# CONSTRUCTION QUALITY ASSURANCE PLAN

# TRENCH 13

**US Ecology Nevada, Inc.**
**Hazardous Waste Management Facility**
**Beatty, Nevada**

USEPA ID #NVT330010000
Nevada Hazardous Waste Treatment, Storage and Disposal
Permit NEV HW0025

**Prepared for**

**Prepared by**

**with Assistance from**

**Revision 0: October 2015**
**Revision 1: March 2016**

## CERTIFICATION

**CONSTRUCTION QUALITY ASSURANCE PLAN**
**TRENCH 13**
**REVISION 1**

**US Ecology Nevada, Inc.**
**Hazardous Waste Management Facility**
**Beatty, Nevada**

I certify under penalty of law that this document and all appendices were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

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# TABLE OF CONTENTS

**CERTIFICATION** ..... **i**
**TABLE OF CONTENTS** ..... **ii**

**1. INTRODUCTION** ..... **1-1**

**2. DISPOSAL TRENCH DESIGN CONCEPT** ..... **2-1**
2.1 DESIGN CONCEPT ..... 2-1
2.1.1 Below-Grade ..... 2-1
2.1.2 Above-Grade ..... 2-2
2.2 SUBGRADE DESIGN ..... 2-2
2.2.1 Trench Excavation ..... 2-2
2.2.2 Liner System Description ..... 2-2
2.2.3 Leachate Collection and Recovery System ..... 2-3
2.3 EXCAVATION SLOPE STABILITY EVALUATION ..... 2-4
2.4 RUN-ON/RUN-OFF CONTROL ..... 2-5
2.4.1 During Operations ..... 2-5
2.4.2 Post-Closure ..... 2-6
2.5 SURFACE FACILITIES MODIFICATIONS ..... 2-6
2.5.1 Facilities Relocation ..... 2-6
2.5.2 Monitor Well Abandonment ..... 2-6
2.5.3 Temporary Fence Relocation ..... 2-6

**3. RESPONSIBILITY AND AUTHORITY** ..... **3-1**
3.1 PERMITTING AGENCIES ..... 3-1
3.2 OPERATOR ..... 3-1
3.3 PROJECT MANAGER ..... 3-2
3.4 PROJECT ENGINEER ..... 3-2
3.5 CONSTRUCTION QUALITY ASSURANCE CONTRACTOR ..... 3-2
3.5.1 CQA Officer ..... 3-2
3.5.2 CQA Personnel ..... 3-3
3.5.3 Quality Assurance Laboratory ..... 3-4
3.6 CHIEF SURVEYOR ..... 3-4
3.7 EARTHWORK CONTRACTOR ..... 3-5
3.8 GEOSYNTHETIC MATERIAL MANUFACTURERS ..... 3-5
3.8.1 Geomembrane Manufacturer ..... 3-5
3.8.2 Geotextile Manufacturer ..... 3-5
3.8.3 Geocomposite/Geonet Manufacturer ..... 3-5
3.8.4 Geosynthetic Clay Liner (GCL) Manufacturer ..... 3-5
3.9 GEOMEMBRANE FABRICATOR ..... 3-6
3.10 GEOSYNTHETIC MATERIALS INSTALLER ..... 3-6

**4. CQA PERSONNEL QUALIFICATIONS** ..... **4-1**
4.1 CQA OFFICER ..... 4-1
4.2 CQA INSPECTION PERSONNEL ..... 4-1

4.3 CHIEF SURVEYOR ..... 4-1

**5. MEETINGS ..... 5-1**
5.1 PRE-BID MEETING ..... 5-1
5.2 PRE-CONSTRUCTION MEETING ..... 5-1
5.3 WEEKLY PROGRESS MEETINGS ..... 5-2
5.4 CONSTRUCTION PROBLEM OR WORK DEFICIENCY MEETING ..... 5-2

**6. DOCUMENTATION ..... 6-1**
6.1 PRE-CONSTRUCTION SUBMITTALS ..... 6-1
6.1.1 Geomembrane Manufacturer ..... 6-1
6.1.2 Geomembrane Fabricator ..... 6-1
6.1.3 Geotextile Manufacturer ..... 6-2
6.1.4 Geocomposite/Geonet Manufacturer ..... 6-3
6.1.5 Geosynthetic Clay-Liner Manufacturer ..... 6-3
6.1.6 Installer ..... 6-4
6.2 DAILY RECORDKEEPING ..... 6-4
6.3 INSPECTION DATA SHEETS ..... 6-5
6.4 LINER INSTALLATION SUBMITTALS ..... 6-6
6.5 CONSTRUCTION PROBLEM IDENTIFICATION AND CORRECTIVE MEASURES REPORTS ..... 6-6
6.6 ACCEPTANCE OF COMPLETED COMPONENTS ..... 6-7
6.7 PROJECT COMPLETION SUBMITTALS ..... 6-7
6.8 FINAL DOCUMENTATION ..... 6-7

**7. CONSTRUCTION SEQUENCE AND CQA PROCEDURES ..... 7-1**
7.1 CONSTRUCTION SEQUENCE ..... 7-1
7.2 CONSTRUCTION SPECIFICATIONS AND PROCEDURES ..... 7-2
7.2.1 Earthwork ..... 7-2
7.2.2 Liner Placement ..... 7-3
7.2.3 Procedure for Confirming Line and Grade ..... 7-4
7.2.4 Quality Control Procedures ..... 7-4

**LIST OF TABLES**

Table CQA 1: Construction Quality Assurance Daily Report

Table CQA 2: Lift Control Requirements

Table CQA 3: Sample / Test Locations Report

Table CQA 4: Construction Problem Identification and Corrective Measures Report

**LIST OF APPENDICES**

APPENDIX A TRENCH 13 DESIGN DRAWINGS

APPENDIX B CONSTRUCTION MATERIALS SPECIFICATIONS

APPENDIX C: CONSTRUCTION METHOD SPECIFICATIONS

# 1. INTRODUCTION

This Construction Quality Assurance (CQA) Plan is for Disposal Trench 13 at the US Ecology Nevada, Inc. (USEN) Hazardous Waste Management Facility (HWMF), located about 11 miles south of Beatty, Nevada, in Nye County. The CQA Plan has been prepared to comply with the requirements of HW Permit Number NEV HW0025 dated December 8, 2011 (RCRA Permit). The CQA Plan has been developed under the direction of a professional engineer registered in the state of Nevada. The Plan describes the design features and procedures to be employed in the construction of Trench 13.

USEN is proposing to construct a new hazardous waste disposal unit (Trench 13) at the Beatty facility to increase waste disposal capacity. This CQA Plan presents the design concept used to develop the below-grade and above-grade portions of the trench and details of its construction.

Appendices to this CQA Plan include:

- **Appendix A**, Trench 13 design drawings;
- **Appendix B**, Construction materials specifications; and
- **Appendix C**, Construction methods and quality control requirements.

This CQA Plan addresses the development of Trench 13 in five Phases, Phases 13A, 13B, 13C, 13D, and 13E. In the CQA Plan and Appendices, references to the trench or disposal unit usually apply to the total below-grade and above-grade portion of Trench 13, and references to cells usually apply to the individual Phases of Trench 13 development. The phased cells could be constructed and begin operations either separately or concurrently depending upon final development scheduling as determined by USEN. This CQA Plan is intended to be equally applicable to independent or concurrent development of Phases 13A, 13B, 13C, 13D, and/or 13E.

# 2. DISPOSAL TRENCH DESIGN CONCEPT

## 2.1 DESIGN CONCEPT

The disposal structure of Trench 13 was designed considering the following design parameters.

- The disposal structure must provide a disposal volume that is consistent with the high cost of its construction. The configuration presented in this Plan provides a total disposal capacity of over 8.6 million cubic yards, with approximately 4.2 million cubic yards as below-grade disposal and 4.4 million cubic yards as above-grade disposal.
- Trench excavation and disposed waste position must be consistent with applicable regulatory requirements, including the lease agreement between USEN and the State of Nevada for the property on which Trench 13 is located. The configuration presented is consistent with these requirements, based upon frequent discussions between USEN and NDEP during design. Significant aspects of this consistency with requirements include the following.
- The disposal structure, including the final cover, is designed (and will be constructed) to be entirely located within the legal metes and bounds of the facility property, as agreed upon between USEN and the State of Nevada.
- The structure will be designed with access to other facility components, including entrance facilities, such as offices, truck scale and laboratory; and operational facilities including shops, waste stabilization facilities, and wash points.
- The structure will be capable of being constructed using conventional earthwork equipment.
- The final (covered) trench configuration will have stable, maintenance-free outer slopes, considering normal static loading and seismic-induced loading associated with the prescribed design conditions. On the basis of stability evaluation, it was determined that the perimeter slopes of the final cover can be approximately three units horizontal to one unit vertical (3H:1V). The flatter top section of the final cover should be approximately 20 units horizontal to one unit vertical (20H:1V) slope until the transition to the steeper perimeter slopes. This slope provides sufficient stability of the final cell configuration and allows for surface water runoff.

### 2.1.1 Below-Grade

Important aspects of the below-grade design concept include the following:

- Trench 13 will be excavated to a maximum depth below original ground surface of approximately 75 feet:
- Trench 13 excavated sidewalls will be approximately 0.5H:1.0V or approximately 63.5 degrees below horizontal; and

- Trench 13 will have a composite liner satisfying Federal and State requirements.

### 2.1.2 Above-Grade

Above-grade waste disposal will proceed with outer waste and interim cover slopes of 3H:1V and a final maximum elevation (top of final cover) of 2860 feet NGVD. The Trench 13 final cover will be a monolithic profile designed specifically for the low precipitation, arid setting of the Beatty facility incorporating a surficial material on steeper slopes intended to resist erosion during the initial years following closure when vegetation coverage (and surface stabilization provided by vegetation) is minimal.

## 2.2 SUBGRADE DESIGN

### 2.2.1 Trench Excavation

Trench 13 site preparation activities include removal and replacement of a small portion of an upper, low cohesion, soil layer. Improvement of this surface layer will be followed by trench excavation, trench subgrade and slope preparation (including leak detection system (LDS) riser recesses cut into the side walls, installation of prepared subgrade, and construction of LDS and leachate collection and recovery system (LCRS) sumps). Liner placement on the trench floor and side walls (including excavation of a perimeter liner anchor trench) will follow excavation and subgrade preparation. The Trench 13 design was developed to facilitate landfill construction in five Phases, with the initial Phase (Phase A), and then proceeding with subsequent Phases (Phases B, C, D, and E).

### 2.2.2 Liner System Description

The below-grade portions of Trench 13 employ a liner system consistent with the liner system specified by the RCRA Hazardous and Solid Waste Amendments (HSWA) of 1984 as minimum technological requirements (MTR) to prevent the migration of hazardous wastes from land disposal units to groundwater and the surrounding environment. The liner system is identical, with changes (as necessary) to utilize materials that are currently manufactured and available, to the liner system that was approved and used in Trench 12 and satisfies applicable Federal and State requirements. Details on how the liner system meets the MTR is further discussed in the Trench 13 Landfill Engineering Report (Section 5.3).

The basic liner system is comprised of the following elements (in order from the deepest to the shallowest):

- Prepared subgrade on the floor only (minimum nine inches of material meeting a $1.0 \times 10^{-5}$ cm/sec permeability specification),
- Geosynthetic-clay liner (GCL),
- 60-mil (0.060 inches thick) HDPE flexible membrane liner,
- double-sided geocomposite, consisting of a geonet heat-bonded between two geotextiles (300-mil on the floor and 200-mil on the side slopes),
- 80-mil HDPE flexible membrane liner,
- 300-mil double-sided geocomposite (on the floor of the trench) and 200-mil geonet with overlying non-woven geotextile (on the trench side walls), and
- 40-mil HDPE flexible membrane liner on trench sidewalls. Note: this material provides UV protection to the underlying geotextile and prevents precipitation from entering the sidewall geonet, but serves no hydraulic purpose relative to compliance with RCRA requirements for liners.

The Trench 13 liner system base (subgrade) will be nine-inches (minimum) of compacted native soil subgrade beneath all trench floor areas except for LCRS sumps, where 36-inches of compacted soil subgrade will be placed beneath sump.

The synthetic polyethylene liners used in the Trench 13 liner system are manufactured specifically for liquid containment purposes. The quality of the geomembrane (also called flexible membrane liner or FML) material will be monitored by quality assurance/quality control (QA/QC) personnel so that the materials satisfy the required specifications (as presented in this CQA Plan). Manufacturer data on synthetic material resistance and strength, as well as USEN laboratory data for typical Beatty facility leachate, indicate that polyethylene liner materials are resistant to the wide range of chemicals likely to be disposed at the facility.

### 2.2.3 Leachate Collection and Recovery System

The Trench 13 double liner system incorporates an LCRS and LDS. The LCRS is located above the primary liner, and is designed to collect and allow removal of liquids from within the disposal trench. The LDS is located between the primary and secondary liner members, and its main function is to detect and remove leakage through the primary liner.

The LCRS is associated with the primary liner system. The function of the LCRS is to intercept liquids infiltrating through the waste and to allow such liquid to flow toward and into the sumps for removal. The typical sump configuration is shown on **Drawing 009**[1]. Liquid is removed from the sumps using pumps and riser piping as shown on **Drawings 009** and **010**. The components of the LCRS sump are configured and sized to accommodate the maximum anticipated leachate flows while maintaining a fluid head above the primary liner that will not exceed one foot. In the event of pump failure, the primary LCRS liner system has a holding capacity equaling the liquid volume that could be generated during a 24-hour period following a 25-year precipitation event before exceedance of one foot of fluid head on the primary liner. Flow and pump sizing calculations are provided in Appendix 2, Calculation C.04, of the Trench 13 Engineering Report.

## 2.3 EXCAVATION SLOPE STABILITY EVALUATION

Excavation slope stability is of primary concern during waste disposal operations when the excavated slopes are not buttressed by disposed waste. After waste placement against the excavation sidewalls, the weight of disposed waste against the slopes will be sufficient to render the slopes stable under essentially any static or dynamic loading condition. USEN experience at this facility, including experience gained through extensive subsurface investigation, geotechnical engineering evaluations, and actual performance of excavated slopes, has clearly demonstrated that the excavation depths and slopes planned for Trench 13 will provide the required stability during construction and below-grade disposal operations. Slope stability calculations are provided in Appendix 2, Calculation C.02, of the Trench 13 Engineering Report. A geotechnical evaluation, specific to the location of Trench 13, is included in Appendix 5 of the Trench 13 Engineering Report. The geotechnical evaluation supports design assumptions.

Important aspects of the slope stability evaluations are summarized below.

- The 75-feet deep, 0.5H:1.0V excavation slopes were determined to be acceptably stable under static loading and pseudo-static loading (simulating ground motion from seismic activity). That measure of stability is slopes with a safety factor (against failure) of at least 1.5 during static loading and at least 1.0 during pseudo-static loading.
- Of the possible deep-seated failure planes evaluated, the planes exhibiting the lowest safety

[1] In this report, all Trench 13 Design Drawings are included in **Appendix A**.

factor (but still higher than minimum requirements) extended from near the base of the excavation slope to about 50 feet outside the excavation crest.

- The period of time during which a deep-seated slope failure of this type is conceivable is very brief, likely only a few months in duration, since waste disposal in Trench 13 will begin to buttress the excavation slope, and increase safety factors, as soon as the first waste is placed against the base of the south trench side slope.

## 2.4 RUN-ON/RUN-OFF CONTROL

### 2.4.1 During Operations

The facility is located on a rise in the desert valley floor formed by an alluvial fan. This rise extends up-valley from the facility approximately 4.1 miles, forming an upstream drainage basin area of about 1.7 square miles. Drainage from the remainder of the desert and surrounding mountains is provided by the normally dry Amargosa River channel and natural drainage swales in the desert, and would not impact the facility during a 100-year storm event.

The Trench 13 design documents include measures to manage stormwater run-on and run-off during construction, disposal operations, and after final closure. Stormwater control features are included on **Drawings 012, 014**, **015**, **016**, and **019**. The berms, channels, and a basin prevent run-on from areas outside the Trench 13 foot print and direct runoff from the perimeter of an active Phase of Trench 13 to natural or enhanced drainage channels outside of the facility boundaries.

Stormwater management features for Trench 13 include channels north and east of Trench 13 and a berm along the western portion of Trench 13. The channel on the north and eastern limits of Trench 13 will include a 12 foot wide base with 3H:1V side walls. The channel is designed to collect and transport the majority of stormwater run-off from the USEN facility, and has a carrying capacity greater than a 100-year, 24-hour precipitation event.

A berm will be used on the western limits of Trench 13 to prevent run-on into the disposal cell from adjacent property to the west. Both the channel and berm direct stormwater to natural channels just prior to discharge off-site.

Stormwater falling inside the trench during disposal operations will be managed appropriately inside the trench as leachate or will be managed outside the trench as a waste. There are no situations where leachate would be allowed to enter surface water outside the trench.

### 2.4.2 Post-Closure

With regard to surface-water management, the final cover will prevent run-on from areas outside the final cover footprint from affecting the final cover or covered waste. The final cover design incorporates measures intended to manage stormwater run-off from the cover and control cover material erosion.

The orientation of the final cover of Trench 13 is such that the majority of stormwater run-off will be channelized and directed into on-site channels discussed in Section 2.4.1.

## 2.5 SURFACE FACILITIES MODIFICATIONS

### 2.5.1 Facilities Relocation

No facility relocations are anticipated as part of Trench 13 construction or operation.

### 2.5.2 Monitor Well Abandonment

Monitor Well MW-327 is located within the footprint of Trench 13 Phase E. At the time of Phase E construction, the well will be properly abandoned in accordance with regulatory requirements or replaced. To prevent future issues with the foundation of Trench 13, the monitoring well will be plugged and abandoned with a neat cement grout backfill in accordance with specifications included in **Appendix B**, Section 5.3. Groundwater monitoring and management is further discussed in Appendix 7 of the Trench 13 Engineering Report.

### 2.5.3 Temporary Fence Relocation

Trench 13 construction, including surface soil improvement, anchor trench excavation, and liner construction, will require earthmoving equipment traffic to pass close to the south boundary of current facility operations (i.e., the container management areas and areas associated with closed Trench 11). In these areas, it might be necessary that construction equipment temporarily cross the area boundaries that are marked by fencing. Temporary boundary fence relocation will be done in a manner that does not reduce facility security or permanently impact the final covers of Facility disposal sites. The boundary fence, along with appropriate signage, will be relocated to the correct HWMF boundary following completion of Trench 13 excavation and liner construction.

# 3. RESPONSIBILITY AND AUTHORITY

The following paragraphs generally outline the areas of responsibility and lines of authority for each organization involved in Trench 13 construction. This section is intended to establish the necessary lines of communication and the decision-making process for the execution of construction within the guidelines of this CQA Plan.

## 3.1 PERMITTING AGENCIES

The Nevada Department of Conservation and Natural Resources, Division of Environmental Protection (NDEP) is authorized by law to issue a permit for the construction of a hazardous waste management facility. The Permitting Agency (or State) has the responsibility and authority to review and accept or reject any design revisions or requests for variance that are submitted by USEN after the permit is issued. The agency also has the responsibility and authority to review all CQA documentation during or after facility construction to confirm that the facility was constructed in accordance with the facility operating permit.

In addition, USEN is authorized by U.S. EPA to store and dispose of PCB wastes. The U.S. EPA Administrator delegated authority to issue Approvals under TSCA to the Regional Administrator of Region 9 by U.S. EPA Delegation Order 12-5 issued January 9, 2008. The Regional Administrator further delegated authority to issue Approval to the Director of the Waste Management Division by U.S. EPA Regional Order 1260.02D issued February 11, 2008.

## 3.2 OPERATOR

USEN is responsible for the operation of the HWMF. The Operator has the authority to select and dismiss organizations charged with construction and quality assurance activities. The Operator also has the authority to accept or reject reports and recommendations of the CQA Officer and the materials and workmanship of the contractor. The Operator will also provide a Project Manager who will be responsible for coordinating and scheduling construction activities. The construction supervisor will keep the Project Manager and Project Engineer informed of the construction progress.

## 3.3 PROJECT MANAGER

The Project Manager is responsible for the design and construction of the Trench 13 disposal area at the Beatty facility. This responsibility includes assuring the Permitting Agencies, by arranging for submission of CQA documentation, that the disposal area is constructed as specified in an approved design. The Operator and Project Manager have the authority to select and dismiss organizations charged with CQA and construction activities. The Project Manager also has the authority to accept or reject design plans and specifications, CQA Plans, reports and recommendations of the CQA Officer, and the materials and workmanship of any contractors.

## 3.4 PROJECT ENGINEER

USEN may retain the services of one or more Project Engineer(s) for the design and construction of Trench 13. Each designated Project Engineer will be a registered professional engineer in the State of Nevada. The Project Engineer is responsible for designing a hazardous waste land disposal facility that fulfills the operational requirements of the facility and the performance requirements of the Permitting Agency. Design activities might not end until the facility is completed. The Project Engineer might be requested to change some component designs if unexpected site conditions are encountered or changes in construction methodology occur that could adversely affect facility performance.

Additional responsibility and authority can be delegated to the Project Engineer by the expressed consent of the Project Manager. Additional responsibility and authority may include formulating and implementing a site-specific CQA Plan, periodic review of CQA documentation, modifying construction site activity, and specifying specific corrective measures in cases where deviation from the specified design or failure to meet design criteria, plans, and specifications is detected by CQA personnel.

## 3.5 CONSTRUCTION QUALITY ASSURANCE CONTRACTOR

### 3.5.1 CQA Officer

The CQA Officer is the firm or individual responsible for observation, testing, and documentation of the activities related to construction quality assurance during the installation of the various materials, soil, and geosynthetics associated with the project. The CQA Officer also is responsible

for issuing a final report to the Operator summarizing the observations and testing performed during the construction process, and certifying that the facility was constructed in accordance with the project specifications.

### 3.5.2 CQA Personnel

The overall responsibility of the CQA personnel is to perform those activities specified in the CQA Plan (e.g., inspection, sampling, and documentation). At a minimum, CQA personnel will include a CQA Officer and the necessary supporting CQA personnel. The CQA Officer will report to the Project Manager. The specific responsibilities and authority of each of these individuals are defined in the CQA Plan and in the associated contractual agreements with USEN. Specific responsibilities of the CQA Officer include:

- Reviewing design criteria, plans, and specifications for clarity and completeness so that the CQA Plan can be implemented, and documenting their review;
- Educating CQA personnel on CQA requirements and procedures;
- Scheduling and coordinating CQA inspection activities, including surveying and quality control checks;
- Reviewing survey data to assure that construction is proceeding in accordance with the design plans;
- Directing and supporting CQA personnel in performing observations and tests by:
    - Confirming that the equipment is uniquely identified and the calibration of measuring and testing equipment is conducted, recorded properly, and the calibration status is indicated;
    - Confirming that the testing equipment, personnel, and procedures do not change over time or making sure that any changes do not adversely impact the inspection process;
    - Confirming that the test data are accurately recorded and maintained (this may involve selecting reported results and backtracking them to the original observation and test data sheets);
    - Verifying that the raw data are properly recorded, validated, reduced, summarized, and interpreted.
- Providing to Project Manager and Project Engineer daily reports on the inspection results including:

- Identification of work that the CQA Officer believes should be accepted, rejected, or uncovered for observation, or that may require special testing, inspection, or approval;
- Rejection of defective work and written verification that corrective measures are implemented;
- Verifying that a contractor's performance is in accordance with the project specifications;
- Reporting to the Project Managers immediately, any work that is not in compliance with the plans and specifications if corrective measures are not being taken; and
- Reporting to the contractor results of all observations and tests as the work progresses and verifying that they are in conformance with the specified acceptance criteria;

- For the supporting CQA personnel, specific responsibilities may include:
  - Performing independent on-site inspection of the work-in-progress to assess compliance with the facility design criteria, plans, and specifications;
  - Verifying that the equipment used in testing meets the test requirements and that the tests are conducted according to the standardized procedures defined by the CQA Plan; and
  - Reporting to the CQA Officer results of all inspections including work that is not of acceptable quality or that fails to meet the specified designs.

### 3.5.3 Quality Assurance Laboratory

The Quality Assurance Laboratory (or laboratories) is a party, independent from the Operator, Manufacturer, fabricator, transporter and Installer, responsible for conducting tests on samples of the various geosynthetic materials and/or soil obtained from the site. The Quality Assurance Laboratory may be from the same firm as the CQA Officer.

## 3.6 CHIEF SURVEYOR

The Chief Surveyor will be responsible for assisting the Project Engineer with project layout, survey control, cross-sections and as-built drawings. The Chief Surveyor will assist the Project Engineer with information necessary for the Project Engineer or CQA Officer to certify that the facility was constructed to the lines and grades indicated on the as-built drawings. The CQA

Officer in concurrence with the Project Manager will ensure that the required surveying is performed for verification of compliance with the plans and specifications.

## 3.7 EARTHWORK CONTRACTOR

The Earthwork Contractor is the firm responsible for disposal area construction, placement of excavated soil as directed, and placement and compaction of soil fill. The Earthwork Contractor will store equipment and materials in a manner that does not interfere with access to the facility or permanently impact areas not included in the USEN leased property.

## 3.8 GEOSYNTHETIC MATERIAL MANUFACTURERS

### 3.8.1 Geomembrane Manufacturer

The Manufacturer is responsible for the production of geomembrane. If required by contract, the Manufacturer also may be responsible for the fabrication and/or the transportation of the geomembrane rolls between the manufacturing facility and the fabricator and/or the site.

### 3.8.2 Geotextile Manufacturer

The Manufacturer is responsible for the production of geotextile rolls. If required by contract, the Manufacturer also may be responsible for the transportation of the geotextile rolls between the manufacturing facility and the site.

### 3.8.3 Geocomposite/Geonet Manufacturer

The Manufacturer is responsible for the production of geocomposite and geonet. If required by contract, the Manufacturer also may be responsible for the fabrication and/or the transportation of the geocomposite/geonet rolls between the manufacturing facility and the fabricator and/or the site.

### 3.8.4 Geosynthetic Clay Liner (GCL) Manufacturer

The Manufacturer is responsible for the production of the GCL from granulated bentonite and geotextile rolls. If required by contract, the Manufacturer also may be responsible for the transportation of the GCL between the manufacturing facility and the site.

Throughout the remainder of this document the word "Manufacturer" will be used generically in reference to the respective geomembrane, geotextile, geocomposite/geonet, or GCL Manufacturer.

## 3.9 GEOMEMBRANE FABRICATOR

The Geomembrane Fabricator is responsible for the fabrication of geomembrane panels from geomembrane rolls. If required by contract, the Fabricator also may be responsible for transportation of the geomembrane panels to the site. The Fabricator and Manufacturer could be the same entity.

## 3.10 GEOSYNTHETIC MATERIALS INSTALLER

The Geosynthetic Materials Installer is responsible for the handling, storing, placing, seaming, temporary loading and other aspects of the geosynthetic material installation as required herein. The Geosynthetic Materials Installer is also responsible for submitting all quality control certificates to the Operator including, but not limited to, those from the geomembrane, geotextile, geocomposite, and GCL Manufacturer. The Installer will store equipment and materials in a manner that does not interfere with access to the facility or permanently impact the buffer zone.

# 4. CQA PERSONNEL QUALIFICATIONS

## 4.1 CQA OFFICER

The CQA Officer is the individual assigned singular responsibility for all aspects of the CQA Plan implementation. On a day-to-day basis, the CQA Officer reports to the Project Manager. The CQA Officer will possess adequate formal academic training in engineering, engineering geology, or closely associated disciplines and will possess sufficient practical, technical, and managerial experience to oversee successfully and implement construction quality assurance activities for hazardous waste management facilities. The CQA Officer will be expected to ensure that communication of all CQA-related matters is conveyed to and acted upon by the affected organizations. The CQA Officer will be a professional engineer registered in the State of Nevada.

## 4.2 CQA INSPECTION PERSONNEL

The CQA personnel will report to the CQA Officer. The CQA personnel will possess adequate formal training and sufficient practical, technical, and administrative experience to execute and record inspection activities successfully. This will include demonstrated knowledge of specific field practices relating to construction techniques used for hazardous waste management facilities, observation and testing procedures, equipment, documentation procedures and site safety.

## 4.3 CHIEF SURVEYOR

The Chief Surveyor will be land surveyor registered in the State of Nevada.

# 5. MEETINGS

## 5.1 PRE-BID MEETING

A pre-bid meeting will be held at the project site to allow all geosynthetic materials, earthwork, and other services/materials bidders the opportunity to preview the facility and the working conditions. The meeting will consist of a tour of the facility and the work area, followed by an overview of the work to be performed, the project schedule, and the project drawings and specifications.

## 5.2 PRE-CONSTRUCTION MEETING

A pre-construction meeting will be held on site prior to the start of the excavation and geosynthetic installation work. At a minimum, the Operator, the Project Engineer, the Installer, the Earthwork Contractor, and the CQA Officer will be in attendance.

The following topics will be addressed during this meeting.

- Construction methods and projected scheduling.
- Provide each party with all relevant documents and supporting information.
- Review the project plans and specifications, including addenda to this document, with each party.
- Familiarize each organization with this plan and its role relative to the design criteria, plans, and specifications.
- Determine any changes to this plan that are needed to ensure that the facility will be constructed to meet or exceed the specified design.
- Review methods for documenting and reporting inspection data.
- Review the responsibilities of each party.
- Review the lines of authority and communication with each party.
- Review work area security and safety protocol.
- Review the procedures for observation, testing, and documentation required of each party. This review will include a discussion of sampling and testing strategies.
- Review the methods for handling construction deficiencies, repairs, and re-testing.
- Review the methods for establishing pay quantities.

- Review the methods for distributing and storing material samples, documents and reports.
- Review the methods for the prevention of damage to the construction materials from inclement weather or other adverse events.
- Conduct a tour of the facility and the work area to review construction conditions and material and equipment storage locations.

The pre-construction meeting will be documented by the CQA Officer or other party designated at the beginning of the meeting. The minutes of the pre-construction meeting will become part of the official record of construction and will be transmitted to all appropriate parties.

## 5.3 WEEKLY PROGRESS MEETINGS

Progress meetings will be held at the work area on a regular basis unless otherwise specified by the Project Manager, at a minimum of once per week, with representatives of the Operator, Earthwork Contractor (during earth work construction), and CQA Officer and the Installer (during geosynthetic materials installation work) in attendance. The purpose of the meetings will be to address the following:

- Review the progress of the work and the overall project schedule;
- Review the work activities and locations since the last meeting and subsequent to the next meeting;
- Discuss unresolved construction deficiencies;
- Discuss potential problem areas; and
- Review recent observations and test data.

The progress meetings will be documented by the CQA Officer or the Project Manager. The meeting minutes will become part of the official construction record and will be transmitted to the Project Manager, Project Engineer and to all appropriate parties.

## 5.4 CONSTRUCTION PROBLEM OR WORK DEFICIENCY MEETING

A special meeting will be held when and if a problem or deficiency is present or is likely to occur. As a minimum, the problem or work deficiency meeting will be attended by the impacted parties, as appropriate, and the CQA Officer. If the problem requires a design clarification or modification, the Project Engineer will be consulted.

The problem or work deficiency meeting will address the following:

- Define and discuss the problem or deficiency or the potential for one to occur;
- Review the potential solutions and the pros and cons associated with each;
- Determine a course of action and notify the appropriate parties of such; and
- Implement a corrective action plan to resolve the problem or deficiency or prevent one from occurring.

The problem or work deficiency meeting will be documented by the CQA Officer. The meeting minutes will become part of the official construction record and will be transmitted to all appropriate parties. Documentation of the problem or deficiency is described in detail in **Section 6.5**.

# 6. DOCUMENTATION

## 6.1 PRE-CONSTRUCTION SUBMITTALS

After award and at least one week prior to commencement of the work, the appropriate party will submit the following information to the Project Manager.

### 6.1.1 Geomembrane Manufacturer

The Manufacturer will provide a detailed description of quality control procedures for the manufacturing and testing of the geomembrane including, but not limited to, the following:

- Geomembrane sampling and testing frequencies and procedures;
- Explanation of the geomembrane roll numbers, lot numbers, and/or batch numbers;
- A copy of each of the quality control certificates issued for the specific material to be utilized on this project;
- A copy of each of the geomembrane Manufacturers' quality assurance testing methods and results of tests conducted on the material manufactured for this project;
- A copy of the geomembrane Manufacturer's roll quality control certificates. These will be supplied at a minimum frequency of one per every 50,000 square feet of' geomembrane material produced and supplied to this project and will indicate conformance with each of the properties listed in **Appendix B**. These certificates will be issued only for the actual geomembrane rolls sampled and tested by the geomembrane Manufacturer or his representative; and
- A list of actual property values for comparison to specifications for the geomembrane material being procured for this project.

The Operator reserves the right to visit the geomembrane manufacturing facility at any time, particularly during production of materials specifically produced for this project. The Operator reserves the right to refuse use of any geomembrane supplied without the proper quality control documentation.

### 6.1.2 Geomembrane Fabricator

The Fabricator will provide a detailed description of quality control procedures for the fabrication and testing of fabricated geomembrane panels including, but not limited to, the following:

- Fabricated geomembrane roll seam sampling and testing frequencies and procedures;

- Explanation of the geomembrane roll numbers and panel numbers; and
- A copy of the geomembrane fabricator's roll quality control certificates. These will be supplied at a minimum frequency of one per every 50,000 square feet of geomembrane material fabricated and supplied to this project and will indicate conformance with each of the properties listed in **Appendix B**. These certificates will be issued only for the actual geomembrane rolls sampled and tested by the geomembrane fabricator or his representative.

The Operator reserves the right to visit the fabricating facility at any time, particularly during fabrication of materials produced for this project. The Operator reserves the right to refuse use of any fabricated product without the proper quality control documentation.

### 6.1.3 Geotextile Manufacturer

The Manufacturer will provide a detailed description of quality control procedures for the manufacturing and testing of the geotextile including:

- Geotextile sampling and testing frequencies and procedures;
- Explanation of the geotextile roll numbers, lot numbers, and/or batch numbers;
- A copy of each of the quality control certificates issued by the resin supplier for the specific material to be utilized on this project;
- A copy of each of the geotextile Manufacturer's quality assurance testing methods and results for the resin utilized in manufacturing the material for this project;
- A copy of the geotextile Manufacturer's roll quality control certificates. These will be supplied at a minimum frequency of one per every 50,000 square feet of geotextile material produced and supplied to this project and will indicate conformance with each of the properties listed in **Appendix B**. These certificates will be issued only for the actual geotextile, rolls sampled and tested by the geotextile Manufacturer or his representative; and
- A detailed list of minimum property values for the geotextile material being produced for this project.

The Operator reserves the right to visit the fabricating facility at any time, particularly during fabrication of materials produced for this project. The Operator reserves the right to refuse use of any fabricated product without the proper quality control documentation.

### 6.1.4 Geocomposite/Geonet Manufacturer

The Manufacturer will provide a detailed description of quality control procedures for the manufacturing and testing of the geocomposite including, but not limited to, the following.

- Geocomposite/geonet sampling and testing frequencies and procedures;
- Explanation of the geocomposite/geonet roll numbers, lot numbers, and/or batch numbers;
- A copy of each of the quality control certificates issued for the specific material to be utilized on this project;
- A copy of each of the geocomposite/geonet Manufacturers' quality assurance testing methods and results of tests conducted on the material manufactured for this project;
- A copy of the geocomposite/geonet Manufacturer's roll quality control certificates. These will be supplied at a minimum frequency of one per every 50,000 square feet of' geocomposite/geonet material produced and supplied to this project and will indicate conformance with each of the properties listed in **Appendix B**. These certificates will be issued only for the actual geocomposite/geonet rolls sampled and tested by the geocomposite/geonet Manufacturer or his representative; and
- A detailed list of minimum property values for the geocomposite/geonet material being produced for this project.

The Operator reserves the right to visit the geocomposite/geonet manufacturing facility at any time, particularly during production of materials specifically produced for this project. The Operator reserves the right to refuse use of any geocomposite/geonet supplied without the proper quality control documentation.

### 6.1.5 Geosynthetic Clay-Liner Manufacturer

The Manufacturer will provide a detailed description of quality control procedures for the manufacturing and testing of the geosynthetic clay liner (GCL) including, but not limited to, the following.

- GCL sampling and testing frequencies and procedures;
- Explanation of the GCL roll numbers, lot numbers, and/or batch numbers;
- A copy of each of the quality control certificates issued by the supplier for the specific material (bentonite and geotextile) to be utilized on this project;
- A copy of each of the GCL Manufacturer's quality assurance testing methods and results for the materials utilized in manufacturing the liner for this project;
- A copy of the GCL Manufacturer's roll quality control certificate signed by a responsible

party of the GCL Manufacturer and indicating conformance with the material properties specifications provided in **Appendix B**. These certificates will be issued only for the actual GCL rolls sampled and tested by the GCL Manufacturer or his representative. Each quality control certificate will include roll identification numbers and results of quality control tests; and

- A detailed list of minimum property values for the GCL material being produced for this project.

The Operator reserves the right to visit the fabricating facility at any time, particularly during fabrication of materials produced for this project. The Operator reserves the right to refuse use of any fabricated product without the proper quality control documentation.

### 6.1.6 Installer

The Installer will provide the following information:

- A quality control manual for the installation, seaming, repairing and testing of geomembrane;
- A detailed installation schedule for the project including, but not limited to, installation activities and dates and/or durations of the various activities;
- Chemical and ultra-violet resistance properties of the polymeric thread to be used in sewing geotextiles;
- Quality control certification for the extrudate material to be utilized on this project. The certification will include identification of the results of testing for, as a minimum, specific gravity and melt index; and
- A detailed geomembrane panel layout drawing or drawings. The drawing(s) submitted will be of sufficient size and detail to distinguish the geomembrane panels and various features of the cell. The Operator reserves the right to reject any drawings submitted and/or request additional information to be submitted to satisfy the intent of this specification.

The Installer will be responsible for obtaining and submitting the geosynthetic materials information outlined in **Section 6.1**.

## 6.2 DAILY RECORDKEEPING

A summary report with supporting inspection data sheets will be prepared daily by the CQA Officer. This report provides the chronological framework for identifying and recording all other reports. At a minimum, the summary reports will include the following information:

- Unique identifying sheet number for cross-referencing and document control;

- Date, project name, location, and other identification;
- Data on weather conditions;
- Reports on any meetings held and their results;
- Equipment and personnel being worked in each location, including subcontractors;
- Descriptions of areas being inspected and documented;
- Description of off-site materials received, including any quality verification (vendor certification) documentation;
- Descriptions of materials incorporated into cell construction;
- Calibrations, or re-calibrations, of test equipment, including actions taken as a result of re-calibration;
- Decisions made regarding approval of units of material and/or corrective actions to be taken in instances of substandard quality;
- Unique identifying sheet numbers of inspection data sheets and/or problem reporting and corrective measures reports used to substantiate the decisions described in the preceding item; and
- Signature of the CQA Officer.

An example of a typical Construction Quality Assurance Daily Report is included as **Table CQA 1**.

## 6.3 INSPECTION DATA SHEETS

All observations, and field and/or laboratory tests, will be recorded on an inspection data sheet. Typical sheets are included as **Tables CQA 2** and **CQA 3**.

At a minimum, the inspection data sheets will include the following information:

- Unique identifying sheet number for cross-referencing and document control;
- Description or title of the inspection activity;
- Location of the inspection activity or location from which the sample increment was obtained;
- Type of inspection activity; procedure used (reference to standard method when appropriate);
- Recorded observation or test data, with all necessary calculations;
- Results of the inspection activity; comparison with specification requirements;
- Personnel involved in the inspection activity; and

- Signature of the appropriate CQA personnel and concurrence by the CQA Officer.

## 6.4 LINER INSTALLATION SUBMITTALS

The Installer will submit the following information to the CQA Officer or Project Manager during the installation process.

- Daily reports detailing the names of personnel and their arrival and departure times, the progress of the work, the arrival of material on site, and any problems encountered.
- Signed subgrade acceptance certificates for each of the areas prior to that area being covered by the geomembrane.
- Quality control documentation for the various installation functions as required by this document.

## 6.5 CONSTRUCTION PROBLEM IDENTIFICATION AND CORRECTIVE MEASURES REPORTS

A problem is defined herein as an actual physical condition that is in some way significantly different or inconsistent with a project design feature, or an instance of material or workmanship that does not meet the specified design. As appropriate, Construction Problem Identification and Corrective Measures Reports will be cross-referenced to specific inspection data sheets where the problem was identified. A typical sheet is included as **Table CQA 4**. At a minimum, they will include the following information:

- Unique identifying sheet number for cross-referencing and document control;
- Detailed description of the problem;
- Location of the problem;
- Results of QA Inspection and Tests, Deficiencies Observed, Actions Taken, and Corrective action of Contractor
- Verbal Instructions Given;
- Controversial Matters in Detail/Disagreements;
- Final results/ Resolution/Correct Action;
- Remarks; and
- Signature of the appropriate CQA personnel and concurrence by the CQA Officer.

Upon receiving the CQA Officer's written concurrence, copies of the report will be sent to the Project Engineer for his comments and acceptance.

## 6.6 ACCEPTANCE OF COMPLETED COMPONENTS

All daily inspection summary reports, inspection data sheets, and problem identification and corrective measures reports, will be reviewed by the CQA Officer.

