

Midlothian, VA

PROJECT: Bristol, LF EVOH Cover, Bristol LF, VA
02218208.16 DATE: 1/30/2023

SUBJECT: SWP588 - EVOH Cover System Deployment Plan TRANSMITTAL ID: 00001

PURPOSE: For your review and comment VIA: Info Exchange

FROM

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TO

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Transmittal

DATE: 1/30/2023
TRANSMITTAL ID: 00001

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REMARKS: Good evening,

Please see the attached cover letter, drawing set, and specification for the SWP588 EVOH Cover System. Let Charles and I know if you have any questions or comments.

Thanks,

Thomas

DESCRIPTION OF CONTENTS

QTY	DATED	TITLE	NOTES
1	1/30/2023	31 05 19.16 - LLDPE 40mil EVOH Geomembrane Liner_V1.0.pdf	
1	1/30/2023	EVOH Cover Letter 1.0.pdf	
1	1/30/2023	EVOH Cover System v1.0 01-30-23.pdf	

Transmittal

DATE: 1/30/2023
TRANSMITTAL ID: 00001

COPIES:

Thomas Williams	(SCS Engineers)
Spencer Adams	(SCS Engineers)

January 30, 2023
File No. 02218208.11

Mr. Jonathan Chapman
Enforcement Specialist
VA DEQ – Southwest Regional Office
355-A Deadmore Street
Abingdon, Virginia 24210

Subject: EVOH Cover System Deployment Plan and Procurement
Solid Waste Permit No. 588
Bristol Integrated Solid Waste Management Facility – Bristol, Virginia

Dear Mr. Chapman:

On behalf of the City of Bristol, Virginia (the City), SCS Engineers (SCS) is submitting the Ethylene Vinyl Alcohol (EVOH) Geomembrane Deployment Plan and product specification to the Virginia Department of Environmental Quality (VDEQ). The plan and specification are being submitted in accordance with items 6.ii and 6.iii of Appendix A of the Consent Decree between VDEQ and the City.

SCS has prepared the attached drawings (7 sheets) titled “Interim EVOH Cover System Preliminary Design Plans” dated January 30, 2023 which include the layout and details of the proposed EVOH deployment. The design addresses the gas collection infrastructure, grading work to be completed prior to deployment, estimates of stormwater volumes, stormwater channel profile, material volumes, and construction materials to be used. Drawings used for the purposes of bidding, procurement and construction of the EVOH cover system will generally conform to the layout and details in the attached drawings.

SCS has also prepared a specification for the EVOH geomembrane based upon industry standards and discussions with material manufacturers. This specification and drawing set represent the first steps in the procurement process. SCS and the City have coordinated with potential suppliers to specify a product that is not anticipated to have long lead times.



Mr. Jonathan Chapman
January 30, 2023
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If you have any questions or require additional information, please contact either of the undersigned.

Sincerely,



Charles J. Warren, PE
Project Manager
SCS Engineers



Thomas R. Williams
Project Engineer
SCS Engineers

CJW/TRW

cc: Randall Eads, City of Bristol
Mike Martin, City of Bristol
Joey Lamie, City of Bristol
Jake Chandler, City of Bristol
Jeff Hurst, VDEQ
Crystal Bazyk, VDEQ
Stacy Bowers, VDEQ
Daniel Scott, VDEQ

Encl. Interim EVOH Cover System Preliminary Design Plans dated January 30, 2023 (7 Sheets)
Material Specification – LLDPE Geomembrane Liner with EVOH Core dated January 30, 2023

SECTION 31 05 19.16

LLDPE GEOMEMBRANE LINER WITH EVOH CORE

1.0 GENERAL

1.1 SCOPE

The work covered in this Section includes the manufacturing, fabrication, testing, supply and installation of Linear Low-Density Polyethylene (LLDPE) geomembrane with EVOH (ethylene vinyl alcohol) core for the EVOH Cover System. The CONTRACTOR shall furnish all labor, materials, transportation, handling, storage, supervision, tools, equipment and other incidentals necessary to install, test, and quality control the geomembrane as required by the Contract Documents.

1.1.1

These specifications describe Linear Low-Density Polyethylene (LLDPE) geomembranes with Ethylene Vinyl Alcohol (EVOH) core. The supply and installation of these materials shall be in strict accordance with this specification, and be subject to the terms and conditions of the Contract.

1.1.2

The EVOH cover system geomembrane within the disposal area shall be LLDPE with a nominal thickness of 40 mils. Material shall be textured on both sides. The top side of the material shall be green or gray and the bottom side black.

1.2 DEFINITIONS

1.2.1 Owner

The Owner or his designated representative.

1.2.2 Engineer

The Engineer who is acting as the Design Engineer and Owner's designated representative.

1.2.3 QAO

The Quality Assurance Officer who is the on-site project representative.

1.2.4 QAE

The Quality Assurance Engineer, who is in direct supervision of the QAO.

1.3 QUALITY ASSURANCE AND CONTROL DURING INSTALLATION

The ENGINEER or OWNER third party Construction Quality Assurance (CQA) Consultant will observe geomembrane installation and construction and certify that construction is in accordance with Contract Documents. All tests and test frequencies specified in this section are Construction Quality

Control (CQC) tests, and these tests are the responsibility of the CONTRACTOR or his representative unless otherwise noted.

1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD TEST METHODS/PRACTICE:

- ASTM D 792 Specific Gravity (Relative Density) and Density of Plastics by Displacement
- ASTM D 1004 Initial Tear Resistance of Plastic Film and Sheeting
- ASTM D 1204 Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
- ASTM D 1238 Flow Rates of Thermoplastics by Extrusion Plastometer
- ASTM D 1248 Polyethylene Plastics Molding and Extrusion Materials
- ASTM D 1434 Standard Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting
- ASTM D 1505 Density of Plastics by the Density-Gradient Technique
- ASTM D 1603 Carbon Black in Olefin Plastics
- ASTM D 3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis
- ASTM D 4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- ASTM D 4833 Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
- ASTM D 5199 Measuring Nominal Thickness of Geotextiles and Geomembranes
- ASTM D 5321 Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
- ASTM D 5323 Practice for Determination of 2% Secant Modulus for Polyethylene Geomembranes
- ASTM D 5596 Standard Test Method For Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
- ASTM D 5617 Test Method for Multi-Axial Tension Test for Geosynthetics

- ASTM D 5721 Practice for Air-Oven Aging of Polyolefin Geomembranes
- ASTM D 5885 Test method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
- ASTM D 6392 Standard Test Method for Determining the Integrity of Non-reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
- ASTM D 6693 Test Method for Determining Tensile Properties of Non-reinforced Polyethylene and Non-reinforced Flexible Polypropylene Geomembranes
- ASTM D 7238 Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent Condensation Device
- ASTM D 7466 Test Method for Measuring the Asperity Height of Textured Geomembranes
- ASTM D 8117 Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by Differential Scanning Calorimetry

GEOSYNTHETICS RESEARCH INSTITUTE (GRI) STANDARD PRACTICE FOR:

- GRI GM-6 Pressurized Air Channel Test for Dual Seamed Geomembranes
- GRI GM-17 Test Methods, Test Properties and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes
- GRI GM-19a Specification for Seam Strength and Related Properties of Thermally Bonded Homogeneous Polyolefin Geomembranes/Barriers

1.5 SUBMITTALS

The CONTRACTOR or Geosynthetic INSTALLER shall submit the following information to the ENGINEER for approval at least 30 days (unless otherwise specified) prior to procurement of the geomembrane:

1.5.1 Proof of Manufacturer's Qualifications:

- The Manufacturer must have at least two (2) years documented experience in the manufacture of the geomembrane and/or documented experience totaling 10,000,000 ft² of the manufactured geomembrane (or similar 40 mil LLDPE material) for at least ten (10) completed facilities.
- Manufacturer's Brochure: Submit complete manufacturer's specifications, descriptive drawings, and literature for the geomembrane, including the product identification and supplier of the polymer resin and recommended method for handling and storage of all materials prior to installation. Include information on plant size, equipment, personnel, number of shifts per day and capacity per shift.

- Manufacturer Quality Control (MQC) Program: Submit a complete description of the geomembrane manufacturer's formal quality control programs for manufacturing, fabricating, testing, quality control, defects repair, handling, and shipping. The description shall include, but not be limited to, polymer resin supplier(s) and product identification, acceptance testing, production sampling and testing, installation testing, documentation of changes, alterations, repairs, retests, and acceptance.
- Prior to Purchasing material the following conformance testing is required: Submit independent quality control laboratory test results demonstrating compliance with material properties listed herein, including *Table 31 05 19.16 - 3 Resin Properties (Without Carbon Black)* and *Table 31 05 19.16 - 3*. The independent laboratory tests are to be performed once by an approved laboratory independent of the manufacturer. In addition, the manufacturer must provide a certificate of compliance which states that the material to be installed will use the same resin type and formulation as that for which test results are submitted.

1.5.1.1 Manufacturer Quality Control Certificates:

The Geosynthetic Installer shall submit test reports to the ENGINEER prior to geomembrane shipment. The tests and frequencies are specified in Part 2 - "Manufacturer Quality Control Tests" and material properties. Prior to shipping to the site, the Contractor shall submit a certificate or affidavit signed by a legally authorized official of the Manufacturer for the co-extruded EVOH LLDPE barrier geomembrane attesting that the co-extruded EVOH LLDPE barrier geomembrane meets the physical and manufacturing requirements stated in these Specifications. The Contractor shall also submit a sample of the co-extruded EVOH LLDPE barrier geomembrane to be used (sample may be of different color). The sample shall be labeled with the product name and be accompanied by the Manufacturer's specifications.

The following information must be submitted for approval prior to shipping the material:

Resin:

- Batch number, lot number, or identification number and production date(s).
- A certification by a qualified individual employed by the manufacturer that the quality of the resin used to manufacture the geomembrane rolls assigned to this project meets specified properties measured using test methods indicated in the specifications, or equivalent;
- Copy of quality control certificates issued by the Resin Supplier.
- Certified statement that no reclaimed polymer was added to the resin during the manufacture of the actual geomembrane to be used in this project.

Geomembrane:

- Roll numbers, production dates, and identification;
- A certification by a qualified individual employed by the manufacturer that the geomembrane roll assigned to this project meets specified properties measured using test methods indicated in the specifications, or equivalent;

- A list of quantities and descriptions of materials other than the base polymer which comprise the geomembrane.

Factory Visit:

At the request of the OWNER or the ENGINEER, submit contact names, telephone numbers, addresses, and production schedule information for purposes of scheduling an OWNER or ENGINEER'S plant visit during production.

1.5.2 Proof of Geosynthetic INSTALLER'S Qualifications:

- List at least ten (10) completed facilities totaling a minimum 10,000,000 ft², for which the Geosynthetic Installer has manufactured the proposed geomembrane (or similar 40 mil LLDPE material), including thickness, amount, date(s) and intended usage. (See Part 2).
- Show a minimum of two years continuous experience and list completed facilities for which the Geosynthetic Installer has installed the geomembrane (or similar 40 mil LLDPE material), totaling a minimum of 10,000,000 ft².
- The name or names of the field superintendents who will be proposed for the project and a list of completed facilities for which the field superintendent has installed the selected geomembrane (or similar 40 mil LLDPE material) totaling a minimum of 10,000,000 ft².
- The name or names of the Master Seamer(s) who will be proposed for the project and a list of completed facilities for which the Master Seamer(s) has installed the selected geomembrane (or similar 40 mil LLDPE material) totaling a minimum of 2,000,000 ft².
- Construction Quality Control Program: Submit a complete description of the Geosynthetic Installer's formal quality control programs for handling, installing, testing, quality control, and defect repair. The description shall include, but not be limited to installation testing, documentation of changes, alterations, repairs, retests, and acceptance. The document shall include a complete description of seaming by extrusion welding and hot wedge welding.
- Panel Layout Drawing: As a minimum, PLANS shall include an approximate panel deployment sequence, panel orientation, type of weld to be used for each seam, incorporate restrictions on panel and seam orientation, methods of deployment, and details of each step in the construction of any penetrations. The panel layout drawing shall be drawn to scale, and shall indicate areas where horizontal seams will be utilized.
- Proposed schedule of installation showing the critical path of installation.
- Licensed Installer: The Geosynthetic Installer shall be approved and/or licensed by the geomembrane manufacturer.
- Warranty: Submit an advance (sample) copy of the warranty.

1.5.3 Instructions and Drawings Required After Contract Award

1.5.3.1 Storage, Handling, Installation, and Seaming

The Contractor shall furnish complete written instructions to the Engineer for the storage, handling, installation, and seaming of the membrane in compliance with this specification and the condition of his warranty.

1.5.3.2 Repairs

The material supplier shall furnish complete written instructions for the repair of geomembrane material to the Engineer no less than 30 days prior to installation.

1.5.3.3 Layouts

The Contractor shall furnish panel layouts and seam details as required for the membrane installation. The goal of the plan will be to minimize the required number of seams. Care should be taken to reduce areas of stress concentration. Horizontal seams are not allowed unless the slope length exceeds roll lengths. In that event, the horizontal seam will be installed on a 45 degree diagonal across the slope. Details of placement around penetrations, if any, such as pipes shall be provided. The above details must be approved by the Engineer prior to liner installation. Material left outside shall not be exposed to sunlight for more than 30 days.

1.5.4 Shop Drawing Submittals

1.5.4.1 Samples and Specifications

In order to qualify as an approved lining material, the Contractor shall submit material samples and minimum specifications to the Engineer. The specification sheet shall give full details of minimum physical properties and test methods used, placement and site seaming methods, and a certificate confirming compliance of the material with the minimum specifications. A list of similar projects completed in which the manufactured material has been successfully used shall be submitted.

1.5.4.2 Certification

The Contractor shall submit a certification from the manufacturer of the sheeting, stating that the sheeting meets physical property requirements for the intended application, and that the membrane meets the physical requirements of the Geosynthetic Research Institute for the manufacture and installation of LLDPE membrane. The manufacturer will also certify the presence of the gas barrier EVOH core layer.

1.5.4.3 Certification Delivery

Upon delivery of the rolls of geomembrane, provide a copy of the certification from the manufacturer certifying the batch delivered to the site meets the minimum specifications and was QC inspected. The certificate shall be signed by a person with authority to bind the manufacturer.

1.5.4.4 Test Results

The Contractor shall submit results of confirmation testing showing that the material lot of the resin used in the membrane supplied meets the material requirements for the resin. A description of the quality control steps used during manufacture shall also be provided.

1.5.5 During Construction Conformance Test Results:

Submit conformance test results to the ENGINEER for approval within 3 days of testing completion. See Part 1.5.C. for conformance testing requirements and frequency.

1.5.6 List of Personnel:

The CONTRACTOR or Geosynthetic Installer shall submit a list of proposed seaming personnel and their experience records. All personnel shall be approved by the ENGINEER before they perform seaming operations.

