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PERMIT MODIFICATION AND DESIGN REPORT FOR PHASE 1 OF THE PROMONTORY LANDFILL FACILITY

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1.0 INTRODUCTION

This Permit Modification and Design Report (PMDR) provides information on proposed permit modifications and details on the initial Phase 1 development for the Promontory Landfill Facility (PLF). This PMDR discusses the currently permitted design of the PLF and the proposed modifications to the permitted design and operation of the landfill facility. The proposed design modifications include support analyses and calculations.

1.1 BACKGROUND

1.1.1 LANDFILL SITE

The PLF is a new, permitted 2,000-acre facility (1,000 acres for disposal bounded by 1,000 acres of buffer area) which will serve as a Class I landfill located on the west side of the southern tip of the Promontory Point Peninsula in Box Elder County, Utah and is protected visually from the Wasatch Front by several small islands and mountains. Access to the landfill facility would be either by way of the Union Pacific Railroad, the Union Pacific Railroad causeway, a private dike, or a county road as shown on Figure C-001. Promontory Point Resources, LLC (PPR) has purchased the property from the previous applicants, Promontory Landfill, LLC. PPR will own and operate the PLF. The PLF was issued a Solid Waste Permit Renewal by the Utah Solid and Hazardous Waste Control Board on September 1, 2011 (see Appendix A).

1.1.2 LANDFILL OPERATION STATUS

To date, construction and operations at PLF, have not commenced. Excavation and development of Phase 1 is anticipated to commence by Summer 2016 pending approval of this PMDR. Development of the PLF will commence with Phase 1 in the south west corner of the site and expand to the north and west as it is developed.

1.2 PROPOSED DEVELOPMENT MODIFICATIONS

As part of development of Phase 1 of the PLF various design elements are proposed as modifications to the design included in the Promontory Landfill LLC Class I Landfill Permit Application, dated August 2008 to provide more flexibility in the development of the landfill and utilization of materials as they become available. Following is a list of the design modification items.

1. Liner Alternatives:
   - Alternative 1: Geocomposite clay layer (GCL), geomembrane, geotextiles, drainage gravel, operations layer
   - Alternative 2: GCL, geomembrane, sand
2. Clay (prescriptive) low permeability layer substitution for permitted GCL in liner.
3. Base grade modification to three percent from five percent.
4. Leachate recirculation.
5. Fill slope variation to 3:1 gross slope (2.5:1 between 15-foot benches).
6. Evapotranspirative final cover alternative.

The above proposed design modifications comply with the current permitted capacity and do not impact the overall site life or footprint of the PLF. These design modifications are discussed in detail in Section 2.0.

1.3 DOCUMENT PURPOSE AND SCOPE

This PMDR is submitted in accordance with requirements in Section II.A of the Solid Waste Permit Renewal dated August 31, 2011. This PMDR provides the construction design drawings for the Phase 1 development. This report incorporates the construction plans (Appendix B), specifications (Appendix C) and other pertinent technical information (i.e., Appendix D - Design Calculations, Appendix E - Geotechnical Design Report, Appendix F – Construction Quality Control and Construction Quality Assurance (CQC/CQA Plan). The construction plans, as well as associated specifications, will provide the Contractor with the information necessary to construct the project and the CQC/CQA plans describe liner construction monitoring procedures to verify that the work has been completed in accordance with the plans, specifications and applicable regulatory requirements relative to liner placement.

This report has been prepared on behalf of Promontory Landfill LLC by Tetra Tech BAS. The professional certification of this document by the party assigned is presented in Section 4.0.

2.0 PERMIT MODIFICATION REQUEST AND UPDATES

This section describes the proposed design modification elements previously listed in Section 1.2 as compared to those elements included in the Promontory Landfill LLC Class I Landfill Permit Application. Also, as required in the Solid Waste Renewal Permit, this section presents the closure and post-closure cost estimate revision which is due by August 31, 2016.

2.1 LINER ALTERNATIVES

Alternatives to the permitted liner design are proposed in order to gain flexibility in construction as certain materials meeting performance requirements become available that may be utilized in the liner construction. These alternatives are proposed for Phase 1 and future phases, as applicable.

2.1.1 PERMITTED LINER DESIGN

The permitted composite liner design consists of a clay layer and a HDPE layer. A clay layer consisting of a geocomposite clay layer (GCL) has been previously approved as the low permeable soil component. The HDPE layer would be 60 mil or thicker to minimize puncture risk. The HDPE would be protected from site soils by the clay layer. The leachate collection system would consist of a geonet. Overlaying the leachate collection layer would be a 20 ounce/yard nonwoven filter geotextile mat. The purpose of this mat is to separate the leachate collection system and the waste. A protective soil layer will be placed on top of the geotextile mat to protect the mat and geonet from protrusions and to also provide a buffering and filtration function. The protective layer will consist of a homogenous material with an average particle size less than ½-inch diameter, and a maximum particle size less than 1 inch diameter.

2.1.2 PROPOSED LEACHATE COLLECTION LAYER ALTERNATIVES

In order to utilize construction materials as they become available, two lateral drainage layer alternatives are presented one which includes soil operations layer, geotextiles and gravel, while the second consisting of only a thick layer of course sand. The two alternatives are described below. Detailed design and support calculations are included in the Design Report portion of this document included in Section 3.0.

2.1.2.1 ALTERNATIVE 1

Alternative 1 includes the following from bottom to top (see Figure C-501, Detail 3):

- Prepared liner subgrade;

- GCL (non-woven);
- 60-MIL HDPE Geomembrane (textured on both sides);
- Cushion geotextile;
- Nine (9) inch gravel drainage layer;
- Non-woven geotextile filter fabric; and
- Minimum 18-inch protective soil cover.

2.1.2.2 ALTERNATIVE 2

Alternative 2 includes the following from bottom to top (see Figure C-501, Detail 2):

- Prepared liner subgrade;
- GCL;
- 60-MIL HDPE Geomembrane (textured on both sides); and
- Minimum 18-inch coarse sand.

2.2 LINER LOW-PERMEABILITY LAYER SUBSTITUTION

An alternative to the permitted low-permeability layer of the liner design is proposed in order to gain flexibility in construction as certain materials become available that may be utilized in the liner construction. This alternative is proposed for Phase 1 and future phases, as applicable.

2.2.1 PERMITTED LOW-PERMEABILITY LAYER

The permitted composite liner design consists of a clay layer and a HDPE layer. A clay layer consisting of a GCL, is presented in the permit document and is also allowed in Section II.C of the Solid Waste Permit Renewal issued September 1, 2011 (see Appendix A). Section II.C indicates that the facility has been approved for an equivalent design which uses a geosynthetic clay liner in place of the liner required in Utah Administrative Code (UAC) R315-303-3(3)(a)(ii).

2.2.2 PROPOSED LOW-PERMEABILITY LAYER

The low-permeability layer portion of the liner is proposed to utilize clay soils in lieu of a GCL, at the owner's option should appropriate materials become available. The clay layer will meet the prescriptive requirements of UAC R315-303-3(3)(a)(ii) which requires that the lower liner be constructed of at least two feet of recompacted clay or other soil material with a permeability of no more than 1×10^{-7} cm/sec. Detailed design and support calculations are included in the Design Report portion of this document included in Section 3.0.

2.3 BASE GRADE MODIFICATION

An alternative to the permitted base grade is proposed for stability and operational concerns. This alternative is proposed for Phase 1 and future phases, as applicable. It is proposed that the base grades be excavated to the maximum extent possible maintaining a five-foot seperation between the historical high level of groundwater and the bottom of the lowest liner component, along with a three percent sheet grade as opposed to the currently permitted five percent grade (see Figures C-101 and C-301). The proposed grade decrease is still within the allowed base grade in UAC R315-303-3(3)(a)(ii) which allows for base grades as flat as two percent. It is proposed that flowlines of the leachate collection pipes be greater than one percent. Detailed design and support calculations are included in the Design Report portion of this document included in Section 3.0.

2.4 LEACHATE UTILIZATION

An alternative to leachate utilization is proposed. The currently permitted use/disposal of leachate is for either dust control/compaction water on lined areas or pumped to evaporation basins. It is proposed that the leachate may also be recirculated into the waste thus increasing anerobic digestion and landfill gas production which may be used to generate electricity. Leachate recirculation is allowed by UAC R315-303-3(2)(b) on landfills with composite liners like the PLF. Leachate recirculation would only occur in lined portions of the facility. Leachate production would be closely monitored to ensure that the moisture holding capacity of the refuse is not exceeded.

2.5 FILL SLOPE MODIFICATION

Modification of the design of the final fill slopes is proposed. The currently permitted final fill slopes are set at 4:1 (horizontal:vertical) gross or approximate 3.5:1 slopes between 15-foot benches. The proposed modification to the final fill slopes will be gross 3:1 or 2.5:1 slopes between 15-foot benches (see Figure C-102). This design modification is supported by the stability analysis provided in Appendix E and disucssed in Section 3.1.4. This modification is proposed for Phase 1 and future phases, as appllicable.

2.6 ALTERNATIVE FINAL COVER DESIGN

The current permitted final cover design for the PLF is as follows (from bottom to top):

- GCL;
- 40 MIL Very Flexible Polyethylene (VFPE);
- Bi-planar Geocomposite; and
- 18 inches of site soils.

An alternative to the permitted final cover is proposed as allowed in UAC R315-303-3(4)(a)(i) and (ii) which allows the director to approve an alternative cover design if it can be documented that the alternative cover achieves an equivalent reduction in infiltration as achieved by the standard design and the alternative final cover provides equivalent protection from wind and water erosion as achieved by the standard design. The proposed alternative design will consist of a monolithic soil evapotranspiration cover for placement on final fill slopes which will be designed to a depth and soil type which will perform equivalently to the prescriptive standard in UAC R315-303-3(4). Detailed design and support calculations will be presented at the time of closure when final cover materials have been selected and modeled.

2.7 CLOSURE AND POST-CLOSURE MAINTENANCE COST ESTIMATE REVISION/UPDATE

As required in the Solid Waste Renewal Permit, the closure cost estimate revision/update is due by August 31, 2016. In light of the design of Phase 1, the closure and post-closure cost estimates have been updated from 2008 to 2016 rates and reflects the costs of placement of the proposed alternative final cover on the final fill slopes and the prescriptive cover on the deck areas. The post-closure costs reflect the appropriate maintenance costs for each final cover type.

The cost estimates assume that closure activities would be implemented as each phase within the disposal site is completed. These closure activities would minimize the need for further maintenance, and minimize or eliminate the threat to human health and the environment from post-closure escape of solid waste constituents, leachate, contaminated run-off or waste decomposition products to the ground, groundwater, surface water or the atmosphere.

The previous cost estimate prepared as part of the permit application assumed the first module to close to be 20 acres. The redesign of the landfill development provides for the initial phase to consist of 31 acres; therefore the cost estimates are based on closure of the first 31 acres of the PLF. Table A and B presents the revised/updated costs, and supporting documentation is included in Appendix G. The closure and post-closure costs have been prepared as required by UAC R315-309-2 and in accordance with UAC R315-309-2(3)(a) and (b).

3.0 PHASE 1 DESIGN

This section describes the design and proposed construction of Phase 1 which meets the design requirements of UAC R315-303 for Class I landfills as well as the Solid Waste Permit Renewal conditions for the PLF. Design elements include the liner design configuration, design criteria and supporting calculations. Construction design elements include the excavation, subgrade preparation, composite liner system, leachate collection and removal system (LCRS), operations layer, and surface water drainage control system. In addition, this section summarizes the CQA plan and operational requirements for Phase 1.

3.1 DESIGN

3.1.1 LINER CONFIGURATION

The Phase 1 development area will be the initial phase in the development of the PLF (see Figure C-100). The limits of disturbance for the Phase 1 area is approximately 43 acres, of which approximately 34 acres are to be lined. Within this configuration, the floor area consists of approximately 26.6 acres and the slopes 4.2 acres. The liner plans for Phase 1 is shown on C-101, C-103 and C-105 of the Construction Plans (Appendix B).

The base of Phase 1 is designed at a minimum three (3) percent sheet flow gradient and the LCRS mainline is at two (2) percent. Subgrade elevations were set to maintain positive gravity flow of liquids through the LCRS to the sump. A pump will be installed in the sump and leachate will be pumped into tanks located to the south west of the cell. The excavation slopes are comprised of a maximum of 3:1 (horizontal:vertical) slope grades.

3.1.2 DESIGN CRITERIA

The Phase 1 liner system reflects current design criteria requirements in UAC R315-303-3(3). These criteria are discussed in the following applicable construction element sections.

3.1.3 DESIGN CALCULATIONS

Design calculations were performed for various elements of the Phase 1 liner system. The following calculations are included in Appendix D.

- Liner and LCRS Pipe Calculations:
  - Geotextile cushion;

- LCRS pipe strength;
- LCRS pipe capacity;
- LCRS pipe spacing;

- Hydrologic and hydraulic calculations for stormwater drainage systems; and
- Leachate Generation - HELP Modeling.

3.1.4 SLOPE STABILITY ANALYSIS

Analysis of slope stability is mandated for subgrade slopes by 40 CFR, Part 258.15, which requires the operator to ensure against landfilling over unstable areas which may compromise the integrity of landfill structural components. Final refuse fill slope stability is governed in UAC R315-302-1(2)(b).

A slope stability analysis, which was based on site-specific geotechnical field investigations, proposed liner materials and calculations for static and pseudostatic slope stability, was prepared for the Phase 1 design. The methods and results of this work are documented in a report titled Slope stability Evaluation, Promontory Point Landfill Cell 1, Phase 1A, Ogden Utah (see Appendix E). Static and pseudostatic slope stability calculations were completed for subgrade, liner, interim fill, and final fill slope geometries for Phase 1.

3.1.5 CONSTRUCTION ELEMENTS

3.1.5.1 EXCAVATION

The geometry for the Phase 1 excavation is shown on Sheets C-101, C-103, and C-105 of the Construction Plans (Appendix B). The excavated soils will be stockpiled onsite, used within the cell or exported. Total excavation is approximately 785,000 cubic yards, see the break down by phase in Table 1.

Table 1
Earthwork Volumes

Phase	Excavation (CY)
Phase 1A	448,000
Phase 1B	228,000
Phase 1C	109,000
Total	**785,000**

3.1.5.2 COMPOSITE LINER

For the liner construction, a composite liner system (two-layer low-permeability systems) and an LCRS are proposed, which meet the requirements specified in UAC R315-303-3(3)(a) and (b) and the Promontory Landfill LLC Class I Landfill Permit Application document. The UAC contains design requirements for a prescriptive liner system and also allow an operator to develop and submit for approval, an alternative liner design in accordance with UAC R315-303-3(3)(b). An alternative liner and LCRS were approved by the Utah Solid and Hazardous Waste Control Board for the PLF which allows a GCL in lieu of the two-foot low-permeability soil layer. Dependent upon materials availability either the prescriptive low-permeability soil layer or GCL may be utilized in the composite liner construction.

Appendix D contains design support calculations for the composite liner system. The calculations check the integrity of the liner material to resist puncture, shearing and tearing. Appendix D also includes calculations for the leachate collection and recovery system design.

Where the edges of the Phase 1 composite liner system meet future liner systems of adjacent phases, the soil and geosynthetic components from each liner system will be appropriately joined and/or welded together to form a continuous liner between the phases as shown in the Construction Plans. A representative of the geosynthetic installation contractor and CQA personnel will approve the condition of the subgrade prior to placement of geosynthetic materials.

The liner design consists of the side slope and bottom areas as described in the following two sections.

3.1.5.2.1 Side Slopes

The composite liner system for the slope liner section is comprised of the following (from bottom to top as shown below in Figure C-501, Detail 4):

- Prepared liner subgrade;
- Geotextile-backed GCL or two-foot low-permeability soil layer (with a hydraulic conductivity less than or equal to $1x10^{-7}$ cm/sec);
- 60-MIL HDPE Geomembrane (textured on both sides);
- 16 ounce cushion geotextile; and
- 24-inch protective soil cover.

The composite liner system has been designed to prevent migration of leachate into the underlying ground and facilitate leachate collection by the LCRS.

3.1.5.2.2 Floor Areas

The composite liner system for the bottom liner section (gradients less than 5:1) is comprised of the following (from bottom to top as shown below in Figure C-501, Details 2 and 3):

- Prepared liner subgrade;
- Geotextile-backed GCL or two-foot low-permeability soil layer (with a hydraulic conductivity less than or equal to $1x10^{-7}$ cm/sec);
- 60-MIL HDPE Geomembrane (textured on both sides);
- Cushion geotextile;
- Six (6) inches gravel drainage layer;
- Non-woven geotextile filter fabric; and
- 18-inch protective soil cover.

Or

- Prepared liner subgrade;
- Geotextile-backed GCL or two-foot low-permeability soil layer (with a hydraulic conductivity less than or equal to $1x10^{-7}$ cm/sec);
- 60-MIL HDPE Geomembrane (textured on both sides); and
- 18-inch coarse sand.

The composite liner system has been designed to prevent the migration of leachate into the underlying ground and facilitate leachate collection by the LCRS.

The HDPE geomembrane or flexible membrane liner (FML) will be textured on the surface placed over the finished subgrade and will be overlain by geotextile. This allows the geotextile to move above the FML without affecting the integrity of the low-

permeability performance of the waste containment system. The floor FML will be textured on both sides to provide the highest possible friction interface on the floor and increase the stability of the waste prism.

The construction drawings contain details for anchoring of the liner materials at the top of slope. These anchors provide restraint against pull out, which is not likely to occur given the proposed uniform waste filling operation which will provide buttressing and support of the liner system. All anchor trenches shall be monitored during construction and density tests shall be completed in accordance with the CQA plan.

3.1.5.3 LEACHATE COLLECTION AND REMOVAL SYSTEM

A LCRS shall be installed above the FML on the floor, bench, and slope areas. The LCRS was designed in consideration of the following criteria:

- Provide for efficient collection and removal of leachate by gravity flow; and
- Limit the maximum amount of hydraulic head on the primary liner to less than 12 inches.

Modeling of potential leachate was performed using the United States Environmental Protection Agency (EPA) Hydrologic Evaluation of Landfill Performance (HELP) version 3.07. The HELP model output files for each run are included in Appendix D.

The HELP Model was developed to provide landfill designers and regulators with a tool for rapid, economical screening of alternative designs. The computer program uses climatologic, soil, and design data to produce daily estimates of water movement across, into, through, and out of the landfill. To accomplish this; daily precipitation, runoff, infiltration, surface evaporation, subsurface evapotranspiration, stored soil moisture, percolation, and subsurface lateral drainage are modeled to maintain a water balance. The model utilizes daily climatic data to develop a daily water balance for up to thirty years.

The HELP Model was used to evaluate and design of both base liner section options and the slope liner for conformance with regulatory requirements. Specifically, the HELP Model was used to evaluate the total head on the liner and to determine leachate generation rates for use in designing and sizing the leachate pipes and storage tanks.

A review of historic climatic records from nearby weather stations revealed that the largest amount of rain in one year was 33.93 inches recorded at Brigham City waste plant in 1983. The Bringham City waste plant is approximately 24 mile north east of PPL. The 33.93 inch annual rainfall was used and HELP synthetically generated precipitation for a five year period for the intermediate condition to determine the worst

case scenario, or highest leachate generation rate to be expected. The default weather data from Salt Lake City was used for the final condition, with 200 feet of refuse over 30 year duration to determine the range of leachate generation to be expected.

The input used in the HELP to model the proposed liner design profile are listed in the first section of each HELP Model output file. The input listing shows layer type, thickness, and soil characteristics. The soil characteristics are default values suggested by the HELP Model to simulate the soils to be used in the proposed design. The HDPE layer was assumed to have a pinhole density of 3 per acre and installation defect of 3 per acre, and a placement quality of "3-good".

The following table summarizes the main input values and results for the various scenarios.

Table 2
HELP Results

Liner Section	Refuse Thickness (feet)	Duration (years)	Max Head Over Liner (Inches)	Peak Leachate Generation (cf/ac)	Average Annual Leachate Total (cf/ac/year)
			Interim Condition		
Base Alt. 1	20	5	1.04	503.66	4,698.91
Base Alt. 2	20	5	2.29	386.3	4,663.92
Slope	10	5	3.91	286.74	4,759.77
			Final Condition		
Base Alt. 1	200	30	0.43	203.64	933.43
Base Alt. 2	200	30	1.56	258.32	933.43
Slope	100	30	8.73	135.90	3,591.77

3.1.5.3.1 Leachate Tank Sizing

The HELP results were used to size the leachate tank for the initial phase. Cell 1 will have approximately 15 acres of base liner and 4 acres of slope liner, using the average leachate generation rates listed in Table 2 results in a total leachate flow of approximately 1,860 gallons per day. The leachate tanks have a capacity of 8,700 each, two tanks will be installed during Phase 1 construction (see Sheet C-504) for a total capacity of 17,400 gallons; therefore, the tanks will have to be emptied every 9 days on average. However, the yield values in the HELP analysis are conservative as they do not account for phasing over time and closure of certain areas. Therefore, the

tank capacity is sufficient for peak leachate generation and should not require evacuation on a frequent basis.

3.1.5.3.2 LCRS Clogging

The LCRS drainage layer is critical for maintaining low levels of head over the liner by quickly removing leachate. The base liner will have either a gravel drainage layer with a filter geotextile and two feet of protective cover soil above it (Alternative 1) or a coarse sand drainage layer (Alternative 2). The protective cover soil and filter geotextile will help filter the leachate before it enters the gravel drainage layer therefore clogging is expected to be minimal, however there is no filtering of leachate before it gets to the drainage layer in the Alternative 2 base liner configuration; therefore, clogging must be analyzed. A sensitivity analysis was performed using the HELP model and varying the hydraulic conductivity of the coarse sand layer and keeping all other inputs constant to determine the lowest hydraulic conductivity of the coarse sand layer that would still provide adequate drainage and keep the leachate head over the liner below 12 inches. A hydraulic conductivity of 1.0×10^{-3} cm/sec resulted in a head over the liner of approximately 11.95 inches, therefore it was determined that the lowest allowable hydraulic conductivity should be 1.0×10^{-3} cm/sec. The specified hydraulic conductivity for the coarse sand layer is 1.0×10^{-1} cm/sec which results in a factor of safety of approximately 100 when compared to the lowest allowable hydraulic conductivity.

3.1.5.3.3 Collection Pipes

The drainage layer on the floor will be drained by four-inch diameter slotted HDPE lateral pipes in gravel trenches that span across the base, intercepts the sheet flow, and concentrates the flow in the pipes, the lateral collectors will be spaced at maximum 200-foot intervals. The lateral pipes connect to a six-inch diameter LCRS mainline pipe creating a dendritic network of leachate collection pipes. The LCRS mainline pipe connects directly to the leachate sump.

3.1.5.3.4 Clean-Outs and Sump

Access for cleaning of the six-inch mainline shall be provided by extending the LCRS line above the liner limit. The LCRS collection system is equipped with sampling ports located prior to discharge of liquids into an outfall containment tank. The leachate will gravity drain to the sump, where it will be pumped to the leachate tanks. There will be two outfall containment tanks for the LCRS installed as part of Phase 1A and the tank pad will have room for an additional tank to be added later as the landfill is developed.

3.1.5.4 STORMWATER DRAINAGE CONTROL

Stormwater is water that does not come into contact with the refuse. Stormwater drainage can be described as being either run-on - stormwater flows entering the developed portion of the site from adjacent undeveloped areas, or run-off - stormwater flow coming from the developed portion of the site that has not had contact with refuse, i.e. stormwater flows over native cut slopes or intermediate cover.. All stormwater that comes into contact with refuse is considered leachate and must remain within the boundaries of the landfill liner and be managed as leachate. The landfill run-off will be kept separated from the run-on flows.

The diversion channels are designed to handle the 25-year, 24-hour storm event. The quantity of flow expected for the run-on condition of the Phase 1 landfill cell was determined by using the precipitation rainfall depth of 2.25 inches (NOAA precipitation frequency data server Atlas 14). The Runoff Curve Number varies across the tributary area from 63 for soil type A and 88 for type D soils. The areas of the various hydrologic soil types was determined using the Web Soil Survey website from the USDA. Vegetation was assumed to be poor condition desert shrub. The 48 acre tributary is divided into eastern and western. The time of concentration was calculated using Kirpich and Manning's equations for sheet flow, shallow concentrated flow and channelized flow accordingly. The peak flow generated was determined by applying the US Soil Conservation Science Technical Release 55 (TR-55) method. Details of the input parameters and model output are included in Appendix D. Table 3 shows the peak discharge generated from the run-on.

Table 3
25-Year, 24-Hour Peak Flow

Subarea	Peak Discharge (cfs)
A1 (Western Run-On)	14.68
B1 (Eastern Run-On)	41.72

The diversion channels that convey the run-on around the site consist of earthen swales that are lined with an erosion control blanket. The channels were sized using Flowmaster hydraulic software from Bentley Systems Inc.

The run-off from the Phase 1 landfill cell will be managed through temporary drainage facilities consisting of benches, down drains, and drainage swales. Run-off from the landfill as well as the onsite facilities will be routed through the detention basin to

capture sediment and pollutants prior to the stormwater discharging from the site. If required, culverts will be placed along the access road as needed.

Stormwater that collects inside of the landfill cell but does not come into contact with refuse will drain to an earthen lined pond located in the northern portion of the cell. As the landfill expands through the phases 1A, 1B, and 1C the pond will be reconstructed to accommodate the runoff volume of the subsequent interim drainage conditions. The 2 year, 24 hour storm event of 1.32 inches was multiplied by the tributary area to determine the size of the ponds. Figures D-2 through D-4 show the various pond configurations and calculations (Appendix D). Stormwater that accumulates at the interior basin will be allowed to settle prior to pumping to site drainage facilities.

3.1.5.5 CONSTRUCTION SWPPP

The draft construction stormwater pollution prevention plan (SWPPP) has been prepared for the Phase 1 landfill cell in accordance to Utah Administrative Code R317-8-3.9. The Utah Pollutant Discharge Elimination System (UPDES) requires construction stormwater permits for construction activities that disturb one acre or more.

The permit requires submission of a Notice of Intent (NOI) by creating an account on the Utah.gov website. The construction general permit must be renewed annually and the online account can be used to renew the permits. An owner or operator may submit a Notice of Termination (NOT) form at the end of the construction activity. A draft construction SWPPP is included in Appendix H.

3.1.5.6 INDUSTRIAL SWPPP

Operators of facilities that have industrial stormwater discharges are covered by the General Multi-Sector Industrial Storm Water Permit. Coverage is based on the facility's Standard Industrial Classification (SIC) code which is 4953 for Refuse Systems.

The permit requires submission of a Notice of Intent (NOI) by creating an account on the Utah.gov website. The general permit cycle is for 5 years and the online account can be used to renew the permits. A draft industrial SWPPP is included in Appendix I.

3.1.6 CONSTRUCTION QUALITY ASSURANCE

To verify that the liner installation has been completed in accordance with the Construction Plans and Specifications and that the work meets applicable regulatory requirements, construction will be monitored in accordance with the procedures and

schedule described in the CQA plan. The cited procedures provide for inspection and testing of all critical components and construction work for the composite liner system, and LCRS, including visual inspection of subgrade preparation, material handling and placement, field testing of all seams, monitoring LCRS gravel placement, monitoring LCRS pipe installation and field testing of the operations layer compaction.

The CQA plan provides for independent laboratory testing for material conformance of all manufactured construction components including geotextiles and geomembranes. In addition, shear strength testing of the proposed side slope liner section will be completed to demonstrate that the actual products used in construction will exhibit a sufficient degree of interface and internal friction. The CQA plan is included in Appendix F.

3.1.7 PHASE 1 LANDFILL OPERATIONS

To maintain the integrity of the liner system and provide for efficient collection and removal of leachate, procedures shall be implemented to control fill sequencing, waste placement and LCRS operations after liner construction as described below.

3.1.7.1 FILL SEQUENCE AND CONTROL

The refuse fill plan for Phase 1A, 1B, and 1C is shown on Sheet C-102, C-104 and C-106 respectively. The refuse fill design grades are 3:1 gross and 2.5:1 between benches with 15-foot wide benches to be located every 50 vertical feet maximum.

3.1.7.2 WASTE PLACEMENT

To minimize the potential for damage to the liner system resulting from initial waste disposal operations, the following procedures will be implemented:

Initial Waste Fill Placement - Initial waste fill operations will include a uniform 10 to 20 foot initial lift of select waste. This lift of waste will be placed to protect the operations layer. In addition, the first lift of waste and associated daily cover will be graded to direct clean stormwater and surface water run-off away from the phase and to minimize stormwater infiltration into the refuse prism. Filling operations will then proceed with typical lifts of approximately 20 feet, thereafter.

Waste Inspection - Waste will be inspected by operations staff to eliminate objects that could be driven through the liner system during placement and compaction of the initial lifts of waste. Waste inspection will be conducted continuously throughout the period of waste placement against the liner. The following items will be diverted from

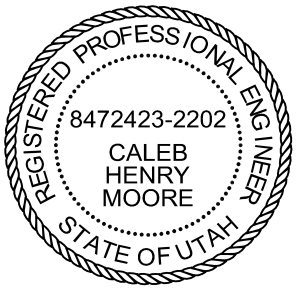
the first lift of fill: large metal objects, construction and demolition debris, and large green waste material.

Waste unloading, spreading and compacting. – Waste transport vehicles can travel in direct contact with the operations layer. The heaviest pieces of landfill equipment should minimize direct contact on the operations layer. Any area of the operations layer that appears to have been disturbed by heavy equipment shall be inspected. Incoming refuse vehicles will tip loads onto the operations layer or from the deck of the adjacent compacted refuse fill. After waste has been unloaded from the refuse vehicles, a uniform lift thickness shall be established. To minimize the potential for objects to penetrate the operations layer, refuse will not be pushed excessively. During compaction, all compaction equipment shall stay on the deck of the waste fill and shall not operate on the front slope of waste or the operations layer. The side slope liner system left exposed for future liner tie-in shall be monitored for potential damage from erosion, ultraviolet degradation, equipment impacts, and animal burrowing.

4.0 PROFESSIONAL CERTIFICATION

Current regulations require that a registered civil engineer or a certified engineering geologist prepare and certify the Design Report for a landfill containment system.

With the signature and seal below, the Phase 1 design for the Promontory Landfill Facility has been prepared in accordance with UAC R315-303-3(6)(a) and Section II.A of the Solid Waste Permit Renewal issued September 1, 2011, as certified by Mr. Caleb Moore, a Utah Registered Civil Engineer, Registration Number 8472423-2202.



Caleb H. Moore, P.E.
Registration No. 8472423-2202

5.0 LIST OF REFERENCES

Utah Administrative Code, R315 Environmental Quality, Waste Management and Radiation Control, Waste Management

Advanced Environmental Engineering, Inc., 2008, "Promontory Landfill LLC, Class I Landfill, Permit Application."

APPENDIX A

PERMITS

UTAH SOLID AND HAZARDOUS WASTE CONTROL BOARD
SOLID WASTE PERMIT RENEWAL

PROMONTORY CLASS I LANDFILL

Pursuant to the provisions of the *Utah Solid and Hazardous Waste Act*, Title 19, Chapter 6, Part 1, Utah Code Annotated (UCA) 1953, as amended (the Act) and the *Utah Solid Waste Permitting and Management Rules*, Utah Administrative Code (UAC) R315-301 through 320 adopted thereunder, a Permit is issued to

Utah Landfill & Ballast, LLC
as owner and operator

to own, construct, and operate the Promontory Class I Landfill located at and around the surrounding vicinities of Section 19, Township 6 North, Range 5 West, Salt Lake Base and Meridian, Box Elder County, Utah as shown in the permit renewal application that was determined complete on May 25, 2011, Tracking Number 2008.02932.

Utah Landfill & Ballast, LLC. (Permittee) is subject to the requirements of UAC R315-301 through 320 and the requirements set forth herein.

All references to UAC R315-301 through 320 are to regulations that are in effect on the date that this Permit becomes effective.

This Permit shall become effective: September 1, 2011.

This Permit shall expire at midnight August 31, 2021.

Closure Cost Revision Date: August 31, 2016.

Signed this 31st day of August, 2011.

Original Document signed by Scott T. Anderson on 8/31/11

Scott T. Anderson, Executive Secretary
Utah Solid and Hazardous Waste Control Board

FACILITY OWNER/OPERATOR INFORMATION

LANDFILL NAME:	Utah Landfill and Ballast LLC-Promontory MSW Landfill
OWNER NAME:	Utah Landfill & Ballast, LLC
OWNER ADDRESS:	1830 West Highway 112, Tooele, Utah 84074
OWNER PHONE NO.:	(435) 840-2800
OPERATOR NAME:	same as owner
OPERATOR ADDRESS:	same as owner
OPERATOR PHONE NO.:	same as owner
TYPE OF PERMIT:	Class I Landfill
PERMIT NUMBER:	0202R1
LOCATION:	Landfill site is located in Township 6 North, Range 5 West, Section 19, SLBM, Box Elder County (and all other geographical coordinates as outlined in the application); Latitude: 41º 12' 55", Longitude: 112º 28' 5".
DIRECTIONS TO FACILTY:	Location of site is on the west side of the southern tip of the Promontory point Peninsula. Access routes considered to the landfill are by way of the Union Pacific Railroad causeway, a private dike, or a county road from the north connecting to State Route 83.

PERMIT REQUIREMENTS

Permit as used in this document is defined in UAC R315-301-2(55).

The renewal application, *Promontory Landfill LLC Class I Landfill Permit Application*, Tracking Number 2008.02932, as deemed complete on the date shown on the signature page of this Permit, is hereby incorporated by reference into this Solid Waste Permit and will be referred to as the Permit Application throughout this Permit. All representations made in the Permit Application are part of this Permit and are enforceable under UAC 315-301-5(2). The Permit Application will become part of the operating record of the landfill. Where differences in wording exist between this Permit and the Permit Application, the wording of this Permit supersedes that of the Permit Application.

This Permit consists of the signature page, Facility Owner/Operator Information section, sections I through V and the Permit Application as defined above.

The facility as described in this Permit does not currently have any structures such as scale house and maintenance building, disposal cells for all permitted waste, dead animal disposal cells, recyclable storage areas, etc.

By this Permit to own and operate, the Permittee is subject to the following conditions.

I. GENERAL COMPLIANCE RESPONSIBILITIES

A. General Operation

The Permittee shall operate the landfill in accordance with all applicable requirements of UAC R315-302 and 303, for a Class I landfill, that are in effect as of the date of this Permit unless otherwise noted in this Permit. Any permit noncompliance or noncompliance with any applicable portions of UCA 19-6-101 through 123 and applicable portions of UAC R315-301 through 320 constitutes a violation of the Permit or applicable statute or rule and is grounds for appropriate enforcement action, permit revocation, modification, or denial of a permit renewal application.

B. Acceptable Waste

This Permit is for the disposal of non-hazardous solid waste that may include:

1. Municipal solid waste;
2. Commercial waste;
3. Industrial waste;
4. Construction/demolition waste;
5. Special waste as allowed by UAC R315-315 and authorized in section III-I of this Permit and limited by this section; and
6. Conditionally exempt small quantity generator hazardous waste as specified in UAC R315-303-4(7)(a)(i)(B) and PCB's as specified by UAC R315-315-7(2).

Acceptable wastes are restricted to wastes that are received under sole contracts with local governments, within Utah, for waste generated within the boundaries of the local government. Each contract shall be approved by the Executive Secretary prior to acceptance of the waste at the landfill.

C. Prohibited Waste

1. Hazardous waste as defined by UAC R315-1 and R315-2;

2. Containers larger than household size (five gallons) holding any liquid, non-containerized material containing free liquids or any waste containing free liquids in containers larger than five gallons; or

3. PCB's as defined by UAC R315-301-2, except as allowed in Section IB (Acceptable Waste) of this Permit.

4. Regulated asbestos-containing material.

5. All wastes not received by contracts approved by the Executive Secretary are prohibited.

Any prohibited waste received and accepted for treatment, storage, or disposal at the facility shall constitute a violation of this Permit, of UCA 19-6-101 through 123 and of UAC R315-301 through 320.

D. Inspections and Inspection Access

The Permittee shall allow the Executive Secretary of the Utah Solid and Hazardous Waste Control Board or an authorized representative of the Board, or representatives from the Bear River Health Department, to enter at reasonable times and:

1. Inspect the landfill or other premises, practices or operations regulated or required under the terms and conditions of this Permit or UAC R315-301 through 320;

2. Have access to and copy any records required to be kept under the terms and conditions of this Permit or UAC R315-301 through 320;

3. Inspect any loads of waste, treatment facilities or processes, pollution management facilities or processes, or control facilities or processes required under this Permit or regulated under UAC R315-301 through 320; and

4. Create a record of any inspection by photographic, videotape, electronic, or any other reasonable means.

E. Noncompliance

If monitoring, inspection, or testing indicates that any permit condition or any applicable rule under UAC R315-301 through 320 may be or is being violated, the Permittee shall promptly make corrections to the operation or other activities to bring the facility into compliance with all permit conditions or rules.

In the event of any noncompliance with any permit condition or violation of an applicable rule, the Permittee shall promptly take any feasible action reasonably necessary to correct the noncompliance or violation and mitigate any risk to the human health or the environment. Actions may include eliminating the activity causing the noncompliance or violation and containment of any waste or contamination using barriers or access restrictions, placing of warning signs, or permanently closing areas of the facility.

The Permittee shall: document the noncompliance or violation in the operating record on the day the event occurred or the day it was discovered; notify the Executive Secretary of the Solid and Hazardous Waste Control Board by telephone within 24 hours or the next business day following documentation of the event; and give written notice of the noncompliance or violation and measures taken to protect public health and the environment within seven days of Executive Secretary notification.

Within thirty days of the documentation of the event, the Permittee shall submit to the Executive Secretary a written report describing the nature and extent of the noncompliance or violation and the remedial measures taken or to be taken to protect human health and the environment and to eliminate the noncompliance or violation. Upon receipt and review of the assessment report, the Executive Secretary may order the Permittee to perform appropriate remedial measures including development of a site remediation plan for approval by the Executive Secretary.

In an enforcement action, the Permittee may not claim as a defense that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with UAC R315-301 through 320 and this Permit.

Compliance with the terms of this Permit does not constitute a defense to actions brought under any other local, State, or Federal laws. This Permit does not

exempt the Permittee from obtaining any other local, State or Federal permits or approvals required for the facility operation.

The issuance of this Permit does not convey any property rights, other than the rights inherent in this Permit, in either real or personal property, or any exclusive privileges other than those inherent in this Permit. Nor does this Permit authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations including zoning ordinances.

The provisions of this Permit are severable. If any provision of this Permit is held invalid for any reason, the remaining provisions shall remain in full force and effect. If the application of any provision of this Permit to any circumstance is held invalid, its application to other circumstances shall not be affected.

F. Revocation

This Permit is subject to revocation if any condition of this Permit is not being met. The Permittee will be notified in writing prior to any proposed revocation action and such action will be subject to all applicable hearing procedures established under UAC R315-12 and the *Utah Administrative Procedures Act*.

As part of the revocation the Executive Secretary shall exercise the option to require payment of funds under the financial assurance mechanism held by the Executive Secretary.

G. Attachment Incorporation

Attachments to the Permit Application are incorporated by reference into this Permit and are enforceable conditions of this Permit, as are documents incorporated by reference into the attachments. Language in this Permit supersedes any conflicting language in the attachments or documents incorporated into the attachments.

II. DESIGN AND CONSTRUCTION

A. Design and Construction

The Permittee shall construct any landfill cell, sub-cell, run-on diversion system, runoff containment system, waste treatment facility, or final cover in accordance with an equivalent design that is submitted as part of the Permit Application and

in accordance with the Utah Solid Waste Permitting and Management Rules (UAC R315-301 thru 320).

Prior to construction of any landfill cell, sub-cell, engineered control system, waste treatment facility, or final cover, the Permittee shall submit construction design drawings and a Construction Quality Control and Construction Quality Assurance (CQC/CQA) Plan to the Executive Secretary for approval. Buildings do not require approval. The Permittee shall construct any landfill cell, sub-cell, cell liner, engineered control system, waste treatment facility, and the final cover in accordance with the design drawings and CQC/CQA Plans submitted and approved by the Executive Secretary.

Subsequent to construction the Permittes shall notify the Executive Secretary of completion of construction of any landfill cell, sub-cell, engineered control system, waste treatment facility, or final cover. Landfill cells may not be used for treatment or disposal of waste until all CQC/CQA documents and construction related documents including as-built documents are approved by the Executive Secretary. The Permittee shall submit as-built drawings for each construction event that are signed and sealed by an engineer registered in the State of Utah.

The Permittee shall notify the Executive Secretary of any proposed incremental closure, placement of any part of the final cover, or placement of the full final cover. Construction of any portion of the final cover shall be considered as a separate construction event and shall be approved separately from any other construction or expansion of the landfill. Design approval must be received from the Executive Secretary prior to construction and shall be accompanied by a CQC/CQA Plan, for each construction season where incremental or final closure is performed.

A qualified party, independent of the owner shall perform the quality assurance function on liner components, cover components, and other testing as required by the approved CQC/CQA Plan. The results shall be submitted as part of the as-built drawings to the Executive Secretary.

All engineering drawings submitted to the Executive Secretary shall be stamped and approved by a professional engineer with a current registration in Utah.

If ground water is encountered during excavation of the landfill, the Executive Secretary shall be notified immediately, and a contingency plan implemented or alternative construction design developed and submitted for approval.

B. Run-On Control

Drainage channels and diversions shall be constructed as specified in the Permit Application and maintained at all times to effectively prevent runoff from the surrounding area from entering the landfill.

C. Equivalent Design

This facility has been proposed and is approved for an equivalent design which uses a geosynthetic clay liner in place of the liner required by UAC R315-303-3(3)(a)(ii). The Executive Secretary has determined that a geosynthetic clay liner is equivalent to the liner required by UAC R315-303-3(3)(a)(ii).

III. LANDFILL OPERATION

A. Operations Plan

The Operations Plan included in the Permit Application and the solid waste permit issued by the Executive Secretary shall be kept onsite at the landfill or at the location designated in Section III. K. of this Permit. The landfill shall be operated in accordance with the operations plan as included in the Permit Application. If necessary, the facility owner may modify the Operations Plan, provided that the modification meets all of the requirements of UAC R315-301 through 320, is as protective of human health and the environment as that approved in the Permit Application, and is approved by the Executive Secretary as a minor modification under UAC R315-311-2(1)(a)(xiii). Any modification to the Operations Plan shall be noted in the operating record.

Any modification to the operations plan must be submitted to the Executive Secretary for approval and is considered a minor permit modification in compliance with UAC R315-311-2(1)(a)(xiii) unless the Executive Secretary determines the change should be subject to public comment under UAC R315-311-2(1)(b).