Upon completion of construction, the Project Manager or his designated representative and the CQA Officer will visit the facility for a final inspection of the completed disposal unit for compliance with the design. An inspection report will be prepared by the CQA Officer outlining the results of the inspection and any corrective measures deemed necessary to correct deficiencies. Documentation of corrective measures will be attached to the inspection report once corrective measures are completed (see **Table CQA 4**).

## 6.7 PROJECT COMPLETION SUBMITTALS

Within two weeks following completion of the project the Installer will supply the following:

- Geomembrane installation certification.
- A warranty obtained from the geomembrane Manufacturer and the geomembrane Fabricator.
- A warranty for the installation of the geosynthetic materials. The warranty will cover installation-related defects for a period not less than one year following completion of the installation.

The CQA Officer will submit a final certification report in accordance with **Section 6.8** within 30 days of completion of cell construction.

## 6.8 FINAL DOCUMENTATION

Within 30 days following completion of each Phase of construction, a final certification report must be submitted by the CQA Officer to the Project Manager. The final certification report will include descriptions of each Phase of construction, construction materials, and quality assurance procedures. As a minimum, the following information will be included:

- Daily inspection summary reports;
- Laboratory and field test results summary sheets for all testing required by this plan;
- Problem identification and corrective measures reports;

- Acceptance reports;
- Design clarification forms;
- QA/QC submittals for geosynthetic materials;
- Minutes of pre-construction meetings and weekly meetings;
- Geomembrane repair summaries; and
- As-built drawings.

Inspection data sheets will be retained as backup. This document must include certification of each construction component by the CQA Officer responsible for that Phase of construction. This certification must be signed by a professional engineer registered in the State of Nevada. This report will be reviewed by the Operator and submitted to the Permitting Agency.

# 7. CONSTRUCTION SEQUENCE AND CQA PROCEDURES

## 7.1 CONSTRUCTION SEQUENCE

The design of Trench 13 was developed to facilitate construction of the landfill in five Phases. At the time of preparation of this CQA Plan the intent is to begin with the easternmost portion of the Trench as the initial Phase, and a progression of development from east to west. If the easternmost portion of Trench 13 is constructed as the initial landfill Phase, construction staging will likely occur to the west of that Phase. As such, a portion of the adjoining Phase at each stage of development will require excavation to facilitate construction and operational traffic routes "into" and "out of" the active Trench Phase. If necessary, this progression could be altered and started on the western portion of the Trench as the initial Phase, and a progression of development from the west to east.

Construction and disposal operations will be closely coordinated to maintain continuous disposal operations and construction schedules. The basic construction sequence for each Trench 13 below-grade construction phase are expected to be as follows.

1. Relocate fences in the construction area, if necessary.
2. Provide temporary stormwater, erosion and sediment control. Operator or Earthwork Contractor will file a Notice of Intent with the EPA for each phase of landfill construction and implement an approved Storm Water Pollution Prevention (SWPP) Plan to address the temporary construction conditions.
3. Excavate non-cohesive surface soil around the perimeter of the construction area. Replace with compacted soil.
4. Excavate to final depth, incorporating LDS riser trenches (also herein called 'recesses') into the sidewall above the sumps as excavation progresses. Construction access ramps likely will enter the trench from the east (in subsequent Phases).
5. Construct subgrade with 9 inches (minimum) of compacted soil on floor bottom.
6. Construct LDS and LCRS Sumps with 36 inches of prepared subgrade. Amend prepared subgrade with Portland cement in the vicinity of the LDS sump and along sidewalls to improve constructability.
7. Excavate liner anchor trench if not completed during surface recompaction.

8. Install sidewall liner components
9. Install trench floor and sump liner and LDS/LCRS components.
10. Submit required construction completion documentation and obtain NDEP approval for disposal of waste.

Above-grade waste placement will commence when waste disposal in specific portions (e.g., Phase 13A area) reaches original ground level. The basic sequence for the Trench 13 above-grade waste placement and final cover placement are expected to be as follows.

1. Dispose waste in Trench 13 above-grade area with careful elevation control, installing protective interim containment berm, maintaining internal drainage in active arears, and placing at least one foot of interim cover soil on the exterior edges of the waste surface.
2. Continue waste, protective interim containment berm, and interim cover placement until the waste elevations shown on **Drawing 011** are reached (note that elevations on the drawing are waste elevations, excluding interim cover).
3. Confirm that waste elevations are appropriate for final cover placement, regrade waste as necessary.
4. Place soil cover component layers to complete the final cover.

## 7.2 CONSTRUCTION SPECIFICATIONS AND PROCEDURES

Material and construction specifications and installation procedures for all components of Trench 13 below-grade and above-grade construction are provided in **Appendices B** and **C**. A summary of the specifications and procedures is provided below.

### 7.2.1 Earthwork

The below-grade portion of Trench 13 is designed with five Phases. The excavation requirement is that the total depth of the trench will be about 75 feet below grade. The slopes will be constructed at 0.5H:1.0V. The walls will be smoothed (or masked, as discussed in **Appendix C, Section 3.4.1**) during excavation to remove protruding rocks and reduce depressions. Earthwork material specifications are include in **Appendix B**, **Section 3**.

### 7.2.2 Liner Placement

#### 7.2.2.1 GCL Installation Procedure

The procedures that are to be followed to install the GCL are provided in **Appendix C**, **Section 5**, as cited below.

- **Section 5.2**: Inspection of subgrade for material that could damage the GCL, and removal of such material.
- **Section 5.3**: GCL placement, and procedures for protection of the GCL material before and during placement of material on the GCL.
- **Section 5.4**: Techniques to bond GCL seams.

#### 7.2.2.2 Geocomposite and Geonet Installation Procedure

Procedures to be followed to install geocomposite and geonet layers are provided in the various specifications in **Appendix C**, as identified below.

- Sections 6.1, 6.2 and 6.3: Geocomposite and geonet layers placement, and procedures for protection of the geocomposite and geonet layers material before and during placement of other material on top of these materials.
- Section 6.4: Techniques to bond geocomposite and geonet layers seams and to ensure continuity of flow.
- Sections 6.5 and 6.6: Techniques to repair damaged geocomposite and geonet layers, and to cover installed materials.

#### 7.2.2.3 Geomembrane Installation Procedure

Procedures to be followed to install geomembranes are provided in the various specifications in **Appendix C**, as cited below.

- **Section 7.2**: Inspection of geomembrane bed for material that could puncture the geomembrane, and removal of such material.
- **Section 7.3**: Geomembrane placement, and procedures for protection of the geomembrane material before and during placement of material on the geomembrane.
- **Section 7.4**: Techniques to bond geomembrane seams.
- **Section 7.6**: Methods to be employed for repair of the liner system components.

#### 7.2.2.4 Geotextile Installation Procedure

Procedures to be followed to install geotextile layers are provided in the various specifications in **Appendix C**, as identified below.

- Section 8: Procedures to be followed to install geotextiles.

### 7.2.3 Procedure for Confirming Line and Grade

The procedure to be followed to confirm, by surveying methods, the line and grade of soil construction and waste placement is provided in **Appendix C**, **Section 2**.

### 7.2.4 Quality Control Procedures

The QC procedures to be followed by USEN for all aspects of Trench 13 construction are incorporated into the specifications included in this section and **Appendix C**.

**Table CQA 1**
**Construction Quality Assurance Daily Report**

**Daily Report No.:_____Prepared By:_____Date:_____**

| | | |
|---|---|---|
| **Weather Conditions:** | | |
| **Work Summary:** | | |
| **Health and Safety**<br>Daily Safety Topic:<br><br>Hazards Identified/Mitigation Taken: | | |
| | **Personnel and Equipment** | **Work Performed** |
| **Earthwork** | | |
| **Liner and geotextile** | | |
| **Surveying** | | |

| | | |
|---|---|---|
| **CQA** | | |
| **Others** | | |

| | |
|---|---|
| **Meetings Held** (cross reference to meeting notes) | |
| **Meeting 1**<br>**Purpose**<br>**Attendees**<br>**Results** | **Meeting 2**) |

| | | |
|---|---|---|
| **CQA Inspections Conducted**<br>**<u>Type</u>** | **<u>Location</u>** | **<u>Results</u>** |

| | |
|---|---|
| **Materials Received On Site** | **Quality Documentation Provided** |
| **Construction Materials Used** (item and location) | **Equipment Calibrated** |

| | |
|---|---|
| **Corrective Action Taken** | **Results** (see Corrective Measure Report) |

| |
|---|
| **Other Notes for This Daily Report** |
| **CQA Signature** |

Table CQA 1

**Table CQA 2: Lift Control Requirements**

**Inspection Sheet Number: _____Location: _____**

**Date: _____**

| Item | Specifics | Inspector |
|---|---|---|
| **EQUIPMENT USED** | | |
| Type | | |
| Configuration | | |
| Weight | | |
| **PASSES PER LIFT** | | |
| Lift Number | | |
| **MOISTURE CONTENT** | | |
| Adjustment Method Used | | |
| Equilibration Time | | |
| Quantity of Water Used | | |
| **LIFT THICKNESS** | | |
| Loose (inches) | | |
| Compacted (inches) | | |
| **LIFT PLACEMENT** | | |
| Start Time | | |
| Finish Time | | |
| Observation Start/Complete | | |
| **GENERAL OBSERVATIONS** | | |

**Table CQA 3: Sample / Test Locations Report**

**Inspection Sheet Number:** _____ **Location:** _____

**Date:** _____

| Sample Type | Location | Time Collected | Collectors Initials | Pass / Fail | CQAO Approval | Comments |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
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| | | | | | | |

| Field Analyses | Test Method | Requirement |
|---|---|---|
| DN = Density (nuclear) | ASTM D6938 | every 2,000 $yd^3$ |
| DS = Density (sand cone) | ASTM D1556 | every 10 DN samples |
| MN = Moisture (nuclear) | ASTM D6938 | every 2,000 $yd^3$ |
| Laboratory Analyses | | |
| MO = Moisture (oven dry) | ASTM D2216 | every 10 MN samples |

**Table CQA 4: Construction Problem Identification and Corrective Measures Report**

**Corrective Measures Report Number: _____ Date: _____**

**Inspection Sheet Number: _____ Date: _____**

| | | | |
|---|---|---|---|
| Inspection Problem | | | |
| QA Inspection Location and Construction Activity | | | |
| Result of QA Inspection and Tests, Deficiencies Observed, Actions Taken, and Corrective Action of Contractor | | | |
| Verbal Instructions Given to Contractor | | | |
| Controversial Matters in Detail/Disagreements | | | |
| Resolution/Corrective Action (retest, rework) | | | |
| Remarks | | | |
| Inspector's Signature | Date | CQA Officer Signature | Date |

# APPENDIX A

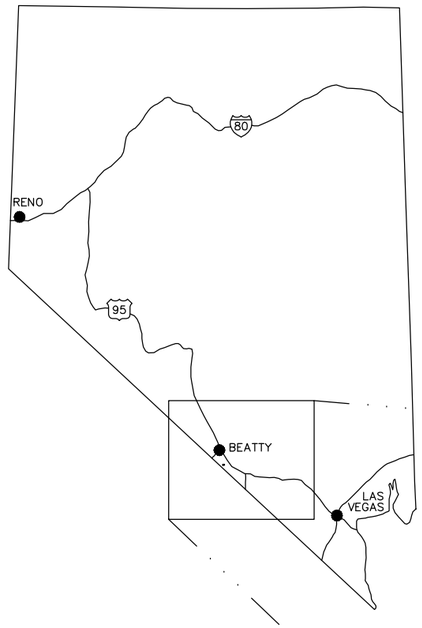
# TRENCH 13 DESIGN DRAWINGS

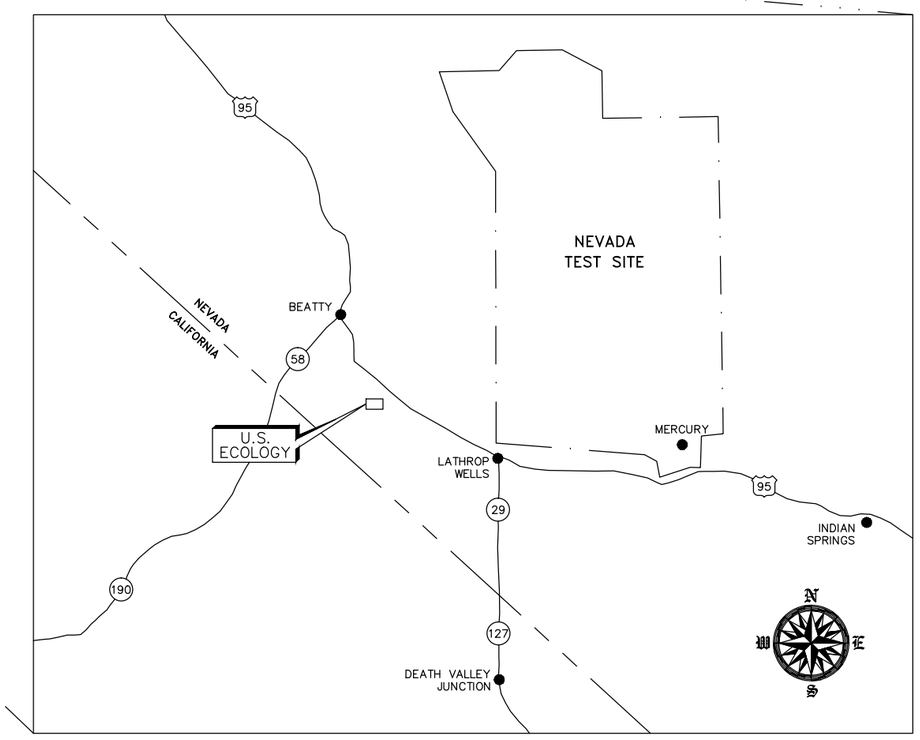
**DRAWINGS LIST**

| Drawing Number | Drawing Title |
|---|---|
| NV13-15-001 | Cover Sheet |
| NV13-15-002 | Site Plan |
| NV13-15-003 | Northern and Southern Horizontal Control Line |
| NV13-15-004 | Western and Eastern Horizontal Control Line |
| NV13-15-005 | Subgrade Excavation 1 of 2 |
| NV13-15-006 | Subgrade Excavation 2 of 2 |
| NV13-15-007 | Subgrade Profiles |
| NV13-15-008 | Liner Details |
| NV13-15-009 | LCRS/LDS Sump Details 1 of 2 |
| NV13-15-010 | LCRS/LDS Sump Details 2 of 2 |
| NV13-15-011 | Final Waste Grade – Plan View |
| NV13-15-012 | Final Cover – Plan View |
| NV13-15-013 | Final Cover Profiles |
| NV13-15-014 | Surface Water Management 1 of 3 |
| NV13-15-015 | Surface Water Management 2 of 3 |
| NV13-15-016 | Surface Water Management 3 of 3 |
| NV13-15-017 | Phase Construction |
| NV13-15-018 | Above-Grade Waste, Interim Protective Berm, and Cover Placement |
| NV13-15-019 | Final Cover Details |

# LANDFILL TRENCH 13 DESIGN
# HAZARDOUS WASTE MANAGEMENT FACILITY
# BEATTY, NEVADA

## RCRA FACILITY ID NO. NVT330010000
## HAZARDOUS WASTE PERMIT NUMBER NV HW0025




VICINITY MAP

20 10 0 20
SCALE MILES


PREPARED BY:

AquAeTer
optimizing resources | water, air, earth

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7430 EAST CALEY AVE
CENTENNIAL, CO 80111
(303)-771-9150

PROFESSIONAL ENGINEER-STATE OF NEVADA
CHRISTOPHER A. BOLIN
Exp. 12/31/16
ENVIRONMENTAL
PROFESSIONAL No. 023644

SWIFT RIVER ENVIRONMENTAL SERVICES, LLC

SWIFT RIVER ENVIRONMENTAL SERVICES, LLC
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LITTLETON, CO 80120
(303)-695-4660

PROFESSIONAL ENGINEER-STATE OF NEVADA
STEPHEN L. WAMPLER
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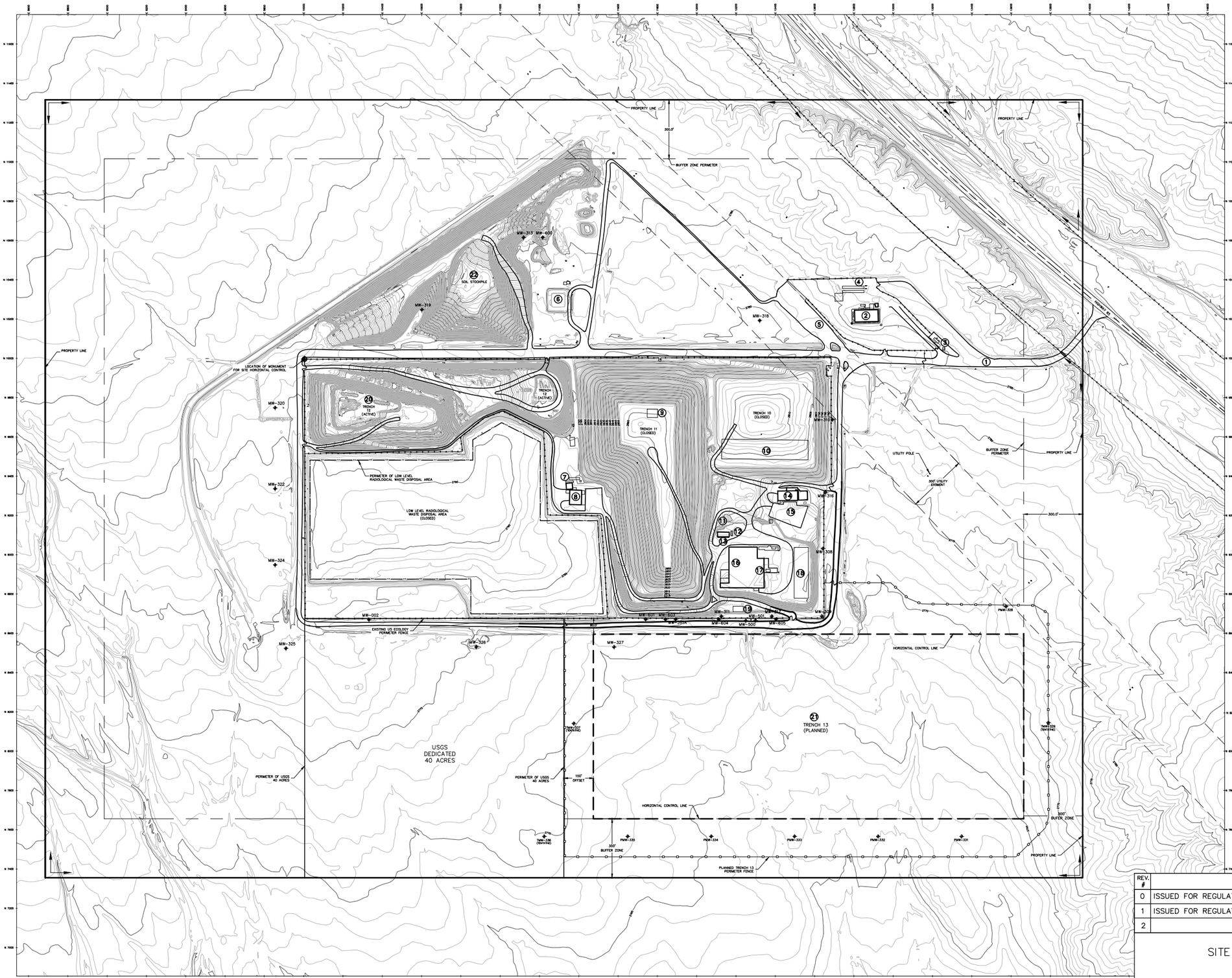
CIVIL
PROFESSIONAL No. 013641


INDEX OF DRAWINGS


| SHEET NUMBER | SHEET TITLE |
|---|---|
| NV13-15-001 | COVER SHEET |
| NV13-15-002 | SITE PLAN |
| NV13-15-003 | NORTHERN AND SOUTHERN HORIZONTAL CONTROL LINE |
| NV13-15-004 | WESTERN AND EASTERN HORIZONTAL CONTROL LINE |
| NV13-15-005 | SUBGRADE EXCAVATION 1 OF 2 |
| NV13-15-006 | SUBGRADE EXCAVATION 2 OF 2 |
| NV13-15-007 | SUBGRADE PROFILES |
| NV13-15-008 | LINER DETAILS |
| NV13-15-009 | LCRS AND LDS SUMP DETAILS 1 OF 2 |
| NV13-15-010 | LCRS AND LDS SUMP DETAILS 2 OF 2 |
| NV13-15-011 | FINAL WASTE GRADE PLAN VIEW |
| NV13-15-012 | FINAL COVER PLAN VIEW |
| NV13-15-013 | FINAL COVER PROFILES |
| NV13-15-014 | SURFACE WATER MANAGEMENT 1 OF 3 |
| NV13-15-015 | SURFACE WATER MANAGEMENT 2 OF 3 |
| NV13-15-016 | SURFACE WATER MANAGEMENT 3 OF 3 |
| NV13-15-017 | PHASE CONSTUCTION |
| NV13-15-018 | ABOVE-GRADE WASTE, PROTECTIVE BERM, AND FINAL COVER PLACEMENT |
| NV13-15-019 | FINAL COVER DETAILS |




1. MAIN SITE ENTRANCE
2. ADMINISTRATION OFFICE AND LABORATORY
3. SECURITY AND DRIVERS TRAILER
4. INBOUND AND OUTBOUND SCALES
5. PROFILING STATION
6. WATER STORAGE
7. FUEL STORAGE
8. MAINTENANCE SHOP
9. WEATHER STATION AND TRENCH 11 LYSIMETER
10. DRY HAZARDOUS WASTE STORAGE AREA 3
11. OUTDOOR TREATMENT PANS
12. REAGENT STORAGE SILOS
13. OPERATIONS OFFICE
14. PCB PROCESSING AREA AND STORAGE/PCB TANK FARM
15. REAGENT SOLIDS STORAGE
16. CONTAINER MANAGEMENT AND STORAGE BUILDING
17. INDOOR TREATMENT PANS
18. DRY HAZARDOUS WASTE STORAGE AREA 2
19. EVAPORATION TANK (TRUCK WASH PAD)
20. TRENCH 12 (ACTIVE)
21. TRENCH 13 (PLANNED)
22. SOIL STOCKPILE (SEE NOTE 6)

MW-316 EXISTING MONITORING WELL LOCATION
PMW-328 PLANNED MONITORING WELL LOCATION
TMW-328 TENTATIVELY PLANNED MONITORING WELL LOCATION
APPROXIMATE RADIOLOGICAL WASTE DISPOSAL PERIMETER
BUFFER ZONE PERIMETER
PROPERTY LINE
EXISTING FENCE
INTERNAL ROADWAYS
GATE
TRENCH 13 HORIZONTAL CONTROL LINE (LIMIT OF WASTE, SEE NOTE 5)
PLANNED TRENCH 13 PERIMETER FENCE
UTILITY POLE
TORTOISE FENCE FOLLOWS PROPERTY LINE OR US HIGHWAY 95 R.O.W. FENCE LINE BETWEEN DESIGNATED SYMBOLS

NOTES:
1. DATE OF AERIAL TOPOGRAPHY: 2014
2. HORIZONTAL CONTROL: SITE CORRDINATE SYSTEM
3. MONUMENT COORDINATES: 10,000 N – 10,000 E
4. ELEVATION: FEET (NORTH AMERICAN VERTICAL DATUM 1988)
5. THE HORIZONTAL CONTROL LINE IS THE FINAL HORIZONTAL LIMIT OF WASTE PLACEMENT FOR ALL PHASES OF TRENCH 13.
6. ADDITIONAL STOCKPILE LOCATIONS SHALL BE PROPOSED TO NDEP PRIOR TO EACH OF PHASE OF LANDFILL DEVELOPMENT

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
| 2 | | |

SITE PLAN

PROFESSIONAL ENGINEER - STATE OF NEVADA
STEPHEN J. WAMPLER
Exp 6/30/16
CIVIL
NO. 013641

US ecology

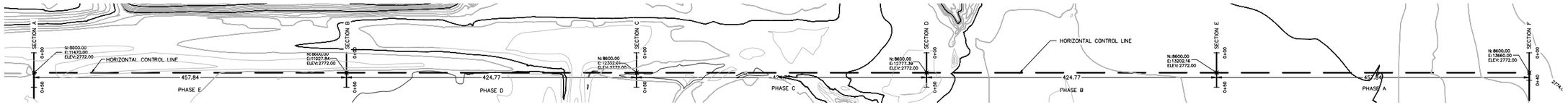
BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

PROJECT NUMBER: 143418

AquaTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| CWK | 1/27/15 | CAB | 3/25/15 | SLW | 10/12/15 | 1" = 250' |

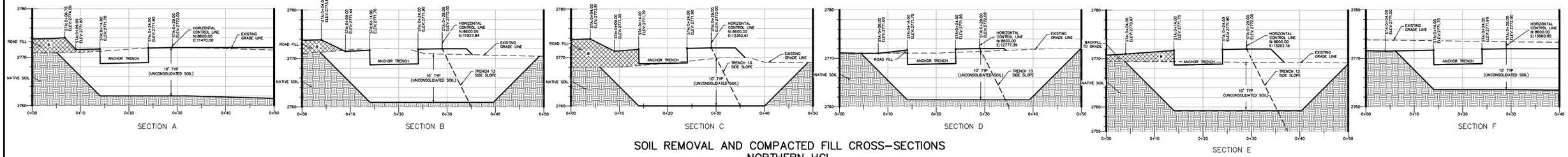
DRAWING NO: NV13-15-002




NORTHERN HORIZONTAL CONTROL LINE PLAN VIEW

80 0 80 160

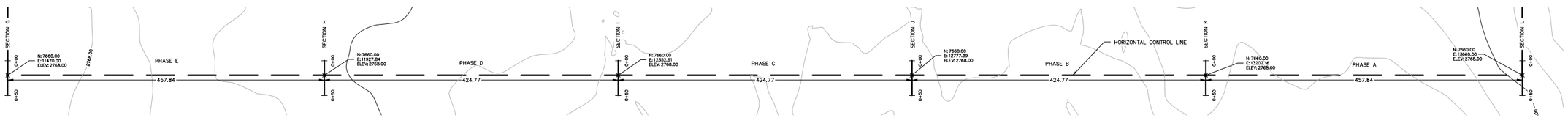
SCALE: 1"=80'




SOIL REMOVAL AND COMPACTED FILL CROSS-SECTIONS
NORTHERN HCL

10 0 10 20

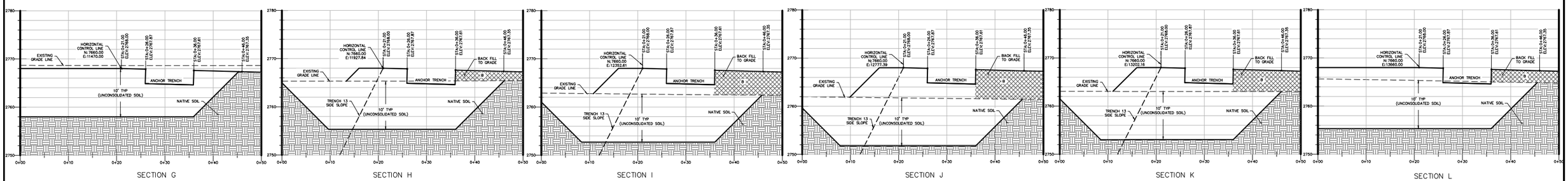
SCALE: 1"=10'




SOUTHERN HORIZONTAL CONTROL LINE PLAN VIEW

80 0 80 160

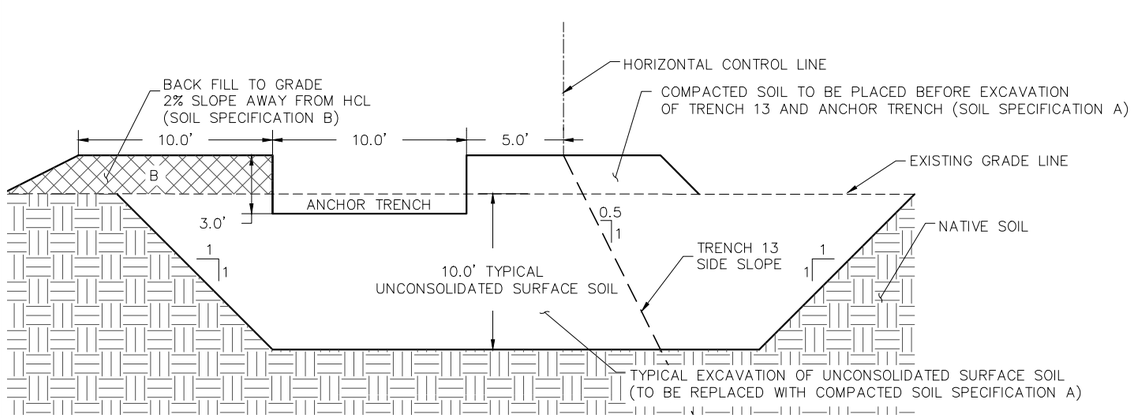
SCALE: 1"=80'




SOIL REMOVAL AND COMPACTED FILL CROSS-SECTIONS
SOUTHERN HCL

10 0 10 20

SCALE: 1"=10'




TYPICAL ANCHOR TRENCH AND SURFACE
SOIL REMOVAL/COMPACTED FILL DETAIL.
(N.T.S.)

NOTES:

1. LIMITS OF SURFACE SOIL REMOVAL AND REPLACEMENT ARE SHOWN AT A NOMINAL DEPTH OF 10 FEET BELOW EXISITNG GRADE. ACTUAL EXCAVATION DEPTH AND PLACEMENT OF COMPACTED FILL SHALL BE DETERMINED BY SITE-SPECIFIC CONDITIONS.
2. REMOVAL AND REPLACEMENT OF UNCONSOLIDATED SURFACE SOIL MUST INCLUDE SOIL BENEATH THE ANCHOR TRENCH EXTENDING THROUGH SOIL THAT WILL BECOME THE TRENCH 13 SIDEWALL.
3. HORIZONTAL CONTROL LINE (HCL) IS THE FINAL HORIZONTAL LIMIT OF WASTE PLACEMENT FOR ALL PHASES OF TRENCH 13
4. COMPACTED SOIL PLACED ABOVE "EXISTING GRADE LINE" IS A LEVELING BERM AT AN ELEVATION OF 2772 FEET ALONG THE NORTHERN HCL, AN ELEVATION OF 2768 ALONG THE SOUTHERN HCL, AND A CONNECTING SURFACE ALONG THE EASTERN AND WESTERN HCL.
5. ASSUME SOIL SPECIFICATION A FOR FOR COMPACTED SOIL PLACEMENT IF NOT LABELED OTHERWISE.
6. SOIL SPECIFICATION A: (SEE TRENCH 13 CQA PLAN)
7. SOIL SPECIFICATION B: (SEE TRENCH 13 CQA PLAN)

ELEVATION: FEET (NAVD 1988)
HORIZONTAL CONTROL: SITE COORDINATE SYSTEM

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
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NORTHERN AND SOUTHERN
HORIZONTAL CONTROL LINE

PROFESSIONAL ENGINEER - STATE OF NEVADA
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Exp. 6/30/16
CIVIL
No. 01364

US ecology

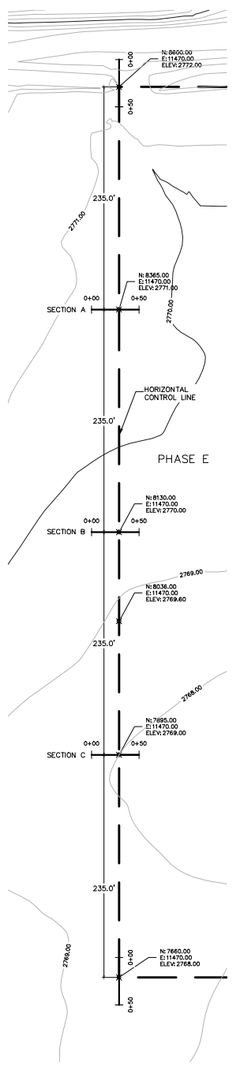
BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

PROJECT NUMBER: 143418

AquaTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| CWK | 3/05/15 | CAB | 3/25/15 | SLW | 10/12/15 | VARIES |

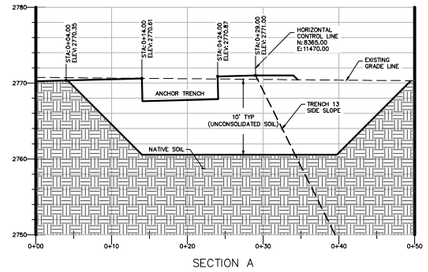
DRAWING NO: NV13-15-003



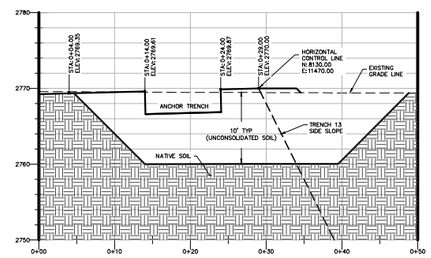

WESTERN HORIZONTAL CONTROL LINE PLAN VIEW

80 0 80 160

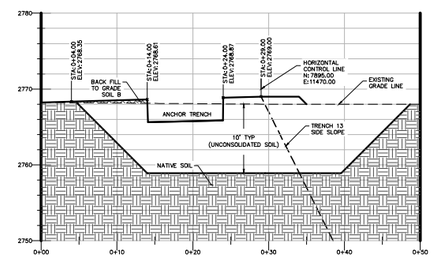
SCALE: 1"=80'




SECTION A




SECTION B

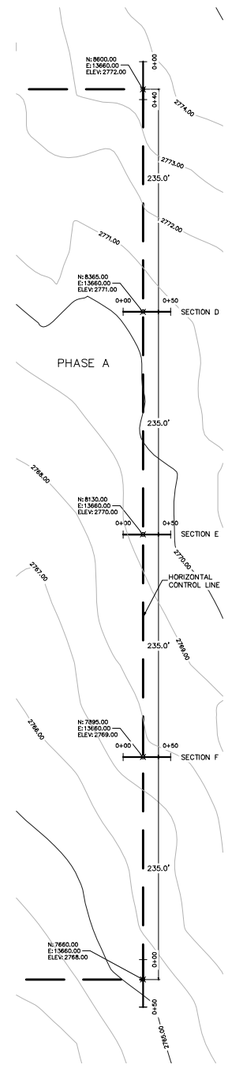



SECTION C

SOIL REMOVAL AND COMPACTED FILL CROSS-SECTIONS
WESTERN HCL

10 0 10 20

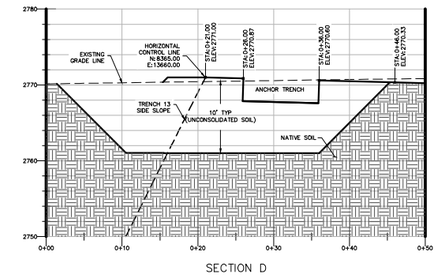
SCALE: 1"=10'



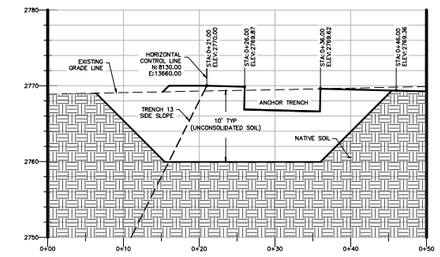

EASTERN HORIZONTAL CONTROL LINE PLAN VIEW

80 0 80 160

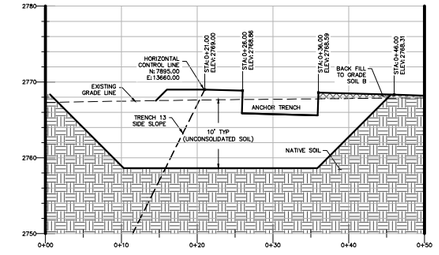
SCALE: 1"=80'




SECTION D




SECTION E




SECTION F

SOIL REMOVAL AND COMPACTED FILL CROSS-SECTIONS
EASTERN HCL

10 0 10 20

SCALE: 1"=10'

NOTES:

1. LIMITS OF SURFACE SOIL REMOVAL AND REPLACEMENT ARE SHOWN AT A NOMINAL DEPTH OF 10 FEET BELOW EXISITNG GRADE. ACTUAL EXCAVATION DEPTH AND PLACEMENT OF COMPACTED FILL SHALL BE DETERMINED BY SITE-SPECIFIC CONDITIONS.
2. REMOVAL AND REPLACEMENT OF UNCONSOLIDATED SURFACE SOIL MUST INCLUDE SOIL BENEATH THE ANCHOR TRENCH EXTENDING THROUGH SOIL THAT WILL BECOME THE TRENCH 13 SIDEWALL.
3. HORIZONTAL CONTROL LINE (HCL) IS THE FINAL HORIZONTAL LIMIT OF WASTE PLACEMENT FOR ALL PHASES OF TRENCH 13
4. COMPACTED SOIL PLACED ABOVE "EXISTING GRADE LINE" IS A LEVELING BERM AT AN ELEVATION OF 2772 FEET ALONG THE NORTHERN HCL, AN ELEVATION OF 2768 ALONG THE SOUTHERN HCL, AND A CONNECTING SURFACE ALONG THE EASTERN AND WESTERN HCL.
5. ASSUME SOIL SPECIFICATION A FOR FOR COMPACTED SOIL PLACEMENT IF NOT LABELED OTHERWISE.
6. SOIL SPECIFICATION A: (SEE TRENCH 13 CQA PLAN)
7. SOIL SPECIFICATION B: (SEE TRENCH 13 CQA PLAN)

ELEVATION: FEET (NAVD 1988)
HORIZONTAL CONTROL: SITE COORDINATE SYSTEM

| REV. # | DESCRIPTION | DATE |
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| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
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WESTERN AND EASTERN
HORIZONTAL CONTROL LINE

PROFESSIONAL ENGINEER-STATE OF NEVADA
STEPHEN L. WAMPLER
Exp 6/30/16
CIVIL
REG. NO. 013641

US ecology

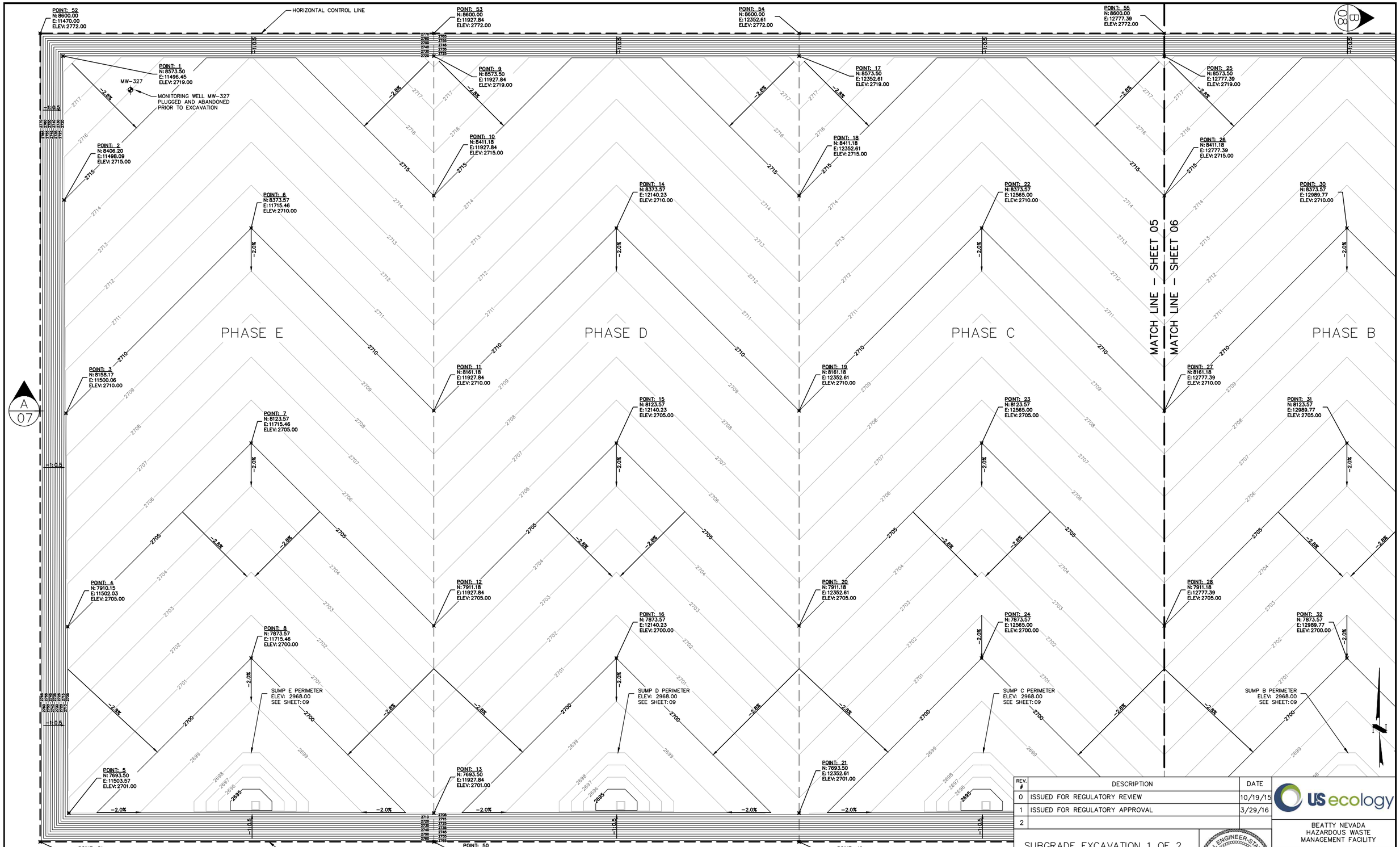
BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

PROJECT NUMBER: 143418

AquaCeTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| CWK | 3/05/15 | CAB | 3/25/15 | SLW | 10/12/15 | VARIES |

DRAWING NO: NV13-15-004




*PLEASE REFERENCE SHEET 06 FOR SURVEY CONTROL POINT TABLE

NOTES:

1. CONTOURS AND SPOT ELEVATIONS (IN FEET) ON TRENCH FLOOR ARE SHOWN AT TOP OF PREPARED SUBGRADE, BEFORE THE PLACEMENT OF THE TRENCH 13 LINER SYSTEM AND AFTER THE PLACEMENT OF PREPARED SUBGRADE. AS SPECIFIED IN THE DESIGN REPORT FOR TRENCH 13, A MINIMUM OF 9 INCHES OF COMPACTED FINE-GRAINED MATERIAL IS PLACED OVER THE ENTIRE FLOOR OF TRENCH 13 TO COMPRISE THE PREPARED SUBGRADE. SEE SHEET 09 FOR SPECIFICATIONS FOR SUMP AREAS.
2. HORIZONTAL CONTROL LINE (HCL) IS THE FINAL HORIZONTAL LIMIT OF WASTE PLACEMENT FOR ALL PHASES OF TRENCH 13.
3. ALL SUBGRADE EXCAVATION SIDE-SLOPES ARE AT 1:0.5 (VERTICAL:HORIZONTAL).
4. THE MINIMUM BOTTOM SLOPE TO ALL SUMPS OF TRENCH 13 IS 2%.
5. RUN ON CONTROL FOR ALL PHASES OF CONSTRUCTION OF TRENCH 13 IS PROVIDED IN THE SURFACE WATER MANAGEMENT PLAN ON SHEETS 14 AND 15.
6. SEE DETAILS 12 AND 13 ON SHEET 10 FOR LCRS CENTERLINE AND LATERAL PIPES.

