

E Leak Detection Detail

# LINER NOTES

1. Geotextile Fabric Padding: Geotextile fabric shall be PermeaTex 4080 nonwoven geotextile. Geotextile fabric shall be 8oz per yard with a minimum grab tinsile strength of 205

Smooth Liner: Smooth liner shall be a AGRU Smooth 60 mil HDPE liner. Liner shall have a minimum yield strength of 125 lb/in and shall have a minimum puncture resistance of

Knobbed Liner: Knobbed liner shall be a AGRU Drain Liner 60 mil liner. Liner shall have 0.13" wide and tall knobs. Liner shall have a minimum yield strength of 132 lb/in and shall have a minimum puncture resistance of 95 pounds.

# GENERAL SPECIFICATIONS

Standard Specifications:

This pond design was intended for the construction of two septage storage ponds located on Kittitas County tax parcel number 295134.

The Washington State Department of Transportation "Standard Specifications for Road, Bridge and Municipal Construction" 2018 Edition, and referred to as the "Standard Specifications", are hereby part of the contract plans. Any inconsistency in the parts of the contract including these contract plans shall be brought to the attention of Western Pacific Engineering & Survey, Inc., prior to construction. During the performance of the work, if the contractor discovers any conflict, error, ambiguity, or discrepancy within the contract plans, contractor shall report it immediately, in writing, to Western Pacific Engineering & Survey, Inc., and to the responsible agency's designated engineer. The Standard Specifications can be obtained at the following web sites:

https://www.wsdot.wa.gov/Publications/Manuals/M41-10.htm

Special Provisions:

The following special provisions and responsible agency standards amend the Standard Specifications. The contractor shall do all work in accordance with the contract plans, these special provisions, responsible agency standards, and the Standard Specifications.

# 1-06.1 Approval of Materials:

Delete the first paragraph and replace with the following: The Contractor shall submit a written list of all materials to the Engineer prior to construction. Submittals for all non-standard materials used in the project shall be reviewed and approved by the governing agency prior to use. The contractor shall provide materials submitted for all non-standard materials to the respective agencies. All materials shall be approved by the design engineer prior to the start of construction.

1-06.2(1) Sampling and Testing for Acceptance:

Modify the section as follows: The word Engineer or Project engineer shall refer to the owner and their designated inspector.

Special inspection shall be as follows, unless modified by the design engineer due to field conditions.

Soil embankment shall be randomly tested for compaction with a minimum of one test per 10,000 square feet, but no less than three tests per four feet of lift.

Inspection and testing of the liner shall be as listed in the Liner Specifications Section.

Continuous on-site inspection of the liner installation shall be performed by a third party inspection agency.

1-07.1 Laws to be Observed:

This Section is supplemented by adding the following:

Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

- All persons on the site or who may be affected by the work;
  All the work and materials and equipment to be incorporated therein, whether in
- storage on or off the site; and Other property at site or adjacent thereto.

Contractor shall comply with all applicable laws and regulations related to the safety of persons or property including WISHA and OSHA regulations.

It is the responsibility of the Contractor to obtain all necessary permits and pay all associated fees to perform the work required by these plans.

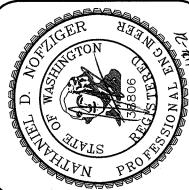
1-07.17 Utilities and Similar Facilities:

This Section is supplemented by adding the following: The contractor shall be responsible for verifying the location, dimension and depth of all existing utilities prior to construction, whether shown on the contract plans or not. Locations of said utilities as construction, whether shown on the contract plans or not. Locations of said utilities as shown on the contract plans are based upon the best-known records available and are subject to a degree of unknown variation. If conflict should occur, the contractor shall immediately advise the design engineer to prepare a design revision. Approval of the design revision from the engineer and design engineer shall be obtained prior to proceeding with construction. It is the contractor's responsibility to notify the appropriate utilities involved prior to the start of any excavation. Call 811 for utility locates two working days prior to excavation. The contractor shall make all necessary arrangements, for construction of utilities shown on the contract plans and/or indicated in the contract document with the serving utility. The contractor shall perform all work in the contract document, with the serving utility. The contractor shall perform all work and shall furnish and install all materials as required by the utility. In cases where the serving utility furnishes materials and/or installs some components, the contractor shall furnish and/or install all other items of work not provided by the utility that are necessary for a complete and functioning utility system.