B. Security

The Permittee shall operate the Landfill so that unauthorized entry to the facility is restricted. All facility gates and other access routes shall be locked during the time the landfill is closed. At least 2 person employed by the Permitte shall be at the landfill during all hours that the landfill is open. Fencing and any other access controls as shown in the Permit Application shall be constructed to prevent access of persons or livestock by other routes.

C. Training

Permittee shall provide training for on-site personnel in landfill operation, including waste load inspection, hazardous waste identification, and personal safety and protection.

D. Burning of Waste

Intentional burning of solid waste is prohibited and is a violation of UAC R315-303-4(2)(b). All accidental fires shall be extinguished as soon as reasonably possible.

E. Daily Cover

The solid waste received at the landfill shall be completely covered at the end of each working day with a minimum of six inches of earthen material. At the end of each day of operation the amount of cover placed shall be recorded in the operating record and certified by the operator.

An alternative daily cover material may be used when the material and operation meets the requirements of UAC R315-303-4(4)(b) through (d) or when the alternative daily cover meets the requirement of UAC R315-303-4(4)(e).

F. Ground Water Monitoring

The Permittee shall monitor the ground water underlying the landfill in accordance with the Ground Water Monitoring Plan and the Ground Water Monitoring Quality Assurance/Quality Control Plan contained in the Permit Application. If necessary, the facility owner may modify the Ground Water Monitoring Plan and the Ground Water Monitoring Quality Assurance/Quality Control Plan, provided that the modification meets all of the requirements of UAC R315-301 through 320 and is as protective of human health and the environment as that approved in the Permit Application, and is approved by the Executive Secretary as a minor modification under UAC R315-311-2(1)(a). Any modification to the Ground Water Monitoring Plan and the Ground Water Monitoring Quality Assurance/Quality Control Plan shall be noted in the operating record. Plan changes that are found by the Executive Secretary to be less protective of human health or the environment than the approved plan are a major modification and are subject to the requirements of UAC R315-311.

The Permittee shall submit a Ground Water Monitoring Quality Assurance/Quality control Plan prior to receipt of waste.

G. Gas Monitoring

The Permittee shall monitor explosive gases at the landfill in accordance with the Gas Monitoring Plan contained in the Permit Application and shall otherwise meet the requirements of UAC R315-303-3(5). If necessary, the Permittee may modify the Gas Monitoring Plan, provided that the modification meets all of the requirements of UAC R315-301 through 320 and is as protective of human health and the environment as that approved in the Permit Application, and is approved by the Executive Secretary as a minor modification under UAC R315-311-2(1). Any modification to the Gas Monitoring Plan shall be noted in the operating record. Plan changes that are found by the Executive Secretary to be less protective of human health or the environment than the approved plan are a major modification and are subject to the requirements of UAC R315-311.

If the concentrations of explosive gases at any of the facility structures, at the property boundary, or beyond the property boundary ever exceed the standards set in UAC R315-303-2(2)(a), the Permittee shall immediately take all necessary steps to ensure protection of human health and notify the Executive Secretary. Within seven days of detection, place in the operating record the explosive gas levels detected and a description of the immediate steps taken to protect human health. Implement a remediation plan that meets the requirements of UAC R315-303-3(5)(b) and shall submit the plan to, and receive approval from, the Executive Secretary prior to implementation.

H. Waste Inspections

The Permittee shall visually inspect incoming waste loads to verify that no wastes other than those allowed by this permit are disposed in the landfill. A complete waste inspection shall be conducted at a minimum frequency of 1 % of incoming loads, but no less than one complete inspection per day. Loads to be inspected are to be chosen on a random basis. The operating record shall contain documentation that each load is received under a contract approved by the Executive Secretary.

All loads suspected or known to have one or more containers capable of holding more than five gallons of liquid shall be inspected to assure that each container is empty.

All loads that the operator suspects may contain a waste not allowed for disposal at the landfill shall be inspected.

Complete random inspections shall be conducted as follows:

1. The operator shall conduct the random waste inspection at the working face or an area designated by the operator.

2. Loads subjected to complete inspection shall be unloaded at the designated area;

3. Loads shall be spread by equipment or by hand tools;

4. A visual inspection of the waste shall be conducted by personnel trained in hazardous waste recognition and recognition of other unacceptable waste; and

5. The inspection shall be recorded on the waste inspection form found in Appendix O of the Permit Application. The form shall be placed in the operating record at the end of the operating day.

I. Disposal of Special Wastes

If loads of incinerator ash are accepted for disposal it shall be transported in such a manner to prevent leakage or the release of fugitive dust. The ash shall be completely covered with a minimum of six inches of material, or use other methods or material, if necessary, to control fugitive dust. Ash may be used for daily cover when its use does not create a human health or environmental hazard.

Animal carcasses may be disposed in the landfill working face and must be covered with other solid waste or earth by the end of the operating day in which they are received. Alternatively, animal carcasses may be disposed in a special trench or pit prepared for the acceptance of dead animals. If a special trench is used, animals placed in the trench shall be covered with six inches of earth by the end of each operating day.

J. Self Inspections

The Permittee shall inspect the facility to prevent malfunctions and deterioration, operator errors, and discharges that may cause or lead to the release of wastes or contaminated materials to the environment or create a threat to human health or the environment. These general inspections shall be completed no less than quarterly and shall cover the following areas: Waste placement, compaction, cover; cell liner; leachate collection system; fences and access controls; roads; run-on/run-off controls; ground water monitoring wells; final and intermediate cover; litter controls; and records. A record of the inspections shall be placed in the daily operating record on the day of the inspection. Areas needing correction,

as noted on the inspection report, shall be corrected in a timely manner. The corrective actions shall be documented in the daily operating record.

K. Recordkeeping

The Permittee shall maintain and keep on file at the field office on-site, a daily operating record and other general records of landfill operation as required by UAC R315-302-2(3). The landfill operator, or other designated personnel, shall date and sign the daily operating record at the end of each operating day. Each record to be kept shall contain the signature of the appropriate operator or personnel and the date signed.

1. The daily operating record shall include the following items:

   a. The number of loads of waste and the weights or estimates of weights or volume of waste received each day of operation and recorded at the end of each operating day;

   b. Major deviations from the approved plan of operation recorded at the end of the operating day the deviation occurred;

   c. Results of other monitoring required by this Permit recorded in the operating record on the day of the event or the day the information is received;

   d. Records of all inspections conducted by the Permittee, results of the inspections, and corrective actions taken shall be recorded in the record on the day of the event.

2. The general record of landfill operations shall include the following items:

   a. A copy of this Permit including the Permit Application;

   b. Results of inspections conducted by representatives of the Utah Solid and Hazardous Waste Control Board and/or representatives of the Bear River Health Department, when forwarded to the Permittee;

   c. Closure and Post-closure care plans;

   d. Records of employee training; and

   e. Results of groundwater monitoring; and

f. Results of landfill gas monitoring.

L. Reporting

The Permittee shall prepare and submit, to the Executive Secretary, an Annual Report as required in UAC R315-302-2(4). The Annual Report shall include: the period covered by the report, the annual quantity of waste received, an annual update of the financial assurance mechanism, any leachate analysis results, all ground water monitoring results, the statistical analysis of ground water monitoring results, the results of gas monitoring, the quantity of leachate pumped, and all training programs completed.

M. Roads

All access roads, within the landfill boundary, used for transporting waste to the landfill for disposal shall be improved and regularly maintained as necessary to assure safe and reliable all-weather access to the disposal area.

IV. CLOSURE REQUIREMENTS

A. Closure

Final cover of the landfill shall be as shown in the Permit Application. The final cover shall meet, at a minimum, the standard design for closure as specified in the UAC (R315-303-3(4)) plus sufficient cover soil or equivalent material to protect the low permeability layer from the effects of frost, desiccation, and root penetration. A quality assurance plan for construction of the final landfill cover shall be submitted to, and approval of the plan must be received from the Executive Secretary prior to construction of any part of the final cover at the landfill. A qualified person not affiliated with the landfill owner shall perform permeability testing on the recompacted clay placed as part of the final cover.

B. Title Recording

The Permittee shall meet the requirements of UAC R315-302-2(6) by recording with the Box Elder County Recorder as part of the record of title that the property has been used as a landfill. The recording shall include waste locations and waste types disposed.

C. Post-Closure Care

Post-closure care at the closed landfill shall be done in accordance with the Post-Closure Care Plan contained in the Permit Application. Post-closure care shall continue until all waste disposal sites at the landfill have stabilized and the finding of UAC R315-302-3(7)(c) is made.

D. Financial Assurance

A financial assurance mechanism, that meets the requirements of UAC R315-309, covering closure and post-closure care costs shall be proposed by the Permittee, submitted to the Executive Secretary, and Executive Secretary approval received prior to receipt of waste. The Permittee, prior to receipt of waste, shall establish the approved mechanism and fund it as required. The financial assurance mechanism(s) shall be adequately maintained to provide for the cost of closure at any stage or phase or anytime during the life of the landfill or the permit life, whichever is shorter, and must be fully funded within ten years of the date waste is first received at the landfill. The Permittee shall keep the approved financial assurance mechanism in effect and active until closure and post-closure care activities are completed and the Executive Secretary has released the facility from all post-closure care requirements.

If a trust fund is chosen as the financial assurance method the first payment to the fund will be 10% of the estimated closure and post-closure care costs. If a trust fund is used, annual payments shall be determined by the following formula:

$$NP=[CE-CV]/Y$$

where NP is the next payment, CE is the current cost estimate for closure and post-closure care (updated for inflation or other changes), CV is the current value of the trust fund, and Y is the number of years remaining in the pay-in period.

The Permittee shall notify the Executive Secretary of the establishment of the approved financial assurance mechanism and must receive acknowledgment from the Executive Secretary that the established mechanism complies with the approved method.

E. Financial Assurance Annual Update

An annual revision of closure and post-closure costs for inflation and financial assurance funding as, required by R315-309-2(2), shall be submitted to the Executive Secretary as part of the annual report.

F. Closure Cost and Post-Closure Cost Revision

The Permittee shall submit a complete revision of the closure and post-closure cost estimates by the Closure Cost Revision Date listed on the signature page of this Permit any time the facility is expanded, any time a new cell is constructed, or any time a cell is expanded.

V. ADMINISTRATIVE REQUIREMENTS

A. Permit Modification

Modifications to this Permit may be made upon application by the Permittee or by the Executive Secretary. The Permittee will be given written notice of any permit modification initiated by the Executive Secretary.

B. Permit Transfer

This Permit may be transferred to a new permittee or new permittees by meeting the requirements of the permit transfer provisions of UAC R315-310-11.

C. Expansion

This Permit is for a Class I or II Landfill. The permitted landfill shall operate according to the design and Operation Plan described and explained in the Permit Application. Any expansion of the current footprint designated in the description contained in the Permit Application, but within the property boundaries designated in the Permit Application, shall require submittal of plans and specifications to the Executive Secretary. The plans and specifications shall be approved by the Executive Secretary prior to construction.

Any expansion of the landfill facility beyond the property boundaries designated in the description contained in the Permit Application shall require submittal of a new Permit Application in accordance with the requirements of UAC R315-310.

Any addition to the acceptable wastes described in Section 1B shall require submittal of all necessary information to the Executive Secretary and the approval of the Executive Secretary. Acceptance for PCB bulk product waste under UAC R315-315-7(3)(b) can only be done after submittal of the required information to the Executive Secretary and modification of Section IC of this Permit.

D. Expiration

Application for permit renewal shall be made at least six months prior to the expiration date, as shown on the signature (cover) page of this Permit. If a timely renewal application is made and the permit renewal is not complete by the expiration date, this Permit will continue in force until renewal is completed or denied.

E. Status Notification

Eighteen months from the date of this Permit the Executive Secretary shall be notified in writing of the status of the construction of this facility unless construction is complete and operation has commenced. If construction has not begun within 18 months the Permittee shall submit adequate justification to the Executive Secretary as to the reasons that construction has not commenced. If no submission is made or the submission is judged inadequate by the Executive Secretary, this Permit will be revoked.

F. Construction Approval and Request to Operate

The Permittee shall meet each of the following conditions prior to receipt of waste:

1. The Permittee shall notify the Executive Secretary, prior to acceptance of waste, that all the requirements of this Permit have been met and all required facilities, structures and accounts are in place as required.

2. The Permittee shall submit to the Executive Secretary, for approval, documentation that all local zoning requirements and local government approvals have been obtained for operation of this landfill.

3. The Permittee shall submit to the Executive Secretary, prior to the construction of any portion of the landfill; including offices, fences, and gates; documentation that the Permittee owns or has/have a lease that allows this property to be used as a landfill.

4. The Permittee shall not construct any portion of the landfill where the bottom elevation is less than 5 feet above the historic high ground water level.

G. Contract Approval

The Permittee must receive waste only from local governments that have contracts with the facility owner. All new contracts and changes in existing contracts must be reviewed and receive approval from the Executive Secretary prior to receipt of waste.

F:\Class I II and V permit form.doc
File: - Permit #0202R1

APPENDIX B

CONSTRUCTION PLANS

PROMONTORY POINT LANDFILL

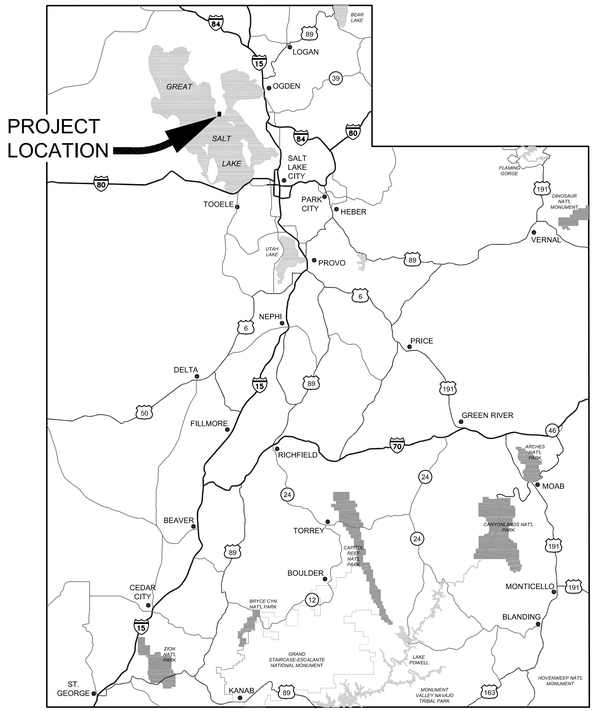
OGDEN, UTAH

PHASE 1

PHASES 1A, 1B, 1C

DEVELOPMENT PROJECT

MAY 2016



LOCATION MAP

INDEX OF SHEETS

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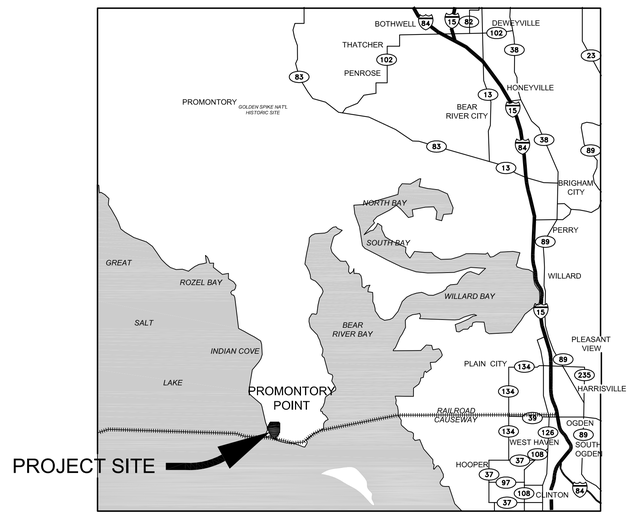
C-100 SITE MAP
C-101 PHASE 1A EXCAVATION
C-102 PHASE 1A FILL - FOR REFERENCE
C-103 ONLY
C-104 PHASE 1B EXCAVATION
C-105 PHASE 1B EXCAVATION
C-106 PHASE 1B FILL - FOR REFERENCE
C-107 ONLY
C-301 PHASE 1C EXCAVATION
C-401 PHASE 1C FILL - FOR REFERENCE
C-501 ONLY
C-502 CROSS-SECTION
C-503 LEACHATE OUTFALL AREA GRADING
C-504 DETAILS
C-505 DETAILS
C-506 DETAILS
C-507 DETAILS
DETAILS
LEACHATE OUTFALL SYSTEM DETAILS
LEACHATE CONTROL DETAILS



VICINITY MAP

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

COVER SHEET

DESIGNED BY : DLL	FILE : C-001 Cover Sheet.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-001	
APPROVED BY : CHM	DATE : 05-2016		

FOR PERMIT PURPOSES ONLY - NOT FOR CONSTRUCTION

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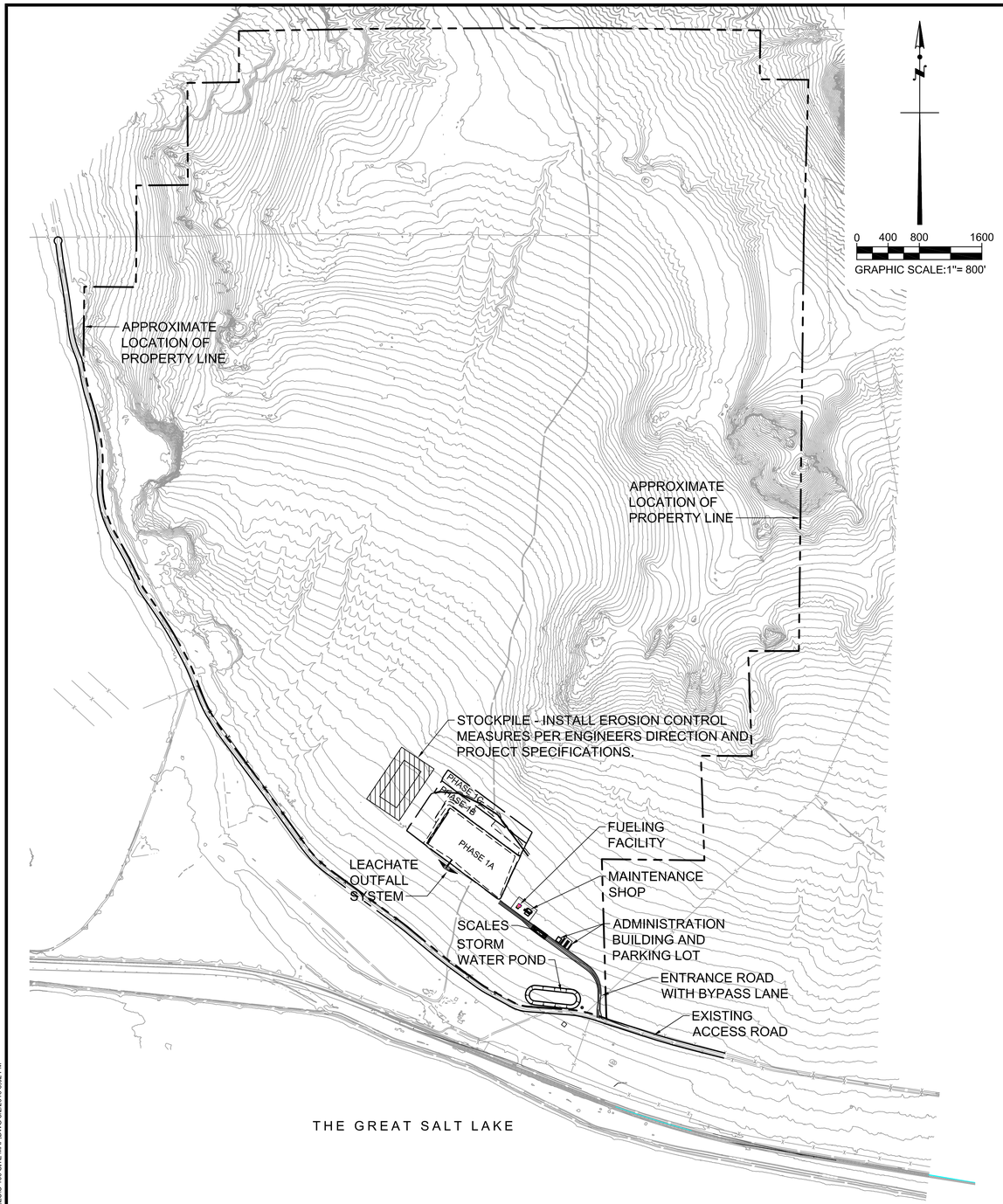

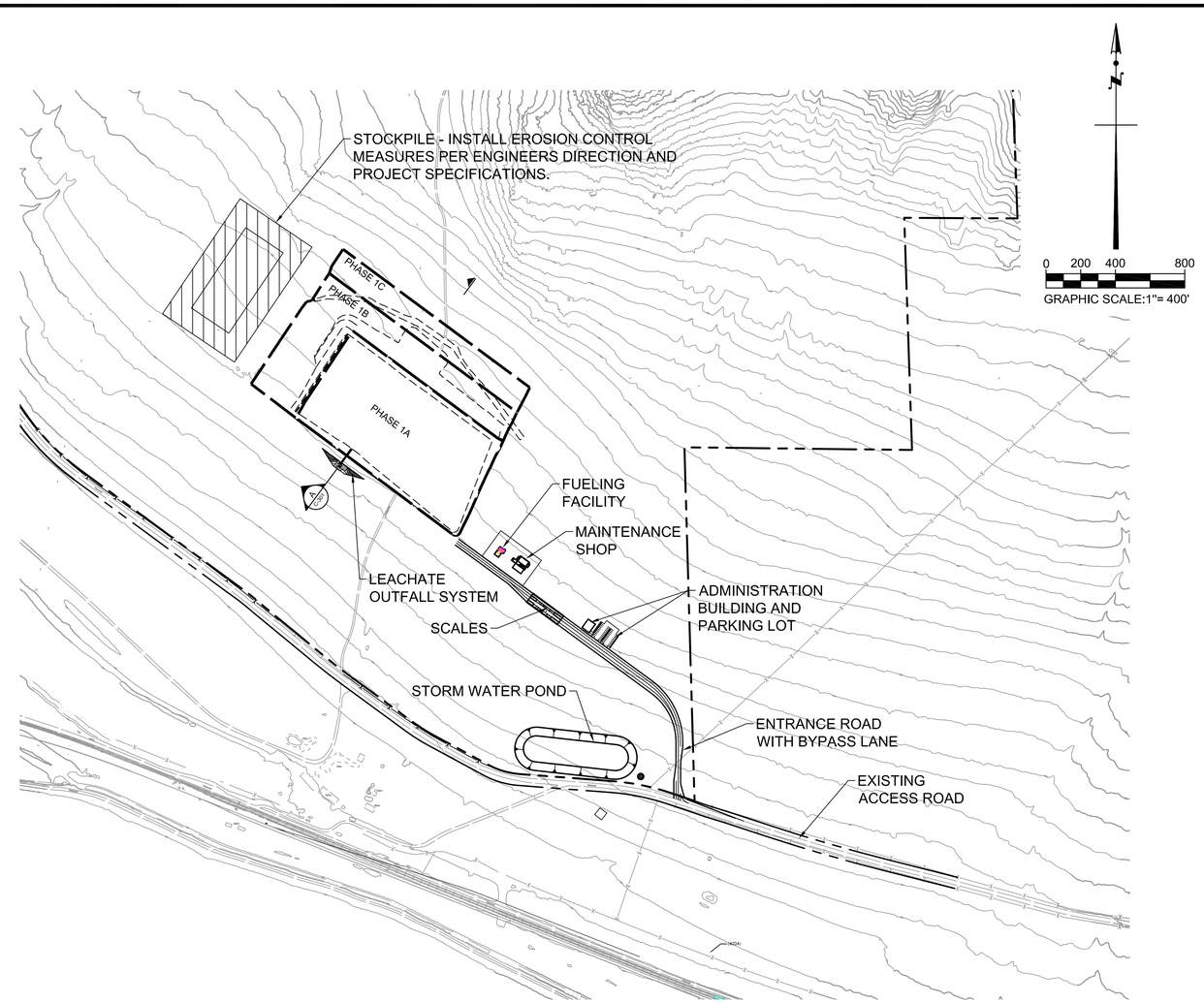

LEGEND

- PROPERTY LINE
- 10 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 10 PROPOSED MAJOR CONTOUR
- 9 PROPOSED MINOR CONTOUR
- SUBTITLE-D LIMIT OF WASTE
- LIMIT OF EXISTING LINER
- LINER LIMIT
- LCRS MAINLINE
- LCRS LATERAL
- ANCHOR TRENCH
- FLOWLINE
- TOP / TOE / GRADEBREAK
- K — SECTION NAME
- C-301 — REFERENCE SHEET

ABBREVIATIONS

CF	CUBIC FOOT
DIA	DIAMETER
FL	FLOWLINE
FS	FINISHED SURFACE
FT	FOOT
GB	GRADE BREAK
GCL	GEOSYNTHETIC CLAY LINER
HDPE	HIGH DENSITY POLYETHYLENE
HP	HIGH POINT
INV	INVERT
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
OZ	OUNCE
O.C.	ON CENTER
TYP	TYPICAL
SDR	STANDARD DIMENSION RATIO
SD	STORM DRAIN

NOTE:
FUELING FACILITY, MAINTENANCE SHOP, ADMINISTRATION BUILDING AND PARKING LOT, ENTRANCE ROAD WITH BYPASS LANE, SCALES, AND STORM WATER POND TO BE CONSTRUCTED UNDER SEPARATE PERMIT.

SHEET C-101

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

SITE MAP

DESIGNED BY : DLL	FILE : C-100 Site Map.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-100	
APPROVED BY : CHM	DATE : 05-2016		

FOR PERMIT PURPOSES ONLY - NOT FOR CONSTRUCTION

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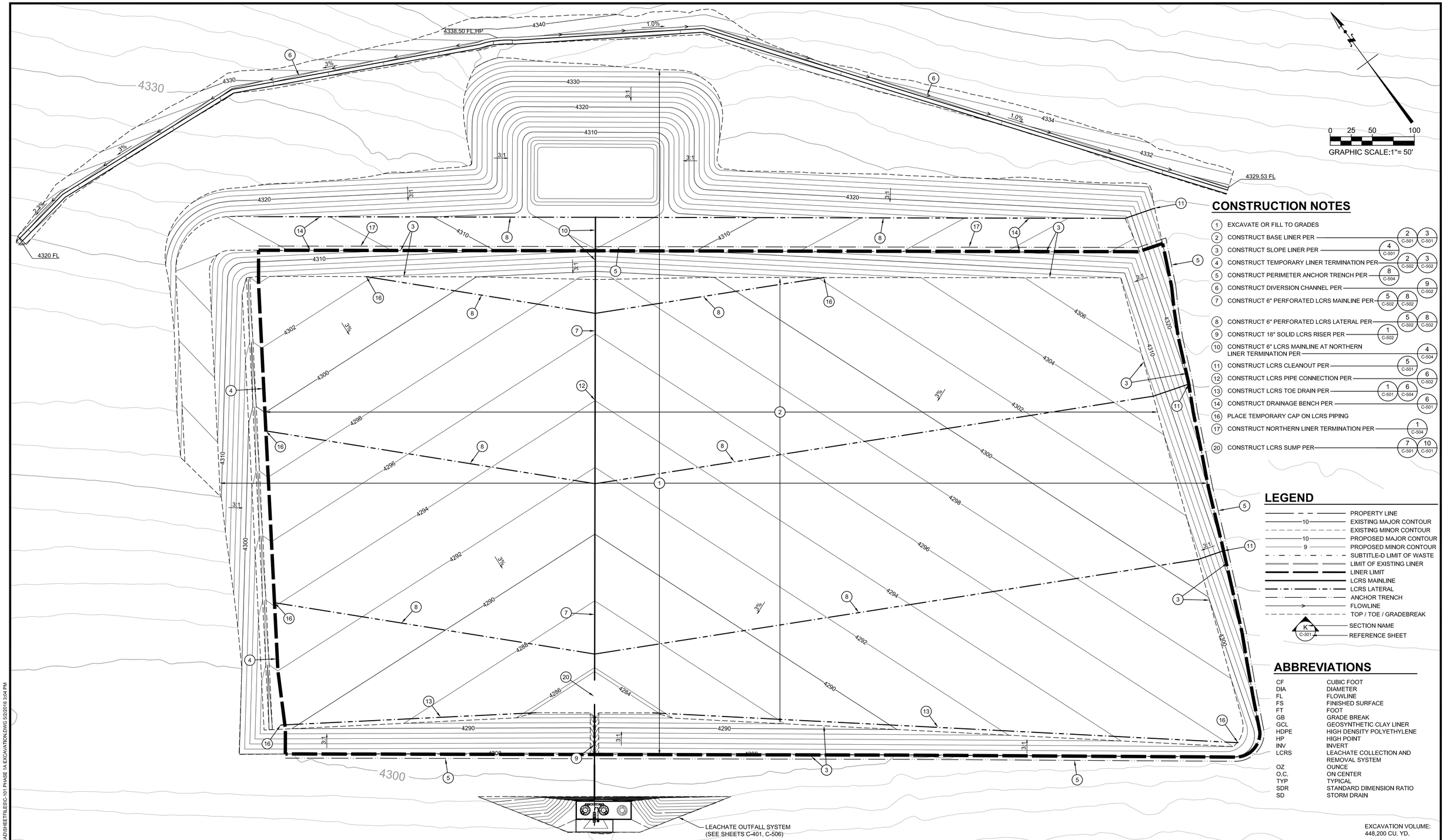

CONSTRUCTION NOTES

1. EXCAVATE OR FILL TO GRADES
2. CONSTRUCT BASE LINER PER — 2 C-501, 3 C-501
3. CONSTRUCT SLOPE LINER PER — 4 C-501
4. CONSTRUCT TEMPORARY LINER TERMINATION PER — 2 C-502, 3 C-502
5. CONSTRUCT PERIMETER ANCHOR TRENCH PER — 8 C-504
6. CONSTRUCT DIVERSION CHANNEL PER — 9 C-502
7. CONSTRUCT 6" PERFORATED LCRS MAINLINE PER — 5 C-502, 8 C-502
8. CONSTRUCT 6" PERFORATED LCRS LATERAL PER — 5 C-502, 8 C-502
9. CONSTRUCT 18" SOLID LCRS RISER PER — 1 C-502
10. CONSTRUCT 6" LCRS MAINLINE AT NORTHERN LINER TERMINATION PER — 4 C-504
11. CONSTRUCT LCRS CLEANOUT PER — 5 C-501
12. CONSTRUCT LCRS PIPE CONNECTION PER — 6 C-502
13. CONSTRUCT LCRS TOE DRAIN PER — 1 C-501, 6 C-504
14. CONSTRUCT DRAINAGE BENCH PER — 6 C-501
16. PLACE TEMPORARY CAP ON LCRS PIPING
17. CONSTRUCT NORTHERN LINER TERMINATION PER — 1 C-504
20. CONSTRUCT LCRS SUMP PER — 7 C-501, 10 C-501

LEGEND

- PROPERTY LINE
- 10 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 10 PROPOSED MAJOR CONTOUR
- 9 PROPOSED MINOR CONTOUR
- SUBTITLE-D LIMIT OF WASTE
- LIMIT OF EXISTING LINER
- LINER LIMIT
- LCRS MAINLINE
- LCRS LATERAL
- ANCHOR TRENCH
- FLOWLINE
- TOP / TOE / GRADEBREAK
- K — SECTION NAME
- C-301 — REFERENCE SHEET

ABBREVIATIONS

CF	CUBIC FOOT
DIA	DIAMETER
FL	FLOWLINE
FS	FINISHED SURFACE
FT	FOOT
GB	GRADE BREAK
GCL	GEOSYNTHETIC CLAY LINER
HDPE	HIGH DENSITY POLYETHYLENE
HP	HIGH POINT
INV	INVERT
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
OZ	OUNCE
O.C.	ON CENTER
TYP	TYPICAL
SDR	STANDARD DIMENSION RATIO
SD	STORM DRAIN

EXCAVATION VOLUME:
448,200 CU. YD.

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

PHASE 1A EXCAVATION

DESIGNED BY : DLL	FILE : C-101 Phase 1A Excavation.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-101	
APPROVED BY : CHM	DATE : 05-2016		

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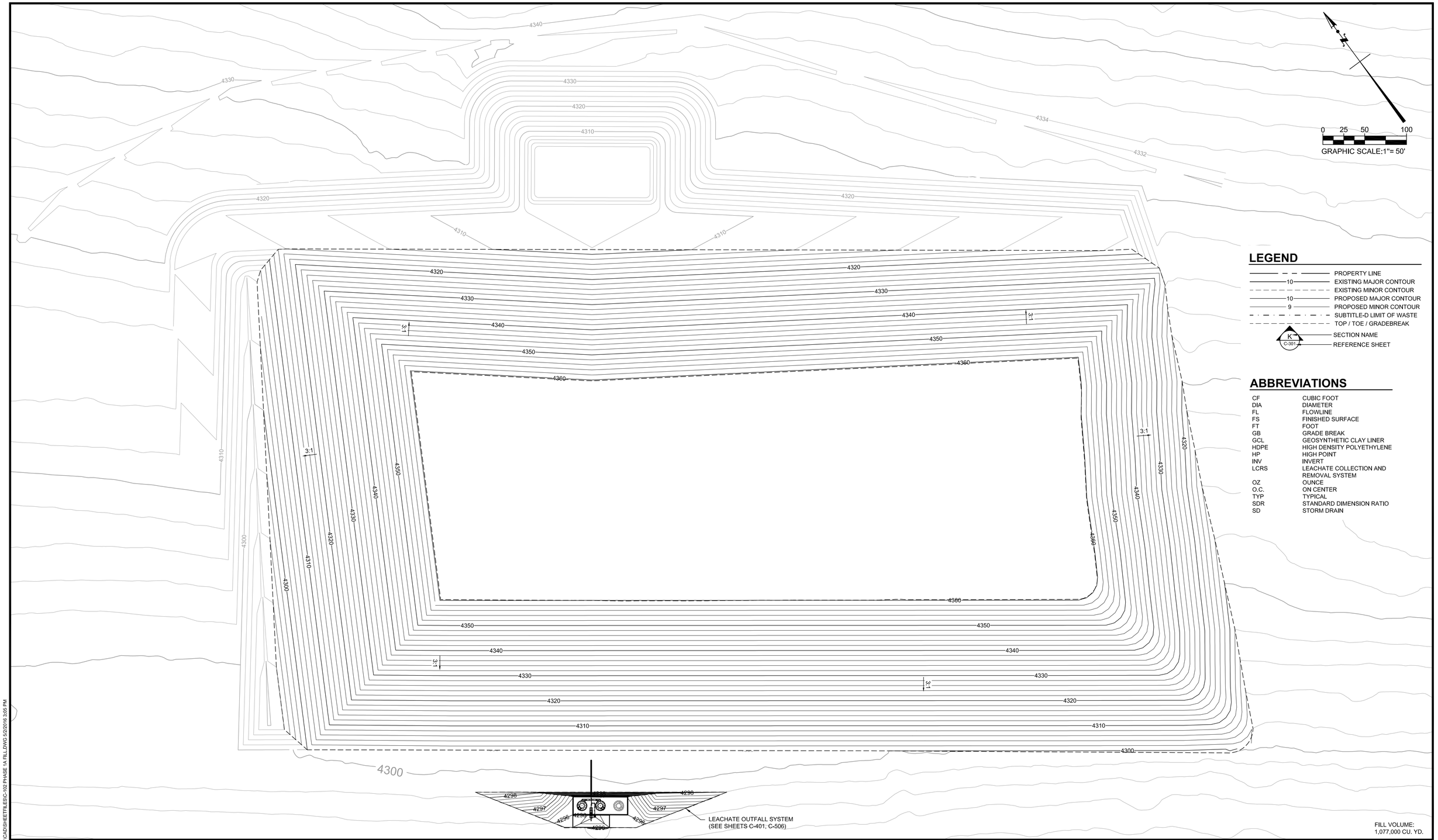
FOR PERMIT PURPOSES ONLY - NOT FOR CONSTRUCTION



LEGEND

- PROPERTY LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- SUBTITLE-D LIMIT OF WASTE
- TOP / TOE / GRADEBREAK
- SECTION NAME (K)
- REFERENCE SHEET (C-301)

ABBREVIATIONS

CF	CUBIC FOOT
DIA	DIAMETER
FL	FLOWLINE
FS	FINISHED SURFACE
FT	FOOT
GB	GRADE BREAK
GCL	GEOSYNTHETIC CLAY LINER
HDPE	HIGH DENSITY POLYETHYLENE
HP	HIGH POINT
INV	INVERT
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
OZ	OUNCE
O.C.	ON CENTER
TYP	TYPICAL
SDR	STANDARD DIMENSION RATIO
SD	STORM DRAIN

FILL VOLUME:
1,077,000 CU. YD.

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

PHASE 1A FILL - FOR REFERENCE ONLY

DESIGNED BY : DLL	FILE : C-102 Phase 1A Fill.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-102	
APPROVED BY : CHM	DATE : 05-2016		

FOR PERMIT PURPOSES ONLY - NOT FOR CONSTRUCTION

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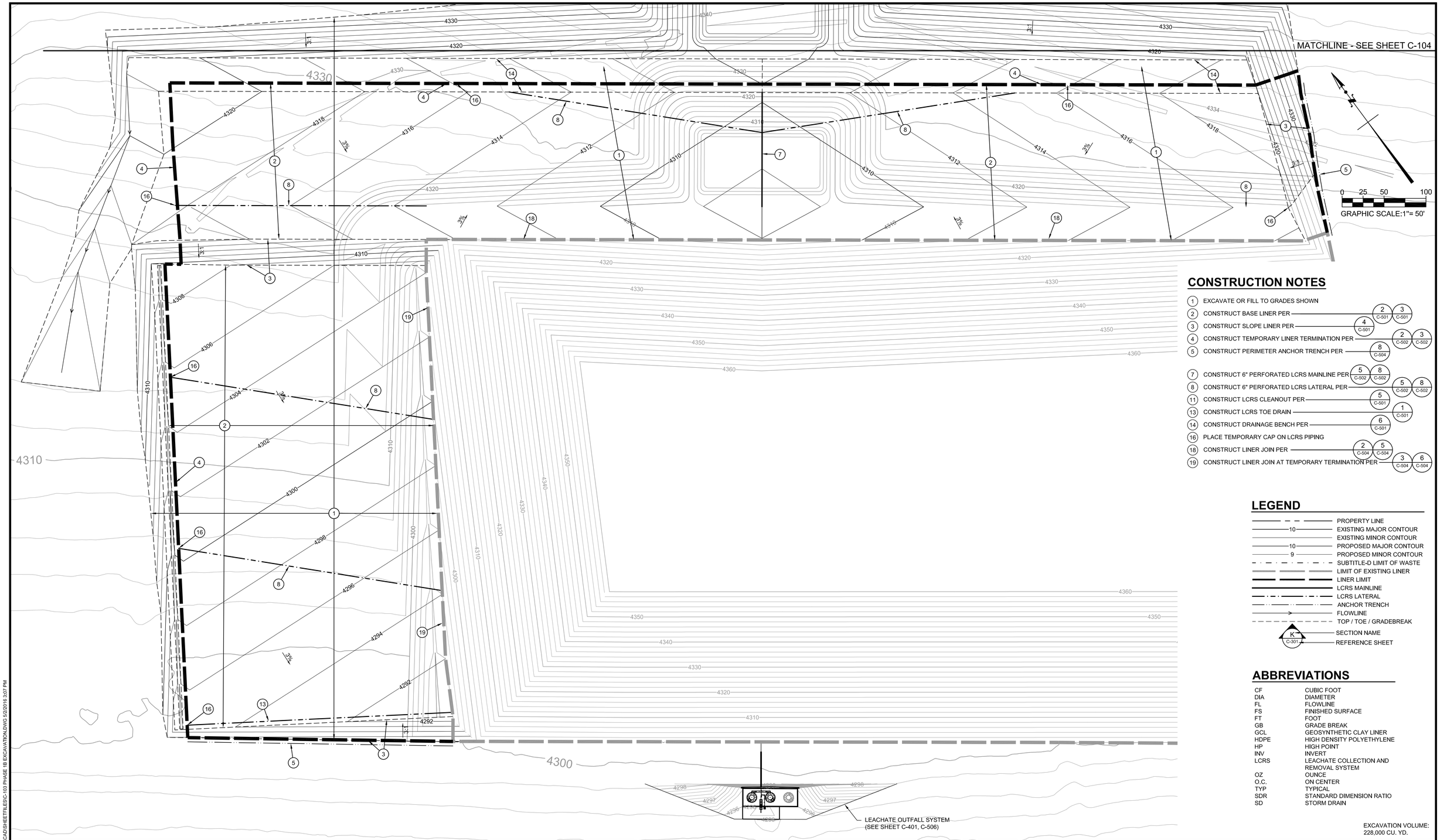

CONSTRUCTION NOTES

1. EXCAVATE OR FILL TO GRADES SHOWN
2. CONSTRUCT BASE LINER PER — 2/C-501, 3/C-501
3. CONSTRUCT SLOPE LINER PER — 4/C-501
4. CONSTRUCT TEMPORARY LINER TERMINATION PER — 2/C-502, 3/C-502
5. CONSTRUCT PERIMETER ANCHOR TRENCH PER — 8/C-504
7. CONSTRUCT 6" PERFORATED LCRS MAINLINE PER — 5/C-502, 8/C-502
8. CONSTRUCT 6" PERFORATED LCRS LATERAL PER — 5/C-502, 8/C-502
11. CONSTRUCT LCRS CLEANOUT PER — 5/C-501
13. CONSTRUCT LCRS TOE DRAIN — 1/C-501
14. CONSTRUCT DRAINAGE BENCH PER — 6/C-501
16. PLACE TEMPORARY CAP ON LCRS PIPING
18. CONSTRUCT LINER JOIN PER — 2/C-504, 5/C-504
19. CONSTRUCT LINER JOIN AT TEMPORARY TERMINATION PER — 3/C-504, 6/C-504

LEGEND

- PROPERTY LINE
- 10 — EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 10 — PROPOSED MAJOR CONTOUR
- 9 — PROPOSED MINOR CONTOUR
- SUBTITLE-D LIMIT OF WASTE
- LIMIT OF EXISTING LINER
- LINER LIMIT
- LCRS MAINLINE
- LCRS LATERAL
- ANCHOR TRENCH
- FLOWLINE
- TOP / TOE / GRADEBREAK
- K / C-301 — SECTION NAME / REFERENCE SHEET

ABBREVIATIONS

CF	CUBIC FOOT
DIA	DIAMETER
FL	FLOWLINE
FS	FINISHED SURFACE
FT	FOOT
GB	GRADE BREAK
GCL	GEOSYNTHETIC CLAY LINER
HDPE	HIGH DENSITY POLYETHYLENE
HP	HIGH POINT
INV	INVERT
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
OZ	OUNCE
O.C.	ON CENTER
TYP	TYPICAL
SDR	STANDARD DIMENSION RATIO
SD	STORM DRAIN

EXCAVATION VOLUME:
228,000 CU. YD.