ELEVATIONS: FEET (NAVD 1988)
HORIZONTAL CONTROL: SITE COORDINATE SYSYEM

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
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SUBGRADE EXCAVATION 1 OF 2

PROFESSIONAL ENGINEER-STATE OF NEVADA
STEPHEN L. WAMPLER
Exp. 6/30/16
CIVIL
No. 013641

US ecology

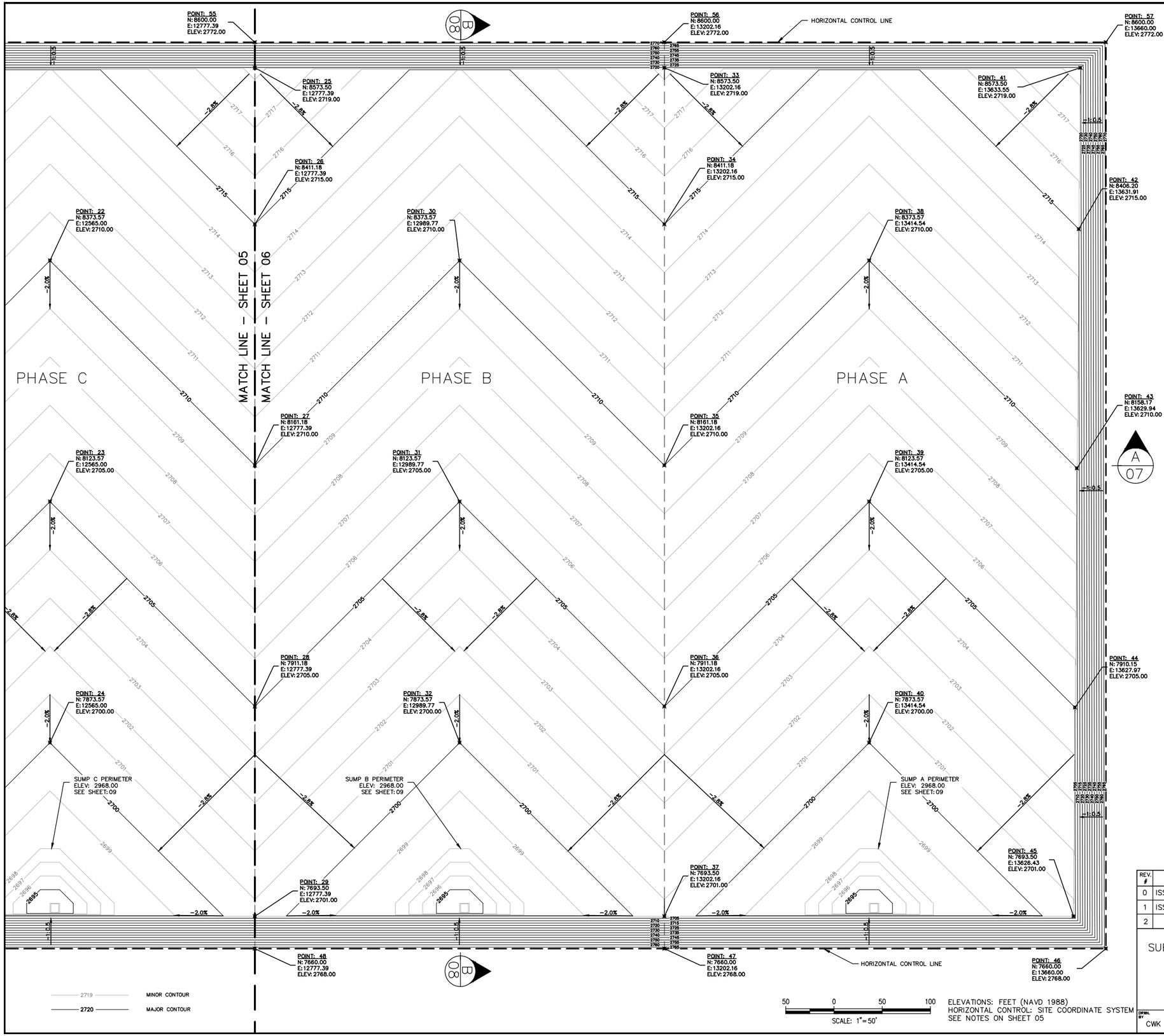
BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

PROJECT NUMBER: 143418

AquaCeTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| CWK | 2/04/15 | CAB | 3/25/15 | SLW | 10/12/15 | 1" = 50' |

DRAWING NO: NV13-15-005




ELEVATIONS: FEET (NAVD 1988)
HORIZONTAL CONTROL: SITE COORDINATE SYSTEM
SEE NOTES ON SHEET 05

## Point Table

| Point # | Northing | Easting | Elevation |
|---|---|---|---|
| 1 | 8573.50 | 11496.45 | 2719.00 |
| 2 | 8406.20 | 11498.09 | 2715.00 |
| 3 | 8158.17 | 11500.06 | 2710.00 |
| 4 | 7910.15 | 11502.03 | 2705.00 |
| 5 | 7693.50 | 11503.57 | 2701.00 |
| 6 | 8373.57 | 11715.46 | 2710.00 |
| 7 | 8123.57 | 11715.46 | 2705.00 |
| 8 | 7873.57 | 11715.46 | 2700.00 |
| 9 | 8573.50 | 11927.84 | 2719.00 |
| 10 | 8411.18 | 11927.84 | 2715.00 |
| 11 | 8161.18 | 11927.84 | 2710.00 |
| 12 | 7911.18 | 11927.84 | 2705.00 |
| 13 | 7693.50 | 11927.84 | 2701.00 |
| 14 | 8373.57 | 12140.23 | 2710.00 |
| 15 | 8123.57 | 12140.23 | 2705.00 |
| 16 | 7873.57 | 12140.23 | 2700.00 |
| 17 | 8573.50 | 12352.61 | 2719.00 |
| 18 | 8411.18 | 12352.61 | 2715.00 |
| 19 | 8161.18 | 12352.61 | 2710.00 |
| 20 | 7911.18 | 12352.61 | 2705.00 |
| 21 | 7693.50 | 12352.61 | 2701.00 |
| 22 | 8373.57 | 12565.00 | 2710.00 |
| 23 | 8123.57 | 12565.00 | 2705.00 |
| 24 | 7873.57 | 12565.00 | 2700.00 |
| 25 | 8573.50 | 12777.39 | 2719.00 |
| 26 | 8411.18 | 12777.39 | 2715.00 |
| 27 | 8161.18 | 12777.39 | 2710.00 |
| 28 | 7911.18 | 12777.39 | 2705.00 |
| 29 | 7693.50 | 12777.39 | 2701.00 |
| 30 | 8373.57 | 12989.77 | 2710.00 |
| 31 | 8123.57 | 12989.77 | 2705.00 |
| 32 | 7873.57 | 12989.77 | 2700.00 |
| 33 | 8573.50 | 13202.16 | 2719.00 |
| 34 | 8411.18 | 13202.16 | 2715.00 |
| 35 | 8161.18 | 13202.16 | 2710.00 |
| 36 | 7911.18 | 13202.16 | 2705.00 |
| 37 | 7693.50 | 13202.16 | 2701.00 |
| 38 | 8373.57 | 13414.54 | 2710.00 |
| 39 | 8123.57 | 13414.54 | 2705.00 |
| 40 | 7873.57 | 13414.54 | 2700.00 |
| 41 | 8573.50 | 13633.55 | 2719.00 |
| 42 | 8406.20 | 13631.91 | 2715.00 |
| 43 | 8158.17 | 13629.94 | 2710.00 |
| 44 | 7910.15 | 13627.97 | 2705.00 |
| 45 | 7693.50 | 13626.43 | 2701.00 |
| 46 | 7660.00 | 13660.00 | 2768.00 |
| 47 | 7660.00 | 13202.16 | 2768.00 |
| 48 | 7660.00 | 12777.39 | 2768.00 |
| 49 | 7660.00 | 12352.61 | 2768.00 |
| 50 | 7660.00 | 11927.84 | 2768.00 |
| 51 | 7660.00 | 11470.00 | 2768.00 |
| 52 | 8600.00 | 11470.00 | 2772.00 |
| 53 | 8600.00 | 11927.84 | 2772.00 |
| 54 | 8600.00 | 12352.61 | 2772.00 |
| 55 | 8600.00 | 12777.39 | 2772.00 |
| 56 | 8600.00 | 13202.16 | 2772.00 |
| 57 | 8600.00 | 13660.00 | 2772.00 |

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
| 2 | | |

SUBGRADE EXCAVATION 2 OF 2

PROFESSIONAL ENGINEER-STATE OF NEVADA
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Exp. 6/30/16
CIVIL
No. 013641

US ecology

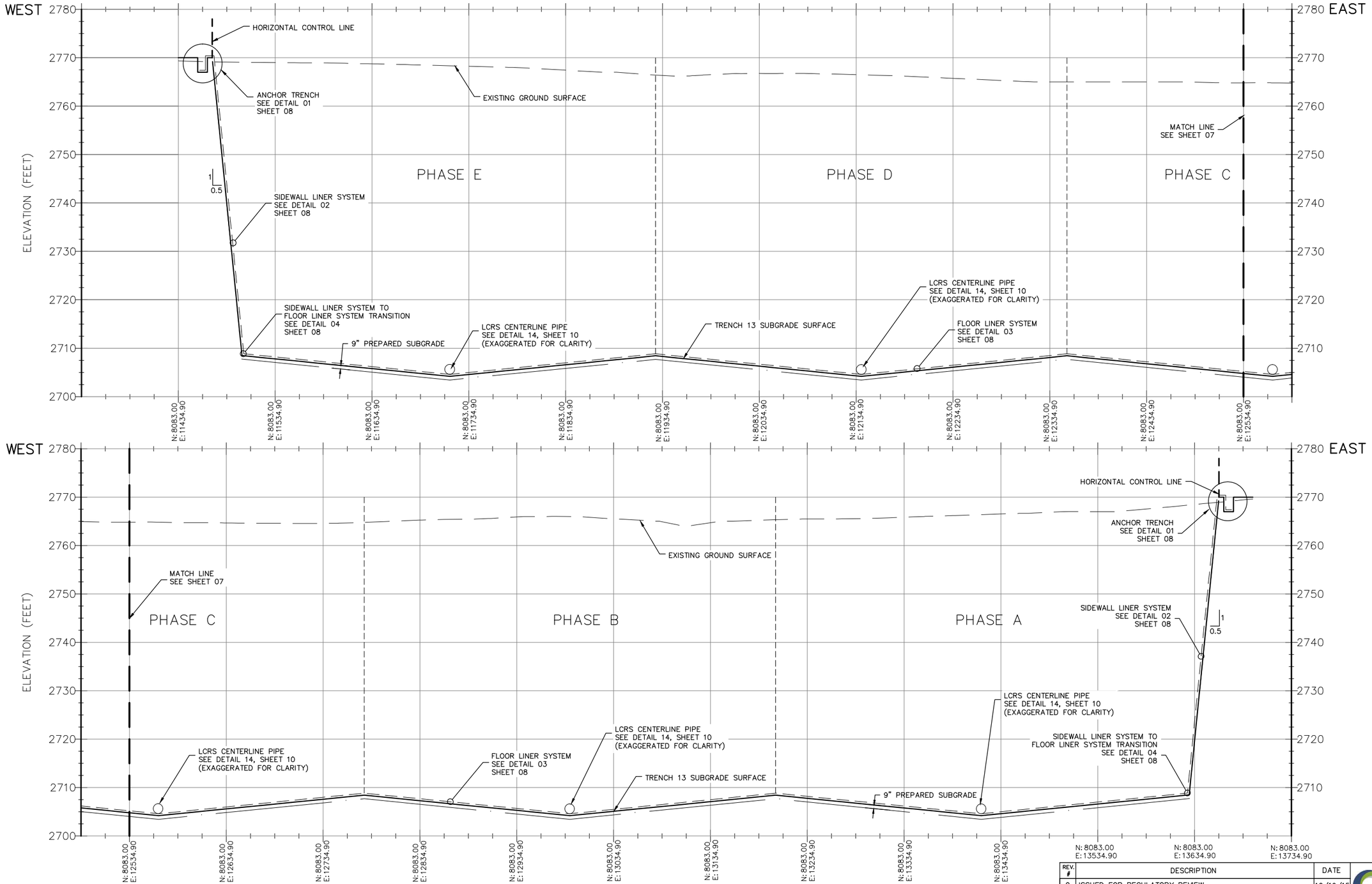
BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

PROJECT NUMBER: 143418

AquAeTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| CWK | 2/04/15 | CAB | 3/25/15 | SLW | 10/12/15 | 1" = 50' |

DRAWING NO: NV13-15-006




## (A) WEST TO EAST PROFILE VIEW OF TRENCH 13 SUBGRADE

(VERTICAL EXAGGERATION OF 5X FOR CLARITY)

50 0 50 100

SCALE: 1"= 50'

ELEVATIONS: FEET (NAVD 1988)
HORIZONTAL CONTROL: SITE COORDINATE SYSTEM

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
| 2 | | |

SUBGRADE PROFILES

PROFESSIONAL ENGINEER-STATE OF NEVADA
STEPHEN L. WAMPLER
Exp. 6/30/16
CIVIL
No. 013641

US ecology

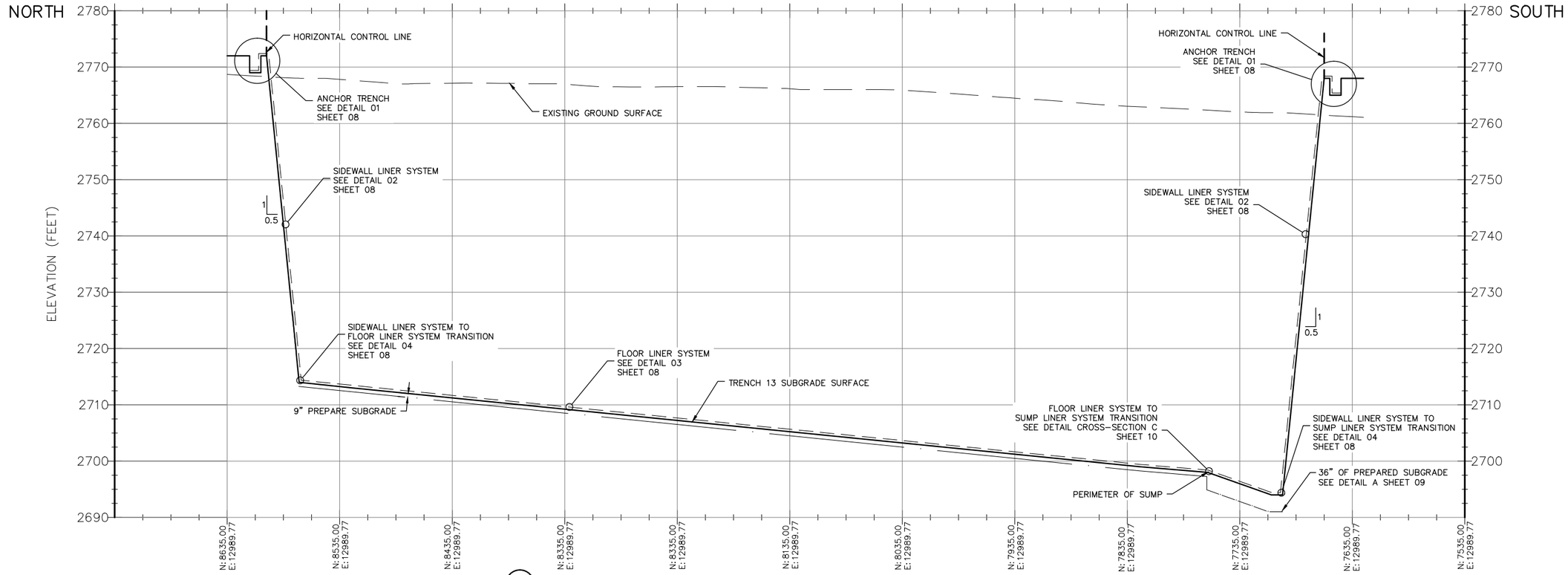
BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

PROJECT NUMBER: 143418

AquAeTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| CWK | 2/25/15 | CAB | 3/25/15 | SLW | 10/12/15 | 1" = 50' |

DRAWING NO: NV13-15-007

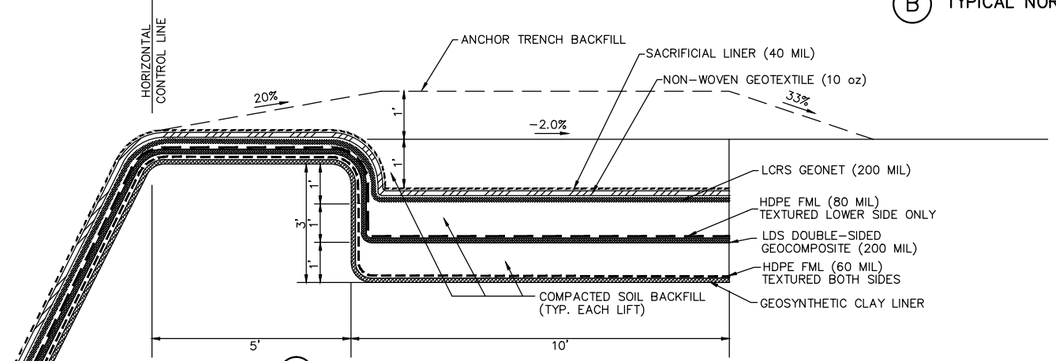



B TYPICAL NORTH TO SOUTH PROFILE VIEW OF TRENCH 13 SUBGRADE AT PHASE CENTERLINE

(VERTICAL EXAGGERATION OF 5X FOR CLARITY)

50 0 50 100

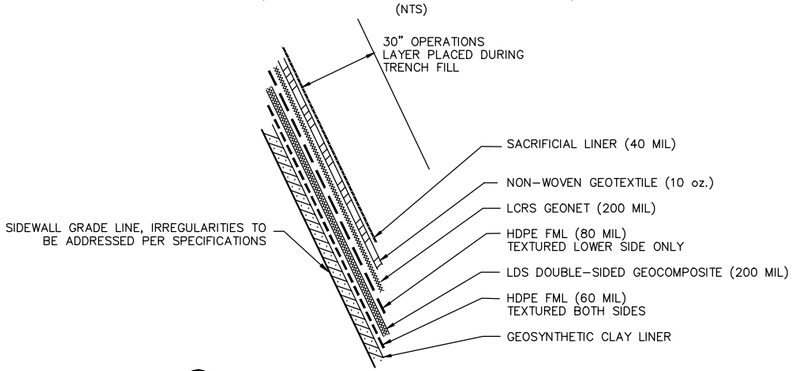
SCALE: 1"=50'




1 ANCHOR TRENCH DETAIL (TYPICAL)

(GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY)

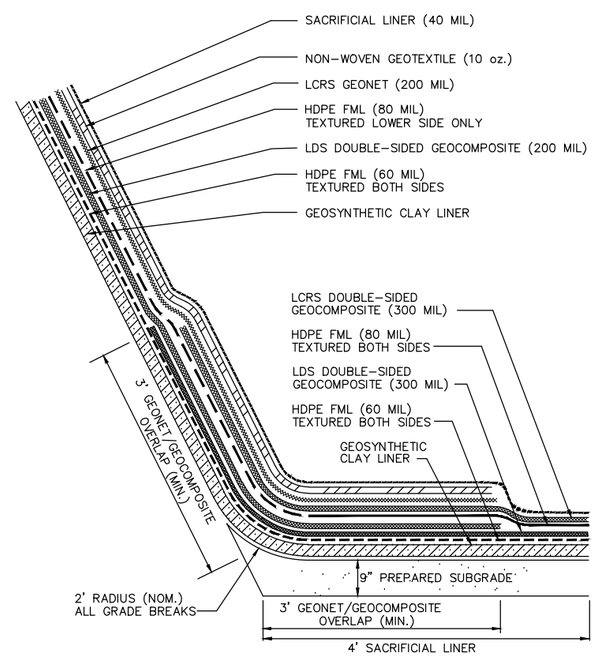
(NTS)




2 SIDEWALL LINER SYSTEM (TYPICAL)

(GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY)

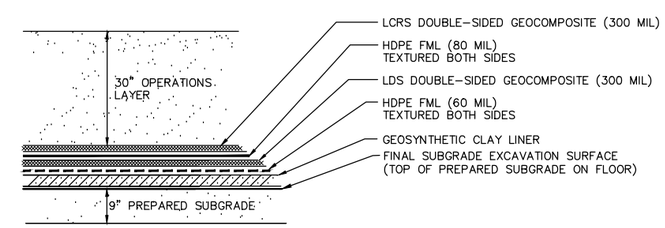
(NTS)




4 SIDEWALL LINER SYSTEM TO FLOOR LINER SYSTEM TRANSITION (TYPICAL)

(GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY)

(NTS)




3 FLOOR LINER SYSTEM (TYPICAL)

(GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY)

(NTS)

ELEVATIONS: FEET (NAVD 1988)
HORIZONTAL CONTROL: SITE COORDINATE SYSTEM

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
| 2 | | |

LINER DETAILS

PROFESSIONAL ENGINEER-STATE OF NEVADA
STEPHEN L. WAMPLER
Exp. 6/30/16
CIVIL
No. 013641

US ecology

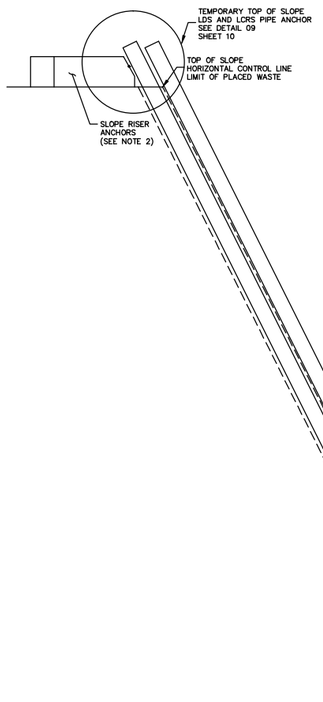
BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

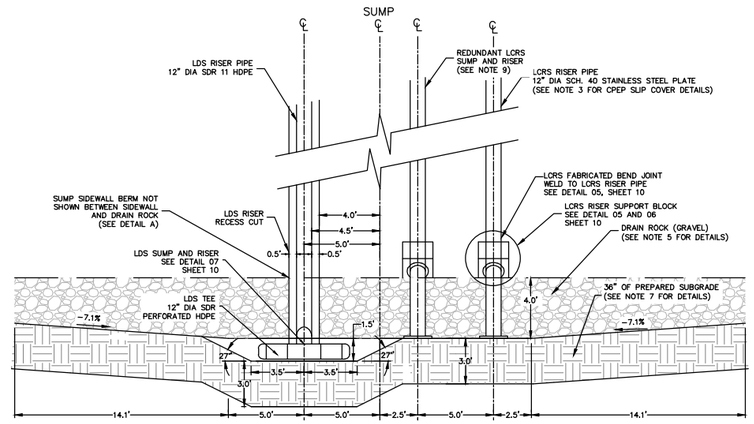
PROJECT NUMBER: 143418

AquAeTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| CWK | 2/25/15 | CAB | 3/25/15 | SLW | 10/12/15 | VARIES |

DRAWING NO: NV13-15-008



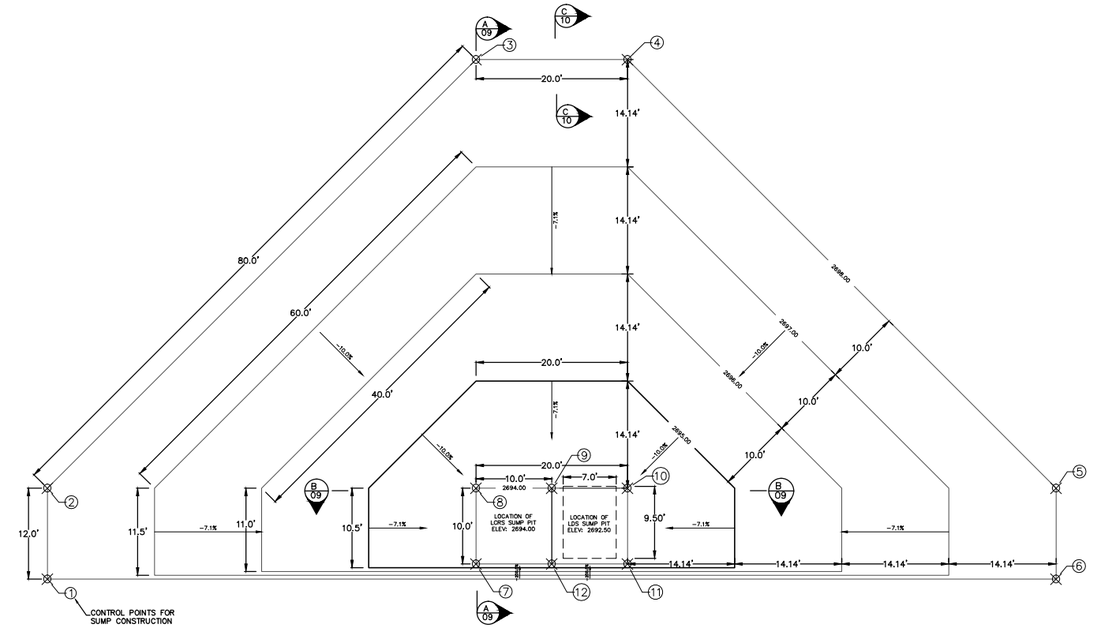




(B) TYPICAL TRANSVERSE SECTION OF SUMPS AND RISERS

(GEOSYNTHETICS NOT SHOWN FOR CLARITY)

5 0 5 10

SCALE: 1"=5'




TYPICAL SUMP PLAN VIEW

(SEE CROSS-SECTIONS AND DETAILS FOR LCRS AND LDS RISER SPECIFICATIONS)

10 0 10 20

SCALE: 1"=10'

**SUMP CONTROL POINTS – PHASE E**

| Point Number | Elevation | Northing | Easting |
|---|---|---|---|
| POINT 1 | 2698.00 | 7695.00 | 11648.89 |
| POINT 2 | 2698.00 | 7707.00 | 11648.89 |
| POINT 3 | 2698.00 | 7763.57 | 11705.46 |
| POINT 4 | 2698.00 | 7763.57 | 11725.46 |
| POINT 5 | 2698.00 | 7707.00 | 11782.03 |
| POINT 6 | 2698.00 | 7695.00 | 11782.03 |
| POINT 7 | 2694.00 | 7697.00 | 11705.46 |
| POINT 8 | 2694.00 | 7707.00 | 11705.46 |
| POINT 9 | 2694.00 | 7707.00 | 11715.46 |
| POINT 10 | 2694.00 | 7707.00 | 11725.46 |
| POINT 11 | 2694.00 | 7697.00 | 11725.46 |
| POINT 12 | 2694.00 | 7697.00 | 11715.46 |

**SUMP CONTROL POINTS – PHASE D**

| Point Number | Elevation | Northing | Easting |
|---|---|---|---|
| POINT 1 | 2698.00 | 7695.00 | 12073.66 |
| POINT 2 | 2698.00 | 7707.00 | 12073.66 |
| POINT 3 | 2698.00 | 7763.57 | 12130.23 |
| POINT 4 | 2698.00 | 7763.57 | 12150.23 |
| POINT 5 | 2698.00 | 7707.00 | 12206.80 |
| POINT 6 | 2698.00 | 7695.00 | 12206.80 |
| POINT 7 | 2694.00 | 7697.00 | 12130.23 |
| POINT 8 | 2694.00 | 7707.00 | 12130.23 |
| POINT 9 | 2694.00 | 7707.00 | 12140.23 |
| POINT 10 | 2694.00 | 7707.00 | 12150.23 |
| POINT 11 | 2694.00 | 7697.00 | 12150.23 |
| POINT 12 | 2694.00 | 7697.00 | 12140.23 |

**SUMP CONTROL POINTS – PHASE C**

| Point Number | Elevation | Northing | Easting |
|---|---|---|---|
| POINT 1 | 2698.00 | 7695.00 | 12498.43 |
| POINT 2 | 2698.00 | 7707.00 | 12498.43 |
| POINT 3 | 2698.00 | 7763.57 | 12555.00 |
| POINT 4 | 2698.00 | 7763.57 | 12575.00 |
| POINT 5 | 2698.00 | 7707.00 | 12631.57 |
| POINT 6 | 2698.00 | 7695.00 | 12631.57 |
| POINT 7 | 2694.00 | 7697.00 | 12555.00 |
| POINT 8 | 2694.00 | 7707.00 | 12555.00 |
| POINT 9 | 2694.00 | 7707.00 | 12565.00 |
| POINT 10 | 2694.00 | 7707.00 | 12575.00 |
| POINT 11 | 2694.00 | 7697.00 | 12575.00 |
| POINT 12 | 2694.00 | 7697.00 | 12565.00 |

**SUMP CONTROL POINTS – PHASE B**

| Point Number | Elevation | Northing | Easting |
|---|---|---|---|
| POINT 1 | 2698.00 | 7695.00 | 12923.20 |
| POINT 2 | 2698.00 | 7707.00 | 12923.20 |
| POINT 3 | 2698.00 | 7763.57 | 12979.77 |
| POINT 4 | 2698.00 | 7763.57 | 12999.77 |
| POINT 5 | 2698.00 | 7707.00 | 13056.34 |
| POINT 6 | 2698.00 | 7695.00 | 13056.34 |
| POINT 7 | 2694.00 | 7697.00 | 12979.77 |
| POINT 8 | 2694.00 | 7707.00 | 12979.77 |
| POINT 9 | 2694.00 | 7707.00 | 12989.77 |
| POINT 10 | 2694.00 | 7707.00 | 12999.77 |
| POINT 11 | 2694.00 | 7697.00 | 12999.77 |
| POINT 12 | 2694.00 | 7697.00 | 12989.77 |

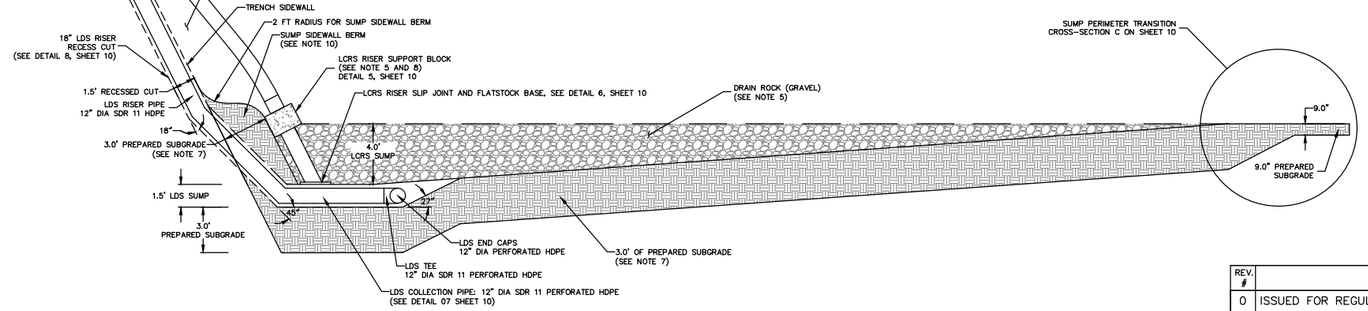
**SUMP CONTROL POINTS – PHASE A**

| Point Number | Elevation | Northing | Easting |
|---|---|---|---|
| POINT 1 | 2698.00 | 7695.00 | 13347.98 |
| POINT 2 | 2698.00 | 7707.00 | 13347.98 |
| POINT 3 | 2698.00 | 7763.57 | 13404.54 |
| POINT 4 | 2698.00 | 7763.57 | 13424.54 |
| POINT 5 | 2698.00 | 7707.00 | 13481.11 |
| POINT 6 | 2698.00 | 7695.00 | 13481.11 |
| POINT 7 | 2694.00 | 7697.00 | 13404.54 |
| POINT 8 | 2694.00 | 7707.00 | 13404.54 |
| POINT 9 | 2694.00 | 7707.00 | 13414.54 |
| POINT 10 | 2694.00 | 7707.00 | 13424.54 |
| POINT 11 | 2694.00 | 7697.00 | 13424.54 |
| POINT 12 | 2694.00 | 7697.00 | 13414.54 |

NOTE: ALL ELEVATIONS IN TABLE ARE TOP OF PREPARED SUBGRADE

NOTES

1. CONTROL POINT LOCATIONS ARE DISPLAYED IN THE TYPICAL SUMP LAYOUT. PHASE-SPECIFIC NORTHINGS AND EASTINGS ARE PROVIDED IN THE TABLES ABOVE.
2. EXTEND 3 RISERS AND RELOCATE 3 SLOPE RISER ANCHORS TO ACCOMMODATE ABOVE-GRADE WASTE DISPOSAL
3. THE SLIP COVER IS SPLIT LONGITUDINALLY AND PLACED ON THE LCRS RISER TO PREVENT WASTE SETTLEMENT FROM TRANSFERRING LOADS TO THE LCRS RISER OR LINER SYSTEM. USE 10' SECTIONS OF CORRUGATED POLYETHYLENE (CPEP) PIPE (OR ACCEPTABLE ALTERNATIVE), CUT TO FIT AS NECESSARY, DO NOT JOIN ADJACENT SECTIONS.
4. IN THE LDS SUMP AREA ADD 3%-5% PORTLAND CEMENT (OR OTHER ACCEPTABLE MATERIAL) TO PREPARED SUBGRADE TO PROVIDE SUFFICIENT COHESION TO ALLOW SUMP CUT.
5. THE SUMP SHALL BE BACKFILLED WITH WELL-GRADED DRAIN ROCK, EXTENDED TO THE EXTERIOR PERIMETER OF THE SUMP. THIS GRAVEL SHALL ACT AS SUPPORT FOR THE LCRS RISER SYSTEM.
6. THE LCRS RISER SUPPORT BLOCK SHOULD BE CAST-IN-PLACE (SEE DETAIL 05, SHEET 10). THE RISER SUPPORT BLOCK SHALL BE PLACED 6 INCHES AWAY FROM THE SUMP SIDEWALL BERM OF TRENCH 13. THE LONG RADIUS ELBOW SHALL ACCOUNT FOR THE OFFSET SO THE UPPER PORTION OF THE LCRS RISER PIPE WILL SIT FLUSH AGAINST THE SIDEWALL. THE TOP AND BOTTOM OF THE RISER SUPPORT BLOCK SHALL BE CAST SO AS TO BE SQUARE WITH THE LCRS LONG RADIUS ELBOW.
7. THE ENTIRE SUMP AREA SHALL BE EXCAVATED 3.0 FEET BELOW THE SPECIFIED GRADE AND BACK FILLED WITH 3.0 FEET OF PREPARED SUBGRADE, DETAILED IN THE TRENCH 13 DESIGN REPORT, UNTIL SPECIFIED GRADE IS MET. PREPARED SUBGRADE WILL BE SOIL CEMENT IN CENTRAL SUMP AREA WHERE NEEDED, TO FACILITATE STEEP ANGLE OR VERTICAL CUTS IN THE PREPARED SUBGRADE.
8. LONG RADIUS ELBOW TO OFFSET RISER SUPPORT BLOCK 6 INCHES FROM SUMP SIDEWALL BERM AND LINER COMPONENTS. OFF-SET SPACE TO BE FILLED WITH DRAIN ROCK (GRAVEL) TO TOP OF RISER SUPPORT BLOCK.
9. THE SUMP WILL CONTAIN TWO LEACHATE COLLECTION AND REMOVAL SYSTEMS (LCRS), BOTH SYSTEMS WILL BE IDENTICAL IN DESIGN AND FABRICATION, AND WILL HAVE A 5.0 FOOT SEPARATION BETWEEN THE CENTERLINES OF BOTH RISER PIPES.
10. SUMP SIDEWALL BERM IS 3 FEET THICK (HORIZONTAL DIMENSION) AND EXTENDS ACROSS FULL WIDTH OF SUMP AT FOOT OF SIDEWALL. TOP ELEVATION OF BERM IS A CONSTANT 2698.00 (FT NAVD). VERTICAL THICKNESS REDUCES AS SUMP SHALLOWS LATERALLY. BERM IS SAME MATERIAL AS PREPARED SUBGRADE.