1-08.0 Prosecution and Progress: Preliminary Matters:

This Section is supplemented with the following: The contractor shall have and maintain on the job site during the performance of the work complete sets or copies of the following documents:

- 1. Contract plans which have been approved for construction by the responsible Responsible agency standards applicable to the construction operations; and 1. One set of record drawings
- All work shall be constructed according to the approved contract plans and standard specifications. Any deviation from the approved contract plans will require written approval from the engineer. The contractor shall keep and maintain on the site one set of record drawings. The contractor shall mark on the record drawings all project conditions. locations, configurations, and any other changes or deviations which may vary from the details represented on the original contract plans. When construction is complete, the record drawings shall be submitted to the design engineer for use in preparing permanent record drawings.



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Designed by NDN Drawn by Tml/NDN Checked by NDN Project No. 20410 Date: April 2020 Scale:

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The contractor shall obtain and have available, copies of the applicable responsible agency standards at the job site during the related construction operations.

Prior to performing any work, the contractor shall contact and coordinate with the engineer to set up scheduling of inspections. Utility systems will be inspected for approval by the respective utility entity.

#### 2-01 Clearing, grubbing and Roadside Cleanup:

The description shall be supplemented as follows: clearing, grubbing, stripping and cleanup shall be performed in accordance with 2-01. Clearing – prior to the start of any earthwork, all existing vegetation, debris, rubble, asphalt pavement, etc., shall be removed from the project area and disposed of at an approved waste site secured by the contractor. Excavation and grading outside of the right-of-way shall comply with the current edition of the International Building Code. All slopes shall be a maximum of 3 horizontal to 1 vertical (3H: 1V unless otherwise noted on the contract

#### 2-03 Excavation and Embankment:

This Section is revised and supplemented by the following: Prior to any excavation, including trenching, strip all organic topsoil. The subgrade for embankments shall be prepared by stripping topsoil and then compact (proof roll) the subgrade to at least 95 percent of the maximum density. Embankment material shall be native soils less than 8" in greatest diameter.

Compaction - All materials and layers shall be placed and compacted to 95% in loose layers not exceeding eight inches in thickness. The contractor shall be responsible for importing and/or exporting all materials as required to construct the earthwork and surfacing to the lines and grades shown on the approved contract plans.

Finished Surfaces- The contractor shall provide a finished surface on which to lay the geotextile fabric that is free from all sharp and angular stones. Therefore provide a compacted 1" minimum of loamy native soils between the embankment and the geotextile fabric. Loamy soils shall be 1/2" minus material.

# 2-03.3(14)D Compaction and Moisture Control Tests:

Maximum density shall be determined by the ASTM D1557 test method for maximum density/optimum moisture. The contractor shall provide all necessary excavation, vibratory compaction equipment, and labor to facilitate the taking of compaction tests. The contractor shall provide all necessary test pits and additional work as directed by the owners representative. The contractor shall provide the responsible agency an opportunity to be present during compaction testing. compaction results shall be with referral to required maximum densities.

#### 4-04.3(5) Shaping and Compaction:

Replace the first sentence of the first paragraph with the following: Immediately following spreading and final shaping, each layer of surfacing shall be compacted at least 95 percent of the density determined by the control tests. In areas of proposed landscaping, compaction need not exceed 90 percent.

