility test would be performed by the Engineer.

6. Health and Safety Work Plan: A plan for the Contractor's employees that identifies the potential health and safety hazards at the site and that establishes safe working procedures for his employees. The plan shall be consistent with the requirements of all applicable local, state and federal regulations, including 29 CFR 1910.120. The Contractor shall also be responsible for the implementation of the Health and Safety Work Plan. Contractor's Health and Safety Work Plan must be reviewed and agreed to by Olin. Contractor's Health and Safety Work Plan must match or exceed Olin's.

1.07 Subsurface Conditions

The Contractor should examine the site, records of existing utilities and construction, and the subsurface investigation reports for the site. Detailed data on subsurface conditions at the site are contained in the following reports which are available for the Contractor's review by contacting the Owner:

1. Remedial Investigation, Gibson Site, Niagara Falls, New York, dated 31 July 1986, prepared by Harding Lawson Associates.

2. Draft Feasibility Study Report, Gibson Site, dated 5 November 1986, prepared by Woodward-Clyde Consultants.

3. Design Report for Slurry Wall, Gibson Site, dated May 1988, prepared by Woodward-Clyde Consultants.

Within the limits of the proposed slurry wall, the subsurface conditions at the site generally consist of up to 6 ft of fill overlying gray-brown and/or red-brown clay, which in turn overlies rock. The fill includes mixed natural soils, cake waste, flash, lime grit and construction rubble. Bedrock was encountered at a depth of about 25 ft. below the ground surface. The groundwater was encountered generally three to five ft. below the ground surface.

It should be noted that the creek that borders the north and east portions of the site will be partially filled in prior to excavation of the slurry wall along the creek. It is planned that the fill will consist of material obtained from excavations near the site. The fill will be placed in a controlled manner (i.e., compacted in lifts). The fill along the creek will be approximately 10 ft. thick.

The Owner makes no warranty, expressed or implied, of the subsurface conditions stated herein or in the above referenced reports. General subsurface conditions are as described in this Specification and the referenced reports.

2.00 - PRODUCTS

2.01 Materials

A. Bentonite

Bentonite used in preparing the bentonite-water slurry shall be powdered sodium montmorillonite bentonite. Bentonite shall meet the requirements of API Standard 13A "Specification for Oil Well Drilling Fluid Materials". The bentonite shall be covered to protect it from the elements and contaminants in transit to and in storage at the site. All bentonite shall be supplied by one manufacturer. The bentonite Manufacturer's Certification Report shall be provided by the contractor.

B. Water

Water used in preparing the bentonite-water slurry shall be clean, potable and free from deleterious amounts of oil, salts, organic matter or other deleterious substances such that the resulting slurry has the necessary properties to provide stability of the trench and to provide the desired backfill characteristics. The total dissolved solids shall be less than 500 ppm. The Contractor shall submit to the Engineer for comment the water quality test results and the location of the source or sources of water.

C. Additives to Slurry

No additives such as dispersants, plugging agents, and/or softeners may be added to the water or slurry so as to obtain proper workability of the slurry and efficient use of the bentonite unless the Contractor can prove by performing laboratory tests that the additives will not adversely effect the design mix (e.g., increase its permeability). Additives to the slurry shall be approved by the Engineer prior to use in the slurry.

D. Backfill

The soil-bentonite material placed as backfill in the trench shall consist of a mixture of select excavated soils and/or soils obtained from a borrow area and bentonite-water slurry (and powdered bentonite, if required), demonstrated by laboratory design mix testing as having a permeability equal to or less than 5×10^{-8} cm/sec as determined in a flexible wall permeameter at an effective confining stress of 0.35 t/ft^2. The blended backfill material shall be free of roots, organic soil, trash, debris, lumps or stones larger than two inches in diameter, frozen material of any kind, or other deleterious materials. The backfill shall be thoroughly mixed and shall not contain unmixed pockets of slurry or soil exceeding 2 inches in diameter. The physical properties of the backfill shall fall within the ranges given in Section 3.04.

2.02 Equipment

A. Slurry Mixing Plant

The Contractor's slurry plant shall include a mixer capable of producing a colloidal suspension of bentonite in water, an agitator, pumps, and necessary valves, hoses, supply lines and other equipments as needed to provide an adequate supply of hydrated slurry to the trench excavation. The Contractor shall provide the necessary valves, hoses, and other necessary items to bring water to the mixing area. The mixer used in preparing the slurry may be a high-speed colloidal-type mixer, or another type capable of achieving complete dispersion of bentonite and additives, and capable of continually mixing to provide a uniform and thoroughly blended slurry.

Hand mixing or trench mixing of the slurry shall not be allowed.

Storage of the slurry shall be in above-ground tanks or in excavated pits on-site. The storage facilities shall be of sufficient size to accommodate the trench excavation rate and to allow complete hydration of the bentonite before mixing with additives. The storage facilities shall be equipped with a circulation system for agitation of the slurry and shall have adequate capacity to provide fully hydrated slurry to the trench if substantial loss of slurry from the trench occurs.

B. Excavation Equipment

Equipment for excavating the slurry trench shall consist of either a backhoe, a dragline or special slurry trench equipment (e.g. clam shell) or combinations of such equipment capable of continuously excavating the required width of trench to its final depth. The equipment shall be capable of excavating the minimum required width in a single pass of the excavating tool. The width of the excavating tool shall be equal to or greater than the specified width of the slurry wall. Special chopping tools or similar equipment may be used to assist excavation in hard formations. Air lift pumps and slurry desanders or other appropriate tools and equipment shall be used as necessary to clean the trench bottom and/or slurry, as required.

C. Backfill Equipment

Equipment for mixing the backfill shall be suitable types of earthmoving or grading equipment, or mechanical blenders that are capable of thoroughly mixing the backfill materials into a relatively homogeneous mass meeting the required physical properties. Equipment for placing the backfill into the trench shall be capable of placing the backfill in a controlled manner so as to produce a uniform, continuous slurry wall without causing segregation of the backfill components or trapped pockets of slurry.

3.00 - EXECUTION

3.01 General Execution Requirements

A. Location and Dimensions

The slurry wall shall be constructed to the lines, depths, and widths shown on the Drawings, unless otherwise directed by the Engineer.

1. Depth: The depth of the slurry wall shall extend from the top of the working pad, through the site fill and natural overburden soils, and to the bottom of the slurry wall as shown on the Drawings, penetrating a minimum of 2 (+4", -0") feet into the keying stratum. The keying stratum shall be the red-brown plastic clay.

   After examination of the bottom material, the Engineer shall determine the necessity for extending the trench deeper. After the trench excavation reaches the accepted depth, the Contractor shall measure and document the actual depth of the slurry wall.

2. Width: The minimum required widths of the slurry wall are shown on the Drawings, and shall extend for the entire depth of the cutoff wall. Contractor shall measure and document the actual width of the slurry wall for the entire depth of the wall. Should the Contractor elect, for his own convenience, to construct a wider slurry wall, the additional widths and materials will be at no additional cost to the Owner.

3. Alignment: The slurry wall shall be constructed along the horizontal alignment shown on Drawings. Deviation of more than 1 foot from the alignment shall not be made without prior written approval of the Engineer.

   The vertical alignment of the slurry wall shall not deviate by more than three percent of its full depth.

4. Corners: The corners of the bottom of the slurry wall shall overlap a minimum of 3 ft. for the entire depth of the wall as shown on the Drawings.

B. Maintenance of Site

1. Working Surface: During the course of construction, the Contractor shall maintain the working surface in such a condition so as not to impair the construction operations, including excavation of the slurry trench, quality of the soil-bentonite backfill, access to the trench for observations and measurements, and trafficability of vehicles associated with the work. Any deterioration of the working surface shall be promptly repaired by the Contractor so as not to delay the work.

2. Site Drainage: The Contractor shall familiarize himself with the surface water drainage patterns of the site. The Contractor shall provide and maintain a drainage system consisting of berms, ditches, sumps, and pumps as required to direct and remove surface water from the area so that it does not flow into the slurry trench or the soil bentonite backfill mixing areas. The intent is to minimize the erosion of the completed slurry wall and spreading of slurry over the work area.

   Stormwater collected in the Contractor's drainage system shall be directed into the existing drainage system. The Contractor shall provide final site drainage in the areas of his work that shall include berms and swales so as to prevent ponding of surface water on site after completion of construction and site restoration.

3. Spillage of Slurry: The Contractor shall be responsible to contain within the work area any spillage of slurry or runoff containing bentonite. The Contractor shall promptly clean up a spillage of slurry and dispose of it on-site in disposal areas designated by the Owner.

4. On-Site Access: The Contractor shall not cause blockage of site entrance, exit, and access roads, except as approved by the Owner.

5. Dust Control: A dust control plan shall be submitted by the Contractor, approved by the Owner, and implemented by the Contractor. Adjustments and/or modifications that are deemed necessary by the Health and Safety Officer must be added at the Contractor's expense.

3.02 Bentonite-Water Slurry

A. Method of Mixing and Storage

The bentonite-water slurry shall be prepared by mixing bentonite with water in an approved mixer that achieves complete dispersion of the bentonite particles.