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

PHASE 1B EXCAVATION

DESIGNED BY : DLL	FILE : C-103 Phase 1B Excavation.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-103	
APPROVED BY : CHM	DATE : 05-2016		

FOR PERMIT PURPOSES ONLY - NOT FOR CONSTRUCTION

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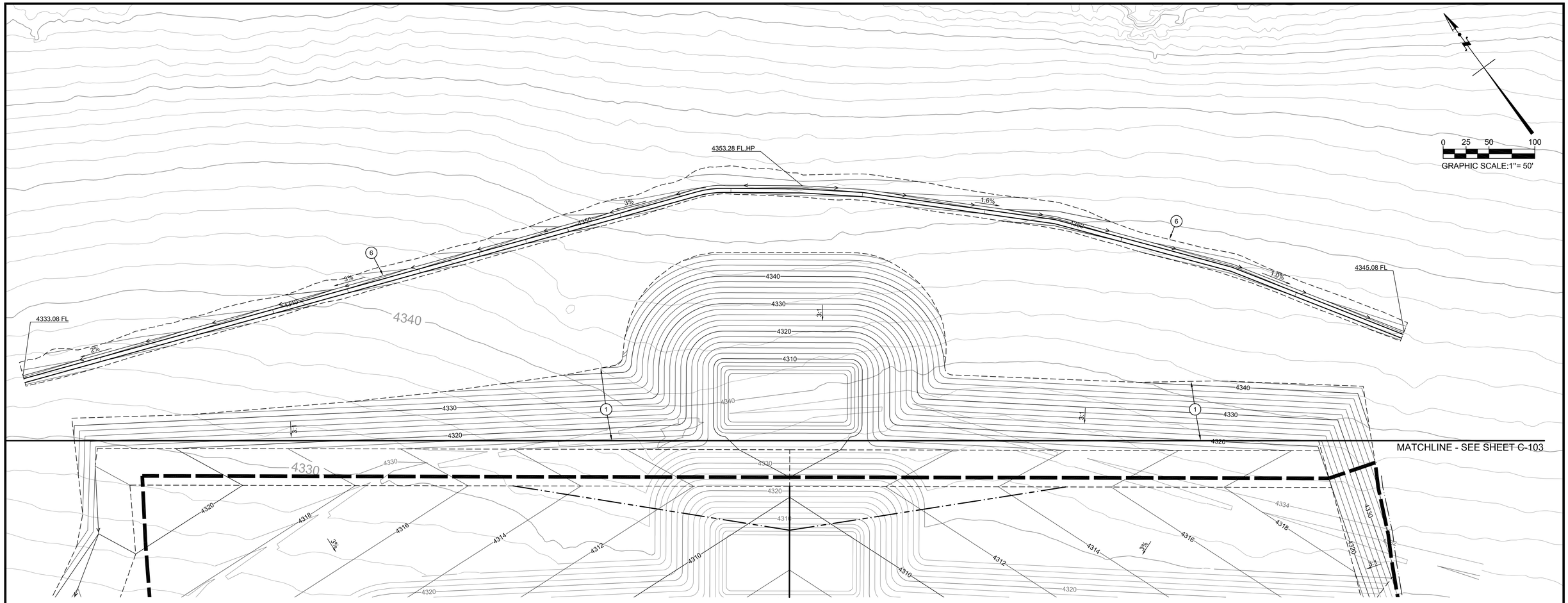

ABBREVIATIONS

CF	CUBIC FOOT
DIA	DIAMETER
FL	FLOWLINE
FS	FINISHED SURFACE
FT	FOOT
GB	GRADE BREAK
GCL	GEOSYNTHETIC CLAY LINER
HDPE	HIGH DENSITY POLYETHYLENE
HP	HIGH POINT
INV	INVERT
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
OZ	OUNCE
O.C.	ON CENTER
TYP	TYPICAL
SDR	STANDARD DIMENSION RATIO
SD	STORM DRAIN

LEGEND

- PROPERTY LINE
- 10 — EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 10 — PROPOSED MAJOR CONTOUR
- 9 — PROPOSED MINOR CONTOUR
- SUBTITLE-D LIMIT OF WASTE
- LIMIT OF EXISTING LINER
- LINER LIMIT
- LCRS MAINLINE
- LCRS LATERAL
- ANCHOR TRENCH
- FLOWLINE
- TOP / TOE / GRADEBREAK
- K — SECTION NAME
- C-301 — REFERENCE SHEET

CONSTRUCTION NOTES

1. EXCAVATE OR FILL TO GRADES SHOWN
6. CONSTRUCT DIVERSION CHANNEL PER — 9 / C-502

EXCAVATION VOLUME:
228,000 CU. YD.

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

PHASE 1B EXCAVATION

DESIGNED BY : DLL	FILE : C-104 Phase 1B Excavation.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-104	
APPROVED BY : CHM	DATE : 05-2016		

FOR PERMIT PURPOSES ONLY - NOT FOR CONSTRUCTION

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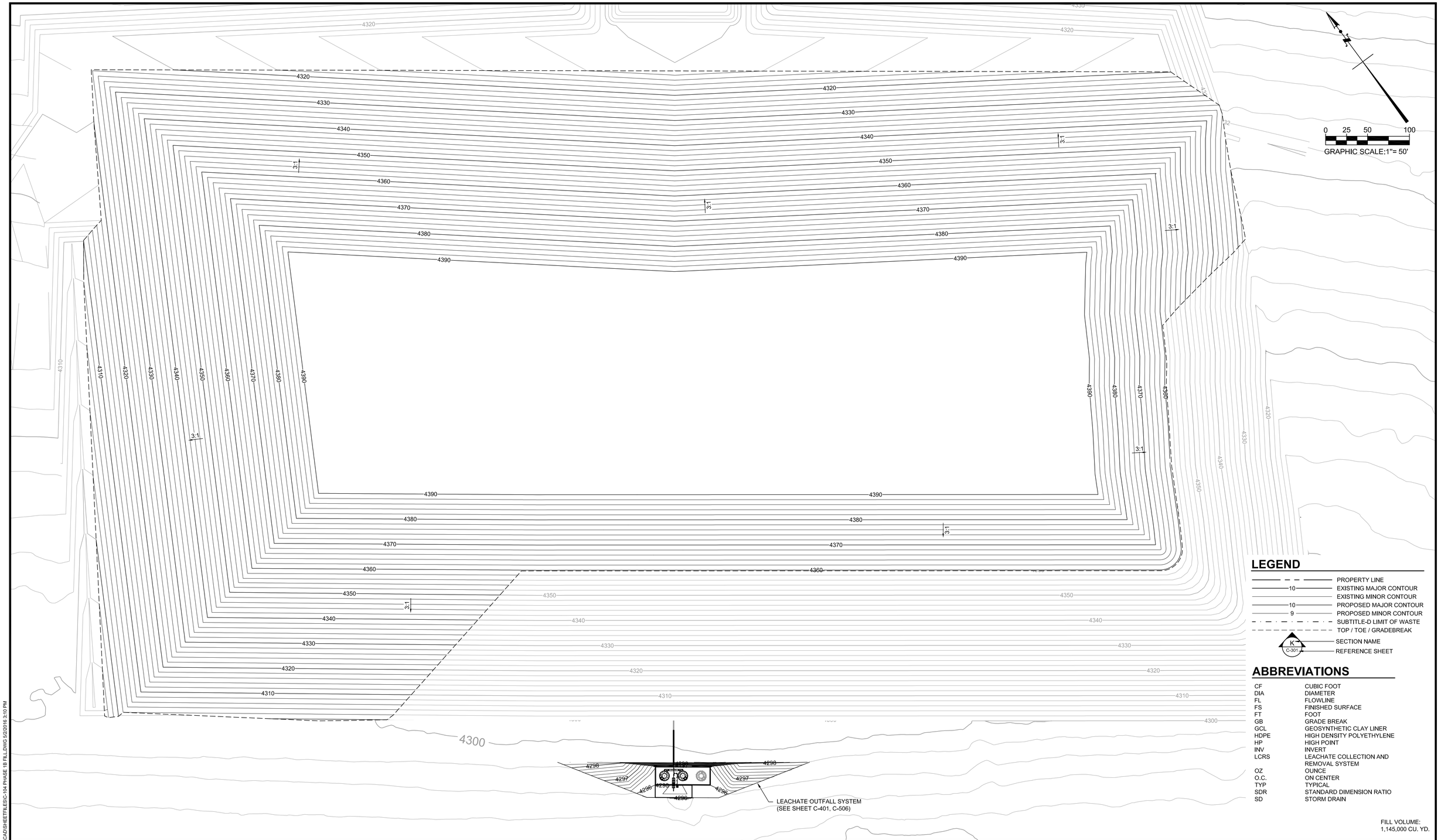

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

PHASE 1B FILL - FOR REFERENCE ONLY

DESIGNED BY : DLL	FILE : C-104 Phase 1B Fill.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-105	
APPROVED BY : CHM	DATE : 05-2016		

FOR PERMIT PURPOSES ONLY - NOT FOR CONSTRUCTION

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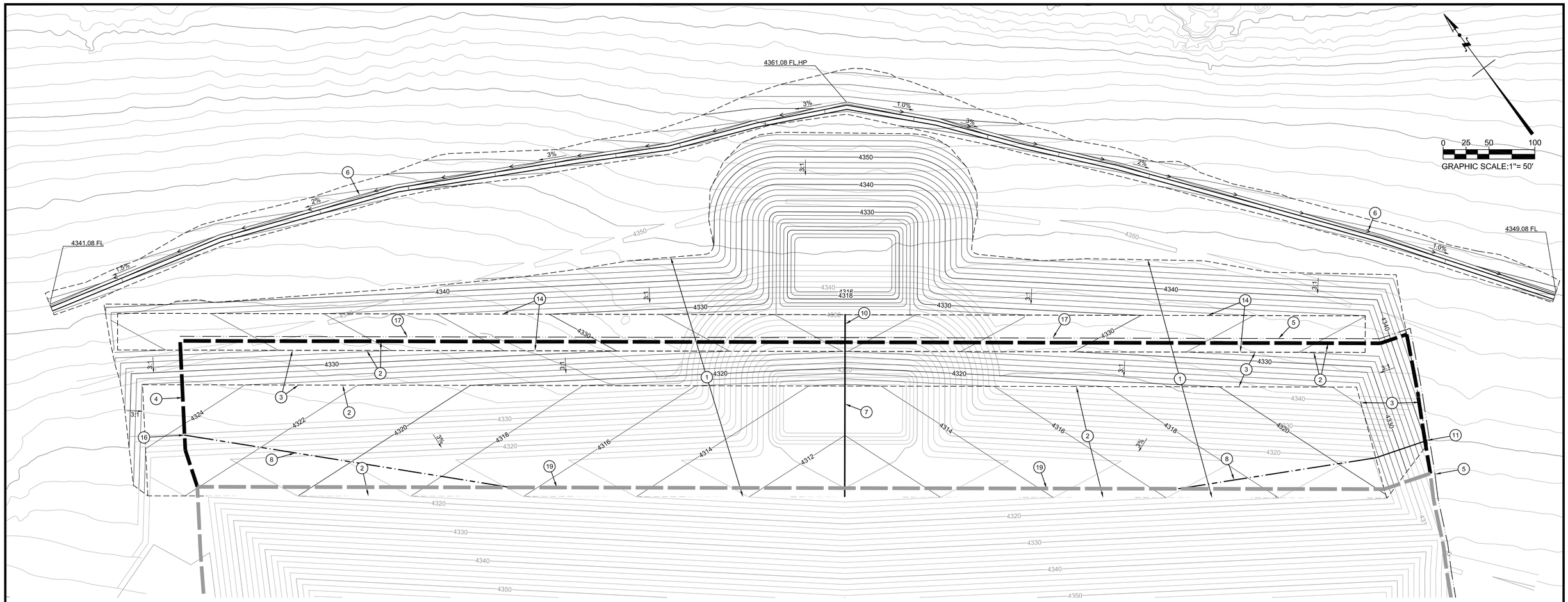

ABBREVIATIONS

CF	CUBIC FOOT
DIA	DIAMETER
FL	FLOWLINE
FS	FINISHED SURFACE
FT	FOOT
GB	GRADE BREAK
GCL	GEOSYNTHETIC CLAY LINER
HDPE	HIGH DENSITY POLYETHYLENE
HP	HIGH POINT
INV	INVERT
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
OZ	OUNCE
O.C.	ON CENTER
TYP	TYPICAL
SDR	STANDARD DIMENSION RATIO
SD	STORM DRAIN

LEGEND

- PROPERTY LINE
- 10 — EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 10 — PROPOSED MAJOR CONTOUR
- 9 — PROPOSED MINOR CONTOUR
- SUBTITLE-D LIMIT OF WASTE
- LIMIT OF EXISTING LINER
- LINER LIMIT
- LCRS MAINLINE
- LCRS LATERAL
- ANCHOR TRENCH
- FLOWLINE
- TOP / TOE / GRADEBREAK
- K — SECTION NAME
- C-301 — REFERENCE SHEET

CONSTRUCTION NOTES

1. EXCAVATE OR FILL TO GRADES SHOWN
2. CONSTRUCT BASE LINER PER — 2 C-501, 3 C-501
3. CONSTRUCT SLOPE LINER PER — 4 C-501
4. CONSTRUCT TEMPORARY LINER TERMINATION PER — 2 C-502, 3 C-502
5. CONSTRUCT PERIMETER ANCHOR TRENCH PER — 8 C-504
6. CONSTRUCT DIVERSION CHANNEL PER — 9 C-502
7. CONSTRUCT 6" PERFORATED LCRS MAINLINE PER — 5 C-502, 8 C-502
8. CONSTRUCT 6" PERFORATED LCRS LATERAL PER — 5 C-502, 8 C-502
10. CONSTRUCT 6" LCRS MAINLINE AT NORTHERN LINER TERMINATION PER — 4 C-504
11. CONSTRUCT LCRS CLEANOUT PER — 5 C-501
14. CONSTRUCT DRAINAGE BENCH PER — 6 C-501
16. PLACE TEMPORARY CAP ON LCRS PIPING
17. CONSTRUCT NORTHERN LINER TERMINATION PER — 1 C-504
19. CONSTRUCT LINER JOIN AT TEMPORARY TERMINATION PER — 3 C-504, 6 C-504

EXCAVATION VOLUME:
109,000 CU. YD.

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

PHASE 1C EXCAVATION

DESIGNED BY : DLL	FILE : C-106 Phase 1C Excavation.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-106	
APPROVED BY : CHM	DATE : 05-2016		

FOR PERMIT PURPOSES ONLY - NOT FOR CONSTRUCTION

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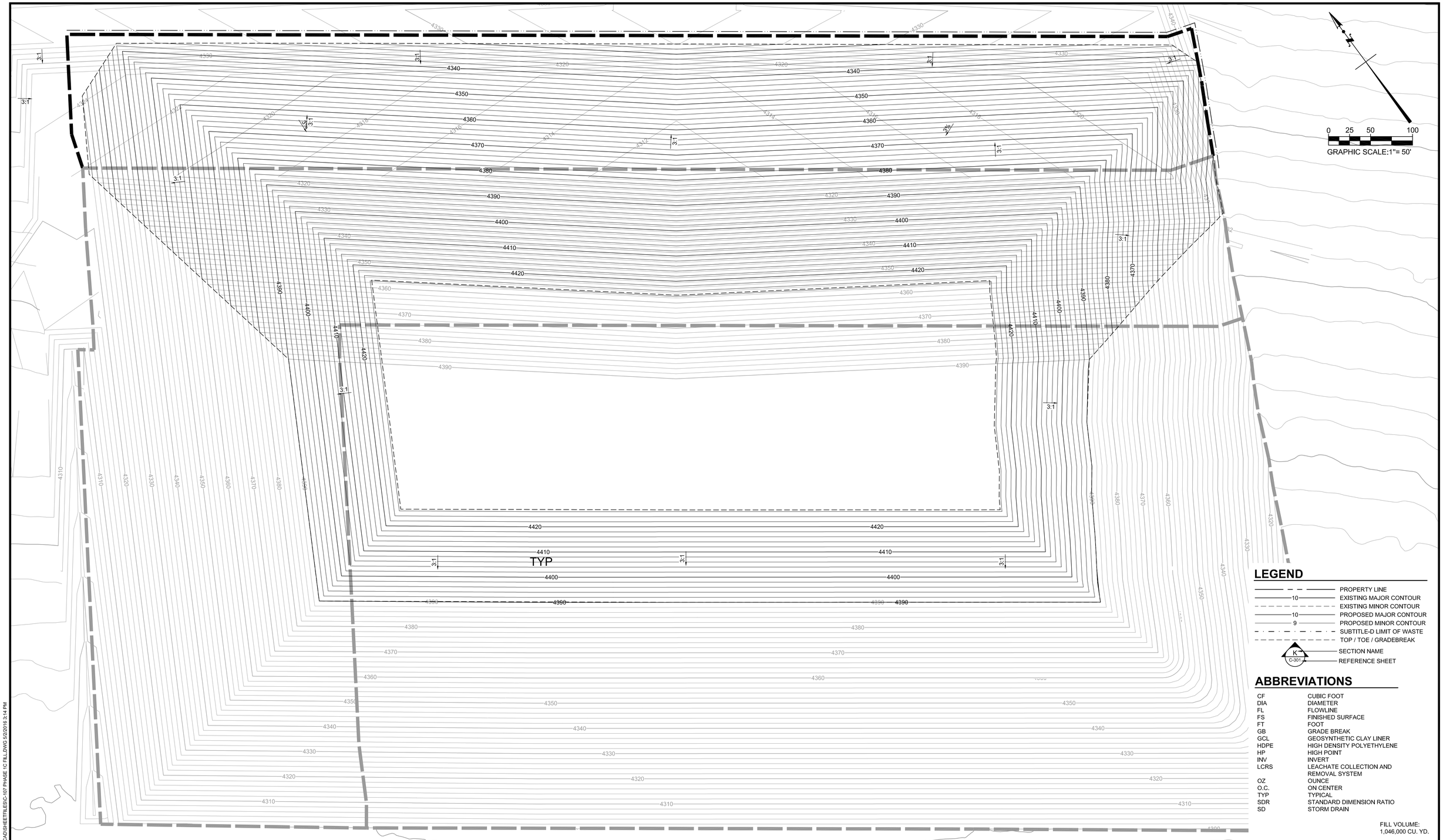

LEGEND

- PROPERTY LINE
- 10 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 10 PROPOSED MAJOR CONTOUR
- 9 PROPOSED MINOR CONTOUR
- SUBTITLE-D LIMIT OF WASTE
- TOP / TOE / GRADEBREAK
- K / C-301 SECTION NAME / REFERENCE SHEET

ABBREVIATIONS

CF	CUBIC FOOT
DIA	DIAMETER
FL	FLOWLINE
FS	FINISHED SURFACE
FT	FOOT
GB	GRADE BREAK
GCL	GEOSYNTHETIC CLAY LINER
HDPE	HIGH DENSITY POLYETHYLENE
HP	HIGH POINT
INV	INVERT
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
OZ	OUNCE
O.C.	ON CENTER
TYP	TYPICAL
SDR	STANDARD DIMENSION RATIO
SD	STORM DRAIN

FILL VOLUME:
1,046,000 CU. YD.

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

PHASE 1C FILL - FOR REFERENCE ONLY

DESIGNED BY : DLL	FILE : C-107 Phase 1C Fill.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-107	
APPROVED BY : CHM	DATE : 05-2016		

FOR PERMIT PURPOSES ONLY - NOT FOR CONSTRUCTION

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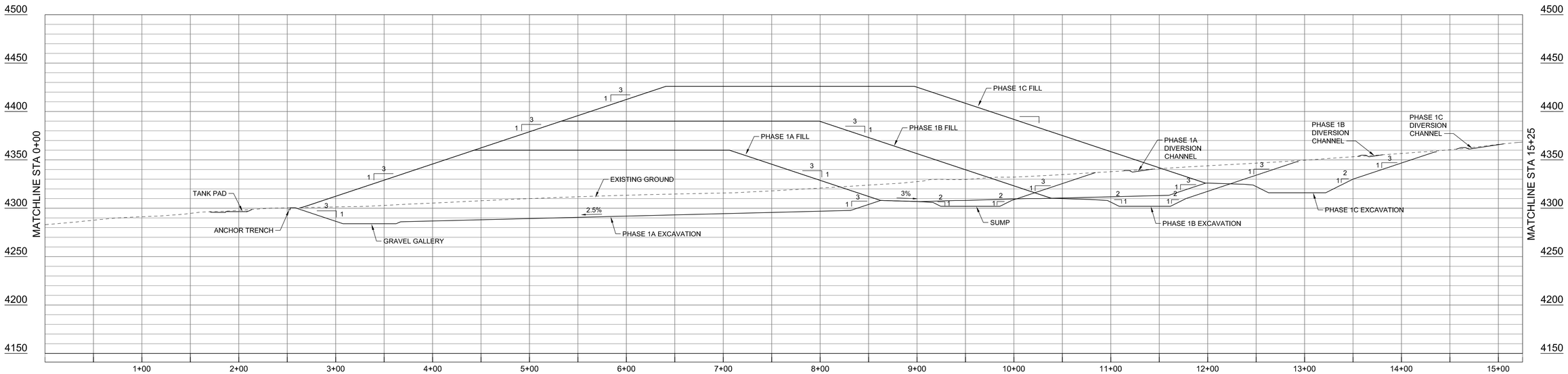

SECTION A
SCALE
HORIZONTAL: 1"=50'
VERTICAL: 1"=50'

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

CROSS-SECTION

DESIGNED BY : DLL	FILE : C-301 Cross-Section.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	**C-301**	
APPROVED BY : CHM	DATE : 05-2016		

FOR PERMIT PURPOSES ONLY - NOT FOR CONSTRUCTION

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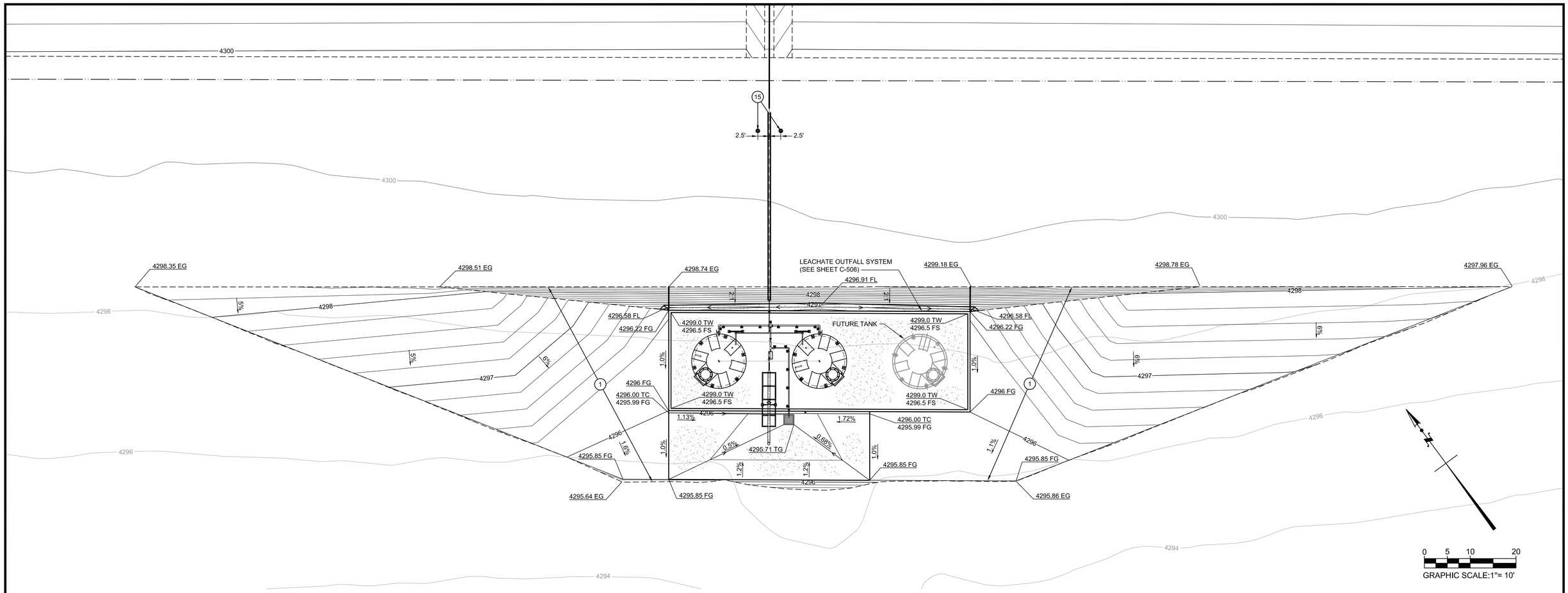


LEGEND

- PROPERTY LINE
- 10 — EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 10 — PROPOSED MAJOR CONTOUR
- 9 — PROPOSED MINOR CONTOUR
- LCRS MAINLINE
- LCRS LATERAL
- ANCHOR TRENCH
- FLOWLINE
- TOP / TOE / GRADEBREAK
- K / C-301 — SECTION NAME / REFERENCE SHEET

ABBREVIATIONS

CF	CUBIC FOOT
DIA	DIAMETER
FL	FLOWLINE
FS	FINISHED SURFACE
FT	FOOT
GB	GRADE BREAK
GCL	GEOSYNTHETIC CLAY LINER
HDPE	HIGH DENSITY POLYETHYLENE
HP	HIGH POINT
INV	INVERT
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
OZ	OUNCE
O.C.	ON CENTER
TYP	TYPICAL
SDR	STANDARD DIMENSION RATIO
SD	STORM DRAIN

CONSTRUCTION NOTES

1. EXCAVATE OR FILL TO GRADES AND CONTOURS SHOWN
15. CONSTRUCT BOLLARD PER 7 / C-502

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

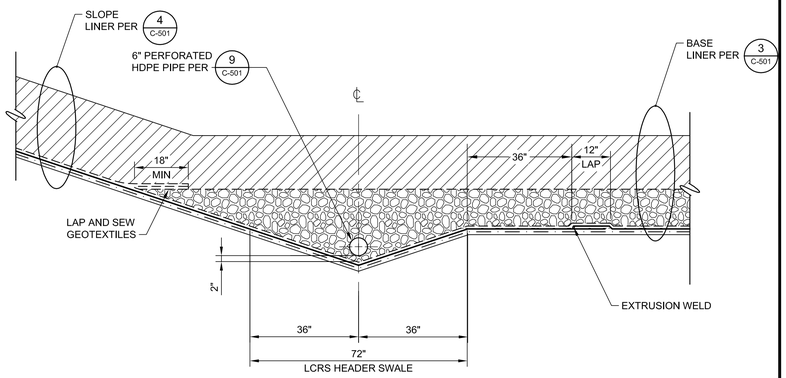
PROMONTORY POINT, LLC

LEACHATE OUTFALL AREA GRADING

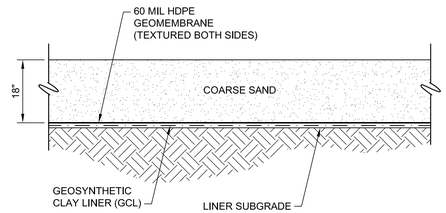
DESIGNED BY :	DLL	FILE : C-401 Leachate Outfall Area Grading.dwg	
DRAWN BY :	PV / ANP	DATE : 05-2016	SCALE: AS SHOWN
CHECKED BY :	GES	DATE : 05-2016	C-401
APPROVED BY :	CHM	DATE : 05-2016	

FOR PERMIT PURPOSES ONLY - NOT FOR CONSTRUCTION

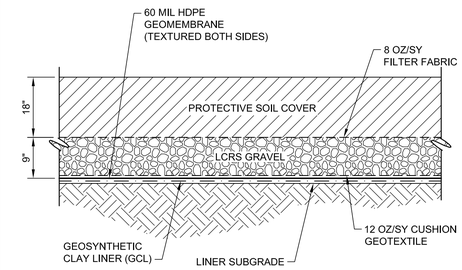
P:\PROM PT LLC\PROM PT LF\CELL 1\CAD\SHEETFILES\C-401 LEACHATE OUTFALL AREA GRADING.DWG 5/2/2016 3:16 PM



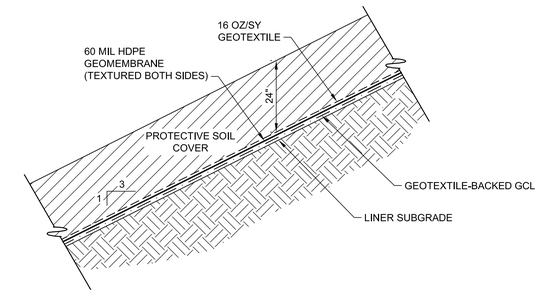
1	LCRS TOE DRAIN AND TRENCH
NTS	REFERENCE SHEET:



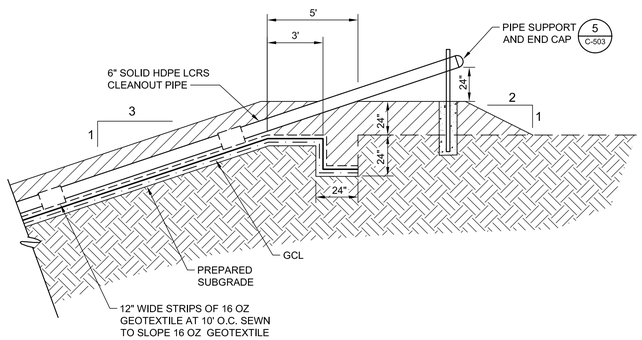
2	BASE LINER
NTS	REFERENCE SHEET:



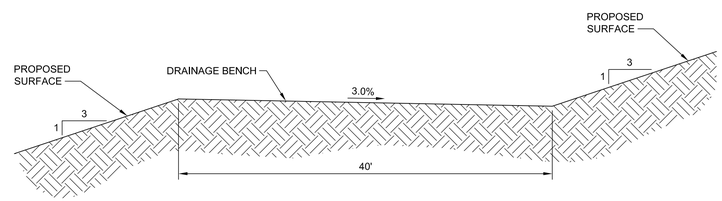
3	BASE LINER
NTS	REFERENCE SHEET:



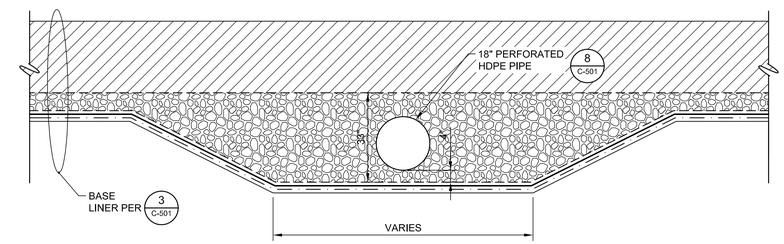
4	SLOPE LINER
NTS	REFERENCE SHEET:



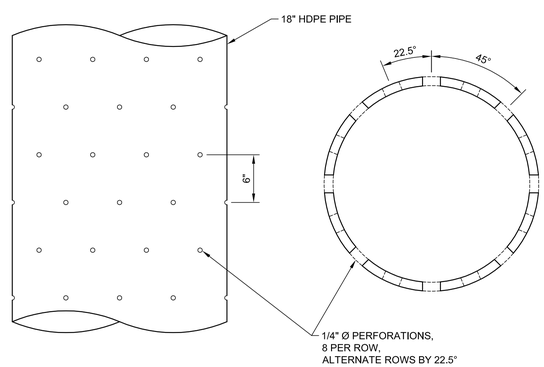
5	6" LCRS RISER CLEANOUT
NTS	REFERENCE SHEET:



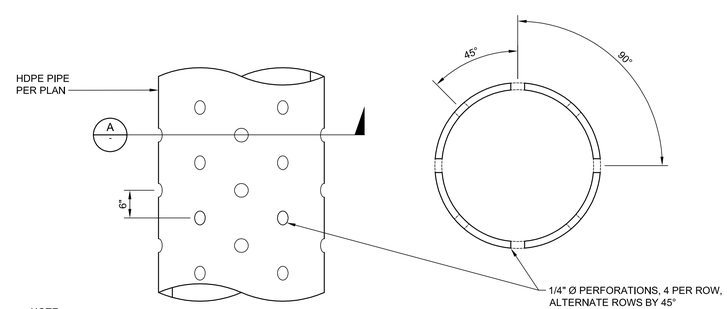
6	DRAINAGE BENCH
NTS	REFERENCE SHEET:



7	LCRS SUMP
NTS	REFERENCE SHEET:



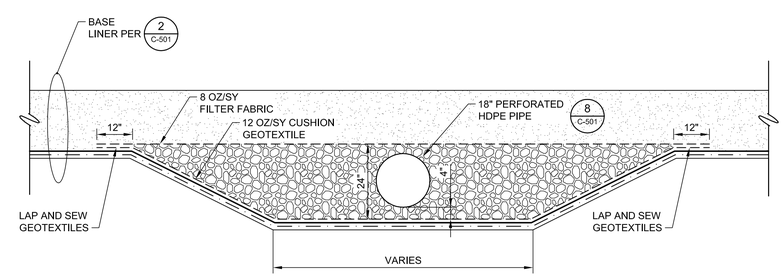
8	LCRS SUMP PERFORATED PIPE
NTS	REFERENCE SHEET:



NOTE:
ENGINEER WILL SELECT SLOTTED OR PERFORATED PIPE BASED ON SUBMITTAL FOR GRANULAR DRAINAGE MATERIAL. CONTRACTOR TO PROVIDE PRICING FOR EITHER OPTION.

SECTION A
NTS

9	PERFORATED HDPE PIPE
NTS	REFERENCE SHEET:



10	LCRS SUMP
NTS	REFERENCE SHEET:

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

DETAILS

DESIGNED BY : DLL	FILE : C-501 Details.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-501	
APPROVED BY : CHM	DATE : 05-2016		

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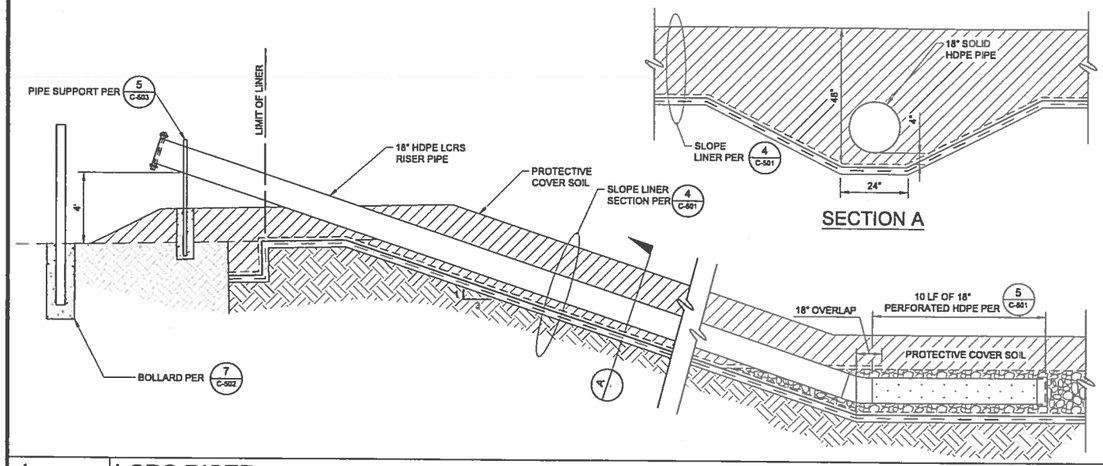
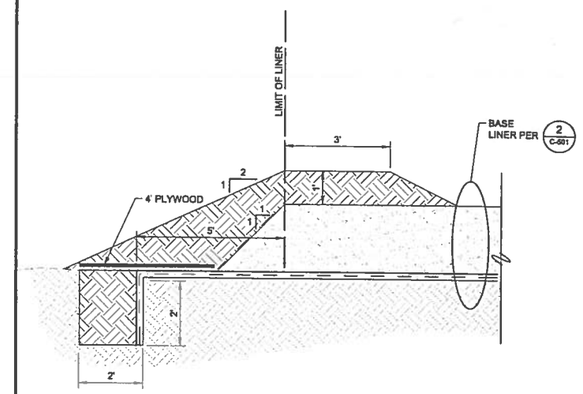
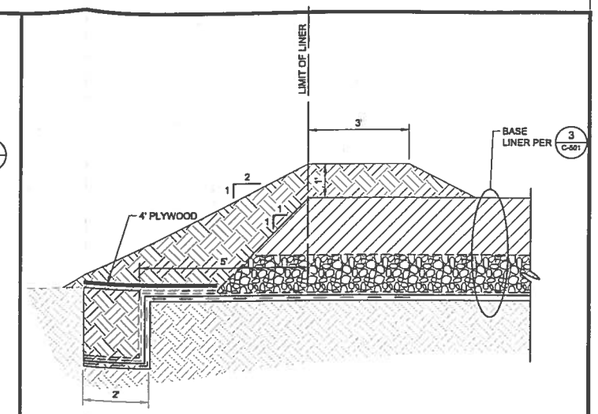
P:\PROM PT LLC\PROM PT LF\CELL 1\CAD\SHEETFILES\C-501 DETAILS.DWG 5/2/2016 3:16 PM



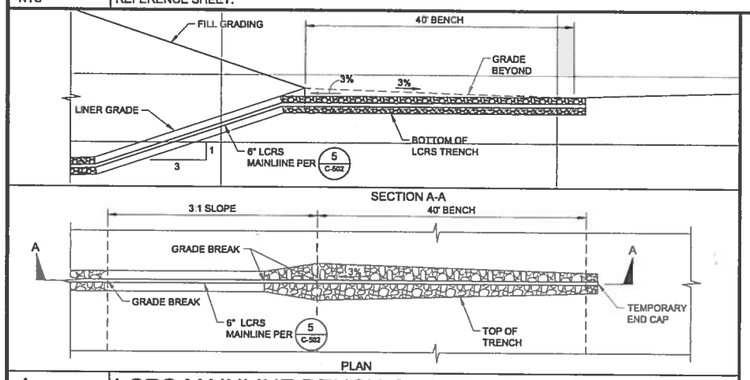
1 LCRS RISER
NTS REFERENCE SHEET:



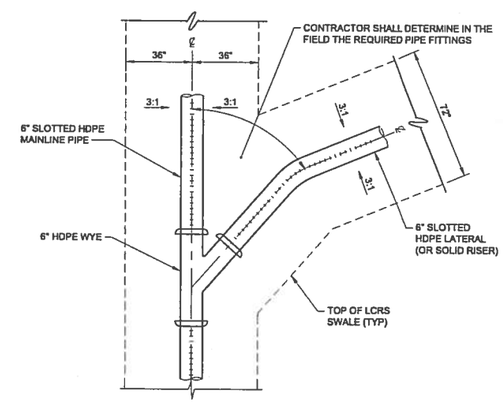
2 TEMPORARY LINER TERMINATION
NTS REFERENCE SHEET:



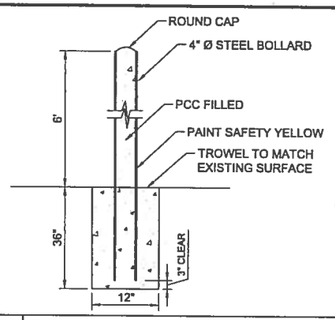
3 TEMPORARY LINER TERMINATION
NTS REFERENCE SHEET:



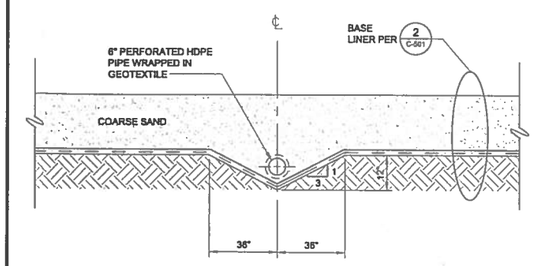
4 LCRS MAINLINE BENCH CROSSING
NTS REFERENCE SHEET:



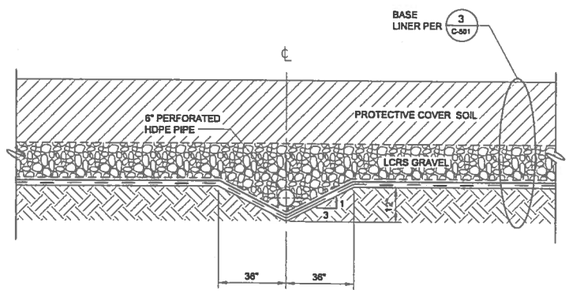
6 LCRS PIPE CONNECTION
NTS REFERENCE SHEET:



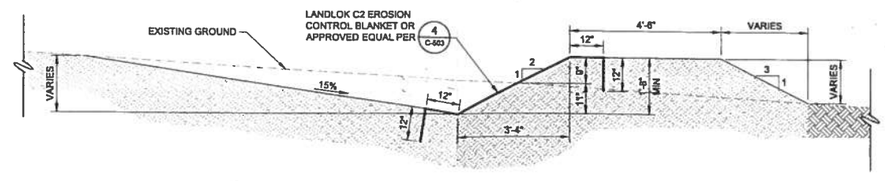
7 BOLLARD
NTS REFERENCE SHEET:



8 LCRS LATERAL AND MAINLINE
NTS REFERENCE SHEET:



5 LCRS LATERAL AND MAINLINE
NTS REFERENCE SHEET:



9 DIVERSION CHANNEL
NTS REFERENCE SHEET:

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

DETAILS

DESIGNED BY : DLL	FILE : C-502 Details.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-502	
APPROVED BY : CHM	DATE : 05-2016		

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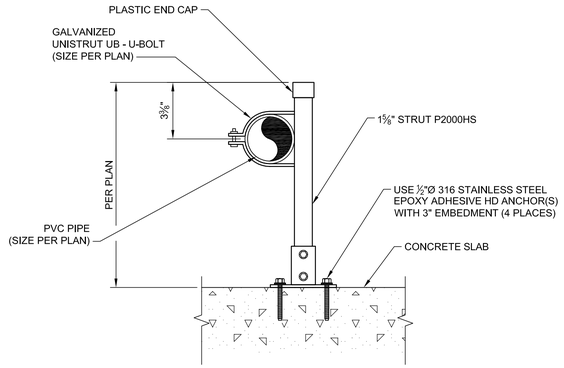
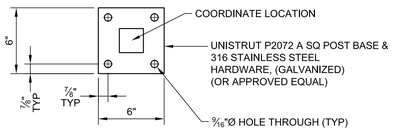


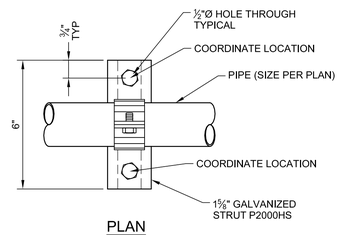
ELEVATION



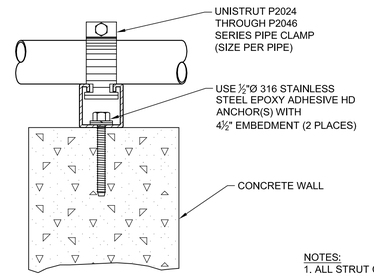
PLAN

NOTES:
1. ALL STRUT CHANNEL MATERIAL SHALL BE GALVANIZED.
2. ALL CONDUIT SUPPORTS AND ANCHORS SHALL BE ASSEMBLED WITH 316 STAINLESS STEEL BOLTS, WASHERS, LOCK WASHERS, NUTS AND SPRING NUTS.