### <u>8-01 Erosion Control and Water Pollution Control:</u>

Add the following to the Section: the contractor shall provide temporary ditching, sediment ponds, silt fencing, rock construction entrance and/or other measures to assure that siltation control is provided and maintained during construction. The contractor shall take all necessary precautions to assure that silt-laden water does not enter existing and new filtration systems. All storm facilities shall be flushed and cleaned prior to final acceptance.

# LINER SPECIFICATIONS

# . INTRODUCTION

Geosynthetic components of lining systems which are addressed in this manual are HDPE/LLDPE Geomembranes. The contractor shall recognize that specific documentation of the specific installation is required to substantiate this Quality Control Program.

II. HDPE/LLDPE GEOMEMBRANE INSTALLATION

# A. Earth Work

The general and/or earthwork contractor shall be responsible for preparing and maintaining the subgrade in a condition suitable for liner installation unless agreed otherwise.

2. Surfaces to be lined shall be smooth and free of debris, roots. and angular or sharp rocks to a depth of four (4) inches. All fill shall consist of well-graded material free of organics, trash, clayballs or other harmful matter. No sharp edged stones, stones larger than one inch diameter or hard objects shall be allowed within the top four inches of the subgrade. The surface shall be compacted in accordance with project specifications but in no event below the minimum required to provide a firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the surface without causing rutting or other harmful effects. The subgrade shall have no sudden sharp or abrupt changes in grade.

The earthwork contractor shall protect the subgrade from becoming too dry, flooding and freezing. Protection, if required, may consist of a thin plastic protective cover (or other material as approved by the engineer) installed over the subgrade until the placement of the liner begins. Subgrade found to have cracks greater than 1/2 inch in width or depth or which exhibit swelling, heaving or other similar conditions shall be reworked by the general contractor to remove these defects.

4. Surface acceptance: Upon request, contractor will provide the Owner's Representative with a written acceptance of the surface lined. This acceptance will be limited to an amount of area that contractor linied in a particular work shift. Subsequent repairs to the subgrade and the surface shall remain the responsibility of the earthwork contractor.

# B. Crest Anchorage System

The anchor trench shall be excavated by the earthwork contractor to lines and widths shown on the design drawings prior to geomembrane placement.

2. Corners in the anchor trench shall be slightly rounded where the geomembrane enters the trench to minimize sharp bends in the liner.

C. Preparation for Geomembrane Deployment

1. Panel Layout: Prior to liner deployment, layout drawings shall be produced to indicate the panel configuration and location of seams.

2. Identification: Each panel used shall be given a numeric or alpha-numeric identifier with a logical progression. This identification shall also include the date of deployment and manufacturing roll number.

#### D. Field Panel Placement

Location: contractor will attempt to install field panels at the location indicated on the layout drawing. If panels are positioned in a location other than that indicated on the layout drawings, the revised location shall be noted in the field on a layout drawing which will be modified at the completion of the project to reflect actual panel locations.

Weather Conditions: Geomembrane deployment shall not be done during any precipitation, in the presence of excessive moisture (i.e. fog, dew), in an area of standing or ponded water, or during high

#### 3. Method of Deployment:

The method and equipment used to deploy the panels must not damage the geomembrane or the supporting subgrade surface.

2. No personnel working on the liner will smoke, wear shoes that can damage the geomembrane, or engage in actions which could result in damage to the geomembrane.

Adequate temporary ballast and/or anchoring, (i.e. sandbags,) which will not damage the geomembrane, will be placed to prevent uplift of the liner by wind.

5. Any damage to a panel of geomembrane will be repaired in accordance with Section IV. Any area of a panel seriously damaged (torn, twisted, or crimped) will be marked, repaired, and/or removed from the work area with resulting seaming and/or repairs performed in accordance with Section IV of this document.

4. The geomembrane will be deployed in a manner to minimize wrinkles.

#### E. Field Seaming

General Requirements:

In general, seams shall be oriented parallel to the slope (down hill), horizontal seams on slopes shall be kept to a minimum. Whenever possible, horizontal seams should be located not less than five (5) feet from the toe of the slope. Each seam shall be numbered in a manner compatible with the panel layout drawing for documentation of seam testing results.