The bentonite-water slurry shall be allowed to hydrate completely before its use in the trench. Hydration may be accomplished by storing the slurry in a tank or pit with a circulation system. Complete hydration is defined as the stabilization of the slurry viscosity and fluid loss properties. The bentonite slurry shall be stored under essentially constant-circulation until used. Circulation may cease for short periods when construction activities are not in progress (i.e., weekends, holidays).

B. Proportions and Properties

1. Proportions and Initial Properties: The bentonite-water slurry shall have properties, when completely hydrated, within the following limits:

Bentonite Content	4 percent or greater (by weight)
Density	1.03 g/cm^3 (64.3 lb/ft^3) minimum
Viscosity	40 Marsh seconds minimum
Filtrate Loss	less than 25 ml in 30 min. at 100 lb/in^2 pressure
pH	between 7 and 10

2. Properties in the Trench: The bentonite-water slurry as used for trench stabilization shall have properties in the trench within the following limits:

Density	1.03 to 1.30 g/cm^3 (64.3 to 81.1 lb/ft^3)
Viscosity	40 Marsh seconds minimum

The Contractor shall maintain the properties of the slurry in the trench by using approved additives, recirculation, desanding or replacement. At all times, the backfill density shall be at least 0.25 g/cm^3 (16 lb/ft^3) greater than the slurry density as measured at the bottom of the trench.

3.03 EXCAVATION

A. Excavation Procedure: Excavation shall not start until 1) the laboratory report of the backfill design mix has been received by the Engineer and a backfill design mix has been accepted, and 2) the backfill mixing area has been prepared.

The trench shall be excavated vertically from the ground surface through the site fill and natural overburden soils and shall terminate a minimum of 2 ft into the keying stratum as shown on the Drawings. Excavation of the slurry trench shall be accomplished by the equipment accepted by the Engineer. The accepted equipment shall excavate in a manner to provide a continuous cut-off wall along the alignment of the trench from the starting point to the finishing point. Pre-augering, chiseling, or other suitable methods may be used when necessary to ease excavation of hard materials. Use of such methods shall not be done without the prior acceptance of the Engineer.

Bentonite-water slurry shall be introduced into the trench at the beginning of excavation and shall be maintained at a level no more than two ft. below the top of the trench. As shown on the Drawings, the existing grade may vary as much as four ft. along ~~the~~ alignment of the slurry wall. The Contractor shall perform ~~any~~ work needed to maintain the slurry level at no more than two ft. below the top of the trench. The Contractor shall maintain the stability of the excavated trench at all times (including weekends and/or holidays) for its full depth.

The soil excavated from the trench shall be placed on the working pad or hauled to the backfill mixing area for mixing and blending, or hauled to an on-site disposal area designated by the Owner. The excavated soil shall not be stockpiled within 10 ft. from the edge of trench, or as directed by the Engineer to maintain trench stability.

The soil excavated from the trench along the southern and western alignments of the slurry wall shall not be used in the backfill and shall be disposed of on-site under the cap, in an area designated by the Owner.

The Contractor shall allow time during the excavation cycle for inspection of the work and measurements by the Engineer. The Contractor shall provide:

1. Suitable means of access to the trench for inspection and depth measurements.

2. Labor to assist the Engineer in measuring the depth of the trench.

3. A suitable depth measuring device with prominent markers at one-foot intervals.

4. The contractor shall provide a suitable trench width measuring device.

B. Key: When the keying stratum has been reached, as evidenced by the cuttings brought up by the excavating tools, the depth of the trench shall be measured by the Contractor and inspected by the Engineer. The Contractor shall then excavate an additional 2 ft. into the keying stratum to attain the bottom of the slurry wall.

C. Trench Bottom Cleaning: Upon completion of excavation, and prior to backfill placement, loose material greater than 6 inches in thickness shall be removed from the bottom of the trench by suitable means. The bottom surface shall be checked for sediment by the Contractor and observed by the Engineer, by means of a probing rod or other suitable devices, supplied by the Contractor.

3.04 SOIL -BENTONITE BACKFILL

A. Mixing: The excavated material and/or select borrow material shall be mixed with new or recycled bentonite slurry to achieve a homogeneous mixture meeting the physical properties and permeability criteria specified. The addition of water will not be permitted. Mixing shall be accomplished adjacent to the trench or at a remote location by equipment proposed by the Contractor and accepted by the Engineer. Mixing should continue until the soil-bentonite backfill is a homogeneous mixture with a consistency necessary to maintain the desired backfill slopes (see paragraph B, "Placement"). The backfill shall not contain unmixed pockets of slurry or soil. The maximum size of clay lumps permitted in the backfill shall be 2 inch. Backfill mixing shall be far enough away from the trench to avoid spillage into the trench.

B. Placement: No soil-bentonite backfill shall be placed in the trench until that portion of the trench has been accepted by the Engineer. The backfill shall be placed in such a manner so as not to trap pockets of slurry within the backfill. Placement of backfill shall begin at the point of start of trench excavation and proceed in the direction of the excavation.

Backfilling shall not start until the length of the trench is at least ten times the excavated depth. Placement of backfill in the first section shall be done by lowering the bucket of the excavating equipment or a tremie pipe to the bottom of the trench and discharging the backfill directly on the bottom of the trench at the starting point of excavation. This process of placement shall be continued (i.e., discharging backfill directly on top of previously placed backfill) until the level of the backfill reaches the top of the trench in the first section and the backfill has formed a uniform slope from the bottom of the trench to the top of the trench. Alternatively, a starter trench or ramp may be utilized beyond the limits of the work. The starter trench or ramp must be of sufficient length to permit the backfill slope to form before the toe of the backfill reaches the starting point of the slurry wall alignment. The Contractor shall submit details of the starter trench to the Engineer for comment, prior to its use.

Free-dropping of the backfill through the slurry will not be permitted. Also, pumping of backfill shall not be permitted.

After initial backfill has been placed so that its surface rises to the top of the trench (above the slurry level), additional backfill may be placed at the top of the previously deposited backfill, by pushing additional backfill with the blade of a dozer or placing the backfill with a front-end loader, so that

the backfill below the slurry level will slowly slide down the slope of the previously placed backfill and the slurry surface ~~will~~ be pushed into the trench. The location where the backfill ~~is~~ pushed into the trench shall be a minimum of 10 ft behind the portion of the advancing surface of backfill that has risen to the top of the trench.

The consistency of the backfill shall be such that the slope of backfill is between 6(horiz) to 1(vert) and 12(horiz) to 1(vert). A distance of not less than 20 ft and not more than 100 ft shall be maintained between the toe of the advancing slope of the backfill and the portion of the trench being excavated and cleaned, unless otherwise accepted by the Engineer.

Soil-bentonite backfill shall not be placed if the average air temperature is less than 30 degrees Fahrenheit. Frozen backfill shall not be placed.

The Contractor shall avoid excessive delays (i.e., more than two working days) in the placement of backfill once this operation begins. The Contractor shall remove all sand layers that may develop on the surface of the backfill in the trench to the satisfaction of the Engineer.

C. Proportions and Properties: The slump of the backfill shall range from 4 in. to 6 in. This requirement may be varied by the Engineer in order to improve the slope of the backfill and integrity of the slurry wall.

The density of the backfill shall be at least 0.25 g/cm^3 (16 lb/ft^3) greater than the density of the slurry at the bottom of the trench.

The backfill shall consist of a well graded material. A minimum of 25 percent (by dry weight) shall pass the No. 200 sieve (U.S. size) and 100 percent (by dry weight) shall pass the 2 in. sieve (U.S. size).

The soil used in the backfill shall have plasticity index (as defined in ASTM D-4318) of two or greater.

At least 80 percent of the laboratory permeability tests results on the design backfill mix shall have a permeability of less than or equal to 5×10^{-8} cm/sec with no result exceeding 1×10^{-7} cm/sec as determined in the laboratory in the flexible wall permeameter at an effective confining stress of 0.35 tons/sq. ft.

D. Testing by Others:

Woodward-Clyde has performed laboratory permeability and gradation tests to develop one of many possible acceptable design backfill mixes for the slurry wall. The soil used in the design mix was obtained from an off-site source referred to as borrow "pit off of Route 78 in Lockport, New York", and was supplied by Haseley Trucking Co. Inc., Niagara Falls, New York. Woodward-Clyde developed backfill mixes which had a permeability that met the requirements of the Specifications (i.e., a permeability less than or equal to 5×10^{-8} cm/sec).

Woodward-Clyde's testing procedures and test results are contained in the Design Report for Slurry Wall, Gibson Site, dated May 1988, which is available for review by contacting the Owner.

The results of testing performed by Woodward-Clyde is provided for the use of the Contractor, if desired, but in no way obligates the Contractor to use these mixes. If contractor elects to design his own mix, then the Contractor is obligated to submit a backfill design mix as required in Section 1.06. The contractor shall be ultimately responsible for the performance of the cut-off wall backfill.

3.05 TOP OF SLURRY WALL

Backfill shall be placed in the slurry trench to the grades shown on the Drawings. If, during the course of construction, the level of the backfill settles more than 6 inches below the design grades the Contractor shall place additional backfill in the trench to the design grades. The Contractor shall pump off any free standing water that forms on top of the soil-bentonite backfill.