1	PIPE SUPPORT
NTS	REFERENCE SHEET:



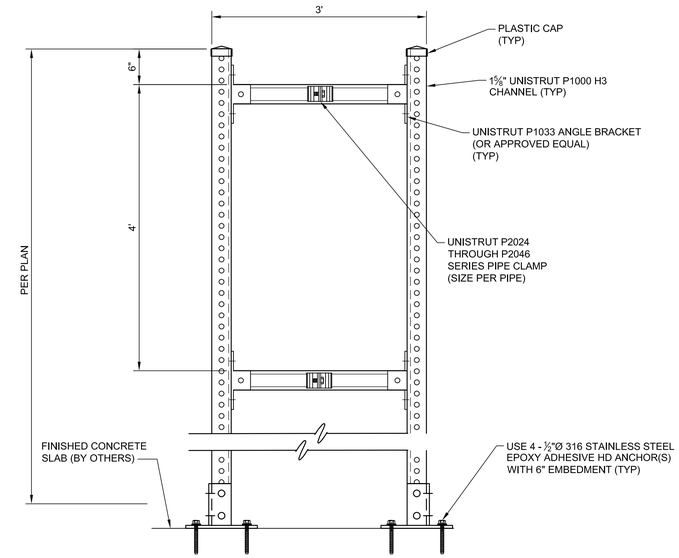
PLAN

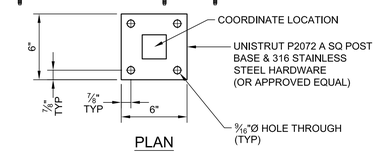


ELEVATION

NOTES:
1. ALL STRUT CHANNEL MATERIAL SHALL BE GALVANIZED.
2. ALL CONDUIT SUPPORTS AND ANCHORS SHALL BE ASSEMBLED WITH 316 STAINLESS STEEL BOLTS, WASHERS, LOCK WASHERS, NUTS AND SPRING NUTS.

2	PIPE SUPPORT
NTS	REFERENCE SHEET:

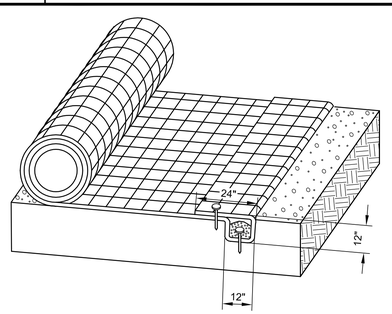




PLAN

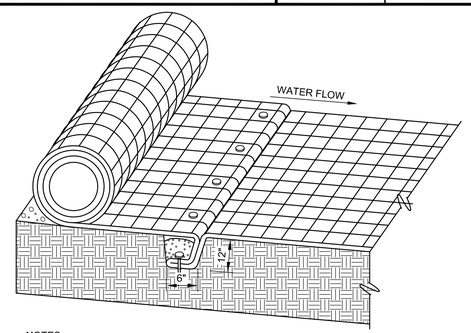
NOTES:
1. ALL STRUT CHANNEL MATERIAL SHALL BE GALVANIZED.
2. ALL CONDUIT SUPPORTS AND ANCHORS SHALL BE ASSEMBLED WITH 316 STAINLESS STEEL BOLTS, WASHERS, LOCK WASHERS, NUTS AND SPRING NUTS.
3. 3 FRAME ASSEMBLIES TOTAL
4. ALL UNISTRUT CONNECTION SHALL USE HEX-HEAD BOLT CONNECTS THAT ARE THREADED INTO SPRING NUT OR APPROVED EQUAL.

3	PIPE SUPPORT
NTS	REFERENCE SHEET:



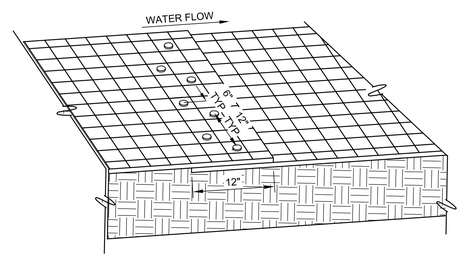
NOTES:
1. SECURE AT 12" INTERVALS, BACKFILL AND COMPACT SOIL

TERMINAL ANCHOR TRENCH



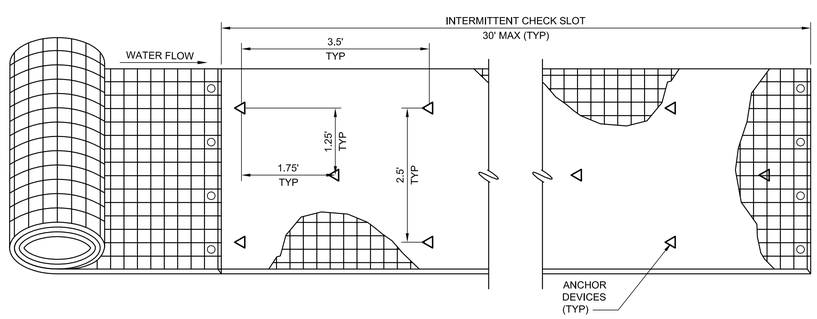
NOTES:
1. SECURE AT 12 VERTICAL INCH INTERVALS, BACKFILL AND COMPACT SOIL

INTERMITTENT CHECK SLOT

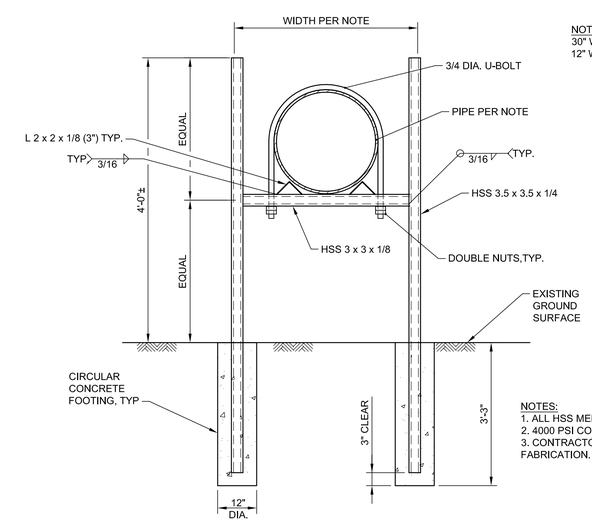


NOTES:
1. BACKFILL AND COMPACT SOIL

OVERLAP AT ROLL END



4	LANDLOK EROSION CONTROL BLANKET
NTS	REFERENCE SHEET:



NOTE:
30" WIDTH FOR 18" PIPE
12" WIDTH FOR 6" PIPE

NOTES:
1. ALL HSS MEMBERS SHALL BE GALVANIZED.
2. 4000 PSI CONCRETE SHALL BE USED FOR FOOTING.
3. CONTRACTOR TO VERIFY PIPE LOCATION PRIOR TO FABRICATION.

5	PIPE SUPPORT
NTS	REFERENCE SHEET:

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

DETAILS

DESIGNED BY : DLL	FILE : C-503 Details.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-503	
APPROVED BY : CHM	DATE : 05-2016		

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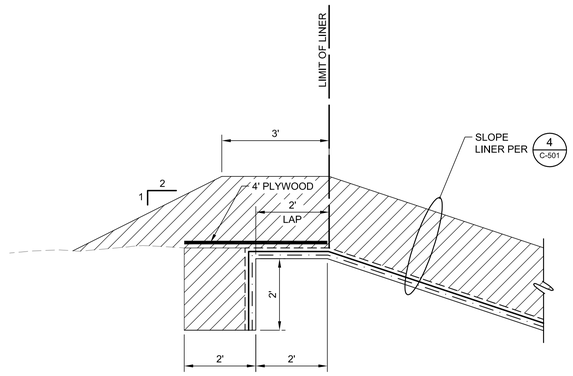
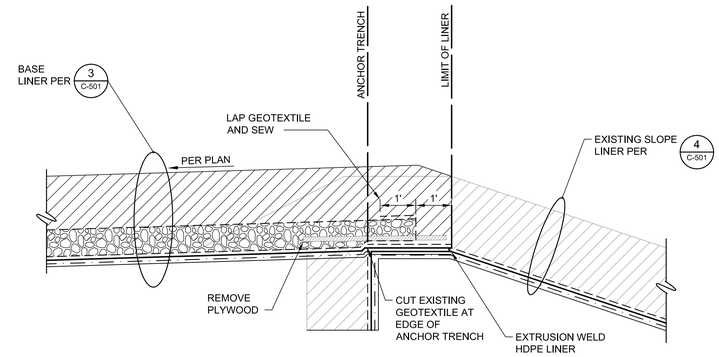
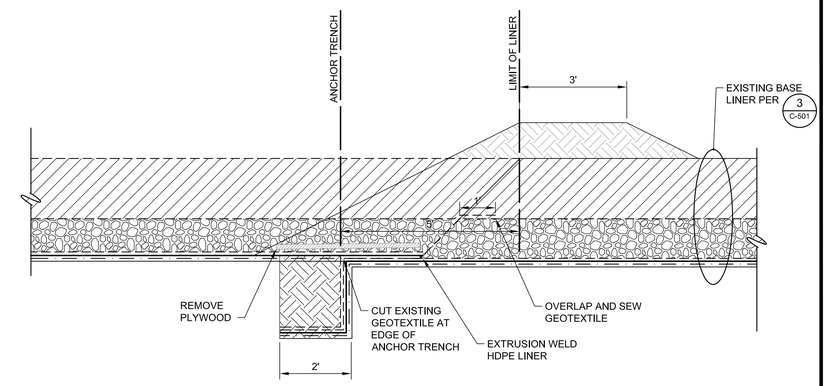


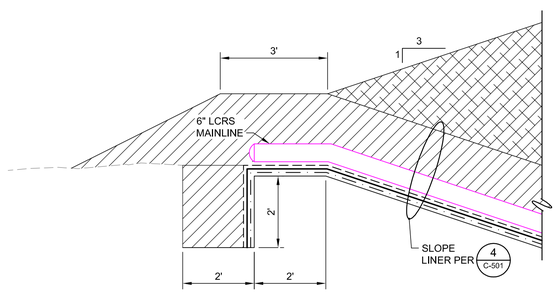
1	NORTHERN LINER TERMINATION
NTS	REFERENCE SHEET:



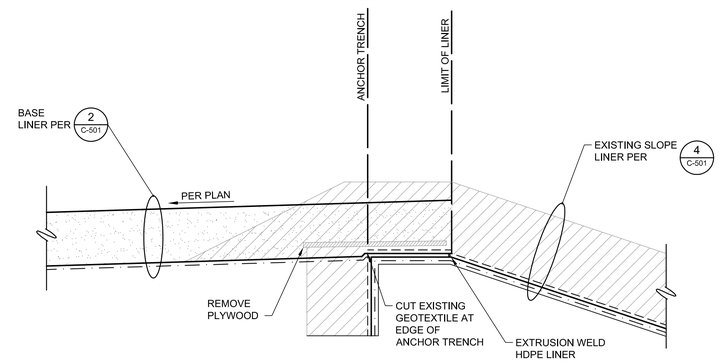
2	LINER JOIN
NTS	REFERENCE SHEET:



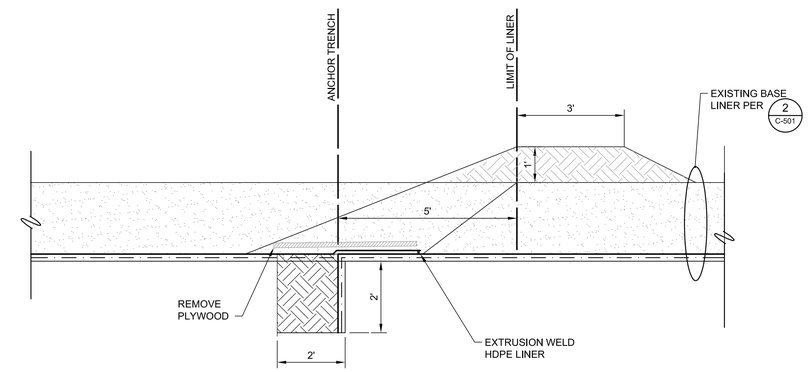
3	LINER JOIN AT TEMPORARY TERMINATION
NTS	REFERENCE SHEET:



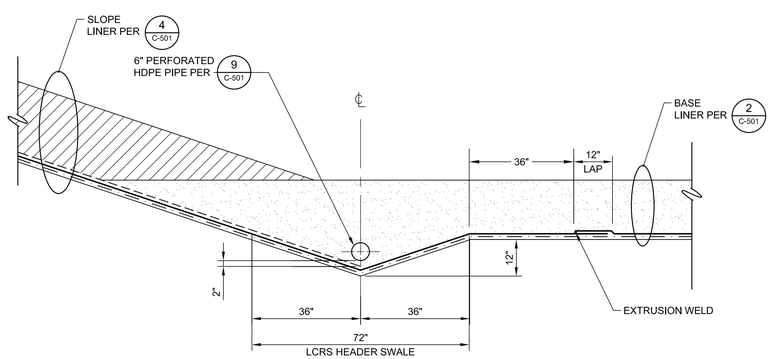
4	6" LCRS MAINLINE AT NORTHERN LINER TERMINATION
NTS	REFERENCE SHEET:



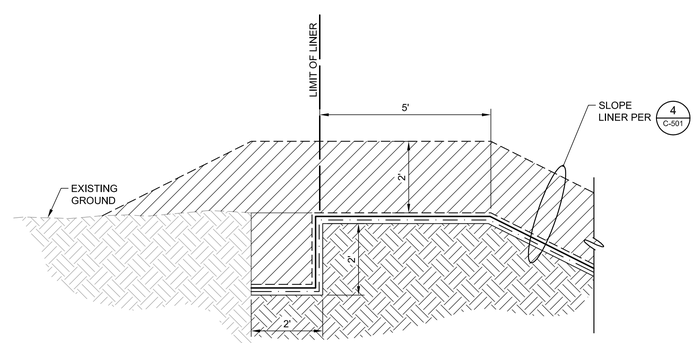
5	LINER JOIN
NTS	REFERENCE SHEET:



6	LINER JOIN AT TEMPORARY TERMINATION
NTS	REFERENCE SHEET:



7	LCRS TOE DRAIN AND TRENCH
NTS	REFERENCE SHEET:



8	PERIMETER ANCHOR TRENCH
NTS	REFERENCE SHEET:

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

DETAILS

DESIGNED BY : DLL	FILE : C-504 Details.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-504	
APPROVED BY : CHM	DATE : 05-2016		

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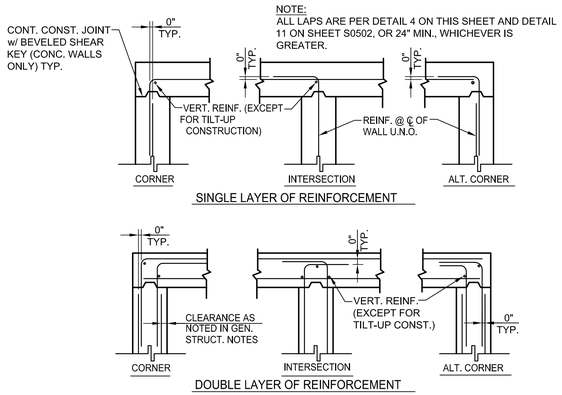
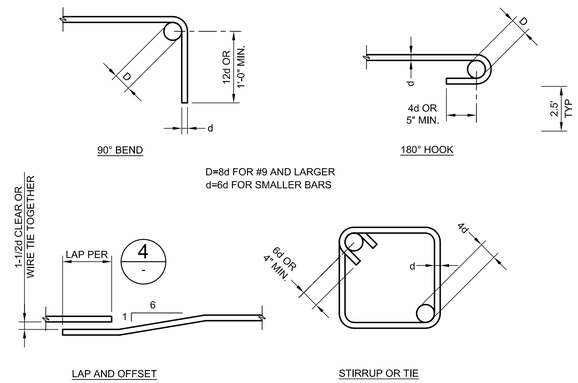


1 WALL AND FOOTING REINFORCEMENT AT CORNERS AND INTERSECTIONS

NTS REFERENCE SHEET:

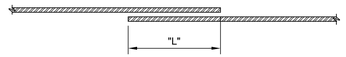


2 TYPICAL BAR BENDS

NTS REFERENCE SHEET:

REINFORCING LAP SPLICE SCHEDULE

BAR	f'c=2500	f'c=3000	f'c=4000	f'c=5000
	L (inches)	L (inches)	L (inches)	L (inches)
3	24	22	19	17
4	32	29	25	23
5	39	36	31	28
6	47	43	37	34
7	69	63	54	49
8	78	72	62	56
9	88	81	70	63

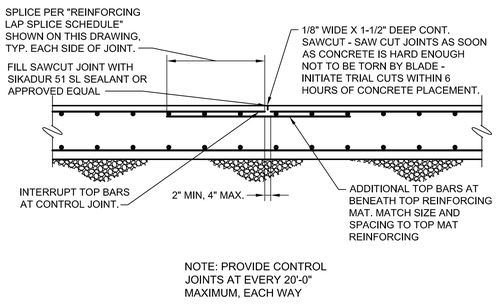


NOTES:

1. LAPS SHOWN IN THIS TABLE ARE CLASS B, CATEGORY 3 TYPE SPLICES. LAP LENGTH IS BASED UPON SMALLER OF TWO BARS BEING SPLICED WHEN NOT THE SAME SIZE.
2. INCREASE LAP LENGTHS BY A FACTOR OF 1.3 FOR HORIZONTAL REINFORCEMENT SO PLACED THAT MORE THAN 12 INCHES OF CONCRETE IS CAST IN THE MEMBER BELOW THIS REINFORCEMENT.

3 REINFORCING LAP SPLICE SCHEDULE

NTS REFERENCE SHEET:



4 CONTROL JOINT

NTS REFERENCE SHEET:

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

DETAILS

DESIGNED BY : DLL	FILE : C-505 Details.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-505	
APPROVED BY : CHM	DATE : 05-2016		

FOR PERMIT PURPOSES ONLY - NOT FOR CONSTRUCTION

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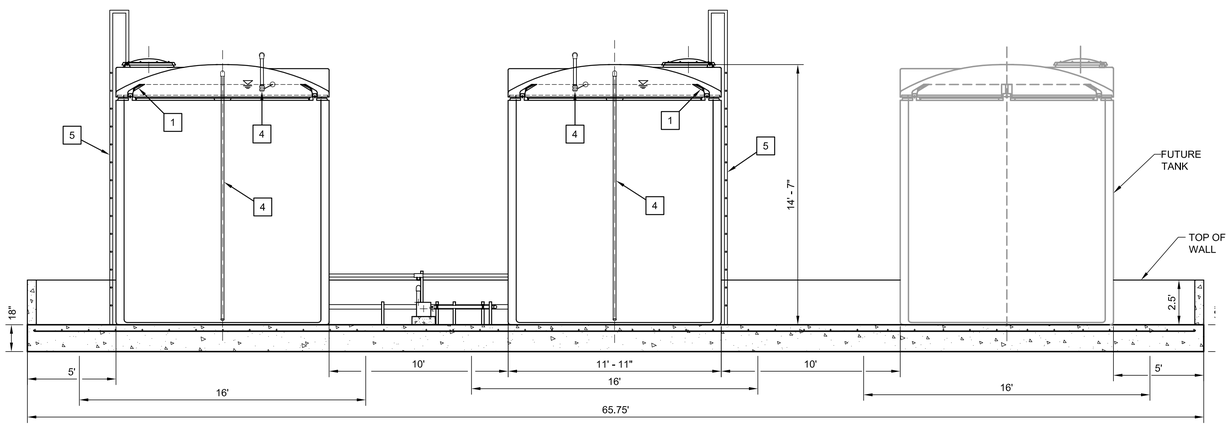
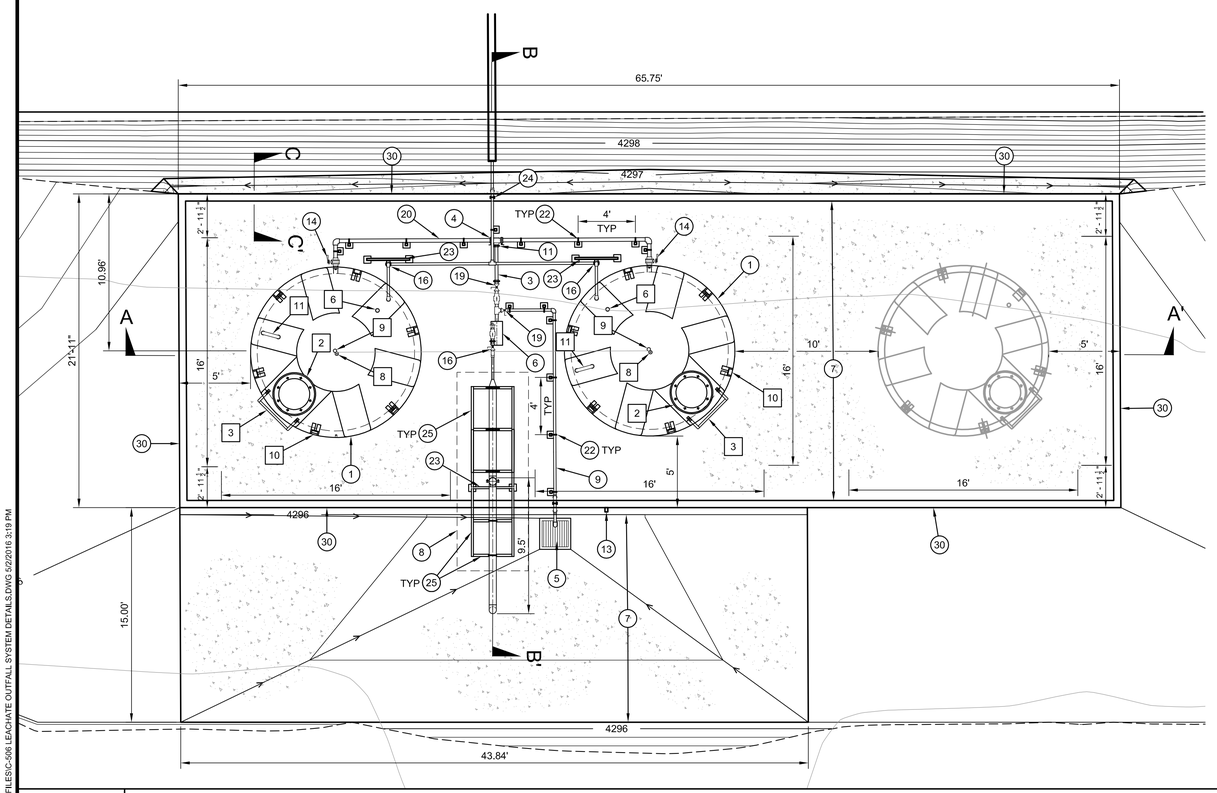
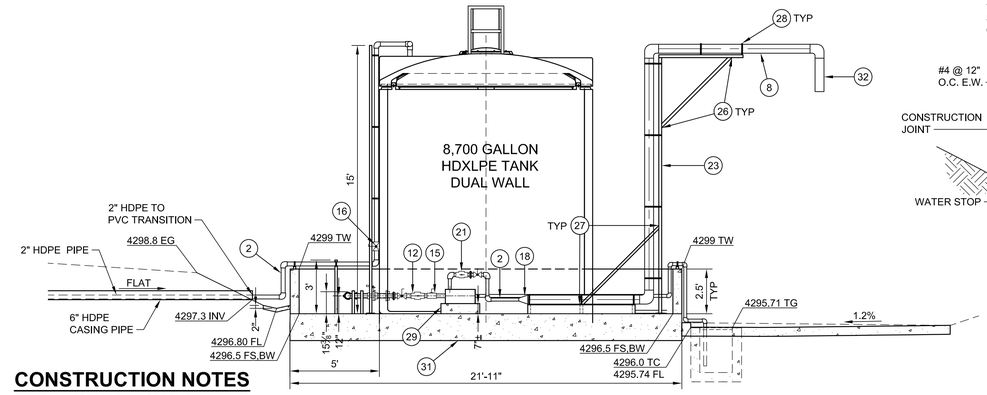


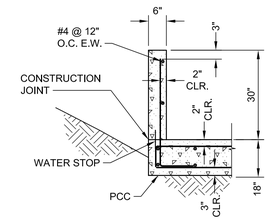
SECTION A-A'
SCALE: 1"=4'





SECTION B-B'
SCALE: 1"=4'

NOTE:
PROVIDE WALL CONTROL JOINTS AT 12'-0" MAX. SPACING. ALL JOINTS TO BE SEALED WITH BACKER ROD AND CAULKING.



SECTION C-C'
SCALE: 1"=2'

CONSTRUCTION NOTES (THIS SHEET ONLY)

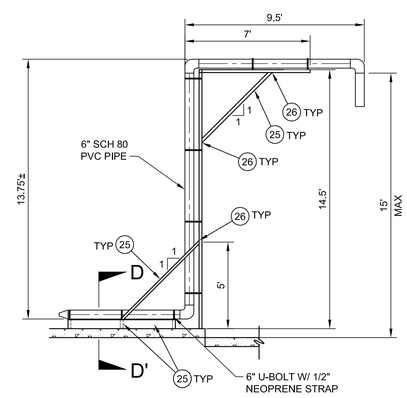
1. INSTALL LEACHATE STORAGE TANK, POLY PROCESSING 8,700 GALLON SAFE TANK DOUBLE WALL HIGH DENSITY CROSS-LINKED POLYETHYLENE.
2. INSTALL 2" PVC PIPE AND FITTINGS, SCH 80
3. INSTALL 2.5" PVC SCH 80, FLANGE, VANSTONE,
4. INSTALL 3" PVC SCH 80, FLANGE, VANSTONE,
5. INSTALL 18"x18"x30" BROOKS CONCRETE CATCH BASIN WITH TRAFFIC RATED FRAME AND GRATE OR EQUAL.
6. INSTALL GRUNDFOS 20501 LC ELECTRIC PUMP, (1) QTY WITH 2.5" INLET AND 2" OUTLET OR APPROVED EQUAL.
7. CONSTRUCT 8" THICK PCC CONCRETE FOUNDATION PAD (COMPRESSIVE STRENGTH OF 4,000 PSI), #5 REBAR @ 12" O.C. EACH WAY
8. INSTALL FILL STAND PER (2)
9. INSTALL 2" PVC DRAIN PIPE AND FITTINGS WITH TRUE UNION BALL VALVE.
10. INSTALL 6" PVC, SCH 80
11. INSTALL 3" PVC, SCH 80 TEE, AND 3" TO 2.5" REDUCER
12. INSTALL 2.5" PVC CHECK VALVE
13. INSTALL MANUAL PUMP ON/OFF SWITCH. MOUNT TO WALL.
14. INSTALL TRUE UNION SHUT OFF VALVE. INCLUDE BELLOWS EXPANSION JOINT.
15. INSTALL 2.5" PVC, SCH 80 TEE, AND 2.5" TO 2" REDUCER
16. INSTALL 2" PVC TRUE UNION BALL VALVE.
17. CONSTRUCT PCC HOUSEKEEPING PAD
18. INSTALL 6" TO 2" PVC PIPE REDUCER
19. INSTALL 2.5" PVC TRUE UNION BALL VALVE.
20. INSTALL 3" PVC, SCH 40
21. INSTALL 2" PVC CHECK VALVE
22. INSTALL PIPE SUPPORT PER (1 / C-503)
23. INSTALL PIPE SUPPORT PER (3 / C-503)
24. INSTALL PIPE SUPPORT PER (2 / C-503)
25. 1 5/8" GALVANIZED P1000 UNISTRUT CHANNEL (OR APPROVED EQUAL)
26. UNISTRUT P2265 ANGLE BRACKET (45°) (GALVANIZED) (OR APPROVED EQUAL)
27. UNISTRUT P2267 ANGLE BRACKET (60°) (GALVANIZED) (OR APPROVED EQUAL)
28. GALVANIZED PIPE CLAMP
29. CONSTRUCT 7"± THICK CONCRETE HOUSEKEEPING PAD
30. CONSTRUCT SECONDARY CONTAINMENT RETAINING PER SECTION C-C HEREON.
31. CONSTRUCT 18" THICK CONCRETE MAT FOUNDATION WITH #7 @12" OC. BOTH WAYS, TOP & BOTTOM. TO BE VERIFIED BY TANK MANUFACTURER.
32. INSTALL PVC SOCK

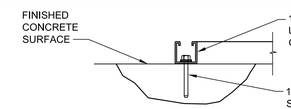
TANK CONSTRUCTION NOTES

1. MOLDED-IN LIFTING LUGS (6) PL, USE ALL LUGS WHEN LIFTING
2. 24" POLY PROCESSING MANWAY INCLUDING VENT OR APPROVED EQUAL.
3. MOLDED-IN LADDER ATTACHMENT LUG TYP (2)
4. INSTALL 2" REVERSE FLOAT TYPE SIGHT GAGE WITH PIPE SUPPORT. INCLUDE ADDITIONAL UNISTRUT PIPE SUPPORT. (2)
5. FIBERGLASS REINFORCED PLASTIC (FRP) LADDER.
6. INSTALL SONIC LEVEL INDICATOR TO CONTROL LEACHATE SUMP PUMP.
8. PRESSURE RELIEF VALVE (2)
9. HIGH LEVEL ALARM (2)
10. WIND/SEISMIC RESTRAINT (TYPICAL)
11. U-VENT (2)

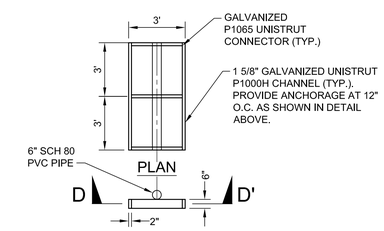
NOTES:

1. PERSONAL PROTECTIVE EQUIPMENT MUST BE WORN AT ALL TIMES WHEN HANDLING OPEN LEACHATE AND WASTE. PER SITE HEALTH AND SAFETY PLAN.
2. THE CONTRACTOR SHALL PROVIDE AND INSTALL ALL REQUIRED PIPE, FITTINGS AND SUPPORTS TO ACHIEVE THE INTENT OF THE STORAGE FACILITY DESIGN.
3. CONTRACTOR SHALL SUBMIT CALCULATIONS AND DETAILS FOR WIND AND SEISMIC RESTRAINTS OF LEACHATE STORAGE TANKS FOR REVIEW AND ACCEPTANCE.
4. ALL EXPOSED PVC PIPING SHALL BE COMPLETELY COATED FOR UV PROTECTION PER SPECIFICATIONS.
5. CONTRACTOR SHALL SUBMIT STRUCTURAL CALCULATIONS AND DETAILS FOR TANK FOUNDATIONS AND CONCRETE SLABS FOR REVIEW AND ACCEPTANCE.
6. LEACHATE TANKS SHALL INCLUDE EMERGENCY AIR SURGE PROTECTION.
7. ALL PIPE SUPPORT MATERIALS SHALL BE GALVANIZED CARBON STEEL.
8. ALL EQUIPMENT ANCHORS SHALL BE 316 STAINLESS STEEL AND SHALL BE COATED WITH AN APPROVED ANTI-SIEZE COMPOUND.
9. ALL TANK CONNECTIONS SHALL INCLUDE A BELLOWS TRANSITION FITTING/EXPANSION JOINT. THE TRANSITION FITTING/EXPANSION JOINT SHALL BE INSTALLED AND SUPPORTED PER MANUFACTURERS RECOMMENDATIONS.
10. ANCHORAGE FOR TANKS SHALL BE DESIGNED BY THE MANUFACTURER TO RESIST WIND AND SEISMIC FORCES. MANUFACTURER SHALL SUBMIT CALCULATIONS AND SHOP DRAWINGS SIGNED AND STAMPED BY A UTAH LICENSED CIVIL OR STRUCTURAL ENGINEER PRIOR TO FABRICATION FOR EACH TANK. A MINIMUM OF 6 ANCHORING LOCATIONS WITH 3/4" DIA. S.S. ANCHORS EMBEDDED 12" MIN. INTO TANK FOUNDATION SHALL BE PROVIDED. ANCHOR BOLTS FOR TANK ANCHORAGE SHALL BE STAINLESS STEEL THREADED RODS. EXPANSION ANCHORS MAY NOT BE USED FOR THE ANCHORAGE OF TANKS.





ANCHORAGE DETAIL



SECTION D-D'
SCALE: 1"=4'

NOTES:

1. ALL STRUT CHANNEL MATERIAL SHALL BE GALVANIZED.
2. ALL CONDUIT SUPPORTS AND ANCHORS SHALL BE ASSEMBLED WITH 316 STAINLESS STEEL BOLTS, WASHERS, LOCK WASHERS, NUTS AND SPRING NUTS.
3. 3 FRAME ASSEMBLIES TOTAL
4. ALL UNISTRUT CONNECTION SHALL USE HEX-HEAD BOLT CONNECTS THAT ARE THREADED INTO SPRING NUT OR APPROVED EQUAL.

1	LEACHATE TANK AND TANK PAD	2	FILL STAND
SCALE: 1"=5'	REFERENCE SHEET:	SCALE: 1"=4'	REFERENCE SHEET:

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

LEACHATE OUTFALL SYSTEM DETAILS

DESIGNED BY : DLL	FILE : C-506 Leachate Outfall System Details.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-506	
APPROVED BY : CHM	DATE : 05-2016		

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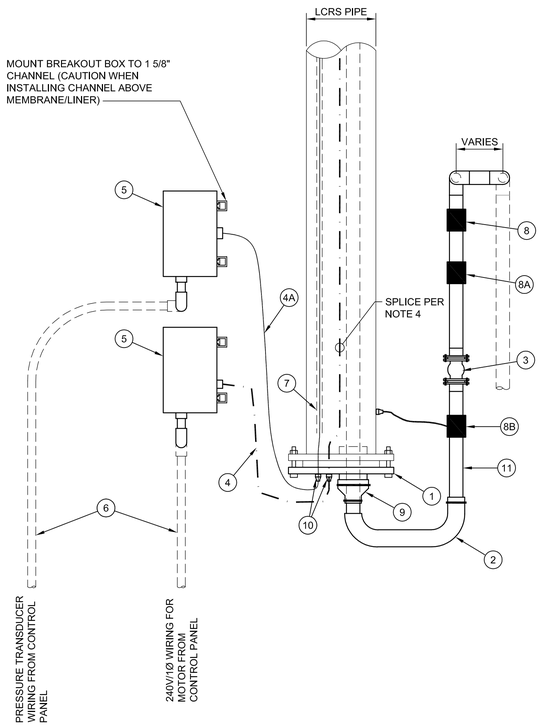
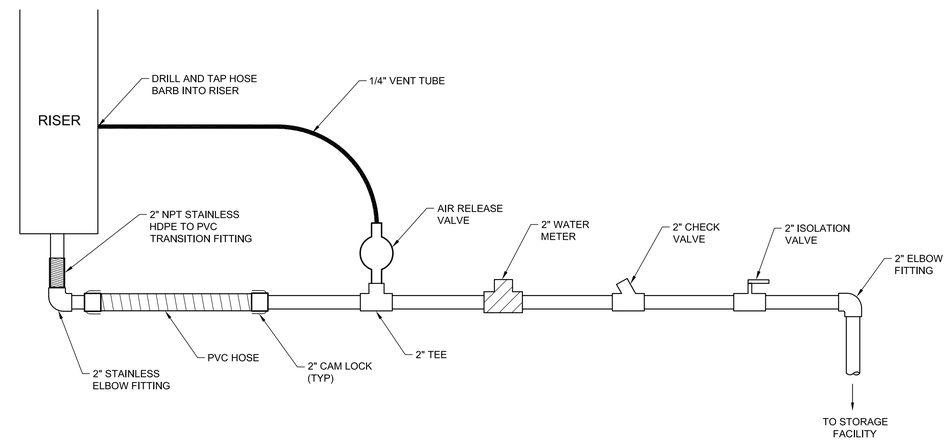


1 TOP OF RISER CONNECTION PLAN

NTS REFERENCE SHEET:

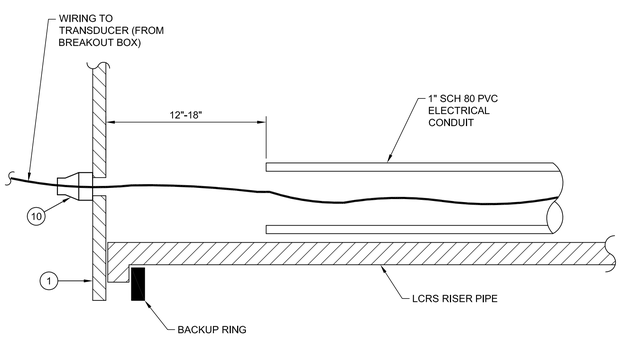


2 METERING PIPE RUN

NTS REFERENCE SHEET:

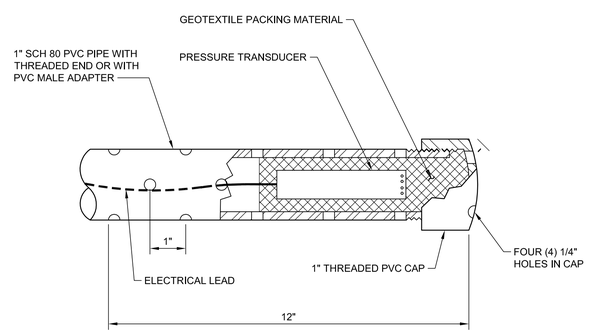
CONSTRUCTION NOTES

1. REAL ENVIRONMENTAL PRODUCTS FLANGE PLATE (ONE 4" PIPE PIPE STUB WELDED THROUGH FLANGE)
2. 2" HIGH PRESSURE FLEX HOSE WITH SS CLAMPS. PAINT YELLOW FOR U.V. PROTECTION
3. FLOW METER MCMASTER - CAAR 4041K26
4. ELECTRICAL CORD, 12/4, TYPE SOOW FROM BREAKOUT BOX TO INSIDE RISER. USE SUBMERSIBLE PUMP SPLICE KIT INSIDE RISER TO TRANSITION TO 12/4 FLAT-JACKETED PUMP WIRE
5. PRESSURE TRANSDUCER WIRE - NO SPLICES OR CUTS FROM TRANSDUCER TO BREAKOUT BOX TO PRESERVE INTEGRITY OF VENT TUBE.
6. NEMA 4X STAINLESS STEEL BREAKOUT BOXES (2) MOUNTED TO 1 5/8" CHANNEL. INSTALL HOFFMAN DRAIN VENT IN BOTTOM OF EACH BOX.
7. ELECTRICAL CONDUITS TO CONTROL PANEL INSTALL SEALOFFS AND COMPLY WITH NEC FOR MATERIALS AND BURIAL
8. TOP END OF TRANSDUCER TUBE PER DETAIL 3
9. 2" ISOLATION VALVE MCMASTER - CAAR 5539T28 OR 49355K28
10. 2" STAINLESS STEEL SWING-TYPE CHECK VALVE MCMASTER - CAAR 46635K69
11. AIR RELIEF VALVE - PLUMB EXHAUST VENT TO RISER PIPE (STAINLESS STEEL) MCMASTER - CAAR 8126K12
12. 4" x 2" FERNCO COUPLING
13. NEMA 4X CORD GRIP - SIZE TO WIRE - DRILL AND TAP THREADS INTO FLANGE PLATE
14. 2" SCH 80 PVC PIPE PAINT FOR UV PROTECTION



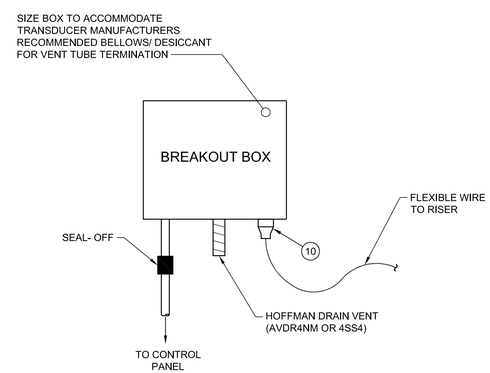
3 TOP END OF TRANSDUCER TUBE DETAIL

NTS REFERENCE SHEET:



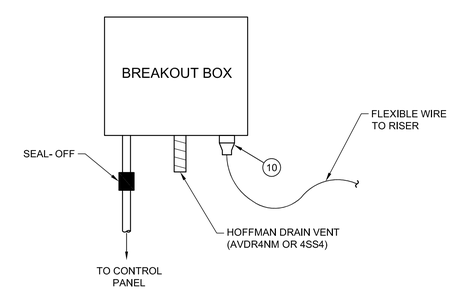
4 BOTTOM END OF TRANSDUCER TUBE

NTS REFERENCE SHEET:



5 TRANSDUCER BREAKOUT BOX

NTS REFERENCE SHEET:



6 PUMP POWER BREAKOUT BOX (TYP)

NTS REFERENCE SHEET:

NO.	REVISION DESCRIPTION	BY:

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

LEACHATE CONTROL DETAILS

DESIGNED BY : DLL	FILE : C-507 Leachate Control Details.dwg		
DRAWN BY : PV / ANP	DATE : 05-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 05-2016	C-507	
APPROVED BY : CHM	DATE : 05-2016		

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APPENDIX C

SPECIFICATIONS

SECTION A

MOBILIZATION/CONSTRUCTION SUPPORT TASKS
PROJECT SURVEY

1.0 GENERAL

The work covered by this section consists of furnishing all labor, equipment and supervision, and performing all operations necessary for mobilization, construction support tasks, and project survey.

1.1 MOBILIZATION

Mobilization shall consist of expenditures for all preparatory work and operations, including but not limited to, bond and insurance costs; those costs deemed necessary for the movement of personnel, equipment, supplies, and incidentals to the project sites; and for all other work and operations which must be performed or costs incurred prior to beginning work on the various contract items on the project site as well as the related demobilization costs anticipated at the completion of the project.

1.2 CONSTRUCTION SUPPORT TASKS

1.2.1 Temporary Facilities for Own Use

- Furnish office and sanitary facilities for own use.
- Furnish utilities as required for own use. Coordinate with landfill operator and servicing utility agencies for use of existing facilities on site.
- Pay for utility service.
- Remove the above on completion of the work.

1.2.2 Temporary Facilities for CM/CQA

The Contractor shall provide a field office that shall have a minimum floor space of 400 square feet, at least 2 doors, and window area of not less than 44 square feet. All doors and windows shall be provided with screens.

Furniture shall be provided as follows:

- 1 plan table
- 1 standard 5-foot double-pedestal desk with a drawer suitable for holding files
- 8 chairs
- 1 drafting stool
- 1 plan rack.
- 1 conference table.