(A) TYPICAL LONGITUDINAL SECTION OF SUMPS AND RISERS

(GEOSYNTHETICS NOT SHOWN FOR CLARITY)

5 0 5 10

SCALE: 1"=5'

ELEVATION: FEET (NAVD 1988)
HORIZONTAL CONTROL: SITE COORDINATE SYSTEM

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| 2 | | |

US ecology

BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

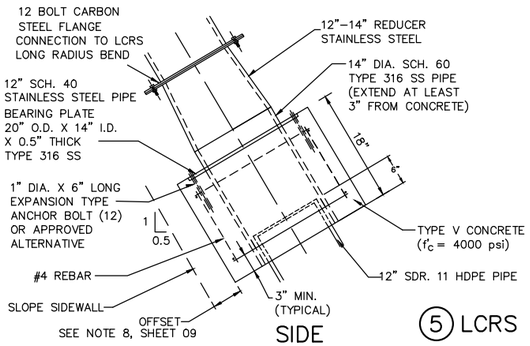
LCRS AND LDS SUMP DETAILS
1 OF 2

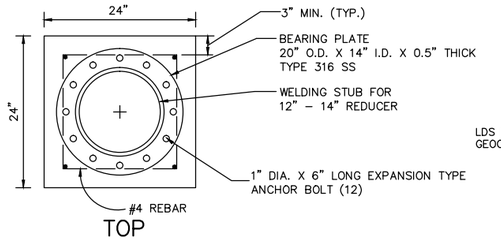
PROFESSIONAL ENGINEER - STATE OF NEVADA
STEPHEN L. WAMPLER
Exp. 6/30/16
CIVIL
No. 013641

PROJECT NUMBER: 143418

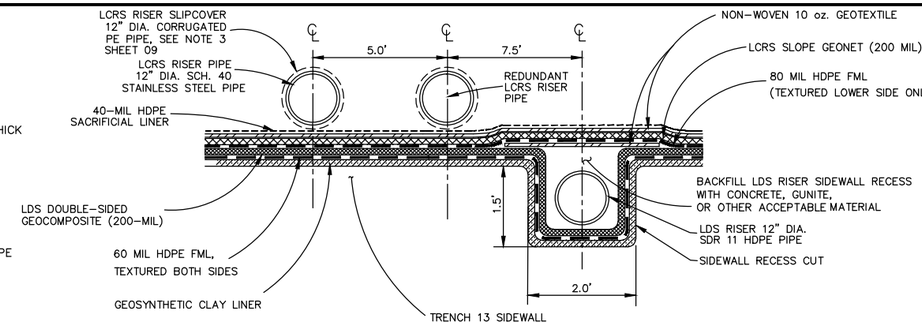
AquAeTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: | DRAWING NO: |
|---|---|---|---|---|---|---|---|
| CWK | 2/13/15 | CAB | 3/25/15 | SLW | 10/12/15 | VARIES | NV13-15-009 |

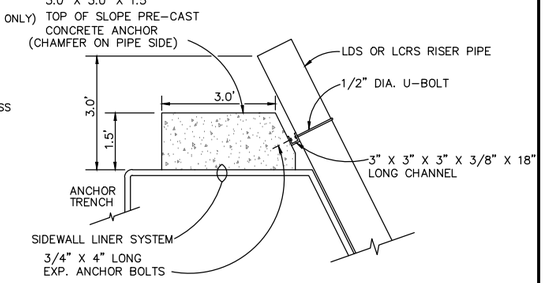


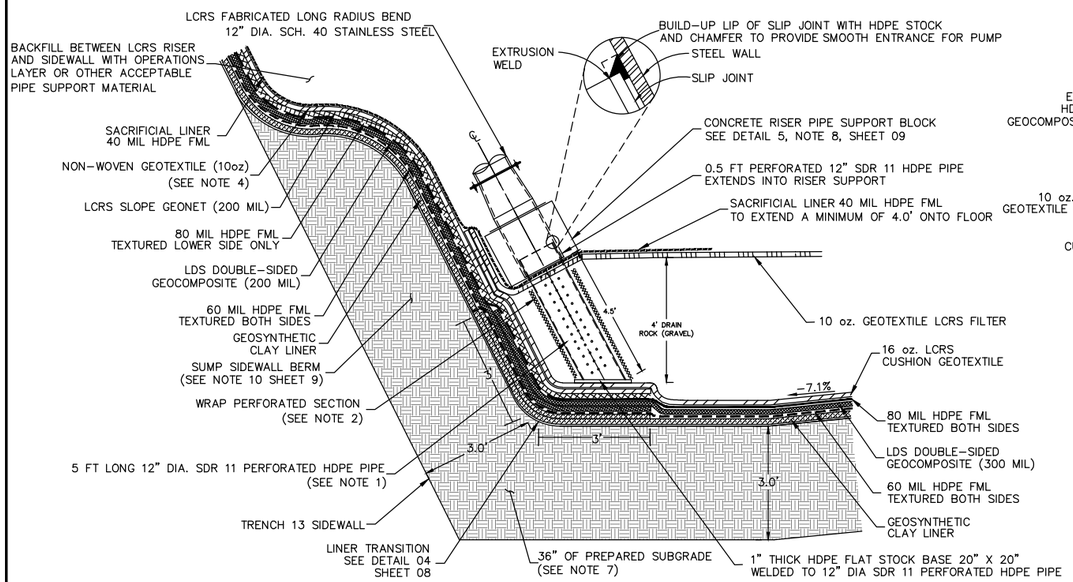

## 5 LCRS RISER SUPPORT
(NTS)



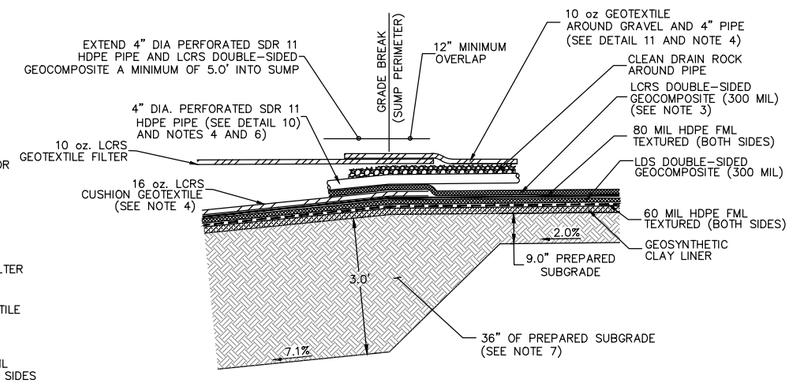

## 8 TYPICAL SIDEWALL CROSS–SECTION SHOWING RISERS AND RECESS
(GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY SEE SHEET 08 FOR DETAILED LEGEND)
(NTS)



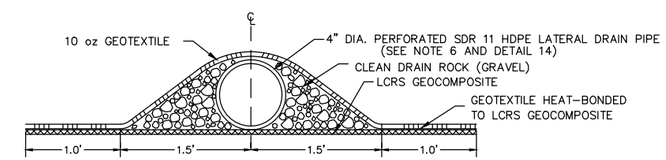

## 9 TYPICAL TOP OF SLOPE RISER ANCHOR
(GEOSYNTHETICS NOT SHOWN FOR CLARITY)
(NTS)



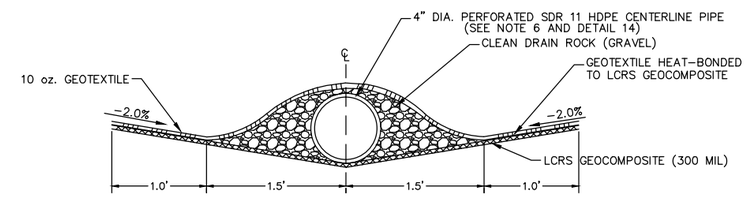

## 6 DETAIL OF LCRS SUMP PIT AND RISER
(GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY)
(NTS)



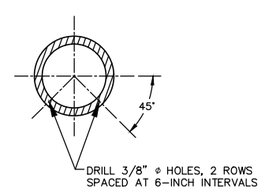

## C DETAIL CROSS–SECTION AT SUMP PERIMETER
(GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY)
(NTS)



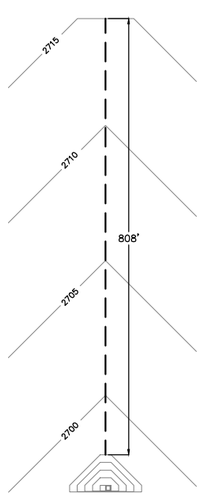

## 10 LATERAL PIPE CROSS–SECTION (TYP)
(GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY)
(BASE LINER COMPONENTS NOT SHOWN, SEE DETAIL 3, SHEET 08)
(NTS)



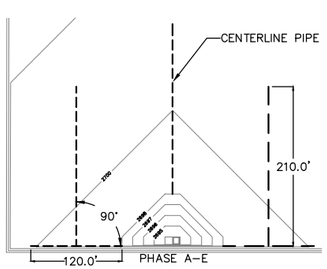

## 11 CENTERLINE PIPE CROSS–SECTION
(GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY)
(BASE LINER COMPONENTS NOT SHOWN, SEE DETAIL 3, SHEET 08)
(NTS)



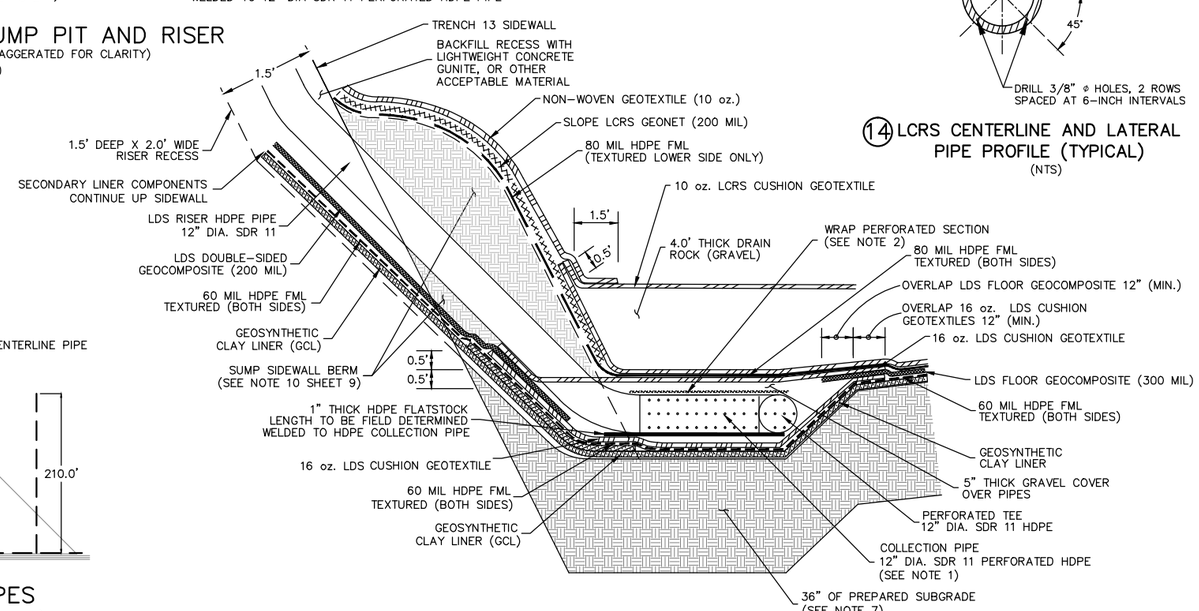

## 14 LCRS CENTERLINE AND LATERAL PIPE PROFILE (TYPICAL)
(NTS)




## 13 CENTERLINE PIPE PLAN VIEW (TYP)
(NTS)




## 12 LATERAL PIPES PLAN VIEW (TYP)
(NTS)




## 7 DETAIL OF LDS SUMP PIT AND RISER
(GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY)
(NTS)

NOTES:

1. PERFORATIONS ARE 6– 1/2" DIA. HOLES SPACED AT 60 DEGREES ; 24 HOLES PER FOOT. PIPE LENGTHS SHALL BE FIELD DETERMINED
2. DOUBLE LAYER OF GEONET AND SECURE WITH STAINLESS STEEL CLAMPS.
3. EXTEND LCRS GEOCOMPOSITE 12" (MIN.) INTO SUMP.
4. EXTEND 10 oz FILTER AND 16 oz. LCRS CUSHION GEOTEXTILES 12" (MIN.) PAST GRADE BREAK. HEAT BONDED 10oz FILTER AND 16oz LCRS GEOTEXTILE AT WALL AND SUMP EDGE
5. LCRS GEOCOMPOSITE ON TRENCH FLOOR = 300 MIL GEONET AND 8 oz. GEOTEXTILES
   LCRS GEOCOMPOSITE ON SIDEWALL = 200 MIL GEONET AND 8 oz. GEOTEXTILE
   LDS GEOCOMPOSITE ON TRENCH FLOOR = 300 MIL GEONET AND 8 oz. GEOTEXTILES
   LDS GEOCOMPOSITE ON SIDEWALL = 200 MIL GEONET and 6 oz. GEOTEXTILES
6. CENTERLINE PIPE AND LATERAL PIPES ARE 4" DIA PERFORATED SDR 11 HDPE WITH 2 – 3/8" HOLES SPACE AT 45 DEGREES DOWN FROM HORIZONTAL EVERY LINEAL FOOT. THE PIPES WILL BE COVERED WITH DRAIN ROCK (GRAVEL) 3 FEET IN WIDTH.
7. THE ENTIRE SUMP AREA SHALL BE EXCAVATED 3.0 FEET BELOW THE SPECIFIED GRADE AND BACK FILLED WITH 3.0 FEET OF PREPARED SUBGRADE, DETAILED IN THE TRENCH 13 DESIGN REPORT, UNTIL SPECIFIED GRADE IS MET. PREPARED SUBGRADE WILL BE SOIL CEMENT IN CENTRAL SUMP AREA WHERE NEEDED, TO FACILITATE STEEP ANGLE OR VERTICAL CUTS IN THE PREPARED SUBGRADE.

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
| 2 | | |

US ecology

BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

LCRS AND LDS SUMP DETAILS
2 OF 2

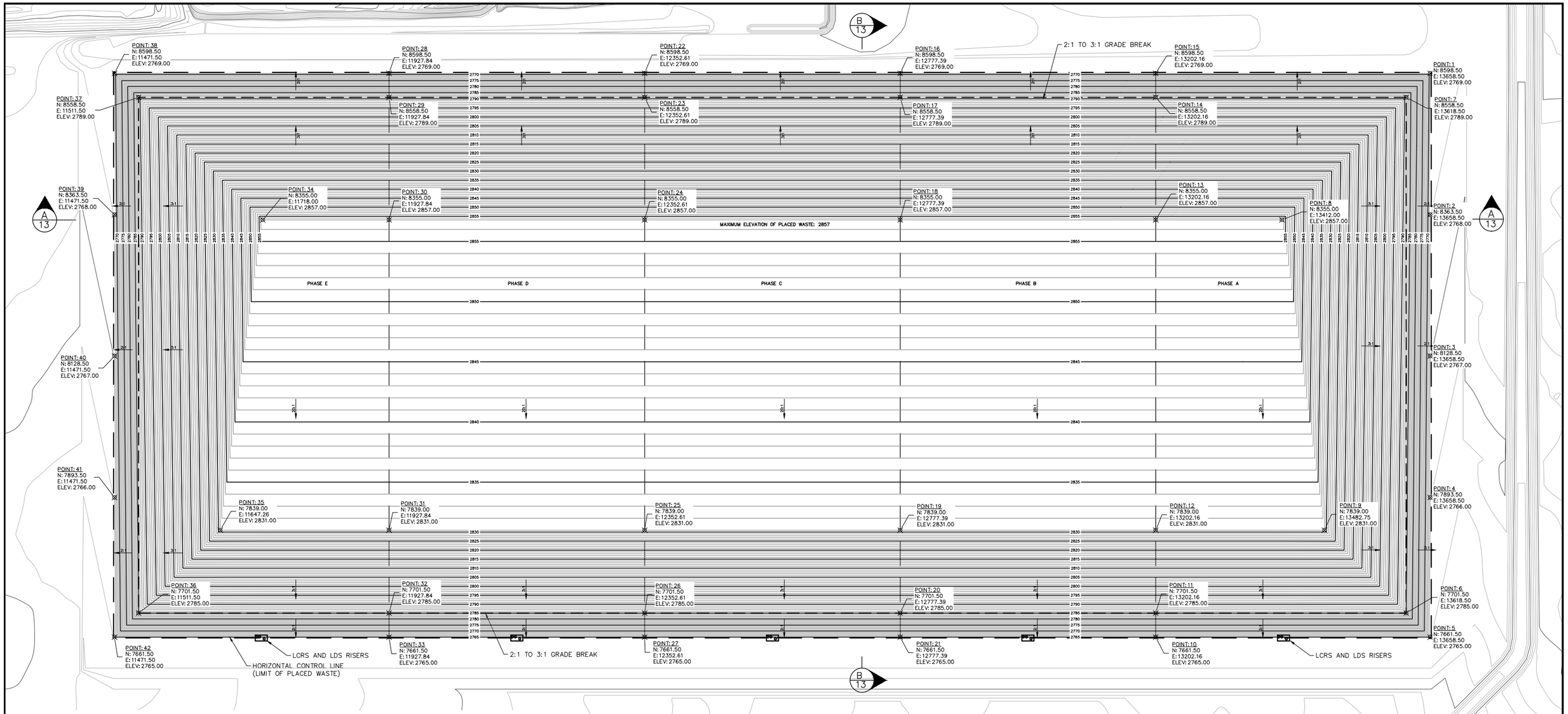
PROFESSIONAL ENGINEER – STATE OF NEVADA
STEPHEN L. WAMPLER
Exp. 6/30/16
CIVIL
No. 013641

PROJECT NUMBER: 143418

AquaTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| CWK | 2/15/15 | CAB | 3/25/15 | SLW | 10/12/15 | VARIES |

DRAWING NO: NV13–15–010




| Point Table | | | |
|---|---|---|---|
| Point # | Northing | Easting | Elevation |
| 1 | 8598.50 | 13658.50 | 2769.00 |
| 2 | 8363.50 | 13658.50 | 2768.00 |
| 3 | 8128.50 | 13658.50 | 2767.00 |
| 4 | 7893.50 | 13658.50 | 2766.00 |
| 5 | 7661.50 | 13658.50 | 2765.00 |
| 6 | 7701.50 | 13618.50 | 2785.00 |
| 7 | 8558.50 | 13618.50 | 2789.00 |
| 8 | 8355.00 | 13412.00 | 2857.00 |
| 9 | 7839.00 | 13482.75 | 2831.00 |
| 10 | 7661.50 | 13202.16 | 2765.00 |
| 11 | 7701.50 | 13202.16 | 2785.00 |
| 12 | 7839.00 | 13202.16 | 2831.00 |
| 13 | 8355.00 | 13202.16 | 2857.00 |
| 14 | 8558.50 | 13202.16 | 2789.00 |
| 15 | 8598.50 | 13202.16 | 2769.00 |
| 16 | 8598.50 | 12777.39 | 2769.00 |
| 17 | 8558.50 | 12777.39 | 2789.00 |
| 18 | 8355.00 | 12777.39 | 2857.00 |
| 19 | 7839.00 | 12777.39 | 2831.00 |

| Point Table | | | |
|---|---|---|---|
| Point # | Northing | Easting | Elevation |
| 20 | 7701.50 | 12777.39 | 2785.00 |
| 21 | 7661.50 | 12777.39 | 2765.00 |
| 22 | 8598.50 | 12352.61 | 2769.00 |
| 23 | 8558.50 | 12352.61 | 2789.00 |
| 24 | 8355.00 | 12352.61 | 2857.00 |
| 25 | 7839.00 | 12352.61 | 2831.00 |
| 26 | 7701.50 | 12352.61 | 2785.00 |
| 27 | 7661.50 | 12352.61 | 2765.00 |
| 28 | 8598.50 | 11927.84 | 2769.00 |
| 29 | 8558.50 | 11927.84 | 2789.00 |
| 30 | 8355.00 | 11927.84 | 2857.00 |
| 31 | 7839.00 | 11927.84 | 2831.00 |
| 32 | 7701.50 | 11927.84 | 2785.00 |
| 33 | 7661.50 | 11927.84 | 2765.00 |
| 34 | 8355.00 | 11718.00 | 2857.00 |
| 35 | 7839.00 | 11647.26 | 2831.00 |
| 36 | 7701.50 | 11511.50 | 2785.00 |
| 37 | 8558.50 | 11511.50 | 2789.00 |
| 38 | 8598.50 | 11471.50 | 2769.00 |

| Point Table | | | |
|---|---|---|---|
| Point # | Northing | Easting | Elevation |
| 39 | 8363.50 | 11471.50 | 2768.00 |
| 40 | 8128.50 | 11471.50 | 2767.00 |
| 41 | 7893.50 | 11471.50 | 2766.00 |
| 42 | 7661.50 | 11471.50 | 2765.00 |

NOTES:

1. SEE SHEET 17 AND 18 FOR WASTE PLACEMENT FINAL COVER SEQUENCING
2. SITE FEATURES SUCH AS PROPERTY BOUNDARIES, ROADS, FENCES, AND MONITORING WELLS SHOWN ON SHEET 12

80 0 80 160

SCALE: 1"= 80'

ELEVATION: FEET (NAVD 1988)
HORIZONTAL CONTROL: SITE COORDINATE SYSTEM

| REV. # | DESCRIPTION | DATE |
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FINAL WASTE GRADE PLAN VIEW

PROFESSIONAL ENGINEER - STATE OF NEVADA
STEPHEN L WAMPLER
Exp. 6/30/16
CIVIL
No. 01364

US ecology

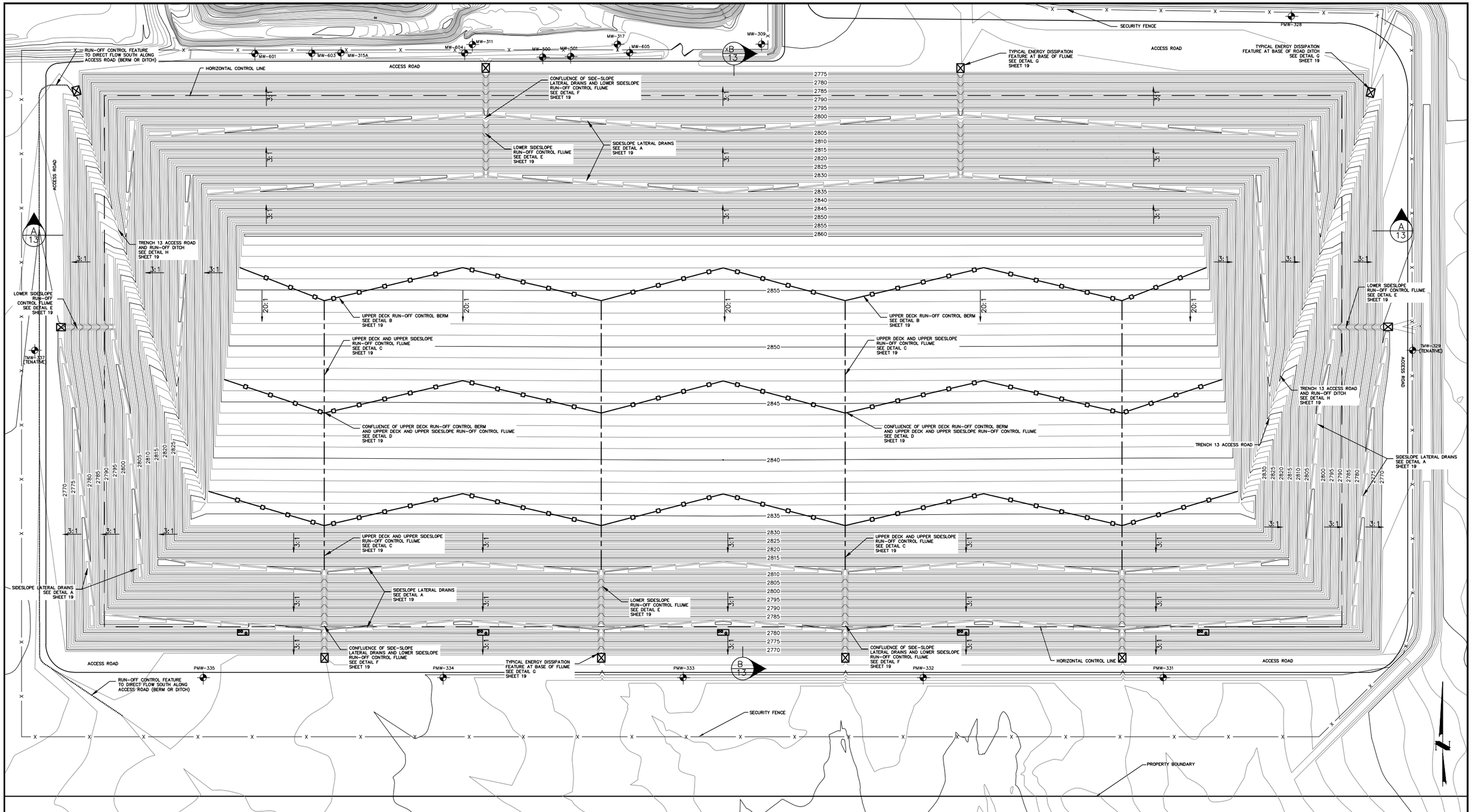
BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

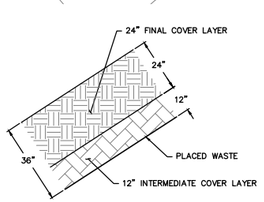
PROJECT NUMBER: 143418

AquAeTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| CWK | 2/08/15 | CAB | 3/25/15 | SLW | 10/12/15 | 1" = 80' |

DRAWING NO: NV13-15-011




## 15 TYPICAL FINAL COVER DETAIL
(NTS)

LEGEND

- LCRS AND LDS SUMP RISERS AND LEACHATE STORAGE
- PMW-335 — PLANNED MONITORING WELL
- MW-601 — EXISTING MONITORING WELL
- TMW-329 — TENTATIVELY PLANNED MONITORING WELL
- SECURITY FENCE
- UPPER DECK RUN-OFF CONTROL BERMS
- UPPER DECK AND LOWER SIDESLOPE RUN-OFF CONTROL FLUMES
- TYPICAL ENERGY DISSIPATION FEATURE
- RUN-OFF CONTROL FEATURE (DITCH OR BERM)

ELEVATION: FEET (NAVD 1988)
HORIZONTAL CONTROL: SITE COORDINATE SYSTEM

80 0 80 160
SCALE: 1"=80'

NOTES:

1. FINAL COVER IS 3.0 FEET MINIMUM THICKNESS OVER PLACED WASTE (SEE SHEET 11 AND 13)
2. CONTROL POINTS NOT PROVIDED, VERIFICATION OF PLACED FINAL COVER THICKNESS WILL BE BY COMPARISON OF 50'X50' GRID SURVEY ON TOP OF PLACED WASTE AND TOP OF FINAL COVER
3. SEE SHEET 14, 15, AND 16 FOR STORMWATER MANAGEMENT FEATURES OUTSIDE THE LIMIT OF WASTE DISPOSAL.
4. SEE SHEET 18 FOR FINAL COVER PLACEMENT SEQUENCING

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
| 2 | | |

FINAL COVER PLAN VIEW

PROFESSIONAL ENGINEER - STATE OF NEVADA
STEPHEN L. WAMPLER
Exp. 6/30/16
CIVIL
NO. 013641

US ecology

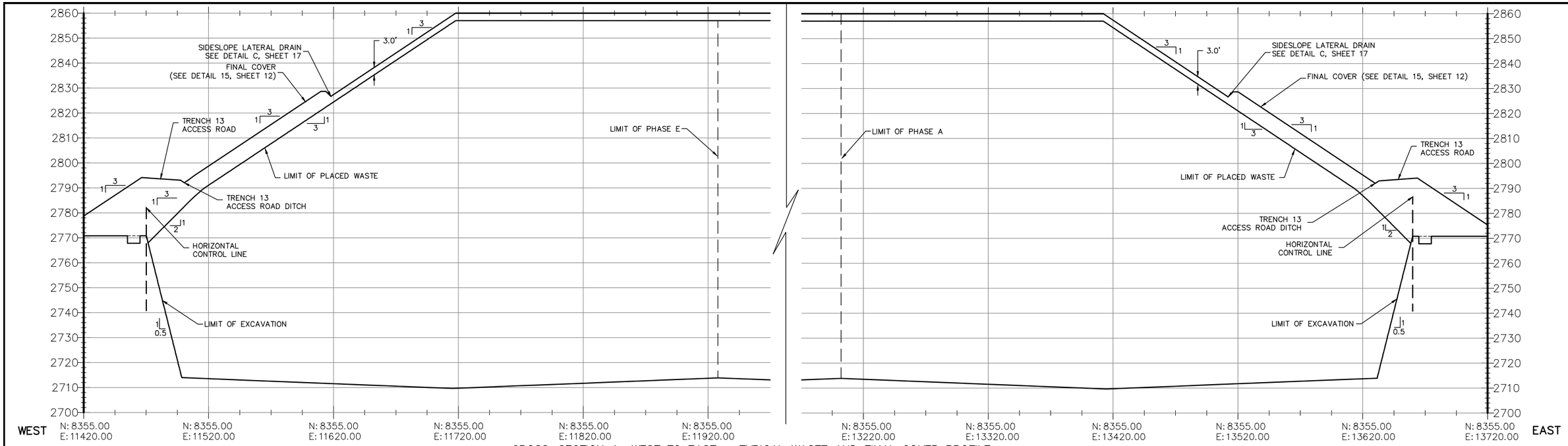
BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

PROJECT NUMBER: 143418

AquaTer
optimizing resources | water, air, earth

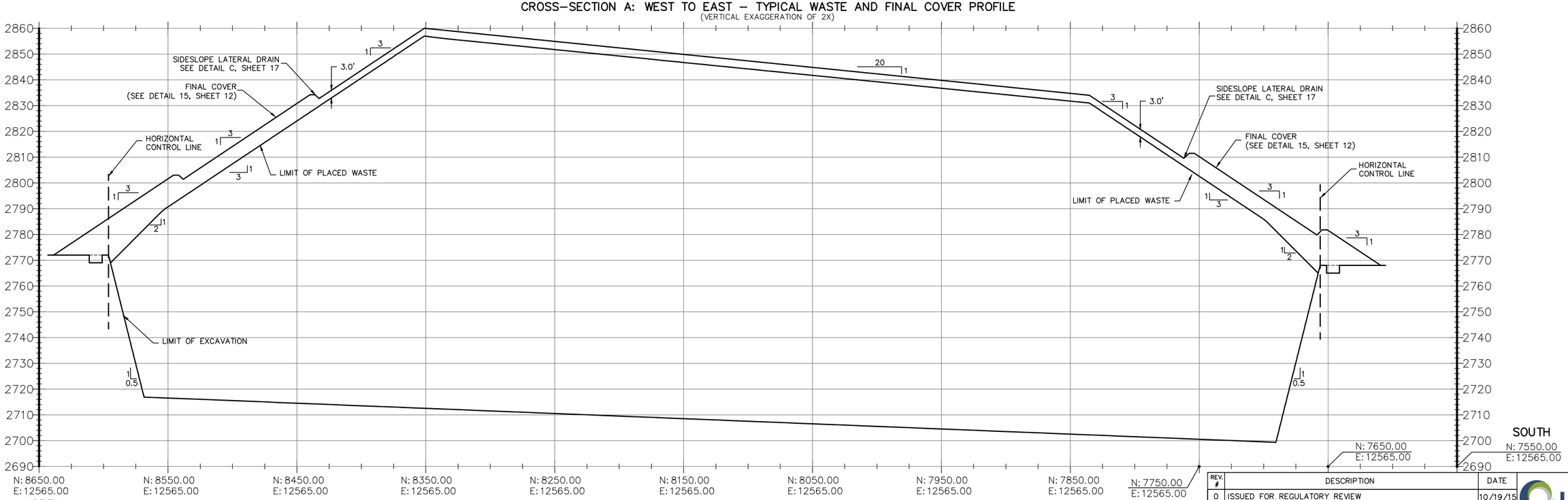
| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| CWK | 2/20/15 | CAB | 3/25/15 | SLW | 10/12/15 | 1" = 80' |

DRAWING NO: NV13-15-012




CROSS–SECTION A: WEST TO EAST – TYPICAL WASTE AND FINAL COVER PROFILE

(VERTICAL EXAGGERATION OF 2X)




CROSS–SECTION B: NORTH TO SOUTH
TYPICAL WASTE AND FINAL COVER PROFILE AT PHASE CENTERLINE

(VERTICAL EXAGGERATION OF 2X)

40 0 40 80

SCALE: 1"= 40'

ELEVATION: FEET (NAVD 1988)
HORIZONTAL CONTROL: SITE COORDINATE SYSTEM

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
| 2 | | |

FINAL COVER PROFILES

PROFESSIONAL ENGINEER-STATE OF NEVADA
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CIVIL
No. 013641

US ecology

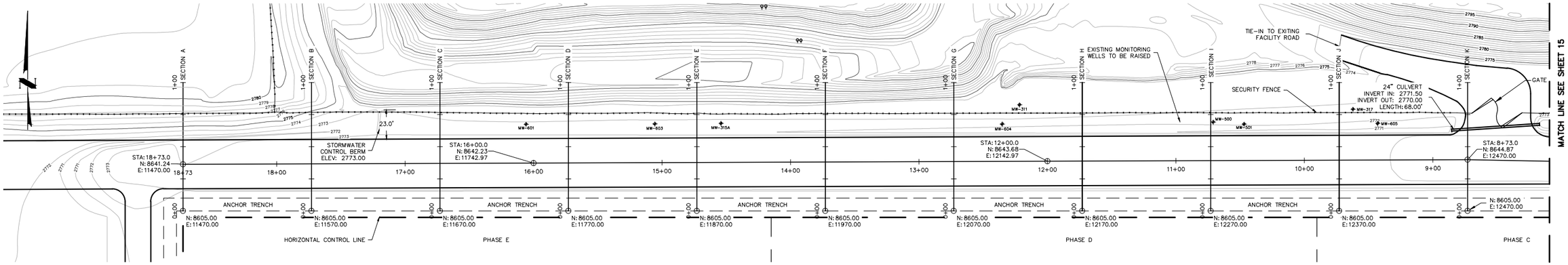
BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

PROJECT NUMBER: 143418

AquAeTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| CWK | 2/25/15 | CAB | 3/25/15 | SLW | 10/12/15 | 1" = 40' |

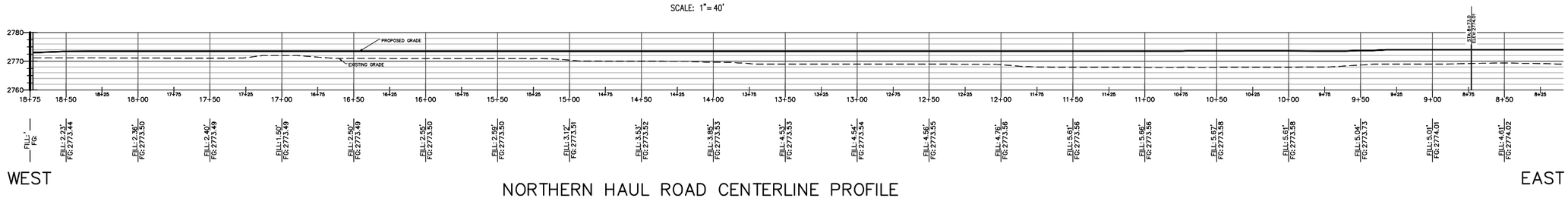
DRAWING NO: NV13–15–013




## NORTHERN HAUL ROAD AND DRAINAGE DITCH PLAN

40 0 40 80

SCALE: 1"= 40'

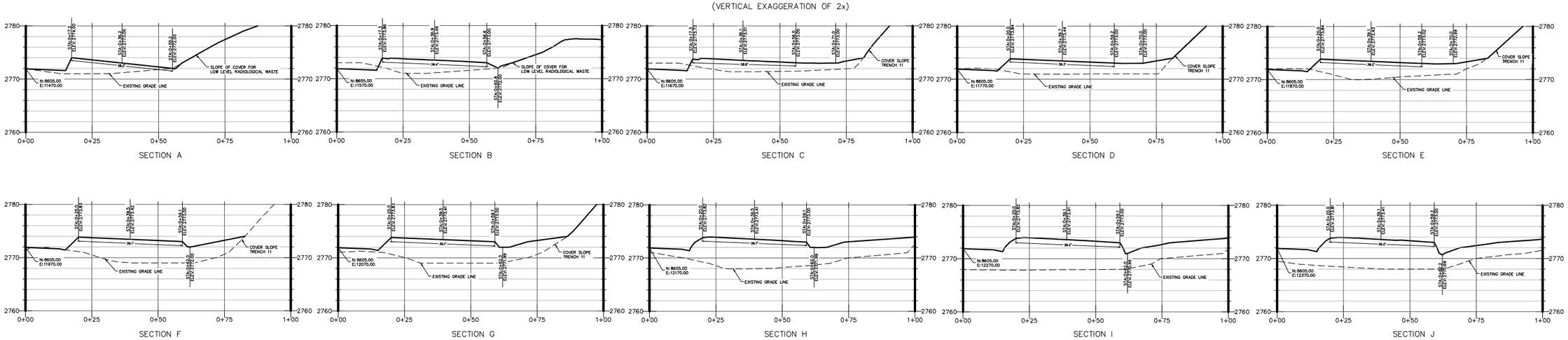



## NORTHERN HAUL ROAD CENTERLINE PROFILE

40 0 40 80

SCALE: 1"= 40'

(VERTICAL EXAGGERATION OF 2x)

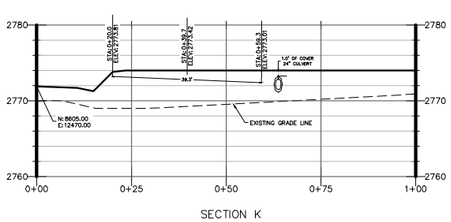



## NORTHERN HAUL ROAD AND DRAINAGE DITCH CROSS-SECTIONS

20 0 20 40

SCALE: 1"= 20'

(VERTICAL EXAGGERATION OF 2x)




NOTES:

1. SURFACE PREPARATION FOR ROAD FILL WILL REQUIRE REMOVAL OF VEGETATION AND 0.5 FT OF SCARIFICATION
2. ROAD FILL TO BE COMPACTION SPECIFICATION B BACKFILL
3. ANCHOR TRENCH AND SOIL SPECIFICATION A BACKFILL NOT SHOWN, REFER TO SHEETS 03 AND 04

ELEVATION: FEET (NAVD 1988)
HORIZONTAL CONTROL: SITE COORDINATE SYSTEM

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
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SURFACE WATER MANAGEMENT
1 OF 3

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CIVIL
No. 01364

US ecology

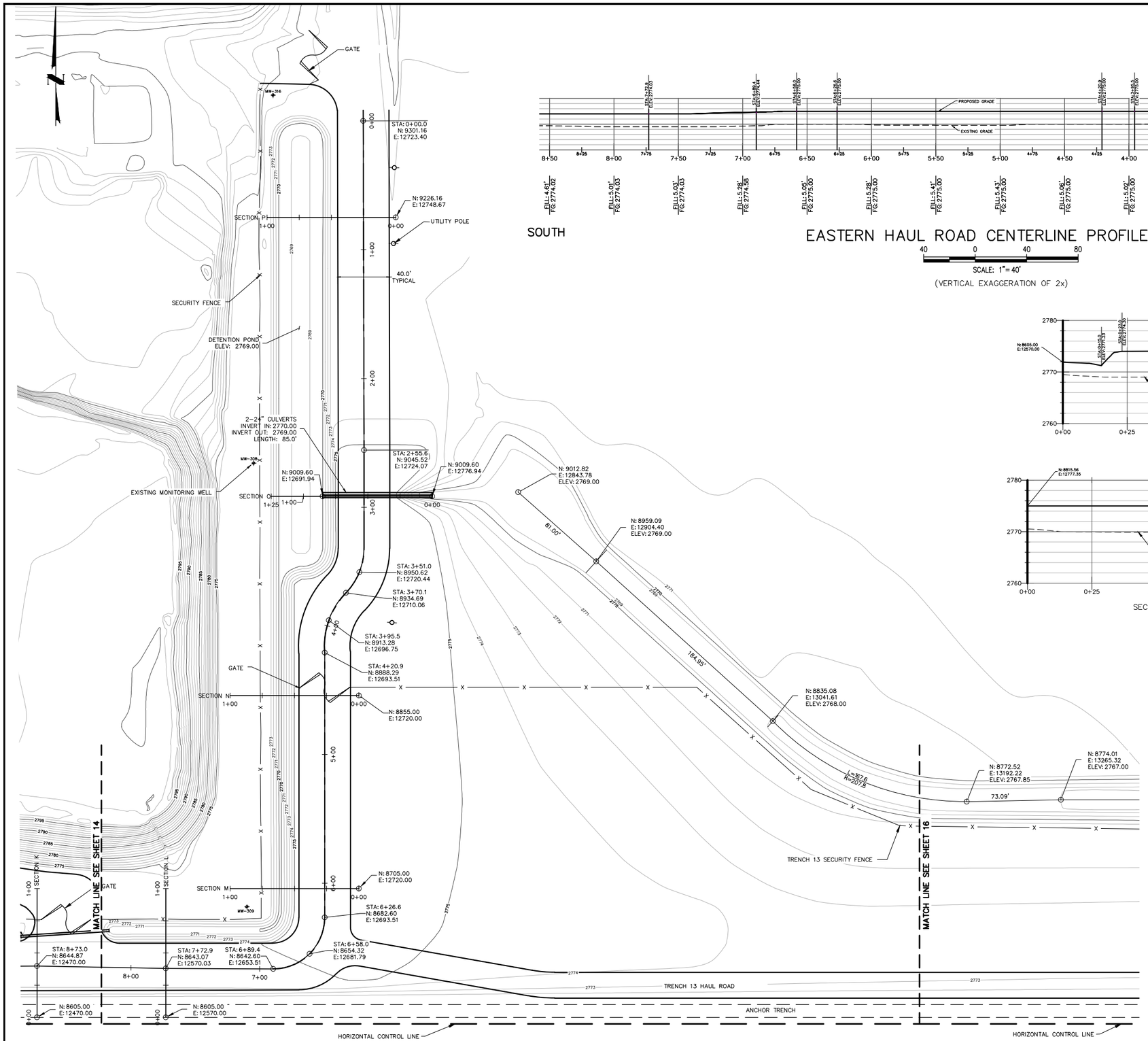
BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

PROJECT NUMBER: 143418

AquAeTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| CWK | 2/25/15 | CAB | 3/25/15 | SLW | 10/12/15 | VARIES |

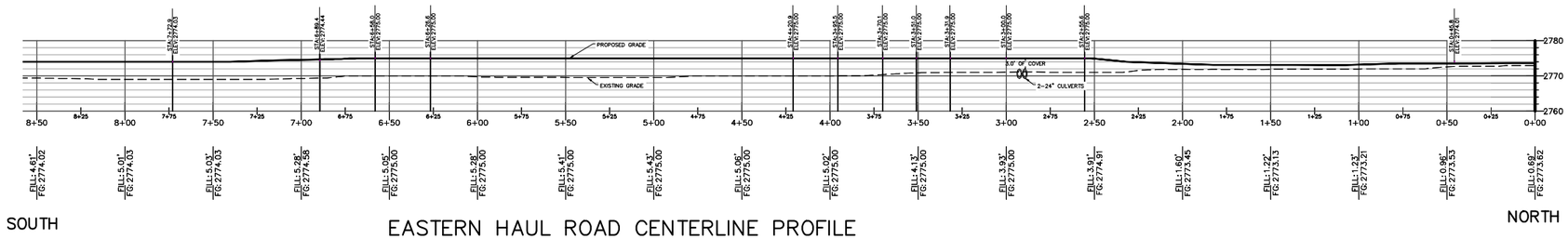
DRAWING NO: NV13-15-014




EASTERN HAUL ROAD, DETENTION POND, AND DIVERSION CHANNEL

40 0 40 80

SCALE: 1"= 40'