2. Personnel: `All personnel performing seaming operations shall trained in the operation of the equipment being used and will qualify by successfully welding a test seam as described herein. The project foreman will provide direct supervision of all personnel seaming to verify proper welding procedures are followed.

#### F. Equipment:

1. Fusion Welding: Fusion Welding consists of placing a heated wedge, mounted on a self propelled vehicular unit, between two (2) overlapped sheets such that both sheets are heated to temperatures ranging from 600 degrees °F. to 850 degrees °F. After being heated by the wedge, the overlapped edges pass through a set of preset pressure rollers which compress the panels together forming a continuous homogenous fusion weld. The fusion welder is equipped with a temperature readout device which continuously monitors the temperature of the wedge.

Extrusion Fillet Welding: Extrusion welding consists of introducing a ribbon of molten resin along the edge of the seam overlap to the two sheets to be welded. The molten polymer causes some of the material of each sheet to be liquefied resulting in a homogeneous bond between the molten weld bead and the surfaces of the sheets. The extrusion welder is equipped with gauges giving the temperature in the apparatus and the preheat temperature at the

# G. Seam Preparation:

f. Keep welding rod clean and dry.

1. Fusion Welding: a. Overlap the panels approximately four (4) to 6 (six) inches. Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust, dirt and debris.

c. It is acceptable to grind the overlap at butt seams the facilitate airtesting through this seam area. d. Adjust the panels so that seams are aligned with the fewest possible number of wrinkles and "fishmouths"

#### 2. Extrusion Welding: a. Overlap the panels a minimum of three (3) inches. Temporarily bond the panels to be welded taking care not to

damage the geomembrane. c. Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust dirt and debris of any kind prior to

d. Grind seam overlap and weld within15 minutes of grinding. In

manner that does not cause excessive damage the geomembrane.

e. Purge the extruder prior to beginning the seam to remove all heat-degraded Extrudate from the barrel.

H. Test Seams: Test seams shall be performed at the beginning of each seaming period or at least once each five to six hours for each seaming apparatus used that day. Test seams shall be made on fragment

pieces of the liner and under the same conditions as actual seams. Test Seam Length: The test seam shall be at least three feet long, made by joining 2 pieces at least 9" in width.

2. Sample Procedures:

sample fails. The entire procedure shall be repeated.

a. Visually inspect the seam for squeeze out, footprint, pressure and general appearance. b. Two samples one inch wide shall be cut from the test seam. The samples shall then be tested in peel and shall not fail in the seam. A passing test shall be exhibit film tear bond (FTB). If a

3. If any of the second set of samples fail, the machine shall not be accepted and used for seaming until the problem is corrected and 2 passing tests are achieved.

4. After completion of the test the remaining portion of the test seam shall be discarded. Documentation of the test seams will be maintained by listing date, time (am or pm), machine I.D. number, operators initials, temperature control setting and test results.

5. Passing test results records shall be maintained on contractor's test weld report form.

6. If test samples are to act as destructive samples then the sample shall be marked, logged and saved. I

I. General Seaming Procedures:

wrinkle.

Seaming shall extend past the outside edge of the containment area and can continue to the area to be placed in the anchor trench.

2. While welding a seam, monitor and maintain the proper overlap. 3. Inspect seam area to assure area is clean and free of moisture, dust, dirt and debris of any kind.

4. While welding a seam, monitor temperature gauges to assure proper settings are maintained and that the machine is operating properly.

5. Align wrinkles at the seam overlap to allow welding through a

Fishmouths or wrinkles at seam overlaps that cannot be welded through shall be cut along the ridge in order to achieve a flat overlap. The cut area shall be seamed. Any portion where the overlap is inadequate shall be patched with an oval or round patch extending six inches beyond the cut in all directions.