Electric power shall be provided to include a minimum of four 120V duplex convenience outlets. The office shall be illuminated at the tables and desk. An outdoor lighting fixture with a 300-watt bulb shall be installed.

Heating and air conditioning of sufficient capacity shall be provided at no expense to the Owner. The Contractor shall provide drinking water within the office.

Contractor shall provide for high-speed internet service to the field office.

The field offices shall be placed at a location approved by the Owner. A portable sanitation unit shall be provided and maintained for the sole use of the Engineer's staff.

1.2.3 Dust Control

Dust control operations shall be performed by the Contractor at the time, location and in the amount required, and as often as necessary to prevent excavation, fill placement, and/or other activities from producing dust in amounts harmful to person or causing a nuisance to persons living nearby or occupying buildings in the vicinity of the work.

In accordance with the Department of Environmental Quality (DEQ), Division of Air Quality (DAQ) requirements, the Contractor shall prepare and submit a Fugitive Dust Control Plan (FDCP) prior to proceeding with the work. All operations shall be conducted in accordance with Rule 307-309 and all other the applicable DAQ regulations and/or requirements.

The Engineer shall have the authority to suspend all construction operations if, in his opinion, the Contractor fails to adequately provide for dust control.

1.2.4 Protection of Existing Utilities

Prospective bidders shall visit the work site and determine for themselves the existing conditions, including location of utilities. Utility locations will be discussed with the Owner staff during the Pre-Construction Conference described herein.

Should the Contractor's operation be temporarily halted due to conflict with an existing facility, the Contractor shall have no claims against the Owner due to delay and for equipment idle or down time.

The Contractor is responsible for determining the exact location of existing underground utilities and other obstructions that may have to be disturbed by his/her operations and protection thereof.

Contractor shall contact the Engineer for assistance in locating utilities prior to all construction work.

Contractor shall schedule and implement its operation in a manner that does not interfere with the activities of recycling or landfill operations. The Contractor shall take precaution so as to avoid damaging existing public facilities and private improvements. During construction, the Contractor is responsible for the safety of the existing facilities adjacent to and encompassed within the work areas of the Contract.

1.2.5 Water Pollution Control

The Contractor is advised that work under this contract shall be subject to the requirements of the National Pollutant Discharge Elimination System (NPDES) general requirements.

The Contractor shall comply with the Storm Water Permit requirements of the DEQ, Division of Water Quality (DWQ). Prior to beginning work on the project, the Contractor shall have a Storm Water Pollution Prevention Plan (SWPPP) prepared and submitted by a qualified individual, as defined by DWQ, for the specific landfill work to be conducted during the course of the Contract.

Contractor shall not be entitled to any time extensions or compensation for any cost due to any action required as a result of Contractor's failure to comply with those provisions of the SWPPP within Contractor's control. Contractor will be responsible for ensuring that Contractor's subcontractor(s) comply with the provisions of this Section. Contractor shall be liable for any action or fine imposed by the regulatory agencies on those incidents of noncompliance which are within Contractor's area of responsibility.

The Contractor shall exercise every reasonable precaution to protect channels, storm drains and bodies of water from pollution. Pollution control work shall consist of implementing practices or constructing facilities in accordance with local, state, or federal regulations, which may be required to provide for retention and control of pollutants.

1.2.6 Nuisance Water

It is anticipated that nuisance water, such as rainfall, surface runoff and/or groundwater may be encountered within the construction site during the period of construction under this contract. The Contractor, by submitting his bid, will be held to have investigated the risks arising from such waters and to have made his bid in accordance therewith. The Contractor is responsible for the diversion and control of surface water and/or groundwater within the work area throughout the construction period.

The Contractor shall at all times protect the work from damage by such waters and shall take all due measures to prevent delays in progress of the work caused by such waters. The cost for any repairs due to such damage shall be the responsibility of the Contractor. The Contractor shall dispose of nuisance water at his own expense and without adverse effects upon the work site or any other property.

Sequencing of work and interim control devices shall be employed such that surface and/or groundwater flows shall be controlled so as not to adversely impact adjacent areas on or off the site.

1.2.7 Drainage Precaution

At the completion of each work day, the Contractor shall take all necessary preventive measures to avoid or minimize damage resulting in erosion or impounding caused by storm water runoff within the construction area. Erosion control measures shall consist of constructing sandbag berms, desilting basins, drains, temporary storm water pumping

facilities, and other such measures required to provide for the prevention, control and abatement of storm water discharges and damage resulting therefrom. The cost for any repairs due to such damage shall be the sole responsibility of the Contractor.

1.2.8 Construction Water

All water required for construction activities shall be provided by the Contractor. The Contractor shall make its own arrangements to purchase, store, transport, and apply construction water as necessary to complete the work as required by the Specifications.

Prior to construction or installation of any temporary facilities, the Engineer shall approve the source of water. Water shall meet applicable standards as applied by the local, state, or responsible regulatory agencies. The Contractor shall furnish a water analysis report, performed by an accredited laboratory, demonstrating that the waste source is in compliance with all applicable requirements. The routing of temporary lines and location of the water storage facilities shall also be submitted to the Engineer for approval.

1.2.9 Site Safety Plan

Within seven (7) days of the award of the Contract, the Contractor shall submit for the review of the Engineer, a copy of its Injury and Illness Prevention Program (IIPP) and a site specific Health and Safety Plan (HASP) that complies all Utah Occupational Safety and Health (UOSH) requirements. The IIPP and HASP shall be in sufficient detail to include all aspects of health and safety that may be anticipated by the scope of work. The IIPP and HASP shall be signed by a Certified Industrial Hygienist.

The Contractor shall at all times be responsible for the safe prosecution of the Work and protection of its employees and the public. Review of the Contractor's IIPP and HASP by the Engineer shall not relieve the Contractor of responsibility for any aspect of the work, or for compliance with all Federal, State, and local laws pertaining to health and safety. Strict adherence to the Contractor's HASP will be required for all Contractor and subcontractor personnel.

The contents of the HASP must meet all regulatory requirements for the specific work which is proposed.

1.2.10 Pre-Construction Conference

Prior to the start of the Work, a pre-construction conference will be arranged by the Owner and the Engineer. This conference will be attended by the Contractor and his major subcontractors. The purpose of this conference is to acquaint the Contractor with the Owner's administrative requirements and policies, to give emphasis to those contract requirements considered most essential, to introduce the Owner's Representative and Contractor personnel, to reach agreement on the timing and method of all procedures related to the efficient progress of the Work, and to discuss any other items that may require clarification. The procedures and distribution of all correspondence and documents related to the Contract will also be established. The pre-construction conference will be held at the Landfill at a mutually agreed upon date and time.

1.2.11 Project Meetings

Project meetings will be held on a regular basis, (typically weekly) at a time to be established by the Engineer to discuss the progress and execution of the Work. The Contractor and any subcontactors, suppliers, or vendors whose presence is necessary or requested will attend these meetings. All decisions, instructions and interpretations given by the Engineer at these meetings will be binding and final. The proceedings of these meetings will be recorded by the Engineer, and the Contractor will be furnished copies for their use.

1.2.12 Submittals

During the pre-construction conference, the Contractor shall provide for the Engineer's review a complete listing of all anticipated Contractor submittals and the proposed submittal dates for each. The Contractor shall indicate items as shop drawings, compliance certificates, material samples, or guarantees.

All submittals shall be provided to the Construction Manager in PDF format. Items such as bound O&M manuals, etc. shall also have three (3) hard copies provided, as well as a digital copy of the information.

Contractor submittals shall be accompanied by a transmittal letter which shall clearly indicate the item being submitted for review. The transmittal letter shall include a blank white space Three (3) inches by Four (4) inches for review notations. Each transmittal shall have identified the following information as applicable:

- Project title and location
- Contractor/Sub Contractor name
- Supplier name
- Manufacturer name
- Specification location

If additional data for the submitted item is anticipated to be provided at a later date, the Contractor shall so state on the transmittal.

Submittals shall be numbered consecutively and only one item shall be included per submittal. Subsequent submittals for the same item shall reference the original number and include an extension of that number, i.e., 2.0 becomes 2.1 or 2-A, etc.

Each submittal required by the Special Provisions shall be furnished at least 15 working days prior to the intended use, unless otherwise indicated.

Engineering data shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; the external connection, anchorages and supports required; performance characteristics; dimensions needed for installation and correlations with other materials and equipment; and all additional information as required in these Special Provisions.

Submittal data shall be sufficient to verify compliance with all requirements of these Specifications and references.

Certified test results (test certificates) required for demonstrating proof of compliance of materials with specification requirements will be signed by an official authorized to certify on behalf of the Contractor and will contain the name and address of the Contractor, the project name and location, the quantity, and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates will be signed by a laboratory official authorized to certify on behalf of the laboratory and will contain the name and address of the testing laboratory, the material tested, the testing standards followed, and the testing results. Certification will not be construed as relieving the Contractor from furnishing satisfactory material, if, after tests are performed on samples, the material is found not to meet the specific requirements.

Any changes proposed by the Contractor shall be stated in a cover letter and essential details of such changes shall be clearly shown in the data submitted.

Calculations to support the adequacy of the design in meeting specified performance ratings or requirements shall be submitted when required by the Special Provisions.

Data sheets, catalog cuts or drawings showing more than the particular item under consideration shall be marked to cross off all but the applicable information.

The Engineer's review of drawings and data submitted by the Contractor will cover only general conformity to the Drawings and Specifications. After the Engineer has completed the review, the submittal will be returned with one or more of the following notations:

- No Exception Taken
- Make Corrections Noted
- Rejected
- Revise and Resubmit
- Submit Specified Item

A "No Exception Taken" response to a submittal does not constitute a blanket approval of dimensions, quantities, and details of the material, equipment, device, or items shown, and does not relieve the Contractor from responsibility for errors or deviation from the Contract requirements. A "Make Corrections Noted" response does not relieve the Contractor from the responsibility of providing all information required by the Contract.

The project requirements include pre-shipment approval of several of the liner components. The Contractor is advised that material will not be approved for use in the work until the appropriate submittals have been provided and are approved by the Engineer.

Review of partial or incomplete submittals will be at the discretion of the Engineer.

The Engineer will advise the Contractor of any anticipated additional costs related to review of partial or incomplete submittals, or expedited review when due to late submission by the

Contractor. Upon Contractor's request and agreement with the Engineer, the additional or expedited review will proceed.

1.2.13 Equipment and Material Storage

The project limits, as designated by the Owner, areas identified on the project drawings, and other locations as approved by the Engineer may be utilized by Contractor for equipment and material storage. Any additional space shall be obtained by Contractor, at Contractor's own expense.

1.3 PROJECT SURVEY

1.3.1 Survey Responsibility

The Engineer will establish benchmarks and primary control points outside the Work limits. The Contractor shall employ a licensed Land Surveyor or a qualified Registered Civil Engineer licensed in the State of Utah to provide all lines and grades necessary to perform the Work and data for Record Drawings as indicated in these Contract Documents.

1.3.2 Survey Data Submittal

All Contractor survey information shall be submitted to the Engineer no later than five (5) working days from the date the survey was conducted. The data shall be provided on USB "thumb drive" or CD ROM with hard copy print out in accordance with Section 1.3.8.

A. Pre-construction Survey

Owner will generate an electronic pre-construction survey surface. The surface shall be generated using approved pre-construction aerial or ground survey data. All electronic surfaces shall be generated using raw survey data (i.e., mass points and break lines) and shall not rely on contours or digitization methods to generate surfaces. Surfaces shall be comprised of a Triangulated Irregular Network (TIN), also being the basis for a Digital Terrain Model (DTM). All such surfaces shall be created commensurate with National Mapping Accuracy Standards equal to that matching the scale and contour interval of the contract drawings.

B. Survey Control Plan

The contractor shall submit a survey control plan indicating proposed control points provided in the construction drawings. The plan shall be submitted to the Engineer at least ten (10) days in advance of beginning any construction and the Engineer shall respond with comments or approval within five (5) days of receipt. Primary control shall be based on and tied to at least three surveyor control stations provided by the Engineer. The establishment of all future primary control points will be tied to the same control stations or to the previously established primary control stations. No work shall commence until any/all discrepancies between the survey information contained in the construction documents and the field conditions at the start of work are resolved. Any changes to the survey control plan during the project shall be submitted to the Engineer for approval prior to implementation.

1.3.3 Primary and Secondary Survey Control

A system of primary survey control (basis for setting out) has been established in the construction documents by the Engineer for use by the Contractor. The Contractor shall verify the accuracy of the primary control provided and establish a survey control plan for secondary control points necessary for construction work layout. All secondary survey control shall be established proximate to the work site and used for developing subsequent control and/or laying out the work. Layout lines for use in constructing the work shall be taken directly from the secondary control. Secondary control shall be established by the Contractor's surveyor with due diligence in accordance with local survey industry standards.

1.3.4 Survey of Buried or Concealed Work

The Contractor's measurements of lines, grades and distances are subject to check surveys by the Engineer's surveyor. All underground and other subgrade work shall not be buried until the following are satisfied:

- Contractor has informed the Engineer in writing that the work is complete and ready for inspection and check survey.
- Contractor has provided Engineer with the survey data prepared by Contractor's surveyor for review.
- Engineer has performed any necessary check surveys.
- Contractor has received a written notice from the Engineer to proceed.

1.3.5 Protection of Monuments, Stakes And Marks

The Contractor shall preserve and protect all survey monuments and related marks at the site and shall maintain the primary control points per the Survey Control Plan (Section 1.3.2 B).

Any removal, disturbance or destruction of monuments shall be conducted in accordance with the contract documents and Survey Control Plan.

All stakes or otherwise deleterious material originating for construction activities shall be collected and disposed of properly, in particular for earthwork scheduled to receive or be placed/compacted on top of or come in contact with geomembrane materials.

1.3.6 Survey Timing/Frequency

The Contractor's surveyor shall complete the survey of each constructed element in a timely manner so as not to delay any of the work. For grade sensitive elements (e.g., ditch or road subgrade), the CQC survey must be presented to and accepted by the Engineer prior to proceeding with the next work element (e.g., paving).

For long linear elements such as roads and drainage ditches, the CQC survey shall be completed in segments as the work progresses (i.e., not when the entire length has been graded) to prevent grade errors from compounding and causing major rework. The survey shall be performed immediately after completing each 200-foot-long segment or as

determined practical by the Engineer prior to recording said data. The Engineer shall review the data and notify the Contractor immediately of any discrepancies noted.

In all cases, the Engineer shall be afforded the opportunity to conduct a QA check survey of all aforementioned Contractor CQC survey segments prior to the contractor proceeding with construction in these areas.

1.3.7 Survey Deliverables

A. Survey Recordkeeping

Survey records consisting of copies of original field notebooks, field/office calculations, survey notes, sketches, field drawings, CAD drawings and surveyor's red line as-built drawings and data from electronic data collectors shall be stored in a survey field notebook/binder or plan rack as appropriate. Any surveyor's red line "mark-up" drawings and survey field notebook(s) will become the property of the Engineer upon project completion.

B. As-Built Survey Data

The Contractor's survey data shall be collected throughout the project to show as-built conditions. This includes all underground as well as surface elements. In addition to a hard copy printout, this data shall be provided in an ASCII format and shall include: point number, northing and easting, elevations, and descriptions of point.

The ASCII format shall be as follows:

PPPP,NNNNNN.NNN,EEEEEEE.EEE,ELEV,Description

Where P is the point number, N is the Northing, E is the Easting, Elev is the elevation and Description is the description or type of point.

The Contractor shall, upon 24-hour advance notice, provide access to any equipment, files and personnel used for logging and processing survey data (including earthwork volume computations) to Engineer for verification purposes.

The Contractor's surveyor shall merge design drawings and as-built data into original survey as-built drawings. Data shall include:

- Geosynthetic Material Subgrade - Contractor shall utilize a 50-foot grid to survey point over point for verification for all landfill base (floor) and slope areas, as well as all tops and toes of slopes and for all angle points, bends, grade breaks or other surface variations necessary for accurate verification of the individual groundwater protection layer thicknesses.
- Low Permeability Material Layer – Drawing shall show completed limits of the Low Permeable Material layer. Contractor shall use the same subgrade Survey Grid for point over point verification that the 24 inch minimum thickness of the Low Permeable Material Layer has been achieved, (if Low-Permeable Material is used)..

The drawing shall include a thickness verification table with point on point from top of subgrade to the top of Low-Permeability layer elevation, and elevation differential.

- Geomembrane Drawing: - Drawing shall show the limits of the installed liner, anchor trenches, terminations, and joins.

- LCRS Drainage Layer Thickness Drawing - Drawing shall show the thickness of the LCRS drainage layer using the same subgrade Survey Grid for survey point over point to verify that the 9-inch minimum thickness of the LCRS Gravel Layer has been achieved. The drawing shall include a thickness verification table with point on point from top of low-permeability layer elevation to top of LCRS drainage layer elevation, and elevation differential.

  A separate drawing showing LCRS top of pipe locations and elevations at 25-feet on center, including all grade breaks, angle points, riser tops and toes and points of connection shall also be prepared.

  OR

- Coarse Sand Layer Thickness Drawing - Drawing shall show the thickness of the Coarse Sand drainage layer using the same subgrade Survey Grid for survey point over point to verify that the 18-inch minimum thickness of the Coarse Sand Layer has been achieved. The drawing shall include a thickness verification table with point on point from top of low-permeability layer elevation to top of Coarse Sand drainage layer elevation, and elevation differential.

  A separate drawing showing LCRS top of pipe locations and elevations at 25-feet on center, including all grade breaks, angle points, riser tops and toes and points of connection shall also be prepared.

- Protective Soil Cover Layer Drawing - Drawing showing the thickness of the Protective Soil Cover layer using the same subgrade Survey Grid for survey point over point to verify the 18-inch floor and 24-inch slope minimum thicknesses of the Protective Soil Cover layer. The drawing shall include a thickness verification table with point on point from top of LCRS drainage layer elevation to top of Protective Soil Cover layer elevation, and elevation differential.

- The Contractor may combine the thickness verification drawings onto one "Survey Verification Drawing" showing the specified point numbers in plan view, with elevations and differential thicknesses of material from one surface to the next (for ease of review and verification), in a table on the plans sheet. A draft layout of the proposed plan shall be submitted for review and approval by the Engineer. All "Survey Verification Drawing" or other as-built drawings shall be prepared, stamped and signed by a land surveyor licensed in the State of Utah or Licensed Civil Engineer registered in the State of California that may (pursuant to the State

of Utah Professional Engineer's Act) practice Land Surveying. A Surveyor Certification Statement shall be included on each Survey Verification Drawing as follows:

> "The Undersigned Utah Licensed Professional Engineer/Land Surveyor responsible for surveying for this project hereby certifies that the thicknesses of the soil layers, and alignment of features shown on these drawings represent the as-constructed condition of the Groundwater Protection System – Composite Liner Plans, and that the minimum thicknesses as required by the Groundwater Protection System– Composite Liner Details have been constructed."
>
> Only a Utah Registered Professional Engineer with licensure allowing the practice of Land Surveying may sign in lieu of a Utah Licensed Land Surveyor.

- Miscellaneous Civil Improvements - Drawing shall show the location, of all civil improvements. Survey data shall include the coordinate data and elevations at all grade breaks and angle points.
- Geomembrane Panel Layout Drawings - The contractor shall provide record drawings of the geomembrane panel layout drawings with locations of all destructive seam test locations. Panels and destruct tests shall be numbered consistent with the requirements of other Sections of these specifications.
- Curve data including center line stationing, elevation offsets to edge, cross slope (percent) as well as longitudinal slope (percent) for all drainage structures, roadways (paved and temporary).
- Elevations and coordinates at beginning, end, changes in alignment and grade breaks should be located during original survey work.
- Coordinates and elevation of all corners for drainage facilities including drop structures to properly locate the as-built position on record drawings.
- Coordinates and elevations for flow line of interceptor drains, drainage ditches, at a center to center spacing not to exceed 25 feet or otherwise approved by Engineer. The edge of the channel where it adjoins any other structure (e.g., perimeter access road) shall be surveyed at the same spacing.
- Elevations and coordinates for transition structures at a spacing not to exceed ten (10) feet or two (2) shots, whichever provides a more accurate location.
- Coordinates and elevations necessary to locate all new and/or relocated infrastructure including but not limited to gas lines, condensate lines, power poles, and guy wire supports. Vertical clearance and location in plan shall be provided for all above ground utility lines installed as well as existing lines where vertical clearance has been changed due to cut and/or fill placement.

- All newly installed, exposed or modified existing below ground utilities shall be located in plan by elevation and coordinates prior to covering (i.e. groundwater collector and LCRS piping, etc).

Upon completion of work, one complete set of as-built contract (red line) drawings shall be delivered to the Engineer within 15 working days of project completion as a condition of final acceptance of the work.

C. Surveys for Minimum Thickness Tolerances

1. Survey verification for each layer of the composite liner system shall be performed as defined in 1.3.7 B. Finish grades for each of the composite liner elements shall be completed to the following tolerances:

   a. Finish grading for the subgrade of the low permeable layer shall be performed to a tolerance of minus 0.20 feet to plus 0.00 feet.

   b. Thickness verification of the Low Permeability Layer shall be performed to a tolerance of minus 0.00 feet to plus 0.20 as measured from the top of the subgrade (or from the prepared subgrade on slopes) to the top of the Low Permeability Layer. At no point, shall the thickness of the Low Permeability Soil Layer be less than the Specified two (2) feet (if used).

   c. Finish grading of the LCRS Gravel Layer shall be performed to a tolerance of minus 0.00 feet to plus 0.20 feet from top of the Low Permeable Layer.

   OR

   a. Finish grading of the coarse sand Layer shall be performed to a tolerance of minus 0.00 feet to plus 0.20 feet from top of the Low Permeable Layer.

   b. Finish grading of the Protective Soil Cover Layer shall be performed to a tolerance of minus 0.00 feet to plus 0.20 feet above the finished LCRS gravel layer.

1.3.8 Earthwork Quantities

A. As-Built Data

For purposes of payment on earthwork quantities, the Contractor shall conduct a comprehensive as-built survey which complies with all aforementioned requirements. The Contractor may determine as-built topography using aerial photogrammetry methods, ground survey methods, or a combination thereof. The method used shall be submitted in writing to and pre-approved by the Engineer.

The National Map Accuracy Standards shall be adhered to at a minimum. Scale and contour intervals shall be at least equal to that of the design drawings. At a minimum the following intervals shall apply: For earthwork areas less than 10 acres, the maximum contour

mapping interval will be one (1) foot; otherwise larger areas shall use 2 foot contour interval mapping.

The Contractor shall produce a complete electronic as-built surface in conformance with the requirements set forth in these specifications. The generated electronic surface file shall be provided to the Engineer for verification.

The Contractor shall produce an electronic boundary file which accurately conforms to the project site boundary depicted on the plans or as modified during construction by approved change order. The electronic boundary file shall be provided to the Engineer for verification prior to use in any earthwork computations or map generation.

B. Earthwork Volume Computations

At the conclusion of all excavation and/or grading activities that require volume verification and computation, the Contractor will perform a post construction topographic survey(s). Earthwork volumes will be computed by comparing difference between the pre-construction and post construction surfaces described above. Any independent volume verification by the Engineer shall utilize the same basic procedures as those used by the Contractor. However, in the event of a discrepancy, final pay quantities will be based on computations performed by the Engineer, unless the Contractor can demonstrate, specifically, inconsistencies in the Engineers survey data.

Any interim or soon to be buried (or otherwise obstructed) earthwork shall be surveyed and quantified as the project progresses to enable timely verification by the Engineer.

2.0 PRODUCTS (Not Used)

3.0 EXECUTION (Not Used)

4.0 MEASUREMENT AND PAYMENT

4.1 Mobilization

Payment for Item No. 1 will be made at a percentage of the bid price according to the following schedule.

Percent (%) of Contract Work Completed (Excluding Mobilization)	Amount of Mobilization Considered Complete
5%	50%
10%	75%
15%	85%
20%	90%

Payment of the total contract price for mobilization shall constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to completion of this item of work. The deletion of work or the addition of extra work as provided for herein shall not affect the price for mobilization.

4.2 Construction Support Tasks

To facilitate progress payments, the Contractor shall submit for the approval of the Engineer, a Schedule of Values which reflects a breakdown and distribution of costs between the various components of the Construction Support Tasks.

Payment of the Total Lump Sum Price for Construction Support Tasks shall constitute full compensation for all labor, material, equipment and all other items and arrangement necessary and incidental to comply with the requirements of this section and no additional payment shall be allowed.

4.3 Project Survey

To facilitate progress payments, the Contractor shall submit for the approval of the Engineer, a Schedule of Values which reflects a breakdown and distribution of costs between the various components of Project Survey.

Payment of the Total Lump Sum Price for Project Survey shall constitute full compensation for all labor, material, equipment and all other items and arrangement necessary and incidental to comply with the requirements of this section and no additional payment shall be allowed.

END OF SECTION A

SECTION B
EARTHWORK

1.0 GENERAL

This section sets forth the requirements for excavation, material processing, fill placement, and compaction, and subgrade preparation for the composite liner system.

A Construction Quality Control/Construction Quality Assurance (CQC/CQA) Plan (Appendix A at the end of this section) has been developed in conjunction with this Project and is included with these Specifications for the Contractor's reference. The Contractor shall assure that the Engineer shall, at all times, have safe access to the work for the purpose of monitoring, observation, and CQC/CQA Plan implementation.

An independent engineering firm, under Contract to the Owner, will conduct Quality Assurance (CQA) monitoring, observation, and documentation. The Contractor shall coordinate and cooperate with the Engineer during all manufacturer's quality control sampling, testing, and certification required by these Specifications.

1.1 Work Included

In general, the work includes:

- Excavation and embankment fill required to bring the proposed composite liner subgrade and adjacent areas to the line and grades indicated on the Drawings.
- Alluvial removal as determined by the CQA Geotechnical Engineer.
- Preparation of slope and cell floor surfaces to provide an approved subgrade for installation of the geomembrane liner.
- Processing, placement, compaction, and finish grading of onsite, native material for the Protective Soil Cover layer.
- Excavation and embankment fill required for miscellaneous site improvements including access roads and water storage facilities.
- Compliance with erosion control methods outlined in the Contractor submitted SWPPP as required in the General Conditions.

Option:

- Processing, curing, placement, compaction, and finish grading of onsite, native material in accordance with the Drawings and Specifications to achieve an approved low permeable layer that will achieve a hydraulic conductivity not greater than 1×10^{-7}.

1.2 Groundwater and Stormwater Management

In accordance with Section A 1.2.5 of these Specifications, the Contractor shall develop a Storm Water Pollution Prevention Plan (SWPPP) and Storm Water Monitoring Program

(SWMP) for the project in accordance with DEQ DWQ requirements.

Construction related activities, including but not limited to the elements of the SWPPP, shall be performed to eliminate both storm water and non-storm discharges to storm water control systems, by Contractor and subcontractor(s). The Engineer will notify Contractor of any non-compliance with the foregoing stipulations and appropriate actions shall be taken promptly. Contractor shall also notify the Engineer of any condition which could lead to noncompliance with the permit requirements.

Contractor shall not be entitled to any time extensions or compensation for any cost due to any action required as a result of Contractor's failure to comply with those provisions of the SWPPP within Contractor's control. Contractor will be responsible for ensuring that Contractor's subcontractor(s) comply with the provisions of this Section. Contractor shall be liable for any action or fine imposed by the regulatory agencies on those incidents of noncompliance, which are within Contractor's area of responsibility.

The Contractor shall exercise every reasonable precaution to protect channels, storm drains and bodies of water from pollution, including siltation arising from Contractor's operations, or erosion siltation from completed areas. Pollution control work shall consist of implementing practices or constructing facilities in accordance with local, state, or federal regulations, which may be required to provide for retention and control of pollutants.

1.3 Fugitive Dust Control Plan:

In accordance with Section A 1.2.3 of these Specifications, the Contractor prepare and implement a Fugitive Dust Control Plan (FDCP) as required by Rule 307-309 DEQ, DAQ. All operations shall be conducted in accordance with Rule 307-309 and all other the applicable DAQ regulations and/or requirements.

1.4 References:

- Geotechnical Data Summary and Preliminary Geologic Map, Promontory Point Landfill, Box Elder County, Utah dated October 6, 2015, as prepared by Tetra Tech.

1.5 Submittals Required

The Contractor shall thoroughly review the Specifications and identify all required project submittals. The submittals listed below are intended as a general summary of the submittal items contained in this section. This submittal list does not release the Contractor from the responsibility of identifying and providing all information requested.

- SWPPP and SWMP
- Fugitive Dust Control Plan
- Screening/Processing Plans for PSC

2.0 MATERIAL

2.1 Embankment Fill Material

Native material generated from the excavation or from stockpiles indicated on the Drawings shall be used in the construction of embankment fills (non-low permeable layer material or protective cover soil fills). Rocks or rock fragments greater than three (3) inches in any dimension shall be removed from the fill and disposed of as directed by the Engineer. Rocks or rock fragments less than three (3 inches shall be distributed evenly throughout the fill. "Nesting" of rock or rock fragments will not be permitted.

These provisions, allowing incorporation of rock or rock fragments within fill areas shall not relieve the Contractor of the responsibility to prepare the final subgrade surface for geosynthetic installation in accordance with other provisions of these Specifications, nor do they supersede the gradation requirements outlined in Section G for the protective cover soils material.

Embankment fill shall be compacted to 90% relative compaction, as determined by ASTM D 1557, at optimum to 2% above optimum moisture content

2.2 Low Permeable Material

A. Low permeable material shall be natural clayey material free from roots, organic matter, frozen material, debris, solid waste, rocks, or slag larger than 1-inch, and other deleterious materials. Selective excavation and processing will be required to produce a material that will achieve the specified hydraulic conductivity of not greater than 1×10^{-7} when compacted to 90 percent of the maximum dry density at a moisture content of 1 to 4 percent above optimum as determined by ASTM D 1557

B. The Low-Permeability Material shall have a soil classification of clayey sand (SC), lean clay, sandy clay, or silty clay (CL), or fat clay or sandy clay (CH), using the Unified Soil Classification System, be continuously visually classified per ASTM D2488, and shall meet the following requirements:

1. Particle Size: Material having 100 percent by weight passing 1-inch sieve, 90 percent by weight passing U.S. No. 4 sieve and at least 60 percent by weight passing U.S. No. 200 sieve measured by ASTM D422. The maximum in-place dry clod size shall be 1 inch.

2. Atterberg limit:

   a. Liquid Limit: 20 minimum to 60 maximum and

   b. Plasticity Index: 10 to 40.

3. Hydraulic Conductivity: shall be less than or equal to $1X10^{-7}$cm/s measured by ASTM D5084.

4. Soil classification of clayey sand (SC), lean clay, sandy clay, or silty clay (CL), or fat clay or sandy clay (CH), using the Unified Soil Classification System by ASTM D2487.

If low-permeable soil material is to be produced onsite, the Contractor shall mobilize equipment, as required, to segregate, process, and moisture condition the selected material to produce a well graded, homogenous, low permeable material such that the largest material is no greater than 1-inch in any dimension. Screening and processing equipment shall be of sufficient size and capability to produce the specified product at a rate consistent with the Contractor's submitted schedule. The Contractor shall comply with all local, state, and federal laws associated with operation of the screening and processing plant and shall be responsible for all permits required in conjunction with the operation.

The low permeable material shall be produced in a quantity sufficient to meet the requirements of the project (i.e. 24-inch thick low permeable layer).

Prior to proceeding with the processing operation, the excavation area shall be cleared and grubbed, and a pre-construction topographic survey shall be performed before any additional work is completed in the area. At the completion of all work, a final topographic survey of the excavation area shall be performed to verify borrow quantities.

Throughout the course of excavation and processing operations, the Contractor shall maintain positive drainage through the work areas. BMP storm water and erosion control devises and improvements shall be maintained and upgrade routinely during the course of the project. The Contractor shall include all aspects of the excavation and processing area interim drainage control in the SWPPP to be submitted to the Engineer.

The location of the low permeable material stockpile and curing areas shall be approved by the Engineer.

2.2.1 Demonstration Fill

The first order of operations shall be to produce a sufficient amount of low permeable material to facilitate construction of a demonstration fill. The purpose of the demonstration fill is to evaluate the performance of the construction equipment to be used for screening, processing, placement, compaction and the Contractor's proposed methods of maintenance to prevent desiccation of the low-permeability material, to verify that the low permeability material will meet the project performance requirements for hydraulic conductivity, identify optimum moisture content and relative compaction necessary for the material to meet the project performance specification and to obtain approval from the DEQ for the low-permeability material and material placement properties.

The demonstration fill may be constructed within the proposed liner area and shall measure approximately 100-feet by 30-feet by 24-inches deep and shall include a section representing construction of the low permeability material in slope conditions. All aspects of the subgrade preparation and fill construction shall be in accordance with these specifications. The demonstration fill will be observed and tested by the CQA monitor and

the Contractor shall allow two weeks from the date of completion of the demonstration fill for receipt of test results. During that period, the Contractor may proceed with other items of work such as excavation/fill, subgrade preparation, storm drain and groundwater collection system etc. Scheduling of such items will be at the discretion of the Contractor, and no additional Contract time will be allotted as a result of the two-week review period.

If test results reflect that the demonstration fill meets the project requirements, the test area may be incorporated into the final liner section provided that the Contractor maintains the integrity of the low permeability layer in accordance with the Specifications. If the demonstration fill does not meet the project requirements, all material shall be removed from the liner area and a new demonstration fill shall be constructed.

Prior to construction of the demonstration fill, the Contractor shall submit for the review of the Engineer, the proposed location of the demonstration fill area, the equipment to be used, the methods to be employed

The location of the low permeable material stockpile and curing areas shall be approved by the Engineer.

2.2.1 Low Permeable Material Properties (CQA Testing)

Low-Permeability soils will be evaluated by the Geotechnical CQA Consultant according to the following minimum testing schedule to characterize material properties during construction:

TABLE 2.2.1

Test Description	Test Designation	Minimum Test Frequency	Requirement
Processed Moisture Content (following moisture conditioning)	ASTM D 4643 (microwave) ASTM D 2216 (oven)	1 per 5,000 CY or 2 per day	Between 1% to 3% of optimum moisture content
Moisture Density Relationship	ASTM D 1557	1 per 5,000 CY or 1 per material type	Optimum
In-Place Moisture-Density (Nuclear and/or Drive Ring)	ASTM D 6938, ASTM D 2937	1 per 250 CY placed Or 4 per construction day	90% Compaction at least 2% above optimum moisture content
In-place Density and Moisture Content (Sand-Cone)	ASTM D 1556	1 per 2,500 CY placed or 10% of nuclear gauge tests	90% Compaction at least 2% above optimum moisture content
Particle Size Analysis	ASTM D422	1 per 1,500 CY (conducted on samples retrieved for laboratory permeability testing)	30% passing a no. 200 sieve
Atterberg Limits	ASTM D 4318	1 per 1,500 CY (conducted on samples retrieved for laboratory permeability testing)	
Laboratory Permeability*	ASTM D5084	1 per acre, per 8-inch lift placed**	$\leq 1 \times 10^{-7}$ cm/s
BAT Permeability		1 per acre, per 8-inch lift placed**	$\leq 1 \times 10^{-7}$ cm/s
Classification of Soils	ASTM D2487	1 per 1,500 CY Or 1 per day (minimum)	SC, CL, CH
Visual Inspection	ASTM D2488	Daily	Free of organics

*ASTM D 5084 shall be conducted on remolded samples compacted to the specified in-place compaction under a minimum confining pressure of 30 psi.

**Results of the test pad may require an increase in this frequency at the discretion of the Regional Water Quality Control Board/CQA monitor.

2.2.2 Demonstration Fill

Demonstration fill soils will be evaluated by the Geotechnical CQA Consultant according to the following minimum testing schedule to characterize material properties:

TABLE 2.2.2

Test Description	Test Designation	Minimum Test Frequency	Result
Atterberg Limits and Grain Size Analyses	ASTM D 4318 ASTM D 422	5 at variable depths through the fill	
Laboratory Permeability	ASTM D 5084	5 at variable depths through the fill.	$\leq 1 \times 10^{-7}$ cm/s
Permeability Test	BAT in-situ	5 at variable depths through the fill	$\leq 1 \times 10^{-7}$ cm/s
Moisture Density Relationship	ASTM D 1556		
CQA Observation		Continuous	

2.3 Protective Soil Cover

Material for the protective soil cover (PSC) shall be processed material obtained from the project excavation.

PSC will be evaluated by the Geotechnical CQA Consultant according to the following minimum testing schedule to characterize material properties:

TABLE 2.2.3

Test Description	Test Designation	Minimum Test Frequency	Result
Particle Size Analysis	ASTM D422	1 per 1,500 CY (conducted on samples retrieved for laboratory permeability testing)	Max particle size of 1-inch
Optimum Moisture Density Relationship	ASTM D 1557	2 or 1 per materials type, whichever is greater	
In-Place Moisture Density (Nuclear Gauge or Drive Ring)	ASTM D 6938 ASTM D 2937	1 per 1000 CY Minimum 10 tests total.	85% to 87% Compaction in lower 12- inches, on slopes, and 9-inches on base. 90% in the upper 12-inches on slope and 9-inches on base
CQA Observation		Continuous	Free of organics

3.0 CONSTRUCTION METHODS

3.1 Clearing and Grubbing

Prior to earthwork operations, all work areas shall be cleared and grubbed in accordance with Utah Manual of Standard Specifications Section 31 11 00. Vegetation within the limits of work shall be stripped to a sufficient depth to remove all vegetation including roots. All material generated from clearing and grubbing operations shall be transported to, and disposed of in the active landfill area as directed by the Engineer. Disposal fees for disposal of these materials shall be waived.

All existing improvements and material designated to be removed and salvaged shall be transported to the storage area indicated on the Drawings, or as directed by the Engineer. Items to be salvaged shall be removed in such a manner so as to minimize damage to the material. All salvaged and stored material shall be placed above the ground, on pallets or lumber.

Clearing and grubbing operations shall be considered as incidental to the earthworks operations, and no additional compensation will be made.

3.1.1 General Earthworks Requirements

All earthwork shall conform to the following requirements, where applicable, unless otherwise noted in these Specifications:

A. The Contractor shall be solely responsible for the satisfactory completion of all earthwork in accordance with the Drawings and Specifications.

B. Equipment used in the excavation, transport, stockpiling, processing, placement and compaction of all materials used in earthwork construction of the composite liner system will be standard-of-practice grading machinery of known specifications suitable for performing the required work in a timely and efficient manner.

C. All material considered by the Engineer to be unsuitable for use in the construction of the composite liner system components shall be removed. All materials incorporated as part of compacted fill must be inspected and placement must be observed by the Engineer.

D. All clearing, grubbing, stripping, and site preparation for the Project shall be accomplished to the satisfaction of the Engineer prior to placement of fill material. No additional compensation shall be made for clearing and grubbing activities.

E. The ground surface prepared to receive fill shall be moisture conditioned and graded until it is uniform and free from uneven features which may prevent uniform compaction. The ground surface to receive fill shall be brought to approximate optimum moisture content, mixed as required, and compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D 1557. The prepared

surface shall be firm and unyielding. Prior to fill placement, the ground surface to receive fill shall be inspected by the Engineer.

F. Fill material shall be placed in thin, horizontal lifts with a maximum uncompacted thickness not to exceed 8 inches. Each layer shall be spread evenly and thoroughly mixed to obtain a near uniform condition in each layer. In areas of excess lift thickness, regrading of the surface to the maximum lift thickness will be completed prior to proceeding with compaction in that area.

G. Minimum compaction and moisture requirements for fills shall be as follows:

- Embankment fills shall be 90 percent of the maximum dry density as determined by ASTM D 1557 and shall be placed at optimum, to ±2 percent of optimum moisture content for the specified material.
- Low permeable fill materials shall be compacted to 90 percent of the maximum dry density as determined by ASTM D 1557, and shall be maintained at a moisture content of 2% above optimum moisture content.
- Protective Soil Cover Materials shall be compacted to per Section G percent of the maximum dry density as determined by ASTM D 1557, and shall be placed at a moisture content of ±2 percent of optimum moisture content in the uppermost 12 inches of the layer.

H. Where tests by the Engineer indicate that the moisture content or density of any layer of fill, or portion thereof, is below the Project requirements, the particular layer or portion thereof will be retested by the Engineer. If failing tests are again noted, the area shall be reworked until the required moisture/density has been attained. No additional fill shall be placed over an area until the prior fill has been tested horizontally and vertically and meets the requirements of these Specifications to the satisfaction of the Engineer.

I. Where work is interrupted by heavy rains, fill operations shall not be resumed until observations and field tests by the Engineer indicate the moisture content and density of the in-place fills and/or materials intended for placement are within the limits previously specified. This requirement does not preclude the Contractor from disking or aerating excessively wet areas to enhance drying.

J. As determined by the Engineer, fill over cut slopes shall be properly keyed through top soils, colluvium, or creep material into firm material. All transitions shall be stripped of all loose soils prior to placing fill.

K. Throughout construction, all excavation and/or fill areas shall be graded to provide positive drainage to appropriate collection/transport structures and to prevent ponding of water. Surface water shall be controlled to avoid damage to adjoining properties, refuse slopes, or to finished work on the site.

L. The Contractor shall assume all responsibility for damage to the installed containment system components arising from sequencing and location of haul routes.

3.2 Excavation

The Contractor shall complete excavations as indicated on the Drawings and as specified herein. Unauthorized excavation below the design subgrade will not be permitted.

All excavated material, not used as embankment fill, or processed for PSC, shall be transported to an onsite stockpile approved by the Owner.

3.3 Embankment Fill

Material generated in the excavation may be incorporated into embankment fills, (non-low permeable material or protective cover soil fills) provided that it complies with the requirements of Subsection 2.0, Materials. The Contractor is advised that screening of native materials will be required to meet the maximum particle size requirements.

3.4 Excavation Tolerances

The proposed subgrade for the low permeable layer of the floor area (top of native material) shall be brought to a uniform line and grade approximating the gradient and grades indicated on the Drawings. The proposed subgrade shall be finished to a tolerance of plus 0.00 feet to minus 0.20 feet from that uniform gradient.

The slopes shall be a uniform plane in conformance with the lines and grades indicated on the Drawings. Variances from a uniform plane shall not exceed ± 0.20 feet vertical, measured in any direction for a horizontal distance of 20 feet.

3.5 Low Permeable Material

3.5.1 Processing

The Contractor shall establish a separate area for processing, mixing, and curing the low-permeability material prior to transporting the material to the cell floor, or slopes. The material shall be processed to obtain a uniform soil condition, and moisture conditioned (or dried) to a moisture content of 1 to 3 percent above optimum moisture content as determined by ASTM D 1557. Rock and rock fragments greater than 1-inch in the greatest dimension shall be removed during the processing operation.