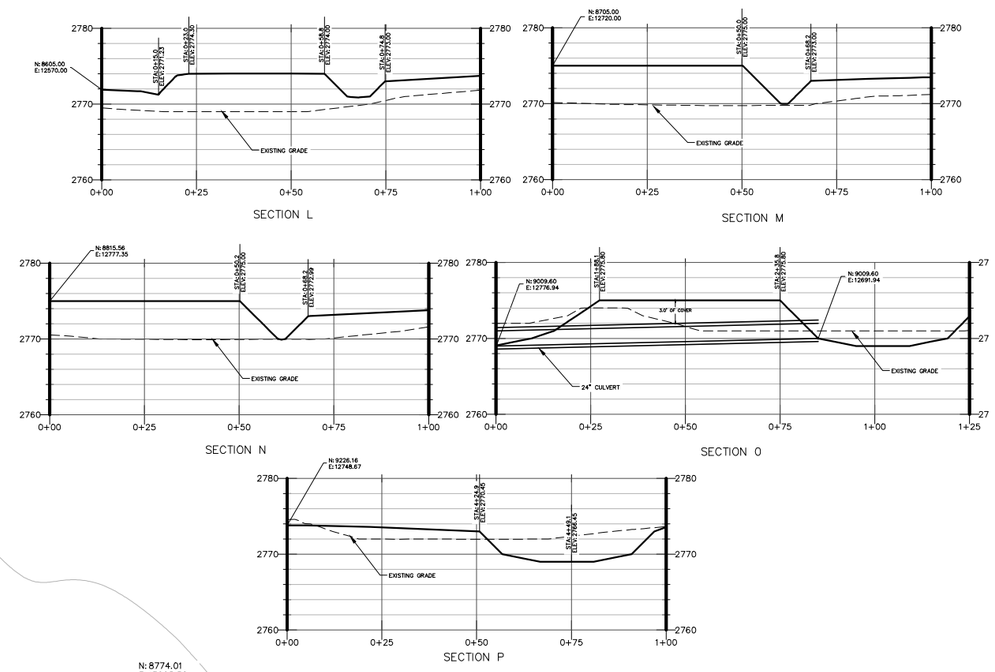



EASTERN HAUL ROAD CENTERLINE PROFILE

40 0 40 80

SCALE: 1"= 40'

(VERTICAL EXAGGERATION OF 2x)




EASTERN HAUL ROAD AND DETENTION POND CROSS-SECTIONS

20 0 20 40

SCALE: 1"= 20'

(VERTICAL EXAGGERATION OF 2x)

NOTES:

1. SURFACE PREPARATION FOR ROAD FILL WILL REQUIRE REMOVAL OF VEGETATION AND 0.5 FT OF SCARIFICATION
2. ROAD FILL TO BE COMPACTION SPECIFICATION B BACKFILL
3. ANCHOR TRENCH AND SOIL SPECIFICATION A BACKFILL NOT SHOWN, REFER TO SHEETS 03 AND 04

ELEVATION: FEET (NAVD 1988)
HORIZONTAL CONTROL: SITE COORDINATE SYSTEM

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
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MANAGEMENT FACILITY

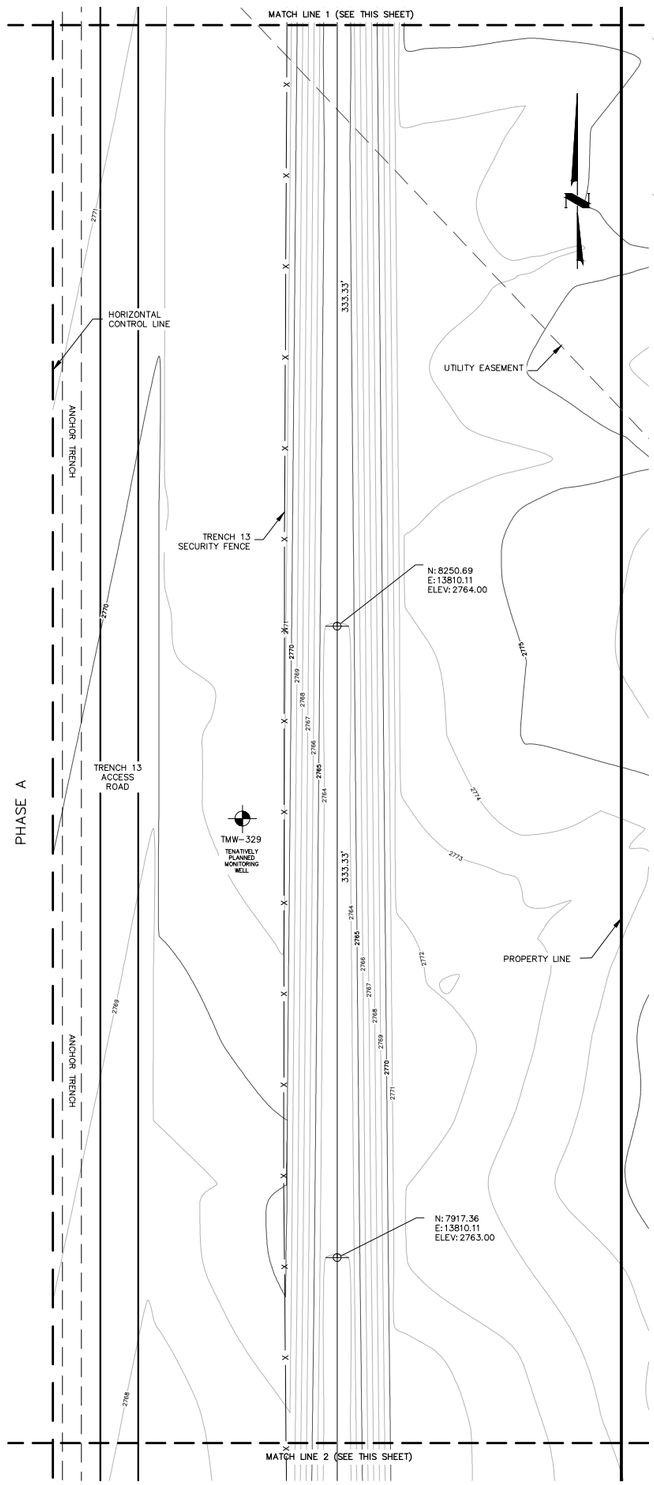
SURFACE WATER MANAGEMENT
2 OF 3

PROFESSIONAL ENGINEER - STATE OF NEVADA
STEPHEN L. WAMPLER
Exp. 6/30/16
CIVIL
No. 013641

PROJECT NUMBER: 143418

AquaTer
optimizing resources | water, air, earth

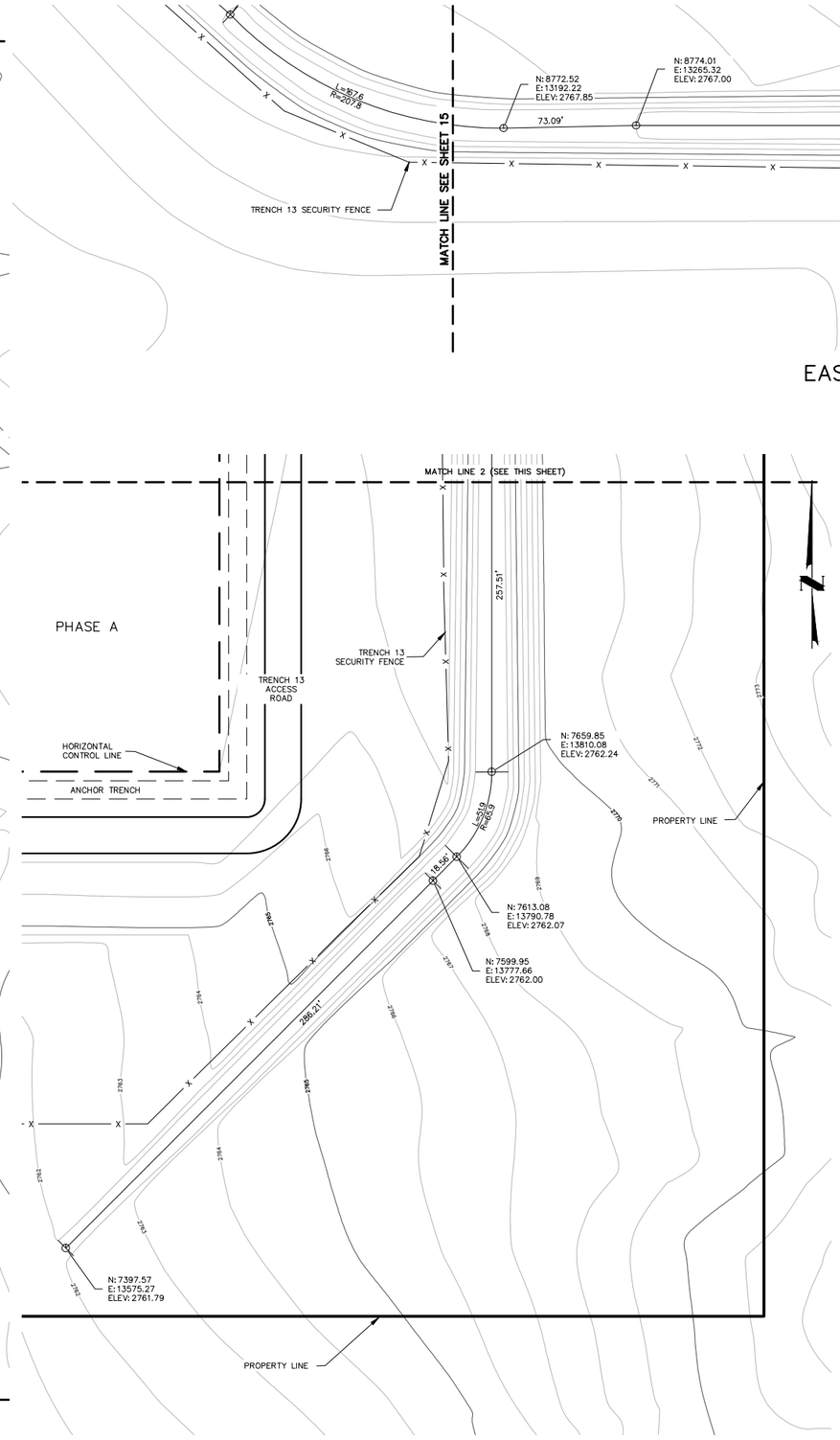
| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: | DRAWING NO: |
|---|---|---|---|---|---|---|---|
| CWK | 3/23/15 | CAB | 3/25/15 | SLW | 10/12/15 | VARIES | NV13-15-015 |




EASTERN DIVERSION CHANNEL PLAN

40 0 40 80

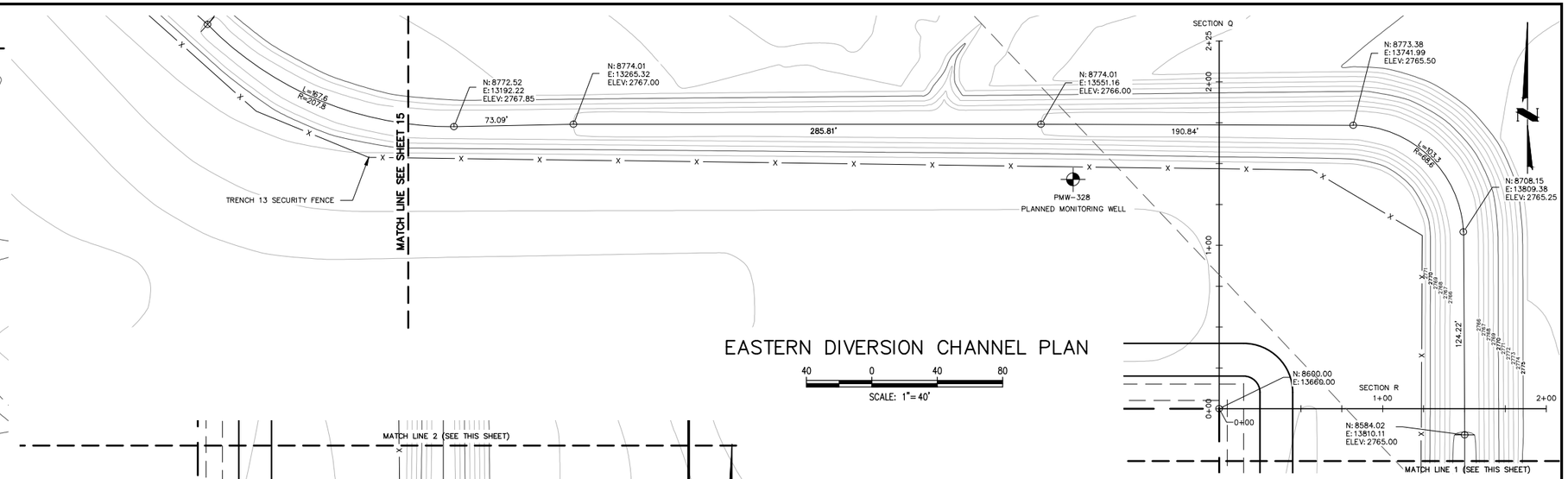
SCALE: 1"= 40'




EASTERN DIVERSION CHANNEL PLAN

40 0 40 80

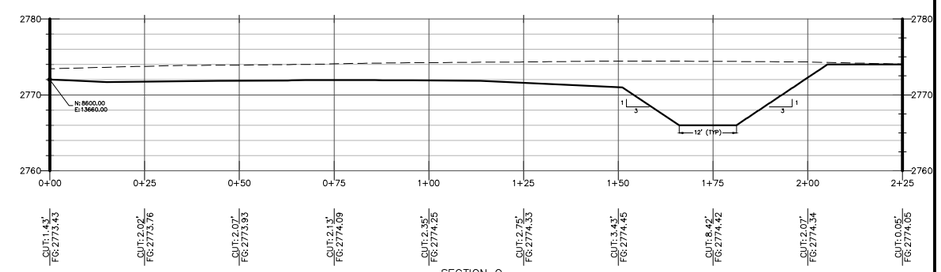
SCALE: 1"= 40'




EASTERN DIVERSION CHANNEL PLAN

40 0 40 80

SCALE: 1"= 40'



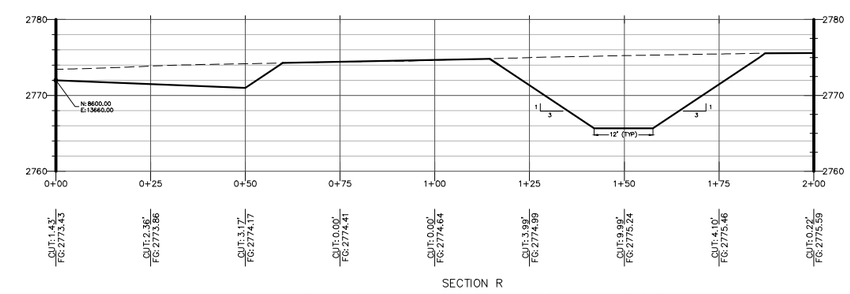

SECTION Q

DIVERSION CHANNEL CROSS-SECTION SOUTH TO NORTH

20 0 20 40

SCALE: 1"= 20'

(VERTICAL EXAGGERATION OF 2X)




SECTION R

DIVERSION CHANNEL CROSS-SECTION WEST TO EAST

20 0 20 40

SCALE: 1"= 20'

(VERTICAL EXAGGERATION OF 2X)

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
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SURFACE WATER MANAGEMENT
3 OF 3

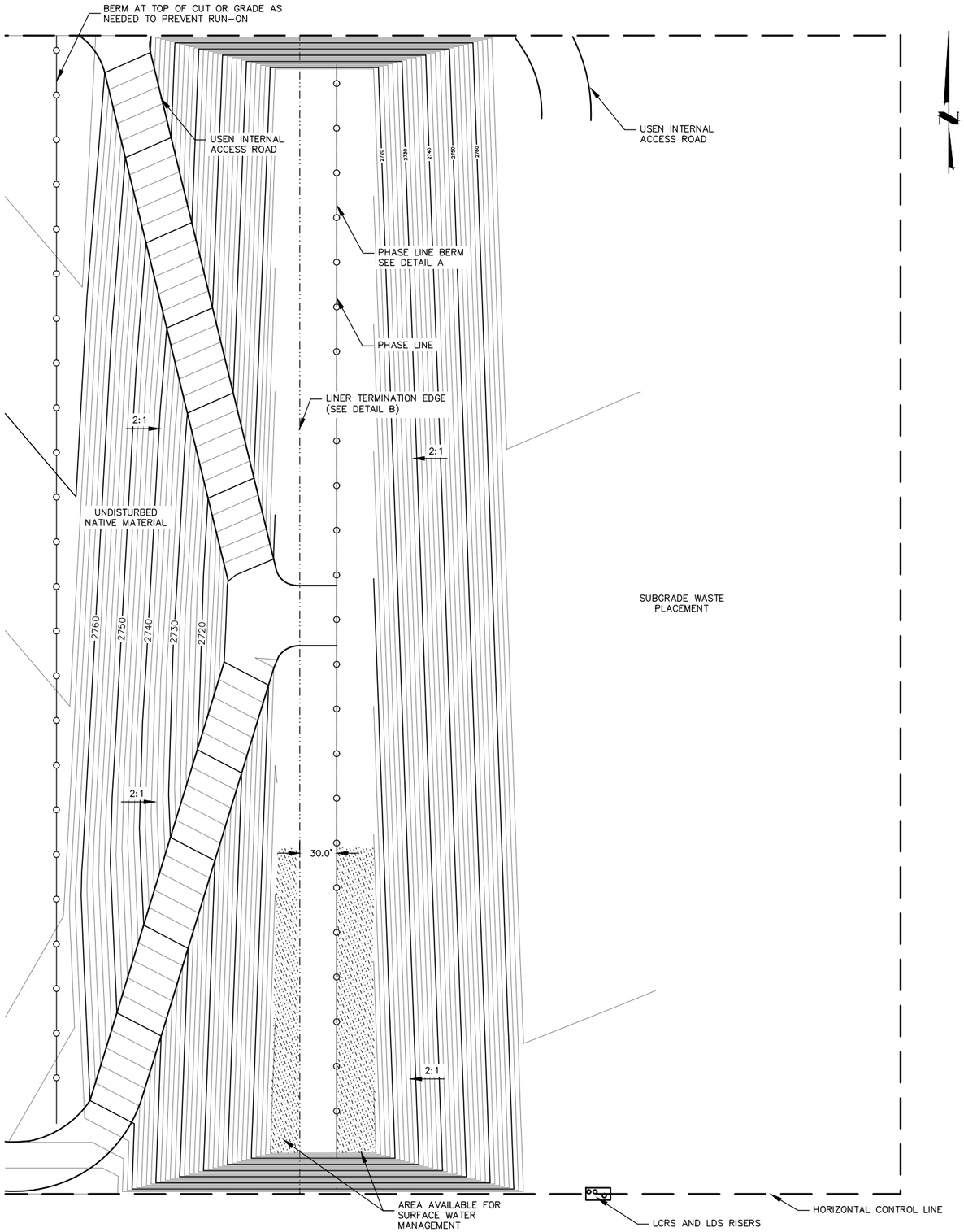
PROFESSIONAL ENGINEER - STATE OF NEVADA
STEPHEN L. WAMPLER
Exp. 6/30/16
CIVIL
No. 01364

PROJECT NUMBER: 143418

AquaTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| CWK | 3/23/15 | CAB | 3/25/15 | SLW | 10/12/15 | VARIES |

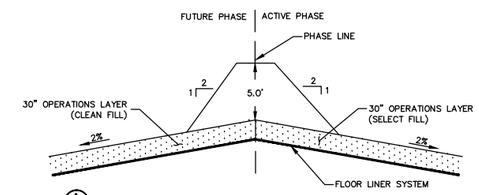
DRAWING NO: NV13-15-016




TYPICAL FULL PHASE DEVELOPMENT PLAN

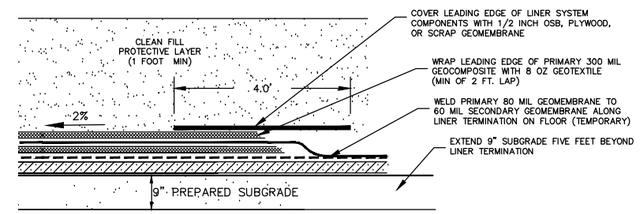
50 0 50 100

SCALE: 1"=50'




Ⓐ TYPICAL PHASE LINE BERM DETAIL

(N.T.S.)




Ⓑ TYPICAL FLOOR LINER TERMINATION DETAIL

(GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY)

(N.T.S.)

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
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PHASE CONSTUCTION

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STEPHEN L. WAMPLER
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CIVIL
No. 013641

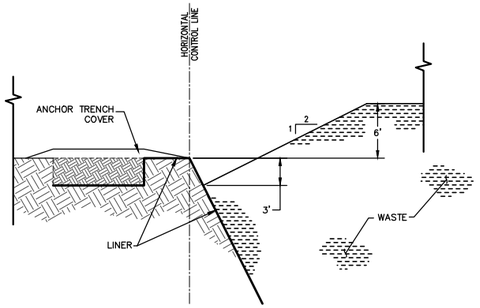
US ecology

BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

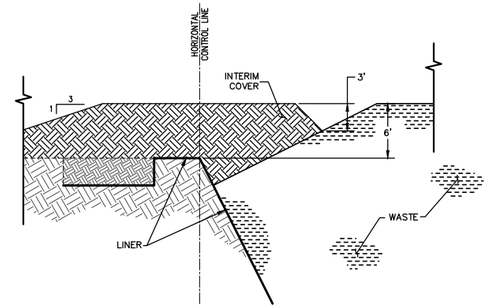
PROJECT NUMBER: 143418

AquAeTer
optimizing resources | water, air, earth

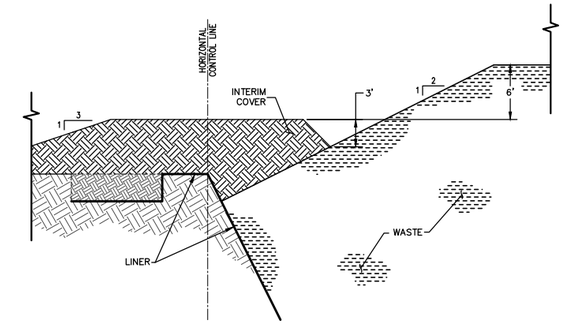
| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: | |
|---|---|---|---|---|---|---|---|
| CWK | 9/23/15 | CAB | 9/23/15 | SLW | 10/16/15 | VARIES | DRAWING NO: NV13-15-017 |




SEQUENCE #1a - INITIAL ABOVE-GRADE WASTE PLACEMENT
N.T.S.




SEQUENCE #1b - INTERIM COVER PLACEMENT
N.T.S.



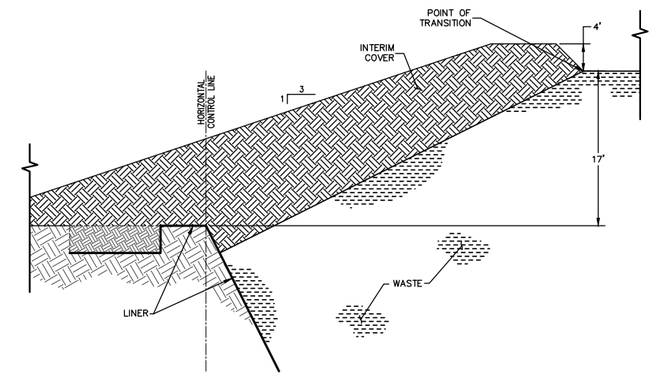

SEQUENCE #1c - ADDITIONAL WASTE PLACEMENT
N.T.S.



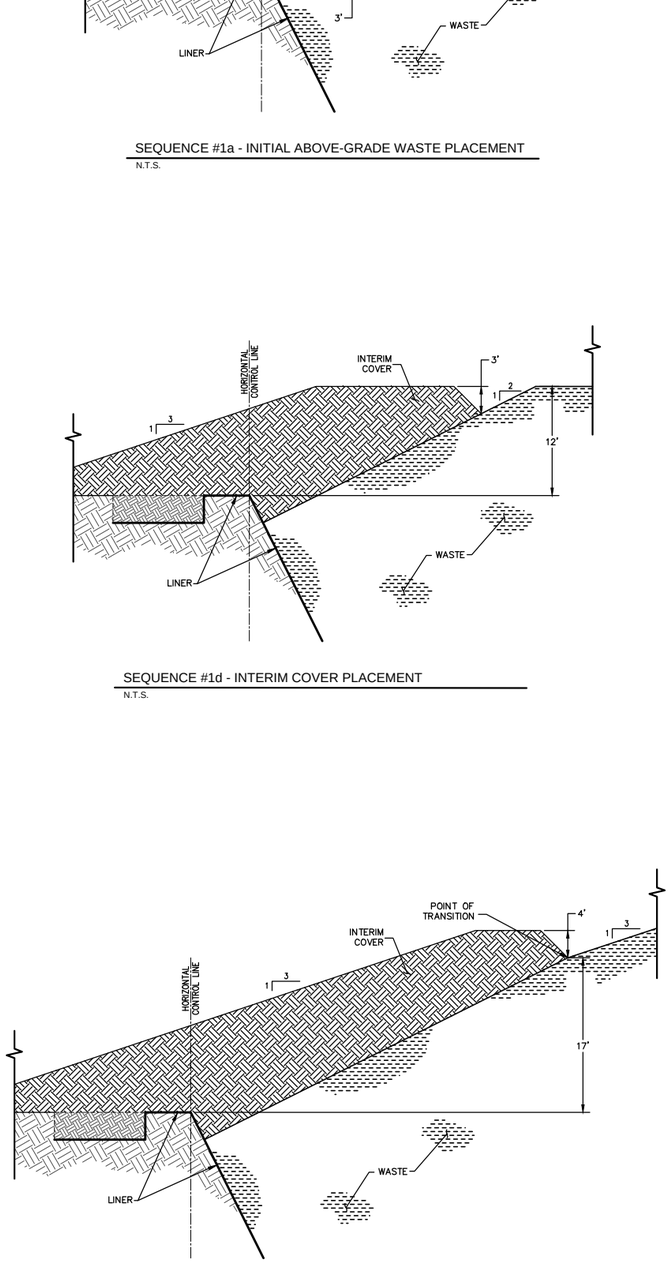

SEQUENCE #1d - INTERIM COVER PLACEMENT
N.T.S.



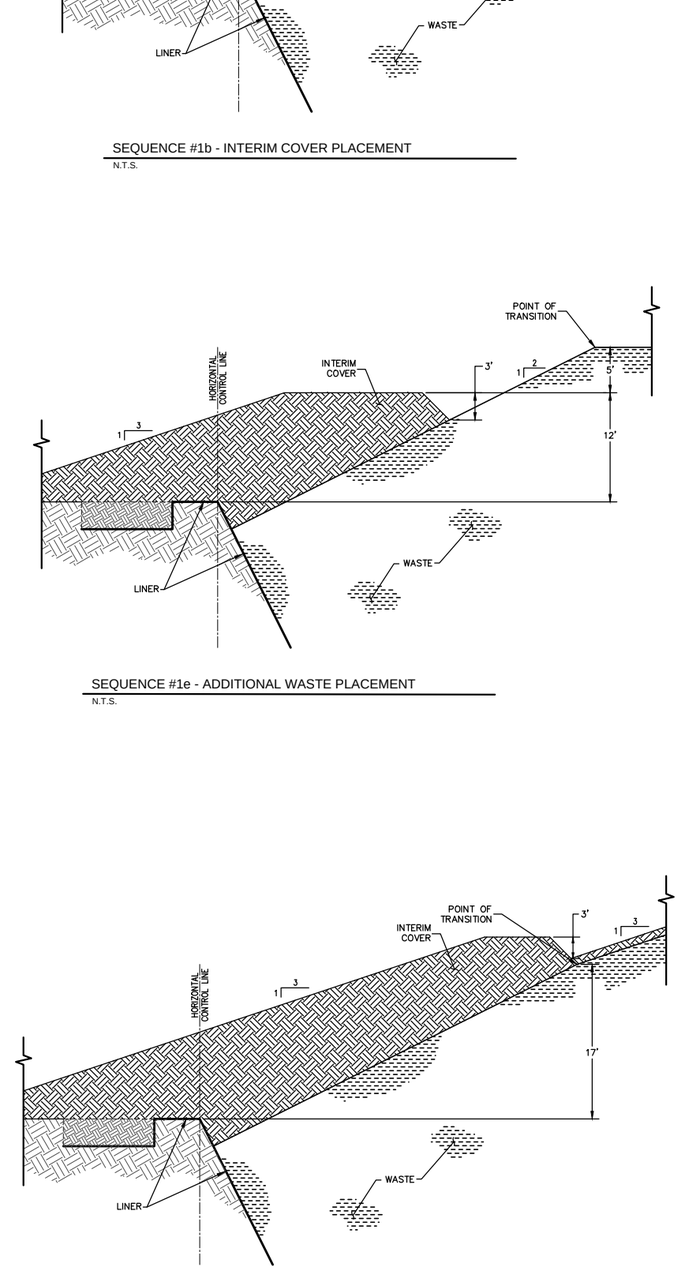

SEQUENCE #1e - ADDITIONAL WASTE PLACEMENT
N.T.S.



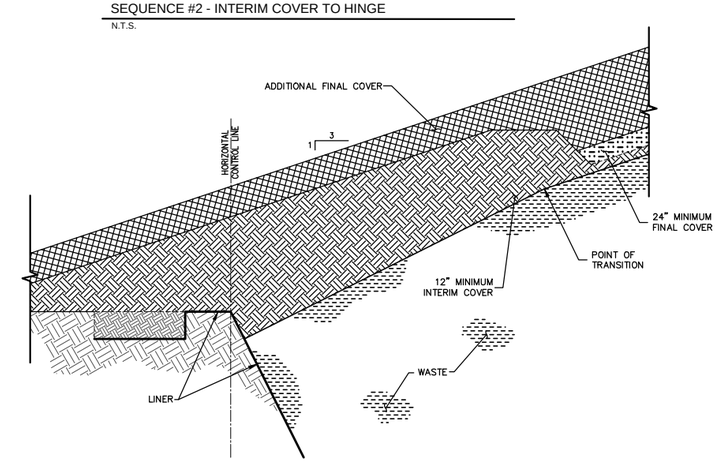

SEQUENCE #2 - INTERIM COVER TO HINGE
N.T.S.




SEQUENCE #3 - CONTINUED WASTE PLACEMENT
N.T.S.




SEQUENCE #4 - INTERMEDIATE COVER GRADING
N.T.S.




SEQUENCE #5 – FINAL COVER PLACEMENT
N.T.S.

| REV. # | DESCRIPTION | DATE |
|---|---|---|
| 0 | ISSUED FOR REGULATORY REVIEW | 10/19/15 |
| 1 | ISSUED FOR REGULATORY APPROVAL | 3/29/16 |
| 2 | | |

ABOVE–GRADE WASTE, INTERIM PROTECTIVE BERM, AND COVER PLACEMENT

PROFESSIONAL ENGINEER – STATE OF NEVADA
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Exp. 6/30/16
CIVIL
No. 01364

US ecology

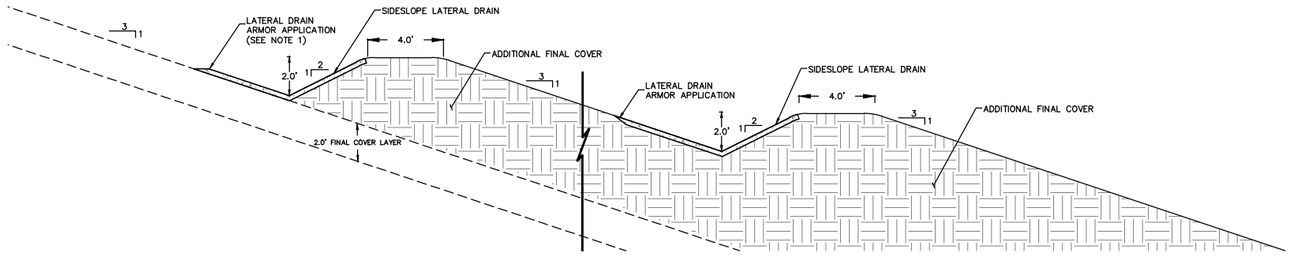
BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

PROJECT NUMBER: 143418

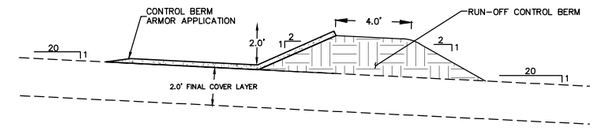
AquAeTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: |
|---|---|---|---|---|---|---|
| VT | 9/15/15 | CAB | 9/23/15 | SLW | 10/16/15 | N.T.S. |

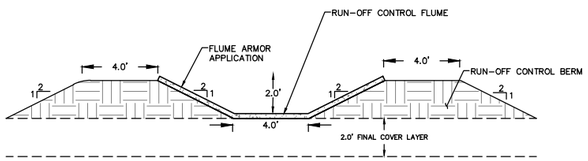
DRAWING NO: NV13–15–018



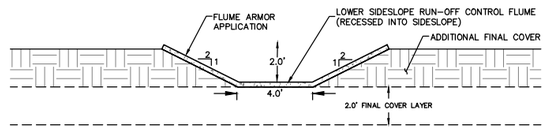

Ⓐ SIDE SLOPE LATERAL DRAIN PROFILE
(N.T.S.)



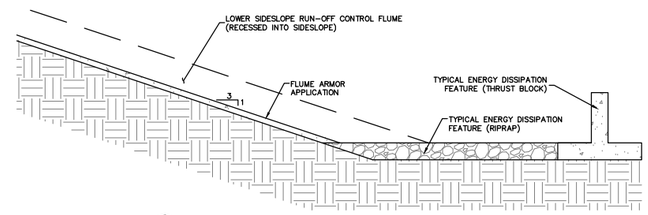

Ⓑ UPPER DECK RUN-OFF CONTROL BERM PROFILE
(N.T.S.)



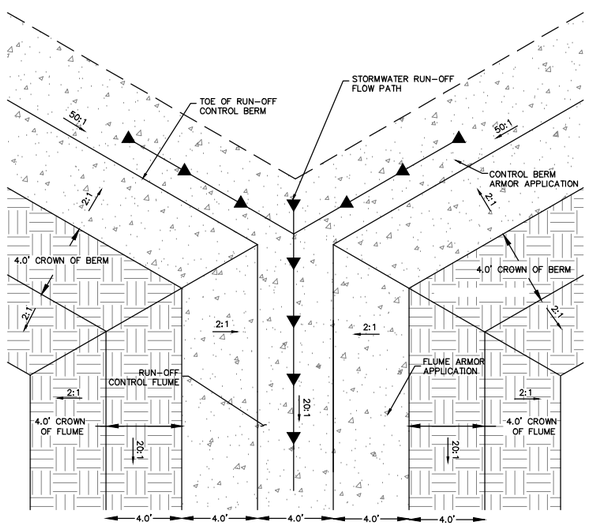

Ⓒ UPPER DECK AND UPPER SIDESLOPE RUN-OFF CONTROL FLUME PROFILE
(N.T.S.)



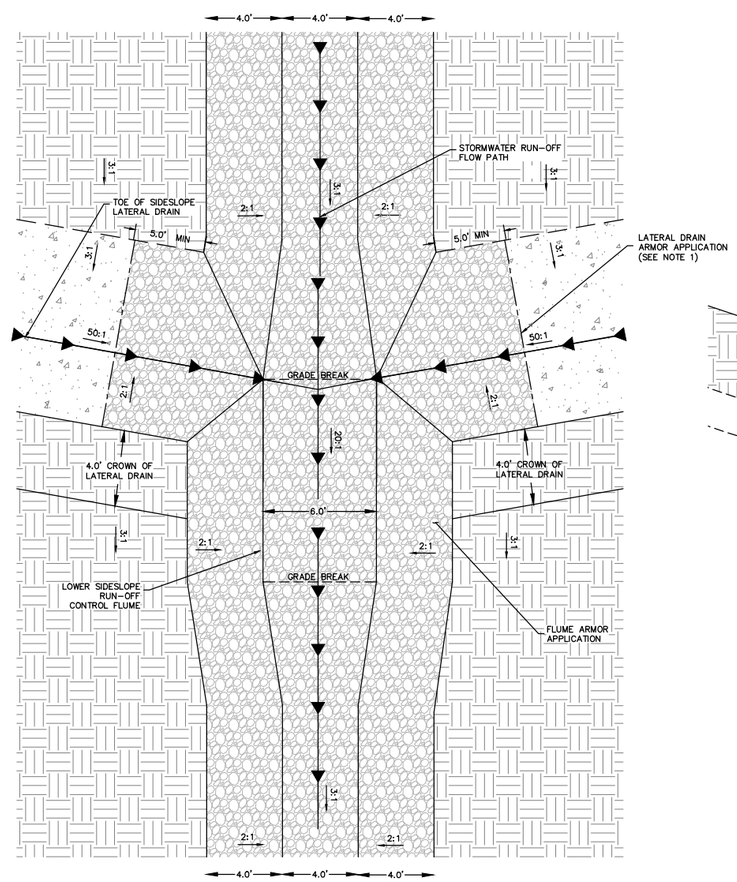

Ⓔ LOWER SIDESLOPE RUN-OFF CONTROL FLUME PROFILE
(N.T.S.)



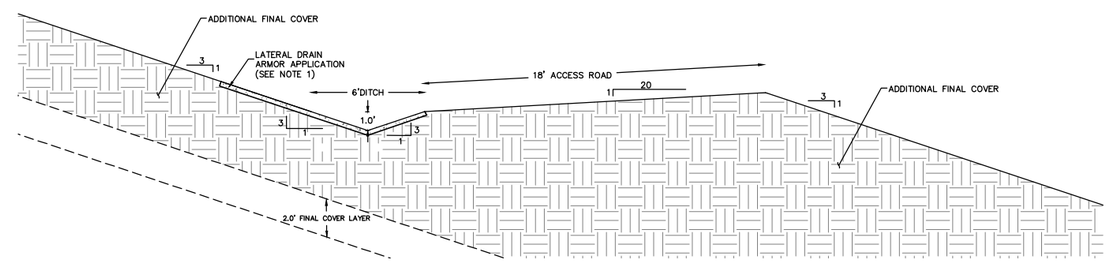

Ⓖ TYPICAL ENERGY DISSIPATION FEATURE
(N.T.S.)




Ⓓ CONFLUENCE OF RUN-OFF CONTROL BERM AND UPPER DECK AND UPPER SIDESLOPE RUN-OFF CONTROL FLUME
(N.T.S.)




Ⓕ CONFLUENCE OF SIDESLOPE LATERAL DRAINS AND LOWER SIDESLOPE RUN-OFF CONTROL FLUME
(N.T.S.)




Ⓗ TRENCH 13 ACCESS ROAD AND DRAINAGE DITCH PROFILE
(N.T.S.)

NOTE

1. AT INTERSECTION OF LATERAL DRAINS AND ACCESS ROAD DITCHES OR SIDESLOPE RUN-OFF CONTROL FLUMES, ADDITIONAL ARMORING WILL BE NECESSARY TO RESIST EROSION.