The Contractor shall protect the surface of the slurry wall to prevent desication cracks from forming in the backfill. The Contractor shall repair any desication cracks that form in the backfill to the satisfaction of the Engineer.

3.06 CLEANUP AND RESTORATION

A. Working Surface

After completion of the cutoff wall construction, the Contractor shall remove any remaining excavated material, slurry, or backfill from the working pad. The working pad shall be restored to a condition satisfactory to Olin.

B. Working Areas and Access Roads

The Contractor shall remove from the work areas and from the access roads any excess or spilled slurry, excavation spoil, or backfill material and all equipment, temporary structures, and debris incidental to his operations. The work areas and access roads shall be restored to the satisfaction of Olin.

C. Excess Materials

Excess materials excavated from the trench, excess backfill and excess slurry shall be disposed of on-site in disposal areas designated by the Owner. The Contractor shall, however, minimize the amount of excess materials by prudent planning of material use. The excess slurry shall be stabilized by adding cement to it as it is pumped through a mixer, before it is disposed of on-site. The stabilized slurry shall be strong enough to allow placement and compaction of the site capping system above it. The Contractor shall submit detailed procedures for stabilizing the slurry to the Quality Assurance Engineer for comment, prior to performing this work. The disposal of all excess materials shall be done in a manner acceptable to the Engineer.

3.07 INSPECTION AND TESTING

A. General

Quality control of construction of the slurry trench cutoff wall shall be the responsibility of the Contractor. The Contractor's quality control activities during construction shall follow the accepted Quality Control Program and any additional measurements and tests requested by the Engineer. The contractor must submit his Quality Control Program for approval by the Engineer and Owner before commencing work.

The Contractor shall record the results of all quality control activities on suitable forms and furnish one copy daily to the Engineer. The results of laboratory tests shall be in the form of a laboratory report and one copy furnished to the Engineer. Recording of all quality control activities shall be referenced by date, time, station, and depths, as appropriate.

The Engineer may make additional measurements and tests as he deems necessary to determine the acceptability of the work. The additional measurements and tests made by the Engineer do not relieve the Contractor from his obligation to perform his own quality control work.

B. Observations and Measurements During Construction

1. Keying Stratum

The Contractor shall observe the materials being excavated from the trench. When the keying stratum has been reached, as evidenced by inspection of the cuttings brought up by the excavating tools, the Contractor shall notify the Engineer for verification that the keying stratum has been reached, and shall measure the depth of the trench at that point. Such observations and measurements shall be made and recorded at intervals not exceeding 10 ft. along the alignment of the trench.

2. Bottom of Trench

After the required depth of trench has been reached and the bottom cleaned, the Contractor shall probe the bottom with an appropriate tool to check for excessive sediment, as described in paragraph 3.03, to determine whether additional bottom cleaning is required. The Engineer will observe the probing operation and indicate whether the bottom is acceptable for backfilling. Such probes shall be made and recorded at intervals not exceeding 10 ft. along the alignment of the trench. If deemed necessary by the Quality Assurance Engineer, the contractor shall also sample the bottom of the trench for sediment, to determine if additional bottom cleaning is required. The sampling device shall be acceptable to the QA Engineer.

3. Depth of Trench

After cleaning and acceptance of the bottom of the trench by the Engineer, the Contractor shall measure the depth of the trench to within 0.1 ft. with an appropriate device. The Engineer will observe the measurement operation. Such measurements shall be made and recorded at intervals not exceeding 10 ft. along the alignment of the trench. If deemed necessary by the Quality Assurance Engineer, the contractor shall also sample the bottom of the trench for sediment, to determine if additional bottom cleaning is required. The sampling device shall be acceptable to the QA Engineer.

4. Backfill

As backfill is being placed, the Contractor shall determine the slope and uniformity of slope which the backfill forms by making depth measurements to the top of the backfill at intervals not exceeding 10 ft. along the slope at least once daily. The Engineer will observe the measurement operation.

C. Sampling and Testing

1. Slurry

Samples of freshly mixed slurry and samples of slurry recirculated from the trench, taken from the storage ponds, shall be tested for density and viscosity at least twice daily and for filtrate loss for each batch of bentonite mixed pH should be tested twice weekly. Samples of slurry in the trench, taken from approximately mid-depth near the point of excavation, shall be tested for density and viscosity at least two times daily. Samples of slurry taken from near the base of the trench, shall be tested for density and viscosity at least three times a week.

2. Water

A sample of the water used for making the slurry shall be tested for pH and total dissolved solids once at the start of the work and once each time the water source is changed. The Engineer may request additional tests if slurry properties or behavior indicate the necessity for additional tests.

3. Backfill

Samples of the backfill taken from the mixing area shall be tested for density and slump at least twice daily. Twice a week, the Contractor shall take a 5-lb sample of the backfill from the mixing area at the locations accepted by the Engineer and ship it to the approved laboratory for gradation and permeability testing in a flexible-wall permeameter. However, for the first week of backfill placement, the Contractor shall perform a laboratory permeability test in a flexible-wall permeameter and a gradation test once daily.

4. Keying Stratum

Samples of the soil from the keying stratum shall be taken by means of a special sampling device attached to the end of the excavating tool. The samples shall be given to the Engineer for inspection and then stored in jars labeled with the station and depth of the sample. The samples shall be taken at intervals not exceeding 25 ft. along the alignment of the trench.

11) Cap Construction

Cap construction shall proceed in lifts as shown and specified on the engineering drawings after the slurry wall has been constructed. A slurry wall cap shall be constructed on top of the slurry wall perimeter as shown on the design drawings. Excavated slurry wall backfill and soil shall be stabilized and placed under the cap area.

Berm key shall be constructed in 8" lifts using same mix as the slurry wall backfill. Key shall be constructed after slurry wall has reached "set" and has been approved the Engineer. Each lift shall be compacted to 90% maximum Modified Proctor Density. Lifts shall be added until the final lift reaches the elevations required and shown on the drawings.

o Clean Structural Fill (18")

Contractor shall locate borrow source of uncontaminated good structural fill and pay for testing. Fill shall be classified CL or SC according to the Unified Soil Classification. Grain size, Atterberg Limits, Material Properties, and a Standard Proctor Curve tests shall be performed on the proposed fill and submitted to Olin for approval.
Borrow fill shall be used for the top 18" layer of the cap placed over the FML. All structural fill placed under the cap shall be placed in 12" (maximum) layers and compacted to 90% maximum Standard Proctor Density near the optimum water content. Layers are to be constructed using equipment that does not damage liner.

The cap must be graded as shown on the drawings to allow proper drainage. Grade tolerance is ±2". Grade in the cap area must be to final grade elevations shown on design drawings minus 6".

o Clay

The bottom layer of the low permeability cap design shall consist of a minimum of 24" of compacted clay having a saturated hydraulic conductivity of not more than 1×10^{-7} cm/sec.

The clay barrier shall be placed in lifts not exceeding 8" in loose thickness. Each lift shall be compacted to a minimum of 90% maximum Modified Proctor Density using a sheepshoot roller or other approved equipment. Clay in-place density and moisture content shall be controlled and verified by field testing to be maintained within the range or "window" demonstrated likely to produce an in-place permeability less than or equal to 1×10^{-7} cm/sec.

Clay barrier is to be free of rocks, sticks, etc., or any materials that could possibly damage the flexible membrane liner (FML). Finished surface of clay barrier shall be smooth and uniform and free of voids.

o Geogrid

1. Description: The contractor shall install the geogrid reinforcement in accordance with the plans and Project QA/QC Plan.

2. Material Specification:

2.1 The geogrid reinforcement shall be a biaxially-oriented polymer grid structure composed of polypropylene, polyester or high density polyethylene.

2.2 The grid spacing shall be such to provide an opening between the grid elements no smaller than 1.0 inch and no larger than 1.3 inches (nominal) in either direction. The joints at crossover points of grid elements must be integrally connected extrusion of the mesh itself or welding of crossover points in such a manner that the elements will not separate under handling and construction activities, nor under stress levels and environmental conditions anticipated over the life of the structure.

2.3 The geogrid to be used shall meet or exceed the following minimum property values:

TABLE 1
GEOGRID MINIMUM PROPERTY REQUIREMENTS

Geogrid	T-Design[2] (lbs/in)	T-Ultimate[2] (lbs/in)
High Strength at base	58.2 @ 5%	99.9

NOTES:

1. All numerical values represent minimum average roll values required.

2. Geogrid strength, T, tested in acordance with ASTM D-4595.

2.4 For each consignment, the contractor shall furnish a sample of the geogrid and two copies of a certificate signed by a legal authorized officer of the geogrid manufacturer certifying that the product meets the requirements of this specification prior to commencing construction. Proof of test results shall be submitted with the certificates. Samples and product certificate for the facing materials shall also be submitted. At least two weeks prior to construction, the Contractor shall provide suitable samples of the geogrid (taken from actual rolls that will be delivered to the site). Any geogrid materials which are found to not be in compliance with this Specification shall not be used on this job. The QC Engineer's representative will be present at all times during installation.