All cross/butt seams between two rows of seamed panels shall have the overlaps trimed back to prevent the wedge of the welder from becoming stuck in the overlap. It is acceptable to grind the overlap at butt seams the facilitate airtesting through this seam area.

8. All "T" joints shall have the overlap from the wedge welder seam trimmed back to allow an extrusion fillet weld. Then grind four (4) to six (6) inches on either side of the seam and extrūsion weld all of the area prepared by grinding.

#### SECTION III Seam Testing-Quality & Control-Geomembranes

A. Concept: contractor installation crews will non-destructively test all field seams over their full length using air pressure testing, vacuum testing or other approved method, to verify the continuity and integrity of the seams.

B. Air Pressure Testing: The weld seam created by the fusion welding process is composed of two welded seams separated by an unwelded channel approximately 3/8 of an inch wide. This channel permits seams to be tested by inflating the sealed channel with air to a predetermined pressure and observing the stability of the pressurized channel over time.

C. Equipment for air testing:

1. An air pump (manual or motor driven) capable of generating and sustaining a pressure of 30 PSI.

2. A rubber hose with fittings and connections.

3. A sharp hollow needle with a pressure gauge capable of reading and sustaining a pressure of 30 PSI.

#### 4. Procedure for air testing:

5. Seal both ends of the seam to be tested.

6. Insert needle in the sealed channel

7. Inflate the test channel to a pressure between 25 to 30 PSI. in accordance with the following schedule, close valve, and allow time for the injected air to come into equilibrium in the channel. Observe initial pressure after this time. Set the initial pressure to between 27 and 30 psi. After five minutes of testing, the pressure drop shall be no less than 4psi.

8. Observe and record the air pressure five minutes after the relaxing period ends. If loss of pressure exceeds the value above or if the pressure does not stabilize, locate the faulty area and repair.

Upon completion of the pressure test the end of the seam opposite the pressure gauge is cut. A decrease in gauge pressure must be observed or the air channel will be considered blocked and the test will be repeated after the blockage is corrected.

Remove needle and seal resulting hole by extrusion welding.

Record test results on non-destructive test form.

12. In the event of a Non-Complying Air pressure test, the following procedure shall be followed.

13. Check seam-end seals and retest seams.

14. If non-compliance reoccurs, cut one inch samples from each end of the seam and additional samples at the distance specified.

Perform destructive field peel test on the samples.

16. If all samples pass destructive testing remove the overlap left by the wedge welder and perform an Air Pressure/Soap Test or vacuum test. 17. If a leak is detected by the air pressure/soap or the vacuum test.

repair by extrusion welding. Test repair by vacuum testing. 18. If no leak is discovered air pressure/soap testing, the seam will

pass non-destructive testing. 19. If no leak is discovered by vacuum testing, the seam will pass non-destructive testing.

20. If one or more samples fail the peel test, additional samples will be taken.

21. When two passing samples are located, the seam between these two locations will be considered complying. The area outside of this length will be considered non-complying and the entire length extrusion welded.

22. Test the entire length of the repaired seam by vacuum testing

D. Air Pressure Testing/Soap Testing: This test is used when the seam fails the air pressure test due to slow pressure loss. The procedure is to constantly supply pressure to the seam air channel while spraying the length with a soap and water solution and visually examining the seam for pubbles. Note: This option is not recommended during high wind conditions.

1. Equipment for Air Pressure/Soap Testing:

a. The same equipment as the air pressure test b. A soap solution and means to apply the solution. 2. Procedure for Air Pressure/Soap Testing

a. Trim excess overlap material off at edge of seam Insert needle gauge assembly in opposite ends of the seam to be tested to show that pressure is continuous throughout the channel.

c. Maintain 30 psi d. Apply soap solution to the weld edge and visually examine for

bubbles. e. If no bubbles appear the problem is with the inside track "secondary weld". This seam is acceptable providing it has

passed peel tests. f. If any pubbles appear on the outside track Primary weld , repair defect by extrusion welding and vacuum test the repair.