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FINAL COVER DETAILS

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STEPHEN L. WAMPLER
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CIVIL
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US ecology

BEATTY NEVADA
HAZARDOUS WASTE
MANAGEMENT FACILITY

PROJECT NUMBER: 143418

AquAeTer
optimizing resources | water, air, earth

| DRWN. BY | DATE | CHKD. BY | DATE | APRVD. BY | DATE | SCALE: | |
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# APPENDIX B

# CONSTRUCTION MATERIALS SPECIFICATIONS

# APPENDIX B CONSTRUCTION MATERIALS SPECIFICATIONS

**1. CONSTRUCTION MATERIALS SPECIFICATIONS ..... B-1**

**2. SOIL MATERIALS ..... B-2**
2.1 SPECIFICATION FOR SURFACE SOIL LAYER IMPROVEMENT ..... B-2
2.1.1 Soil Specification A ..... B-2
2.1.2 Soil Specification B ..... B-2
2.2 SPECIFICATION FOR LINER SUBGRADE ON TRENCH FLOOR AND IN SUMPS ..... B-2
2.3 GRAVEL MATERIALS FOR LDS/LCRS SUMPS AND TRENCH FLOOR PIPE BEDDING ..... B-3
2.4 SELECT WASTE OPERATIONS LAYER ..... B-3
2.5 INTERIM COVER LAYER SOIL ..... B-3
2.6 FINAL COVER LAYER SOIL ..... B-4
2.7 FINAL COVER DRAINAGES AND ROCK ARMORING ..... B-4

**3. LINER MATERIAL ..... B-6**
3.1 SACRIFICIAL LINER ..... B-6
3.2 GEOTEXTILE ..... B-6
3.3 GEONET ..... B-7
3.4 GEOMEMBRANE ..... B-7
3.5 GEOCOMPOSITE ..... B-8
3.6 GEOSYNTHETIC CLAY LINER (GCL) ..... B-9

**4. PIPING ..... B-11**
4.1 LCRS PIPING ..... B-11
4.1.1 LCRS Collection Pipe (Bottom Section) ..... B-11
4.1.2 LCRS Collection Pipe to Long-Radius Transition (LCRS Riser Support) ..... B-11
4.1.3 LCRS Long-Radius Bend ..... B-11
4.1.4 LCRS Riser Pipe ..... B-12
4.1.5 LCRS Riser Pipe and Long-Radius Bend Slip Cover ..... B-12
4.2 LDS PIPING ..... B-12
4.2.1 LDS Collection Pipe ..... B-12
4.2.2 LDS Collection Tee ..... B-12
4.2.3 LDS Elbows ..... B-12
4.2.4 LDS Riser Pipe ..... B-13
4.3 LATERAL AND CENTERLINE LEACHATE COLLECTION PIPES ..... B-13

**5. CONCRETE ..... B-14**
5.1 LCRS RISER PIPE SUPPORT CONCRETE BLOCK ..... B-14
5.2 TOP OF SLOPE CONCRETE ANCHOR ..... B-14
5.3 NEAT CEMENT GROUT – MONITORING WELL ABANDONEMNT ..... B-14
5.4 CEMENT GROUT – COVER DRAINAGE FEATURES ..... B-14

# 1. CONSTRUCTION MATERIALS SPECIFICATIONS

This presentation of construction materials specifications is supplemental to such information provided in project drawings. In the event that information included herein is in any way incomplete or conflicts with that provided in project drawings, the project drawings are to be considered primary.

# 2. SOIL MATERIALS

Soil materials will consist of the predominantly sand and gravel soils obtained from stockpiles and the Trench 13 excavation area, supplemented as needed with imported soil materials. Materials that cannot be satisfactorily placed and/or compacted to a stable condition will be designated as unsuitable. Unsuitable materials will include trash, organic substances, large rocks[2] or other materials determined to be unsuitable by the Project Manager. These materials will be removed from the fill material and segregated from suitable soil.

## 2.1 SPECIFICATION FOR SURFACE SOIL LAYER IMPROVEMENT

### 2.1.1 Soil Specification A

Soil materials for replacement of the loose surface soil layer will consist of site materials with no materials larger than six inches, 95% smaller than 3.0 inches, and between 5% and 20% passing the #200 sieve. Suitable materials from direct excavation or stockpiles will be placed in lifts not exceeding 12 inches thick and compacted to 95 percent MDD (maximum dry density) by ASTM D 1557 at a moisture content between the OMC (optimum moisture content) and OMC +2 percent. Mixture with fine-grained soil amendment(s) is not required if the natural material satisfies the grain size specification.

### 2.1.2 Soil Specification B

This soil will be the same material and same grain sizes as provided in Section 2.1.1; however, there is no compaction or moisture content requirement.

## 2.2 SPECIFICATION FOR LINER SUBGRADE ON TRENCH FLOOR AND IN SUMPS

Soil materials for the liner subgrade layer will consist of site materials, amended as necessary with imported fine-grained materials to achieve the grain size specification. The final subgrade soil will have not more than 10 percent (by weight) coarser than 1.0 inch and not less than 10 percent

[2] Rocks more than six inches in diameter should be rare in suitable material and absent where excluded by gradation specification.

(by weight) smaller than the #200 sieve. Suitable materials from direct excavation or stockpiles, will be approved by the CQA Officer, and will be placed in lifts not exceeding 12 inches thick (before compaction) and compacted to 95 percent MDD by ASTM D 1557 at a moisture content between the OMC and OMC +2 percent.

## 2.3 GRAVEL MATERIALS FOR LDS/LCRS SUMPS AND TRENCH FLOOR PIPE BEDDING

Gravel materials for use in LDS/LCRS sumps will consist of screened site materials with 100% smaller than 2.0 inches, not less than 90 smaller than 1.5 inches, not more than 15% smaller than 0.75 inches, and not more than 5% smaller than the #4 sieve. All gravel material will be stockpiled and placed in such a manner as to minimize the intrusion of fines and to minimize segregation of various gravel sizes. Gravel materials for LDS and LCRS sumps, and for placement along LCRS piping, will be loosely placed with no compaction or moisture content specification.

## 2.4 SELECT WASTE OPERATIONS LAYER

The operations layer is not a bottom liner component, but its presence and material type are significant in hydrologic calculations completed as part of LCRS design. It is the initial 30 inches of material placed above the liner across the bottom of each disposal cell (Phases 13A – 13E). The operations layer is to be an SM (silty sand) material, by Universal Soil Classification System (ASTM D2487), can be comprised of clean soil, select waste, or a combination of clean soil and select waste. The first foot (12 inches) of operations layer above the liner will be primarily (i.e., greater than 50 percent) sand, with a total of less than 50 percent gravel and silt/clay size particles. It will contain no particles larger than one inch. Select waste streams will be discriminated based upon visual inspections and reference to generator knowledge. Site stockpile soil will be screened prior to use. The next 1.5 feet (18 inches) also should be SM material, but can contain particles up to 6.0 inches in diameter. The select waste operations layer should be placed in two lifts (as noted above), as dry as is practical, and with as little passage of heavy equipment as is practical (before the full layer is in placed). This layer has no compaction or moisture content specifications.

## 2.5 INTERIM COVER LAYER SOIL

Soil materials for the Trench 13 interim soil layer will contain no materials larger than 6.0 inches

except when determined by the design or quality assurance engineer, to be '*de minimis*' (or minimal) by visual observation and rarely, if ever, in grain-to-grain contact. If materials greater than 6.0 inches are included in the interim soil layer, it might be necessary to increase the thickness of the interim cover layer or the final cover layer to meet the objectives of the cover system. Suitable materials will be derived from direct excavation or stockpiles, non-hazardous soil materials, or from on-site screening of these materials. Typically, this layer will be placed in a single lift. Lift thickness will be measured and documented, but there is no compaction specification for this material, which will be placed as above-grade waste disposal proceeds.

## 2.6 FINAL COVER LAYER SOIL

The Final Cover Layer will consist of sand and gravel soils obtained from USEN stockpiles and from direct excavation. Soil materials for the final cover layer will contain only minimal materials larger than 6.0 inches, 90 percent smaller than 1.0 inch, and not less than 5.0 percent passing the #200 sieve. The presence of particles exceeding 6.0 inches in the final cover layer, do not affect the long-term moisture holding and moisture-releasing capacity of these soil layer so long as such materials are minimal constituents (by volume) of the final cover layers and are rarely, if ever, in grain-to-grain contact. Particles of 6.0 inch and larger dimension can be judged acceptable in the final cover layer, by the design or quality assurance engineer, if '*de minimis*' (or minimal) by visual observation.

## 2.7 FINAL COVER DRAINAGES AND ROCK ARMORING

Lateral drains are located on Trench 13 sideslopes and are constructed of final cover layer soils obtained from USEN stockpiles and from direct excavation, as further defined in Section 2.6. The lateral drains will be lined with rock armoring material with a $D_{50}$ of 2.0 inches or greater.

Berms located on the 20H:1V upper deck of Trench 13 will be constructed of soil obtained from USEN stockpiles and from direct excavation. The upper deck berms will be lined with rock armoring material with a $D_{50}$ of 2.0 inches or greater.

Flumes located on the 20H:1V upper deck of Trench 13 will be constructed of soil obtained from USEN stockpiles and from direct excavation. The upper deck flumes will be lined with rock armoring material with a minimum $D_{50}$ of 2.0 inches or greater.

Flumes located on the 3H:1V sideslopes of Trench 13 are constructed of final cover layer soils obtained from USEN stockpiles and from direct excavation, as further defined in Section 2.6. The flumes will be lined with rock armoring material with a minimum $D_{50}$ of 12.0 inches or rock armoring with a minimum $D_{50}$ of 4.0 inches and interstitial spaces filled with cement grout.

Access road drainages are sloped at 5 to 10 percent. The access road and drainage will be constructed of soils obtained from USEN stockpiles and from direct excavation. The access road drainages will be lined with rock material with a minimum $D_{50}$ of 6.0 inches or grouted rock, as described previously.

Rock armoring shall be hard, durable, angular to sub-rounded in shape, and free from cracks, shale, and organic matter. All rock material shall be angular to sub-rounded and have a minimum specific gravity of 2.5 grams per cubic centimeter.

# 3. LINER MATERIAL

## 3.1 SACRIFICIAL LINER

The flexible membrane liner (FML) or geomembrane materials will be made of new, high-density polyethylene (HDPE) or very flexible polyethylene (VFPE or LLDPE) materials. The purpose of the sacrificial liner, as stated in the design report, is to protect the subsequent liner components from ultra-violet light and other environmental hazards. Minimum specifications, unless other indicated, for the sacrificial HDPE liner are included in the table below.

Minimum Specifications for 40 mil High Density Polyethylene Liner – No Texture:

| Property | Test Method | Value |
|---|---|---|
| Thickness, minimum average, mil | ASTM D5994 | 40 (0.040 inch) |
| Density | ASTM D792 | 0.94 gm/cm$^3$ |

## 3.2 GEOTEXTILE

Geotextile for use in this project will consist of needle punched non-woven polypropylene materials designed and fabricated to meet the requirements of the project. All geotextile is to be stored and installed in such a way as to prevent degradation by direct sunlight, wind, or mechanical damage.

Unless otherwise indicated, specifications for geotextile materials are included in the tables below.

Minimum Specifications for 10 ounce geotextile.

| Property | Test Method | Value |
|---|---|---|
| Thickness, mil (in) | ASTM D5199 | 100 (0.100) |
| Mass per Unit Area oz/sq. yd (lbs/ft^2) | ASTM D5261 | 10.0 (0.069) |
| Strain at Yield, % | ASTM D4632 | 50 |
| UV Resistance, % | ASTM D4355 | 70% after 500 hours |
| Tensile Strength, lbs/in | ASTM D4595 | 150 |

Minimum Specifications for 16 ounce geotextile.

| Property | Test Method | Value |
|---|---|---|
| Mass per Unit Area oz/sq. yd (lbs/ft^2) | ASTM D5261 | 16.0 (0.11) |

## 3.3 GEONET

The geonet materials will be made of new, high-density polyethylene (HDPE) or very flexible polyethylene (VFPE) materials, as required by the design drawings, manufactured specifically for the purpose of liquid conveyance. The geonet will have, unless otherwise indicated in these specifications or project drawings, the following minimum property values.

| Property | Test Method | Minimum Property Value |
|---|---|---|
| Thickness, mil | ASTM D 5199 | 200 (0.200 inch) |
| Weight, lbs/ft^2 | ASTM D 5261 | 0.162 |
| Tensile Strength, lb/in | ASTM D 5035 | 45 |
| Transmissivity, gal/min·ft^2 | ASTM D 4716 | 9.66 |
| Strain at Yield, % | ASTM D 4595 | 23% |

## 3.4 GEOMEMBRANE

The flexible membrane liner (FML) or geomembrane materials will be made of new, high-density polyethylene (HDPE) or very flexible polyethylene (VFPE or LLDPE) materials, as required by the design drawings, manufactured specifically for the purpose of liquid containment. All geomembrane liner materials will have sufficient strength and resistance to chemical or ultraviolet radiation attack for the intended use. Minimum specifications, unless otherwise indicated, for HDPE materials are included in the table below.

General Requirements

- Composition: High-density polyethylene (HDPE) containing no plasticizers, fillers, extenders, or chemical additives, except for the following:
    - Two to three percent by weight of carbon black to resin for ultraviolet resistance; and
    - Antioxidants and heat stabilizers, not to exceed 1.5 percent by weight, may be added as required for manufacturing.
- Textured sheets should be textured on both sides to the same roughness.
- Sheet width should be a minimum of 20 feet.

Minimum Specifications for 80 mil High Density Polyethylene Liner – Textured on both sides

| Property | Test Method | Value |
|---|---|---|
| Thickness, minimum average, mil | ASTM D5994 | 76 (0.076 inch) |
| Density | ASTM D792 | 0.94 gm/cm$^3$ |
| Tensile strength @ yield | ASTM D6693 | 176 lb/in-width |

| | | |
|---|---|---|
| Elongation @ yield | ASTM D6693 | 13% |

Minimum Specifications for 80 mil High Density Polyethylene Liner – Textured on one side

| Property | Test Method | Value |
|---|---|---|
| Thickness, minimum average, mil | ASTM D5994 | 76 (0.076 inch) |
| Density | ASTM D792 | 0.94 gm/cm$^3$ |
| Tensile strength @ yield | ASTM D6693 | 176 lb/in-width |
| Elongation @ yield | ASTM D6693 | 13% |

Minimum Specifications for 60 mil High Density Polyethylene Liner – Textured on both sides

| Property | Test Method | Value |
|---|---|---|
| Thickness, minimum average, mil | ASTM D5994 | 57 (0.057 inch) |
| Density | ASTM D792 | 0.94 gm/cm$^3$ |
| Tensile strength @ yield | ASTM D6693 | 132 lb/in-width |
| Elongation @ yield | ASTM D6693 | 13% |

The Manufacturer will certify that the geomembrane has been inspected and quality-control tested during the manufacturing process, and that the materials are free of holes, blisters, undispersed raw materials, and contamination by foreign materials.

In addition, the Manufacturer will certify that the geomembrane meets all strength and resistance requirements for the intended use.

Documentation must be provided verifying that all factory welds meet the requirements for field seaming, and that the destructive and non-destructive testing required for field seaming has been performed also for factory seams.

## 3.5 GEOCOMPOSITE

The geocomposite is a geonet sandwiched between two layers of geotextile to create a double-sided geocomposite. The geocomposite final product and its components will have the following property values.

Minimum specifications for the geocomposite material comprised on a 200 mil geonet bonded to two 6 ounce geotextile layers.

Minimum specifications for the geocomposite component

| Property | Test Method | Minimum Property Value |
|---|---|---|
| Transmissivity, gal/min·ft | ASTM D4716 | 0.48 |
| Weight (Total), lbs/sq.ft | ASTM D5261 | 0.25 |

Minimum specifications for the geonet component

| Property | Test Method | Minimum Property Value |
|---|---|---|
| Thickness, mil | ASTM D5199 | 200 |
| Tensile Strength, lb/in | ASTM D5035 | 50 |
| Unit Weight, lbs/sq. ft | ASTM D-5261 | 0.162 |

Minimum specifications for the geotextile component

| Property | Test Method | Minimum Property Value |
|---|---|---|
| Unit Weight, oz/yd$^2$ | ASTM D5261 | 6 |
| Elongation @ yield, % | ASTM D4632 | 50 |
| Permittivity, sec$^{-1}$ | ASTM D4491 | 1.5 |
| UV Resistance | ASTM D4355 | 70% after 500 hours |

Minimum specifications for the geocomposite material comprised on a 300 mil geonet bonded to two 8 ounce geotextile layers.

Minimum specifications for the geocomposite component.

| Property | Test Method | Minimum Property Value |
|---|---|---|
| Transmissivity, gal/min·ft | ASTM D4716 | 4.35 |

Minimum specifications for the geonet component.

| Property | Test Method | Minimum Property Value |
|---|---|---|
| Thickness, mil | ASTM D5199 | 300 |

Minimum specifications for the geotextile component.

| Property | Test Method | Minimum Property Value |
|---|---|---|
| Unit Weight, oz/yd2 | ASTM D5261 | 8 |
| Permittivity, sec-1 | ASTM D4491 | 1.26 |

## 3.6 GEOSYNTHETIC CLAY LINER (GCL)

This liner system component is a reinforced GCL consisting of a layer of sodium bentonite between two nonwoven geotextiles. The GCL will be manufactured by mechanically bonding the geotextiles using a needle punching process to enhance frictional and internal shear strength characteristics. The final product will have the following minimum values.

| Property | Test Method | Value |
|---|---|---|
| Hydraulic Conductivity, cm/sec | ASTM D5887 | 5.0E-9 |
| Bentonite Mass/Area, lb/ft2 | ASTM D5993 | 0.75 (min) |
| GCL Grab Strength, lbs/in MARV | ASTM D6768 | 50 |
| GCL Strain @ Yield, % | ASTM D4595 | 15 |

The bentonite will be bonded between the confining geotextiles in a manner to ensure that the bentonite will not be displaced during handling, transportation, storage and installation, including cutting, patching, and fitting around penetrations.

The geotextiles should be continuously inspected for broken needles with an inline metal detector. Broken needles should be removed from the geotextile.

A minimum overlap guide-line and a construction match-line delineating the overlap zone should be imprinted with non-toxic ink on both edges of the GCL panel to ensure the accuracy of the seam. These lines should be used during CQA to ensure the minimum overlap is achieved. The minimum overlap guideline should indicate where the edge of the panel must be placed in order to achieve a full six inches of bentonite overlap for each panel.

# 4. PIPING

Pipe used for LCRS collectors, LCRS risers, and LDS risers will consist of steel, HDPE, and polyethylene pipe materials of the type and diameters specified in project drawings. Collection piping will be of the diameter, wall thickness, and perforation detail indicated in project drawings. All piping connections will be made in accordance with Manufacturer recommendations.

## 4.1 LCRS PIPING

### 4.1.1 LCRS Collection Pipe (Bottom Section)

The LCRS collection pipe is used to collect (by pumping) leachate from the LCRS sump. The bottom section of the collection pipe is approximately 5 feet in length and 12-inch diameter SDR 11 perforated HDPE pipe that is extrusion-welded at a 63.4 degree angle to a 1.0-inch thick, 20-inch square HDPE flatstock base. The LCRS collection pipe will have six 1/2-inch diameter holes spaced at 60 degrees radially around the pipe, and will have 24 holes per foot (3-inches on center).

### 4.1.2 LCRS Collection Pipe to Long-Radius Transition (LCRS Riser Support)

The transition (riser support) between the LCRS collection pipe and the LCRS long-radius bend pipe (described below) includes a 14-inch diameter, Schedule 60, Type 316 stainless steel pipe that is a minimum 21-inches in length, a 20-inch O.D. by 14-inch I.D. by 0.5-inch thick type 316 stainless steel bearing plate with twelve 1.0-inch diameter by 6-inch long expansion type anchor bolts, a 14-inch to 12-inch Schedule 40 stainless steel reducer, and a 12-bolt stainless steel flange. The transitions will be set in a concrete foundation block which will transfer the LCRS long radius bend, riser pipe, and potential down-drag loads to the LCRS gravel.

### 4.1.3 LCRS Long-Radius Bend

The LCRS long radius bend will be 12-inch diameter Schedule 40 stainless steel pipe at a length of 20 feet. The LCRS long-radius bend will offset the riser support block and LCRS collection pipe 3.5 feet from the upper sidewall, to clear the sump sidewall berm. Manufacture of the necessary sweeping bend must not compromise the strength of the stainless steel. The LCRS long radius bend will connect the LCRS riser transition and support block to the LCRS riser pipe. The

bottom of the LCRS long radius bend will be welded to a 12-bolt stainless steel flange. The top of the long radius bend will be butt-welded to the LCRS riser pipe.

#### 4.1.4 LCRS Riser Pipe

The LCRS riser pipe will be 12-inch diameter Schedule 40 stainless steel pipe at a length to be field-determined.

#### 4.1.5 LCRS Riser Pipe and Long-Radius Bend Slip Cover

The LCRS riser pipe and long-radius bend pipe will be sheathed with a slip cover made from 10 foot sections of corrugated polyethylene pipe (CPEP) or acceptable alternative. The CPEP will be split longitudinally and placed over the LCRS riser pipe.

### 4.2 LDS PIPING

#### 4.2.1 LDS Collection Pipe

The LDS collection pipe collects leachate from the LDS sump and will be 12-inch diameter SDR 11 perforated HDPE pipe at a length to be field-determined. The LDS collection pipe will have six 1/2-inch diameter holes spaced at 60 degrees radially around the pipe, and will have 24 holes per foot (3-inch on center).

#### 4.2.2 LDS Collection Tee

The LDS collection tee will be 12-inch diameter SDR 11 perforated HDPE tee at a length to be field determined. The LDS collection tee will have six 1/2-inch diameter holes spaced at 60 degrees radially around the pipe, and will have 24 holes per foot. The LDS collection tee will connect at its midpoint to the LDS collection pipe.

#### 4.2.3 LDS Elbows

The LDS elbows will be 12-inch diameter SDR 11 HDPE pipe at a length to be field-determined. The first elbow will sweep at a 45 degree angle and will connect the lower section of the LDS riser pipe to the LDS collection pipe. The second elbow will sweep at an 18 degree angle and will connect the lower section of the LDS riser pipe to the riser used in the sidewall recess. The upper 18 degree sweep must be gradual enough to allow installation of down-hole pump equipment.

### 4.2.4 LDS Riser Pipe

The LDS riser pipe will be 12-inch diameter SDR 11 HDPE pipe at a length to be field determined. The pipe will sit in an 18-inch recessed cut in the sidewall of Trench 13 and will connect to the LDS elbows.

## 4.3 LATERAL AND CENTERLINE LEACHATE COLLECTION PIPES

The lateral and centerline leachate collection pipes will be 4-inch diameter SDR 11 perforated HDPE pipe. The pipes will have two 3/8-inch diameter holes at 45 degrees below horizontal per lineal foot.

# 5. CONCRETE

## 5.1 LCRS RISER PIPE SUPPORT CONCRETE BLOCK

The LCRS riser pipe support is a cast-in-place unit built of 4,000 psi concrete, using Type V sulfate-resistant cement. The exterior dimensions of the concrete block are 24-inch by 24-inch by 18-inch and is built in-place around the 14-inch Schedule 60 Type 316 stainless steel pipe of the LCRS collection pipe to long radius transition. The concrete foundation block transfers the load of the riser pipe and potential down-drag loads to the LCRS gravel, thus preventing stress concentrations on the liner system.

## 5.2 TOP OF SLOPE CONCRETE ANCHOR

This is a concrete block with an adjustable U-bolt. The block has no minimal strength requirements, is approximately 3-feet by 3-feet by 1.5-feet, is pre-cast, and has a 63.4 degree chamfer on the pipe side. The U-bold is attached to the concrete anchor, on the chamfer side, with a ¾-inch by 4-inch long anchor bolt. This component provides lateral restraint for the riser pipe while allowing vertical movement to accommodate settlement.

## 5.3 NEAT CEMENT GROUT – MONITORING WELL ABANDONEMNT

The final Phase of construction, Phase E, will require the abandonment of monitoring well MW-327. This well extends below the base of Trench 13. To prevent future issues with the foundation of Trench 13, the monitoring well will be abandoned with a neat cement grout backfill. The neat cement grout should be mixed with water in the proportion of five to six gallons of water per sack of cement (i.e., about 94 pounds). Hydrated lime may be substituted for cement up to 10 percent by volume. Between two and four pounds of bentonite powder should be added to the mix for each sack of cement used. The neat cement grout will be pumped into place with a tremie pipe that extending to within 10 feet of the bottom.

## 5.4 CEMENT GROUT – COVER DRAINAGE FEATURES

Sideslope flumes and access road drainages require large rock material to provide sufficient tractive force resistance. An alternative to large rock material includes use of rock material with

a minimum $D_{50}$ of 4.0 inches and grouting of interstitial spaces. The cement grout should have a minimum 28-day compressive strength of 2,500 pounds per square inch.

# APPENDIX C

# CONSTRUCTION METHOD SPECIFICATIONS

# APPENDIX C: CONSTRUCTION METHOD SPECIFICATIONS

**1. INTRODUCTION ..... C-1**

**2. PHYSICAL LAYOUT ..... C-2**

**3. EARTHWORK ..... C-4**
3.1 CONSTRUCTION LIMITS ..... C-4
3.1.1 Surface Soil Recompaction Excavation Limit ..... C-4
3.1.2 Anchor Trench Excavation Limit ..... C-4
3.1.3 Trench 13 Excavation Limit ..... C-4
3.2 SURFACE SOIL RECOMPACTION AREA – TRENCH PERIMETER ..... C-5
3.2.1 Surface Soil Recompaction Excavation Limit ..... C-5
3.3 TRENCH EXCAVATION ..... C-7
3.4 TRENCH SIDEWALLS ..... C-8
3.4.1 Sidewall Preparation ..... C-8
3.4.2 Slope Riser Trenched Recesses ..... C-9
3.5 SELECT WASTE OPERATIONS LAYER ..... C-9
3.6 TRENCH BOTTOM SUBGRADE PREPARATION ..... C-9
3.7 FINAL COVER CONSTRUCTION ..... C-11
3.7.1 Construction Specification for Interim Cover Layer Soil ..... C-12
3.7.2 Construction Specification for Final Cover Layer Soil ..... C-12
3.7.3 Construction Specification for Cover Drainage Features ..... C-13

**4. GEOSYNTHETIC MATERIALS (GENERAL) ..... C-15**

**5. GEOSYNTHETIC CLAY LINER (GCL) ..... C-16**
5.1 LABELING, PACKAGING, TRANSPORTATION AND STORAGE ..... C-16
5.2 SUBGRADE PREPARATION ..... C-18
5.3 GCL INSTALLATION ..... C-19
5.4 JOINING GCL PANELS ..... C-21
5.5 DETAIL WORK AND PATCHING ..... C-21

**6. GEOCOMPOSITE/GEONET ..... C-23**
6.1 LABELING, PACKAGING, TRANSPORTATION AND STORAGE ..... C-23
6.2 SUBGRADE PREPARATION ..... C-24
6.3 GEOCOMPOSITE/GEONET INSTALLATION ..... C-25
6.4 JOINING GEOCOMPOSITE/GEONET PANELS ..... C-25
6.5 DETAIL WORK AND PATCHING ..... C-27
6.6 LINER MATERIAL COVER ..... C-27

**7. GEOMEMBRANE ..... C-28**
7.1 GEOMEMBRANE LABELING, DELIVERY, STORAGE, AND HANDLING ..... C-28
7.2 SURFACE PREPARATION ..... C-29
7.3 GEOMEMBRANE INSTALLATION ..... C-30
7.3.1 Panel Layout ..... C-30

7.3.2 Weather Conditions ..... C-30
7.3.3 General Placement ..... C-31
7.3.4 Geomembrane Anchoring ..... C-32
7.3.5 Panel Placement and Alignment ..... C-32
7.3.6 Panel Identification ..... C-33
7.3.7 Installation Schedule ..... C-33
7.4 FIELD SEAMING ..... C-34
7.4.1 Geomembrane Panel Alignment ..... C-34
7.4.2 Personnel Requirements ..... C-34
7.4.3 Weather Conditions ..... C-35
7.4.4 Test Seams ..... C-35
7.4.5 Test Seam Evaluation Criteria ..... C-36
7.4.6 General Seaming Procedures ..... C-37
7.5 FACTORY SEAMS ..... C-39
7.6 GEOMEMBRANE PENETRATIONS ..... C-39
7.7 DEFECTS AND REPAIRS ..... C-40
7.7.1 General ..... C-40
7.7.2 Evaluation ..... C-40
7.7.3 Procedures for Repair ..... C-40
7.8 NON-DESTRUCTIVE SEAM CONTINUITY TESTING ..... C-41
7.8.1 General ..... C-42
7.8.2 Testing Procedures ..... C-42
7.8.3 Installer Quality Control ..... C-43
7.9 DESTRUCTIVE SEAM TESTING ..... C-44
7.9.1 Testing Location and Frequency ..... C-44
7.9.2 Sample Size ..... C-45
7.9.3 Testing Procedure ..... C-45

**8. GEOTEXTILE ..... C-48**
8.1 LABELING, PACKAGING, TRANSPORTATION AND STORAGE ..... C-48
8.2 HANDLING AND PLACEMENT ..... C-48
8.3 CONFORMANCE TESTING ..... C-49
8.4 SEAMS AND OVERLAPS ..... C-49
8.5 REPAIR ..... C-49

**9. LINER SYSTEM COMPONENT DESCRIPTIONS ..... C-51**
9.1 BASE LINER SYSTEM COMPONENTS ..... C-51
9.2 SLOPE LINER SYSTEM COMPONENTS ..... C-52
9.3 TRENCH BOTTOM/SIDEWALL TRANSITION LINER SYSTEM COMPONENTS ..... C-53

**10. LEACHATE COLLECTION SYSTEM ..... C-54**
10.1 LEACHATE COLLECTION AND RECOVERY SYSTEM ..... C-54
10.2 LEAK DETECTION SYSTEM ..... C-56

**11. LINER SYSTEM EXPOSURE PROTECTION ..... C-57**

## LIST OF TABLES

Table C-1: Soil Placement Inspection Schedule

Table C-2: Geomembrane Installer's Certification – Subgrade Acceptance

# 1. INTRODUCTION

The Construction Specifications document provides detailed discussion and specifications for the construction of the at-grade and below-grade features of Trench 13. Within these Construction Specifications, the following reference convention is used:

- References to material specifications are to **Appendix B** of the CQA Plan; and
- References to design drawings are to **Appendix A** of the CQA Plan. Drawings are referenced by the last three digits of their sequential number, e.g., Drawing NV13-15-007 is referred to as **Drawing 007**.

These Construction Specifications are supplemental to such information provided in project drawings. In the event that information being included herein is in any way incomplete or conflicts with that provided in project drawings, the project drawings are to be considered primary.

## 2. PHYSICAL LAYOUT

This work will consist of the layout, by appropriate land survey methods, of excavation area limits and other construction details. All components will be laid out in accordance with the location coordinates, lines and grades, and construction details shown on the project plans. Staking will be verified in accordance with the project plans using appropriate land surveying and quality control inspection techniques.

Verification of the constructed positions and dimensions (horizontal coordinates and elevation) of the excavated trench will be accomplished in accordance with the following:

- Following excavation, a detailed survey of the excavated Trench 13 floor, prior to placement of 9-inch subgrade and following placement of 9-inch subgrade, should be completed. The vertical control criterion for survey accuracy should be at least 0.1 feet, and comparison of actual and design grade should done on a 50-feet grid. All grid intersections must be verified to include a minimum of 9 inches of compacted subgrade materials;
- Following excavation of LCRS/LDS sumps, a detailed survey of the excavated sump floor must be made prior to placement of 36-inch subgrade and following placement of 36-inch subgrade placement. The vertical control criterion for survey accuracy should be at least 0.1 feet, and comparison of actual and design grade should be done on a 10-feet grid. All grid intersections must be verified to include a minimum of 36 inches of compacted subgrade material;
- Prior to Final Cover placement, a detailed survey of the waste and Interim Cover grade should be completed. The vertical control criterion for survey accuracy should be at least 0.25 feet, and comparison of actual and design grade should done on a 50-feet grid;
- A survey of the Final Cover, using the same vertical and horizontal criteria as above, will be compared to the survey of the upper surface of the Interim Cover. The comparison will confirm that 90 percent of the points of measurement (i.e., grid intersections on 50-ft grid) of total final cover thickness satisfy the minimum requirement of 2.0 feet and that there is no point of measurement where the total final cover thickness is more than 0.25 feet less than the design requirement of 2.0 feet; and
- The CQA Officer will be responsible for verifying construction by checking survey data for compliance with the design drawings. Any significant differences will be noted by the CQA Officer, and the Project Manager will be notified.

A Land Surveyor licensed in the State of Nevada should supervise or perform all necessary surveying for the successful execution of the work.

Changes to the physical layout will have the approval of the Project Engineer prior to implementation.

# 3. EARTHWORK

Trench 13 earthwork activities include excavation and improvement of the surface soil layer, trench excavation, excavation of LCRS riser recesses, and final cover placement. The Trench 13 footprint is located on undeveloped land to the south of the existing facility, and should provide adequate space for excavation equipment to be operated and to transport excavated material to designated laydown locations.

## 3.1 CONSTRUCTION LIMITS

The excavation plan and horizontal limits of grading for Trench 13 are provided on **Drawings 005** and **006**.

### 3.1.1 Surface Soil Recompaction Excavation Limit

**Drawings 003** and **004** show the estimated horizontal limit of the excavation around the Trench 13 perimeter for surface soil removal, replacement, and recompaction. The actual vertical limits of the soil recompaction excavation will be based on field determination of the thickness of the loose (non-cohesive) surface soil layer.

### 3.1.2 Anchor Trench Excavation Limit

Anchor trench excavation details are shown on **Drawings 003** and **004**. Anchor trench construction is to be done in conjunction with surface soil removal, replacement, and recompaction. The detailed drawings illustrate the horizontal limits of the anchor trench around the entire footprint of Trench 13, as well as specific grading details required to properly mitigate against surface water run-on.

### 3.1.3 Trench 13 Excavation Limit

The excavation plan and horizontal limit of excavation for Trench 13 are provided on **Drawings 005** and **006**. Excavation slopes are consistent at 0.5 feet horizontal to 1 foot vertical (0.5H:1.0V) for all Trench 13 side slopes. A slope stability calculation located in the Trench 13 Engineering Design Report (**Appendix B**) confirms the stability of the design. Trench 13 sub-

grade elevations and grades shown on **Drawings 005** and **006** and are accompanied by a survey control point table. The control points were established to ensure minimum slopes are met through all phases of Trench 13 construction, the horizontal control is the existing site coordinate system and vertical control is NAVD 1988 (elevations shown in feet).

The Trench 13 subgrade is controlled by the elevation of the LDS/LCRS sumps for each respective Phase, with minimum floor slopes at 2.8 percent directing liquid flow to each Phase centerline and 2.0 percent down the centerline of each respective Phase. Floor slopes facilitate leachate drainage into each of the five sumps. The subgrade slopes and elevations of each respective sump are identical in all Phases.

A horizontal control line (HCL) provides the lateral limit of excavation as shown on **Drawings 003** and **004**. The HCL is determined from constraints on the lateral extent of waste as described in Chapter 1.0 of the CQA Plan. The position of the HCL is consistent with the property lease agreement between USEN and the State of Nevada, and is about 80 feet from the south side of Trench 11 and existing USEN processing facility, 150 feet from the east edge of the dedicated USGS 40 acres (west of Trench 13), and 300 feet from the southern and eastern property lines of the USEN facility.

Excavated soil materials will be stockpiled at facility locations determined by USEN to be appropriate for temporary or long-term soil stockpiling. Some stockpiled materials will be reused as Trench 13 construction materials, including materials segregated by gradation and materials that will be selectively screened before reuse.

## 3.2 SURFACE SOIL RECOMPACTION AREA – TRENCH PERIMETER

### 3.2.1 Surface Soil Recompaction Excavation Limit

A slope stability calculation, included in the Trench 13 Engineering Design Report (Appendix 2), indicates that sufficient stability can be achieved by removing and recompacting the surface soil layer. Where the thickness of the replaced surface soil layer is 15 feet or less, the desired stability can be achieved when the replaced and compacted soil has a cohesion value of about 300 PSF. The desired cohesion can be achieved using the natural surface soil when recompacted to 95% MDD (by ASTM D 1557). Where the replaced surface soil layer is more than 15 feet thick, further

measures will be necessary to provide a higher cohesive strength. The determination of when higher cohesion is required, the specific cohesion requirement, and the means for achieving the higher cohesion will be determined on a case-by-case basis by the Project Engineer. Material amendment and compaction specifications are provided in **Section 2.1** of **Appendix B**. Removal and recompaction of the surface soil around the Trench 13 perimeter must be completed prior to trench excavation.

**Appendix A**, **Drawings 003** and **004** show the expected limits of surface soil excavation. The Project Engineer or CQA personnel will determine the actual depth of the surface soil recompaction excavation as excavation proceeds. Geotechnical investigation, provided in Appendix 5 of the Trench 13 Engineering Design Report, provides estimates of the thickness of surface soil requiring removal, replacement, and recompaction. The horizontal and vertical limits of the soil replacement excavation will be controlled to be as small an area (and volume) as is practical while assuring that the volume (and footprint) of surface soil removal, replacement, and recompaction is sufficiently large to include: 1) the horizontal plane that defines the position of the Trench 13 excavation at the base of the soil replacement excavation and 2) the limits of the liner anchor trench. The minimum horizontal limits of the surface soil recompaction excavation, as shown on **Drawings 003** and **004**, are designed to satisfy these requirements.

Surface soil recompaction inspection activities that will be conducted during fill conditioning, placement, and compaction include:

- Testing of fill material characteristics;
- Measurement of loose lift thickness;
- Testing of the density and moisture content of the compacted fill;
- Ensuring that the fill contains no organic or other deleterious materials; and
- Observation of type of compaction equipment, number of passes, and uniformity of compaction coverage.

Sampling and testing of the fill materials will be accomplished periodically to verify type, gradation, and compaction curves to ensure the fill materials meet the applicable construction and materials specifications. The following minimum testing frequencies will be used.

- Moisture-density tests and grain-size determinations will be done to confirm that the

material is acceptable and to determine fill compaction requirements. At least five sets of such tests will be done. The test results will be compared to the properties of materials tested during the development of the 2013 Design, to confirm that an acceptable cohesive strength can be obtained using natural materials

- In-situ density tests will be performed at a minimum of one test per compacted lift or one test for every 2,000 cubic yards placed, whichever is less.

A schedule of the soil placement inspection requirements is attached as **Table C-1**. If the grain size analysis test results do not satisfy project specifications, the Project Engineer will be contacted to determine the acceptability of the fill material.

In the event that density testing indicates that the target density is not achieved, the area within 100 feet of the failing testing will be recompacted and retested. Confirmation of satisfactory compaction in a re-compacted area will be by done by three satisfactory density tests, at locations selected to represent the entire 100 by 100 feet area, passing the density specification.

## 3.3 TRENCH EXCAVATION

The Trench 13 excavation will be made using conventional earthwork equipment and equipment operations and traffic patterns intended to allow the excavation process to proceed efficiently and in compliance with design criteria. Accurate and continuous control by conventional or other survey methods, including electronic or GPS (global positioning satellite) equipment control, will be used to achieve and maintain uniform excavation slopes of 0.5H:1.0V on side walls from the top to bottom of excavations. Special attention to excavation method and slope survey control will be required at side wall intersections (i.e., excavation corners) in order that the desired uniform intersection slope (0.71H:1.00V) is maintained from the top to bottom of excavation. Deviations from the designed uniform slopes must be identified as soon as possible by daily (or more frequent) survey control and appropriate excavation adjustments made to re-achieve the design slopes as excavation proceeds Deviations from design slopes must be reported to the CQA Office and Project Engineer.

As trench sidewall excavation limits are reached, conventional construction equipment will be used to excavate the planar trench bottom. Accurate and continuous control by conventional or other survey methods, including electronic or GPS equipment control, will be used to achieve and maintain uniform trench bottom elevations and slopes.

## 3.4 TRENCH SIDEWALLS

### 3.4.1 Sidewall Preparation

Irregularities are possible in the excavated surface of Trench 13 sidewalls. The final sidewall surface might include angular or irregular surfaces that require additional attention to prevent stress concentrations that could locally compromise the performance of the liner system. Such irregularities could include positive irregularities (e.g., projections into the trench air space) or negative irregularities (e.g., holes or pits extending into the sidewall soil). In instances where the irregularities are high on the sidewall, soil removal or soil replacement might not be feasible, but the size and nature of the irregularity may warrant the application of masking measures before liner installation. Masking measures may include the application of additional geotextile panels, geocomposite panels, or gunite/shotcrete materials. Such masking/cushioning will be done before placement of the lowest component of the liner systems (i.e., the GCL layer). The extent and degree of irregularity masking materials will be determined by the CQA Engineer. Masking materials are not considered integral components of the LCRS/LDS liner system. These masking/cushioning sub-liner geosynthetic panels will extend from the anchor trench, beneath the GCL liner layer, down the sidewall to positions at least five-feet vertically below the identified sidewall irregularities and at least two feet horizontally on each side.

Corrective measures are applied to sidewall irregularities based upon the observed severity. Inspection of the sideslope surfaces and the determination of subsequent irregularity masking must be performed in the field by a qualified and licensed professional engineer. Corrective measure may include additional geotextile panels, geocomposite panels, or gunite material as summarized below.

- Typical prepared sideslopes (free of irregularities) will receive no masking.
- Minor severity irregularities will be covered with non-woven geotextile panels (16-oz or heavier).
- Moderate severity irregularities will be covered with a sacrificial double-sided geocomposite panel (either 200 or 300 mil).

- High severity irregularities will receive gunite materials to fill in or otherwise smooth the surface.

Documentation in the construction records (e.g., daily reports) will include the location and estimated extent of the irregularity and the nature of action taken to address the irregularity.

### 3.4.2 Slope Riser Trenched Recesses

As shown in Detail 8 on **Drawing 010**, shallow recesses will be excavated into the trench sidewalls for placement of the LDS riser pipes that extend up the sidewalls from each of the five LDS sumps. The trenched recesses will allow the primary liner system (components above the primary HDPE geomembrane) to be installed above the secondary liner system and flush with trench sidewalls. The trenched recesses will be cut by backhoe or excavator as excavation proceeds. Light-weight concrete (or other satisfactory fill material) will be used as necessary to fill the trenched recesses after the secondary liner and LDS piping are placed and restore a suitable sidewall surface over which the primary liner system can be placed.

## 3.5 SELECT WASTE OPERATIONS LAYER

The select waste operations layer should be placed in two lifts, as dry as is practical, and with as little passage of heavy equipment as is practical (before the full layer is in placed). This layer has no compaction or moisture content specifications.