3. Construction Requirements:

3.3 The Contractor shall be responsible for the following:

a. After delivery to the site, all geogrid material shall be protected from mud or other materials which may affix themselves to the geogrid.

b. The geogrid shall be placed at the levels shown on the plans, and the QC Engineer shall observe all geogrid placement. The geogrid shall be laid at the proper elevation in accordance with the plans and the Project QA/QC Plan. The geogrid shall be pulled taut to remove wrinkles or folds and secured in place with staples, pins, backfill, or as approved by the QA Engineer.

c. Adjacent geogrid sheets shall be placed in such a manner as to facilitate the use of bodkin joint connections.

d. Fill material shall be placed on top of the geogrid and compacted in lifts as indicated on the plans, and in the Standard Specifications and applicable Special Provisions. All fill materials shall be placed, spread and compacted in such a manner that does not result in the development of wrinkles in and/or movement of the geogrid. No construction equipment shall be allowed to operate directly on the geogrid. A minimum fill thickiness of 12 inches shall be maintained between the tracks and wheels of construction vehicles and the geogrid at all times. Turning of vehicles on the lift directly above the geogrid should be kept to a

minimum and sharp turns (45 degrees or greater) will not be allowed. Sudden braking shall also be avoided. The Contractor will be responsible for any damage to the geogrid resulting from his filling methods and shall replace any damaged geogrid at the direction of the QC Engineer at the Contractor's expense.

4. Method of Measurement: Quantities of geogrid reinforcement shall be measured by the square yard. The total quantity shall be computed based on the total area of geogrid shown on the construction plans, including the area of geogrid used in overlaps. Measurements will include overlaps specified in the Project QA/QC Plan. No payment will be made for geogrid reinforcement placed outside of the lines shown on the plans, unless approved in writing by the QC Engineer.

5. Basis of Payment: The accepted quantities shall be paid for at the contract unit price per square yard for "High Strength Geogrid." This price shall include all work necessary to complete this item.

BIAXIAL GEOGRID

The geogrid shall be a regular grid structure formed by biaxially drawing a continuous sheet of select polypropylene material and shall have aperture geometry and rib and junction cross-sections sufficient to permit significant mechanical interlock with the material being reinforced. The geogrid shall have high flexural rigidity and high tensile modulus in relation to the material being reinforced and shall also have high continuity of tensile strength through all ribs and junctions of the grid structure. The geogrid shall maintain its reinforcement and interlock capabilities under repeated dynamic loads while in service and shall also be resistant to ultraviolet degradation, to damage under normal construction practices and to all forms of biological or chemical degradation normally encountered in the material being reinforced.

The geogrid shall also conform in all respects to the property requirements listed below.

PROPERTY	TEST METHOD	UNITS	VALUE
Interlock			
o aperture size[1]	I.D. Calipered[2]		
o MD		in	1.0 (nom)
o CMD		in	1.3 (nom)
o open area	COE Method[3]	%	70 (min)
o thickness	ASTM D1777-64		
o ribs		in	0.05 (nom)
o junctions		in	0.16 (nom)

Reinforcement

o flexural rigidity	ASTM D1388-64[4]		
o MD		mg-cm	750,000 (min)
o CMD		mg-cm	1,000,000 (min)
o tensile modulus	GRI GG1-87[5]		
o MD		lb/ft	18,500 (min)
o CMD		lb/ft	30,000 (min)
o junction strength	GRI GG2-87[6]		
o MD		lb/ft	1,050 (min)
o CMD		lb/ft	1,890 (min)
o junction efficiency	GRI GG2-87[6]	%	90 (min)

Material

o polypropylene	ASTM D4101 Group 1/Class 1/Grade 2	%	98 (min)
o carbon black	ASTM 4218	%	0.5 (min)

Dimensions

o roll length	ft	164
o roll width	ft	9.8
o roll weight	lb	102

Notes:
1. MD dimension is along roll length. CMD dimension is across roll width.
2. Maximum inside dimension in each principal direction measured by calipers.
3. Percent open area measured without magnification by Corps of Engineers method as specified in CW 02215 Civil Works Construction Guide, November 1977.
4. ASTM D 1388-64 modified to account for wide specimen testing as described in Tensar test method TTM-5.0 "Stiffness of Geosynthetics."
5. Secant modulus at 2% elongation measured by Geosynthetic Research Institute test method GG1-87 "Geogrid Tensile Strength." No offset allowances are made in calculating secant modulus.
6. Geogrid junction strength and junction efficiency measured by Geosynthetic Research Institute test method GG2-87 "Geogrid Junction Strength."

o Filter Fabric (Geotextile Fabric)

Filter fabric shall be placed over the FML as shown on drawings. Fabric shall be spread smoothly and lap spliced in accordance with the Project QA/QC Plan. Fabric shall be a non-woven needlepunched geotextile, such as Fibretex by Acme STW, Inc. or equivalent as approved by Olin. Thickness shall be as specified on the drawings:

- 60 mil (ASTM D-1777) over top FML layer.
- 110 mil (ASTM D-1777) between FML layers.

o FLEXIBLE MEMBRANE LINER (FML)

A. General:

1. Description:

This work includes the manufacture, fabrication, supply, and installation of 40 mil high density polyethylene (HDPE) geomembrane liners for the cap. The work includes furnishing all labor, materials, transportation, supervision, tools, and construction machinery which may be necessary to construct and test the liner installation as described in the project QA/QC Plan.

All procedures, operations, and methods shall be in strict accordance with the project QA/QC Plan.

2. Definitions:

a. Installer: Contractor's subcontractor responsible for the installation and seaming of rolls and shall be approved in writing by the geomembrane manufacturer.

b. Geosynthetic Quality Assurance Laboratory: The firm and its representatives responsible for conducting tests on samples of geosynthetics taken from the HDPE rolls and FML seams. The Geosynthetic Quality Assurance Laboratory shall be independent from the Owner, Manufacturer, Fabricator, and Installer, and cannot be provided by any party involved with the manufacture, fabrication, or installation of any of the geosynthetic components.

c. Manufacturer/Fabricator: The individual or firm responsible for production of geomembrane rolls from the HDPE resin/factory fabrication of geomembrane panels from geomembrane rolls.

d. Resin Supplier: The Individual or firm who produces and delivers HDPE resin to the Manufacturer.

3. Qualifications of Manufacturer/Fabricator:

a. The Manufacturer/Fabricator must have at least five (5) years' continuous experience in the manufacture of HDPE geomembrane rolls and/or experience totaling 2,000,000 sq ft of manufactured HDPE geomembrane rolls for at least 10 completed facilities.

b. Installer: Installation shall be performed under the direction of a single field installation engineer who shall remain on site and be responsible and in charge throughout the liner installation (including subgrade acceptance, liner layout, seaming, testing and repairs) and all other activities contracted for with the Installer. This field engineer shall have installed or supervised the installation of a minimum of 2,000,000 sq ft of HDPE geomembrane, and shall be in absolute charge of the installation. Actual seaming shall be performed under the direction of a "master seamer" who may be the same person as the field engineer, and who has successfully seamed a minimum of 1,000,000 sq ft of HDPE geomembrane using the same type of seaming apparatus as that used for this project.

The field engineer and/or masterseamer shall be on site whenever seaming is being performed and shall provide direct supervision over less experienced seamers. NO WORK SHALL BE ALLOWED AT ANY TIME THAT THE INSTALLER FAILS TO PROVIDE A QUALIFIED FIELD ENGINEER.

All personnel performing seaming operations shall be qualified by experience or by successfully passing seaming tests as prescribed herein.

B. Related Work:

1. References: These specifications include references to test procedures of the American Society for Testing and Materials (ASTM), the Federal Test Method Standards (FTMS), and the "Standards for Flexible Membrane Liners" of the National Sanitation Foundation (NSF).

C. Submittals:

The Contractor shall be responsible for the following submittals:

1. Submittals by the Manufacturer/Fabricator:

The Manufacturer shall provide the following information:

a. Corporate Background and Information

b. Manufacturing Capabilities

1.) Geomembrane samples and a list of material properties, including certified test results. Material properties and test methods shall be in conformance with those defined In Table 1.

c. A Qualification Proof which includes a list of at least ten completed facilities, totaling a minimum of 2,000,000 sq ft, for which the Manufacturer has manufactured an HDPE geomembrane.

d. A Statement that no reclaimed polymer is added to the resin (however, the use of polymer recycled during the manufacturing process may be permitted if done with appropriate cleanliness and if recycled polymer does not exceed 2 percent by weight).

e. Origin (Resin Supplier's name, resin production plant) and identification (brand name, number) of the HDPE resin.

f. Information on the raw materials, including:

i.) copies of the quality control certificates issued by the HDPE Resin Supplier.

ii.) production date(s) of the HDPE resin.

iii.) reports on the tests conducted to verify the quality of the HDPE resin used to manufacture the geomembrane rolls assigned to the project.

g. Copies of quality control certificates for the geomembrane rolls. The quality control certification shall include:

i.) roll numbers and identification;

ii.) a properties sheet including, at a minimum, all specified properties, measured using test methods indicated in the specifications, or equivalent;

iii.) a list of quantities and descriptions of materials other than the base polymer which comprise the geomembrane;

iv.) the sampling procedure and results of testing;

v.) certification that property values given in the properties sheet are guaranteed by the Geomembrane Manufacturer; and

vi.) the signature of the manufacturer's authorized representative employed by the Geomembrane Manufacturer, such as the production manager;

vii.) minimum certifiable properties valued in accordance with Table 1.

h. Fabrication capabilities and a description of Fabricators' Quality Assurance/Control Methods.

i. A Qualification Proof which includes a list of at least 10 successfully completed facilities for which the Fabricator has fabricated HDPE geomembrane blankets, totaling a minimum of 2,000,000 sq ft.