1.5.7 Submittals Required for Project Closeout

Record Drawings:

Submit geomembrane record drawings to the ENGINEER.

Geomembrane Warranty

Submit geomembrane warranty to the ENGINEER.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Handling

The Geosynthetic Installer's personnel shall handle the material with care, shall use adequate equipment and shall take all precautions necessary to prevent damaging the geomembrane.

1.6.2 Inspection upon Delivery

Upon delivery at the site, the Geosynthetic Installer, in the presence of a CQA Representative, conduct a visual inspection of rolls or factory panels for defects and for damage. This inspection shall be conducted without unrolling rolls or unfolding factory panels unless, in the Geosynthetic Installer's or CQA Representative's opinion, defects or damages are found or suspected.

Defects or flaws in the materials shall be brought to the attention of the CQA Representative. Rolls, factory panels, or portions thereof, which have unacceptable flaws shall be recorded by the CQA Representatives and Geosynthetic Installer, rejected and shall be removed from the site.

Rejected materials shall be replaced by the CONTRACTOR at no additional cost to the OWNER. No time extension will be allowed in the case of rejected materials.

1.6.3 During Construction Conformance Testing

At the direction of the CQA Representative, the Geosynthetic INSTALLER shall take samples from the delivered lot or factory seams retained (delivered along with the lot) and sent to the CQA Geosynthetic Laboratory for conformance testing. The cost for laboratory conformance testing shall be paid by the OWNER. The conformance tests and minimum frequency outlined in *Table 31 05 19.16 - 1* are required prior to installation.

Table 31 05 19.16 - 1

Conformance Testing Requirements

Properties	Test Method	Test Value	Testing Frequency (minimum)
Thickness (min. ave.) – mils <ul style="list-style-type: none"> • lowest individual for 8 out of 10 values - % • lowest individual for any of the 10 values - % 	D 5994	nom -5% (38) -10% (36) -15% (34)	per roll
Tensile Properties (min.) <ul style="list-style-type: none"> • break strength – lb/in. • break elongation - % 	D 6693 Type IV	60 250	45,000 ft ²
Puncture Resistance (min. ave.) - lb	D 4833	44	45,000 ft ²
Tear Resistance (min. ave.) - lb	D 1004	22	45,000 ft ²
Carbon Black Content (range)	D 4218 ¹	2.0% - 3.0%	45,000 ft ²
Carbon Black Dispersion	D 5596	²	45,000 ft ²

All conformance test results shall be reviewed and approved by the ENGINEER prior to any placement. If a conformance test result fails the specifications, at least two additional conformance tests shall be performed on samples taken immediately from adjacent numbered rolls. If both additional conformance test results pass the specifications, the entire lot or 45,000 square feet shall be accepted except that roll from which the failed sample is taken. If any of the conformance test results fails for the two (minimum) additional samples, the entire lot or 45,000 square feet shall be rejected by the ENGINEER.

1.6.4 Storage

The Geosynthetic Installer shall be responsible for ensuring that the stored materials are protected from rain, snow, ice, dirt, ultra violet light, shock, theft, vandalism, passage of vehicles, and other sources of damage. The CONTRACTOR is responsible for clearing, grubbing, and grading necessary to prepare the storage area. Provide for surface water control, access and storage area surfacing, and lighting necessary for adequate unloading of highway transport vehicles and access by construction equipment. At a minimum, storage methods will conform to the manufacturer’s guidance.

1.7 Warranty

Provide a ten (10) year material warranty and workmanship defects for a period of one (1) year following the date of final completion of the work under this contract. The warranty required herein shall be provided in addition to any warranty required by the General Conditions.

2.0 PRODUCTS

2.1 MANUFACTURING PLANT VISIT

The Manufacturer shall allow the ENGINEER, CQA Representative, OWNER, or designated alternates to visit the manufacturing plant for a project specific visit. The ENGINEER, OWNER or designated

¹ Other methods such as D 1603 (tube furnace) or microwave methods are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.

² Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3

alternate shall be allowed to review the manufacturing process, quality control, laboratory facilities and testing procedures as necessary to verify that:

- Properties guaranteed by the Manufacturer meet all specifications;
- Measurements of properties by the Manufacturer are properly documented and test methods used are acceptable;
- Rolls of geomembrane are free of holes, blisters, or any sign of contamination by foreign matter;
- Packaging and transportation procedures do not damage the geomembrane;
- Roll packages are labeled to indicate the name of the manufacturer, the type of geomembrane, the roll thickness and the roll number; and
- That extrusion rods and/or beads are derived from the same base resin type as the geomembrane.

2.2 GEOMEMBRANES

2.2.1 Single Source

All geomembrane sheets and extrudate material for the construction of the project shall be obtained from a single material supplier and manufacturer. It must be certified and warranted that the sheets, extrudate, and pipe boots are compatible with one another. The Geosynthetic Installer shall provide manufacturer's warranties for the sheets, extrudate material, and pipe boots.

2.3 MATERIAL PROPERTIES

2.3.1 Geomembrane

The membrane shall be comprised of LLDPE material manufactured of new, first quality products designed and manufactured as a component of a hydraulic barrier in landfills or similar structures. The membrane shall have a minimum thickness required by the plans. The raw polymer shall meet or surpass the minimum standards as set forth in the Geosynthetic Research Institute's (GRI) Test Method GM17 "Test Methods, Test Properties, and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes" and GRI Test Method GM19 "Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes".

The membrane shall meet or exceed the requirements of Table 31 05 19.16 - 2. Geomembrane shall meet or exceed the requirements of Table 31 05 19.16 - 3. Equivalent test methods are subject to the approval of the ENGINEER.

Table 31 05 19.16 - 2 Resin Properties (without Carbon Black)

Properties	Test Method	Test Value
Minimum Polymer Composition (% polyethylene)	Thermal Gravimetric Analysis (TGA)	95

Properties	Test Method	Test Value
Geomembrane sheet density (g/cc)	D 1505 / D 792 Method B	≥0.93
Maximum Polymer Melt Index (g/10 min)	D 1238 Condition E	<1.0

2.3.2 Extrudate

Extrudate shall be the same resin as the geomembrane. The manufacturer shall provide documentation and shall certify that the extrudate meets this requirement.

2.3.3 Material Composition

The geomembrane shall consist of new, first-quality products designed and manufactured specifically for the purpose of this project, as satisfactorily demonstrated by prior use. The geomembrane shall be unmodified containing no plasticizer, fillers, chemical additives, reclaimed polymers, or extenders. A core layer of Ethylene Vinyl Alcohol will be included to reduce gas permeability. Approximately 2 percent carbon black shall be added to the resin for ultraviolet resistance. The only other allowable compound elements shall be anti-oxidants and heat stabilizers, of which up to 1.5 percent total, as required for manufacturing, may be added.

2.3.4 Defects

The membrane material shall be so produced as to be free of holes, blisters, undispersed raw materials, or sign of contamination by foreign matter. Defects discovered in the field shall be repaired by cutting out the defect and welding a new piece of membrane material in its place. The weld shall be placed in accordance with the requirements for field welded seams. Seams for repairs shall be tested in accordance with the required field seam test procedures.

2.3.5 Labels

Labels on each roll shall identify the thickness, length, width, and manufacturer's mark number. The roll shall also indicate the date, lot, and batch number of the roll, the square feet in the roll, and the total roll weight as measured after manufacture. Should the total weight not meet the minimum weight based upon the minimum material density of 0.93 g/cc, the material thickness, and square footage provided, then the delivered material will be rejected for use.

2.3.6 Transportation, Handling, and Storage

Transportation, handling, and storage of the membrane shall be in accordance with written instructions from the manufacturer. These instructions shall be supplied prior to delivery of the material. In general, equipment used shall be adequate to handle the rolls of membrane without risk of damage to the material. Extreme care will be taken whenever handling the material. The rolls of membrane shall be stored on a surface free of sticks, rocks, roots, or other matter that may damage the material. Upon delivery, QC and QA personnel shall inspect each roll of material for damage. This inspection shall be recorded and included in the QA/QC reports.

2.3.7 Seams

There shall be no factory seams. Seams shall be welded in the field by factory trained technicians using a non-destructive hot-wedge fusion or extrusion process in compliance with the product manufacturer's guidance. Edges of rolled material shall be trimmed at the factory to remove non-

conforming material. The first three feet of material on selected rolls shall be used for confirmation testing of the characteristics of the membrane material. Sampling and testing shall be performed by the QAO. Additional tests shall be conducted for each 5,000 square yards of material placed.

2.4 MANUFACTURER QUALITY CONTROL TESTS

2.4.1 Test Reports

Submit all test reports to the ENGINEER for review and approval.

2.4.2 Manufacturer Quality Control (MQC) Tests:

2.4.2.1 Resin

Resin shall be tested at a frequency of one test per resin batch. One batch is defined as one rail car load of resin. As a minimum perform tests for Density and Melt Index. Compliance with the Polymer Composition test requirement shall be established with a manufacturer's certificate of compliance. The finished rolls shall be identified by a roll number corresponding to the resin batch used.

2.4.2.2 Geomembrane

Geomembrane shall be tested for properties required by *Table 31 05 19.16 - 3*. The minimum test frequencies in *Table 31 05 19.16 - 3* shall be observed.

Table 31 05 19.16 - 3 Manufacturer Quality Control Testing Requirements

Properties	Test Method	Test Value	Testing Frequency (minimum)
Thickness (min. ave.) – 40 mils <ul style="list-style-type: none"> • lowest individual for 8 out of 10 values - % • lowest individual for any of the 10 values - % 	D 5994	nom -5% (38) -10% (36) -15% (34)	per roll
Asperity Height (min. ave.) – mils	D 7466	16	Every 2 nd roll ³
Formulated Density (max.) – g/cc	D 1505 / D 792	0.939	50,000 ft ²
Tensile Properties ⁴ <ul style="list-style-type: none"> • break strength – lb/in. • break elongation⁵ - % 	D 6693 Type IV	60 250	50,000 ft ²
Puncture Resistance (min. ave.) - lb	D 4833	44	50,000 ft ²
Tear Resistance (min. ave.) - lb	D 1004	22	50,000 ft ²
Gas Permeability (max. methane permeance) – m/s	D 1434	<3.70 ⁻¹³	100,000 ft ²
Carbon Black Content, %	D 4218 ⁶	2.0 - 3.0	50,000 ft ²

³ Alternate the measurement side for double sided textured sheet.

⁴ Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.

⁵ Break elongation is calculated using a gage length of 2.0 in. at 2.0 in. /min.

⁶ Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.

Carbon Black Dispersion (None in EVOH layer)	D 5596	7	50,000 ft ²
Oxidative Induction Time ⁸ (OIT) (min. ave.)			
Standard OIT – min.	D 8117	100	100,000 ft ²
- or -			
High Pressure OIT – min.	D 5885	400	
Oven Aging at 85°C ⁹	D 5721		
Standard OIT (min. ave.) - % retained after 90 days	D 8117	35	per formulation
- or -			
High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	60	
UV Resistance ¹⁰	D 7238		per formulation
High Pressure OIT (min. ave.) - % retained after 1600 hrs ¹¹	D5885	35	

3.0 INSTALLATION

3.1 GENERAL REQUIREMENTS

3.1.1 Superintendent

Installation shall be performed under the direction of a qualified field superintendent who shall remain on site and be in charge throughout the entire geomembrane installation (including subbase acceptance, geomembrane layout, panel placement, seaming, testing and repairs) and all other activities performed by the Geosynthetic Installer. The Geosynthetic INSTALLER’S field superintendent shall have previously installed or supervised the installation of a minimum of 10,000,000 ft² of the selected geomembrane or comparable 40 mil LLDPE geomembrane.

3.1.2 Seaming Personnel

All personnel performing seaming operations shall be qualified by experience and by successfully passing trial seam tests and shall be approved by the CQA Representative prior to installing the geomembrane.

3.1.3 Master Seamer

Actual seaming shall be performed under the direction of a "Master Seamer" who may be the same person as the field superintendent, and who has seamed a minimum of 2,000,000 ft² of the selected geomembrane or comparable 40 mil LLDPE geomembrane using the type of seaming apparatus as that proposed for use for this project. The Master Seamer must be on site whenever installation and/or seaming is being performed.

⁷ Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3

⁸ The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

⁹ It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

¹⁰ The condition of the test should be 20 hr. UV cycle at 75 °C followed by 4 hr. condensation at 60 °C

¹¹ UV resistance is based on percent retained value regardless of the original HP-OIT value.

3.1.4 Wind

The CONTRACTOR shall provide sufficient ballast and temporary anchorage to protect the material from wind damage or displacement. The CONTRACTOR is responsible for protecting the material from damage due to weather at all times.

3.2 INSTALLATION EQUIPMENT

3.2.1 Seaming Methods

Approved processes for field seaming are extrusion welding and fusion (wedge) welding. Solvent or adhesive welding is prohibited unless approved by the ENGINEER. Proposed alternate processes shall be documented and submitted to the ENGINEER for approval PRIOR to installation. Only apparatus which have been specifically approved by make and model shall be used.

3.2.2 Welding Equipment

The Geosynthetic Installer shall provide welding equipment with gauges showing temperatures at the nozzle or barrel (extrusion welder) and at the wedge (fusion welder). The fusion-welding apparatus must be automated self-propelled devices, and shall be equipped with gauges giving the important temperatures and pressures. Equipment shall be maintained in good condition and in adequate number to avoid delaying work in the event of equipment failure or malfunction, and shall be supplied by a power source capable of providing constant voltage under a combined line load. At least one spare operable seaming apparatus of each type used shall be maintained on-site. Equipment used for seaming shall be handled so as to avoid damaging the geomembrane. The welding apparatus shall be able to produce a "double hot wedge" with void for non-destructive testing.

3.2.3 Field Tensiometer

The Geosynthetic Installer shall provide a field tensiometer for on-site peel and shear testing of geomembrane seams. The tensiometer shall be calibrated prior to arrival at the site, capable of performing testing according to ASTM D 6392, and be accompanied by evidence of current valid calibration. The tensiometer shall be motor driven and have jaws capable of traveling at a maximum measured rate of 2 inches per minute. The tensiometer shall be equipped with a gauge that measures the force exerted between the jaws in pounds and have a digital readout.

3.2.4 Punch Press

The Geosynthetic Installer shall provide a punch press for the on site preparation of specimens for testing. The press shall be capable of cutting specimens in accordance with ASTM D 6392.

3.3 PREPARATION

3.3.1 Surface Preparation

Prior to geomembrane panel deployment, the Geosynthetic Installer shall inspect the surface upon which the geomembrane will be placed. The surface shall be smooth, free of rocks, soil particles greater than 3/8-inch, protrusions, sharp objects, and deleterious material that could puncture or abrade the geomembrane. Edges of excavations and grade breaks shall be rounded to preclude sharp corners. As necessary, the surface shall be groomed by hand to bring the surface up to the desired smoothness. The surface should provide a firm, unyielding foundation to provide continuous

contact between the surface and the membrane with no sudden, sharp or abrupt changes or break in grade. No standing water or excessive moisture shall be allowed.