Placement around the LCRS Riser should be done with small equipment such that care is taken not to damage or move the LCRS Riser. Minor compaction might be necessary around the LCRS Riser to ensure stability.

## 3.6 TRENCH BOTTOM SUBGRADE PREPARATION

The excavated trench bottom locations will be overlain by a compacted subgrade material that will be a minimum of 9.0 inches thick beneath all portions of the trench bottom except for sump areas, and will be a minimum of 36.0 inches thick beneath the sump areas and along the sidewalls of the sump (See **Drawing 008**, **Drawing 009**, and **Drawing 010** for details). As illustrated on **Drawings 005** and **006** (and explained in the notes), the subgrade will be constructed using survey control points in order to maintain grade throughout all Phases of construction. These control

points are to be met after the placement of 9.0 inches (floor) and 36 inches (sump) of compacted subgrade material (minimum), and before the placement of the floor and sump liner system.

The purposes of this prepared subgrade layer are to provide:

- A smooth bearing surface for the geosynthetic components of the liner system;
- A low permeability stratum (1 x $10^{-5}$ cm/sec hydraulic conductivity) as required by the RCRA Permit, and
- Additional leachate adsorption capacity to supplement that of the GCL components.

Testing done for Trench 12 confirmed that a $1x10^{-5}$ cm/sec hydraulic conductivity of subgrade materials can be achieved using either natural site excavated materials or natural materials mixed with another soil material. This testing confirmed that the specified hydraulic conductivity can be achieved using site excavated soils when not more than 10 percent (by weight) of these soil materials is more coarse than about 1.0-inch and at least 10 percent (by weight) is smaller than the #200 sieve (silt and clay size particles). USEN and/or its contractors will segregate and stockpile excavated materials satisfying the necessary grain-size specification for subgrade construction. As necessary to achieve the grain-size specification, the natural materials will be screened (on site) and amended (as necessary) with fine-grained soil.

The capacity of the proper gradation of subgrade material to achieve the hydraulic conductivity specification is documented in the Trench 12 Engineering Report Supplement[3]. Quality control testing to confirm that the screened native material has the proper gradation will be determined by grain-size analyses of randomly located stockpile samples done at a frequency of one test per 2,000 cubic yards of material stockpiled. If the grain-size analysis test results do not satisfy project specifications, the Project Engineer will be contacted to determine the acceptability of the fill material.

The subgrade layer will be placed and compacted to 95 percent of maximum dry density at a moisture content between the OMC and OMC +2%, as determined by ASTM D1557. The achievement of the proper subgrade compaction requirement will be determined by in-situ density

[3] AquAeTer, Inc. Supplement – Landfill Report for Trench 12. October 2007.

tests performed at a minimum of one test per each one test for every 10,000 square feet of subgrade placed. A schedule of the subgrade placement inspection requirements is attached as **Table C-1**.

The subgrade material and the constructed subgrade will be tested at one location for every 40,000 square feet of constructed bottom and sump subgrade (200-ft grid and at least one test in each sump), remold to density target (±2 PCF) and moisture target (±1%). Each sample will be of the full thickness of floor subgrade or a 12 inch lift of sump subgrade. The following is used to confirm that the specified hydraulic properties are achieved.

1. The constructed compacted subgrade will be field-tested to confirm achievement of the specified compaction properties (density and moisture content).

2. Representative samples of the full thickness of constructed subgrade will be taken for laboratory analysis (hydraulic conductivity) of samples remolded to closely match the as-constructed density and moisture content.

In the event that density testing indicates that the target density is not achieved, the area within 100 feet of the failing testing will be recompacted and retested. Confirmation of satisfactory compaction in a re-compacted area will be by done by three satisfactory density tests, at locations selected to represent the entire 100 by 100 feet area, passing the density specification.

In the event that testing of constructed subgrade does not satisfy the hydraulic conductivity criterion (i.e., value is higher than $1 \times 10^{-5}$ cm/sec), the "failure areas" will be reworked to full depth, recompacted, and retested to confirm that all applicable criteria are satisfied. The reworked area will include all compacted subgrade within 100 feet horizontally from the failed test. Each placement criterion applicable to compacted subgrade will be verified for the reworked area, including density, moisture content, thickness, and hydraulic conductivity.

## 3.7 FINAL COVER CONSTRUCTION

The Trench 13 final covers will incorporate the following soil components (from bottom to top).

- Interim cover soil layer: The first layer of the final cover is a lightly compacted native soil layer that provides waste containment during disposal operations and, in conjunction with the Final Cover Layer, retards the downward movement of infiltrating water by providing

temporary water-storage, which allows stored water to be returned to the atmosphere by evaporation and plant transpiration. This layer will be at least 12-inches (1.0 foot) thick and extend across the cover to the natural ground surface on all sides of the Trenches.

- Final cover soil layer: This upper layer is a lightly compacted soil layer that resists erosion and, in conjunction with the Interim Cover Layer, retards the downward movement of infiltrating water by providing temporary water-storage, and allowing stored water to be returned to the atmosphere by evaporation and plant transpiration. This layer will vary in thickness to allow the cover to be shaped; however, the layer will be least 24-inches (2.0 feet) thick. This layer will extend across the cover to the natural ground surface on all sides of the Trenches.
- Drainage Features: The final cover design includes a series of lateral drainages and down-drains (flumes) that shed precipitation that does not infiltrate. The goal of the drainages is to collect sheet flow prior to development of concentrated flow. On 3H:1V sideslopes, this is accomplished with lateral drainages. On the 20V:1V upper deck this is accomplished with surface berms. All drainage features are constructed with soils from site sockpiles or direct excavation. Drainage features include aggregate protective armoring.

Soil materials for final cover construction will consist of the predominantly sand and gravel soils obtained from stockpiles and excavations, supplemented as needed with imported soil materials. Materials that cannot be satisfactorily placed and/or compacted to a stable condition will be designated as unsuitable. Unsuitable materials will include trash, organic substances, large rocks, or other materials determined to be unsuitable by the Project Manager. These materials will be removed from the fill material and segregated from suitable soil.

### 3.7.1 Construction Specification for Interim Cover Layer Soil

A low density is desirable for this layer of the final cover, as this is important to the moisture holding capacity and vegetation establishment properties of the soil. Over-compaction could lead to reduced cover effectiveness and should be prevented. A schedule of the interim cover layer placement inspection requirements is attached as **Table C-1**.

### 3.7.2 Construction Specification for Final Cover Layer Soil

The goal during Final Cover Layer placement is to achieve a low initial in-place density, typically not exceeding 85 percent maximum dry density (MDD) as determined by ASTM D 1557. Specific testing will be done prior to placement of the Final Cover Layer as Phases are to be closed to determine MDD and optimum moisture content (OMC). The lower density compaction requirement of the soil cover is important for the moisture holding capacity of the soil. Over-

compaction during initial construction could lead to reduced moisture holding effectiveness and inhibit establishment of vegetation, and should be prevented. Areas of the final cover layer that became overly compacted, such as from repeated vehicle or equipment passage, will be loosened by shallow ripping. Over time, material in the final cover will reach a density similar to those of native materials.

There is no requirement for the thickness of lifts placed, only that the layer have a minimal achievable density. The lower density compaction requirement of the soil cover is important for the moisture holding capacity of the soil. Over-compaction could lead to reduced effectiveness, and should be prevented. Areas of the final cover layer that become overly compacted, such as could result from repeated vehicle or equipment passage, will be loosened by shallow ripping or disking.

All final cover surfaces should be smoothed by rolling or bulldozer back-dragging, to eliminate ridges or row contouring that might concentrate surface water flow. Following slope preparation by earth shaping equipment, it might be necessary to use hand tools to eliminate small ridges left by equipment.

Verification of the achievement of low density will be determined by in-situ density tests performed at a minimum of one test per each one test for every 10,000 square feet of cover placed. In the event that density testing indicates that the target density is not achieved, the area within 100 feet of the failing testing will be re-compacted and retested. Confirmation of satisfactory compaction in a re-compacted area will be by done by three satisfactory density tests, at locations selected to represent the entire 100 by 100 feet area, passing the density specification. A schedule of the final cover layer placement inspection requirements is attached in **Table C-1**.

### 3.7.3 Construction Specification for Cover Drainage Features

Because the drainage features act as Final Cover, placement should be done to achieve a low initial in-place density, typically not exceeding 85 percent maximum dry density (MDD) as determined by ASTM D 1557 and further discussed in Section 3.7.2.

Rock materials, providing drainage armoring, will be installed following drainage feature construction. Cement grout has been incorporated into the design, as an alternative to large rock material, on the access road drainages and on the 3H:1V sideslope flumes.

## 4. GEOSYNTHETIC MATERIALS (GENERAL)

The supplier of the geosynthetic materials will provide documentation confirming that the raw materials comply with the physical properties and performance requirements specified in **Appendix B**. The CQA Officer will review this information to ensure that the test results indicate that the materials meet these specifications. Documentation of the test results will be provided to the Project Engineer. Any non-conformance will be documented and reported to the Project Manager for corrective action recommendations.

# 5. GEOSYNTHETIC CLAY LINER (GCL)

The GCL materials will comply with the properties listed in **Appendix B**.

## 5.1 LABELING, PACKAGING, TRANSPORTATION AND STORAGE

CQA personnel will verify that the proper documentation accompanies each delivery of GCL to the job site and that the GCL is properly stored and protected from damage. The geomembrane material will be inspected by the CQA Officer to confirm that it is not damaged or to ensure that any damage observed is corrected. Damage could include:

- Puncture from nails or splinters;
- Tears from operation of equipment or inadequate packaging;
- Exposure to moisture or temperature extremes resulting in unusable material; or
- Crumpling or tearing from inadequate packaging support.

When damage to protective wrappers or outer material layers has occurred, careful examination of the underlying material by CQA personnel is required. If damage is found, CQA personnel will carefully examine the entire shipment for damage and document the defect. The Project Manager will be informed immediately of any damage to the geomembrane material.

Labeling - Each GCL roll delivered should be labeled with the following, as a minimum:

- Manufacturer's Name;
- Product Identification;
- Batch or lot number;
- Roll Number; and
- Roll length and width.

Any roll delivered to the site without the proper labeling will, at the Project Manager's discretion, be rejected and subsequently removed from the site at the expense of the Manufacturer or Installer.

Packaging - The GCL will be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

All rolls will be labeled and bagged in packaging that is moisture-proof and resistant to photo-degradation by UV radiation.

Transportation - The Manufacturer assumes responsibility for initially loading the GCL. Shipping will be the responsibility of the party paying the freight. Unloading, on-site handling and storage of the GCL are the responsibility of the Installer.

A visual inspection of each roll should be made during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.

The party responsible for unloading the GCL should contact the Manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

Storage - Storage of the GCL rolls will be the responsibility of the Installer. A dedicated storage area will be selected at the job site that is away from high traffic areas and is level, dry and well-drained.

Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks or the dunnage shipped between rolls. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).

The location of temporary site storage should not be in areas where water can accumulate. The rolls should be stored on high flat ground or elevated off the ground to avoid forming a dam that allows the ponding of water. If storage platforms are used, the rolls should be continuously supported throughout their length.

The rolls should not be stacked in a manner that allows deformation of the roll or thinning of the product at the points of contact to occur.

All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

The integrity and legibility of the labels will be preserved during storage.

## 5.2 SUBGRADE PREPARATION

The subgrade should be compacted (trench bottom) and graded or otherwise made smooth (trench bottom and sidewalls) prior to placement of the GCL. The subgrade will be dry and free of debris and possible damaging material, such as

- Vegetation,
- Construction Debris,
- Sticks,
- Sharp projecting rocks,
- Large void spaces,
- Ice,
- Abrupt elevation changes,
- Standing water,
- Cracks larger than one-quarter inch in width,
- Any other foreign matter that could contact the GCL.

Prior to GCL deployment on the Trench floor, the subgrade will be final-graded to fill in voids or cracks to provide a relatively smooth surface for the GCL. At completion of this activity, no wheel ruts, footprints or other irregularities will exist in the subgrade. Furthermore, all protrusions extending more than one-inch (2.54 cm) from the Trench floor surface will be removed, crushed or pushed into the surface manually or with a smooth-drum compactor.

Trench sidewall areas that are judged to be too rough for GCL placement will be addressed, as described in **Section 3.4.1**.

On a continuing basis, the project CQA Officer will verify acceptance of the subgrade by the GCL Installer. It will be the GCL Installer's responsibility thereafter to indicate to the Project Manager any change in the condition of the subgrade that could cause the subgrade to be out of compliance with any of the requirements listed in this section.

## 5.3 GCL INSTALLATION

GCL rolls should be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the GCL. The orientation of the GCL (i.e., which side faces up) should be in accordance with the Project Manager's recommendations. However, unless otherwise specified, the GCL should be installed such that the product name printed on one side of the GCL faces up.

Suitable handling equipment is described below:

- Spreader Bar Assembly - A spreader bar assembly should include both a core pipe or bar and a spreader bar beam. The core pipe should be used to uniformly support the roll when inserted through the GCL core while the spreader bar beam will prevent chains or straps from chafing the roll edges.
- Stinger - A stinger is a rigid pipe or rod with one end directly connected to a forklift or other handling equipment. If a stinger is used, it should be fully inserted to its full length into the roll to prevent excessive bending of the roll when lifted.
- Roller Cradles - Roller cradles consist of two large diameter rollers spaced approximately 3 inches apart, which both support the GCL roll and allow it to freely unroll. The use of roller cradles should be permitted if the rollers support the entire width of the GCL roll.
- Straps - Straps may be used to support the ends of spreader bars but are not recommended as the primary support mechanism. As straps may damage the GCL where wrapped around the roll and generally do not provide sufficient uniform support to prevent roll bending or deformation, great care must be exercised when this option is used.

The CQA Officer will verify that GCL installation is performed in accordance with the specification. During installation, the following observations will be performed.

- Observations to ensure that workers are not engaging in any activity that could damage the liner.
- Observations to verity that the material is not damaged during the installation process.
- Observations of the anchor trench to ensure that it has been constructed as specified in the design drawings. Backfilling of the trench will be performed as soon as possible and compacted with care so as not to damage the GCL.
- The GCL will be installed to minimize instances of excessive tension or wrinkles.
- GCL panels should be placed so that edges are oriented parallel to steep slopes (trench sidewalls only). In corners and other tight areas, panel deployment will be performed such that field seams are minimized.
- Observations of the weather conditions (i.e., temperature, humidity, precipitation, and

wind) to ensure that they are acceptable for GCL placement.

- Measurements to confirm that required overlaps of adjacent GCL panels were achieved, that proper temporary anchorage was used (e.g., sand bags or tires).

As each GCL panel is placed, it will be inspected visually for tears, punctures, or other damage. To accomplish this, the panels will be traversed by CQA personnel in such a way that the entire surface is inspected. Any defects will be marked for repair.

The GCL must be dry when installed and will not be installed in standing water or during rain. The GCL will be covered with the overlying geomembrane as soon as is practical to prevent exposure to weather. GCL that becomes hydrated must be replaced before placement of the overlying geomembrane.

Equipment that could damage the GCL will not be allowed to travel directly on top of the material. Acceptable installation, therefore, can be accomplished such that the GCL is unrolled in front of the backwards-moving equipment. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues. GCL rolls will not be released on the slope and allowed to unroll freely by gravity.

Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. A temporary geosynthetic subgrade covering, commonly known as a slip sheet or rub sheet, may be used to reduce friction damage during placement.

All GCL panels should lie flat on the underlying surface, with no wrinkles or folds, especially at the exposed edges of the panels. The GCL will be installed in a relaxed condition and will be free of excessive tension or stress upon completion of the installation. Stretching of the GCL to fit will not be allowed. The GCL will be pulled tight to smooth out creases or irregularities in the runs.

Only as much GCL will be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL will not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The Project Manager, CQA Officer, and GCL fabricator should be consulted for specific guidance if premature hydration occurs.

## 5.4 JOINING GCL PANELS

The GCL will be placed so that panel edges are parallel to the direction of the slope. Panel ends at the juncture between sidewalls and trench bottom should be overlapped by at least three feet. Joining of panel ends on steep sidewall slopes (i.e., trench 0.5:1.0 sidewalls) will not be allowed. Thus, full length seamless panels, overlapped by at least six inches on edges, are required for Trench 13 sidewalls. All GCL edges on sidewalls will be heat-bonded.

Similarly, GCL panels placed on the Trench floor must be overlapped by at least 12 inches on panel ends and by at least six inches on panel edges. All GCL edges on the trench floor will be heat-bonded. Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to reduce the potential for runoff flow to enter the overlap zone.

For joining panels on the trench floor, bentonite-enhanced seams are to be emplaced between the overlapping adjacent panels. The underlying edge of the longitudinal overlap is exposed and then a continuous bead of granular sodium bentonite is applied along a zone defined by the edge of the underlying panel and the six-inch line. A similar bead of granular sodium bentonite is applied at the end-of-roll overlap. The bentonite will be applied at a minimum application rate of about one quarter pound per lineal foot of panel edges and ends.

The granular bentonite or bentonite sealing compound used for seaming, penetration sealing, and repairs will be made from the same natural sodium bentonite as used in the GCL and will be as recommended by the GCL fabricator.

## 5.5 DETAIL WORK AND PATCHING

The GCL will be sealed around penetrations and embedded structures embedded in accordance with the design drawings.

Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are recommended to avoid damage to the geotextile components of the GCL during the cutting process or damage to any underlying geosynthetic materials.

If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch will be obtained from a new GCL roll and will be cut to size such that a minimum overlap of 12 inches is achieved around all of the damaged area. Dry bentonite or bentonite mastic should be applied around the damaged area prior to placement of the patch. It may be desirable to use heat bonding or an adhesive to affix the patch in place so that it is not displaced during placement of overlying liner material. These repair pieces should not be stapled.

# 6. GEOCOMPOSITE/GEONET

The geocomposite and geonet materials will comply with the properties listed in **Appendix B**.

## 6.1 LABELING, PACKAGING, TRANSPORTATION AND STORAGE

The CQA Officer will check all delivery tickets and Manufacturer's quality control documentation to verify that all required shipping information is provided and to verify that the geocomposite/geonet rolls received meet the project specifications in **Appendix B**. The geocomposite/geonet material also will be inspected by the CQA Officer to confirm that it is not damaged and to ensure that any damage is corrected. Damage may include:

- Puncture from nails or splinters;
- Tears from operation of equipment or inadequate packaging;
- Exposure to moisture or temperature extremes resulting in unusable material; or
- Crumpling or tearing from inadequate packaging support.

When damage to a protective wrapping or outer material layer has occurred, careful examination of the underlying material by CQA personnel is required. If damage is found, CQA personnel will carefully examine the entire shipment for damage and document the defect. The Project Manager will be informed immediately of any damage to the geocomposite/geonet material.

Labeling - Each geocomposite/geonet roll delivered must be labeled with the following, as a minimum:

- Manufacturer's Name;
- Product Identification;
- Batch or lot number;
- Roll Number; and
- Roll length and width.

Any roll delivered to the site without the proper labeling will, at the Project Manager's discretion, be rejected and subsequently removed from the site at the expense of the Manufacturer or Installer.

Packaging - The geocomposite/geonet rolls will be wrapped in ultra-violet light-resistant packaging. The rolls will be shipped to the job site in a manner not to damage the rolls. The geocomposite/geonet will be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

Transportation – The Manufacturer assumes responsibility for initially loading the geocomposite/geonet. Shipping will be the responsibility of the party paying the freight. Unloading, on-site handling and storage of the geocomposite/geonet are the responsibility of the Installer.

A visual inspection of each roll should be made during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.

The party responsible for unloading the geocomposite/geonet should contact the Manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

Storage - Storage of the geocomposite/geonet rolls will be the responsibility of the Installer. A dedicated storage area will be selected at the job site that is away from high traffic areas and is level, dry and well-drained. Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks or by use of the dunnage shipped between rolls. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).

The integrity and legibility of the labels will be preserved during storage.

## 6.2 SUBGRADE PREPARATION

Geocomposite/geonet placement will be on top of other geosynthetic members of the liner system. Thus, only minimal surface preparation is expected to be necessary, such as sweeping or manual removal of soil, rock, or other solid material particles. Before installing geocomposite/geonet material, the Installer will provide written certification to the CQA Officer that the surface on

which that geosynthetic material will be installed is acceptable. A certification acceptance form is provided as **Table C-2**. It will be the Installer's responsibility thereafter to indicate to the Project Manager any change in the condition of this surface that could cause the geocomposites/geonet to be out of compliance with any of the requirements listed in this section.

## 6.3 GEOCOMPOSITE/GEONET INSTALLATION

Rolls should be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the material. The subgrade should be free of foreign and organic material, sharp objects, or debris of any kind, which could potentially damage the geocomposite/geonet. The rolls should be deployed using a spreader bar assembly or stinger attached to a loader bucket or by other methods approved by the Project Engineer. The orientation of the geocomposite/geonet panels should be in accordance with the Project Manager's recommendations. On side slopes, the rolls must be deployed in the general direction of the maximum slope. The deployment equipment must not damage the underlying subgrade or geosynthetic materials. A smooth rub sheet may be needed for installation of the geocomposite/geonet over a textured geomembrane. The rub sheet is placed between the geocomposite/geonet and the textured geomembrane to prevent damage to geocomposite/geonet during positioning. The rub sheet must be removed after deployment. Drainage net and geocomposite/geonet should be placed and secured in an anchor trench as shown on the project drawings. Sandbags should be placed on leading edges of the panels to prevent wind uplift.

Observations of the anchor trench should be made to ensure that it has been constructed as specified in the design drawings. Backfilling of the anchor trench will be performed as soon as possible and compacted with care so as not to damage the geocomposite/geonet.

## 6.4 JOINING GEOCOMPOSITE/GEONET PANELS

As each geocomposite/geonet panel is placed, it will be inspected visually for tears, punctures, or other damage or defect. To accomplish this, the panels will be traversed by CQA personnel in such a way that the entire surface is inspected. Any defects will be marked on the geocomposite/geonet for repair. Other general installation requirements include the following.

- Works should not engage in any activity that could damage the material.

- The geocomposite/geonet will be installed to minimize instances of excessive tension or wrinkles.
- The geocomposite/geonet panels will be placed such that panel end seams will be oriented parallel to steep slopes (trench sidewalls only). In corners and other tight areas, panel deployment will be performed such that field seams are minimized.
- Weather conditions (i.e., temperature, humidity, precipitation, and wind) will be observed to ensure that they are acceptable for geocomposite/geonet placement and seaming.
- Measurements will be made to confirm that required overlaps of adjacent geocomposite/geonet e sheets were achieved, that proper temporary anchorage was used (e.g., sand bags or tires), and that specified temporary and final seaming materials/techniques were used.

The adjacent edges of geocomposite/geonet panels must be overlapped by a minimum of 4 inches. Non-black (for visibility) plastic ties should be used at 5-feet intervals in the direction of the roll length to tie the drainage net panels. Metallic ties will not be allowed. Joining of panel ends on steep side slopes (i.e., 0.5:1.0 trench sidewalls) will not be allowed. Thus, full length seamless panels (or panels incorporating only factory seams with complete QC documentation) are required on sidewalls. The geotextile flaps of the adjacent panels should overlap a minimum of 6 inches and be continuously heat-bonded or sewn on all sides.

The ends of drainage cores and filter fabrics (in the direction of flow) should be overlapped a minimum of 12 inches. Drainage cores should be joined with ties at spacing not exceeding 6 inches on center. The top geotextiles covering the joined cores should be overlapped and sewn using a hand-held sewing machine or thermally bonded to provide a complete seal against backfill soil entering the drainage net core.

Sidewall to floor transitions of geocomposite/geonets must include an overlap of 3.0 feet on the floor and 3.0 feet up the sidewall and a minimum total overlap of 6.0 feet. The overlap will be joined at the sidewall upper edge with contrasting plastic ties at 2 feet intervals.

The CQA Officer will perform the following inspections and observations to verify that field seaming operations are in accordance with these construction specifications.

## 6.5 DETAIL WORK AND PATCHING

Cutting the geocomposite/geonet should be performed using an upward cutting hook blade. Care must be taken to avoid damage to any underlying geosynthetic materials.

If the geocomposite/geonet is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch will be obtained from a new material roll and will be cut to size such that a minimum overlap of 12 inches is achieved around all of the damaged area.

All repairs will be performed as soon as practicable and in accordance with the design specifications. Each repair will be non-destructively tested for continuity. All repairs will be documented including date, location, type, method used, operator, and apparatus.

## 6.6 LINER MATERIAL COVER

The trench floor geocomposite/geonet comprising the top of the liner system should be covered with a Select Waste Operations Layer (**Section 2.5** of **Appendix B**) as soon as possible after placement. The covering operation must not damage the geocomposite/geonet. The cover material must be free of foreign and organic material, sharp objects, or debris of any kind that potentially could damage the geocomposite/geonet. No construction equipment or machinery will be allowed to operate directly on top of the geocomposite/geonet. The use of lightweight machinery (e.g., carts or wheeled generators) with low ground pressure is allowed.

# 7. GEOMEMBRANE

This item will consist of the installation of 40-mil (0.040 inch thick), 60-mil (0.060 inch thick), and 80-mil (0.080 inch thick) high density polyethylene (HDPE) flexible membrane liners meeting the materials requirements of **Appendix B** at locations shown on the project drawings (**Appendix A**). The Manufacturer will provide certification that these materials meet the design requirements. The Installer will provide a geomembrane panel layout prior to material placement. There are no 40-mil HDPE CQA installation requirements, as the layer serves only to protect the subsequent liner components from ultra-violet light and other environmental hazards.

## 7.1 GEOMEMBRANE LABELING, DELIVERY, STORAGE, AND HANDLING

The CQA Officer will check all delivery tickets and Manufacturer's quality control documentation to verify that all required shipping information is provided and to verify that the geomembrane rolls received on site meet the project specifications.

The geomembrane material also will be inspected by the CQA Officer to confirm that it is not damaged and to ensure that any damage is corrected. Damage could include:

- Puncture from nails or splinters;
- Tears from operation of equipment or inadequate packaging;
- Exposure to temperature extremes resulting in unusable material;
- Blocking, or bonding together of adjacent membrane layers, that may be caused by excessive heat; or
- Crumpling or tearing from inadequate packaging support.

When damage to protective wrappers or outer material layers has occurred, careful examination of the underlying material by CQA personnel is required. If damage is found, CQA personnel will carefully examine the entire shipment for damage and document the defect. The Project Manager will be informed immediately of any damage to the geomembrane material.

Geomembrane material will be handled and stored on-site in accordance with this section. The CQA Officer will inform the Project Manager if secure storage is not being provided.

The checks and inspections required by this section will be recorded on an inventory control record that will be retained until the project is certified.

Labeling - Each roll of geomembrane delivered to the site will be labeled by the Manufacturer. The label will clearly state the Manufacturer's name, product identification, thickness, length, width, and roll number. The label will be found on either of the end caps, an inside edge of the roll core, and outside the roll core.

Delivery - The rolls of liner will be packaged and shipped by appropriate means to prevent damage to the material and to facilitate off-loading.

Storage - The on-side storage location for geomembrane material should be level, smooth, elevated, dry, and not susceptible to standing water. Roll stack height should be limited to prevent deformation or damage to the rolls and cores. The storage place should be protected from damage by vehicles and equipment or vandalism. The Operator will provide a suitable storage site.

Handling - The materials are to be handled so as to prevent damage. Instructions for moving geomembrane rolls will be provided by the Manufacturer upon request.

## 7.2 SURFACE PREPARATION

Geomembrane placement will be on top of other geosynthetic members of the liner system. Thus, only minimal surface preparation is expected to be necessary, such as sweeping or manual removal of soil, rock, or other solid material particles. Before installing geomembrane material, the Installer will provide written certification to the CQA Officer that the surface on which that geosynthetic material will be installed is acceptable. It will be the Installer's responsibility thereafter to indicate to the Project Manager any change in the condition of this surface that could cause the geomembrane to be out of compliance with any of the requirements listed in this section.

## 7.3 GEOMEMBRANE INSTALLATION

### 7.3.1 Panel Layout

The Installer will submit a panel layout drawing for each geomembrane layer to be installed to the Project Manager for review a minimum of one week prior to the pre-construction meeting. The drawings submitted should be of sufficient size and detail to distinguish the geomembrane panels. The Project Manager reserves the right to reject any drawing submitted and/or to request additional information to be submitted to satisfy the intent of this specification.

No geomembrane installation work will be allowed without the submission and review of the panel layout drawings as required by this specification.

The submitted panel layout will be considered a guideline for both the Installer and the Project Manager to follow. Minor deviations from the submitted layout will be allowed. However, marked deviations to the submitted and reviewed geomembrane panel layout will not be permitted without prior submission of a modification of such to the Project Manager. Any substantial modifications to the geomembrane configuration should be presented, in writing or drawing, by the Installer a minimum of three days in advance of the work to be performed.

### 7.3.2 Weather Conditions

Geomembrane placement will not proceed:

- During precipitation events, in the presence of excessive moisture (humidity), or in areas of ponded water.
- In the presence of excessive wind as agreed upon by all parties or as determined by the performance of panels during the placement process.

Geomembrane placement can proceed at ambient temperatures below 32°F as measured at a pre-determined location with the approval of the CQA Officer or the CQA Personnel, subject to the seaming requirements of Section 7.4.3.

Any damage incurred by the geomembrane material as a result of excessive wind will be repaired or removed by the Installer at the Installer's expense.

### 7.3.3 General Placement

Assign each panel a simple and logical identifying code. The coding system will be subject to approval and will be determined at the job site.

Visually inspect the geomembrane during placement for imperfections and mark faulty or suspect areas.

The geomembrane will be placed by the Installer in accordance with the following procedures.

- Motorized equipment used to move or place the geomembrane should not be in direct contact with the geomembrane or damage it by contact, leaking fluids, or other means. Areas that are damaged in this manner will be removed or repaired at the Installer's expense.
- Unroll geomembrane panels using methods that will not damage geomembrane and will protect underlying surface from damage.
- Personnel working on the geomembrane will not smoke, wear damaging shoes, throw equipment or engage in other activities that could damage the material.
- Do not allow any vehicular traffic directly on geomembrane. Rubber-tired ATVs and trucks are acceptable if wheel contact is less than six psi.
- Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.
- The geomembrane panels will be installed to allow for geomembrane expansion and contraction such that there will be neither excessive tension nor excessive wrinkling. Expansion of the liner is expected under warm conditions and with direct sunlight. These conditions will cause geomembrane wrinkling that should, once cooled, return to a condition of minimal wrinkling.

The panels will be placed in such a manner that the geomembrane is not scratched or crimped. Any such damage will be repaired or removed in accordance with the procedures described in this section.

As each geomembrane panel is placed, it will be inspected visually for tears, punctures, and thin spots. To accomplish this, the panels will be traversed by CQA personnel in such a way that the entire surface, including all factory seams, is inspected. Any defects will be marked on the geomembrane for repair. In addition, the thickness determinations for each panel will be performed by the CQA personnel using a micrometer. The panel thickness will be determined at five locations along each edge and each side of the panel. The average thickness along each side

and each edge must be at least the nominal thickness, and the thickness for any single reading may not be less than 90 percent of the nominal thickness. If these criteria are not met, the panel must be rejected.

### 7.3.4 Geomembrane Anchoring

The Installer is responsible for both temporary and permanent geomembrane anchorage.

Temporary anchors: Geomembrane panels will be adequately, temporarily anchored by sand bags, rubber tires or a comparable means that does not damage the material, and does not degrade during the time it is in use.

Permanent anchors: The geomembrane panels covering the trench sidewalls will be permanently anchored by placement in anchor trench and being covered with soil as shown on Detail 1 of **Drawing 008**.

### 7.3.5 Panel Placement and Alignment

The geomembrane will be placed by the Installer in accordance with these procedures or alternate procedures approved in advance by the CQA Officer. As a minimum, the procedures outlined in the following paragraphs will be followed.

- The geomembrane panels will be placed and aligned in general accordance with the panel layout submitted by the Installer, or as modified and made part of this document. In general, the geomembrane panels will be configured to minimize the number of field seams, particularly in corners, odd-shaped geometric locations, and outside corners.
- Geomembrane panels will be placed in a controlled manner, such as pulling, hoisting, or rolling. Uncontrolled placement methods, such as "free-falling" will not be allowed.
- Adjacent geomembrane panels (horizontally adjacent on sidewalls or adjacent in any direction of trench bottom) will be overlapped by a minimum of three inches before seaming is completed. This minimum overlap or greater will be marked by the Installer (such as with chalk or high-visibility marker) at intervals of 25 feet or less on the exposed surface of the lower geomembrane. These markings will facilitate overlap inspection after the geomembrane panels are placed and aligned.
- Geomembrane seams with insufficient overlap will be repaired or replaced by, and at the expense of, the Installer in accordance with the procedures outlined in this section.
- Geomembrane panels placed on trench sidewalls will be continuous (unseamed) or factory seamed panels. Welding of horizontal seams (seams that are not parallel to slope) on the

sidewalls will not be allowed.

- Geomembrane panels will be placed to minimize horizontal (cross-panel) seams on slopes steeper than 10 horizontal to 1 vertical. In addition, geomembrane panels placed on slopes that are flatter than 10:1 will be overlapped from top to bottom in the down-slope direction. In this configuration, the up-slope geomembrane panel will overlie the immediately adjacent down-slope panel. The geomembrane panels will be placed and aligned such that the resulting seam locations are, at a minimum, five feet from the toe of slopes and other abrupt changes in grade.

### 7.3.6 Panel Identification

As each geomembrane panel is placed, the Installer will label each in bold print visible from a distance of approximately 30 feet. In general, these markings will be placed in an area that will remain unobscured until overlying geosynthetic layers are placed. It is suggested that the labels be located near each end of the panels across the floor of the landfill area; and, on the crest, just below the crest, and just above the toe of the panels placed on the landfill sidewalls.

The labels will include, as a minimum, the following information.

- A sequential panel number based upon a pre-determined system agreed upon by Installer and CQA Officer.
- The roll number from which the panel was obtained. The Operator reserves the right to reject any geomembrane roll without the proper labeling. Additionally, any portion of a geomembrane roll that cannot be positively identified will be rejected.
- The date the panel was placed.
- The labeling will be made using marking materials that are compatible with the HDPE geomembrane or that is approved by the geomembrane Manufacturer. A sample of the materials used will be submitted to the Project Manager for archiving with the permanent record of construction.

### 7.3.7 Installation Schedule

The Installer will be responsible for seaming all geomembrane panels placed each day or providing adequate temporary anchoring in accordance with this section until such time as they can be seamed.

The Installer will be responsible for tracking and updating the installation schedule as submitted prior to the start of the work. This schedule will be updated, as a minimum, weekly and will be presented to the Project Manager in progress meetings.

## 7.4 FIELD SEAMING

These field-seaming requirements apply to any field seams made in HDPE geomembrane components of the liner system, including, in most aspects, the sacrificial liner materials. However, the sacrificial liner materials may be field seamed on sidewall slopes and quality control testing of seams in the sacrificial liner material is not required.

The CQA Officer will perform and document the required inspections and observations to verify that field seaming operations are in accordance with these construction specifications. Each seam will be observed for seam completeness. Documentation for each seam will include seam identification number, date, weather conditions, identification of seamer and apparatus, and approximate length of seam.

The CQA Officer will verify that the geomembrane has been installed in accordance with all plans and specifications and that all welds have passed both the laboratory strength tests and field tests prior to acceptance of the project by the Project Manager.

### 7.4.1 Geomembrane Panel Alignment

The geomembrane panels will be overlapped and aligned in accordance with this specification. In general, the panels should be installed such that the field seams are aligned parallel to slope (i.e., not across slope). Field-welded seams (i.e., seams made on the steep sidewalls) will not be allowed on trench sidewalls.

### 7.4.2 Personnel Requirements

All Installer personnel performing seaming operation will have a minimum of 1,000,000 square feet of experience using the same primary welding technique on HDPE or VFPE liner. In addition, the Installer will have at least one individual with, as a minimum, 2,000,000 square feet of similar experience, including experience at a hazardous waste management facility. No seaming operations will be performed without this individual present.

### 7.4.3 Weather Conditions

Seaming will not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. Installer will demonstrate that acceptable seaming can be performed by completing acceptable trial welds.

Field seaming of the geomembrane generally will not be performed at ambient temperatures below 32°F unless the geomembrane seam area is pre-heated, by sun or hot air device, to a temperature higher than 32°F. If field seaming of the geomembrane is performed at ambient temperatures below 32°F, alternate procedures for pre-weld testing and seaming will be provided by the CQA Officer or the CQA Personnel.

The ambient temperature will be measured by a thermometer at a pre-determined location that will be mutually agreed upon by all parties in the pre-construction meeting. The temperature will be recorded at regular, periodic intervals by the CQA Officer.

### 7.4.4 Test Seams

All personnel responsible for seaming will perform test seams on geomembrane samples to verify welding equipment is operating properly. No welding equipment or welder will be allowed to perform production welds until equipment and welders have successfully completed a trial weld. Test seams should be made under the same surface and environmental conditions as the production welds (i.e., in contact with subgrade and similar ambient temperature).

A minimum of two test seams per day, per welding apparatus will be performed, one made prior to the start of work and one completed at mid-shift. A test seam also will be performed whenever seaming is discontinued for more than one hour.

Test seams will be performed on "fragment" pieces of geomembrane and will be a minimum of 12 inches in width by about three feet in length with a minimum of a three-inch overlap and the seam centered along the length.

The Installer will cut two adjacent specimens from near each end of the test seam (four samples total). The specimens will be cut in a controlled manner, by die or template, to a predetermined

width. One of each pair of specimens will be tested in shear, the other in peel. In the case of dual-tracked fusion welding, both tracks of the weld will be tested in peel. (Note: Specimens cut in an uncontrolled fashion to a random width will not be acceptable as the strength of test seams is required to be determined).

All test seam specimens will be tested by the Installer in the field for shear and peel using an electrically operated tensiometer, with the capability of registering the force imparted on a geomembrane test specimen. The test seam specimens will be tested at a cross-head rate of two inches per minute. (Note: A hand-operated tensiometer is not acceptable.)

Excessive temperatures affect the strength of the geosynthetics and affect the results of field strength tests performed in conditions varying from laboratory performed strength tests. Specimen testing should not be done at excessive temperatures and care should be taken in testing conditions with exposure to direct sunlight.

Recent calibration of the load registering device and the cross-head speed will be performed. Documentation of such calibration will be presented prior to the first use of the apparatus.

The Installer will record the following information for the testing performed on each test seam:

- Test seam sample number;
- Date and time of test;
- Welder performing test seam;
- Cross-head rate;
- Specimen number and the peak yield load and failure mode; and
- The force per unit width in pounds per inch. An accurate thickness measurement will be required to calculate stress in pounds per square inch.

### 7.4.5 Test Seam Evaluation Criteria

The criteria for evaluating test seams is as follows.

7.4.5.1 Shear

Two test seam specimens will be tested in shear. Each must fail at a strength equal to or greater than 90 percent of the rated strength of the parent sheet material, or 1,500 psi, whichever is greater. The test seam will be designed as unacceptable if the failure occurs in the weld. If both of these criteria are not met, the entire test seam will be considered failing.

7.4.5.2 Peel

Two test seam specimens will be tested in peel. The peel test will be designated unacceptable if the failure in either specimen occurs in the weld area. If this criterion is not met, the entire test seam will be considered failing.

If a test seam fails, the entire test seam procedure will be repeated after the appropriate adjustments to the welding apparatus have been made. This process will be repeated until a successful test seam has been achieved. Alternatively, if a successful test seam is not achieved the welding apparatus and/or the welder will be rejected by the CQA Officer and will not be used for seaming until such time as the deficiencies are resolved.

### 7.4.6 General Seaming Procedures

Field seams between panels should be fusion-welded by the dual-hot-wedge welding method. Extrusion-welded seams should be used at pipe penetrations (if any), at patches required after test samples are taken, and for minor repairs where it is not practical to use hot-wedge seams. Hot-wedge and extrusion welding techniques, including surface and edge preparation, should be as described in EPA/530-SW-91/051.

7.4.6.1 Seam Preparation:

The following general seaming procedures must be met by the Installer:

- Field seaming should follow sheet placement as closely as possible, but with adequate time allowed for the adjacent sheets to equilibrate with respect to temperature.
- The panels of geomembrane should be overlapped by a minimum of the following dimensions:

  - 3 inches (73 mm) for extrusion welding; and
  - 4 inches (100 mm) for fusion welding
- Wipe contact surfaces of the sheets clean to remove dirt, dust, moisture, debris, and foreign materials.
- For extrusion welds, grinding/buffing should be conducted to remove oxidized material at the seam locations. This should be done in accordance with EPA/530- SW-91-051 and the following requirements:
  - The grinding should not extend more than ¼ inch beyond the limit of the extrudate after seam completion;
  - Grinding should be performed preferentially in a perpendicular path across the seam;
  - The depth of grinding should be less than 10 percent of the sheet thickness;
  - Grinding should be performed just prior to extrusion welding; and
  - All shavings produced from grinding should be removed from the seaming area prior to welding.
- The area of a seam should be trimmed in advance of seaming following the following procedure:
  - All trimming of seams should be advanced and maintained at least 50 feet ahead of seaming operations when possible;
  - Trimming should be accomplished using a shielded blade or hook-knife; and
  - Whenever possible, the cutting of the geomembrane will be from the underside of the sheet in an upward motion.