Suitable and sufficient processing equipment shall be onsite to adequately disc, mix, blend, moisture condition, and/or dry the quantity of material being transported and placed in the Contractor's area of processing. Processed material shall be allowed to "cure" for a minimum of 24 hours prior to placement in its final location or prior to commencement of any compaction operations, unless otherwise authorized by the Engineer. If necessary, and at the direction of the Engineer, the Contractor shall temporarily suspend import to the area of processing in order to allow time for proper preparation of the low-permeability material. Sufficient watering apparatus shall be provided with due consideration to the type of fill material, rate of placement, and time of year.

Representative samples of materials to be used for the low-permeability layer of the liner will be tested by the Engineer in order to determine the physical characteristics of the material. During processing and/or grading operations, no soils or soil types other than those within the locations identified on the Drawings may be used, unless the Engineer documents the suitability of these soils with appropriate additional testing paid for by the Contractor.

3.5.2 Placement

Processed low-permeability soils shall be transported, placed, and compacted in lifts, not to exceed 8 inches in loose thickness, to a minimum density of 90 percent of the maximum dry density and a moisture content of between 1 to 3 percent above optimum moisture content as determined by ASTM D 1557. Processed low-permeability soils placed by the Contractor shall be required to achieve an in-place permeability not greater than 1.0×10^{-7} CM/sec as determined using the BAT apparatus (field) and/or laboratory methods.

At the beginning of each grading day, the active fill pad will be inspected by the Engineer. Soils which have dried to a point less than the required moisture levels shall be thoroughly watered and reprocessed in preparation for receiving additional fill.

Where the moisture content of select low-permeability layer materials is below 1 percent above optimum moisture content as determined by ASTM D1557, additional moisture shall be added until the moisture content is within the limits required so as to assure an adequate bonding and compaction of all fill materials.

In the event of rain or for any other reason, if the moisture content of previously placed fill material or processed soils intended for placement is greater than 3-percent above optimum moisture content as determined by ASTM D1557, the low-permeability soil material shall be aerated by blading, disking, or other satisfactory method until the moisture content is between 1 to 3 percent above optimum moisture content as determined by ASTM D1557. Any previously compacted materials which are disturbed (aerated, bladed, etc.) to reduce or increase the moisture content must be recompacted in accordance with these Specifications and to the satisfaction of the Engineer once specified moisture contents are attained.

All recompacted or replaced soils shall be placed in accordance with these Specifications and to the satisfaction of the Engineer.

3.5.3 Tolerances

The low-permeability layer shall be final graded to a tolerance of plus 0.20 foot to minus 0.00 foot of the specified thickness.

All slopes shall be trimmed back to the thickness and gradient indicated on the Drawings, and shall be compacted to the minimum specified density throughout the entire depth.

3.5.4 Maintenance

The Contractor shall be responsible to maintain the moisture content, density, and grade of the low-permeability soil layer until the geomembrane has been installed.

The Contractor shall minimize the time between completion of the low-permeability layer and placement of the geomembrane in order to minimize adverse affects of rain or prolonged exposure (desiccation). Moisture conditioning and/or placement of visqueen shall be employed to protect the subgrade and/or prevent drying of the surface and desiccation cracking.

Should desiccation cracking occur in the surface of the low-permeability layer, the Contractor shall repair the cracks as outlined below:

1. Excavate the desiccated low-permeability material to a depth of 6 inches, or 3 inches below the bottom of visually identifiable desiccation cracks, whichever is greater, using methods approved by the Engineer.
2. Scarify and moisture condition the exposed low-permeability surface.
3. The Engineer shall inspect and approve the surface prior to low-permeability material placement.
4. Place and compact low-permeability material in accordance with the requirements of Subsection 3.4.2 above.

3.5.5 Excess Low Permeable Material

Excess material trimmed from the slopes shall be reprocessed to the specified moisture content, and placed on subsequent slopes, the floor area, or stockpile at a location to be determined by the Owner. The Contractor shall exercise care to ensure that low-permeable materials are not contaminated with native on-site materials and/or unprocessed fills.

3.6 Subgrade Preparation for Geosynthetic Materials

3.6.1 Preparation of Subgrade

Prior to placement of the geosynthetic material, the Contractor shall prepare the low-permeability soil subgrade to provide a uniform surface, free of defects, or imperfections that may result in damage to the liner material.

3.6.2 Finished Surface

The finished surface shall be free from abrupt breaks, sharp objects, or other foreign material that may inhibit placement of the geomembrane. All construction stakes, hubs, or other items used for grade control shall be removed and the void filled with processed material. The subgrade shall be unyielding, smooth, and uniform. The surface shall not be pebbly, or tracked and rutted by equipment. Pockets, holes, or discontinuities shall be repaired. No loose, coarse-grained material shall remain on the surface of the subgrade.

3.6.3 Proof Rolling

Immediately prior to geomembrane placement, the Contractor shall proof roll all surfaces, (i.e. floor area and slopes) with a steel drum roller weighing not less that 200 pounds per linear inch of drum width. All noted deficiencies shall be repaired at the Contractor's expense.

3.6.4 Maintenance

The Contractor shall maintain the surface suitability and integrity of the low-permeability soil layer as indicated in Subsection 3.5.4 above.

3.7 Subgrade Approval

Placement of the geomembrane shall not proceed until the surface has been approved by the Engineer. In addition, the Liner Contractor shall certify in writing prior to proceeding with placement that the subgrade is acceptable for geomembrane installation.

3.8 Anchor Trench Excavation, Backfill and Compaction

Anchor trench excavation, backfill, and compaction shall be completed to the line and grades shown on the Drawings and as noted below.

A. Excavation - Anchor trenches shall be prepared with slightly rounded corners where the geomembrane adjoins the trench so as to avoid sharp bends in the geomembrane material.

B. Placement of Fill Material - The material shall be placed in maximum 4-inch loose lifts if compacted with hand-operated compaction equipment, or maximum 8-inch loose lifts if compacted with a self-propelled compactor. The backfill shall be placed at a moisture content of ±2 percent of optimum moisture content.

C. Compaction - The backfill shall be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557.

D. Equipment - Compaction equipment shall be adequate to achieve the required compaction. Damage to any structures and or improvements resulting from placement or compaction shall be repaired or replaced by the Contractor at no additional cost to the Owner.

3.9 Miscellaneous Liner Anchor Trenches/Terminations

Construction of the miscellaneous anchor trenches/terminations adjacent to the perimeter road, slopes, or at other locations shall include all excavation, HDPE geomembrane, drainage geocomposite, geotextiles, plywood, backfill and compaction shall be as reflected on the drawings. All materials and work shall conform to the applicable portions of these Specifications.

3.10 Screen and Process Protective Soil Cover Material

The Contractor shall mobilize equipment, as required, to segregate, process, and moisture condition onsite excavated material to produce a well graded, homogenous material. Rock and rock fragments greater than one (1) inch in the greatest dimension shall be removed from the material during the processing operation.

Screening and processing equipment shall be of sufficient size and capability to produce the specified product at a rate consistent with the Contractor's submitted schedule. The

Contractor shall comply with all local, state, and federal laws associated with operation of the screening and processing plant and shall be responsible for all permits required in conjunction with the operation.

Throughout the course of excavation and processing operations, the Contractor shall maintain positive drainage through the work areas. BMP storm water and erosion control devises and improvements shall be maintained and upgrade routinely during the course of the project. The Contractor shall include all aspects of the excavation and processing area interim drainage control in the SWPPP to be submitted to the Engineer.

The location of the PSC stockpile shall be approved by the Engineer.

4.0 MEASUREMENT AND PAYMENT

4.1 Clear and Grub

Full compensation for all labor, material, and equipment required for clearing, grubbing, and demolition, as represented by the Contract Documents, shall be included in the Contractor's lump sum price for Clear, Grub, Demolition, and Removals.

All clearing and grubbing, removal of vegetation, existing storm water pond and riser pipe, perimeter storm water controls including sandbags, and/or other operations incidental to and required to complete clearing, grubbing, removal, and or demolition as represented by the Drawings and Specifications shall be considered as included in the Contractor's price.

To facilitate progress payments, the Contractor may submit for the approval of the Engineer, a Schedule of Values which reflects a breakdown and distribution of costs between the various components of Clearing, Grubbing, and Demolition.

The final pay quantities will be determined field verification that the work has been completed in accordance with the drawings and these Specifications. Interim progress payments will be based on the CM evaluation of the estimated percentage of work completed during the subject period.

Clearing and grubbing completed beyond the limits indicated on the drawings will not be compensated unless previously authorized by the Engineer.

4.2 Phase 1 Excavation

The Contract Unit Price for Phase 1 Excavation shall include full compensation for all labor, material, and equipment required to complete the excavation as represented in these Specifications and as indicated on the Drawings. All excavation and transport to the processing or stockpile area(s), and/or other operations incidental to completing the work as represented by the Drawings and Specifications shall be considered as included in the Contractor's unit price.

Final pay quantities will be determined by computing the volumetric difference between the pre-construction topographic survey and the design grades of the Phase 1 excavation area. All calculations will be made, by the Engineer, on a volumetric basis. No other adjustments will be made. Excavation outside of the limits indicated on the drawings will not be

compensated unless previously authorized by the Engineer. Excavation for anchor trenches, sub drains and LCRS lines, liner terminations, etc, will not be measured separately for payment, and are considered as included in the Contractor's unit price for those items.

4.2 Subgrade Surface Preparation – Phase 1 – Floor Areas

The contract unit price for Subgrade Surface Preparation for the Phase 1 Floor Areas shall include full compensation for furnishing all labor, tools, equipment, and incidentals and for doing all the work involved in Subgrade Surface Preparation, complete in place, including transport, placement, and compaction of material, finish grading, and proof rolling, as specified in the Standard Specifications and these Technical Specifications, and as directed by the Engineer.

Final pay quantities will be determined by the actual square footage of Subgrade Surface Preparation completed. Subgrade Surface Preparation completed outside of the tolerances indicated in the Technical Specifications, or limits indicated on the Plans will not be compensated unless previously approved by the Engineer.

4.3 Subgrade Surface Preparation – Phase 1 – Slope Areas

The contract unit price for Subgrade Surface Preparation for the Phase 1 Slope Areas shall include full compensation for furnishing all labor, tools, equipment, and incidentals and for doing all the work involved in Subgrade Surface Preparation, complete in place, including transport, placement, and compaction of material, finish grading, and proof rolling, as specified in the Standard Specifications and these Technical Specifications, and as directed by the Engineer.

Final pay quantities will be determined by the actual square footage of Subgrade Surface Preparation completed. Subgrade Surface Preparation completed outside of the tolerances indicated in the Technical Specifications, or limits indicated on the Plans will not be compensated unless previously approved by the Engineer.

4.4 Low Permeable Material – Phase 1 Base (Floor) Per Detail (Optional)

The Contract Unit Price to Process and place Low Permeable Material for the Phase 1 floor shall include full compensation for all labor, material, and equipment required to complete the work as represented in these Specifications and as indicated on the Drawings. All screening, processing, moisture conditioning, curing, transport, placement compaction, proof rolling, maintenance, and inspections at the various fill areas and/or other operations incidental to completing the work as represented by the Drawings and Specifications shall be considered as included in the Contractor’s unit price.

Final pay quantities shall be determined by computing the actual surface area of Low Permeable material placed to the limits indicated on the drawings. Low Permeable material placed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.5 Low Permeable Material – Phase 1 Slope Areas Per Detail (Option)

The Contract Unit Price to Process and place Low Permeable Material for the Phase 1 slope areas shall include full compensation for all labor, material, and equipment required to complete the work as represented in these Specifications and as indicated on the Drawings. All screening, processing, moisture conditioning, curing, transport, placement compaction, proof rolling, maintenance, and inspections at the various fill areas and/or other operations incidental to completing the work as represented by the Drawings and Specifications shall be considered as included in the Contractor's unit price.

Final pay quantities shall be determined by computing the actual surface area of Low Permeable material placed to the limits indicated on the drawings. Low Permeable material placed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.6 Processed Low Permeable Material to Stockpile

The Contract Unit Price to Process Low Permeable Material to Stockpile shall include full compensation for all labor, material, and equipment required to complete the work as represented in these Specifications and as indicated on the Drawings. All screening, transport, placement and compaction at the stockpiles as represented by the Drawings and Specifications shall be considered as included in the Contractor's unit price.

Final pay quantities shall be determined by computing the actual volume of Low Permeable material processed, based on the volumetric difference between the pre-construction topographic survey and the post-construction survey of the stockpiled material.

4.7 Processed Protective Soil Cover to Stockpile

The Contract Unit Price to Process Protective Soil Cover Material to Stockpile shall include full compensation for all labor, material, and equipment required to complete the work as represented in these Specifications and as indicated on the Drawings. All screening, transport, placement and compaction at the stockpiles as represented by the Drawings and Specifications shall be considered as included in the Contractor's unit price.

Final pay quantities shall be determined by computing the actual volume of Processed Protective Soil Cover material processed, based on the volumetric difference between the pre-construction topographic survey and the post-construction survey of the stockpiled material.

4.8 Embankment Fill

The Contract Unit Price for Embankment Fill shall include full compensation for all labor, material, and equipment required to complete the work as represented in these Specifications and as indicated on the Drawings. All subgrade preparation, loading, transport, grading, compaction, inspections, or other operations incidental to completing the work as represented by the Drawings and Specifications shall be considered as included in the Contractor's unit price.

Final pay quantities will be determined by computing the volumetric difference between the

pre-construction topographic survey and the post construction survey of the embankment fill area. No additional payment shall be made for fill placement completed by the Contractor outside the required limits of fill as reflected on the Drawings.

4.9 Temporary Anchor

The Contract Unit Price for construction of the Temporary Anchor per Detail 2/C-502 shall include full compensation for all labor, material and equipment required to construct the anchor trench in accordance with the details and notes on the Drawings and these Specifications including all geosynthetic materials and PSC installed from the liner limit to the toe of the PSC.

Final pay quantities shall be determined by survey of the actual linear footage of anchor trench constructed. The Contractor shall not be compensated for material placed beyond or above the limits indicated on the Plans, unless those limits have been modified by a contract change order.

4.10 Anchor Trench

The Contract Unit Price for construction of the Anchor Trench per Detail 3/C-502 shall include full compensation for all labor, material and equipment required to construct the anchor trench in accordance with the details and notes on the Drawings and these Specifications including all geosynthetic materials and PSC installed from the liner limit to the toe of the PSC.

Final pay quantities shall be determined by survey of the actual linear footage of anchor trench constructed. The Contractor shall not be compensated for material placed beyond or above the limits indicated on the Plans, unless those limits have been modified by a contract change order.

END OF SECTION B

SECTION C
GEOSYNTHETIC CLAY LINER

1.0 GENERAL

This section sets forth the requirements for the non-woven geotextile supported geosynthetic clay liner (GCL) component for the composite liner system.

A Construction Quality Control/Construction Quality Assurance (CQC/CQA) Plan has been developed in conjunction with this Project and is included with these Specifications for the Contractor's reference. The Contractor shall assure that the Engineer, or the Engineer's designated representative, shall at all times have safe access to the work for the purpose of monitoring, observation, and CQC/CQA Plan implementation.

An independent engineering firm, under contract to the Owner, will conduct Construction Quality Assurance (CQA) monitoring, observation, and documentation. The Contractor shall coordinate and cooperate with the Engineer during all sampling, testing, and certification required by these Specifications.

1.1 Work Included

Furnish and install a non-woven geotextile supported reinforced geosynthetic clay liner (GCL) as indicated on the Drawings and as referenced in these Specifications. The specified GCL shall consist of bentonite clay, encapsulated between two layers of non-woven geotextile, stitch bonded or needle punched, to form a low-permeability hydraulic barrier.

1.2 Construction Quality Control (CQC) Testing

Construction Quality Control (CQC) testing is the responsibility of the Contractor and shall consist of manufacturer's certification and quality control testing at the manufacturing plant, direct shear testing for interface strength, and conformance testing. All CQC testing and certification shall be performed in accordance with these Specifications and all costs associated with CQC testing shall be borne by the Contractor. The Contractor shall submit, in conjunction with the Job Progress Schedule and the Schedule of Values, for approval by the Engineer, a breakdown of costs for CQC testing.

1.3 Submittals Required

The Contractor shall thoroughly review the Specifications and identify all required project submittals. The submittals listed below are intended as a general summary of the submittal items contained in this section. This submittal list does not release the Contractor from the responsibility of identifying and providing all information requested.

1. Raw Bentonite Certificates of Compliance.
2. Carrier Geotextile Certificates of Compliance.
3. Manufacturer's product certification and Quality Control test results as specified herein.

4. Manufacturer's and Contractor's quality control program including shipping, handling, storage, and installation.
5. Conformance Sample Test results.
6. Identification of the Contractor's GAI Certified Independent Testing Laboratory.
7. Installation Plans\Panel Layout.
8. Samples of GCL materials.
9. Warranties as specified herein.
10. Installer's subgrade certification.
11. Quality Control (QC) and Installer's Qualification\Resumes.
12. Record Plans.

2.0 MATERIALS

2.1 Geosynthetic Clay Liner

The Specified GCL consists of a sodium bentonite clay, encapsulated between two layers of non-woven geotextile stitch bonded or needle punched together to form a low-permeability hydraulic barrier, conforming to the requirements listed below.

2.1.2 Bentonite

Raw bentonite shall be a virgin, first-quality product mined and processed specifically for the purpose of manufacturing a GCL. The bentonite used for the seams shall be granular bentonite of the same quality used in the manufacture of the GCL.

2.1.2.1 Physical Properties

Raw bentonite used for the GCL shall meet or exceed the following properties:

Property	Test Method	Units	Value
Swell Index	ASTM D5890	ml/2 grams	24
Fluid Loss	ASTM D5891	ml	18

2.1.2.2 Certification and Testing

The raw bentonite supplier shall sample and test the raw bentonite as specified in ASTM D5889 during processing to ensure product quality. The GCL manufacturer shall sample and test raw bentonite to demonstrate that the material meets or exceeds the values specified for the properties cited above. Prior to shipment of GCL to the site, the Contractor shall submit, for the approval of the Engineer, Certificates of Compliance from the bentonite supplier and GCL manufacturer.

2.1.3 Carrier Geotextile

Carrier geotextile shall consist of non-woven, needle-punched polypropylene geotextile on both sides of the GCL. The bentonite shall be attached to the carrier geotextiles in a manner which prevents separation during transport, handling and installation and which is not detrimental to the other components of the composite liner system. The bentonite clay layer

shall be incorporated between the two layers of carrier geotextiles and interlocked by needle punching or stitching. Edge seams shall be sewn or stitched during manufacture.

2.1.3.1 Physical Properties

The non-woven carrier geotextile shall meet or exceed the minimum average roll values for the following physical properties:

Property	Test Method	Units	Values
Mass per Unit Area	ASTM D5261	oz/sy	5.9

2.1.3.2 Certification and Testing

The GCL manufacturer shall sample and test geotextile(s) as specified in ASTM D5889 to demonstrate that the material meets or exceeds the values specified for the physical properties listed above. Quality control certificates from the geotextile manufacturer and GCL manufacturer shall be submitted to and approved by the Engineer prior to shipment of the GCL to the site.

2.1.4 Geosynthetic Clay Liner

The Contractor shall supply reinforced (needle-punched or stitch-bonded) Geosynthetic Clay Liner (GCL) which shall be manufactured of new, first quality material, specifically for the purpose of providing a hydraulic barrier for the project. The GCL shall have no holes, gels, nicks, tears, cuts on edges, or contamination by foreign matter, and shall be "needle-free". GCL shall be supplied in rolls and folding shall not be permitted.

2.1.4.1 Physical Properties

The geosynthetic clay liner shall meet or exceed the minimum average roll values for the following physical and hydraulic properties:

Table 2.4.1 – GCL Properties

Property	Test Method	Units	Value	MQC Testing Frequency
Clay (as received) • Swell Index • Fluid Loss (1)	 ASTM D 5890 ASTM D 5891	 ml/2g ml	 24 18	 50 tons 50 tons
Geotextiles (as received) • Cap fabric (nonwoven) – mass/unit area (2) • Carrier fabric (nonwoven) - mass/unit area	 ASTM D 5261 ASTM D 5261	 oz/yd^2 oz/yd^2	 5.9 5.9	 25,000 SY
Internal Shear Strength	ASTM D 5321	deg; psf	4.5; 400	See Section D
GCL (as manufactured) • Mass of GCL (3) • Mass of bentonite (3) • Moisture content (1) • Tensile str., MD • Permeability (1), or • Flux (1) • Peel Strength	 ASTM D 5993 ASTM D 5993 ASTM D 5993 ASTM D 6768 ASTM D 5887 ASTM D 5887 ASTM D 6496	 Lb/ft^2 Lb/ft^2 % Lb/in cm/sec cm^3/sec-cm^2 lb/in	 0.81 0.75 35 23 5×10^{-9} 1.0×10^{-6} 2.1	 5,000 SY 5,000 SY 5,000 SY 25,000 SY 30,000 SY 30,000 SY 5,000 SY
• GCL permeability (1), (4) (max at 5 lb/in^2) • GCL Permeability (1), (4) (max at 70 lb/in^2)	ASTM D 6766 ASTM D 6766 mod.	cm/s cm/s	1×10^{-6} 5×10^{-8}	Yearly Yearly
Component Durability Geotextile and reinforcing yards (5) (strength retained)	ASTM D 5721	%	65	Yearly

(1) These values are maximum (all others are minimum)
(2) For both cap and carrier fabrics for nonwoven reinforced GCLs; one, or the other, must contain a scrim component of mass > 2.9 oz/yd^2 for dimensional stability. This only applies to GM/GCL composites which are exposed to the atmosphere for several months or longer so as to mitigate panel separation.
(3) Mass of the GCL and bentonite is measured after oven drying per the stated test method
(4) Value represents GCL permeability after permeation with a 0.1 M calcium chloride solution (11.1 g $CaCl_2$ in 1-liter water). See ASTM D 6141, which is a guide for this particular aspect of the specification. The GCL is to be hydrated with distilled dionized water prior to conducting the tests with the calcium chloride solution. In this regard, ASTM D6766 Scenario 1 and Method C is the procedure to be used. Furthermore, this test is conducted twice at two different normal pressures, i.e., 35 and 500 kPa. The termination criterion at 500 kPa of two pore volumes does not apply and now becomes an outflow-to-inflow hydraulic conductivity within 25%. The maximum allowable values are listed in Table 1.
(5) Value represents the minimum percent strength retained from the as-manufactured value after oven aging at 60°C for 50 days. The geotextiles in their as-received condition are evaluated by incubation in a forced air oven per ASTM D5721 set at 60°C for 50 days. The minimum percent in tensile strength retained at break, as measured by ASTM D6768, is 65%. If individual yarns are used in reinforcing GCLs, they must also meet this same endurance criterion.

2.1.5 Manufacturer's Quality Control

GCL shall be monitored throughout the manufacturing process for product integrity and consistency. Manufacturer shall conduct quality control testing using the test methods and frequencies set forth in Table 1. The Contractor shall submit, for the approval of the Engineer, the manufacturer's QC plan and QC test results.

2.1.6 Identification

The Contractor shall submit a list which indicates date of production, plant location, lot number, manufacturing line number and identification number and square footage of each GCL roll. Rolls shall be listed in the order of production with the status of the roll (approved or rejected for shipment). All rolls shall be included in the list whether or not approved for shipment to the Project. This information will be used by the Engineer to affix rolls to a specific sampling lot for conformance testing per Section 3.9.

Each roll shall be labeled or tagged with roll identification number, name of manufacturer, date of production, product type and grade, lot number, physical dimension, and roll weight. The label or tag information shall be affixed or attached to the roll at all times during deployment of the roll. The product identification number, manufacturer name and lot number shall also be stenciled onto the start of each roll so that a positive verification can be made with label or tag information.

2.1.7 GCL Samples and Manufacturer's Data

The Contractor shall submit for approval of the Engineer, 6 samples of GCL material(s) which have been manufactured in accordance with these Specifications. Samples shall be submitted with literature detailing Manufacturer's Quality Control (QC) Program and recommended procedures for handling, storage, installation, testing, repairing, or other information that will promote proper use of the proposed lining material.

2.1.8 Interface Direct Shear Strength Requirements

The Contractor shall refer to Section D-Altenative for interface direct shear testing requirements.

2.1.9 Certification and Testing

The Contractor shall submit written manufacturer certification, (Attachment 2C-1), for the approval of the Engineer, that the GCL conforms to the material requirements of these Specifications; is similar to and of the same formulation as that for which certification is submitted; and has been demonstrated by actual usage to be satisfactory for the intended application. Manufacturer certification testing and frequency shall be as specified in ASTM D 5889, or at a frequency of one test per 100,000 square feet when not specified by ASTM D 5889, and shall demonstrate that the minimum average roll values for material to be furnished on this project are in accordance with the Specifications. The Contractor shall obtain Engineer's approval of the GCL prior to shipment to the site. The Contractor will not be allowed to unload or store on site any material that is delivered prior to obtaining such approval.

2.1.10 Warranty

The GCL manufacturer shall furnish a written liner warranty on a prorata basis for a period of five (5) years. The warranty shall be against manufacturing defects of workmanship and against deterioration due to ozone, ultraviolet and/or other normal weather aging.

The warranty shall be limited to replacement of material only and shall not cover installation of said material. It shall not cover damage due to vandalism, acts of animals, of earthquakes, and other acts of God.

2.2 Plant Inspection

A representative of the Owner or Engineer may visit the GCL manufacturing plant at any time during the project to observe and inspect the manufacturing process and quality control monitoring, sampling and testing. The Contractor shall notify the Engineer at least 5 working days prior to the start of manufacturing of each material. The Engineer will notify the Contractor at least 48 hours in advance of all visits. The Contractor shall be responsible for making all necessary arrangements for the visits with the manufacturer. All costs of travel, lodging and meals incurred by the Owner or Engineer will be borne by the respective party.

The purpose of the manufacturing plant inspection will be to observe the manufacturing process and the quality control procedures instituted at the manufacturing plant. It is a requirement of these Specifications that conformance sampling be performed on pre-approved materials delivered to the site and, as such, conformance sampling will <u>not</u> be performed during the Owner or Engineer's manufacturing plant inspection. If the Contractor proposes to complete conformance sampling at the plant in order to expedite the construction schedule, then the Contractor shall pay all costs associated with this proposal. Since conformance sampling is to be observed by the Engineer, costs associated with conformance sampling at the manufacturing plant shall include travel and per diem expenses incurred by the Engineer in the performance of such testing and all costs for transporting the samples to the independent testing laboratory.

In lieu of the Engineer witnessing all conformance sampling, the Contractor may utilize the services of an independent laboratory accredited by the Geosynthetic Accreditation Institute (GAI) to perform conformance sampling and inspections at the manufacturing plant.

3.0 CONSTRUCTION METHODS

3.1 <u>Contractor Quality Control (QC) Program</u>

The Contractor shall submit for the approval of the Engineer, at least 15 days prior to scheduled delivery of the geosynthetics, a complete description of their quality control program, as applicable, for handling, installing, testing, repairing and providing a completed lining in accordance with the requirements of these Specifications. Additionally, the Contractor shall designate a full-time Quality Control (QC) Technician to be responsible for supervising and/or conducting the construction QC program. The QC Technician shall have quality control experience on at least five million square feet of GCL. The proposed QC Technician's resume shall be submitted with the Contractor's QC program. The QC Technician shall not be replaced without written authorization by the Engineer. All field QC testing shall be performed in the presence of the Engineer.

3.2 <u>Shipping, Storage and Handling</u>

3.2.1 General

GCL shall be shipped, stored and handled in accordance with ASTM D 5888 and the approved Manufacturer's recommendations. The Contractor shall be completely responsible for shipping, storage, and handling of all GCL. The GCL rolls shall be delivered to the site only after the Engineer receives and approves the required submittals.

3.2.2 Shipping

The Contractor shall notify the Engineer at least 24 hours prior to scheduled delivery. No material shall be unloaded except in the presence of the Engineer or the Engineer's representative. GCL delivered to the site will be inspected for damage during unloading, by the Engineer, and then unloaded and stored with minimal handling.

Damaged rolls shall be marked as 'damaged' and separated from the undamaged rolls until proper disposition of material is determined by the Engineer. The Engineer will be the final authority on the determination of damage.

3.2.3 Handling

No hooks, tongs or other sharp tools or instruments shall be used for handling GCL. The Contractor shall use manufacturer's approved methods and equipment for loading and unloading, and for deployment. GCL shall not be folded or dragged along the ground.

3.2.4 Storage

GCL shall be protected from precipitation, soil, mud, dirt, debris, puncture, cutting or other damaging or deleterious conditions. Rolls of GCL shall be shipped in plastic wrapping, and the wrapping shall remain intact until the rolls are installed.

3.3 Supporting Surface Preparation

Prior to installation of GCL, the supporting surface shall be cleared of any obstructions, or foreign objects that may damage or impair the installation of the GCL. Surfaces supporting the GCL shall be smooth and free of all rocks, sharp stones, sticks, roots, sharp objects, or debris of any kind. The Surface shall provide a firm unyielding foundation for GCL with no sudden, sharp, or abrupt changes or breaks in grade. The Contractor shall be responsible for removal of any underlying geomembrane where the subgrade has been disturbed or damaged and shall repair, re-roll and finish all surfaces to a condition suitable for deployment of GCL materials.

3.3.1 Acceptance of Underlying Surface

No GCL shall be installed until the supporting surface (subgrade) has been inspected and approved for GCL installation by the Engineer. The Contractor shall correct all deficiencies found in the supporting surface prior to deployment of the GCL at no additional cost to the Owner. In addition, the GCL installer shall inspect the subgrade, and shall certify, in writing, that the supporting surface is acceptable for GCL installation.

3.3.2 Maintenance

The Contractor shall maintain the surface suitability and integrity of the underlying supporting surface until the Project is completed and accepted. The Contractor shall correct, at no additional cost to the Owner, all deficiencies in the supporting surface that have appeared since the acceptance of soil subgrade.

3.4 Geosynthetic Clay Liner Installation

3.4.1 Installation Plan

The Contractor shall submit for the approval of the Engineer, an installation plan for the GCL. The installation plan shall show a field panel layout with the proposed placement, sequencing, schedule, and panel identification of the GCL sections. The panel layout plan will show a typical seam section and shall include details of any 3- and 4-way seam intersections. The plan shall also include the proposed method for bonding seams and any products proposed for use in the bonding of seams.

Each panel shall be marked with an "identification code" (numeric or alphanumeric) consistent with the layout plan. The identification code shall be simple and logical and approved for use by the Engineer.

Horizontal seams on slope areas will not be allowed. For the purpose of these Specifications, benches shall be considered as part of the slope section, and seams will not be allowed unless the Contractor elects to place an anchor trench at no additional cost to the Owner.

3.4.2 Material Inspection and Installation

The Contractor shall visually inspect all GCL for imperfections, faulty or suspect areas and possible damage prior to installation. All such defective GCL shall be marked, repaired, and/or tested. GCL that cannot be repaired shall be removed from the work area and replaced at no additional cost to the Owner. The Contractor shall replace faulty material that requires more than one patch per 5,000 square feet of GCL at no additional cost to the Owner.

The Contractor shall use installation procedures which does not damage the underlying geomembrane components, or the supporting subgrade surface.

All personnel working on GCL shall wear shoes that do not damage the GCL. No personnel shall be allowed to engage in activities that could damage the GCL.

Clamps and other metal tools used in the work area shall have rounded edges (no sharp) corners.

Clamps and other metal tools shall not be tossed or thrown.

Panels shall be unrolled with a method that protects the GCL from scratches and crimps and protects the soil subgrade and underlying materials from damage.

The Contractor shall exercise extreme care during GCL installation to prevent damage to the prepared supporting low-permeability soil subgrade surface or underlying geomembrane. The Contractor shall exercise care to prevent the entrapment of rocks, clods of earth or other matter which could damage the GCL. Clean up operations within the work area shall be the on going responsibility of the Contractor. Any GCL surface showing damage due to penetration by foreign objects or distress shall be replaced or repaired.

The Contractor shall place adequate temporary hold-downs to prevent uplift by wind. Hold-downs shall not damage the GCL and shall be continuous along edges to minimize risk of wind flow under panels.

The Contractor shall protect the GCL in heavy traffic areas by overlaying geotextile, extra geomembrane, or other suitable materials. Materials used for protection shall be temporary and shall not be used as any part of the permanent installation. The Contractor shall not allow vehicle traffic on the GCL surface.

3.4.3 Weather Conditions

The GCL shall not be deployed during precipitation, in the presence of excessive moisture, in areas of ponded water, or in the presence of excessive winds. All deployed GCL material shall be covered as soon as possible with geomembrane and before the end of each working day.

3.4.4 Wind Protection

The Contractor shall protect the GCL against adverse effects of high wind such as uplift. Tires (with no exposed metal) or sandbags may be used for this purpose. Sandbags shall be sufficiently close-knit to preclude fines from working through the bottom, sides, or seams. Paper bags, whether or not lined with plastic, shall not be permitted. Burlap bags, if used, shall be lined with plastic. Metal or wire ties shall not be allowed, use only plastic ties. Sandbags that are split, torn or otherwise losing their contents shall be immediately removed from the work area and any spills immediately cleaned up.

3.5 Seams

Seams shall be detailed to have the same minimum hydraulic conductivity as required through the body of the GCL. The Contractor shall overlap all seams by a minimum of 12 inches. The Contractor shall mark rolls with a continuous line along the edge of the roll at a distance of 12 inches for the purpose of verifying the minimum overlap. The Contractor shall apply granular bentonite (of the same quality used in the manufacturer of the GCL) between seams at the rate of 1/4-pound per linear foot of seam. Nails and staples will not be allowed. The Contractor shall follow additional recommendations by the Manufacturer regarding overlap and seaming. For final seaming inspection, seams and the surface of the GCL shall be checked for defects, holes, blisters, undispersed raw materials, or signs of contamination by foreign matter. The Contractor shall distinctively mark, preferably with paint, repair areas, and indicate required type of repair.

The Contractor shall continuously bond the GCL panel overlaps by either thermal fusion using hot-air type equipment, or by adhesive bonding using a urethane based construction adhesive of a type approved by the Engineer prior to construction. Nails and staples will not be allowed. Granular bentonite shall be applied at the rate of ¼ pound per lineal foot within seam overlaps, unless the GCL material was manufactured with a "groove" feature which allows bentonite within the GCL to extrude out into the seam overlap upon hydration. Granular bentonite is to be applied wherever the manufactured "groove" is not present, i.e. within patches and where the panel is cut to an irregular shape."

3.6 Repairs

The Contractor shall repair damaged GCL with patches of the same product. Patches shall overlap the edge of a hole or tear a minimum of 12 inches in all directions shall have granular bentonite applied within the overlap, and shall be continuously heat bonded around the edges of the patch. Nails and staples will not be allowed.

3.7 Anchor Trench Excavation, Backfill and Compaction / Miscellaneous Liner Terminations, Transitions, and Tie-in Details

Installation of the composite liner system includes the construction of various terminations, anchors, trenches, tie-downs, and other appurtenances as indicated on the Drawings. All work associated with these various terminations and tie-ins are to be compensated as separated pay items as identified in Section D-Geomembrane.

3.8 Placement of Overlying Materials Above GCL

During placement of overlying geomembrane material, precautions shall be taken to prevent damage to the GCL by restricting heavy equipment traffic. As approved by the GCL Manufacturer and installation subcontractor, unrolling the geomembrane can be accomplished by using light weight, rubber-tired equipment such as a 4-wheel all-terrain vehicle (ATV). This vehicle can be driven directly on the GCL, provided the ATV makes no sudden stops, starts, or turns.

When placing textured geomembrane over the GCL, a temporary slip sheet (such as 20-mil smooth HDPE) may be required over the GCL in order to allow the geomembrane to slide in to its proper position.

Any leading edge of panels left uncovered shall be protected at the end of the working day with a waterproof sheet which is adequately secured with sand bags or other ballast.

Any aggregate drainage material or soil cover shall be placed with low-ground pressure equipment (5.0 psi maximum ground pressure). A minimum thickness of 12 inches of cover shall be kept between equipment and the GCL/Geomembrane at all times. No vehicles shall be driven directly over the GCL until the proper thickness of cover has been placed. Care should be taken to avoid damaging the GCL by making sharp turns or pivots with equipment.

When covering the GCL/Geomembrane installed on slope areas, the cover should be pushed up slope to minimize tension on the GCL.

3.9 Construction Quality Control\Conformance Testing

Conformance testing will be conducted by an independent test laboratory certified by the Geosynthetic Accreditation Institute (GAI) in the specific tests to be performed. The independent laboratory will be selected by the Contractor and approved by the Engineer. Test results of the independent testing laboratory will be considered final. All costs associated with conformance sampling and testing by the independent testing laboratory will be borne by the Contractor.

3.9.1 GCL Conformance Sampling, Testing, and Reporting

During GCL delivery the Contractor shall obtain all conformance samples in the presence of the Engineer. Samples shall be taken across the entire width of the roll and shall not include the first three feet. Unless otherwise specified, samples shall be three (3) feet long by the roll width. The Engineer shall mark the machine direction on the samples with an arrow, and the Liner Manufacturer's roll identification number.

At a minimum, conformance tests will include determination of the following characteristics for the GCL:

Property	Test Method	Frequency
Mass per Unit Area (0% moisture)	ASTM D 5993	Every 100,000 square feet
Grab Strength	ASTM D 4632	Every 100,000 square feet
Puncture Resistance	ASTM D 4833	Every 100,000 square feet
Hydraulic Conductivity	ASTM D 5804	Every 100,000 square feet
Index Flux	ASTM D 5887	Every 100,000 square feet
Peel Strength	ASTM D 4632	Every 100,000 square feet

3.9.2 Interpretation of Conformance Test Results

A conformance sample that yields any tested property less than the specified average minimum roll property will be recorded as a failure and GCL rolls in the lot represented by that conformance sample will be rejected for use on the project. At the Contractor's option, additional conformance samples representing that lot may be tested to evaluate the physical properties of other rolls within the lot. If only one conformance test fails, the roll that yielded the failure will be rejected and subsequent conformance samples from the same 100,000 square feet or lot will be obtained. If subsequent conformance samples fail the entire lot or 100,000 square feet represented will be rejected for use on the project. If subsequent conformance tests pass, only the rolls which yielded a failure will be rejected for use on the project if the subsequent conformance test passes.

The minimum number of specimens tested will be determined in accordance with ASTM Standards. Certified test results of the independent laboratory shall be submitted for approval by the Engineer following the requirements set forth in these Specifications. Final approval of the GCL shall be contingent upon certification of test results which meet or exceed the requirements of these Specifications.

3.9.3 Non-Destructive Seam Testing

Non-destructive testing of the GCL seams is to be performed by generally following the non-destructive method described in the attached document "GRI GCL8: IN-SITU TENSILE STRENGTH VERIFICATION GCL SEAMS" at five locations along each longitudinal panel seam, using a shear force equal to 50% of the GCL's specified tensile strength. The shear force to be applied, along with other aspects of this testing program, may be adjusted by the design engineer in the course of project.

This testing is to be conducted by the geosynthetic installation contractor, observed by the CQA consultant, and results are to be recorded in the panel deployment logs.

3.10 Record Drawing

In addition to providing survey data from which final pay quantities shall be determined, the Contractor shall submit information required in the preparation of the record drawings for the containment system. This data shall include LCRS swale location and elevations, subgrade elevations and surface areas liner seams and panel corners, anchor trenches, termination locations, destructive seam test locations, protective cover layer limits, and other such information to accurately document the as-constructed condition of all elevations of the composite liner installation. **The survey and record drawing requirement for this project may necessitate that the Contractor be prepared to perform survey work on a daily basis during the liner installation phase of the work, to accurately document the as-built condition of the various components of the system.**

4.0 MEASUREMENT AND PAYMENT

4.1 Miscellaneous Anchor Details, Terminations, and Joins

Compensation for Miscellaneous Anchor Details, Terminations and Joins are defined in Section D – Geomembrane.

4.2 Geosynthetic Clay Liner - Floor Area

The contract unit price for GCL installation on the floor shall include full compensation for all labor, material, and equipment required to furnish and install the GCL in accordance with the details and notes shown on the Drawings, and as indicated in the Specifications, and manufacturer's recommendations.

Final pay quantities shall be determined by computing the actual surface area of GCL placed to the limits indicated on the drawings (Overlap at seams will not be measured for payment). GCL placed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.3 Geosynthetic Clay Liner (GCL) - Slope Areas

The contract unit price for GCL installation on the slopes shall include full compensation for all labor, material, and equipment required to furnish and install the GCL in accordance with the details and notes shown on the Drawings, and as indicated in the Specifications, and manufacturer's recommendations.

Final pay quantities shall be determined by computing the actual surface area of GCL placed to the limits indicated on the drawings (Overlap at seams will not be measured for payment). GCL placed beyond those limits will not be compensated unless previously authorized by the Engineer.

END OF SECTION C

ATTACHMENT 2C-1

MANUFACTURER'S CERTIFICATION FOR GEOSYNTHETIC CLAY LINER

Property	Test Method	Units	Value
Clay (as received) • Swell Index • Fluid Loss (1)	 ASTM D 5890 ASTM D 5891	 ml/2g ml	 24 18
Geotextiles (as received) • Cap fabric (nonwoven) – mass/unit area (2) • Carrier fabric (nonwoven) - mass/unit area	 ASTM D 5261 ASTM D 5261	 oz/yd^2 oz/yd^2	 5.9 5.9
Internal Shear Strength	ASTM D 5321	deg; psf	4.5; 400
GCL (as manufactured) • Mass of GCL (3) • Mass of bentonite (3) • Moisture content (1) • Tensile str., MD • Permeability (1), or • Flux (1) • Peel Strength	 ASTM D 5993 ASTM D 5993 ASTM D 5993 ASTM D 6768 ASTM D 5887 ASTM D 5887 ASTM D 6496	 Lb/ft^2 Lb/ft^2 % Lb/in cm/sec cm^3/sec-cm^2 lb/in	 0.81 0.75 35 23 5×10^{-9} 1.0×10^{-6} 2.1
• GCL permeability (1), (4) (max at 5 lb/in^2) • GCL Permeability (1), (4) (max at 70 lb/in^2)	ASTM D 6766 ASTM D 6766 mod	cm/s cm/s	1×10^{-6} 5×10^{-8}
Component Durability Geotextile and reinforcing yards (5) (strength retained)	ASTM D 5721	%	65

(1) These values are maximum (all others are minimum)

(2) For both cap and carrier fabrics for nonwoven reinforced GCLs; one, or the other, must contain a scrim component of mass > 2.9 oz/yd^2 for dimensional stability. This only applies to GM/GCL composites which are exposed to the atmosphere for several months or longer so as to mitigate panel separation.