3.3.2 Certification of Subgrade Acceptance

The CONTRACTOR shall be responsible for preparing the subgrade soil according to the Contract Documents and geomembrane manufacturer's recommendations. Prior to geomembrane installation the Geosynthetic Installer shall certify in writing that the surface upon which the geomembrane will be installed is acceptable. The Certificate of Acceptance shall be given by the Geosynthetic Installer to the CQA Representative prior to commencement of geomembrane installation in the area under consideration (an example certificate is provided in this section). Commencement of geomembrane installation by the Geosynthetic Installer shall mean acceptance and approval was accomplished.

After the subgrade soil has been accepted by the Geosynthetic Installer, it shall be the Geosynthetic Installer's responsibility to indicate to the CONTRACTOR changes in the subgrade soil condition that require repair work. The CONTRACTOR shall ensure that the subgrade soil is repaired.

3.3.3 Contractor Approval

The installation of the membrane shall be done with labor and equipment provided by the installer of the membrane material. The installer shall provide the proper extrusion or hot-wedge fusion welding equipment for the installation. Only installation methods approved by the manufacturer and the QAO shall be used.

3.3.4 Damaged Subgrade

Prior to geomembrane panel deployment, the CONTRACTOR shall repair damage to the subgrade which has occurred due to his or the Geosynthetic Installer's activities.

3.3.5 Anchor trench

Geomembrane anchor trenches shall be constructed to the lines and grades shown on the PLANS. The geomembrane in the anchor trench shall be constructed as shown on the PLANS, and backfilled as indicated with care not to damage the geomembrane. When the anchor trench will be excavated in soil susceptible to desiccation, no more than the amount of trench required for geomembrane to be anchored in one day shall be excavated. The anchor trench shall be maintained clean and dry prior to backfilling.

3.4 PANEL DEPLOYMENT

3.4.1 Identification

Each field panel shall be given a unique "identification code" (numbers or letters and numbers) consistent with the layout plan.

3.4.2 Installation Sequence

The Geosynthetic Installer shall be responsible for the final installation sequence of geomembrane panels. Geomembrane panels shall not be deployed unless they can be seamed within 8 hours of deployment or earlier.

3.4.3 Orientation

Panels shall be oriented perpendicular to the line of the slope crest. Seams parallel to or less than a 45 degree angle from any crest or toe of slope are defined as horizontal seams. Horizontal seams are prohibited on slopes greater than 10:1 (H:V) and shall be at least 5 feet from the crest or toe of slopes greater than 10:1.

3.4.4 Wrinkles

Geomembrane panels shall be unrolled using methods that will minimize wrinkles and will not damage, stretch, or crimp the geomembrane and shall protect the underlying subsurface from damage. All wrinkles higher than they are wide (across their base) shall be removed by repair methods. The CONTRACTOR and/or Geosynthetic Installer shall also remedy wrinkles which develop during subsequent placement of overlying layers.

3.4.5 Bridging

Material shall be installed to allow for temperature related shrinkage and to avoid bridging of the geomembrane.

3.4.6 Seam Layout

Panels shall be placed such that the seam layout conforms as closely as practicable to the approved panel layout drawing. No panels may be seamed in the field without the CQA Representative's approval. In addition, panels not specifically shown on the seam layout drawing may not be used without the CQA Representative's prior approval. Seams shall be identified using the identification codes shown on the panel and seam layout drawing.

3.5 FIELD SEAMS

3.5.1 Seam Strength

All field seams shall meet or exceed the requirements of *Table 31 05 19.16 - 4* for Geomembrane Seam Properties.

Table 31 05 19.16 - 4 LLDPE Geomembrane Seam Properties

Properties	Test Value ¹²
Hot Wedge Seams ¹³	
• shear strength, lb/in.	60
• shear elongation at break ¹⁴ , %	50
• peel strength, lb/in.	50
• peel separation, %	25
Extrusion Fillet Seams	
• shear strength, lb/in.	60

¹² Test Values are provided for 40 mil LLDPE geomembrane. For all other material thicknesses refer to GRI-GM19a.

¹³ Also for hot air and ultrasonic seaming methods.

¹⁴ Elongation measurements should be omitted for field testing

• shear elongation at break ¹⁵ ,%	50
• peel strength, lb/in.	44
• peel separation, %	25

3.5.2 Installation Rate

Contractor shall install membrane at a rate that does not exceed his capacity for patching and testing all field welds each day. Patches and repairs shall be completed and tested (including visual, air pressure and vacuum) each day on the geomembrane material installed. Destructive test samples shall be obtained daily on the LLDPE material installed.

3.5.3 Overlapping

Panels of geomembrane must have a finished overlap of a minimum of three (3) inches for extrusion welding and four (4) inches for fusion welding, but in any event, sufficient overlap shall be provided to allow peel tests to be performed on the seam.

Field seams shall have a minimum width of one (1) inch.

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.

3.5.4 Weather Conditions for Seaming

Unless authorized in writing by the ENGINEER or CQA Representative, no seaming shall be attempted at ambient temperatures below 32°F (0°C) or above 95°F (35°C). If seaming is authorized at temperatures below 32°F (0°C), pre-heating devices shall be placed on all welding machines. Trial seams shall be prepared and tested every two to three hours. Additionally, if the air temperature drops more than 10°F from the time the trial seam(s) were produced, additional trial seams shall be performed as required by the QA Representative.

3.5.4.1 Cold Weather Seaming

Between ambient temperatures of 32°F (0°C) and 50°F (10°C), seaming may be carried out if the geomembrane is preheated by either the sun or a hot air device, and if there is not excessive cooling resulting from the wind.

3.5.4.2 Warm Weather Seaming

Above an ambient temperature of 50°F (10°C), no preheating is required.

3.5.4.3 Inclement Weather Seaming

In all cases, the geomembrane shall be dry and protected from wind damage. Seaming shall not proceed during precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, in an area of saturated soil, in the presence of wind speeds exceeding 20 mph (32 km/hr), or in an area of free water.

¹⁵ Elongation measurements should be omitted for field testing

3.5.5 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 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 six (6) inches (150 mm) beyond the cut in all directions.

As deemed necessary by the Geosynthetic Installer, CONTRACTOR, or CQA Representative, a movable protective layer shall be used below each overlap of geomembrane that is to be seamed to prevent buildup of moisture between the sheets. Upon completion of welding, the movable protective layer shall be removed entirely.

For seams which are to be extrusion welded, and as necessary for fusion welds, the seam overlap shall be grinded in accordance with the Manufacturer's instructions, within one hour of the seaming operation and in a way that does not damage the geomembrane. The grind shall not extend more than 0.25 inches past the weld and shall not be excessively deep. The composition of the extrudate used shall be identical to the membrane material.

Welding speed and pressure, preheating temperature, nozzle (die) temperature, ambient air and sheet temperatures, and extrudate bead thickness shall not deviate from the Manufacturer's recommendations or welding criteria established during start-up operations unless approved by the ENGINEER and approved and certified in writing by the Fabricator that such deviation will not result in any short or long term damage to the geomembrane.

The edge of cross seams shall be grinded to a smooth incline (top and bottom) prior to welding.

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

In locations where a firm substrate does not exist, a flat board, 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 anchor trenches.

3.6 PROTECTION

3.6.1 Protection of the Geomembrane

- Providing a smooth insulating plate or fabric beneath hot welding apparatus before and after usage.
- Providing additional protection over the geomembrane in heavily trafficked areas.
- Protecting the geomembrane from ultraviolet exposure. The geomembrane shall not be left exposed (uncovered) to the elements for any period longer than 30 days unless otherwise approved by the ENGINEER.
- Positioning overlaps of panels to facilitate drainage prior to seaming.

- Preventing damage to the geomembrane by scraping, scarring, scuffing, scratching, gouging, handling, trafficking, excessive heat, vibration, leakage of hydrocarbons or any other means.
- Assuring that the prepared surface underlying the geomembrane has not deteriorated or changed significantly since acceptance, and is still acceptable at the time of geomembrane placement.
- Assuring that the surfaces underlying the geomembrane are clean and free of debris.
- Preventing personnel working on the geomembrane from smoking, wearing damaging shoes, or engaging in other activities which could damage the geomembrane.
- Using methods to unroll the panels that do not cause scratches or crimps in the geomembrane and do not damage the underlying surfaces.
- Using methods to place the panels that minimize wrinkles (especially differential wrinkles between adjacent panels). Temperature changes should be considered in scheduling of panel deployment and seaming to minimize shrinkage and expansion problems.
- Adequately anchoring the geomembranes before and after deployment to prevent wind damage.
- Minimizing direct contact with geomembrane; (i.e., protecting the geomembrane with geotextiles, extra geomembrane, or other suitable materials) in areas where excessive traffic may be expected.
- Preventing all wheeled and tracked equipment from driving directly on the geomembrane. See Section 3.11 "PLACEMENT OF GEOCOMPOSITE DRAINAGE NET AND VEGETATIVE SUPPORT LAYER MATERIALS" for required minimum protective cover to allow use of equipment.
- Not allowing the geomembrane surface to be used as a work area for preparing patches, storing tools and supplies, etc.
- Ensuring that sharp objects are not left on the surface of the geomembrane.

3.7 FIELD QUALITY CONTROL TRIAL SEAMS

Trial seams shall be performed in the presence of the CQA Representative. Trial seams shall be made on scrap pieces of geomembrane under the same conditions that production seaming will be performed to verify that seaming conditions are satisfactory. Trial seams shall be made, at a minimum, at the beginning, middle, and end of each work day, and at least once every four hours or as directed by the CQA Representative for each seaming apparatus used that day. Also, each seamer shall make at least one trial seam each day. (Note extra requirements for seaming in cold weather)

The trial seam sample shall be at least three (3) feet long by one (1) foot wide (after seaming) with the seam centered lengthwise. The sample shall be marked with date, ambient temperature, and welding machine number. Four adjoining specimens, each one (1) inch (25 mm) wide, shall be cut from the trial seam sample by the Geosynthetic Installer at locations selected randomly by the CQA

Representative. Two of the specimens shall be tested in peel and two tested in shear; none should fail in the seam. If a specimen fails in the seam, the entire trial seam procedure shall be repeated. If an additional specimen fails, the seaming apparatus or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two (2) consecutive successful full trial seams are achieved.

3.8 FIELD NONDESTRUCTIVE SEAM TESTING

To check for seam continuity, the Geosynthetic Installer shall nondestructively test 100 percent of field seams over their entire length using a vacuum test unit, air pressure test, or other approved method. Air pressure testing is only applicable to those processes which produce a double seam with an enclosed space, and shall follow GRI GM6, Pressurized Air Channel Test for Dual Seamed Geomembranes. Tests must include visual inspection of seams. A detailed test protocol must be submitted for approval a minimum of 30 days prior to installation of the liner.

Continuity testing shall be performed as the seaming work progresses, not at the completion of all field seaming.

3.8.1 Vacuum Testing Equipment

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

- The vacuum box (1 to 3 feet long by 1 foot wide) shall have a transparent viewing window on top and a soft, closed cell neoprene gasket attached to the bottom. The housing shall be rigid and equipped with a bleed valve and vacuum gauge. A separate vacuum source shall be connected to the vacuum box. The equipment shall be capable of inducing and holding a vacuum of 5 psig (10 in of Hg vacuum). The viewing window shall be replaced if it becomes excessively scratched.
- A steel vacuum tank and pump assembly equipped with a pressure controller and pipe connections; mounted on a cushion to protect the geomembrane.
- A rubber pressure/vacuum hose with fittings and connections.
- A bucket and wide paint brush.
- A soapy solution.

3.8.2 Vacuum Test Procedure

- Energize the vacuum pump and adjust the tank vacuum to approximately 5 psig (10 in. of Hg vacuum) (35 kPa absolute).
- Apply soapy solution to wet a strip of geomembrane approximately 12 inches by 48 inches (0.3 m by 1.2 m).
- Place the box over the wetted area.
- Close the bleed valve and open the vacuum valve.
- Ensure that a leak tight seal is created by the gasket.

- For a period of not less than 10 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
- If no bubbles appear after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inches (75 mm) overlap, and repeat the process.
- All areas where soap bubbles appear indicate leaks or poor seam continuity and shall be marked, repaired and retested.

3.8.3 Air Pressure Test Equipment (GRI GM-6)

- An air pump (manual or motor driven) equipped with pressure gauge capable of generating and sustaining a pressure between 25 and 30 psi (160 and 200 kPa) and mounted on a cushion to protect the geomembrane.
- A rubber hose with fittings and connections.
- A sharp hollow needle, or other approved pressure feed device.

3.8.4 Air Pressure Test Procedure

- Seal both ends of the seam to be tested (to a maximum length of 500 feet unless other approved by the ENGINEER).
- Insert needle or other approved pressure feed device into the channel created by the dual track fusion weld.
- Energize the air pump to a pressure between 25 and 30 psi (160 and 200 kPa), close valve, and sustain pressure for a minimum of 5 minutes.
- If pressure drop exceeds 2 psi (15 kPa), or does not stabilize, locate the faulty area, repair and retest.
- Remove needle or other approved pressure feed device and seal ends and needle puncture with extrudate.

3.9 FIELD DESTRUCTIVE SEAM TESTING

3.9.1 Test Location

To establish that there is adequate seam strength, destructive seam tests shall be performed at selected locations. Test locations shall be determined after seaming, at the CQA Representative's discretion, and may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential cause of inadequate welding. The Geosynthetic Installer shall not be informed in advance of the locations where the seam samples will be taken.

3.9.2 Test Frequency

As a minimum, one test location shall be selected per 500 feet of seam length produced by each welding machine. (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 the seaming.

3.9.3 Test Procedure

A three foot minimum sample is taken by the Geosynthetic Installer from the seam and cut into three individual one foot samples. Individual samples go to the Installer CQC Organization, the CQA Representative and the OWNER. The Installer CQC Organization and CQA Representative each cut their respective samples into 5 shear and 5 peel (alternating adjacent) test specimens and conduct the tests in accordance with ASTM D 4437. The remaining sample is archived by the OWNER. The OWNER will be responsible for storing the archive samples.

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

3.9.4 Geosynthetic Laboratory Testing

If destructive seam testing is to be performed off-site, packaging and shipping of destructive test samples shall be conducted in a manner which will not damage the test sample. The CQA Representative shall verify that packaging and shipping conditions are acceptable. This procedure shall be fully outlined prior to construction.