2. Submittals by Installer:

a. Seamers names and qualifications.

b. Documentation certifying that the extrudate is compatible with the specifications, and is comprised of the same resins as the geomembrane sheeting.

c. Seaming quality control records, including:

i.) apparatus temperatures;

ii.) extrudate temperatures;

iii.) ambient temperatures for all seaming processes;

iv.) documentation for all seam testing and repairs.

v.) In the event of seaming below 40° F, Manufacturer's certification specifically stating that the low temperature seaming procedure does not cause any physical or chemical modification to the geomembrane that will generate any short- or long-term damage to the geomembrane.

3. Additional Submittals:

a. Installer shall submit samples of proposed field seams and repair welds prior to initiating liner installation.

b. Prior to installation, the installer shall submit a panel and seam layout drawing for each liner system. Each field panel and seam shall be given an "identification code" (number or letter-number). This identification code shall be agreed upon by the QA Engineer, and shall be as simple and logical as possible. (Note that roll numbers established in the manufacturing plant are usually cumbersome and are not related to location in the field.) The drawing shall show the location and number of all panels and expected seams. The QA Engineer shall review the seam layout drawing and verify that it is consistent with accepted state of practice. No panels may be seamed in the field without the QA Engineer's approval. In addition, no panels not specifically shown on the seam layout drawing may be used without the QA Engineer's prior approval.

D. Products:

1. Raw Material:

The raw material shall be first quality polyethylene resin containing no more than 2 percent clean recycled polymer by weight, and meeting the specifications in Table 2. Quality control testing shall be carried out by the Manufacturer to demonstrate that each batch of resin meets the specification requirements. See Table 1.

2. High Density Polyethylene (HDPE) Liner:

HDPE liner shall conform to the minimum properties listed in Table 1, as measured using the test methods specified. No substitute shall be allowed. All liner material used for the cap shall be supplied directly from the manufacturer's plant and from the same resin and manufacturing process.

3. Extrudate:

Extrudate shall be comprised of the same resin as the HDPE liner. The manufacturer shall perform quality control testing for each batch of extrudate and shall certify to the QA Engineer that the extrudate meets these requirements. See Table 1.

E. Execution:

1. Transportation and Handling:

a. All personnel shall handle the material with care, shall use appropriate equipment and shall take all precautions necessary to prevent damaging the geomembrane.

b. Upon delivery at the site, the Contractor and the QC Inspector shall conduct a surface inspection of all rolls or factory panels for defects and for damage. This inspection shall be conducted without unrolling rolls or factory panels, unless, in the QA/QC Inspector's opinion, defects or damages are found or suspected.

c. All flaws in the material shall be brought to the attention of the QA Engineer. Rolls, factory panels, or portions thereof, which have severe flaws, shall be rejected and shall be removed from the site.

d. Rolls or factory panels, which, in the opinion of the QA Inspector, have minor repairable flaws, may be repaired with the QA Engineer's approval.

2. Storage:

A location for storage of the geomembranes shall be provided by the Contractor. The Contractor shall be responsible for ensuring that the materials stored in the storage area are protected from dirt, shock, theft, vandalism, passage of vehicles, and all other sources of damage.

3. Crest Anchorage System:

All liner anchor trenches shall be installed and backfilled in accordance with the project design drawings.

At a minimum, the liners in the trench shall extend to the bottom of the anchor trench as shown on the drawings.

4. Field Panel Placement:

a. Field Panel Identification:

Each field panel shall be given an "identification code" (number or letter-number) consistent with the layout plan.

b. Installation Schedule:

Field panels shall be installed using one of the following schedules:

1. all field panels are placed prior to field seaming (in order to protect the subgrade from erosion by rain);

2. field panels are placed one at a time and each field panel is seamed immediately after its placement (in order to minimize the number of unseamed field panels exposed to wind); and,

3. any combination for the above.

4. In no event shall more panels be placed than can be seamed during the working hour# of the day they are placed.

Unless otherwise authorized by the QA Engineer, when field panels are placed prior to field seaming, placement shall proceed In the direction of prevailing winds. Overlaps shall be shingled to facilitate drainage over the liner and minimize flow under the liner.

5. Seaming:

a. Requirements of Personnel:

All personnel must be approved by the QC Inspector before they may perform seaming operations.

b. Seaming Equipment:

The approved process for field seaming is fusion welding. FUSION WELDING SHALL BE EXCLUSIVELY USED EXCEPT FOR DETAIL WORK WHERE EXTRUSION WELDING IS REQUIRED. Only apparatus which have been specifically approved by the QA Engineer shall be used.

The fusion-welding apparatus shall be automated vehicular-mounted devices, and shall be equipped with gauges giving the applicable temperatures and pressures. This equipment will be used for all long/straight seams.

The extrusion-welding apparatus shall be equipped with gauges giving the temperature in the apparatus and at the preheating nozzle. It shall be used where the double wedge cannot be operated.

Equipment used for seaming shall be handled so as to avoid damaging the geomembrane.

c. Weather Conditions for Seaming:

No seaming shall be attempted at ambient temperatures below 40°F or above 104° unless the Installer can prove that satisfactory start-up and field seams can be achieved using climate-controlled shelters during seaming or other methods approved by the QA Engineer.

Between ambient temperatures of 40°F and 50°, seaming may be carried out if the geomembrane is preheated by either the sun or a hot air device, if there is not excessive cooling resulting from wind, and if the geomembrane Installer can prove by passing start-up seams that the welds pass the start-up requirements.

Above an ambient temperature of 50° F, no preheating is required.

In all cases, the geomembrane shall be dry and protected from wind damage.

d. Seam Layout:

All panels shall be placed such that the seam layout conforms to the seam layout drawing. No panels may be seamed in the field without the QC Inspector's approval. In addition, panels not specifically shown on the seam layout drawing may not be used without the QA Engineer's prior approval.

In general, seams shall be oriented parallel to the line of maximum slope, i.e., oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of seams shall be minimized. No horizontal seam shall be less than 5 feet from the toe of the slope, or areas of potential stress concentrations, unless otherwise authorized.

All seams shall be identified using the identification codes shown on the panel and seam layout drawing.

e. Overlapping:

Panels of geomembrane must have a finished overlap of a minimum of 4 inches for extrusion welding and 6 inches for double wedge fusion welding, but in any event, sufficient overlap shall be provided to allow peel tests to be performed on the seam.

No solvent or adhesive may be used.

The procedure used to temporarily bond adjacent panels together shall not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any spot welding apparatus shall be controlled such that the geomembrane is not damaged.

f. Trial Seams:

All trial seams shall be performed in the presence of the QC Inspector. Trial seams shall be made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. Such trial seams shall be made at the beginning of each seaming period, and at least once every four hours for each seaming apparatus used that day. Also, each seamer shall make at least one trial seam each day.

The trial seam sample shall be at least 3 ft long by 1 ft weld (after seaming) with the seam centered lengthwise.

Six adjoining specimens 25mm (1 In.) weld each will be die cut from the test seam sample. HDPE specimens will be immediately tested with a tensometer in the field for peel (6 specimens) by the Geomembrane Installer, and should not fail in the seam (see Appendix A). If a test seam fails, the entire operation will be repeated. If the additional test seam fails, the seaming apparatus or seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two consecutive successful test seams are achieved. Test seam failure is defined as failure of any one of the specimens tested in peel.

g. General Seaming Procedures:

Prior to seaming, the seam area shall be clean and free of moisture, dust, dirt, debris of any kind, and foreign material.

Seams shall be aligned with the fewest possible number of wrinkles and "fishmouths. "Fishmouths" or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane, extending a minimum of 6 in. beyond the cut in all directions.

A moveable protective layer shall be used below each overlap of geomembrane that is to be seamed to prevent buildup of moisture between the sheets.

For welds which are to be extrudated, and as necessary for fusion welds, the seam overlap shall be ground perpendicular to the seam in accordance with the Geomembrane Manufacturer's Instructions, within one hour of the seaming operation, and in a way that does not damage the geomembranes.

For field seams, the edge of the seam shall be ground to a smooth incline (top and bottom) prior to welding and extrudate must cover a minimum of 80 percent of the grind. Excessive grinding (width and depth) shall be cause for rejection of the work.

For extrudate seams, the extruder shall be purged prior to beginning a seam until all heat-degraded extrudate has been removed from the barrel.

In locations where a firm substrate does not exist, a flat board, a conveyor belt, or a similar hard surface shall be provided directly under the seam overlap to achieve proper support.