(34) Mass of the GCL and bentonite is measured after oven drying per the stated test method

(45) Value represents GCL permeability after permeation with a 0.1 M calcium chloride solution (11.1 g $CaCl_2$ in 1-liter water). See ASTM D 6141, which is a guide for this particular aspect of the specification. The GCL is to be hydrated with distilled dionized water prior to conducting the tests with the calcium chloride solution. In this regard, ASTM D6766 Scenario 1 and Method C is the procedure to be used. Furthermore, this test is conducted twice at two different normal pressures, i.e., 35 and 500 kPa. The termination criterion at 500 kPa of two pore volumes does not apply and now becomes an outflow-to-inflow hydraulic conductivity within 25%. The maximum allowable values are listed in Table 1.

(5) Value represents the minimum percent strength retained from the as-manufactured value after oven aging at 60°C for 50 days. The geotextiles in their as-received condition are evaluated by incubation in a forced air oven per ASTM D5721 set at 60°C for 50 days. The minimum percent in tensile strength retained at break, as measured by ASTM D6768, is 65%. If individual yarns are used in reinforcing GCLs, they must also meet this same endurance criterion.

I, the undersigned, duly authorized representative of the manufacturer, hereby certify that the geosynthetic clay liner supplied for this Project will meet or exceed material requirements of the Specifications and minimum average roll values listed herein (test methods are in accordance with these Specifications); is similar to and of the same formulation as that for which certification is submitted; and has been demonstrated by actual usage to be satisfactory for the intended application.

Manufacturer _____

Signature _____

Name (Print) _____

Title _____

Date _____

SECTION D
GEOMEMBRANE

1.0 GENERAL

This section sets forth the requirements for the High-Density Polyethylene (HDPE) geomembrane.

A Construction Quality Control/Construction Quality Assurance (CQC/CQA) Plan has been developed in conjunction with this Project and is included with these Specifications for the Contractor's reference. The Contractor shall assure that the Engineer shall, at all times, have safe access to the work for the purpose of monitoring, observation, and CQC/CQA Plan implementation.

An independent engineering firm, under contract to the Owner, will conduct Quality Assurance (CQA) monitoring, observation, and documentation. The Contractor shall coordinate and cooperate with the Engineer during all sampling, testing, and certification required by these Specifications.

1.1 Work Included

The specified geomembrane shall be furnished and installed as shown on the Drawings and as required herein for proper installation and functioning of the composite liner system for solid waste and leachate containment. The specified geomembranes consists of a 60-mil thick, high-density polyethylene (HDPE) geomembrane for the base liner (floor) and for slope areas.

The Contractor is advised that acceptance and approval of the geomembrane is a phased process that includes manufacturer’s certifications, manufacturer’s quality control testing, conformance testing, and destructive seam testing. It is a requirement of these Specifications that the manufacturer’s certification(s), and quality control test results for the geomembrane, raw resin, and extrudate rod or bead shall be received (by official submittal), reviewed, and approved by the Engineer prior to shipment of these materials to the site. It is the Contractor’s responsibility to provide the Engineer with all the required documentation and test results specified herein.

1.2 Construction Quality Control (CQC) Testing

Construction Quality Control (CQC) testing is the responsibility of the Contractor and shall consist of manufacturer's certification, direct shear testing for interface strength, conformance testing and destructive seam testing. All CQC testing and certification shall be performed in accordance with these Specifications and all costs associated with QC testing shall be borne by the Contractor. The Contractor shall submit, for approval by the Engineer, a breakdown of costs for CQC testing.

1.3 Submittals Required

The Contractor shall thoroughly review the Specifications and identify all required project submittals. The submittals listed below are intended as a general summary of the submittal items contained in this section. This submittal list does not release the Contractor from the responsibility of identifying and providing all information requested.

1. Manufacturer's product certification and certified quality control test results as specified herein.
2. Manufacturer's and Contractor's quality control program including shipping, handling, storage, and installation.
3. Installation drawings/panel layout.
4. Samples of geomembrane material.
5. Identification of independent testing laboratory.
6. Interface shear strength laboratory test reports/samples.
7. Certified conformance and destructive seam test results.
8. Warranties as specified herein.
9. Geomembrane installer's subgrade certification.
10. Contractor's daily documentation.
11. Quality Control (QC) and Installer's Qualification/Resumes.
12. Subgrade Maintenance Plan.
13. Quality Control (QC) cost breakdown.
14. Record Drawings.

2.0 MATERIALS

2.1 Geomembrane Resin

2.1.1 General

Resin for the geomembrane shall be virgin, first quality high density polyethylene resin (HDPE) produced in North America and compounded and manufactured specifically for the purpose of producing HDPE geomembranes. There shall be no intermixing with other resin types. Reclaimed polymer shall not be added to the geomembrane resin. The manufacturer may recycle edge trim from the roll being produced. Edge trim shall be returned immediately to the process but shall not exceed two (2) percent of the total resin required. Edge trim which has been stored and edge trim from other manufacturing lines shall not be recycled.

2.1.2 Physical Properties

HDPE resin shall meet the following minimum specifications:

TEST	TEST METHOD	UNIT	REQUIREMENTS
Density*	ASTM D-1505	g/cc	0.932 to 0.945
Melt Flow Index	ASTM D-1238 Condition E	g/10 min	<1.0
ASTM - ASTM International * Base resin density without carbon black added.			

2.1.3 Resin Manufacturer Certification and Testing

One set of tests shall be performed per batch of resin. At a minimum, the geomembrane manufacturer shall sample and test each compartment of each rail car or truck to ensure that product purity was maintained during shipment. Certified test results shall be submitted to and approved by the Engineer at least fifteen (15) working days prior to shipping geomembrane to the site.

2.2 <u>Geomembrane Rolls</u>

2.2.1 General

Geomembrane rolls shall be new, first quality seamless high-density polyethylene (HDPE) manufactured in North America specifically for the purpose of this project. The geomembrane roll shall have no holes, pinholes, bubbles, blisters, gels, nicks, cuts on liner edges, or contamination by foreign matter. Geomembrane shall be supplied in rolls; folding shall not be permitted. All additives shall be thoroughly dispersed throughout the geomembrane.

2.2.2 Textured Geomembrane (Double-Sided and Single-Sided)

Textured geomembrane shall have physical properties which equal or exceed the minimum average roll values specified in Table 2.2.2. Textured geomembrane, if produced by coextrusion secondary attachment, shall consist of textured material attached to a base sheet. The base sheet shall have physical properties that meet or exceed those specified in Table 2.2.2. The coextruded secondary attachment sheet shall remain intact and shall be resistant to separation from the base sheet as a result of abrasion and contact with chemicals encountered in solid waste landfill applications. All work associated with secondary attachment shall be performed by the manufacturer of the base sheet.

TABLE 2.2.2 - 60 Mil HDPE Geomembrane

Physical Property	Test Method	Unit	Requirement	Testing Frequency
Thickness (lowest individual for 8 out of 10 values) (lowest individual or any of the 10 values)	ASTM D-5994	mils	60 -10% -15%	Per roll
Asperity Height mils (in ave) (1)	ASTM D 7466	mils	16	Every 2nd roll (2)
Density (min ave)	ASTM D-792 Method A or ASTM D-1505	g/cc	0.940	200,000 lb
Tensile Properties (3) Tensile Strength at Yield Tensile Strength at Break Elongation at Yield Elongation at Break	ASTM D 6693 Type IV	 ppi ppi % %	 126 90 12 100	20,000 lb
Tear Resistance (min ave)	ASTM D-1004	lb	42	45,000 lb
Puncture Resistance (min ave)	ASTM D4833	lb	90	45,000 lb
Environmental Stress Crack (4)	ASTM D-5397 App	hrs	300	Per GRI-GM 10
Carbon black content (range)	ASTM D-4218 (5)	%	2.0 to 3.0	45,000 lb
Carbon black dispersion	ASTM D5596	N/A	note 6	45,000 lb
Oxidative Induction Time (OIT) (min ave) (7) a) Standard OIT or b) High pressure OIT	 ASTM D-3895 ASTM D-5885		 100 min 400 min	200,000 lb
Oven Aging at 85 degrees Celsius (7), (8) a) Standard OIT - % retained after 90 days or b) High pressure OIT - % retained after 90 days	ASTM D-5721 ASTM D-3895 ASTM D-5885	 % %	 55 80	Per each formulation
UV Resistance (9) a) Standard OIT (min ave) or b) High pressure OIT (min ave) - % retained after 1600 hrs (11)	ASTM D-7238 ASTM D-3895 ASTM D-5885	 %	 N.R. (10) 50	Per each formulation

(1) Of 10 readings; 8 out of 10 must be greater than or equal to 7 mils, and lowest individual reading must be greater than or equal to 5 mils; also see Note 6.
(2) Alternate the measurement side for double sided textured sheet
(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Yield elongation is calculated using a gage length of 1.3 inches. Break elongation is calculated using a gage length of 2.0 inches
(4) P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
(5) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.
(6) Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3.
(7) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(8) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(9) The condition of the test should be 20 hr. UV cycle at 75 degrees Celsius followed by 4 hr. condensation at 60 degrees Celsius.
(10) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(11) UV resistance is based on percent retained value regardless of the original HP-OIT value.

2.2.3 Quality Control

Geomembrane shall be monitored throughout the manufacturing process for product integrity and consistency. Manufacturer shall sample rolls for the following physical properties and at the minimum frequency in Table 2.2.2 or per batch of resin, whichever results in the greatest number of tests.

The minimum batch or lot size allowed for geomembrane rolls furnished on this project will be 75,000 square feet.

Certified test results shall be submitted to and approved by the Engineer at least fifteen (15) working days prior to geomembrane delivery to site. The Contractor shall submit a list which indicates date of production, plant location, resin batch number, manufacturing line number and identification number and square footage of each geomembrane roll. Rolls shall be listed in the order of production with the status of the roll (rejected or approved for shipment). All rolls shall be included in the list whether or not approved for shipment to the project. This information will be used by the Engineer to affix rolls to a specific 100,000 square foot, or smaller, lot for conformance testing per applicable portions of this Section.

2.2.4 Roll Identification

Each roll shall be labeled or tagged with the roll identification number, product identification number, name of manufacturer, date and location of production, product type and grade, lot number, and physical dimensions. The label or tag information shall be affixed or attached to the roll at all times during deployment of the roll.

2.2.5 Geomembrane Samples

The Contractor shall submit for approval by the Engineer samples of geomembrane material(s) and field seams prior to the start of construction. The Contractor shall submit six (6) 8-inch by 10-inch samples of geomembrane material(s) and six (6) samples of field seams which have been made in conformance with these Specifications. The field seam samples shall be fabricated by the Contractor using the same materials, equipment, and procedures proposed for the geomembrane installation. Samples shall be twelve (12) inches wide, plus the seam width, and nineteen (19) inches long. The samples shall be numbered and dated.

2.2.6 Warranty

The geomembrane manufacturer shall furnish a written liner warranty on a prorata basis for a period of five (5) years. The warranty shall be against manufacturing defects or workmanship and against deterioration due to ozone, ultraviolet light rays, and/or other normal weather aging.

The warranty shall be limited to replacement of material only and shall not cover installation of said material. It shall not cover damage due to vandalism, acts of animals, earthquakes, and other unusual acts of God.

2.2.7 Manufacturer's Certification

The Contractor shall submit, to the Engineer for approval, written Manufacturer's Certification (Attachment 1) that the geomembrane:

1. Conforms to the material requirements of these Technical Specifications;
2. Is similar to and of the same formulation as that for which certification is submitted; and
3. Has been demonstrated by actual usage to be satisfactory for the intended application.

Manufacturer's certification shall include the minimum average roll values for material to be furnished on this project. The Contractor shall obtain Engineer's approval of the geomembrane prior to shipment to the site. The Contractor will not be allowed to unload or store on site any geomembrane that is delivered prior to obtaining such approval.

2.2.8 Direct Shear Testing

In addition to the manufacturer's certification, the Contractor shall provide for direct shear testing for interface strength in accordance with ASTM Standard D5321 "Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear." Issues and procedures related to soil preparation shall be governed by ASTM D-3080 "Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions."

The laboratory testing equipment shall be capable of providing the following:

1. Total strain of at least two inches.
2. Constant rate of strain.
3. Minimum test sample size of at least 12-inches by 12-inches.
4. Means of producing and maintaining "saturated" conditions.

The Contractor shall obtain appropriate soil samples in the presence of the Engineer, and shall arrange for shipment of the samples to the independent testing laboratory for direct shear testing. Procedures presented in Section 7.5.2 of ASTM D3080 shall be used to prepare the test specimens at ninety (90) percent of maximum dry density as established by ASTM D1557. The samples shall be maintained at a moisture content of 1 to 3 percent above optimum content (ASTM D1557) for direct placement in the shear box.

Shearing shall take place under normal stresses of 10, 30, 60, and 120 psi. Testing at each of the normal stresses shall be undertaken on individual samples, i.e., multi-stage testing of the sample will not be allowed.

The normal stress shall be applied in a single increment. The sample shall be subsequently submerged for a period of at least 48 hours and submerged conditions shall be maintained during shearing. Shearing shall take place at a constant strain rate of 0.04 inch/min. (1.02 millimeter /min). All tests shall be run until a constant shear stress is achieved and in no case shall a test be determined at total strain of less than one (1) inch.

Testing for interface shear will be conducted at a rate of one per 200,000 square feet or a minimum of two (2) per project and shall meet the following minimum specifications:

INTERFACE	MINIMUM ACCEPTABLE INTERFACE SHEAR STRENGTH VALUES
GCL against 60 Mil Textured HDPE (Residual Strength)	C = 0 psf ∅ = 13 degrees
16 oz Geotextile against 60 Mil Textured HDPE (Peak Strength)	C = 0 psf ∅ = 25 degrees
16 oz Geotextile against Protective Soil Cover Material (Residual Strength)	C = 0 psf, ∅ = 17 degrees
Internal GCL (Peak Strength)	< 5,360 psf – C = 0 psf, ∅ = 23.5 degrees, > 5,360 psf – C = 794 psf, ∅ = 16 degrees
Internal GCL (Residual Strength)	< 7,055 psf – C = 0 psf, ∅ = 8 degrees, > 7,055 psf – C = 250 psf, ∅ = 6 degrees

C = Cohesion, ∅ = Friction Angle

A detailed laboratory test report shall be submitted which, at a minimum, shall include:

1. Initial and final moisture content and density.
2. Any deviations or peculiarities in test.
3. Normal displacement vs. time during submergence, compression/consolidation and shearing.
4. Shear stress versus displacement.
5. Interpreted strength values.

The laboratory test report shall also describe the observed condition of the geomembrane specimens after testing. This shall include:

1. Clamping method and any deformation which occurred during testing.
2. Abrasion of geomembrane.
3. Elongation of geomembrane.
4. Other physical changes in material such as wrinkling.
5. Differential movement between specimen and contact surfaces.

6. Tilting.

All geomembrane and geotextile samples are to be returned to the Engineer at the completion of the testing program. These samples, along with the laboratory test report shall constitute a submittal which must demonstrate the minimum friction strength of the composite section. This adequacy shall be determined during a review completed by the Engineer.

All costs associated with direct shear interface testing shall be borne by the Contractor / manufacturer.

2.2.9 Quality Control (QC) Program

The geomembrane manufacturer and the Contractor, each, shall submit a complete description of their quality control program, as applicable, for manufacturing, handling, installing, testing, repairing, and providing a completed lining in accordance with requirements of these Specifications. The description shall include, but not be limited to:

1. Polymer resin supplier.
2. Product identification.
3. Acceptance testing.
4. Fabrication and production testing.
5. Installation testing.
6. Documentation of changes.
7. Alterations and repairs.
8. Retests and acceptance.

2.2.10 Plant Inspection

A representative of the Owner or Engineer may visit the manufacturing plant at any time during the project to observe and inspect the manufacturing process and quality control monitoring, sampling and testing. The Contractor shall notify the Engineer at least five (5) working days prior to the start of manufacturing. The Engineer will notify the Contractor at least forty-eight (48) hours in advance of all visits. The Contractor shall be responsible for making all necessary arrangements for the visits with the manufacturer. All costs of travel, lodging and meals incurred by the Owner or Engineer will be borne by the respective party.

The purpose of the manufacturing plant inspection will be to observe the manufacturing process and the quality control procedures instituted at the manufacturing plant. It is a requirement of these Specifications that conformance sampling will be performed on pre-approved materials delivered to the site and, as such, conformance sampling will <u>not</u> be performed during the Owner or Engineer's manufacturing plant inspection. If the Contractor proposes to complete conformance sampling at the plant in order to expedite the

construction schedule, then the Contractor shall pay all costs associated with this proposal. Since conformance sampling is to be observed by the Engineer, cost associated with conformance sampling at the manufacturing plant shall include travel and per diem expenses incurred by the Engineer in the performance of such testing and all costs for transporting the samples to the independent testing laboratory.

In lieu of the Engineer witnessing all conformance sampling, the Contractor may utilize the services of an independent laboratory accredited by the Geosynthetic Accreditation Institute (GAI) to perform conformance sampling and inspections at the manufacturing plant.

2.3 Extrudate Rod or Bead

2.3.1 General

The extrudate rod or bead shall be high-density polyethylene (HDPE) and shall be of the same formulation and same supplier as the resin used to produce the geomembrane. All additives shall be thoroughly dispersed throughout the extrudate rod or bead. There shall be no contamination by foreign matter in the extrudate rod or bead.

2.3.2 Physical Properties

The extrudate rod or bead shall meet the following specifications:

TEST	TEST METHOD	UNITS	REQUIREMENT
Density	ASTM D-1505	g/cc	0.945 (minimum)
Low Temperature Brittleness	ASTM D-746 Procedure B	F	-40
Carbon Black Content	ASTM D-1603 Procedure B	%	2 to 3
Melt Flow Index	ASTM D-1238, Condition E	g/10 min	0.1 - 0.3
ASTM - American Society for Testing and Materials FTMS - Federal Test Method Standards NSF - National Sanitation Foundation			

2.3.3 Manufacturer Certification and Testing

One set of tests shall be performed per batch of extrudate rod or bead. Certified test results shall be submitted to and approved by the Engineer at least fifteen (15) working days prior to shipping the extrudate rod or bead to the site.

2.4 Plywood Termination Strips

Plywood to be used for terminations strips shall be 1/2-inch CDX, cut to the widths indicated on the Drawings.

3.0 CONSTRUCTION METHODS

3.1 Shipping, Handling and Storage

3.1.1 General

Geomembrane shall be shipped, stored, and handled in accordance with the manufacturer's recommendations and as specified herein. The Contractor shall be completely responsible for shipping, handling, and storage of all geomembrane. The geomembrane rolls shall be delivered to the site only after the Engineer receives and approves, in writing, the submittal information required in these Specifications.

3.1.2 Shipping

The Contractor shall notify the Engineer at least twenty-four (24) hours prior to scheduled delivery of materials on site. All deliveries shall be made during normal working hours, Monday through Friday, unless specifically authorized by the Engineer. No materials shall be unloaded except in the presence of the Engineer or the Engineer's representative.

Geomembrane delivered to the site shall be inspected for damage and unloaded and stored with minimal handling.

Upon delivery, the Contractor, Geomembrane Installer, and the Engineer shall complete a surface observation of all rolls for defects or damage. Damaged rolls shall be separated from undamaged rolls until proper disposition of material is determined by the Engineer. The Engineer will be the final authority on the determination of damage.

3.1.3 Handling

No hooks, tongs, or other sharp tools or instruments shall be used for handling geomembrane. Contractor shall use cloth chokers and spreader bars for loading and unloading and spreader bars and roll bars for deployment. Geomembrane shall not be folded or dragged along the ground.

3.1.4 Storage

Geomembrane shall be protected from soil, mud, dirt, debris, puncture, cutting, or other damaging or deleterious conditions. Geomembrane rolls shall not be stored on wooden pallets. Geomembrane shall not be stacked more than three (3) rolls high. Storage shall be in accordance with the manufacturer's recommendations.

3.2 Supporting Surface

3.2.1 Acceptance of Soil Subgrade

No geomembrane shall be installed until the supporting surface has been inspected and approved for geomembrane installation by the Engineer. The Contractor shall correct all deficiencies found in the subgrade prior to deployment of the geomembrane at no additional cost to the Owner. In addition, the geomembrane installer shall inspect the subgrade and shall certify, in writing, that the subgrade is acceptable for geomembrane installation. The Contractor shall maintain responsibility for subgrade maintenance in accordance with the Specification requirements until completion of the liner installation.

3.2.2 Maintenance

The Contractor shall maintain the surface suitability and integrity of the soil subgrade until installation of the geomembrane is completed and accepted by the Engineer. The subgrade shall be maintained in a condition that minimizes desiccation and provides for a firm and unyielding condition. Water conditioning or placement of visqueen shall be employed to prevent drying of the subgrade and/or saturation due to precipitation. Maintenance of the subgrade shall include non-work hours and weekends as required by weather conditions.

3.3 Geomembrane Installation

3.3.1 Installation Submittals

The Contractor shall submit the following:

1. Installation drawings.
2. Description of installation procedures including subgrade maintenance.
3. Schedule for performing/completing the work.

Installation drawings shall show a field panel lining sheet layout with proposed size, number, position, and placement sequence of all sheets and indicating the location of all field seams and anchors. Installation drawings shall also show complete details and/or methods for anchoring the liner at its perimeter, making field seams and making anchors/seals to pipes and structures penetrating the liner.

A field panel (sheet) is an area of geomembrane which is to be seamed in the field (i.e., a field panel is a roll or a portion of roll cut in the field). The geomembrane installer shall assign each panel over twenty-five (25) square feet an identification code which shall be agreed to and used by the Engineer and the Contractor. The Contractor shall locate the code with roll number near the middle of the panels less than fifty (50) feet in length and at both ends of panels over fifty (50) feet in length.

3.3.2 Material Inspection

Prior to installation, the Contractor shall visually inspect all geomembrane for imperfections, faulty or suspect areas and possible damage. All such defective geomembrane shall be marked, repaired, and/or tested. Geomembrane that cannot be repaired shall be removed from the work area and replaced at no additional cost to the Owner. Contractor shall inspect and replace faulty material that requires more than one (1) patch per 2,000 square feet of geomembrane deployed at no additional cost to the Owner. Patches required for destructive testing will not be included in this tabulation.

3.3.3 General

The Contractor shall thoroughly review the manufacturer's recommendations for proper installation procedures of the specified material. The Contractor shall consult with the manufacturer's representatives regarding site specific and environmental impacts which may affect the installation. Such items as adequate or allowable slack, timing of anchor completion to minimize creep, and temperature considerations shall be reviewed, and appropriate action shall be taken by the Contractor to assure intimate contact between subgrade and geomembrane upon placement of overlying material.

The number of panels deployed on one day shall be limited to the number of panels which can be seamed or tack welded on the same day.

Contractor shall use equipment which does not damage geomembrane or the supporting subgrade surface or underlying geotextile.

All personnel working on geomembrane shall wear shoes that do not damage the geomembrane. No personnel shall be allowed to engage in activities that could damage the geomembrane.

Clamps and other metal tools used in the work area shall have rounded edges with no sharp corners. Clamps and other metal tools shall not be tossed or thrown.

Panels shall be unrolled using a method that protects geomembrane from scratches and crimps and protects soil subgrade from damage.

Contractor shall minimize wrinkles, especially differential wrinkles between panels.

Contractor shall place adequate temporary hold-downs to prevent uplift by wind. Hold-downs shall not damage geomembrane and shall be continuous along edges to minimize risk of wind flow under panels.

Contractor shall protect geomembrane in heavy traffic areas using geotextile, extra geomembrane (sacrificial), or other suitable materials. Material used for protection shall be temporary and shall not be used as any part of the permanent installation.

Contractor shall not allow vehicle traffic on geomembrane surface.

3.3.4 Weather Conditions

3.3.4.1 Temperature

Ambient temperature, measured six (6) inches above geomembrane surface, shall be logged every two (2) hours. Geomembrane shall be deployed between ambient temperatures of 40 degrees Fahrenheit to 105 degrees Fahrenheit and when the relative humidity is less than 80 percent. Deployment of geomembrane below 40 degrees F shall only be allowed after it has been verified that the material can be seamed according to these Technical Specifications, and is approved by the Engineer. When the temperature is below 50 degrees Fahrenheit, preheating by hot air device one inch in front of the extruder shall be provided. Special test welds may be required to verify that weather conditions are not adversely impacting seam quality.

3.3.4.2 Precipitation / Moisture

The geomembrane shall not be deployed during precipitation, in the presence of excessive moisture, or in areas of ponded water. Exceptions to these restrictions may be granted with approval of the Engineer and on condition that adequate steps (such as shelters) are taken by the Contractor to produce high quality seams meeting the requirements of this Section.

3.3.4.3 Wind Protection

The geomembrane shall not be deployed in the presence of excessive winds. The Contractor shall protect the geomembrane against adverse effects of high winds (such as uplift). Sandbags may be used for this purpose. Sandbags shall be sufficiently close knit to preclude fines from working free of the bottom, sides, or seams. Paper bags, whether or not lined with plastic, shall not be permitted. Burlap bags, if used, shall be lined with plastic. Sandbags shall contain not less than 40, nor more than 60, pounds of sand having 100 percent passing a #8 screen. Sandbags shall be tied closed after filling, using only plastic ties. Metal or wire ties shall not be allowed. Sandbags that are split, torn, or otherwise losing their contents shall be immediately removed from the work area and replaced and any spills immediately cleaned up.

3.4 Seams

3.4.1 General

Seams shall be oriented vertically up and down the slopes; not horizontally across the slopes. Intersection of longitudinal and cross seams of adjacent panels shall be staggered not less than two (2) feet. Each seam shall be numbered. A seam numbering system compatible with the panel numbering system shall be used. The number of field seams in corners, off-shaped geometric locations, and outside corners shall be minimized.

Panels shall be overlapped as recommended by the manufacturer. Only procedures that do not damage the geomembrane and that are not detrimental to seam weld material shall be used to temporarily bond adjacent panels together.

3.4.2 Physical Properties: Seams shall meet or exceed the following minimum requirements:

TEST	TEST METHOD	REQUIREMENTS 60-mil Geomembrane
Hot Wedge Seams(1)	ASTM D-4437	
shear strength(2), lb/in.		120
shear elongation at break(3), %		50
peel strength(2), lb/in.		91
peel separation, %		25
Extrusion Fillet Seams	ASTM D-4437	
shear strength(2), lb/in.		120
shear elongation at break(3), %		50
peel strength(2), lb/in.		78
peel separation, %		25

For HDPE seams (both smooth and textured), the strength of four out of five 1.0-inch (25 mm) wide strip specimens tested in peel shall meet or exceed the values given in the above Table. The fifth shall meet or exceed 80% of the given values. In addition, the peel separation (or incursion) shall not exceed the values given in the above table for all five out of five specimens. The value shall be based on the proportion of area of separated bond to the area of the original bonding as follows:

$S = A/A_o\ (100)$

Where;
S = Separation (%)
A = Average area of separation or incursion (in^2 or mm^2)
A_o – original bonding area (in^2 or mm^2)

The area of peel separation can occur in a number of nonuniform patterns across the seam width. The estimated dimensions of this separated area is visual and must be done with care and concern. The area must not include squeeze-out which is part of the welding process.

3.4.3 Seam Preparation

The following steps shall be followed in preparing seams:

1. Clean surface of grease, moisture, dust, dirt, debris or other foreign material.
2. Clean surface of oxidation by disc grinder or equivalent not more than 1 hour before seaming (not required for wedge welding).
3. Use No. 80 grit sandpaper for disc grinder.
4. All areas where grinding is evident shall be repaired with a method approved by the Engineer.
5. Cover with single extrudate any bead grooves.
6. Use soft bristle brush after grinding, if brushing required.
7. Do not use wire brush after grinding.
8. Cut wrinkle and "fishmouth" along ridge.
9. Overlap and seam wrinkles and fishmouths.
10. Patch wrinkles and fishmouths where overlap is less than three (3) inches.
11. Use firm, dry substrate (piece of geomembrane or other material) directly under seam overlap where subgrade is soft.
12. Use plywood or other firm material under seam overlap when welding over anchor trench.

3.4.4 Extrusion Welding

As necessary, welding apparatus shall be purged of heat-degraded extrudate before welding if extruder is stopped for longer than three (3) minutes. All purged extrudate shall be disposed of off the geomembrane. Extrudate rod shall be removed from welder when welder is idle for over two (2) hours.

Each extruder shoe shall be inspected daily for wear to ensure that its offset is the same as the liner thickness. Worn shoes, damaged or misaligned armature brushes, nozzle contamination, or other worn or damaged parts shall be repaired or replaced prior to further usage.

Stop-start welding shall be avoided. Existing welds or welds more than five (5) minutes old shall be ground two (2) inches back from point of stoppage or two (2) inches on each side of identified leaks before welding. Weld shall be restarted two (2) inches on each side of identified leaks or two (2) inches back from point of stoppage.

No equipment will be allowed to commence welding on liner until the trial weld, made by that equipment, has been approved by the Engineer.

Components shall be mounted on a mobile unit for interface extrudate welding. The following accessories shall be included as a minimum:

1. Variable speed control.
2. Wheels with non-skid surface on HDPE.
3. Directional control.
4. Automatic hot air system for preheating welding surfaces.
5. Extruder system with appropriate die.
6. Four adjustable contact pressure rollers.

The "hot air system" shall be tested and set up using scrap material each day prior to commencing seaming. Hot air velocity shall be adjusted to account for wind effects. Contact pressure rollers shall be adjusted to prevent surface ripples in sheet.

3.4.5 Hot Wedge Welding

Welding apparatus shall be automated vehicular mounted device equipped with gauges giving applicable temperatures. The welding apparatus shall be equipped with a temperature gauge.

A smooth insulating plate or fabric shall be placed beneath to hold welding apparatus after usage. Protective fabric or piece of geomembrane shall be placed beneath hot welding apparatus when resting on geomembrane.

Moisture build up between sheets shall be prevented.

No equipment will be allowed to commence welding on liner until the trial seam, made by that equipment, has been approved by the Engineer. All welding conducted at the Contractor's discretion, prior to trial seam results, shall be at the Contractor's risk. Trial seam failures shall be tracked as outlined under "Trial Seams".

A minimum of one (1) spare operable welding apparatus shall be maintained for each three (3) seaming teams.

An electric generator shall be provided that is capable of providing a constant voltage for the anticipated combined line load. The electric generator shall generally be located outside the liner limit. Protective lining and splash pads large enough to catch spilled fuel shall be placed under electric generator when located on the liner.

3.4.6 Trial Seams

Trial seams shall be demonstrated on pieces of geomembrane liner to verify adequate seaming conditions. Trial seams shall be conducted on <u>each piece of equipment</u> in service, at the following frequency:

1. At beginning of each seaming shift (5 hours maximum start of day and mid-day).
2. Anytime a piece of equipment is shut down for more than thirty minutes.
3. At least one per shift for each welding technician performing seaming.
4. As weather conditions dictate, and at Engineer's request.

Welding technicians shall not change parameters (temperature, speed, wheel adjustment) without successfully performing another trial weld.

Trial weld shall be constructed adjacent to the area to be seamed. Trial welds shall be in contact with subgrade or geotextile (same condition as the liner to be seamed).

The trial weld sample shall be at least three (3) feet long and twelve (12) inches wide with the seam centered lengthwise. Two one (1)-inch wide specimens shall be cut by the Contractor in the presence of the Engineer and the specimens obtained near each opposite end of trial weld seam. Specimens shall be quantitatively tested first, for peel adhesion, and then for bonded seam strength (shear).

Regarding the locus-of-break patterns of the different seaming methods in shear and peel, the following are unacceptable break codes per their description in ASTM D6392 (in this regard, SIP is an acceptable break code);

Hot Wedge: AD and AD-Brk > 25%

Extrusion Fillet: AD1, AD2

Exception: AD-WLD (unless strength is achieved)

Separation-in-plane (SIP) is a locus-of-break where the failure surface propagates within one of the seamed sheets during destructive testing (usually in the peel mode). It is not merely a surface skin effect producing a few ductile fibrils (sometimes called ductile drawdown). SIP is acceptable if the required strength, shear elongation, and peel separation criteria are met.

A trial weld passes when both test specimens pass peel and shear tests.

Testing shall be repeated in its entirely if one or more of the specimens fails the peel or shear tests. If trial weld testing fails, the seaming apparatus and operator shall not be used for welding until deficiencies or conditions are corrected and two (2) consecutive successful field test seams are achieved (two (2) specimens in peel and two (2) specimens in shear). All weld seams made by seaming apparatus prior to failure of trial weld shall be checked. Starting back from last seam made, check seams at minimum 10-foot intervals until two (2) consecutive seam tests pass. Seam shall be reconstructed to the satisfaction of the Engineer.

3.4.7 Repairs

Holes smaller than 1/4-inch shall be repaired by extrusion welding. The surface of the geomembrane shall be ground to a minimum one (1) inch around hole immediately before welding. Seams shall be vacuum tested after each welding. Result of test, date of test, and name of quality control technician shall be marked on the geomembrane adjacent to the seam.

Holes larger than 1/4-inch, tears, blisters, undispersed raw material, and contamination by foreign matter shall be patched. Patches shall be round or oval in shape and made of the same material as the geomembrane. Patches shall extend a minimum of six (6) inches beyond the edge of defect and shall be a minimum of 12 inches in diameter. Edge of the patch shall be beveled. Patch shall not be cut with repair sheet in contact with geomembrane. Patch shall be welded to the geomembrane with an approved method and vacuum tested. Result of test, date of test, and name of quality control technician shall be marked on the patch.

Contractor's daily documentation of non-destructive and destructive testing shall be provided to the Engineer's on-site representative. The documentation shall identify seams which were repaired and retested successfully.

3.5 Construction Quality Control (QC)

3.5.1 General

The Contractor shall designate a full-time Quality Control (QC) Technician to be responsible for supervising and/or conducting the construction QC program. The QC Technician shall have quality control experience on five (5) million square feet of HDPE geomembrane. The resume for the QC Technician shall be included in the qualifications package as outlined in Section 1 of these Technical Specifications. The QC Technician shall not be replaced without written authorization by the Engineer. All field QC testing shall be performed in the presence of the Engineer.

3.5.2 Visual Inspection

All seams shall be visually evaluated by the Contractor as the installation progresses and again at completion of the installation. Defective and questionable sections shall be clearly marked and repaired as necessary.

3.5.3 Vacuum Box Testing

The continuity of extruded field seams, beads, and patches shall be tested over their entire length using vacuum box test units. The vacuum test shall be performed concurrently with seaming work, not at completion of seaming.

The vacuum box shall be an American Vacuum Seam Tester, Series A100 as manufactured by American Parts and Service Company, Alhambra, California, or an approved equal. The vacuum box assembly shall consist of the following:

1. Rigid housing.
2. Transparent viewing window.
3. Soft rubber gasket attached to bottom of housing.
4. Porthole or valve assembly.
5. Vacuum gage.

A vacuum pump and tank equipped with pressure controller and pipe connections, rubber pressure/vacuum hose with fittings and connections, clean, dry, soft rags, plastic bucket and applicator, water, and detergent to produce soapy solution shall also be provided.

The vacuum testing procedure shall be as follows:

1. Clean window, gasket surfaces, and check for leaks.
2. Energize vacuum pump and reduce tank pressure to approximately five (5) psi.

3. Wet a strip of geomembrane weld approximately twelve (12) inches by thirty (30) inches (length of box) with soapy solution.
4. Place box over wetted area and compress.
5. Close bleed valve and open vacuum valve.
6. Ensure that a leak-tight seal is created.
7. For a period of not less than fifteen (15) seconds, examine length of weld through viewing window for presence of soap bubbles.
8. If no bubbles appear after fifteen (15) seconds, close vacuum valve and open bleed valve, move box over next adjoining area with minimum three (3) inch overlap of previous test section and repeat process.
9. Areas where soap bubbles appear shall be marked, repaired, and retested.

The following procedures shall be used at locations where seams cannot be vacuum tested:

1. Where possible and/or required, cap-strip seams with same geomembrane.
2. If seam is accessible to testing equipment prior to final installation, vacuum test seam prior to final installation.
3. Seaming and cap-stripping operations shall be observed by the Engineer for uniformity and completeness.

3.5.4 Air Pressure Testing

The Contractor shall test all dual-hot wedge seams in the HDPE lining by using the air pressure test which consists of inserting a needle with gauge in the air space between welds. Air shall be pumped to 35 psi within the weld void and held for at least five (5) minutes. If the pressure loss exceeds two (2) psi within the weld void during air pressure testing, the outside weld edge (not free edge) shall be sprayed with a soap solution and visually examined for bubbles. If no bubbles appear, the problem is with the inside weld and the seam is acceptable. If any bubbles appear, the defect shall be repaired by extrusion welding and tested by vacuum box and/or spark detector.

If pressure loss is not more than 2 psi, the opposite end of the seam will be punctured to release the air. If a blockage is present, it will be located and tests on both sides of the blockage will be completed. All penetration holes created during testing shall be sealed by patching and extrusion welding.

Equipment shall be as follows:

1. Air pumps equipped with pressure gauge capable of generating and sustaining a pressure at 35 psi and mounted on cushion to protect geomembrane.
2. Rubber hose with fittings and connections.
3. Sharp hollow needle or other pressure feed device approved by the Engineer.

The air pressure testing shall be as follows:

1. Seal both ends of the seam to be tested.
2. Insert a needle or other approved pressure feed device into tunnel created by double hot wedge seaming and insert a protective cushion beneath air pump above geomembrane.
3. Pressurize air chamber to 35 psi, and sustain pressure for a minimum of five (5) minutes.
4. Demonstrate air test seam continuity by puncturing end opposite pressure-feed device.
5. If loss of pressure exceeds two (2) psi or does not stabilize, locate faulty area and repair as appropriate.
6. Retest failed areas as appropriate.
7. Remove approved pressure feed device and patch.

3.5.5 Spark Testing

If the fillet weld is used to weld seams, the Contractor may, in lieu of vacuum box testing, test seams and repairs in the geomembrane by using a high voltage spark detector, similar to Tinker and Rasor Holiday Detector (Model AP-W). The setting of the detector shall be 20,000 volts. All seams to be tested shall be provided with 24-30 gauge copper wires properly embedded in the seams and grounded. All spark testing shall be done in the presence of the Engineer. All defective areas shall be marked for repair.

3.5.6 Final Seam Inspection

For final seaming inspection, seams and surface of geomembrane shall be checked for defects, holes, blisters, undispersed raw materials and signs of contamination by foreign matter. The geomembrane surface shall be brushed, blown, and/or washed if dirt inhibits inspection. The Engineer shall decide if cleaning of geomembrane surface and welds is needed to facilitate inspection. The Contractor shall distinctively mark, preferably with paint, repair areas and indicate required type of repair.

3.6 <u>Construction Quality Control/Conformance Testing</u>

Conformance and destructive seam testing will be conducted by an independent testing laboratory certified by the Geosynthetic Accreditation Institute (GAI), selected by the Contractor and approved by the Engineer. Test results of the independent testing laboratory will be considered final. All costs associated with conformance and destructive seam testing sampling and testing by the independent testing laboratory will be borne by the Contractor.

3.6.1 Conformance Sampling, Testing and Reporting

During delivery of geomembrane materials, the Contractor shall obtain all conformance samples in the presence of the Engineer, or as approved by the Engineer, pursuant to Section 2.2.10. Conformance samples shall be taken and tested at a rate of one per lot, or one per 100,000 square feet, whichever results in the greater number of tests. Interface shear strength testing shall be conducted at a rate of one per 200,000 square feet or one per material interface, whichever results in the greatest number of tests.

Samples shall be taken across the entire width of the roll and shall not include the first three (3) feet. Unless otherwise specified, samples shall be three (3) feet long by the roll width. The Engineer shall mark the machine direction on the samples with an arrow, and the geomembrane manufacturer's roll identification number.

At a minimum, conformance tests will include determination of the following characteristics for the HDPE:

1. Density (ASTM D-792 Method A or D-1505)
2. Tear Resistance (ASTM D-1004)
3. Carbon black content (ASTM D-4218)
4. Carbon Black Dispersion (ASTM D-5596)
5. Thickness (ASTM D-5994)
6. Tensile characteristics (yield strength, elongation at yield, break strength, elongation at break) (ASTM D-6693 Type IV)
7. Puncture resistance (ASTM D-4833).
8. Asperity Height (ASTM D-7466)
9. Interface shear strength testing including the following: the smooth HDPE/16-ounce geotextile interface; subgrade soil/textured HDPE interface; 8-ounce geotextile/operations layer interface. Direct shear testing for interface strength shall be carried out in accordance with ASTM D-5321 "Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method." Issues and procedures related to soil preparation shall be governed by ASTM D-3080.

Where optional procedures are noted in the test method, the requirements of the Project Specifications shall prevail.

A conformance sample that yields any tested property less than the specified average minimum roll property will be recorded as a failure. If both conformance samples fail, all rolls within the sampled 100,000 square feet or lot tested will be rejected for use on the project. If only one (1) conformance test fails, the roll that yielded the failure will be rejected and subsequent conformance samples from the same 100,000 square feet or lot will be obtained. If subsequent conformance samples fail the entire lot or 100,000 square feet

represented will be rejected for use on the project. Only the roll which yielded a failure will be rejected from use on the project if the subsequent conformance test passes.

The minimum number of specimens tested will be determined in accordance with ASTM Standards. Certified test results of the independent laboratory shall be submitted for approval by the Engineer following the requirements set forth in these Specifications. Final approval of the geomembrane shall be contingent upon certification of test results, which meet or exceed the requirements of these Specifications.

3.6.2 Destructive Seam Testing

The Contractor shall visually inspect, mark and repair suspicious-looking welds before release of a section to the Engineer for destructive seam testing. The Contractor shall provide the Engineer with a minimum of one (1) destructive sample per 500 linear feet of seam length for destructive seam testing. Destructive seam testing will be performed by the GAI certified, independent testing laboratory, and all testing costs will be paid by the Contractor. The section shall be selected by the Engineer and the Contractor shall not be informed in advance of the sample location. Samples shall be cut as seaming and non-destructive testing progresses, and prior to completion of liner installation. Samples shall be marked with consecutive number and location seam number. Contractor shall record, in written form, the date, time, location, seam number corresponding roll number, welding apparatus identification number, and ambient temperatures at time seam was welded. This information shall be delivered to the Engineer with the destructive samples. The Engineer shall observe acquisition of all destructive samples. The Contractor shall immediately repair holes in geomembrane resulting from obtaining destructive samples and vacuum test patches.

The size of destructive samples shall be as follows:

1. Two (2) 1-inch wide by 12-inch long (plus seam width) for field testing
2. One (1) 12-inch wide by 36-inch long for laboratory testing

The sample shall be cut into three equal parts and distributed as follows:

1. Independent Lab
2. Contractor
3. Engineer (Archive)

The destructive seam testing will be as follows. The two (2) 1-inch wide samples shall be tested in the field for peel adhesion and bonded seam strength (shear) by the Contractor and shall pass the strength requirements established in Section 3.4.2. If one or both of the samples fails in either peel or shear, the Contractor can, at his/her discretion, either: (1) reconstruct or cap strip the seam between passed test locations or, (2) take another test sample ten (10) feet from the point of the failed test and repeat this procedure.