Testing shall include "Shear Testing" and "Peel Testing" (ASTM Designation D 6392). The minimum acceptable values to be obtained in these tests are those indicated in *Table 31 05 19.16 - 4*. At least 5 specimens shall be tested for each test method. Specimens shall be selected alternately by test from the samples (i.e., peel, shear, peel, shear). At least 4 of the 5 specimens tested shall meet or exceed the requirements indicated in *Table 31 05 19.16 - 4*. The failed specimen must not be so significantly different in failure load (>80% of average failure load of the other four specimens) so as to be "suspect" of other problems.

The Geosynthetic Installer's laboratory test results shall be presented in writing to the CQA Representative, ENGINEER and the OWNER as required by ASTM D 6392.

3.9.5 Procedures for Destructive Test Failures

All failed seams must be bounded by two locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 150 feet (50 m) of reconstructed seam, a sample taken from the zone in which the seam has been reconstructed must pass destructive testing.

The CONTRACTOR is responsible for providing quality seams. For all QA retests due to destructive failures exceeding 10% of all tests, the CONTRACTOR shall be charged to QA time and lab costs.

The following procedures shall apply whenever a sample fails a destructive test, whether that test is conducted by the CQA Representative, the Geosynthetic Installer, the CONTRACTORS independent CQC laboratory, or by field tensiometer. The Geosynthetic Installer has two options:

- The Geosynthetic Installer can reconstruct the seam between any two passing test locations;

- The Geosynthetic Installer can trace the welding path to an intermediate location (at 3 m (10 feet) minimum from the point of the failed test in each direction) and take a single specimen for an additional field test at each location. If these additional specimens pass the test, then full samples are taken. If these samples pass the tests, then the seam is reconstructed between these locations. If either sample fails, then the process is repeated, in that direction, to establish the zone in which the seam should be reconstructed.

3.10 DEFECTS AND REPAIRS

3.10.1 Identification

The entire geomembrane, including seams, shall be visually examined by the CQA Representative for identification of visual defects, holes, blisters, undispersed raw materials and signs of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of examination. The geomembrane surface shall be swept or washed by the Geosynthetic Installer if dust, mud or other matter inhibits examination. All areas having defects and/or requiring repairs shall be repaired at no additional cost to the OWNER.

Work shall not proceed with any materials which will cover locations which have been repaired until the CQA Representative has re-examined the repaired area and applicable laboratory test results with passing values are available. Panels or portions or panels which, in the opinion of the CQA Representative, are damaged beyond repair shall be removed from the site and replaced.

3.10.2 Repair Procedures

Any portion of the geomembrane exhibiting a flaw or failing a destructive or nondestructive 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 the QA Representative, Geosynthetic Installer, and ENGINEER. The procedures available include:

3.10.2.1 Patching

Patching will be used to repair large holes (>0.125 inches in diameter), tears, areas of undispersed raw materials, and contamination by foreign matter. The patch shall extend at least 3 inches from the nearest damage if the damage area is less than 1 inch in diameter. When damage exceeds 1 inch in diameter the patch shall extend at least 6 inches from the nearest damage. All extrusion patches shall be vacuum box tested and hot air patches can be either air lanced or vacuum tested.

3.10.2.2 Grinding and Rewelding

Grinding and rewelding will be used to repair small defective sections of extruded seams less than one foot in length.

3.10.2.3 Spot Welding

Spot Welding will be used to repair small tears, pinholes, or other minor, localized flaws measuring less than 0.125 inches in diameter.

3.10.2.4 Capping

Capping will be used to repair large lengths of failed seams; (maximum allowable cap width is three feet).

3.10.2.5 Removal

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

3.10.2.6 Other methods

Other methods approved by the ENGINEER.

3.10.2.7 Repair Provisions

In addition, the following provisions shall be satisfied:

Surfaces of the geomembrane which are to be repaired by extrusion welding shall be abraded no more than one hour prior to the repair.

- All surfaces must be clean and dry at the time of the repair.
- All seaming equipment used in repairing procedures must be approved.
- The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the CQA Representative.
- Patches or caps shall extend at least six (6) inches (150 mm) beyond the edge of the defect, and all corners of the patches shall be rounded with a radius of at least three (3) inches (75 mm).
- The geomembrane below large caps should be appropriately cut or removed to avoid water or gas collection between the two sheets.

3.10.3 Labeling

Repaired field defects, patches, reworked seams, repaired fishmouths and other non-standard field seams shall have the following information marked on the liner with a marker suitable for the purpose:

- Initials of Welder
- Date of Weld
- Initials of QC Technician
- Date of QC Test
- Indication of Pass/Fail

3.10.4 Verification of Repairs

Each repair shall be nondestructively tested. Repairs which pass the non-destructive test shall be taken as an indication of an adequate repair. At the discretion of the QA Representative, large repairs may require destructive test sampling. In the case of failed tests, the repair shall be redone and retested until a passing test result is obtained. The CQA Representative shall observe all non-

destructive testing of repairs and shall record the identification of each repair, date, technician, and test outcome. The liner may not be covered until defects, patches, etc. have been properly tested, logged, and marked.

3.10.5 Wrinkles

When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlying materials, the CQA Representative shall indicate which wrinkles shall be cut and resealed by the Geosynthetic Installer. The seam thus produced shall be tested like any other seam. Wrinkle size shall be evaluated during the time of day and under conditions similar to those expected when overlying protective cover/drainage layer material is to be placed. All wrinkles higher than they are wide (across their base) shall be removed by repair methods.

3.10.6 Bridging

The geomembrane shall be continuously supported on the accepted subgrade. Bridging (unsupported geomembrane) is not permissible. Geosynthetic Installer shall take necessary steps to prevent bridging and repair or replace any geomembrane so affected.

3.11 PLACEMENT OF GEOCOMPOSITE DRAINAGE NET AND VEGETATIVE COVER LAYER MATERIALS

3.11.1 Weather Conditions

Placement of the geocomposite drainage net and overlying vegetative cover layer soils on the geomembrane shall not proceed at an ambient temperature below 40°F (5°C) nor above 95°F (35°C) unless otherwise approved by the CQA Representative.

3.11.2 Material Exposure

The geomembrane shall not be left exposed (uncovered) to the elements including UV light, for any period more than thirty (30) days.

3.11.3 Soils

All soils installed in direct contact with the geomembrane shall have a maximum particle size of 3/8 inches.

3.11.4 Equipment

All protective cover/drainage layer materials placed over geomembrane (and other geosynthetics) shall be installed without damaging the geosynthetics. Equipment used for placing soil shall not be driven directly on the geomembrane. A minimum thickness of one (1) foot of soil is required between a light dozer (such as a low ground pressure Caterpillar D-3 or lighter) and the geomembrane. Placement of material overlying the geosynthetics shall be in conformance with the guidelines for equipment ground pressure in

Table 31 05 19.16 - 5 Soil Thickness for Equipment Operating over Geomembrane

Equipment Ground Pressure (psi)	Minimum Soil Thickness (inches)
------------------------------------	------------------------------------

<4	12
4-6	15
6-8	18
8-11	24

3.11.5 Heavily Trafficked Areas

In heavily trafficked areas such as access ramps, soil cover thickness shall be at least three (3) feet.

3.12 DOCUMENTATION OF CONSTRUCTION

3.12.1 Report

- Upon project completion, the CQA Representative shall prepare a Construction Certification/Documentation Report. This report will document that the work was accomplished according to the Construction Contract Documents, and summarize quality control and quality assurance tests and inspection. If appropriate, supplementary information such as modifications approved by the ENGINEER shall be included to justify deviations from the original contract documents. Justification for all such deviations must be fully documented in the Report. At a minimum, the report shall contain the following information:
 - Identification of parties and their roles and responsibilities with signatures of key personnel and an officer of their employer's company.
 - Scope of work.
 - Summary of the project construction activities.
 - Construction Quality Assurance methodology.
 - Test and inspection results.
 - Results of prequalification testing (including extrudate);
 - The results of all non-destructive seam tests.
 - Subgrade acceptance forms.
 - Construction Quality Assurance certification statement, sealed and signed by a licensed professional ENGINEER.
 - Geomembrane record drawings.
 - Panel and seam layout record drawing.
 - Sample location drawing.
 - Sample tags with duplicates.

- Inventory of amount of material used versus amount delivered to the site.
- CQA and CQC records regarding panel deployment, seaming, and repairs.
 - The Geosynthetic Installer shall provide necessary signatures, test results, record drawings, and inspection results as described by aforementioned Part 3.12
- The results of the test and monitoring reports shall be turned over to the ENGINEER for review on a daily basis. Reports shall be complete within 24 hours of the installation of the panel, seam, repair, etc. Test results and corrections shall be completed prior to placement of cover material.

3.13 LANDFILL GAS CONTROL DURING INSTALLATION

The CONTRACTOR shall be responsible for temporary control and extraction of landfill gas during installation of the geomembrane to avoid formation of "bubbles" underneath the geomembrane.

3.14 SANDBAGS

Liner shall be adequately weighted down with sand bags to limit wind uplift. Unless otherwise noted, sandbags shall remain the property of the Owner upon completion.

3.15 PAYMENT

Payment by the Owner for installation of the membrane shall not be made until testing is completed and the test results reviewed and approved.

3.16 CERTIFICATE

CERTIFICATE OF ACCEPTANCE OF SOIL SUBGRADE BY GEOSYNTHETIC INSTALLER	
INSTRUCTIONS: This part of the certificate should be completed by the CONTRACTOR.	
Contractor	Project
Name:	Location:
Address:	Project:
Location of Soil Subgrade Surface to be Utilized (Include Sketch, if Needed):	
Contractor Authorized Representative:	
Name:	
Title:	
Signature/Date:	
INSTRUCTIONS: This part of the certificate should be completed by the Geomembrane Geosynthetic Installer.	
I the undersigned, duly authorized representative of:	
	(Geomembrane Installation Company)
Do hereby accept the soil subgrade (soil supporting the geomembrane) and shall be responsible for its integrity and suitability, in accordance with the specifications from this date to completion of the installation.	
Geosynthetic Installer Authorized Representative:	
Name:	
Title:	
Signature/Date:	

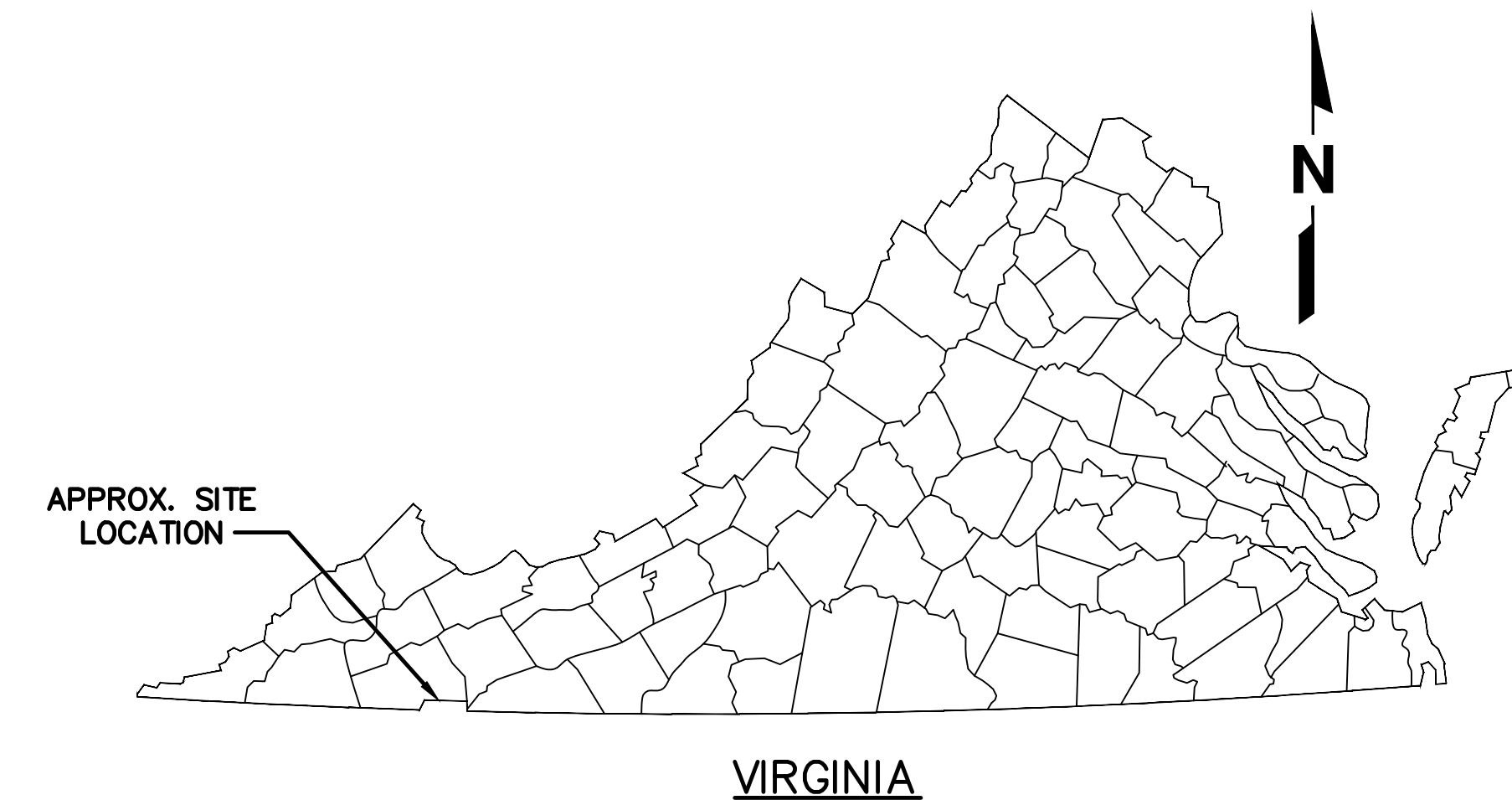
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BRISTOL, VIRGINIA INTEGRATED SOLID WASTE MANAGEMENT FACILITY

SOLID WASTE PERMIT #588

INTERIM EVOH COVER SYSTEM PRELIMINARY DESIGN PLANS

BRISTOL, VIRGINIA



INDEX OF DRAWINGS	
SHEET	SHEET TITLE
1	COVER SHEET
2	GENERAL NOTES AND LEGEND
3	EXISTING CONDITIONS
4	ANTICIPATED CONDITIONS
5	PROPOSED STORMWATER CHANNEL AND LFG COLLECTION STRIPS
6	EVOH COVER SYSTEM INSTALLATION GRADE AND AREA
7	DETAILS

PREPARED FOR:

CITY OF BRISTOL, VIRGINIA
300 LEE STREET
BRISTOL, VIRGINIA 24201

INTEGRATED SOLID WASTE MANAGEMENT FACILITY

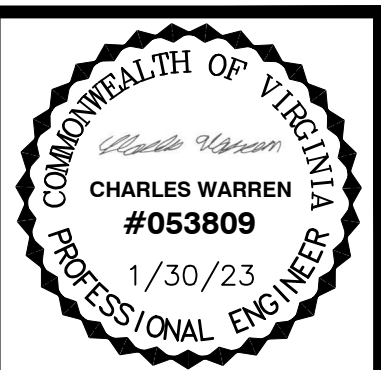
2655 VALLEY DRIVE
BRISTOL, VIRGINIA 24201