Seaming shall extend to the outside edge of panels to be placed in the anchor trench.

h. Factory Seaming:

At the Contractor's option, the geomembrane may be fabricated into panels in a factory by the Fabricator. All requirements outlined herein for panel placement, seaming, testing, and repairs shall be compiled with.

All apparatus temperatures, extrudate temperatures, and ambient temperatures throughout the seaming process for both trial and panel seams shall be documented. All seam tests shall be fully documented, and a copy of the documentation shall be forwarded to the QA Engineer and the Owner for review.

Any seams which fail nondestructive testing shall be repaired to the satisfaction of the QA Engineer. Repairs shall be fully documented and the Contractor shall submit such documents to the QA Engineer and the Owner.

All repairs shall be carried out at the Contractor's expense. Each factory panel shall be given an identification code consistent with the layout drawing.

~~1.~~ Liner Protection During Seaming

All precautions shall be taken as necessary to protect the liner, including, but not limited to: placing all equipment on smooth insulating plates or fabric to prevent damage from generators, welding guns, and construction traffic.

F. Testing:

Testing shall be performed to insure conformance with material specifications before acceptance of rolls and field tests conducted by the Contractor and Quality Assurance Laboratory. All testing and acceptance criteria shall be as specified in Table 1.

1. Conformance Testing:

Prior to or upon delivery of the rolls of HDPE liner, the Contractor will remove samples for testing by the Geosynthetic Quality Assurance Laboratory to ensure conformance to both the design specifications and the list of guaranteed properties. Such testing shall be paid for by the Owner.

As a minimum, the geomembrane will be tested according to the test method listed In Table 1. These test sets shall be performed at the frequencies presented on Table 1.

2. Nondestructive Seam Continuity Testing:

a. To check for seam continuity, the Contractor shall nondestructively test all field seams over their full length using a vacuum test unit (for extrusion welds), air pressure test (for double fusion seams), or other approved method.

Where seams cannot be nondestructively tested, the following procedures shall apply.

i.) All such seams shall be cap-stripped with the same geomembrane.

ii.) If the seam is accessible to testing equipment prior to final installation, the seam shall be nondestructively tested prior to final installation.

iii.) If the seam cannot be tested prior to final installation, the seaming and cap-stripping operations shall be observed by the QC Engineer and Installer for uniformity and completeness.

b. Vacuum Testing (for welds without successful air pressure tests):

Test equipment, including, but not limited to the following, shall be furnished:

i.) a vacuum box assembly consisting of a rigid housing a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a vacuum gauge;

ii.) a steel vacuum tank and pump assembly equipped with a pressure controller and pipe connections;

iii.) a rubber pressure/vacuum hose with fittings and connections;

iv.) a bucket and wide paint brush;

v.) a soapy solution.

Unless otherwise approved by the Engineer, the following procedures shall be followed:

i.) energize the vacuum pump and reduce the tank pressure to approximately 5 psi (10 in. of Hg);

ii.) wet a strip of geomembrane approximately 12 inches by 48 inches with the soapy solution;

iii.) place the box over the wetted area;

iv.) close the bleed valve and open the vacuum valve;

v.) ensure that a leaktight seal is created;

vi.) for a period of not less than 45 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles;

vii.) If no bubble appear after 45 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inches overlap, and repeat the process;

viii.) all areas where soap bubbles appear shall be marked and repaired and retested.

c. Air Pressure Testing (For Double Fusion Seam Only):

The following procedures are applicable to those processes which produce a double seam with an enclosed space.

All test equipment, including but not limited to the following shall be furnished:

i.) an air pump (manual or motor drive) equipped with pressure gauge capable of generating and sustaining a pressure between 25 and 30 psi and mounted on a cushion to protect the geomembrane;

ii.) a rubber hose with fittings and connections;

iii.) a sharp hollow needle, or other approved pressure feed device.

The following procedures shall be followed:

1. seal both ends of the seam to be tested;
2. insert needle or other approved pressure foot device into the tunnel created by the fusion weld;
3. insert psi gauge in the other end of the seam being tested to assure the entire seam is tested;
4. energize the air pump to a pressure between 25 and 30 psi, close valve, and sustain pressure for approximately 8 minutes.
5. if loss of pressure exceeds 5 psi, or if pressure does not stabilize, locate faulty area, repair and retest;
6. remove needle or other approved pressure feed device and the other pressure gauge and seal the geomembrane.

3. Destructive Seam Strength Testing:

To determine seam strength destructive seam tests shall be performed at selected locations. Seam strength requirements are shown in Table 1.

Test locations shall be determined during seaming at the QA Engineer's discretion and may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential cause of imperfect welding.

The Contractor shall not be informed in advance of the locations where the seam samples will be taken.

At a minimum, one test location shall be selected per 500 ft of seam length. (This minimum frequency is to be determined as an average taken throughout the entire facility).

Seam strength testing shall be performed as the seaming work progresses, not at the completion of seaming, and by the Contractor's Quality Control Laboratory.

At a given sampling location, two types of samples shall be taken by the Contractor.

First, two samples for field testing shall be taken. Each of these samples shall be 1 inch wide by 12 inches long, with the seam centered parallel to the width. The distance between these two samples shall be 42 inches.

In the presence of the QA Engineer and QC Field Inspector, the Contractor shall test the two 1-inch-wide strips for peel respectively using ASTM test procedures. If any test sample fails to pass then the following procedures shall be used:

Procedures for Field Destructive Test Failure:

1. The following procedures will apply whenever a sample fails the field destructive test. The Geomembrane Installer has two options:

   a. The Geomembrane Installer can reconstruct the seam between the failed location and any passed test location.

   b. The Geomembrane Installer can retrace the welding path to an intermediate location (at a 3m (10 ft) minimum from the location of the failed test) and take a minimum of 8 x 12 in. sample for an additional field testing (see Section 4.1.3.7). If this additional sample passes the test, then the seam should be reconstructed between that location and the original failed location. If this sample fails, then the process is repeated.

2. In any case, all acceptable reconstructed seams must be bounded by two passed field test locations (i.e., the above procedure should be followed in both directions from the original failed location), and one laboratory test must be taken within the reconstructed area if the failed length exceeds 20 feet.

   The Inspector will document all actions taken in conjunction with destructive test failures.

   If both samples pass the field test described above, a sample for laboratory testing shall be located between the two samples which were tested. The sample for laboratory testing shall be 12 inches wide by 40 inches long with seam centered lengthwise. This sample shall then be cut into three parts and distributed as follows:

   a. one portion to the Installer for laboratory testing, 12 inches x 12 inches;

   b. one portion to the Owner for archive storage, 12 inches x 12 inches; and

   c. one portion for the Geosynthetic Quality Control Laboratory testing, 12 inches x 16 inches.

   All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired in accordance with repair procedures described herein. The continuity of the new seams in the repaired area shall be tested.

4. Geosynthetic Quality Control Testing:

   Packaging and shipping of destructive test samples shall be the responsibility of the Contractor and shall be conducted in a manner

which will not damage the test sample. The QA Engineer and QC representatives shall verify that packing and shipping conditions are acceptable. The Owner will be responsible for storing the archive samples. This procedure shall be fully outlined prior to construction. Test samples shall be tested by the Geosynthetic Quality Assurance Laboratory.

Testing shall include "shear strength" and "peel adhesion" (ASTM D 413 with a 1-inch-wide specimen tested at 2 inches per minute). These terms are defined in the test specifications. The minimum acceptable values to be obtained in these tests are those indicated in Table 1 of these specifications. At least five specimens shall be tested for each test method. Specimens shall be selected alternately by test from the samples (i.e., peel, shear, peel, shear, . . .).

5. QA Contractor's Laboratory Testing:

The QA laboratory test results shall be submitted to the Owner's Representative within 36 hours after sample extraction.

Procedures for Destructive Test Failure:

The following procedures shall apply whenever a sample fails a destructive test conducted by the Owner's Quality Assurance Laboratory. The Contractor has two options:

a. Reconstruct the seam between any two passed test locations, or;

b. Trace the welding path to an intermediate location at a 10 ft minimum from the point of the failed test in each direction) and take a small sample for an additional field test at each location. If these additional samples pass the test. Then the seam Is reconstructed between these locations. If either sample fails, then the process is repeated to establish the zone in which the seam should be reconstructed.

c. All acceptable seams must be bounded by two locations from which samples passing field destructive tests have been taken. In cases exceeding 150 feet of reconstructed seam, a sample taken from the zone in which the seam has been reconstructed must pass laboratory destructive testing.

d. The QC Inspector shall document all actions taken in conjunction with destructive test failures and present this documentation to the QA Engineer.

6. Defects and Repairs:

a. Identification of Defects and Repairs:

All seams and non-seam areas of the geomembrane shall be visually examined by the QC Inspector for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Because light reflected by the

geomembrane helps to detect defects, the surface of the geomembrane shall be clean at the time of examination. The geomembrane surface shall be broomed or washed if the amount of dust or mud inhibits examination.

Each suspect seam location shall be non-destructively tested using the methods described herein. Each location which fails the non-destructive testing shall be marked by the QC Inspector and repaired by the Contractor. Work shall not proceed with any materials which will cover locations which have been repaired until laboratory test results with passing values are available.