E. Vacuum Testing: This test is used when the geometry of the weld makes air pressure testing impossible or impractical or when attempting to locate the precise location of a defect believed to exist after air pressure testing.

 Equipment for vacuum testing: a. Vacuum box 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. b. Vacuum pump assembly or compressor with a venturi equipped with a pressure controller and pipe connections.

c. A rubber pressure/vacuum hose with fittings and connections. d. A soap solution with a means to apply the solution.

Procedure for Vacuum Testing:

a. Trim excess overlap from seam.

move overlap and repeat the process.

Apply soap solution to the area to be tested. Place the vacuum box over the area and apply sufficient downward pressure to seal the box against the liner. Activate the vacuum motor and look for soap bubbles

d. Ensure that a leak-tight seal is created e. For a period of not less than five seconds, examine the geomembrane through the viewing window for the presence of soap

Procedure for non-complying test: a. Mark all areas where soap bubbles appear and repair the marked

f. If no bubbles appear after five seconds, turn off the motor and

b. Retest repaired areas.

F. Destructive Testing: The purpose of destructive testing is to determine and evaluate seam strength. These tests require direct sampling and thus subsequent patching. therefore destructive testing should be held to a minimum to reduce the amount of repairs required.

1. Procedure for Destructive Testing: Destructive test samples shall be marked and cut out randomly at a minimum average frequency of one test location every 500 feet of seam length. Additional test may be taken in areas of contamination, offset welds, visible crystallinity or other potential cause of faulty welds.

a) The sample should be twelve inches wide with a seam fourteen inches long centered lengthwise in the sample. b) Ten one inch sample shall be cut from each end of the test seam for field testing on a calibrated field tensiometer. 5 in Peel and 5 in Shear.

2) If field peel samples pass with FTB and the shear samples pass it will be assumed the sample passes destructive testing. An additional portion of the sample test strip can be sent to a third party laboratory for testing to evaluate seam strength and confirm field testing if required. a) Procedure in the event of Destructive Test Failure:

1. Cut additional field samples for testing a minimum of ten (10) feet either side of the Test test these according to section 2. If the samples pass then reconstruct seam between the passing samples with the extrusion welder

2. Heat tack the overlap along the length of the seam to be reconstructed and extrusion weld

3. Vacuum test the extrusion weld.

If either of the samples fails then additional samples are taken in accordance with the above procedure until passing samples are

5. In the case of reconstructed seams exceeding 150 feet, a sample must be taken and pass destructive testing

All destructive seam samples tested by Northwest Linings will be numbered and recorded on a destructive seam test form.

# <u>SECTION IV Defects and Repairs</u>

A. Inspection

1. The Superintendent shall conduct a detailed walk through and visually check all seams and non-seam areas of the geomembrane for defects, holes, blisters and signs of damage during installation.

2. All other contractor installation personnel shall at all times, be on the lookout for any damaged areas. Damaged areas shall be marked and repaired. B. Repair procedures: Any portion of the geomembrane showing a flaw,

or failing destructive or nondestructive test shall be repaired. Several methods exist for repairs, and the decision as to the appropriate method shall be made by contractor's Project Superintendent. Methods available for repair:

Patching - used to repair large holes, tears and destructive sample locations. All patches shall extend at least six inches beyond the defect and all corners of patches shall be rounded.

3. Spot welding or seaming — used to repair small tears, pinholes or

2. Grinding and welding — used to repair sections of extruded seams

other minor localized flaws. Capping - used to repair lengths of failed extruded areas. 5. Removal of a bad seam and replacement with a strip of new material

seamed into place. C. Verification of Repairs:

Every repair shall be non-destructively tested using the methods set out in this manual Repairs which pass the non-destructive test shall be deemed adequate. Large repairs may require a destructive test. Repair test results shall be logged on a repair report form. The repair location shall be recorded on a record drawing.

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