SCS ENGINEERS

STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
15521 MIDLOTHIAN TURNPIKE, SUITE 305
MIDLOTHIAN, VIRGINIA 23113-7313
PH. (804) 378-7440 FAX. (703) 471-6676
WWW.SCSENGINEERS.COM

SCS PROJECT NO. 02218208.11

JANUARY 30, 2023



NO.	REVISION	DATE

SHEET TITLE	COVER SHEET
PROJECT TITLE	INTERIM EVOH COVER SYSTEM SWP #588 PRELIMINARY DESIGN PLANS

CLIENT	CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY 2655 VALLEY DRIVE BRISTOL, VA 24201
--------	--

SCS ENGINEERS	STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC. 15521 MIDLOTHIAN TPK - MIDLOTHIAN, VA 23113 PH. (804) 378-7440 FAX. (804) 378-7433
PROJ. NO.	02218208.05
DES. BY	TRW/CJW
DWN. BY	TRW
CHK. BY	CJW
APP. BY	CJW

CADD FILE:	02218208.05
DATE:	1/30/23
SCALE:	AS SHOWN

DRAWING NO. **1** of 7

LEGEND:

- 1800 — EXISTING CONTOUR, MAJOR
- - - - EXISTING CONTOUR, MINOR
- 1800 — PROPOSED CONTOUR, MAJOR
- — — — PROPOSED CONTOUR, MINOR
- — — — EXISTING 2" AIR LINE
- — — — EXISTING 4" FORCE MAIN
- — — — EXISTING LFG HEADER
- 4G — EXISTING 4" LFG HEADER
- 6G — EXISTING 6" LFG HEADER
- 8G — EXISTING 8" LFG HEADER
- 12G — EXISTING 12" LFG HEADER
- — — — BUILDING
- L — EXISTING LEACHATE PIPE
- L — PROPOSED LEACHATE PIPE
- L — ● — LEACHATE CLEANOUT
- — — — STORMWATER PIPE
- — — — EXISTING GRAVEL ROAD
- — — — RIP RAP/ ROCKS
- — — — SILT FENCE
- - - - - CELL BOUNDARY
- — — — EDGE OF LINER
- — — — LANDFILL GAS VENT
- — — — LANDFILL GAS PIPE
- 100 — LIMITS OF DISTURBANCE
- — — — SOIL TYPE BOUNDARY
- - - - DRAINAGE AREA
- · — · — STREAM OR WATERLINE
- — — — CENTERLINE
- (TS) TEMPORARY SEEDING
- (PS) PERMANENT SEEDING
- (CIP) CULVERT INLET PROTECTION
- (OP) OUTLET PROTECTION
- (SF) SILT FENCE
- (CE) CONSTRUCTION ENTRANCE
- (MU) MULCHING
- (B/M) BLANKETS AND MATTING
- RUNOFF FLOW DIRECTION
- — — — LFG HEADER 6"Ø

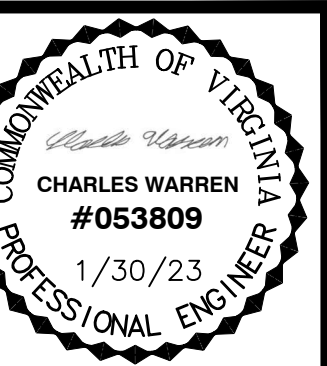
LEGEND:

- CS-## EXISTING TEMPERATURE PROBE
- TP-3 EXISTING WELLHEAD
- ✱ EXISTING AIR RELEASE VALVE
- ✕ EXISTING ISOLATION VALVE
- EXISTING LEACHATE CLEANOUT
- EXISTING U-TRAP
- EXISTING CONDENSATE PUMP STATION
- EXISTING HORIZONTAL COLLECTOR SUMP
- EXISTING LFG LIQUIDS CONTAINMENT TANK
- GP-5 EXISTING GAS PROBE
- MW-110 EXISTING GROUNDWATER MONITORING WELL
- EXISTING MANHOLE

- — — — FACILITY BOUNDARY
- · — · — WASTE MANAGEMENT UNIT BOUNDARY
- - - - APPROXIMATE EXTENT OF WASTE
- — — — EXISTING ROAD OUTLINE
- - - - EXISTING LFG HORIZONTAL COLLECTOR
- - - - PROPOSED LFG HORIZONTAL COLLECTOR
- LFG — EXISTING LFG COLLECTION PIPING
- LFG — PROPOSED LFG COLLECTION PIPING
- 8G — 8G — 8G — PROPOSED 8" LFG COLLECTION PIPING
- 12G — 12G — 12G — PROPOSED 12" LFG COLLECTION PIPING
- 16G — 16G — 16G — PROPOSED 16" LFG COLLECTION PIPING
- 18G — 18G — 18G — PROPOSED 18" LFG COLLECTION PIPING
- 24G — 24G — 24G — PROPOSED 24" LFG COLLECTION PIPING
- 28G — 28G — 28G — PROPOSED 28" LFG COLLECTION PIPING
- 36G — 36G — 36G — PROPOSED 36" LFG COLLECTION PIPING
- — — — PROPOSED 2" AIR LINE
- — — — PROPOSED 4" FORCE MAIN

GENERAL NOTES:

1. OWNER/DEVELOPER: CITY OF BRISTOL, VIRGINIA
2. CONSULTING ENGINEER: SCS ENGINEERS, 15521 MIDLOTHIAN TURNPIKE #305, MIDLOTHIAN, VA 23113
3. LOCATION OF EXISTING SEWER, WATER, OR GAS LINES, CONDUITS, OR OTHER STRUCTURES ACROSS, UNDERNEATH, OR OTHERWISE ALONG THE LINE OF PROPOSED WORK ARE NOT NECESSARILY SHOWN ON THE PLANS, AND IF SHOWN ARE ONLY APPROXIMATELY CORRECT. CONTRACTOR SHALL VERIFY LOCATION AND ELEVATION OF UNDERGROUND UTILITIES SHOWN ON THE PLANS IN AREAS OF CONSTRUCTION PRIOR TO STARTING WORK. CONTACT ENGINEER IMMEDIATELY IF LOCATION OF ELEVATION IS DIFFERENT FROM THAT SHOWN ON THE PLANS, IF THERE APPEARS TO BE A CONFLICT, OR UPON DISCOVERY OF A UTILITY NOT SHOWN ON THE PLANS. THE CONTRACTOR SHALL OBTAIN FIELD UTILITY LOCATIONS BY CALLING "MISS UTILITY" FORTY EIGHT (48) HOURS PRIOR TO WORKING IN THE VICINITY OF EXISTING UTILITIES.
4. BOUNDARY INFORMATION TAKEN FROM OTHERS.
5. THESE DRAWINGS ARE NOT SUITABLE FOR CONSTRUCTION.
6. HORIZONTAL DATA IS BASED ON US STATE PLANE NAD 1983 VIRGINIA SOUTH ZONE. VERTICAL DATA BASED ON NAVD 88.



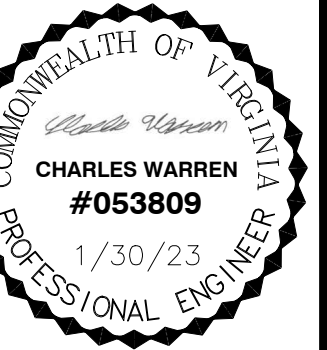
NO.	REVISION	DATE
1		
2		
3		
4		
5		
6		

SHEET TITLE	GENERAL NOTES AND LEGEND
PROJECT TITLE	INTERIM EVOH COVER SYSTEM SWP #588 PRELIMINARY DESIGN PLANS

CLIENT	CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY 2655 VALLEY DRIVE BRISTOL, VA 24201
--------	--

SCS ENGINEERS STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC. 15521 MIDLOTHIAN TURNPIKE #305, MIDLOTHIAN, VA 23113 PH. (804) 375-7440 FAX. (804) 375-7433	DWG. REV. / SCHA CHK. BY: TRW APP. BY: C/JW
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DATE:	1/30/23
SCALE:	AS SHOWN
DRAWING NO.	2 of 7



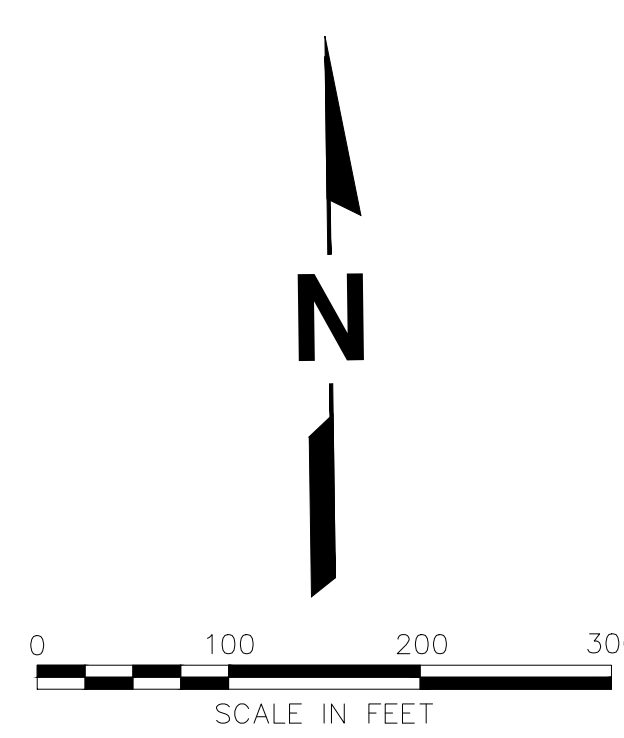
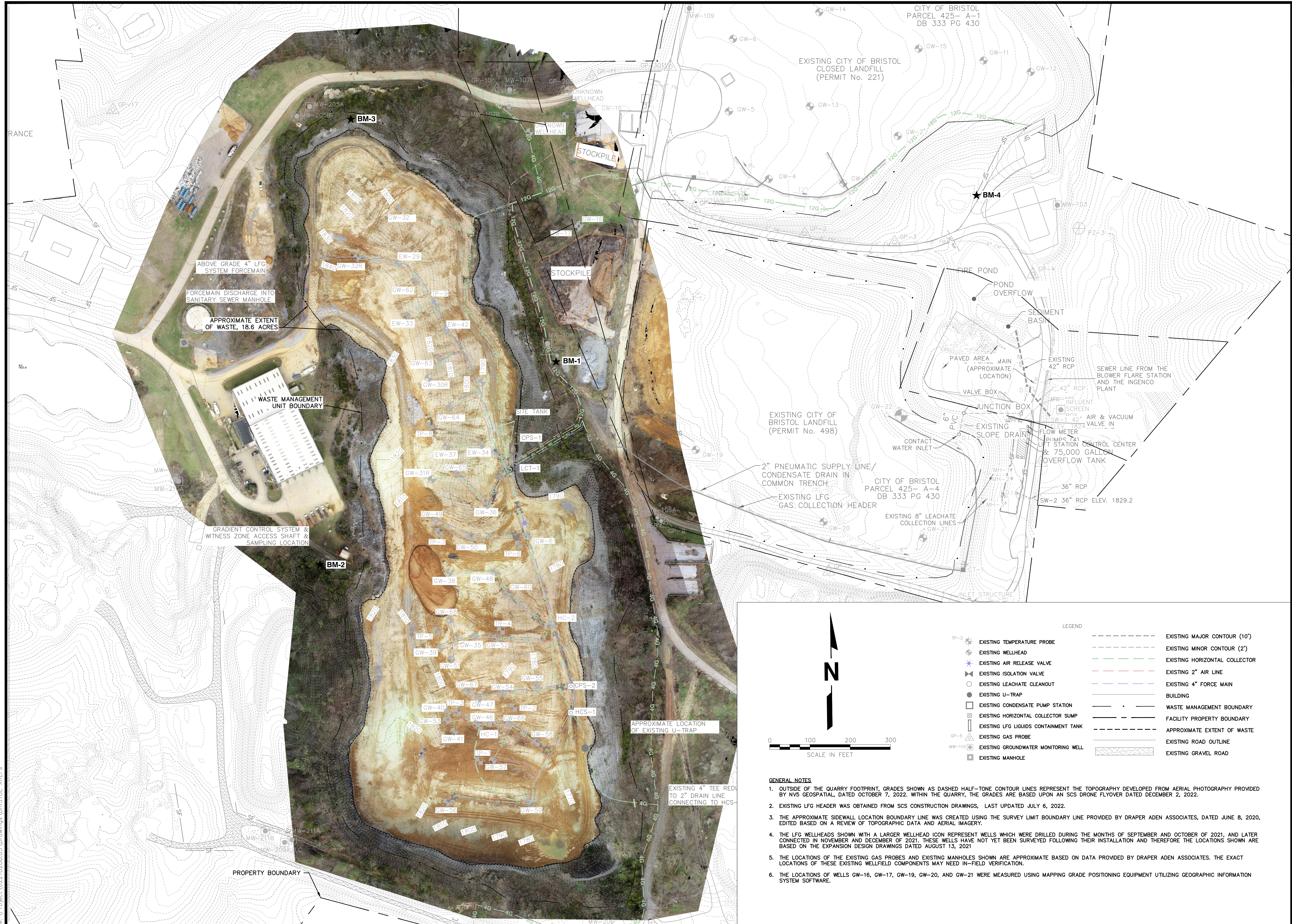
NO.	REVISION	DATE

SHEET TITLE: **EXISTING CONDITIONS**
 PROJECT TITLE: **INTERIM EVOH COVER SYSTEM SWP #588 PRELIMINARY DESIGN PLANS**

CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
 2655 VALLEY DRIVE
 BRISTOL, VA 24201

CLIENT: **SCS ENGINEERS**
 STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
 16521 MIDLOTHIAN TPK., MIDLOTHIAN, VA 23113
 PH. (804) 378-7440 FAX. (804) 378-7433