At any time panels, or portions of panels, which, in the opinion of the QA Engineer, are damaged beyond repair shall be removed from the site. Damage, which, in the QA Engineer's opinion, can be repaired, shall be repaired in accordance with the procedures outlines herein.

b. Repair Procedures:

Any portion of the geomembrane exhibiting a flaw, or failing a destructive or non-destructive test, shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be agreed upon between Installer and QA Engineer. The procedures available include:

i.) Patching - used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter;

ii.) Grinding and rewelding - used to repair small sections of extruded seams;

iii.) Spot welding or seaming - used to repair small tears, pinholes, or other minor, localized flaws;

iv.) Capping - used to repair large lengths of failed seams;

v.) Topping - used to repair areas of inadequate seams, which have an exposed edge;

vi.) Removing base seam and replacing with a strip of new material welded into place - used with large lengths of fusion seams).

In addition, the following provisions shall be satisfied:

i.) surfaces of the geomembrane which are to be repaired shall be ground no more than one hour prior to the repair.

ii.) all surfaces must be clean and dry at the same time of the repair;

iii.) all seaming equipment used in repairing procedures must be approved;

iv.) the repair procedures, materials, and techniques shall be approved in advance of the specific repair by the QA Engineer and Installer;

v.) patches or caps shall extend at least 8 inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 inches; and

vi.) the geomembrane below large caps should be appropriately cut to avoid water or gas collection between the two sheets.

c. Verification of Repairs:

Each repair shall be non-destructively tested using the methods described herein. Repairs which pass the non-destructive test shall be taken as an indication of an adequate repair. At the discretion of the Engineer, large caps may require destructive test sampling. Failed tests indicate that the repair shall be redone and retested until a passing test results. The QA Engineer shall observe all non-destructive testing of repairs and the QC Inspector shall record the number of each repair, date, and test outcome.

d. Large Wrinkles:

When seaming of the geomembrane liner is completed (or when seaming of a large area of the geomembrane liner is completed) and prior to placing overlying materials, the QC Inspector shall direct the Contractor which wrinkles shall be tested like any other seam.

This process applies to both cap liners.

7. Protection of Liners:

To ensure that the liner is not damaged during construction, the following requirements shall be adhered to:

a. Placement of structural fill on the geomembrane shall not proceed at an ambient temperature below 40°F nor above 104° unless approved by the Engineer.

b. The 40-mil HDPE geomembrane, as specified, shall be installed over clay cap material.

c. When deploying structural fill material over the liner system, extreme care shall be taken so as not to damage any part thereof. Equipment shall never be driven directly on the liner system. See project QA/QC Plan for additional precautions. No vehicular equipment shall be allowed in the liner area when deploying geosynthetics. Deployment of the initial 40-mil geomembrane shall be allowed to be made from the top of clay layer.

d. No smoking or sharp objects shall be allowed within 50 feet of the liner. No shoes with deep ridges which can wedge stones in the soles shall be allowed on the liner.

e. ~~A~~ 110-mil geotextile will be installed between the 40-mil HDPE ~~—~~geomembranes.

f. Equipment used for placing structural fill material will not be driven directly on the geomembrane.

g. A minimum thickness of 0.3m (1 foot) of the structural fill material is specified between a long ground pressure construction equipment and the geomembrane liners.

h. The use of penetrating foot compactors above the geomembrane liners will not be permitted.

i. In heavily trafficked areas such as access ramps, structural fill thickness should be at least 0.9m (3 feet).

G. Measurement and Payment:

All work specified herein is considered incidental to and part of the Lump Sum Price in the Contractor's bid.

TABLE 1

HDPE PHYSICAL PROPERTIES

PROPERTIES	SPECIFICATION	TEST METHODS
Thickness	40 Mil 10%	ASTM D 1593
Density	.940 g/cm3	ASTM D 1505
Percentage Elongation at Yield	$\geq$ 10%	ASTM D 638
Percentage Elongation at Break	$\geq$ 500%	ASTM D 638
Tensile Strength at Yield	$\geq$ 70 lb/in width	ASTM D 638
Tensile Strength at Break	$\geq$ 120 lb/in width	ASTM D 638
Stress-Crack Resistance	$\geq$ 1000 hours	ASTM D 1693
Low Temperature, ^{o}F	-40^{o}	ASTM D 746 (Procedure B)
Carbon Black Content	2.0% to 3.0%	ASTM D 1603
Seam Peel Adhesion	FTB*	ASTM D 413
Bonded Seam Strength	63 lb/in and FTB*	ASTM D 3083

* FTB: Film Tear Bond

12) Topsoil

The contractor shall spread 6" ± of topsoil over the entire cap area within the final fence. The remainder of the site shall have 4" ± 1", where required, over all areas regraded or stripped of vegetation.

Provide topsoil consisting of friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and reasonably free from subsoil, roots, heavy or stiff clay, stones larger than 2" in greatest dimension, noxious weeds, sticks, brush, litter, and other deleterious matter.

Obtain topsoil from sources adjacent to the cap site, if available, as approved by Olin, or provide imported topsoil obtained from sources outside the project limits, or from both sources. Topsoil shall be placed in a worked, loose condition smoothly graded and raked free of debris, rocks, and clods.

Topsoil shall be fertile, friable, natural topsoil typical of topsoil of the locality, and shall be obtained from a well drained site that is free of flooding. It shall be without admixture of subsoil or slag and free of stones, lumps, plants or their roots, sticks, clay, peat and other extraneous matter larger than 2 inches in diameter and shall not be delivered to the site or used while in a frozen or muddy condition. Topsoil as delivered to the site or stockpiled shall have pH between 6.0 and 7.0, shall contain not less than 3 percent organic matter nor more than 20 percent as determined by loss by ignition of moisture-free samples dried at 100° to 110° Celsius, and be classified as sandy loam, loam or silty loam by the USDA textural classification system.

At least 4 weeks prior to anticipated start of topsoiling operations a sample of topsoil material shall be delivered from the proposed supplier to the contractor for testing and approval. Based on tests performed by the Contractor, the topsoil shall be identified as acceptable; acceptable with certain fertilizer and limestone applications; or unacceptable. If the topsoil is found acceptable, the fertilizer and lime requirements will be as specified or as recommended by the testing agency. If the topsoil is found unacceptable, the Contractor shall be responsible for identifying another source of topsoil and shall incur all expenses associated with testing additional samples. All topsoil incorporated into the site work shall match the sample(s) provided to the testing agency for testing. See seeding specification for related information.

Previously established grades, as shown on Drawings shall be maintained in a true and even condition.

Except under the cap, subsoil shall be prepared by tilling prior to placement of topsoil to obtain a more satisfactory bond between the two layers. Tillage operations shall be across the slope. Tillage shall not take place on slopes steeper than 3 horizontal to 1 vertical or where tillage equipment cannot be operated. Tillage shall be accomplished by discing or harrowing to a depth of 3 inches parallel to contours. Tillage shall not be performed when the subgrade is frozen, excessively wet, extremely dry or in other conditions which would not permit tillage. The subgrade shall be raked and all rubbish, sticks, roots and stones larger than 2-in shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with topsoil. Subgrade shall be inspected and approved by the Owner before topsoil is placed.

Topsoil shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades, and elevations indicated. No topsoil shall be spread in water or while frozen or muddy.

The topsoil shall then be rolled or compacted with a cultipacker weighing not more than 100 pounds per foot of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional topsoil, and the surface shall be regraded and rolled until a smooth and even finished grade is created.

After topsoil has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking and left in a roughened condition for seeding. All stiff clods, lumps, roots, litter and other foreign material shall be removed form the area and disposed of by the contractor. The areas shall also be free of smaller stones, in excessive quantities, as determined by the Owner.

13) Permanent Fencing

Contractor shall install fencing and gates as shown on Olin drawings.

Base Bid:

Wooden red cedar milled stockade fence - individual pieces field erected and assembled or prefabricated and field errected. Final fence to be plumb and hold true alignment at all straight segments from end to end. ± 1" max.

- 6'-0" high (nominal)
- Pickets - 1 x 3 nominal or 2 1/4" Ø min. tightly assembled w/no gaps.
- Backrails - 2" x 4" (nominal) minimum
- Fasteners - All nails, bolts, screws, and other fasteners and components shall be galvanized or stainless steel, or equal, rust proof material.
- Posts - 4 x 4 min. set vertical plumb and true 3'-0" min. into concrete.
- Gates - Match fence in materials and appearance.
- Hardware - Style to match fence appearance - stainless, or with a non- corrosive finish. Gates to be furnished with lock sets.

14) Grassing

All areas within the fenced area void of grass cover shall be seeded. Also, the entire graded area shall be seeded.

All areas stripped of vegetation during the course of the project shall be seeded:

Furnish all labor, materials, equipment and incidentals required and place topsoil, finish grade, apply lime and fertilizer, apply seed and mulch and maintain all seeded disturbed areas.