7.4.6.2 <u>Seaming</u>

- All geomembrane seams will extend to the end of each panel to be placed in the anchor trench.
- If geomembrane seaming operations are performed at night, adequate lighting will be provided for such as well as for inspection of the seaming conditions and the seams.
- "Fishmouths" and wrinkles at geomembrane seam overlaps will be cut along the ridge of such. Areas with sufficient overlap will be welded in accordance with this specification. Areas of insufficient overlap will be repaired in accordance with the procedures detailed in this section.
- Each field seam should be identified by writing the following information on the geomembrane near the seam with waterproof paint:

- Date, starting time, and mark at starting point of weld;
- Welder's name or identifying initials' and
- Completion time and mark at ending point of weld.

7.4.6.3 Extrusion Seaming Requirements

The extrusion welding apparatus will be equipped with temperature gauges that indicate the temperature of the extrudate in the machine.

The extruder will be purged to remove heat-degraded material prior to the beginning of seaming and whenever the extruder is stopped for an appreciable length of time.

7.4.6.4 Fusion Process

The fusion welding apparatus will be a vehicular mounted, automated device.

## 7.5 FACTORY SEAMS

If factory seamed materials are used, that seaming must satisfy the same requirements as field seams. Documentation must be provided that factory seams have been 100 percent non-destructively tested using recommended techniques before the geomembrane material is shipped from the fabrication plant. Rejected seams must be repaired and re-tested before being shipped, or must be re-tested on-site. The CQA Officer will review fabricator's quality control documentation to ensure that proper seaming procedures were followed and the resulting geomembrane material seams are of the specified quality. The CQA Officer will destructively test at least one factory seam sample for each 500 lineal feet of geomembrane factory seam. The CQA Officer will review the quality control documentation. Any necessary repairs to the geomembrane will be in accordance with approved techniques, and the repaired areas will be non-destructively tested to verify their integrity.

## 7.6 GEOMEMBRANE PENETRATIONS

Penetrations in the geomembrane will be completed in the following manner:

- Pipe boots should be fabricated to a size that tightly fits the outside diameter of the penetrating pipe. The boot should be made of the same type of geomembrane as that of

the liner through which the penetration is being made.

- The skirt of the pipe boot that flares away from the pipe should have at least 12 inches of geomembrane on all sides of the pipe. The skirt of the pipe boot should be seamed to the base geomembrane by extrusion welding. If vacuum testing of the seam is impractical, a copper wire for spark testing should be inserted prior to welding.
- Stainless steel pipe clamps should be used to attach pipe boots to the penetrating pipes and should be of an adequate size to allow for a cushion of compressible material to be placed between the inside surface of the clamp and that of the geomembrane portion of the boot.

## 7.7 DEFECTS AND REPAIRS

### 7.7.1 General

All seam and non-seam areas of the geomembrane will be visually inspected for signs of defective seams, blisters, punctures, undispersed raw materials, and any sign of contamination by foreign matter. Any problems discovered in both seam and non-seam areas will be marked, repaired and re-tested or reevaluated in accordance with this document. The geomembrane surface will be clean at the time of these inspections.

Any sheets that become seriously damaged (torn or twisted permanently) will be replaced at the Installer's expenses. Less serious damage (inadvertent punctures during installation) will be repaired by welding a piece of geomembrane over the damaged area. The repairs must pass non-destructive tests to be considered adequate.

### 7.7.2 Evaluation

Each suspect location in both seam and non-seam areas will be inspected and, where appropriate, non-destructively tested using the methods described in this document. Work will not proceed with any materials that will cover the locations that require repair or that have been repaired but require testing with passing results. Each patch repair will be numbered and logged.

### 7.7.3 Procedures for Repair

All repairs will be performed as soon as practicable and in accordance with the design specifications. Each repair will be non-destructively tested for continuity. All repairs will be documented including date, location, type, method used, operator, and apparatus.

The repair procedures will be in accordance with these specifications. The details of the specific repair procedures to be followed will be discussed in the pre-construction meeting. Procedures available include the following:

- Patching - Used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter.
- Abrading and Re-welding - Used to repair small sections of deficient seams and small surface blemishes that do not penetrate the entire thickness of the geomembrane. The geomembrane surfaces requiring repair will be abraded no more than one hour prior to the repair being made. Grinding will be performed only within the area requiring repair and care will be taken not to significantly damage the liner.
- Spot Welding - Used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced.
- Capping - Used to repair large lengths of failed seams.
- Flap Welding - Used to extrusion weld the flap (excess outer portion) of a fusion weld in lieu of a full cap.
- Removing the unacceptable seam and replace with new material.

In addition, the following procedures will be observed.

- For capping and patches, use flat and unwrinkled geomembrane material free of defects and seams. The material will be of the same type as the liner material unless approved by the CQA Officer.
- Surfaces of the HDPE that are to be repaired by extrusion welds will be lightly abraded to assure cleanliness of the weld area and the integrity of weld bonding.
- All geomembrane surfaces will be clean and dry at the time of repair. As a minimum, patches and caps (a cap is a patch with an extended length) will extend a minimum of six inches for extrusion weld and four inches for wedge weld beyond the limits of the defect, and all corners of patches and caps will be rounded with a radius of approximately three inches.

The seams associated with caps of long lengths may be destructively tested, if deemed necessary by the CQA Officer.

## 7.8 NON-DESTRUCTIVE SEAM CONTINUITY TESTING

Observations are necessary to verify that non-destructive tests are performed on 100 percent of the field seams. Failed seams will be recorded as to location and seaming crew. The data will be

reviewed for possible patterns. Repairs will be made by the Installer in accordance with approved techniques and re-tested to verify their integrity.

### 7.8.1 General

All factory and field seams (except in sacrificial liner material) will be non-destructively tested over their entire length using the pressure test method or the vacuum test method, as appropriate, or other approved method. It is unacceptable for any portion of a seam to remain untested by one of these methods. Non-destructive testing may be carried out as the seaming progresses or at completion of all field seaming.

Areas thought to be potentially inaccessible to non-destructive continuity testing equipment will be brought to the Project Manager's attention prior to the start of work with the submittal of the geomembrane panel layout drawings.

The non-destructive continuity testing of factory seams will be performed prior to the geomembrane rolls being delivered to the site. The non-destructive continuity testing of field seams will be performed by the Installer as the work progresses to provide the opportunity for immediate re-welding and re-testing as necessary. All defects discovered will be marked, repaired and re-tested by the Installer in accordance with these specifications.

### 7.8.2 Testing Procedures

The Installer will submit the proposed specific non-destructive testing procedures to be employed on this project to the Project Manager. The testing procedures will be consistent with the requirements of this specification. The testing procedures must be approved by the Project Manager and CQA Officer. The Operator reserves the right to reject and request modification of any and all non-destructive seam continuity testing procedures submitted.

7.8.2.1 <u>Vacuum Testing:</u>

The equipment will consist of the following: 1) a vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft gasket attached to the bottom, or valve assembly, and a vacuum gauge, 2) a vacuum pump assembly, and 3) a soapy solution and brush.

Test Procedure is performed as follows: 1) apply soapy solution to the seam, 2) place vacuum box over the entire wetted seam area, 3) ensure that a leak-tight seal is created, 4) apply a vacuum of at least 5 psig, 5) examine the geomembrane through the viewing window for the presence of soap bubbles for not fewer than ten seconds, and 6) all areas where soap bubbles appear will be marked and repaired.

7.8.2.2 Air Pressure Testing (for double seam air channel):

The equipment will consist of the following: 1) an air pump or tank equipped with pressure gauge capable of generating and sustaining pressure over 30 psi, 2) a sharp, hollow needle, or other approved pressure feed device equipped with a pressure gauge, and 3) A hot air gun or other device to seal the ends of the air channel.

Test Procedure is performed as follows: 1) seal both ends of seam to be tested, insert air needle into the air channel, and pressurize to at least 25 psi, 2) the minimum pressure will be maintained for a two minute stabilization period, after which the air source will be disconnected from the air pressure gauge and the maximum pressure drop will be measured over a five-minute period, 3) if pressure loss exceeds 4.0 psi or does not stabilize after five minutes, locate faulty area and repair. Puncture opposite end of seam to release air. If blockage is present, locate and test seam on both sides of blockage. A pressure gauge at both ends of the seam will also be acceptable. Remove needle or other approved pressure feed device and seal penetration holes by extrusion welding.

### 7.8.3 Installer Quality Control

The Installer will be responsible for providing quality control inspection staff and documentation for the equipment and testing performed. This will include, but will not be limited to, the following:

- Recent calibration of all gauges employed (vacuum and/or pressure). Proof of recent calibration, in the past six months will be submitted by the Installer for each gauge employed. This proof will be submitted no later than the first use of the apparatus. Negligence in producing this information will prohibit the Installer from using the apparatus.
- An individual who, as a permanent employee of the Installer, is experienced at and responsible for performing the non-destructive seam continuity test in accordance with the prescribed procedures and inspecting for areas of improperly welded geomembrane.

- Labeling directly on the geomembrane surface in the vicinity of the ends of each seam or tested section, the following:
    - Date and time of test;
    - Initials of the operator of the testing device;
    - Status or results of the outcome of non-destructive testing; and
    - Start and finish time and pressure (pressure test method only).
- All non-destructive testing results will be recorded on contractor and CQA officer logs.

## 7.9 DESTRUCTIVE SEAM TESTING

### 7.9.1 Testing Location and Frequency

Destructive seam samples will be obtained from factory and field seams at an average minimum frequency of one per 500 lineal feet of weld. The seam destructive test sampling frequency may be increased by the CQA Officer beyond the specified minimum based upon actual welding conditions and the results of other samples obtained. These additional locations may be based on suspicion of contamination by dirt or moisture, change in seaming materials, increase in failed non-destructive tests, and other causes that could result in unacceptable seams.

Test locations will be determined after welding. The sample locations will, in general, be randomly selected by the CQA Officer as welding progresses. However, selected sample locations may be prompted by suspicion of a poor quality weld.

The Installer will not be informed in advance of seam destructive test locations but will be required to physically obtain the samples from the geomembrane seam in the locations selected by the CQA Officer. The samples will be cut from the geomembrane by the Installer no later than three working days after the location has been selected.

The Installer will repair all holes in the geomembrane resulting from destructive testing. The repairs will be performed and tested in accordance with these Specifications.

### 7.9.2 Sample Size

The location for the destructive samples will be marked by the CQA Officer. The dimensions for the destructive samples will be, as a minimum, 12 inches wide by 34 inches long (minimum 40 inches long for dual tracked welds) with the seam centered lengthwise. The Installer will obtain two one-inch wide strips from each end of the marked seam destructive sample for preliminary field testing as described in the following section. The remaining sample will be cut and divided into two parts as described below:

- One portion of the sample, measuring 12 inches by 18 inches (24 inches for dual-tracked fusion welds), to the CQA Officer for laboratory testing.
- One portion of the sample, measuring 12 inches by 12 inches to the Operator for archiving.

The sample length will be increased to accommodate the additional length required by the Installer for laboratory testing or archiving.

Documentation of seam sampling will include sample location, date and time of sampling, operator and apparatus number used for the seam sampled, pass or fail description, and sample identification number. Each sample must be marked with its identification number.

### 7.9.3 Testing Procedure

7.9.3.1 Preliminary Field Testing

Two specimens, two from each end of the seam destructive sample, are to be removed from the geomembrane by the Installer while in the field. Each of these specimens is to be one inch in width. Two specimens are to be tested in shear and the other two in peel and none are to fail in the seam.

If the laboratory destructive testing is to be performed on-site, the specification for preliminary field seam destructive testing may be waived.

7.9.3.2 Destructive Seam Testing

The destructive seam testing will be performed under the observation of the CQA Officer, or his duly appointed representative, in an on-site or off-site laboratory. This testing is to be completed within 72 hours of the time the samples are removed from the geomembrane installation.

The testing will be performed on a total of ten specimens (fifteen for dual-tracked fusion welds) obtained from the field sample. Five specimens will be tested in each of the shear and peel modes. For the dual-tracked fusion welds, five peel tests will be performed for each track of weld. These shear and peel specimens will be selected from the sample alternately so that no two immediately adjacent specimens are tested in the same mode.

The specimens will be of a size and shape in accordance with ASTM D638, Type I and will be tested at a cross-head rate of two inches per minute.

7.9.3.3 Seam Evaluation Criteria

Each seam sample must meet both the shear and peel criteria before being considered passing. The criteria for each is as follows.

*7.9.3.3.1 Shear*

Of the five specimens tested in the shear mode, each must have strength equal to or greater than 1,500 psi or 90 percent of the rated strength of the geomembrane sheet, whichever is greater. Additionally, as a minimum, four of the five specimens will not fail in the weld.

If, in the series of five specimens tested in shear, these criteria are not met, then the entire seam destructive sample is considered failing.

*7.9.3.3.2 Peel*

Of the five specimens tested in the peel mode, as a minimum, four will not fail in the weld. If more than one specimen fails to meet this criterion, then the entire seam destructive sample is considered failing.

In the instance of the dual-tracked fusion weld, both tracks of the weld will be tested in peel. If either peel test performed on specimens of this weld type fails, the entire specimen is considered failing.

7.9.3.4 Seam Destructive Test Failure Procedure

The Installer will submit a recommended procedure for the tracing and remediation of failed seam destructive tests. This procedure will be submitted as part of the Installer's Quality Control Manual and, as a minimum, will include the following:

- The Installer will reconstruct the failing seam bound by two passing seam destructive tests. The Installer will have the option of obtaining additional seam destructive tests at a minimum of ten-feet intervals in both directions along the failing seam from the failure location. The minimum interval may be increased by the CQA Officer and/or the Project Engineer if test failures become excessive.
- If both of these samples pass the laboratory seam destructive test, then the seam can be reconstructed between them. If one or both of these samples fail the laboratory seam destructive test, then the procedure is repeated until passing laboratory results are obtained.
- If a seam is reconstructed to a length in excess of 125 feet, a seam destructive sample will be obtained from the reconstruction zone that must meet these specifications.

# 8. GEOTEXTILE

The geotextile materials will comply with the properties listed in **Appendix B**.

## 8.1 LABELING, PACKAGING, TRANSPORTATION AND STORAGE

Labeling - Upon initial delivery to the site, each geotextile roll will be labeled on the inside of the roll core and outside of the roll wrapping with the following, as a minimum:

- Manufacturer's Name;
- Product Identification;
- Batch or lot number;
- Roll Number;
- Roll length and width; and
- Material thickness.

Any roll delivered to the site without the proper labeling will, at the Project Manager's discretion, be rejected and subsequently removed from the site at the expense of the Manufacturer or Installer.

Packaging – New rolls of geotextile should be wrapped in a black wrap provided in UV radiation and abrasion protection.

Transportation - Deliver, store, and handle rolls in a manner to prevent damage.

Storage - Geotextile rolls should not be exposed to the elements for more than 30 days unless additional heavy-duty wrapping is provided.

Store rolls in ultraviolet light-resistant packaging, protected from precipitation, strong chemicals, sparks and flames, temperatures in excess of 160 degrees F (71 degrees C), and other environmental conditions that could cause damage to the geotextile.

## 8.2 HANDLING AND PLACEMENT

The Installer will handle all geotextiles in such a manner as to ensure they are not damaged in any way, and will comply with the following. The surface to receive the geotextile will be in a

reasonably smooth condition. Where geotextile is placed on soil, fill deep or sharp-edged depressions, and remove large or sharp-edged rocks, debris and other obstructions that could damage the geotextile. Where geotextile is placed on other geosynthetic materials, inspect for and report foreign materials (such as rocks, sticks, trash items).

- In the presence of wind, all geotextiles will be weighted with sandbags or the equivalent. Such sandbags will be installed during placement and will remain until replaced with operations layer material. Sandbags will be made of material that will not degrade during the time they are in use. They will be filled with soil with a predominant grain size equivalent to sand or smaller.
- Geotextiles will be cut using a geotextile cutter approved by the CQA Officer. If in place, special care must be taken to protect other geosynthetic materials from damage that could be caused by the cutting or the geotextiles.
- During placement, care will be taken not to entrap stones, excessive dust, or moisture in the geotextile that could damage an underlying or overlying geomembrane, generate clogging of drains or filters, or hamper subsequent seaming.
- An examination of the geotextile over the entire surface, after installation, will be conducted to ensure that no potentially harmful foreign objects, such as large or sharp-edged rocks or needles (e.g., broken geotextile sewing needles), are present. Any foreign objects so encountered will be removed by the Installer, or the geotextile will be replaced.

## 8.3 CONFORMANCE TESTING

The CQA Officer will collect samples of geotextile from the materials delivered to the site, for conformance testing.

## 8.4 SEAMS AND OVERLAPS

All geotextiles will be continuously sewn or heat-bonded (i.e., discontinuous or tact sewing is not allowed). Geotextiles will be overlapped a minimum of three inches prior to seaming. Any sewing will be done using polymeric thread with chemical and ultraviolet resistance properties equal to or exceeding those of the geotextile.

## 8.5 REPAIR

Any holes or tears in the geotextile will be repaired.

Should any tear exceed ten percent of the width of the roll, that roll will be removed from the slope and replaced.

A patch made from the same geotextile will be sewn in place with a minimum of six inches overlap in all directions.

Care will be taken to remove any soil or other material that may have penetrated the geotextile.

# 9. LINER SYSTEM COMPONENT DESCRIPTIONS

## 9.1 BASE LINER SYSTEM COMPONENTS

The cross section of the bottom liner system is shown on **Drawing 008**, and includes the following components listed sequentially from top to bottom.

- Operations layer
- Double-sided geocomposite LCRS drainage layer and at select locations shown on Details 12 and 13 on **Drawing 010**, 4.0-inch diameter perforated piping
- 80-mil HDPE flexible membrane liner (FML), textured on both sides
- Double-sided geocomposite LDS drainage layer
- 60-mil HDPE FML, textured on both sides
- Geosynthetic clay liner (GCL)
- 9.0-inch prepared subgrade (fine-grained soil)

The 2.5-feet thick operations layer will be clean soil and/or select waste, with the purpose of protecting the underlying liner components from damage due to heavy equipment or other operations activities. The layer must not contain large or angular elements which could damage the underlying liner system. The first foot of material placed should be of relatively small particle size material (e.g., sand and gravel) not exceeding one inch in diameter. The second foot of material can have larger particles (e.g., up to 6.0 inches in diameter) provided they are encompassed in a soil matrix.

The upper double-sided geocomposite is the drainage layer of the LCRS. The four-inch diameter leachate collection pipes augment flow capacity to accommodate infiltration from the 25-year, 24-hour design storm event. **Drawing 010** shows the layout of these pipes and typical sections for centerline and lateral piping. The geocomposite drainage layer and pipes discharge into the LCRS sumps.

The 80-mil HDPE FML is the low-permeability component of the primary liner system. The 80-mil HDPE FML will be textured on both sides to provide additional interface strength.

The lower double-sided geocomposite is the drainage layer for the LDS. Its function is to facilitate detection, collection and drainage of leachate into the LDS sump.

The 60-mil HDPE FML is the upper low-permeability component of the secondary composite liner system. It is a lesser thickness than the primary FML since the secondary FML is located further below operations activities and is underlain by a GCL. Textured HDPE (on both sides) is selected for the reasons stated above for the primary FML.

The GCL is the lower low-permeability component of the secondary composite liner system.

The nine-inch prepared subgrade layer provides a smooth surface for installation of the geosynthetics materials providing protection of the overlying geosynthetic layers from puncture by angular materials in the subgrade. The nine-inch thick prepared subgrade layer (36.0 inches thick beneath sumps) also provides an additional low permeability layer with added adsorptive capacity.

## 9.2 SLOPE LINER SYSTEM COMPONENTS

A cross section of the liner system on the slopes of the trench is shown on **Drawing 008** and includes the following components listed sequentially from top to bottom:

- 2.5-feet thick operations layer (measured normal to the sidewall, placed as waste is deposited)
- 40-mil HDPE FML(protective layer, not a hydraulic liner component)
- Nonwoven geotextile filter fabric
- Geonet LCRS drainage layer
- 80-mil HDPE FML, smooth on the top side and textured on the bottom side
- Double-sided geocomposite LDS drainage layer
- 60-mil HDPE FML, textured on both sides
- GCL (placed over smooth or specially prepared subgrade)

A ten-feet wide, three-feet deep anchor trench is provided at the top of each slope as shown on **Drawing 008**.

The 2.5-feet thick operations layer is installed incrementally along the slopes as the waste fill is placed. Since the slopes are steep (0.5:1.0) the operations layer will be advanced incrementally at a maximum height of a few feet above the waste fill height.

The sacrificial 40-mil HDPE FML is specified to provide UV exposure protection for underlying geosynthetic materials, especially the uppermost geotextile member. The sacrificial 40-mil HDPE FML also directs rainfall, during cell filling, onto the cell floor for infiltration into the waste and management by the LCRS of infiltration that reaches the LCRS collectors.

## 9.3 TRENCH BOTTOM/SIDEWALL TRANSITION LINER SYSTEM COMPONENTS

The cross section of the liner system at trench bottom/sidewall transition locations is depicted on **Drawing 008**. This detail shows how overlaps will be made for each drainage layer to assure continuity of the LCRS and LDS from the side slope to the base of the landfill. The overlap extends from three feet above the floor to three feet onto the trench bottom.

# 10. LEACHATE COLLECTION SYSTEM

## 10.1 LEACHATE COLLECTION AND RECOVERY SYSTEM

The primary LCRS is located above the primary liner, and is designed to collect and allow removal of liquids within each cell. The secondary system, the LDS, is located between the two liners, and its main function is to provide detection and removal of any leakage through the top liner.

The LCRS is associated with the primary liner system. The function of the LCRS is to intercept leachate draining through the waste and to discharge it into the sumps for removal from the landfill. The typical sump plan view is shown on **Drawing 009**, typical sump cross-sections are shown on **Drawing 009**, Detail A and B. The LCRS sump is four feet deep. Liquid is removed from the sump through a riser that is shown in Detail 6 on **Drawing 010**. The components of the LCRS sump are sized to accommodate the maximum anticipated leachate flows while maintaining fluid head above the primary liner at or below one foot.

Trench 13 LCRS sump components are shown on the typical sump layout details on **Drawings 009** and **010**. The components include:

- Geocomposite (300-mil double-sided, or equivalent): This is the principal LCRS drainage component (at cell bottom locations) that discharges directly to the drain rock at the edge of the sump.
- A 10-ounce LCRS geotextile cushion: This geotextile is used to separate the operations layer from the drain rock (described below). It is used over the entire sump area within the sump perimeter.
- 4.0-inch diameter perforated SDR 11 HDPE pipes: These pipes are secondary flow components that assist the LCRS in handling the maximum anticipated flow resulting from a 25-year, 24-hour design storm event. The pipes discharge directly to the LCRS sump.
- Drain rock: This is a clean gravel conforming to the gradation included in the specifications (**Appendix B**). The LCRS gravel fills the entire sump to the grade break.
- A 16-ounce LCRS geotextile cushion: This is a nonwoven geotextile used to provide additional puncture protection to the liner system within the sump perimeter. Two 10-ounce geotextile cushion sheets will also be acceptable.

Components of the LCRS riser system include the following (starting at the sump):

- Slip joint: Settlement of the riser system is accommodated by a slip joint which is intended not to transfer stress to the liner system. The slip joint is a 12-inch diameter SDR 11 HDPE pipe that is extrusion-welded to a 1.0-inch thick HDPE flatstock base. The pipe is perforated with 1/2-inch diameter holes 60 degrees apart on 3-inch centers (24 holes per foot). A 16-ounce geotextile cushion sheet is placed between the liner system and the slip joint base. The slip joint extends a minimum of 6.0 inches into a riser support (discussed below). The lip of the slip joint pipe in the riser support will be built up, such as with HDPE flatstock (or other alternative), and then chamfered to provide a smooth transition for a pump to be lowered into the sump.
- Riser pipe support: The riser pipe support consists of a concrete foundation block which transfers the pipe and potential down-drag loads to the LCRS gravel, thus preventing stress concentrations on the liner system. The riser pipe support is intended to be a cast-in-place unit built of 4,000 psi concrete, using Type V sulfate-resistant cement. A 14-inch diameter, Schedule 60, Type 316 stainless steel pipe extending at least 3.0-inches from the concrete will be cast in the concrete. The riser pipe will include a 20-inch O.D. by 14-inch I.D. by 0.5-inch thick type 316 stainless steel bearing plate. The bearing plate will include twelve 1.0-inch diameter by 6-inch long expansion type anchor bolts (or approved alternative) extending into the concrete foundation block. The riser pipe support will be positioned in the field such that the slip joint, support, and LCRS long radius bend (described below) are correctly aligned.
- LCRS reducer: The riser pipe support will be welded to a 14-inch by 12-inch stainless steel reducer. The riser pipe support will be welded to the 14-inch side. The 12-inch side of the reducer will be welded to a twelve-bolt stainless steel flange.
- LCRS long radius bend: This is a prefabricated bend that provides the 3.5 feet of deflection required to position the LCRS riser pipe in the center of the riser pipe support. The piece is 20-feet long and fabricated of 12-inch diameter, Schedule 40, stainless steel. Manufacture of the necessary sweeping bend must not compromise the strength of the stainless steel. The bottom of the LCRS long radius bend will be welded to a twelve bolt stainless steel flange.
- LCRS riser pipe: This is a 12-inch diameter, Schedule 40 stainless steel pipe butt-welded to the LCRS long radius bend. `
- Riser pipe slip cover: The function of this component is to minimize the transfer of friction and down-drag loads on the riser pipe caused by settlement of waste. The riser pipe slip cover will be fabricated from a 12-inch diameter corrugated polyethylene pipe that has been split longitudinally and placed over the riser. It is not necessary to join the individual pieces of the slip cover.
- Top of slope anchor: This is a concrete block with an adjustable U-bolt. This component provides lateral restraint for the riser pipe while allowing vertical movement to accommodate settlement.

## 10.2 LEAK DETECTION SYSTEM

The LDS is associated with the secondary liner system. The functions of the LDS are to detect and remove liquid that may migrate through the primary liner system. Components used in the Trench 13 LDS sumps are shown on **Drawing 010**, typical sump cross-sections are shown on **Drawing 009**, Detail A and B. The components include:

- Geocomposite (300-mil double-sided, or equivalent on the floor and 200-mil, or equivalent on the side slopes): This is the principal LDS drainage component that discharges to the LDS sump.
- A 16-ounce LDS cushion geotextile: This is a nonwoven geotextile used to provide additional puncture protection to the liner system within the sump perimeter (see Detail 7 on **Drawing 010**). Two 10-ounce geotextile cushion will also be acceptable.
- Drain rock: A clean gravel conforming to the gradation included in the specifications (**Appendix B**). The LDS gravel fills only the 18-inch deep sump area.
- LDS End Caps, Tee, Collection Pipes: These pieces are all 12-inch diameter SDR 11 HDPE that is perforated to collect flow into the LDS sump. The perforations for the LDS Collection Pipe and Tee should be 1/2-inch diameter holes, 60 degrees apart on 3.0-inch centers (24 holes per foot). A 1.0-inch thick piece of HDPE flatstock is used to evenly distribute the load from the HDPE tee and collection pipes to the trench floor (Detail 7 on **Drawing 010**).
- LDS Elbows: These pieces are all 12-inch diameter SDR 11 HDPE and include a 45 degree sweeping elbow and an 18 degree sweeping elbow. The 18 degree sweeping elbow shall be gradual enough to allow down-hole pumping equipment to be installed.
- A 16-ounce lower LDS geotextile cushion: This is a nonwoven geotextile that provides puncture protection to the secondary liner system in the 18-inch deep portion of the sump as shown in Detail 7 on **Drawing 010**. Two 10-ounce geotextile cushions will also be acceptable.

Components of the LDS riser system include the following (starting at the sump):

- LDS Riser: A 12-inch diameter SDR 11 HDPE pipe used for pump access.
- LDS Riser Recess Trench and Backfill: The LDS Riser (described above) is placed in a 24-inch wide by 18-inch deep recess cut into the sidewall during excavation. Backfill will consist of prayed concrete or gunite, see Detail 8, **Drawing 010**.
- Top of slope anchor: See the LCRS top of slope anchor description above since the units are identical.

## 11. LINER SYSTEM EXPOSURE PROTECTION

Exposure protection is necessary for the liner and leachate collection system components, both during construction as well as during disposal operations. Exposure issues include the following:

- Ultraviolet (UV) Radiation: Some geosynthetic materials (without UV resistance additives) degrade when exposed to sunlight. For Trench 13, the HDPE materials (e.g., FML and geonet) are UV-resistant; hence protection from exposure to UV radiation is not necessary for these materials. Polyester geotextile materials, however are sensitive to UV radiation and must be protected during storage, construction and disposal operations.
- Precipitation/Water: The bentonite within GCLs may expand if exposed to moisture and allowed to hydrate in an unconfined condition (e.g., during material staging or placement). Thus, GCLs must be protected during storage and construction.
- Dust and soil: Geonet materials can become partially filled with dust and soil if not protected from wind and rain during storage and construction. This geonet must be protected during storage and construction.
- Wind: High winds can lift geosynthetics that have not been properly anchored (e.g., during construction). This can result in damage (e.g., tears) or the material blowing away. Therefore, temporary anchorage and repair/replacement procedures are needed during construction. Protection from wind during disposal operations is also needed.

Geosynthetic materials requiring exposure protection and/or special handling during construction include the following.

- GCLs: Store on pallets in delivered plastic packaging and cover with tarps. Protect from rain after installation.
- HDPE FMLs: Store on pallets to avoid damage. Provide temporary anchorage to facilitate installation and prevent wind uplift. Follow inspection, repair, and replacement procedures if wind damage has potentially occurred.
- Geonets: Store on pallets and cover with tarps. Keep free of dust, soil and precipitation during installation.
- Geotextiles: Store on pallets and cover with tarps. Place subsequent layer of liner systems within a reasonable period of time (e.g., within four to six weeks).
- Geocomposites: Same as geotextiles.
- Geosynthetics on the cell bottom are likely to be covered by the operations layer within a reasonable period of time (e.g., four to six weeks) after installation. No further protective measures are required for those elements.

The side slope liner system incorporates a sacrificial 40-mil HDPE FML. The sacrificial liner protects the slope liner during filling and specifically eliminates UV exposure of the primary nonwoven geotextile filter-fabric. The layer also prevents infiltration into the slope LCRS during precipitation. Sand tubes and wind vents will be installed to secure the slope lining system and prevent uplift from wind.

**Table C-1 - Soil Placement Inspection Schedule**

| Inspection Task | Inspection/Test Method Reference | Sample/Test Quantity/Frequency | Observation/Sample Locations | | | |
|---|---|---|---|---|---|---|
| | | | Excavation | Source/ Stockpile | Fill Area | Cover Area |
| **FIELD INSPECTION OF SOIL EXCAVATION, SOIL PLACEMENT, AND FINAL COVER CONSTRUCTION** | | | | | | |
| General project observations | Visual observations, plus basic measurements and recordkeeping | Continuous observation, during trench construction (excavation, soil screening and amendment and soil placement) | Yes | Yes | Yes | Yes |
| Trench feature layout | Observation of survey staking | Continuous observation, during excavation | Yes | NA | Yes | NA |
| Soil material observation | Observation of excavated and imported soil material | Continuous observation, during construction | Yes | Yes | Yes | Yes |
| **SOIL TESTS TO BE DONE DURING TRENCH 13 CONSTRUCTION AND FINAL COVER CONSTRUCTION** | | | | | | |
| Particle-size analysis | ASTM C 136 | 3 tests per material type, reconfirmed as needed | Yes | Yes | Yes | Yes |
| Moisture/density curve | ASTM D1557, Modified proctor moisture-density relation | 3 tests per material type, reconfirmed as needed | Yes | Yes | Yes | Yes |
| Lift thickness | Observation/measurement before and during compaction | Random locations | NA | No | Yes | NA |
| In-place density and moisture content | ASTM D6938 (or approved alternative method) | As specified | No | No | Yes | Yes |

**Table C-1 - Soil Placement Inspection Schedule (continued)**

| Inspection Task | Inspection/Test Method Reference | Sample/Test Quantity/Frequency | Sample Location | | Acceptance Criteria |
|---|---|---|---|---|---|
| | | | Source/ Stockpile | Fill Area | |
| **SURFACE SOIL LAYER RECOMPACTION** | | | | | |
| Direct shear strength of compacted fill | ASTM D3080[4] | 3 tests per material type, reconfirmed as needed | Yes | No | cohesion ≥ 300 PSF |
| Particle-size analysis | ASTM D422 | 3 tests per material type, reconfirmed as needed | Yes | No | 95% <3.0" sieve<br>between 5% and 20% passing #200 sieve |
| Moisture/density relation | ASTM D1557 | 3 tests per material type, reconfirmed as needed | Yes | No | NA |
| In-place density | ASTM D6938 (after compaction) | 1 per lift minimum, or 1 per 2,000 $yd^3$ (placed), or as specified | No | Yes | 95% MDD (min) by ASTM D 1557 |
| Moisture content | ASTM D6938 (after compaction) | 1 per lift minimum, or 1 per 2,000 $yd^3$ (placed), or as specified | No | Yes | OMC to OMC +2% |
| **TRENCH 13 FLOOR AND SUMP SUBGRADE** | | | | | |
| Hydraulic conductivity of compacted subgrade | ASTM D5084 | 3 tests per material type, reconfirmed as needed | Yes | No | $\leq 1 \times 10^{-5}$ cm/sec |
| Particle-size analysis | ASTM D422 | 3 tests per material type, reconfirmed as needed | Yes | No | ≤10% >1.0"<br>≥10% pass #200 sieve |
| Moisture/density relation | ASTM D1557, Modified proctor | 3 tests per material type, reconfirmed as needed | Yes | No | NA |

[4] ASTM D3080 run at normal stresses of 0.5, 1.0, and 2.5 KSF for specimens remolded at 95% MDD (min) and OMC±2%.

**Table C-1 - Soil Placement Inspection Schedule (continued)**

| Inspection Task | Inspection/Test Method Reference | Sample/Test Quantity/Frequency | Sample Location | | Acceptance Criteria |
|---|---|---|---|---|---|
| | | | Source/ Stockpile | Fill Area | |
| | moisture-density relation | | | | |
| In-place density and moisture content, trench floor | ASTM D1557 (after compaction) | one test per each one test for every 10,000 square feet of subgrade placed (placed) | No | Yes | 95% MDD<br>OMC to OMC +2% |
| Thickness, after compaction, trench floor | Measurement after compaction | The vertical control criterion for survey accuracy should be at least 0.1 feet, and comparison of actual and design grade should done on a 50-feet grid. All locations verified to include 9 inches of subgrade materials | NA | Yes | Thickness ≥ 9.0” |
| Hydraulic conductivity of constructed subgrade, trench and sump bottom | ASTM D5084 (remolded sample) | 1 test for every 40,000 square feet of constructed Floor and Sump subgrade (200-ft grid and at least one test in each sump), remold to density target (±2 PCF) and moisture target (±1%). Each sample will be of the full thickness of floor subgrade or a 12 inch lift of sump subgrade. | No | Yes | $\leq 1 \times 10^{-5}$ cm/sec |
| In-place density and moisture content, sump bottom | ASTM D6938 (after compaction) | 1 test per lift, not less than 3 tests per sump | No | Yes | 95% MDD<br>OMC to OMC +2% |
| Lift thickness, sump bottom | Measurement after compaction | Maximum lift thickness of 12 inches and not less than 3 measurements per lift in each sump. For final sump thickness confirmation, the vertical control criterion for survey accuracy should be at least 0.1 feet, and comparison of actual and design grade should be done on a 10-feet grid. All location verified to include 36-inches of subgrade material | NA | Yes | Total compacted lift thickness at same location ≥36.0” |

**Table C-1 - Soil Placement Inspection Schedule (continued)**

| Inspection Task | Inspection/Test Method Reference | Sample/Test Quantity/Frequency | Sample Location | | Acceptance Criteria |
|---|---|---|---|---|---|
| | | | Source/ Stockpile | Fill Area | |
| **SUMP AND LCRS PIPING BEDDING GRAVEL** | | | | | |
| Hydraulic conductivity of gravel | ASTM D 2434 | 3 tests per material type, reconfirmed as needed | Yes | No | Minimum hydraulic conductivity = 1 cm/sec |
| Particle-size analysis | ASTM C136 | 3 tests per material type, reconfirmed as needed | Yes | No | 100% <2.0” sieve<br>90%<1-1/2” sieve<br>≥85% >3/4” sieve<br>≤5% passing #4 sieve |
| **INTERIM COVER LAYER** | | | | | |
| Particle-size analysis | ASTM D422 | 3 tests per material type, reconfirm as needed, verify by visual observation. Materials >6.0 inch might be judged acceptable if ‘*de minimis*’ and rarely, if ever, in grain-to-grain contact. | Yes | NA | 100% <6.0” |
| Lift thickness, for interim cover layer | Measurement after loose placement | Random measurements and observation | NA | Yes | Total loose thickness ≥12.0” |
| **FINAL COVER LAYER** | | | | | |
| Particle-size analysis | ASTM D422 | 3 tests per material type in stockpile, reconfirm as needed, verify maximum size criterion by visual observation at placement. Materials >6.0 inch might be judged acceptable if ‘*de minimis*’ and rarely, if ever, in grain-to-grain contact. | Yes | Yes | 100% ≤ 6.0”<br>≤10% > 1.0”<br>≥5% passing #200 sieve |
| Moisture/density relation | ASTM D1557, Modified proctor moisture-density relation | 3 tests per material type, reconfirmed as needed | Yes | NA | NA |

**Table C-1 - Soil Placement Inspection Schedule (continued)**

| Inspection Task | Inspection/Test Method Reference | Sample/Test Quantity/Frequency | Sample Location | | Acceptance Criteria |
|---|---|---|---|---|---|
| | | | Source/ Stockpile | Fill Area | |
| Lift thickness, final cover layer | Measurement before placement and after placement | One measurement for each 50 ft by 50 ft grid area | NA | Yes | Loose lift thickness > 24.0” |
| In-place density and moisture content | ASTM D1557 (after compaction) | one test for every 10,000 square feet of cover placed | NA | Yes | 85% MDD (±3%)<br>OMC minus 2% or less |
| **FINAL COVER DRAINAGE ARMORING** | | | | | |
| Rock Particle Size | Supplier certification | 1 per source, reconfirm as needed, verify by visual observation | Yes | NA | <u>Without Grout</u><br>$D_{50} \geq 2$ in. (lateral drainages and upper deck berms)<br>$D_{50} \geq 6$ in. (access road drainages)<br>$D_{50} \geq 12$ in. (sideslope flumes)<br><u>With Grout</u><br>$D_{50} \geq 4$ in. (sideslope flumes and access road drainages) |
| Rock Specific Gravity | ASTM C 127 | 1 per material type | Yes | NA | S.G. > 2.5 g/cm$^3$ |
| Rock Angularity | Visual inspection | Random measurements and observation | Yes | NA | Angular to Sub-rounded |
| Grout Compressive Strength | ASTM C39 | 1 per application | Yes | NA | Minimum 28-day compressive strength of ≥ 2,500 psi |
| Grout Thickness | Measurement after placement | Random measurements and observation | NA | Yes | Fill interstitial space |

**Table C-1 - Soil Placement Inspection Schedule (continued)**

| Inspection Task | Inspection/Test Method Reference | Sample/Test Quantity/Frequency | Sample Location | | Acceptance Criteria |
|---|---|---|---|---|---|
| | | | Source/ Stockpile | Fill Area | |
| **FINAL COVER LINE AND GRADE** | | | | | |
| Final Cover Thickness | Survey (compare surfaces) | The vertical control criterion for survey accuracy should be at least 0.25 feet. Compare measurements for each 50 ft by 50 ft grid area | NA | Yes | 90 percent of points of measurement comparison ≥2.0 ft, no point of measurement comparison <1.75 ft |
| Maximum Elevation | Survey | The vertical control criterion for survey accuracy should be at least 0.25 feet. One measurement for each 50 ft by 50 ft grid area | NA | Yes | Maximum elevation of 2,860 ft NAVD88 |

MDD = Standard Proctor (ASTM D1557) maximum dry density.
OMC = Standard Proctor (ASTM D1557) optimum moisture content
TBD = to be determined by soil testing laboratory
PSF = pounds per square foot

**TABLE C-2**
**GEOMEMBRANE INSTALLER'S CERTIFICATION**
**SUBGRADE ACCEPTABILITY**

Project Title:_____

Project Number:_____

Project Location:_____

Date:_____

Geomembrane Contractor:

Representative:

I, the undersigned, a duly authorized representative of _____do hereby accept the subgrade surface, defined as the material supporting the geomembrane, and shall be responsible for its integrity and suitability, in accordance with the Specifications, from this date to acceptance of the geomembrane installation. I have personally inspected the condition of the constructed surfaces and the condition of the area meets or exceeds the minimum requirements for installation of the geomembrane.

Approximate Size of Area:_____

Description of Area:_____

_____

_____

Signed:

Geomembrane Contractor _____

Earthwork Contractor _____

CQA Representative_____