CADD FILE: **02218208.05**
 DATE: **1/30/23**
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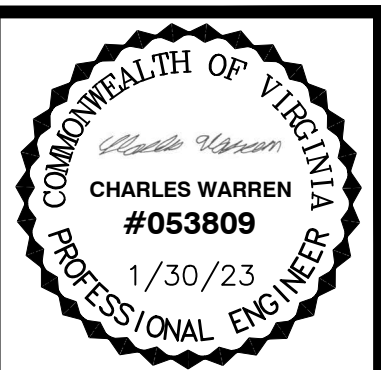
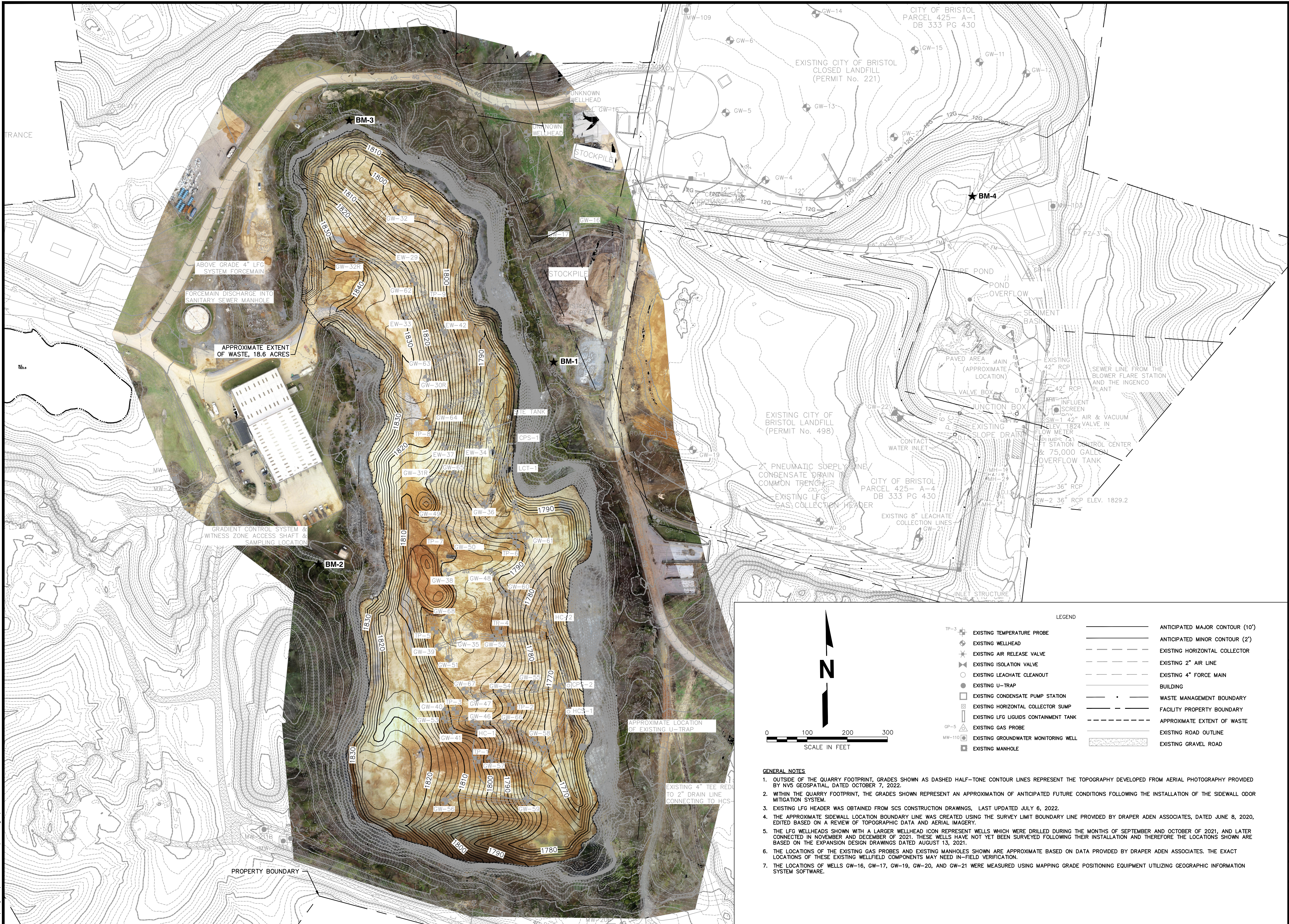
LEGEND

TP-3	EXISTING TEMPERATURE PROBE	---	EXISTING MAJOR CONTOUR (10')
⊕	EXISTING WELLHEAD	---	EXISTING MINOR CONTOUR (2')
⊕	EXISTING AIR RELEASE VALVE	---	EXISTING HORIZONTAL COLLECTOR
⊕	EXISTING ISOLATION VALVE	---	EXISTING 2" AIR LINE
○	EXISTING LEACHATE CLEANOUT	---	EXISTING 4" FORCE MAIN
●	EXISTING U-TRAP	---	BUILDING
⊕	EXISTING CONDENSATE PUMP STATION	---	WASTE MANAGEMENT BOUNDARY
⊕	EXISTING HORIZONTAL COLLECTOR SUMP	---	FACILITY PROPERTY BOUNDARY
⊕	EXISTING LFG LIQUIDS CONTAINMENT TANK	---	APPROXIMATE EXTENT OF WASTE
⊕	EXISTING GAS PROBE	---	EXISTING ROAD OUTLINE
⊕	EXISTING GROUNDWATER MONITORING WELL	---	EXISTING GRAVEL ROAD
⊕	EXISTING MANHOLE	---	

- GENERAL NOTES
- OUTSIDE OF THE QUARRY FOOTPRINT, GRADES SHOWN AS DASHED HALF-TONE CONTOUR LINES REPRESENT THE TOPOGRAPHY DEVELOPED FROM AERIAL PHOTOGRAPHY PROVIDED BY NVS GEOSPATIAL, DATED OCTOBER 7, 2022. WITHIN THE QUARRY, THE GRADES ARE BASED UPON AN SCS DRONE FLYOVER DATED DECEMBER 2, 2022.
 - EXISTING LFG HEADER WAS OBTAINED FROM SCS CONSTRUCTION DRAWINGS, LAST UPDATED JULY 6, 2022.
 - THE APPROXIMATE SIDEWALL LOCATION BOUNDARY LINE WAS CREATED USING THE SURVEY LIMIT BOUNDARY LINE PROVIDED BY DRAPER ADEN ASSOCIATES, DATED JUNE 8, 2020, EDITED BASED ON A REVIEW OF TOPOGRAPHIC DATA AND AERIAL IMAGERY.
 - THE LFG WELLHEADS SHOWN WITH A LARGER WELLHEAD ICON REPRESENT WELLS WHICH WERE DRILLED DURING THE MONTHS OF SEPTEMBER AND OCTOBER OF 2021, AND LATER CONNECTED IN NOVEMBER AND DECEMBER OF 2021. THESE WELLS HAVE NOT YET BEEN SURVEYED FOLLOWING THEIR INSTALLATION AND THEREFORE THE LOCATIONS SHOWN ARE BASED ON THE EXPANSION DESIGN DRAWINGS DATED AUGUST 13, 2021.
 - THE LOCATIONS OF THE EXISTING GAS PROBES AND EXISTING MANHOLES SHOWN ARE APPROXIMATE BASED ON DATA PROVIDED BY DRAPER ADEN ASSOCIATES. THE EXACT LOCATIONS OF THESE EXISTING WELLFIELD COMPONENTS MAY NEED IN-FIELD VERIFICATION.
 - THE LOCATIONS OF WELLS GW-16, GW-17, GW-19, GW-20, AND GW-21 WERE MEASURED USING MAPPING GRADE POSITIONING EQUIPMENT UTILIZING GEOGRAPHIC INFORMATION SYSTEM SOFTWARE.

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NO.	REVISION	DATE

SHEET TITLE: **ANTICIPATED CONDITIONS**
 PROJECT TITLE: **INTERIM EVOH COVER SYSTEM SWP #588 PRELIMINARY DESIGN PLANS**

CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
 2655 VALLEY DRIVE
 BRISTOL, VA 24201

CLIENT: CITY OF BRISTOL

SCS ENGINEERS
 STEARNS, CONRAD AND SCHMIDT
 CONSULTING ENGINEERS, INC.
 16521 MIDLOTHIAN TPK., MIDLOTHIAN, VA 23113
 PH. (804) 378-7440 FAX. (804) 378-7433

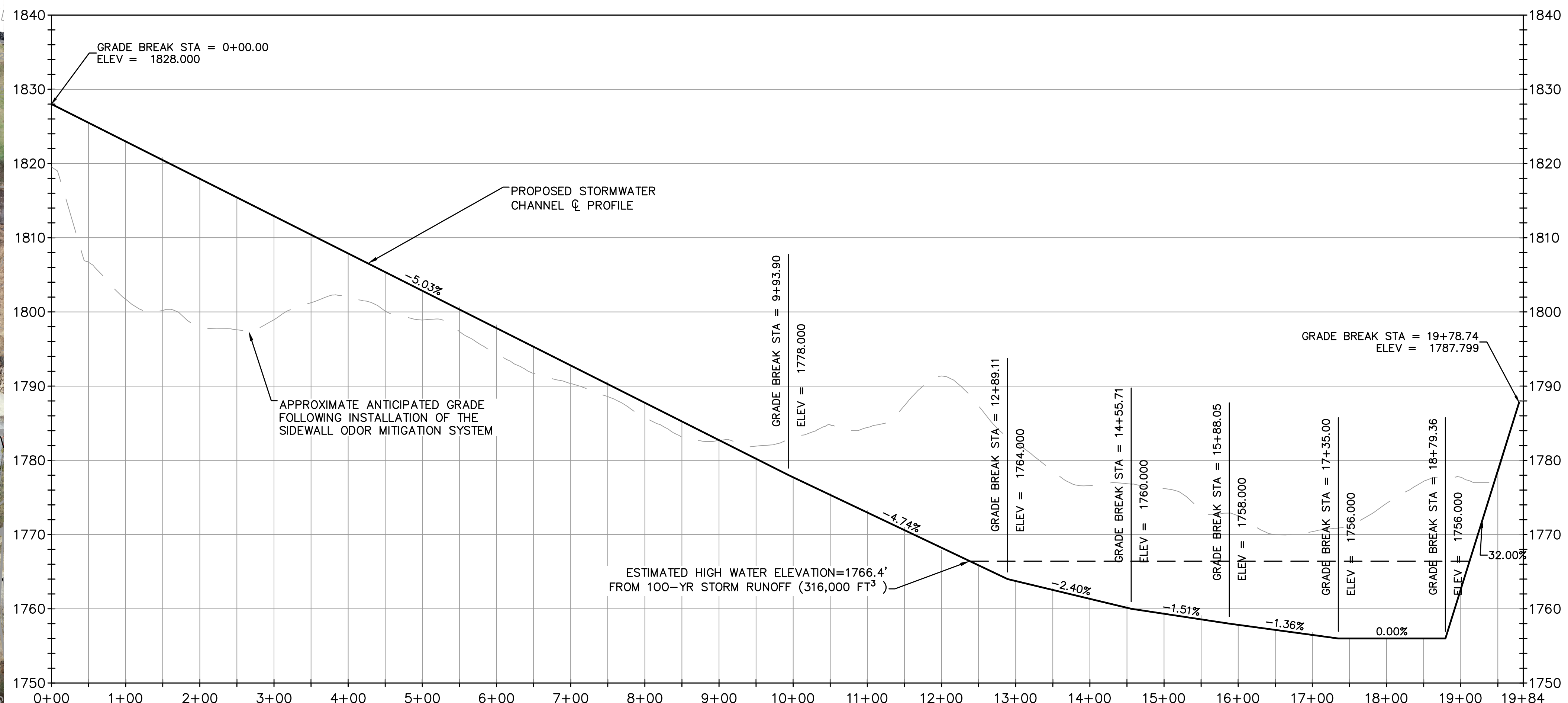
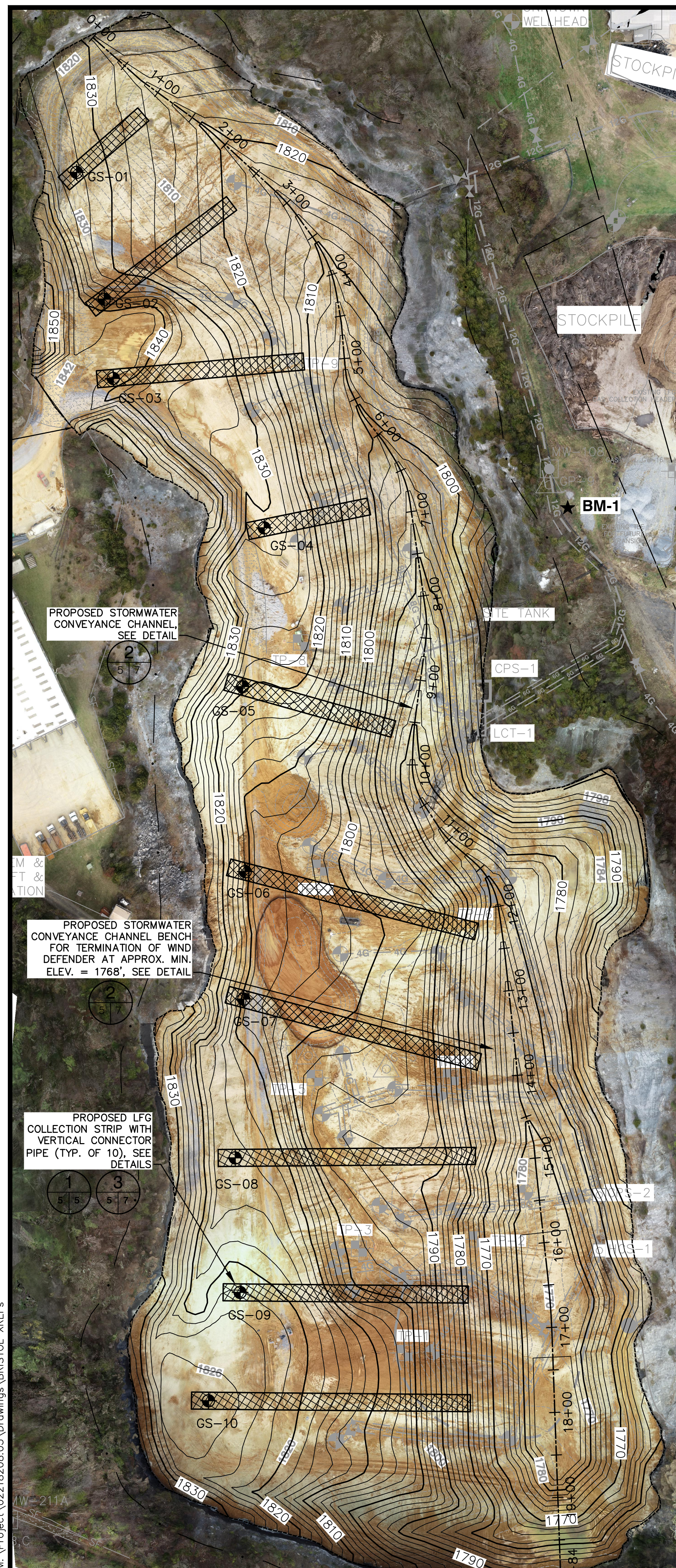
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 DRAWING NO. **4** of 7