Material

Fertilizer shall be commercial mixed free flowing granules or pelleted fertilizer, 10-20-10 ($N-P_2O_5-K_2O$) grade. Fertilizer shall be delivered to the site in original unopened containers each showing the manufacturer's guaranteed chemical analysis name, trade name, trademark, and conforming to applicable State fertilizer laws. At least 40 percent of the nitrogen in the fertilizer used shall be in slowly available (organic) form.

Limestone shall be ground limestone containing not less than 85% calcium and magnesium carbonates and be ground to such fineness that at least 50% shall pass a 100-mesh sieve and at least 90% shall pass a 20-mesh sieve.

Seed shall be labeled in accordance with USDA Rules and Regulations under the Federal Seed Act and applicable State seed laws. Seed shall be furnished in sealed bags or containers bearing the date of the last germination, which date shall be within a period of 6 months prior to commencement of planting operations. Seeding material shall be inspected upon arrival at the job site, and unacceptable material shall be removed from the job site. Seed shall be from same or previous year's crop; each variety of seed shall have a purity of not less than 85%, a percentage of germination not less than 90%, shall have a weed content of not more than 1% and contain no noxious weeds. Purity and germination for warm season grasses shall be best available at time of seeding. The seed mixture shall consist of seed proportioned by weight by planting season as follows:

*Spring Seeding

Tall Fescue	35%
Hard Fescue	15%
Creeping Red Fescue	15%
Perennial Ryegrass	10%
Redtop	5%
Little Bluestem	20%

*Fall Seeding

Tall Fescue	35%
Hard Fescue	20%
Creeping Red Fescue	15%
Perennial Ryegrass	15%
Redtop	5%
Switchgrass	10%

Temporary Seeding

Millet	50%
Annual Ryegrass	50%

*An alternate grass-seeding mixture, which includes Crown Vetch and a mixture of other regional grasses, will be selected after mobilization. This seeding mixture will be subject to approval by Olin and the NYSDEC.

The seed shall be furnished and delivered premixed in the proportions specified above. A manufacturer's certificate of compliance to the specified mixes shall be submitted by the manufacturers for each seed type. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and data of shipment. No seed may be sown until the Contractor has submitted the certificates.

Seed shall be delivered in sealed containers bearing the dealer's guaranteed analysis. Seed shall be protected from moisture or contamination by detrimental material.

Mulch shall be comprised of threshed straw of oats, wheat, barley, or rye that is free from noxious weeds, mold or other objectionable material. The straw mulch shall contain at least 50 percent by weight of material to be 10 inches or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment.

Latex acrylic copolymer, such as Soil Sealant with coalescing agent as manufactured by Soil Stabilization Co., Merced, California or equivalent shall be used as straw mulch tackifier and hydroseed slurry additive.

Wood cellulose, such as American Excelsior Hydrofiber shall be used as mulch in hydroseed slurry.

Seed and fertilizer shall be kept in dry storage away from contamination, insects, and rodents. Seed or fertilizer that has become wet, moldy or otherwise damaged will not be acceptable.

Application

Unless otherwise shown on the Drawings, all disturbed parts of the site not covered with existing woodland shall be covered with a minimum rolled depth of 4-in of topsoil and seeded.

After the topsoil is placed and before it is raked to true lines and rolled, limestone and fertilizer shall be spread evenly over the topsoil surface and thoroughly incorporated by heavy raking or harrowing to at least one half the depth of topsoil.

For all areas to be seeded:

1. Agricultural limestone shall be applied at the rate of one hundred pounds per 1,000 square feet or as determined by the soil test to bring topsoil pH to a range of 6.0 to 7.0.

2. Fertilizer (10-20-10) shall be applied at the rate of thirty pounds per 1,000 square feet unless otherwise determined by the soil test.

3. Spring and fall seeding mix shall be applied at the rate of ten pounds per 1,000 square feet. Temporary seed mix shall be applied at a rate of two (2) pounds per 1,000 square feet.

4. Straw mulch shall be applied to a rate of seventy five pounds per 1,000 square feet on all areas not hydroseeded.

5. Latex acrylic copolymer shall be applied over placed straw mulch at a rate of 1 gallon per 1000 square feet diluted in water at a ratio of 40 parts water to 1 part latex acrylic copolymer mix.

6. Wood cellulose applied by hydroseeding shall be applied at a rate of 35 pounds per 1000 square feet. The hydroseed mix shall be comprised of 50 pounds of wood cellulose per 100 gallons of water to which 1.5 gallons of latex acrylic copolymer is added.

Seeding, mulching and conditioning shall only be performed during those periods within the seasons which are normal for such work as determined by the weather and locally accepted practice, as approved by Olin. The contractor shall seed only on a calm day.

Schedules for seeding and fertilizing must be submitted to Olin for approval prior to the work. Seeding as specified herein shall be accomplished between the following periods:

Spring Seeding Period
March 1 - May 15

Fall Seeding Period
August 15 - October 1

The Contractor shall notify Olin at least 2 weeks prior to the start of seeding operations. Seeding during other periods shall only be undertaken upon approval of Olin.

Seeding during the period of May 16 though August 14 shall be undertaken using the temporary seeding mix only upon approval of Olin. Any areas seeded using temporary seeding mix shall be reseeded during the subsequent fall or spring seeding period. Prior to reseeding all straw mulch must be removed or thoroughly incorporated into the topsoil, and the topsoil seedbed prepared as outlined. Any reseeding of areas in which temporary seeding has occurred shall be at the Contractor's expense.

Seeding shall be done within 5 days following soil preparation. Seed shall be applied with a Brillion Seeder or equivalent at the rates and percentages indicated. As approved by Olin the Contractor may utilize a broadcaster provided the seed is incorporated into the topsoil to a depth of not greater than 0.5 inch using a rake or harrow following broadcasting. As approved by Olin, the Contractor may use a hydroseeder to apply the seed. The spraying equipment and mixture shall be so designed that when the mixture is sprayed over an area, the grass seed and mulch shall be equal in quantity to the specified rates. Prior to the start of work, the Contractor shall furnish Olin with a certified statement as to the number of pounds of materials to be used per 100 gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the Contractor's hydroseeder. Upon completion of seeding operations, the Contractor shall furnish Olin with a certified statement on the actual quantity of solution applied. Hydroseeding will only be allowed under special circumstances (erosion prone areas, etc.) and with special permission from Olin.

In order to prevent unnecessary erosion of newly topsoiled and graded slopes and unnecessary siltation of drainage ways, the Contractor shall carry out seeding and mulching as soon as possible after he has satisfactorily completed an area. When protection of newly topsoiled and graded areas is necessary at a time which is outside of the normal seeding season, the Contractor shall protect those areas by whatever means necessary as approved by Olin and shall be responsible for prevention of siltation in the areas beyond the limit of work.

When newly graded subgrade areas cannot be topsoiled and seeded because of season or weather conditions and will remain exposed for more than 30 days, the Contractor shall protect those areas against erosion and washouts by application of straw mulch as specified as approved by Olin. Prior to application of topsoil, any such materials applied for erosion control shall be removed or thoroughly incorporated into the subgrade by discing.

On slopes, the Contractor shall provide against washouts by an approved method. Any washout which occurs shall be regraded and reseeded at the Contractor's expense until a good sod is established.

MAINTENANCE, AND FINAL ACCEPTANCE

The Contractor shall keep all seeded areas watered, and in good condition, reseeding and remulching all seeded areas if and when necessary until a good, healthy, uniform growth is established over the entire area seeded, and shall maintain all seeded areas in an approved condition until final acceptance.

Olin will inspect all work for provisional acceptance at the end of the eight week maintenance period, upon the written request of the Contractor received at least ten days before the anticipated date of inspection. The maintenance period shall extend for one full growing season following the season in which the last seeding occurred. A full growing season is the period beginning March 1 and ending October 30.

After all necessary corrective work and clean-up has been completed, Olin will certify in writing the final acceptance of the seeded areas. The contractor's responsibility for maintenance of seeded areas, or parts of seeded areas shall cease on receipt of final acceptance.

15) Landscaping

The area above the north and east banks of the new creek channel, between the upper and lower tie-in points, from the top of new bank to the remaining tree line (approximately 10' wide x 500' long) shall be landscaped as follows:

A. 5' from and parallel to top of new creek bank, plant low deciduous trees at 20' on center. Trees shall be a mixture of Eastern Redbud, Flowering Dogwood, Crabapple, or others as approved by Olin.

B. 7' from and parallel to top of new creek bank, plant tall deciduous trees at 20' on center and staggered between the above row of low deciduous trees. Tall trees shall be a mixture of Red Maple, River Birch, Ginko, Sweet Gum, Red Ash, or others as approved by Olin.

All trees shall be a minimum of 1" in diameter at time of planting. All trees shall be properly staked and tied off during the maintenance period. Contractor shall water and maintain trees in a healthy condition until final acceptance. Olin will inspect all work upon the written request of the Contractor, received at least ten days prior to the anticipated date of inspection. The maintenance period shall extend for one full growing season following the season in which the last tree was planted. A full growing season is the period beginning March 1 and ending October 30.

After all necessary corrective work and clean-up has been completed, Olin will certify in writing the final acceptance of the planted trees. The contractor's responsibility for maintenance of planted trees shall cease on receipt of final acceptance.

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