LEGEND

	EXISTING TEMPERATURE PROBE		ANTICIPATED MAJOR CONTOUR (10')
	EXISTING WELLHEAD		ANTICIPATED MINOR CONTOUR (2')
	EXISTING AIR RELEASE VALVE		EXISTING HORIZONTAL COLLECTOR
	EXISTING ISOLATION VALVE		EXISTING 2" AIR LINE
	EXISTING LEACHATE CLEANOUT		EXISTING 4" FORCE MAIN
	EXISTING U-TRAP		BUILDING
	EXISTING CONDENSATE PUMP STATION		WASTE MANAGEMENT BOUNDARY
	EXISTING HORIZONTAL COLLECTOR SUMP		FACILITY PROPERTY BOUNDARY
	EXISTING LFG LIGUIDS CONTAINMENT TANK		APPROXIMATE EXTENT OF WASTE
	EXISTING GAS PROBE		EXISTING ROAD OUTLINE
	EXISTING GROUNDWATER MONITORING WELL		EXISTING GRAVEL ROAD
	EXISTING MANHOLE		

- GENERAL NOTES**
- OUTSIDE OF THE QUARRY FOOTPRINT, GRADES SHOWN AS DASHED HALF-TONE CONTOUR LINES REPRESENT THE TOPOGRAPHY DEVELOPED FROM AERIAL PHOTOGRAPHY PROVIDED BY NV5 GEOSPATIAL, DATED OCTOBER 7, 2022.
 - WITHIN THE QUARRY FOOTPRINT, THE GRADES SHOWN REPRESENT AN APPROXIMATION OF ANTICIPATED FUTURE CONDITIONS FOLLOWING THE INSTALLATION OF THE SIDEWALL ODOR MITIGATION SYSTEM.
 - EXISTING LFG HEADER WAS OBTAINED FROM SCS CONSTRUCTION DRAWINGS, LAST UPDATED JULY 6, 2022.
 - THE APPROXIMATE SIDEWALL LOCATION BOUNDARY LINE WAS CREATED USING THE SURVEY LIMIT BOUNDARY LINE PROVIDED BY DRAPER ADEN ASSOCIATES, DATED JUNE 8, 2020, EDITED BASED ON A REVIEW OF TOPOGRAPHIC DATA AND AERIAL IMAGERY.
 - THE LFG WELLHEADS SHOWN WITH A LARGER WELLHEAD ICON REPRESENT WELLS WHICH WERE DRILLED DURING THE MONTHS OF SEPTEMBER AND OCTOBER OF 2021, AND LATER CONNECTED IN NOVEMBER AND DECEMBER OF 2021. THESE WELLS HAVE NOT YET BEEN SURVEYED FOLLOWING THEIR INSTALLATION AND THEREFORE THE LOCATIONS SHOWN ARE BASED ON THE EXPANSION DESIGN DRAWINGS DATED AUGUST 13, 2021.
 - THE LOCATIONS OF THE EXISTING GAS PROBES AND EXISTING MANHOLES SHOWN ARE APPROXIMATE BASED ON DATA PROVIDED BY DRAPER ADEN ASSOCIATES. THE EXACT LOCATIONS OF THESE EXISTING WELLFIELD COMPONENTS MAY NEED IN-FIELD VERIFICATION.
 - THE LOCATIONS OF WELLS GW-16, GW-17, GW-19, GW-20, AND GW-21 WERE MEASURED USING MAPPING GRADE POSITIONING EQUIPMENT UTILIZING GEOGRAPHIC INFORMATION SYSTEM SOFTWARE.

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STORMWATER CHANNEL CENTERLINE PROFILE
 SCALE: H: 1"=100', V: 1" = 10'
 NOTE: INDICATED SCALE MAY VARY DEPENDING ON PLOT SIZE

EVOH Concept- Gas Collection Strip Panels	
GAS STRIP ID	LENGTH (FT)
GS-01	125
GS-02	205
GS-03	245
GS-04	145
GS-05	205
GS-06	300
GS-07	310
GS-08	300
GS-09	290
GS-10	330
TOTAL	2455

1 LFG COLLECTION STRIP SCHEDULE

PRELIMINARY EARTHWORK ESTIMATE, BASED UPON COMPARISON OF THE ANTICIPATED CONDITIONS TO THE EVOH COVER SYSTEM INSTALLATION GRADE:

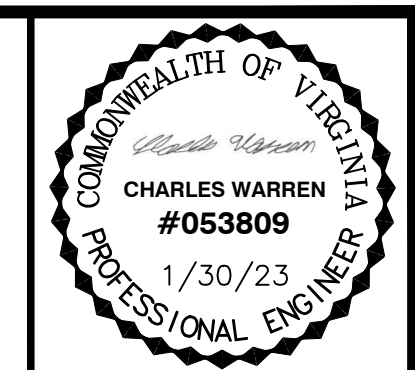
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Name	Type	Cut Factor	Fill Factor	2d Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)
VOLUME - Total Earthwork Estimate	fill	1.000	1.000	804867.12	63872.88	62940.61
						932.27<Cut>

LEGEND

- TP-3 EXISTING TEMPERATURE PROBE
- EXISTING WELLHEAD
- EXISTING AIR RELEASE VALVE
- EXISTING ISOLATION VALVE
- EXISTING LEACHATE CLEANOUT
- EXISTING U-TRAP
- EXISTING CONDENSATE PUMP STATION
- EXISTING HORIZONTAL COLLECTOR SUMP
- EXISTING LFG LIGUIDS CONTAINMENT TANK
- GP-5 EXISTING GAS PROBE
- MW-110 EXISTING GROUNDWATER MONITORING WELL
- EXISTING MANHOLE
- PROPOSED MAJOR CONTOUR (10')
- PROPOSED MINOR CONTOUR (2')
- EXISTING HORIZONTAL COLLECTOR
- EXISTING 2" AIR LINE
- EXISTING 4" FORCE MAIN
- BUILDING
- WASTE MANAGEMENT BOUNDARY
- FACILITY PROPERTY BOUNDARY
- APPROXIMATE EXTENT OF WASTE
- EXISTING ROAD OUTLINE
- EXISTING GRAVEL ROAD
- PROPOSED LFG COLLECTION STRIP

GENERAL NOTES

- WITHIN THE QUARRY FOOTPRINT, THE HALF-TONE CONTOURS REPRESENT AN APPROXIMATION OF ANTICIPATED FUTURE CONDITIONS FOLLOWING THE INSTALLATION OF THE SIDEWALL ODOR MITIGATION SYSTEM. THE FULL-TONE CONTOURS SHOW THE PROPOSED EVOH COVER SYSTEM INSTALLATION GRADE.
- SCS PLANS TO EXPAND THE LANDFILL GAS SYSTEM TO INCORPORATE THE LFG COLLECTION STRIPS. SCS PLANS TO APPLY VACUUM PRESSURE TO THE VERTICAL COLLECTION PIPES NEAR THE TOP OF THE COLLECTION STRIPS.
- EXISTING LFG HEADER WAS OBTAINED FROM SCS CONSTRUCTION DRAWINGS, LAST UPDATED JULY 6, 2022.
- THE APPROXIMATE SIDEWALL LOCATION BOUNDARY LINE WAS CREATED USING THE SURVEY LIMIT BOUNDARY LINE PROVIDED BY DRAPER ADEN ASSOCIATES, DATED JUNE 8, 2020, EDITED BASED ON A REVIEW OF TOPOGRAPHIC DATA AND AERIAL IMAGERY.
- THE LFG WELLHEADS SHOWN WITH A LARGER WELLHEAD ICON REPRESENT WELLS WHICH WERE DRILLED DURING THE MONTHS OF SEPTEMBER AND OCTOBER OF 2021, AND LATER CONNECTED IN NOVEMBER AND DECEMBER OF 2021. THESE WELLS HAVE NOT YET BEEN SURVEYED FOLLOWING THEIR INSTALLATION AND THEREFORE THE LOCATIONS SHOWN ARE BASED ON THE EXPANSION DESIGN DRAWINGS DATED AUGUST 13, 2021.
- THE LOCATIONS OF THE EXISTING GAS PROBES AND EXISTING MANHOLES SHOWN ARE APPROXIMATE BASED ON DATA PROVIDED BY DRAPER ADEN ASSOCIATES. THE EXACT LOCATIONS OF THESE EXISTING WELLFIELD COMPONENTS MAY NEED IN-FIELD VERIFICATION.



DATE	REVISION	NO.

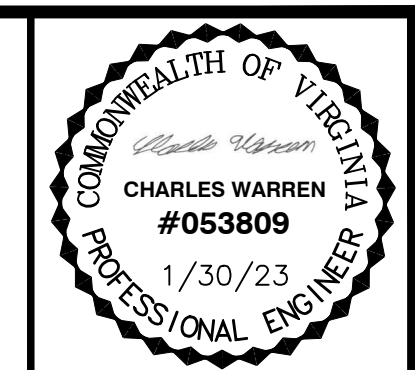
SHEET TITLE: PROPOSED STORMWATER CHANNEL AND LFG COLLECTION STRIPS
 PROJECT TITLE: INTERIM EVOH COVER SYSTEM SWP #588 PRELIMINARY DESIGN PLANS

CLIENT: CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
 2655 VALLEY DRIVE
 BRISTOL, VA 24201

SCS ENGINEERS
 STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
 16521 MIDLOTHIAN TPK - MIDLOTHIAN, VA 23113
 PH. (804) 378-7440 FAX. (804) 378-7433

CADD FILE: 02218208.05
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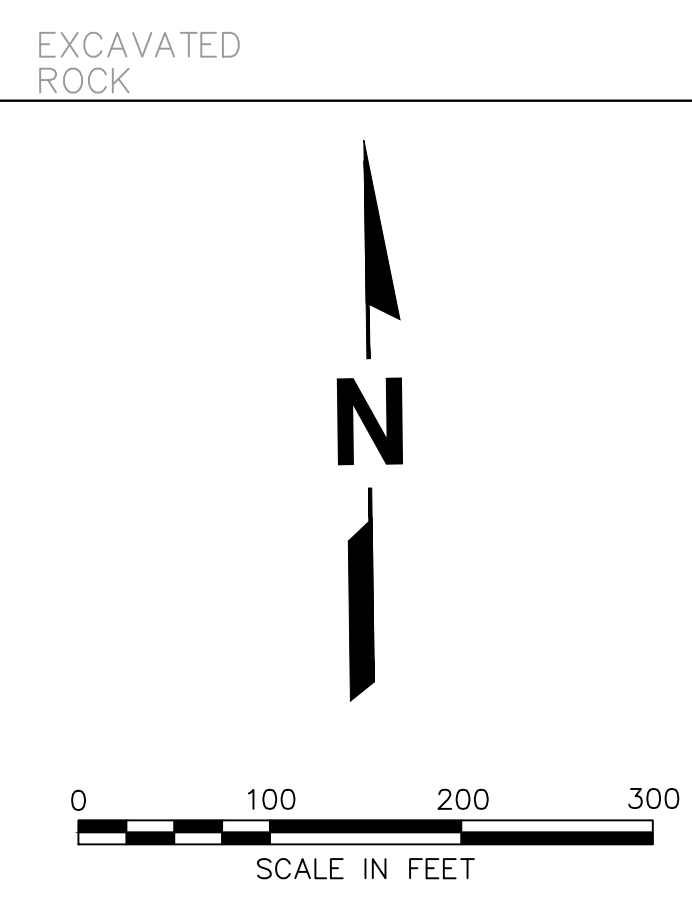
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SHEET TITLE: EVOH COVER SYSTEM INSTALLATION GRADE AND AREA
 PROJECT TITLE: INTERIM EVOH COVER SYSTEM SWP #588 PRELIMINARY DESIGN PLANS

CLIENT: CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
 2655 VALLEY DRIVE
 BRISTOL, VA 24201

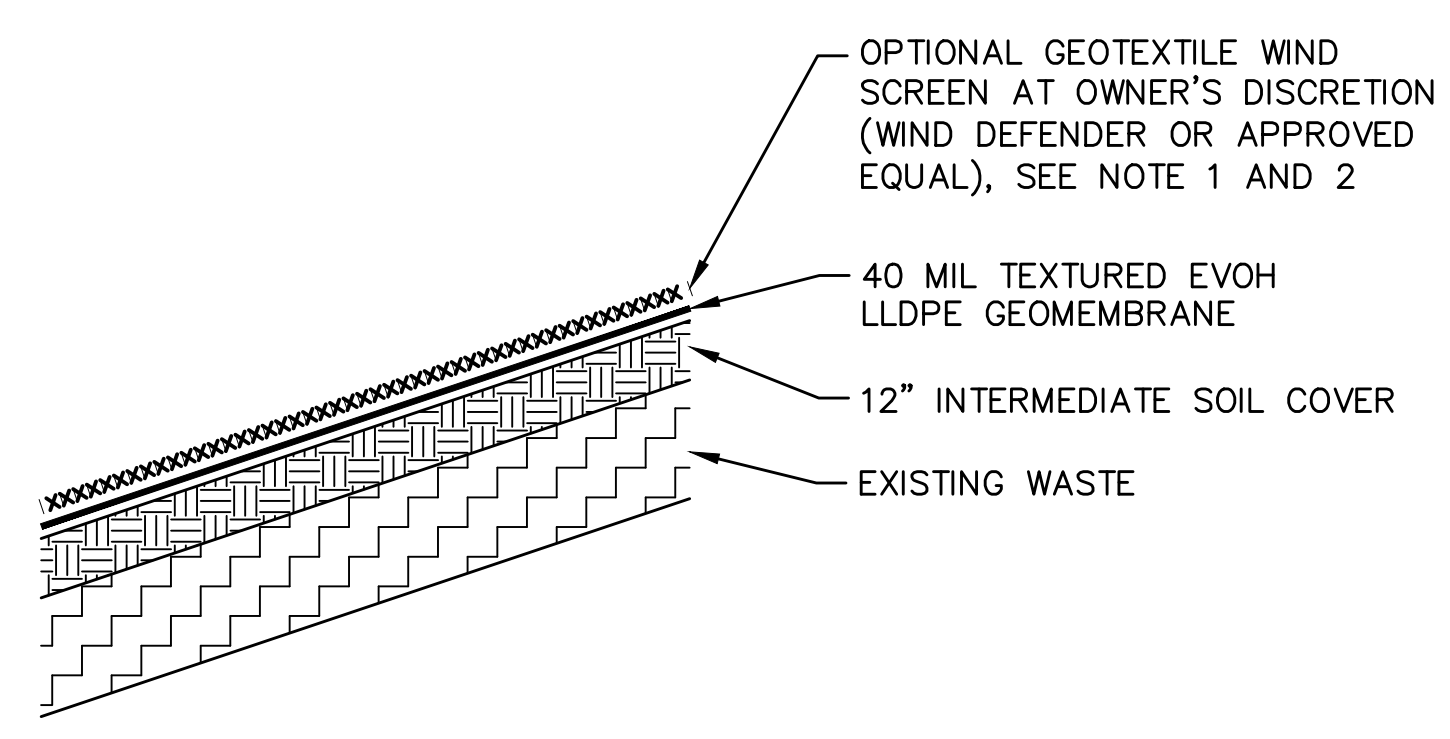
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 DRAWING NO. 6 of 7



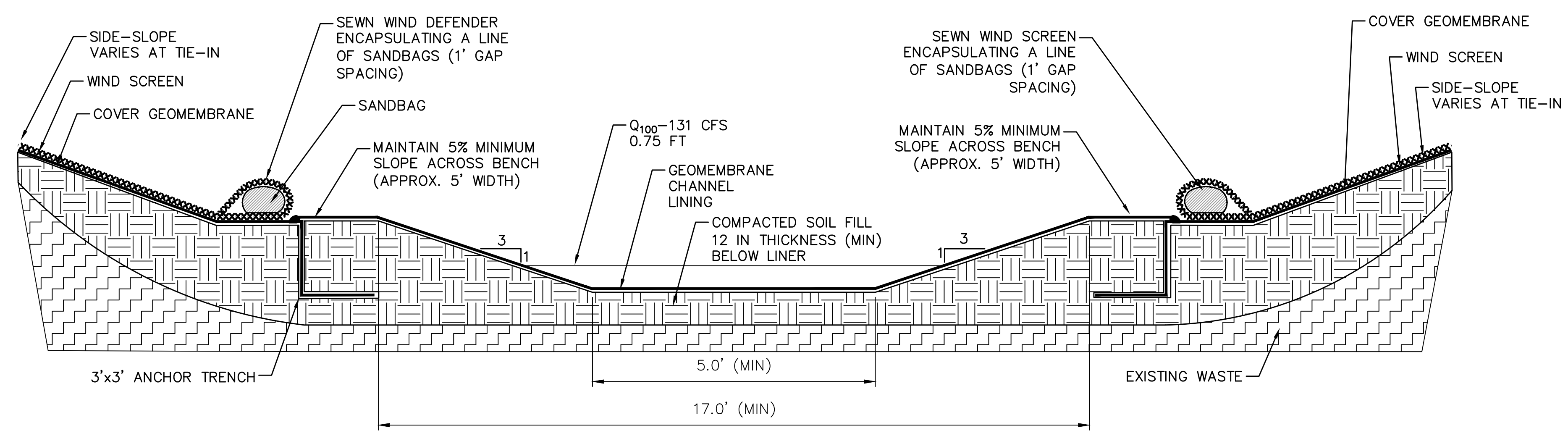
LEGEND			
TP-3	EXISTING TEMPERATURE PROBE	—	PROPOSED MAJOR CONTOUR (10')
⊕	EXISTING WELLHEAD	—	PROPOSED MINOR CONTOUR (2')
⊙	EXISTING AIR RELEASE VALVE	▨	PROPOSED LFG COLLECTION STRIP
⊘	EXISTING ISOLATION VALVE	▩	PROPOSED EVOH COVER EXTENTS
○	EXISTING LEACHATE CLEANOUT	—	EXISTING HORIZONTAL COLLECTOR
⊖	EXISTING U-TRAP	---	EXISTING 2" AIR LINE
□	EXISTING CONDENSATE PUMP STATION	---	EXISTING 4" FORCE MAIN
⊞	EXISTING HORIZONTAL COLLECTOR SUMP	—	BUILDING
⊞	EXISTING LFG LIQUIDS CONTAINMENT TANK	—	WASTE MANAGEMENT BOUNDARY
⊞	EXISTING GAS PROBE	---	FACILITY PROPERTY BOUNDARY
MW-110	EXISTING GROUNDWATER MONITORING WELL	---	APPROXIMATE EXTENT OF WASTE
⊞	EXISTING MANHOLE	---	EXISTING ROAD OUTLINE
		--- </td <td>EXISTING GRAVEL ROAD</td>	EXISTING GRAVEL ROAD

- GENERAL NOTES**
- THE APPROXIMATE THREE DIMENSIONAL SURFACE AREA OF THE EVOH COVER SYSTEM IS 19.0 ACRES.
 - WITHIN THE QUARRY FOOTPRINT, THE GRADES SHOWN REPRESENT THE PROPOSED INSTALLATION GRADE FOR THE EVOH COVER SYSTEM.
 - EXISTING LFG HEADER WAS OBTAINED FROM SCS CONSTRUCTION DRAWINGS, LAST UPDATED JULY 6, 2022.
 - THE APPROXIMATE SIDEWALL LOCATION BOUNDARY LINE WAS CREATED USING THE SURVEY LIMIT BOUNDARY LINE PROVIDED BY DRAPER ADEN ASSOCIATES, DATED JUNE 8, 2020, EDITED BASED ON A REVIEW OF TOPOGRAPHIC DATA AND AERIAL IMAGERY.
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 - THE LOCATIONS OF WELLS GW-16, GW-17, GW-19, GW-20, AND GW-21 WERE MEASURED USING MAPPING GRADE POSITIONING EQUIPMENT UTILIZING GEOGRAPHIC INFORMATION SYSTEM SOFTWARE.



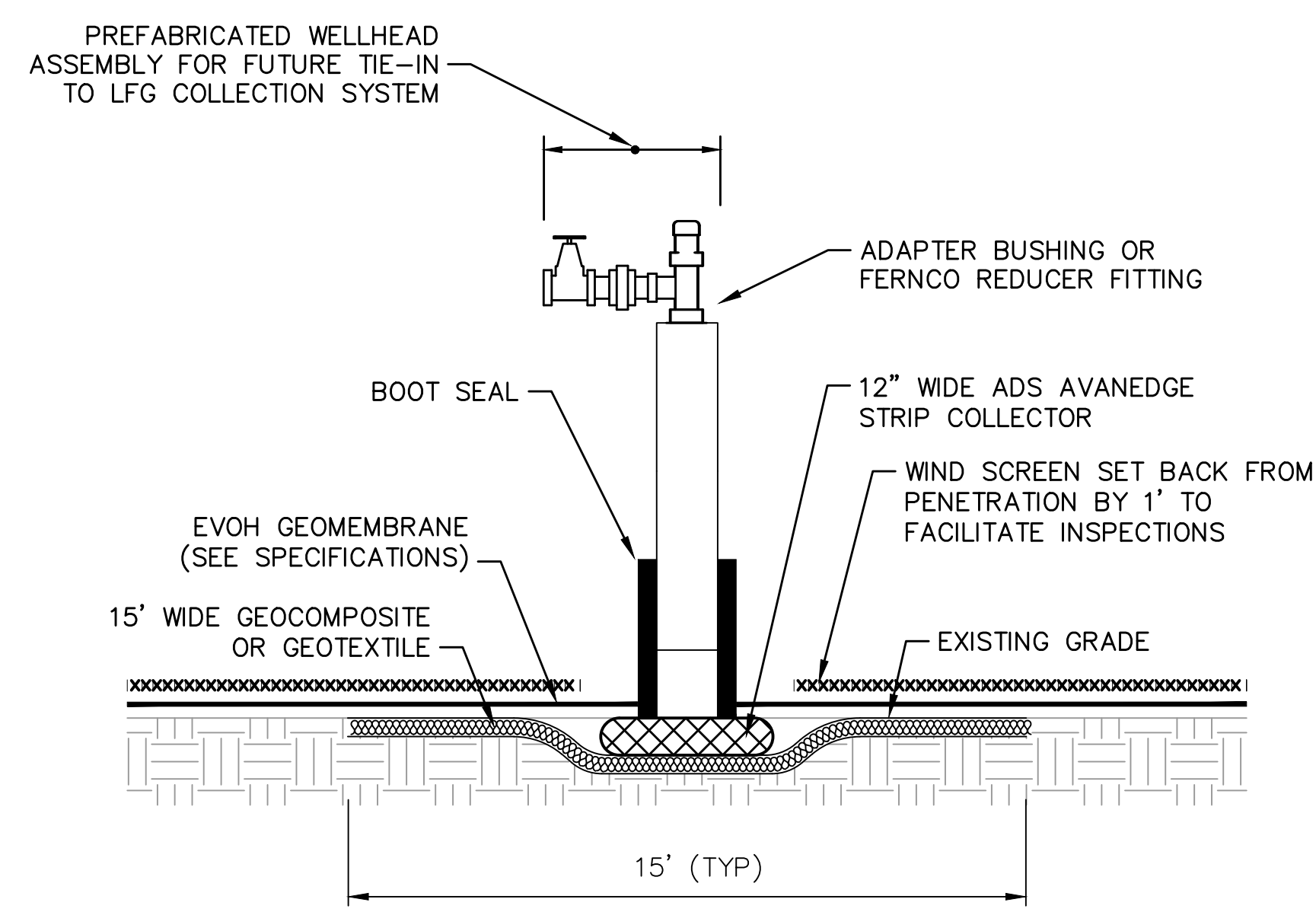
1 INTERIM EVOH COVER
6 | 7 NOT TO SCALE

NOTES:
1. THE OWNER MAY OR MAY NOT ELECT TO INCLUDE A GEOTEXTILE WIND SCREEN

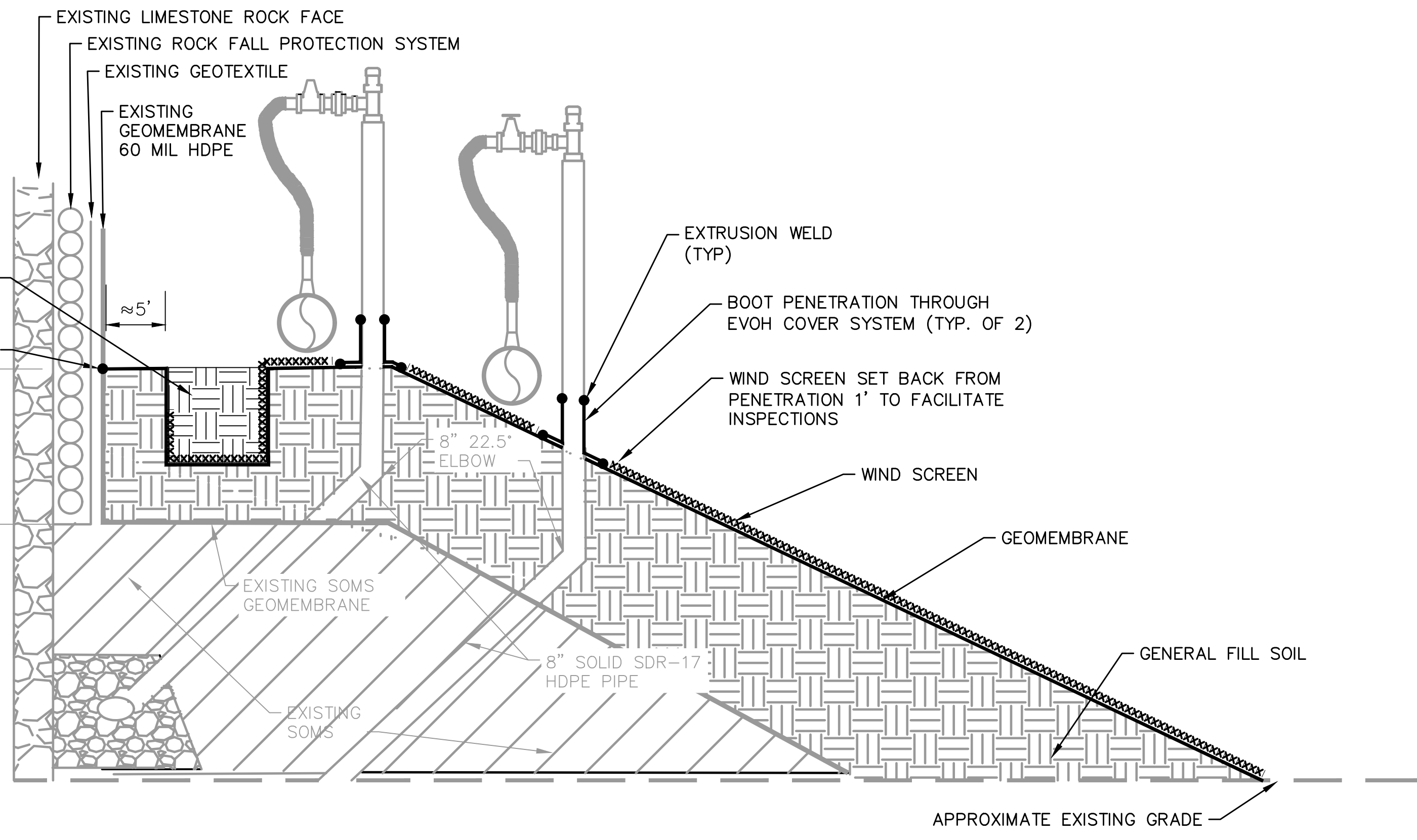


2 STORMWATER CHANNEL PRELIMINARY DESIGN
5 | 7 NOT TO SCALE

NOTES:
1. CHANNEL SLOPE IS APPROXIMATELY 5%. THE 100-YR FLOW DEPTH IS APPROX. 0.75 FT.



3 LFG COLLECTION STRIPS
5 | 7 NOT TO SCALE



4 EVOH COVER SYSTEM TIE-IN TO EXISTING SIDEWALL LINER
6 | 7 NOT TO SCALE

NOTE:
1. THESE DETAILS HAVE BEEN DEVELOPED IN CONJUNCTION WITH PLANNING EFFORTS AND DEPICT CONCEPTUAL DESIGN INFORMATION. THE ACTUAL DESIGN AND MATERIAL MAY BE MODIFIED TO ACCOMMODATE FIELD CONDITIONS OR ADJUSTED BASED ON ADDITIONAL DATA OR COST IMPLICATIONS DURING ENGINEERING DESIGN ACTIVITIES AND CONSTRUCTION.
2. THE OWNER MAY OR MAY NOT ELECT TO INCLUDE A GEOTEXTILE WIND SCREEN. THE DETAILS CURRENTLY ASSUME THE USE OF A GEOTEXTILE WIND SCREEN.
3. INTERIM COVER WILL BE UTILIZED OVER THE EXTENT OF THE LANDFILL IN THE NEAR TERM. IN THE EVENT THE DECISION IS MADE TO PERMANENTLY CLOSE THE LANDFILL, THE LANDFILL WILL RECEIVE FINAL COVER.

DATE
REVISION
NO.

SHEET TITLE
DETAILS

PROJECT TITLE
**INTERIM EVOH COVER SYSTEM
SWP #588 PRELIMINARY DESIGN PLANS**

CLIENT
**CITY OF BRISTOL INTEGRATED SOLID
WASTE MANAGEMENT FACILITY**
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BRISTOL, VA 24201

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DATE: 02/21/2025
DRAWN BY: TRW/SHA
CHECKED BY: C.J.W.
APP'D BY: C.J.W.

CADD FILE:
02218208.05

DATE:
1/30/23

SCALE:
AS SHOWN

DRAWING NO.