If the second test passes, the Contractor shall reconstruct or cap strip the same between the two passed test locations.

If subsequent tests fail, the procedure is repeated until the length of the poor quality seam is established. Repeated failures indicate that either the seaming equipment and/or operator is not performing properly, therefore appropriate action shall be taken.

Once the field tests have passed, the lab sample shall be recovered from between passing field sample locations for testing by the independent testing laboratory.

All specimens of a field weld sample tested by the independent testing laboratory shall pass. If any specimen fails, the entire sample shall be considered as a failure and the field weld shall be rejected. In this event, the field seam(s) shall be rejected as being nonconformant with the Specifications and corrective measures shall be implemented.

For destructive samples which have failed, corrective measures shall include a rerun of the weld test using the same sample. If the second test passes, the Engineer may assume an error was made in the first test and the field seam may be accepted. If the second test fails, the Contractor shall reconstruct or cap strip the field seam between any two previous passed seam locations which include the failed seam or shall go on both sides of the failed seam location (10-feet minimum), take another sample each side and test both in the independent laboratory.

If both samples pass, the Contractor shall reconstruct or cap strip the field seam between the two passing locations. If either fails, the Contractor shall repeat the process of taking samples for testing by the independent testing laboratory. In all cases, acceptable field seams must be bounded by two passed test locations. In cases involving more than 50 feet of reconstructed or cap stripped seam, the reconstructed or cap stripped seam shall also be tested. The results of the independent testing laboratory governs seam acceptance. In no case shall field testing of installed seams be used for final acceptance.

Testing shall include peel adhesion and bonded seam strength (shear; ASTM D6392). At least five (5) specimens each shall be tested for peel and sheer. Minimum test values are presented section 3.4.2 of these Technical Specifications.

The Contractor's laboratory test results shall be presented to the Engineer for comments.

3.7 Record Drawing

In addition to providing survey data from which final pay quantities shall be determined, the Contractor shall submit information required in the preparation of the record drawings for the containment system. This data shall include GCL/LCRS location and elevations, subgrade elevation and surface area, LCRS gravel surface area, liner seams and panel corners, anchor trenches, termination locations, destructive seam test locations, protective

cover layer limits, and other such information to accurately document the as-constructed condition of all elevations of the composite liner installation.

4.0 MEASUREMENT AND PAYMENT

Installation of the composite liner system includes the construction of various terminations, anchors, trenches, tie-downs, and other appurtenances as indicated on the Drawings.

Compensation for **ALL** geosynthetic materials included in Miscellaneous Anchor Details, Terminations and Joins are defined below.

4.1 60-mil HDPE Base Liner Per Detail 2/C-501 and 3-501

The contract unit price for Geomembrane installation on the floor shall include full compensation for all labor, material, and equipment required to furnish and install the geomembrane in accordance with the details, and notes shown on the Drawings and as indicated in the Specifications, and manufacturer's recommendations.

Final pay quantities shall be determined by computing the actual surface area of Geomembrane placed to the limits indicated on the drawings (Overlap at seams will not be measured for payment). Geomembrane placed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.2 60-mil HDPE Slope Per Detail 4/C-501

The contract unit price for Geomembrane installation on the slopes shall include full compensation for all labor, material, and equipment required to furnish and install the Geomembrane in accordance with the details and notes shown on the Drawings and as indicated in the Specifications, and manufacturer's recommendations.

Final pay quantities shall be determined by computing the actual surface area of Geomembrane placed to the limits indicated on the drawings (overlap at seams will not be measured for payment). Geomembrane placed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.3 Temporary Liner Termination Per Detail 2/C-502

The contract unit price paid per lineal foot for Temporary Liner Termination shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in Temporary Liner Termination, complete in place, including and all excavation, geosynthetic materials, plywood, PCS backfill and compaction, and other appurtenances as shown on the drawings, as specified in the Standard Specifications and these Special Provisions, and as directed by the engineer.

Final pay quantities shall be determined by computing the actual lineal foot of Temporary Liner Termination completed to the limits indicated on the drawings (Overlap at seams will not be measured separately for payment). Temporary Liner Termination placed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.4 Anchor Trench Per Detail 3/C-502

The contract unit price paid per lineal foot for Anchor Trenches shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for

doing all the work involved in Anchor Trenches, complete in place, including and all excavation, geosynthetic materials, PCS. backfill and compaction, and other appurtenances as shown on the drawings, as specified in the Standard Specifications and these Special Provisions, and as directed by the engineer.

Final pay quantities shall be determined by computing the actual lineal foot of Anchor Trenches completed to the limits indicated on the drawings (Overlap at seams will not be measured separately for payment). Anchor Trenches placed beyond those limits will not be compensated unless previously authorized by the Engineer

END OF SECTION D

Geomembrane Manufacturer Certification
Attachment D-1

Physical Property	Test Method	Unit	Requirement
Thickness (lowest individual for 8 out of 10 values) (lowest individual or any of the 10 values)	ASTM D-5994	mils	60 -10% -15%
Asperity Height mils (in ave) (1)(2)	ASTM D 7466	mils	16
Density (min ave)	ASTM D-792 Method A or ASTM D-1505	g/cc	0.940
Tensile Properties (3) Tensile Strength at Yield Tensile Strength at Break Elongation at Yield Elongation at Break	ASTM D 6693 Type IV	 ppi ppi % %	 126 90 12 100
Tear Resistance (min ave)	ASTM D-1004	lb	42
Puncture Resistance (min ave)	ASTM D4833	lb	90
Environmental Stress Crack (4)	ASTM D-5397 App	hrs	300
Carbon black content (range)	ASTM D-4218 (5)	%	2.0 to 3.0
Carbon black dispersion	ASTM D5596	N/A	note 6
Oxidative Induction Time (OIT) (min ave) (7) a) Standard OIT or b) High pressure OIT	 ASTM D-3895 ASTM D-5885		 100 min 400 min
Oven Aging at 85 degrees Celsius (7), (8) a) Standard OIT - % retained after 90 days or b) High pressure OIT - % retained after 90 days	ASTM D-5721 ASTM D-3895 ASTM D-5885	 % %	 55 80
UV Resistance (9) a) Standard OIT (min ave) or b) High pressure OIT (min ave) - % retained after 1600 hrs (11)	ASTM D-7238 ASTM D-3895 ASTM D-5885	 %	 N.R. (10) 50

(1) Of 10 readings; 8 out of 10 must be greater than or equal to 7 mils, and lowest individual reading must be greater than or equal to 5 mils; also see Note 6.
(2) Alternate the measurement side for double sided textured sheet
(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Yield elongation is calculated using a gage length of 1.3 inches. Break elongation is calculated using a gage length of 2.0 inches
(4) P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
(5) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.
(6) Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3.
(7) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(8) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(9) The condition of the test should be 20 hr. UV cycle at 75 degrees Celsius followed by 4 hr. condensation at 60 degrees Celsius.
(10) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(11) UV resistance is based on percent retained value regardless of the original HP-OIT value.

I, the undersigned, duly authorized representative of the manufacturer, hereby certify that the 60-mil HDPE geomembrane supplied for this project will meet or exceed material requirements of the Technical Specifications and minimum average roll values listed hereon; is similar to and of the same formulation as that for which certification is submitted; and has been demonstrated by actual usage to be satisfactory for the intended application.

Manufacturer _____ Signature _____

Print Name _____

Date _____ Title _____

SECTION E
GEOTEXTILE

1.0 GENERAL

This section sets forth the requirements for the non-woven geotextile.

A Construction Quality Control/Construction Quality Assurance (CQC/CQA) Plan has been developed in conjunction with this Project and is included with these Specifications for the Contractor's reference. The Contractor shall assure that the Engineer shall, at all times, have safe access to the work for the purpose of monitoring, observation, and CQC/CQA Plan implementation.

An independent engineering firm, under Contract to the Owner, will conduct Quality Assurance (CQA) monitoring, observation, and documentation. The Contractor shall coordinate and cooperate with the Engineer during all manufacturer's quality control sampling, testing, and certification required by these Specifications.

1.1 Work Included

The specified geotextiles shall be furnished and installed as shown on the Drawings and as required herein to protect the geomembrane and to separate the LCRS gravel layer from the overlying protective cover soil layer. The specified geotextile consists of 12-ounce material overlying the geomembrane on the floor, 8-ounce material placed between the LCRS gravel and the protective cover soil, also in conjunction with the bench collectors, and 16-ounce material for placement on the slope areas.

1.2 Manufacturer Certification and Construction Quality Control (QC)

Construction Quality Control (CQC) is the responsibility of the Contractor and shall consist of manufacturer's certification, manufacturer's quality control testing, installation quality control, conformance testing including direct shear testing for interface shear strength, and destructive seam testing. All CQC sampling and testing shall be performed in accordance with these Specifications and all costs associated with quality control, conformance, and destructive seam testing shall be borne by the Contractor. The Contractor shall submit, for approval by the Engineer, a breakdown of costs for the specified testing.

1.3 Submittals Required

The Contractor shall thoroughly review the Specifications and identify all required project submittals. The submittals listed below are intended as a general summary of the submittal

items contained in this section. This submittal list does not release the Contractor from the responsibility of identifying and providing all information requested.

1. Manufacturer's product certifications and certified quality control test results as specified herein.
2. Samples of geotextile materials including thread for sewn seams.
3. Manufacturer/Contractor's installation procedures, panel layout drawings, and QC Plan.
4. Conformance and destructive seam test results.
5. Warranty as specified herein.

2.0 MATERIALS

2.1 Geotextile

2.1.1 General

Non-woven geotextile materials shall be new, first quality products designed and manufactured in North America specifically for this project. Geotextile shall be mildew, insect and rodent resistant, and needle free. Geotextile shall be suitable and durable for the intended application as satisfactorily demonstrated by similar and prior applications. Geotextile shall be 100-percent polyester or polypropylene (with the exception of inhibitors and/or carbon black added for UV resistance), non-woven and needle-punched materials. Polypropylene materials shall be UV stabilized.

2.1.2 Physical Properties: Geotextile shall meet or exceed the following minimum average roll values (weakest principle direction):

Physical Property	Test Method	Units	Requirement				Frequency
			12-oz Cushion	8-oz Filter	12-oz Filter	16 oz Cushion	
Trapezoidal Tear	ASTM D-4533	lbs.	115	79	79	145	100,000 ft^2 or 1 per lot
Puncture Resistance	ASTM D-4833	lbs.	140	N/A	N/A	170	100,000 ft^2 or 1 per lot
Permittivity	ASTM D-4491	sec^{-1}	N/A	0.02	0.02	0.25	100,000 ft^2 or 1 per lot
Grab Tensile	ASTM D-4632	lbs.	300	203	203	370	100,000 ft^2 or 1 per lot
Grab Elongation	ASTM D-4632	%	50	50	50	50	100,000 ft^2 or 1 per lot
CBR Puncture	ASTM D-6241	lb.	N/A	440	440	N/A	100,000 ft^2 or 1 per lot

AOS (2)	ASTM D-4751	inches	N/A	0.024 inches	0.024 inches	N/A	100,000 ft^2 or 1 per lot
UV Resistance (1)	ASTM D-7238	% strength retained	70	50	50	70	100,000 ft^2 or 1 per lot
Weight (mass/unit area)	ASTM D-3776	oz/yd^2	12	8	12	16	100,000 ft^2 or 1 per lot

(1) UV Stability is to be on a 50 mm strip tensile specimens after 500 hours exposure. UV resistance is a minimum value.
(2) All values are minimum average roll values (MARV) except AOS which is a maximum average roll value (MaxARV) and UV stability which is a minimum average value.

2.2 Thread

Thread used to sew panels of geotextile together shall be polymeric thread with physical and chemical-resistance properties that equal or exceed those of the geotextile. The thread color shall contrast with the geotextile color and shall be approved for use by the geotextile manufacturer.

2.3 Manufacturing Quality Control

2.3.1 Roll Identification

Each roll shall be labeled or tagged with roll identification number, lot, name of manufacturer, date and location of production, product type and grade, and physical dimensions. The label or tag information shall be affixed or attached to the roll at all times during deployment of the roll. The roll identification number and manufacturer name shall also be marked on the protective covering.

2.3.2 Quality Control

The manufacturer shall follow a quality control program during all phases of the manufacturing process. Geotextile shall be monitored throughout the manufacturing process for product integrity and consistency. Manufacturer shall sample rolls in accordance with ASTM D-4354 and test for the following physical properties at the following minimum frequency or per lot whichever results in the greatest number of tests:

PHYSICAL PROPERTY	MINIMUM FREQUENCY
Trapezoidal tear	The greater of every 100,000 square feet OR 1 per Lot
Puncture resistance	The greater of every 100,000 square feet OR 1 per Lot
Grab tensile	The greater of every 100,000 square feet OR 1 per Lot
Weight	The greater of every 100,000 square feet OR 1 per Lot
Thickness	The greater of every 100,000 square feet OR 1 per Lot

The minimum frequency includes the square footage of all manufactured rolls on the production line whether or not the roll is designated for shipment to the Project. The minimum lot size allowed for geotextile furnished on this Project will be 75,000 square feet.

Certified test data (actual quality control reports) shall be submitted to, and approved by, the Engineer prior to installation of geotextile. The Contractor shall submit a list which indicates date of production, date of testing, plant location, manufacturing line number, roll identification number, lot number, test results, and square footage of each geotextile roll. Rolls shall be listed in the order of production with the status of the roll (designated for shipment to project or not designated for shipment to project). All rolls shall be included in the list whether or not designated for shipment to the Project. This information will be used by the Engineer to affix rolls to a specific 100,000 square foot or smaller lot for conformance testing per Section 3.5.1.

2.3.3 Plant Inspection

A representative of the Owner or Engineer may visit the manufacturing plant at any time during the project to observe and inspect the manufacturing process and quality control monitoring, sampling and testing. The Contractor shall notify the Engineer at least five (5) working days prior to the start of manufacturing. The Engineer will notify the Contractor at least forty-eight (48) hours in advance of all visits. The Contractor shall be responsible for making all necessary arrangements for the visits with the manufacturer. All costs of travel, lodging and meals incurred by the Owner or Engineer will be borne by the respective party.

The purpose of the manufacturing plant inspection will be to observe the manufacturing process and the quality control procedures instituted at the manufacturing plant. It is a requirement of these Specifications that conformance sampling will be performed on pre-approved materials delivered to the site and, as such, conformance sampling will not be performed during the Owner or Engineer's manufacturing plant inspection. If the Contractor proposes to complete conformance sampling at the plant in order to expedite the construction schedule, then the Contractor shall pay all costs associated with this proposal. Since conformance sampling is to be observed by the Engineer, cost associated with conformance sampling at the manufacturing plant shall include travel and per diem expenses incurred by the Engineer in the performance of such testing and all costs for transporting the samples to the independent testing laboratory.

In lieu of the Engineer witnessing all conformance sampling, the Contractor may utilize the services of an independent laboratory accredited by the Geosynthetic Accreditation Institute (GAI) to perform conformance sampling and inspections at the manufacturing plant.

2.4 Drawings and Data

Complete specifications, data, and detailed drawings covering the material furnished under this Section shall be submitted for approval in accordance with the procedures set forth in the General Conditions. Data and specifications shall include, but shall not be limited to, the following:

1. Manufacturer's written certification that the geotextile conforms to the material requirements of these Technical Specifications.
2. Samples of geotextile and thread.
3. Complete description of geotextile shipping, handling and storage procedures to be followed during Project.
4. Complete description of installation procedures and procedures for seams and repairs to be followed throughout the duration of the Project.
5. Samples of sewn or welded seams.
6. Complete description of quality control procedures and QC Plan to be followed by the Contractor throughout the duration of the Project.
7. Installation drawings which show geotextile panel layout, seaming, and anchor details.
8. Complete description of the Manufacturer's quality control program and test data.

Manufacturing quality control test data shall be submitted to, and approved by, the Engineer prior to delivery of geotextiles to the site.

2.5 Warranty

The geotextile manufacturer shall furnish a written warranty on a prorata basis for a period of 5 years. The warranty shall be against manufacturing defects of workmanship and against deterioration due to ozone, ultraviolet and/or other normal weather aging.

The warranty shall be limited to replacement of material only and shall not cover installation of said material. It shall not cover damage due to vandalism, acts of animals, earthquakes, and other unusual acts of God.

3.0 CONSTRUCTION METHODS

3.1 Shipping, Handling and Storage

3.1.1 General

Geotextile shall be shipped, stored and handled in accordance with ASTM D-4873, the manufacturer's recommendations, and as specified herein. Contractor shall be completely responsible for shipping, storage, and handling of all geotextile.

3.1.2 Shipping

Geotextile shall be shipped and stored in opaque and water tight protective coverings. Contractor shall notify the Engineer at least twenty-four (24) hours prior to scheduled delivery of materials onsite. All deliveries shall be made during normal working hours, Monday through Friday, unless specifically authorized by the Engineer. No materials shall be unloaded except in the presence of the Engineer. Geotextile delivered to the site shall be inspected for damage and unloaded and stored with minimal handling. Upon delivery, Contractor shall assist the Engineer in conducting inventory, handling, and sampling of geotextile at no additional cost to the Owner.

3.1.3 Handling

No hooks, tongs, or other sharp tools or instruments shall be used for handling geotextile. Contractor shall use manufacturer's approved methods and equipment to unload or handle geotextile. Geotextile shall not be dragged along the ground.

3.1.3 Storage

Geotextile shall be protected from ultraviolet light exposure, precipitation or other inundation, soil, mud, dirt, debris, puncture, cutting, or other damaging or deleterious conditions. Geotextile shall not be stored directly on the ground, unless approved by the manufacturer.

3.2 <u>Supporting Surface Inspection</u>

3.2.1 Acceptance of Subgrade Surfaces

The Engineer and Contractor/Installer will conduct a walk through of all areas to receive geotextile, at which time, the Contractor/Installer shall verify in writing that the supporting surface is acceptable for installation of geotextile and that all required installation, testing, etc, of underlying geosynthetic has been performed. The areas to be covered will be turned over to the Contractor/Installer upon such acceptance. The Contractor shall be responsible for maintenance of these areas in accordance with Specification requirements until completion of the geotextile installation.

3.2.2 Pre-Deployment Inspection

No geotextile shall be installed until the supporting surface has been inspected and approved for geotextile installation by the Engineer and Contractor. The Contractor shall

correct all deficiencies in the supporting surface to the satisfaction of the Engineer at no additional cost to the Owner.

3.3 Geotextile Installation

3.3.1 Material Inspection

The Contractor shall visually inspect all geotextile for imperfections, faulty areas, and possible damage prior to installation. All such defective geotextile shall be marked and repaired in accordance with approved methods. Geotextile that cannot be repaired shall be removed from the work area and replaced at no additional cost to the Owner.

3.3.2 General

Geotextile shall be installed as shown on the Drawings and approved installation details, and as specified herein, or in accordance with the approved manufacturer's installation procedures. No geotextile roll shall be installed without approval of the Engineer.

Geotextile rolls shall be of such lengths and widths and shall be placed in such a manner as to minimize field sewing and/or welding. Geotextile shall be cut only with an approved geotextile cutter. Geotextile shall not be torn or ripped. Geotextile shall be anchored at the top of the slopes and other places as shown on the Drawings. All changes to approved installation drawings and procedures shall be approved by the Engineer prior to implementation.

The Contractor shall exercise extreme care during geotextile installation to prevent damage to the prepared supporting subgrade surface or the installed HPDE geomembrane. The Contractor shall exercise care to prevent entrapment of rocks, clods of earth, or other material which could damage the HDPE geomembrane or geotextile, clog the geotextile, or hamper seaming. Any geotextile surface showing injury due to penetration by foreign objects or distress shall be replaced or repaired by the Contractor at no additional cost to the Owner. All underlying geosynthetic materials, in damaged areas, shall be inspected and approved by the Engineer prior to repair and/or replacement of overlying materials.

No foot traffic shall be allowed on the geotextile except with approved smooth-sole shoes. No vehicular traffic shall be allowed on the geotextile. The Contractor shall not use the geotextile as a work area or storage area for tools and supplies.

The Engineer shall have the authority to order the immediate stoppage of work as a result of improper installation procedures or for any reason which may result in defective and improper installation.

Cleanup within the work area shall be an on-going responsibility of the Contractor. Particular care shall be taken to ensure that no trash, tools, or other objectionable materials are trapped beneath the geotextile.

3.3.3 Seams

All geotextile seams shall be formed by welding, or by mating the edges of the geotextile panels, and sewing together with continuous stitches located a minimum of three (3) inches from the mated edges. A 2-thread, double-locked stitch shall be used. Sewing procedures shall conform to the latest procedures recommended by the geotextile manufacturer. Spot sewing shall not be allowed. Seams shall provide seam strength which equals or exceeds 75 percent of parent material strength when tested in accordance with ASTM D-4595 (parent material strength) and ASTM D-4884 (seam strength).

A minimum of three (3) destructive seam strength samples will be obtained for each geotextile material (i.e., 8-ounce, 12-ounce, and 16-ounce). Sample locations will be determined by the Engineer from the installed production seams and tested by the Contractor's independent testing laboratory.

Horizontal seam on slopes shall not be allowed.

Adjacent geotextile panels in pipe trenches shall be overlapped a minimum of 18-inches unless otherwise shown on the Drawings.

3.3.4 Wind Protection

The Contractor shall protect the geotextile against adverse effects of high winds such as uplift. Sandbags may be used for this purpose. Sandbags shall be sufficiently close knit to preclude loss of fines from the bottom, sides or seams. Paper bags, whether or not lined with plastic, shall not be permitted. Burlap bags, if used, shall be lined with plastic. Sandbags shall contain not less than 40, nor more than 60 pounds, of clean, uniform sand having 100 percent passing a No. 8 screen, and no more than five (5) percent fines, and shall be tied closed after filling using only plastic ties. Metal or wire ties shall not be allowed. Sandbags that are split, torn, or otherwise losing their contents shall be immediately removed from the work area and replaced and any spills immediately cleaned up.

3.3.5 Repairs

Geotextile repairs shall be made with patches of the same geotextile material using approved sewing methods, equipment, and techniques. The patch size shall be 24-inches larger in all directions than the area to be repaired. All corners shall be rounded. Should

any tear exceed 10 percent of the width of the geotextile panel, the Contractor shall remove and replace that panel.

3.3.6 Anchor Trench Excavation, Backfill and Compaction / Miscellaneous Liner Terminations, Transitions, and Tie-in Details

Installation of the composite liner system includes the construction of various terminations, anchors, trenches, tie-downs, and other appurtenances as indicated on the Drawings. All work associated with these various terminations and tie-ins are to be compensated as separated pay items as identified in Section D-Geomembrane.

3.4 Construction Quality Control

The Contractor shall institute and follow a quality control plan as recommended by the geotextile manufacturer throughout the duration of the Project to ensure compliance with the Drawings and these Technical Specifications.

3.5 Construction Quality Control (QC) Conformance Testing

Conformance and destructive seam samples will be collected by the Contractor under the observation of the Engineer, and tested by an independent testing laboratory selected by the Contractor, and approved by the Engineer. Test results of the independent testing laboratory will be considered final. All costs associated with conformance and destructive seam sampling and testing by the independent testing laboratory will be borne by the Contractor.

3.5.1 Conformance Sampling and Testing

In the presence of the Engineer, the Contractor will obtain two (2) conformance samples of each type of geotextile proposed for use, at a frequency of 1 per 100,000 square feet or per lot, whichever results in the greater number of samples. Test specimens will be obtained from each conformance sample. The minimum number of specimens tested per conformance sample for each tested geotextile property will be determined in accordance with ASTM D-4759.

The average value will be calculated from the specimen test values of each conformance sample and compared to the minimum average roll value of the tested geotextile property.

At a minimum, conformance tests will include determination of the following characteristics for the filter geotextile:

1. Mass per Unit Area (ASTM D-5261)

2. Grab Tensile Strength (ASTM D-4632)
3. Trapezoidal Tear Strength (ASTM D-4533)
4. Puncture Resistance Strength (ASTM D-6241)
5. Appropriate interface shear testing as noted in Section D of the Specifications.

At a minimum, conformance tests will include determination of the following characteristics for the cushion geotextile:

1. Mass per Unit Area (ASTM D-5261)
2. Grab Tensile Strength (ASTM D-4632)
3. Trapezoidal Tear Strength (ASTM D-4533)
4. CBR Puncture Resistance Strength (ASTM D-6241)
5. Apparent Opening Size (ASTM D-4751)
6. Permittivity (ASTM D-4491)
7. Appropriate interface shear testing as noted in Section D of the Specifications.

A conformance sample that yields any tested property less than the specified average minimum roll property will be recorded as a failure. If both conformance samples fail, all rolls within the sampled 100,000 square feet or lot tested will be rejected for use on the project. If only one (1) conformance test fails, the roll that yielded the failure will be rejected and subsequent conformance samples from the same 100,000 square feet or lot will be obtained. If subsequent conformance samples fail the entire lot or 100,000 square feet represented will be rejected for use on the project. Only the roll which yielded a failure will be rejected from use on the project if the subsequent conformance test passes.

The minimum number of specimens tested will be determined in accordance with ASTM standards. Certified test results of the independent laboratory shall be submitted for approval by the Engineer following the requirement set forth in these Specifications. Final approval of the geotextile shall be contingent upon certification of test results which meet or exceed the requirements of these Specifications.

4.0 MEASUREMENT AND PAYMENT

4.1 Miscellaneous Anchor Details, Terminations, and Joins

Compensation for Miscellaneous Anchor Details, Terminations and Joins are defined in Section D – Geomembrane.

Geotextile installed in conjunction with piping systems is considered as included in the respective pipe item and is not included in this Measurement and Payment section.

4.2 12-oz Cushion Geotextile Base Liner

The contract unit price for 12-oz Geotextile installation on the floor shall include full compensation for all labor, material, and equipment required to furnish and install the Geotextile in accordance with the details and notes shown on the Drawings, and as indicated in the Specifications, and manufacturer's recommendations.

Final pay quantities shall be determined by computing the actual surface area of Geotextile placed to the limits indicated on the drawings (Overlap at seams will not be measured for payment). Geotextile placed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.3 16-oz Geotextile Cushion Slope Per Liner

The contract unit price for 16-oz Geotextile installation on the slope areas shall include full compensation for all labor, material, and equipment required to furnish and install the Geotextile in accordance with the details and notes shown on the Drawings, and as indicated in the Specifications, and manufacturer's recommendations.

Final pay quantities shall be determined by computing the actual surface area of Geotextile placed to the limits indicated on the drawings (Overlap at seams will not be measured for payment). Geotextile placed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.4 16-oz Geotextile Cushion Slope (Replace Exposed Cell 2 Geotextile)

The contract unit price for 16-oz Geotextile installation on the slope areas shall include full compensation for all labor, material, and equipment required to furnish and install the Geotextile in accordance with the details and notes shown on the Drawings, and as indicated in the Specifications, and manufacturer's recommendations. Price shall include any excavation and handling of excavated material required to expose competent geotextile material buried along the toe of slope.

Final pay quantities shall be determined by computing the actual surface area of Geotextile placed to the limits indicated on the drawings (Overlap at seams will not be measured for payment). Geotextile placed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.5 8-oz Separation Geotextile Floor Liner

The contract unit price for 8-oz Filter installation on the floor shall include full compensation for all labor, material, and equipment required to furnish and install the Geotextile above the LCRS Gravel in accordance with the details and notes shown on the Drawings, and as indicated in the Specifications, and manufacturer's recommendations.

Final pay quantities shall be determined by computing the actual surface area of Geotextile placed to the limits indicated on the drawings (Overlap at seams will not be measured for payment). Geotextile placed beyond those limits will not be compensated unless previously authorized by the Engineer.

END OF SECTION E

SECTION F
LEACHATE COLLECTION AND RECOVERY SYSTEM

1.0 GENERAL

This section sets forth the requirements for the construction of the Leachate Collection and Recovery Systems (LCRS).

1.1 Work Included

In general, construction of the LCRS shall include excavation and backfill of trenches, installation of 6-inch and 18-inch diameter HDPE piping (slotted and solid), installation of 8-ounce and 12-ounce non-woven geotextile fabric, placement of LCRS gravel, and construction of an LCRS Outfall System and Storage Facility, all in accordance with the Drawings, these Specifications, and material manufacturer's recommendations.

1.2 Submittals

The Contractor shall thoroughly review the Specifications and identify all required project submittals. The submittals listed below are intended as a general summary of the submittal items contained in this section. This submittal list does not release the Contractor from the responsibility of identifying and providing all information requested.

1. Gravel Samples
2. Certificates of Compliance
3. Sieve Analysis
4. Permeability
5. Aggregate Carbonate Content and Durability Test Results
6. HDPE Pipe and Fittings
7. PVC Pipe, Fittings, and Valves
8. Geotextile
9. Leachate Storage Tanks and Appurtenances
10. Record Drawings

2.0 MATERIALS

2.1 Gravel

Gravel shall consist of a clean, hard, durable, uniform product, free of limestone, organic, and other deleterious material.

2.1.1 Sieve Analysis

Gravel shall be visually classified as having rounded, sub-rounded, and sub-angular edges and shall conform to the following gradation as determined by Sieve Analysis (ASTM D 422):

LCRS GRAVEL

U.S. STANDARD SIEVE	PERCENT PASSING BY WEIGHT
1/2 inch	100
3/8 inch	85-100
No. 4	0-30
No. 8	0-2
No. 200	0

The Contractor shall submit, to the Engineer for approval, certified results of a sieve analysis on the proposed material, signed by a State of Utah registered Civil Engineer or Geotechnical Engineer at a minimum of 1 per 5,000 CY placed or 1 per source.

2.1.2 Permeability

Gravel shall have a minimum permeability of 1 cm/sec. The Contractor shall submit, to the Engineer for approval, certified results of a permeability test on the proposed material, signed by a State of Utah registered Civil Engineer or Geotechnical Engineer. Permeability shall be measured at a minimum of 1 per 5,000 CY placed or 1 per source.

2.1.3 Carbonate Content and Durability Testing

Gravel shall conform to the following carbonate content and durability requirements:

TEST	REQUIREMENT
Aggregate Carbonate Content (ASTM Standard D 3024)	Less than 5 percent Carbonate Content by Weight @ pH = 4.0
Los Angeles Abrasion(ASTM C-131)	Percent shall be no greater than 50 after 500 Revolutions

The Contractor shall submit to the Engineer for approval, certified test results of the aggregate carbonate content and durability testing, signed by a State of Utah registered Civil Engineer or Geotechnical Engineer at a minimum of 1 per source. Gravel shall be source certified as free of limestone.

2.1.4 Gravel Source Certification

The Contractor shall identify the potential source and provide Certificates of Compliance at least 15 working days prior to intended use. Should the Engineer determine that confirmation testing is warranted, the Engineer will bear the responsibility of costs for such additional testing. The Contractor shall reimburse the Engineer for the confirmation tests, if

such tests indicate that the proposed material does not conform to the Project Specifications. The Contractor shall bear the responsibility for the cost of tests specified in 2.1.1, 2.1.2, and 2.1.3 of this Section.

2.2 Coarse Sand Drainage Layer Material

2.2.1 Sieve Analysis

Coarse sand drainage layer material shall be produced from hard, durable, clean sand, gravel or crushed stone, shall be free of organic material, clay balls or other deleterious substances, and shall conform to the gradation as determined by Sieve Analysis (ASTM D 422):

Sieve Size	Percent Passing by Weight
3/8"	70 - 100
No. 4	25 - 40
No. 8	18 - 33
No. 30	5 - 15
No. 50	0 - 7
No. 200	0- 3

2.2.2 Permeability

Coarse sand drainage layer material shall have a minimum permeability of 0.1 cm/sec. The Contractor shall submit, to the Engineer for approval, certified results of a permeability test on the proposed material, signed by a State of Utah registered Civil Engineer or Geotechnical Engineer. Permeability shall be measured at a minimum of 1 per 5,000 CY placed or 1 per source.

2.2.3 Carbonate Content and Durability Testing

Gravel shall conform to the following carbonate content and durability requirements:

Test	Requirement
Aggregate Carbonate Content (ASTM Standard D 3024)	Less than 5 percent Carbonate Content by Weight @ pH = 4.0
Los Angeles Abrasion(ASTM C-131)	Percent shall be no greater than 50 after 500 Revolutions

The Contractor shall submit to the Engineer for approval, certified test results of the aggregate carbonate content and durability testing, signed by a State of Utah registered Civil Engineer or Geotechnical Engineer at a minimum of 1 per source.

2.2.4 Gravel Source Certification

The Contractor shall identify the potential source and provide Certificates of Compliance at least 15 working days prior to intended use. Should the Engineer determine that

confirmation testing is warranted, the Engineer will bear the responsibility of costs for such additional testing. The Contractor shall reimburse the Engineer for the confirmation tests, if such tests indicate that the proposed material does not conform to the Project Specifications. The Contractor shall bear the responsibility for the cost of tests specified in 2.2.1, 2.2.2, and 2.2.3 of this Section.

2.3 Pipe and Fittings

2.3.1 HDPE Pipe and Fittings

LCRS piping and fittings shall consist of high-density polyethylene (HDPE), smooth walled (non-corrugated), solid, slotted, and perforated pipe conforming to requirements of ASTM 3350 for PE 4710 material with a cell classification of 445574C, or better.

The slotted and perforation patterns shall be in accordance with the details on the Drawings. All solid and slotted HDPE pipe and fittings shall be SDR 11. Fittings shall be butt fusion type meeting the requirements of ASTM D 3261 and rated to match the diameter of piping to which they will be fused.

Slotted pipe shall be factory-fabricated as shown on the Drawings.

Slots and perforations shall be free of any burrs or debris, inside or outside of the pipe.

The Contractor shall submit two samples of each type of piping proposed for use. The submittal shall also include manufacturer's catalog cut sheets, recommended methods of jointing, and a Certificate of Compliance for each class of pipe. The submittal shall be provided to the Engineer at least 15 working days prior to intended use.

2.4 Geotextile

Geotextile shall conform to the minimum requirements of Section E of these Specifications.

2.5 Leachate Outfall System

2.5.1 LCRS Storage Tanks:

A. LCRS Storage tanks shall be SAFE-TANK DOUBLE WALL, 8,700 gallon, High Density Cross-Linked Polyethylene (HDXLPE), tanks as manufactured by Poly Processing Company, or an approved equal.

The SAFE-Tank tanks shall be designed for above-ground, vertical installation and designed to store approved chemicals at atmospheric pressures. The assembly shall be designed to prevent rainwater and debris from entering the containment tank. Tanks shall be adequately vented per manufacturer’s design requirements. Tanks shall be provided with ancillary mechanical fittings and accessories as reflected on the drawings. Tanks shall be marked to identify the manufacturer, date of manufacture and serial numbers must be permanently embossed into the tank.

B. Shop Drawings: Shop drawings shall be submitted and approved by the engineer prior to the manufacturing of the tank(s). Sufficient data shall be included to

show that the product conforms to Specification requirements. Submit the following as a single complete initial submittal.

1. Tank double wall tank and Fitting Material
   a. Resin Manufacturer Data Sheet
   b. Fitting Material
   c. Gasket style and material
   d. Bolt material
2. Dimensioned Tank Drawings
   a. Location and orientation of openings, fittings, accessories, restraints and supports.
   b. Details of manways, flexible connections, and vents.
3. Calculations shall be stamped and signed by a registered, third party engineer in the state of the installation.
   a. Wall thickness. Hoop stress shall be calculated using 600 psi @ 100 degrees F.
   b. Tank restraint system. Show seismic and wind criteria.
4. Manufacturer’s 5 year full replacement warranty
5. Manufacturer's unloading procedure
6. Manufacturer's installation instructions
7. Supporting information on Quality Management System.
8. Manufacturer’s Qualifications: Submit to engineer a list of 5 installations in the same service as proof of manufacturer's qualifications.
9. Electrical heat tracing and foam insulation data sheets as required.
10. Factory Test Report:
    a. Material, specific gravity rating at 600 psi @ 100 degrees F. design hoop stress.
    b. Wall thickness verification.
    c. Fitting placement verification.
    d. Visual inspection
    e. Impact test
    f. Gel test
    g. Hydrostatic test

2.5.2. LCRS Storage Tank Accessories: The tanks shall be provided with the following appurtenances:

A. Molded-in lifting lugs.

B. 24-inch diameter combined manway and vent to prevent over pressurization of the tank.

C. Molded-in ladder attachment lugs.

D. Fiberglass FRP safety ladder.

E. 2-inch reverse float level indicator.

F. Ultrasonic Level Transmitter (Flowline Echosafe XP88-89 or equal).

G. High level alarm system.

H. Wind/Seismic Restraint System, including engineer's signed and stamped calculations and drawings for the proposed restraint system.

I. 2-inch drain valve

J. PVC U-Vent with screen

K. Bellows Transition Fitting/Expansion Joints

L. Flexible connections for pipe connections to tanks (Flexijoint)

M. Schedule 80 PVC Fill Line Assembly

The contractor shall submit manufacturer's product data sheets and installation instructions for the components listed above.

2.5.3 LCRS Storage Tank Piping:

A. Plastic Pipe for Use with Solvent Weld Socket or Threaded Fittings: Polyvinyl chloride (PVC) for plastic pipe shall conform to the requirements of ASTM D 1784.

Plastic pipe shall be rigid unplasticized Schedule 80 PVC 1120 or 1220 (Type 1, Grade 2), cell classification 12454, conforming to ASTM D 1785. All pipe shall be marked in accordance with the requirements of ASTM D 1785 and ASTM D 2665, as applicable.

B. Fittings: Schedule 80 fittings shall conform to the requirements of ASTM D-2467.

C. Solvent Primer: Socket type connections shall be primed with primer furnished by the supplier of the PVC pipe and fittings.

D. Solvent Cement: Socket type connections shall only be joined by heavy duty solvent cement furnished by the supplier of the PVC pipe and fittings, and shall conform to ASTM D 2564.

E. Flanges: Van Stone Flanges shall conform to the following:

1. ANSI 150 lbs @ 73.4°F (23°C)
2. Socket diameters conform to ASTM D2467
3. Bolt Hole Pattern conforms to ANSI B16.5; ASTM D4024
4. Diameter conforms to ASME/ ANSI B16.5 class 150 Standard

F. Flange Gaskets: Viton full-face gaskets 1/8-inch thick of 45 to 60 durometer (shore "A") hardness is required for flanged joints.

G. Flange Bolting: Bolts, washers, and nuts for making up flanged joints on PVC pipe shall be cadmium-plate steel, Type A307.

H. Unions: Unions shall be EPDM Socket Union S x S - PVC Schedule 80 meeting the following requirements:

1. Design stress of 2,000 psi at 73°F, Maximum service temperature 140°F.
2. Universal Part No. 897, Female socket connections,
3. ASTM F1970, NSF/ANSI Standard 14, NSF/ANSI Standard 61, Annex G

I. All aboveground PVC piping shall be painted to provide for UV protection. Primer shall be Hi-Build Epoxoline Series L69F and finish coat shall be Endura Shield Series 1095 epoxy paint, each as manufactured by Tnemec Inc. or approved equal. Paint coating shall have a minimum dry thickness of 4 microns (7 microns wet) and be tan in color.

The contractor shall submit manufacturer's product data sheets for the components listed above.

2.5.4 LCRS Storage Tanks Valves:

A. Ball Valve: Ball valves shall be manufactured by Asahi or an approved equal. Ball valves shall be provided and constructed as specified below:

1. True Union Type.
2. Full port design.
3. Pressure rated at 150 pounds per square inch (psi) at 73° F.
4. Body shall be constructed of PVC plastic.
5. Seals and seats shall be Teflon or Viton.

B. Check Valves: Swing check valves shall be manufactured by Asahi/America, Inc., or an approved equal. Check valves shall be provided as specified below:

1. Swing Check Valves shall be PVC body with FKM or EPDM seals and shall incorporate a single disc design suitable for horizontal or vertical applications.
2. Valves shall have a top entry bonnet for maintenance purposes.

3. Valves shall be flat faced flanged end type conforming to ANSI B16.5 bolt pattern for 150 lb. flanges.

The contractor shall submit manufacturer's product data sheets for the components listed above.

2.5.5 Pipe Supports, Brackets, and Fittings: Pipe supports, brackets and fittings shall be as provided by:

A. Unistrut, or approved equal

B. Tolco, or approved equal

C. Pipe supports, brackets and fittings shall be galvanized, electro-plated, or electro-galvanized.

2.5.6 LCRS Pump: The LCRS pump shall be a Grundfos 20501 LC, close coupled, end suction, centrifugal pump, single stage, 2-1/2" suction, 2" discharge, electric pump, or approved equal conforming to the following:

Flange	Class 125, Class 250
Frequency	50 Hz, 60 Hz
Impeller Diameter	5"
Impeller Material	Bronze - I836, C89833
Industry Standards	ISO 9001 Certified, ANSI/NSF-50 Standard
Inlet Size	2-1/2"
Manuf. Product Line	LC
Number of Phases	1, 3
Outlet Size	2"
Power Rating	0.25 hp, 0.5 hp, 0.75 hp, 0.333 hp, 1 hp
Speed Rating	870 RPM, 1150 RPM, 1450 RPM, 1750 RPM
Type	End Suction
Voltage Rating	110-120 V, 208 V, 230 V, 380 V, 460 V
Working Pressure	175 psi, 350 psi
Working Temperature	275 deg F

The contractor shall submit manufacturer's product data sheets, installation instructions, and an O&M manual for the LCRS Pump.

2.5.7 LCRS Fill Stand: The LCRS fill stand shall be fabricated as reflected on the Drawings and shall include the following:

A. Pipe shall be Schedule 80 PVC. All PVC pipe shall be painted in accordance with 2.5.3I. above.

B. Discharge pipe shall be fitted with a flexible PVC hose (e.g. Sun-Flow,Blue Layflat discharge hose) or approved equal.

C. Support frame shall be constructed of galvanized 1-5/8-inch P-1000 Unistrut Channel, or approved equal.

D. Concrete anchors shall be ⅝ – inch galvanized Hilti HAS Bolts x 6-inch embedment in Hilti RE 500 SD Epoxy (ESR 2322) or approved equal.

The contractor shall submit manufacturer's product data sheets for the components listed above.

2.5.8 Sump Grate: The sump grate shall be 18-inch x 18-inch x 30-inhc Brooks Concrete Catch Basin with Traffic rate frame and grate as manufactured by Brookes Concrete, or approved equal.

2.5.9 Pump Control and Alarm System: TBD

CONSTRUCTION METHODS

3.1 Collection System Piping

Installation of the leachate collection and recovery systems piping shall conform to the lines, grades, details, and notes shown on the Drawings, and as referenced in these Specifications.

3.1.1 Pipe Installation

LCRS pipe shall be placed on a 2-inch thick bedding layer composed of approved LCRS gravel with the slots positioned as indicated on the Drawings.

Pipe shall be installed in a manner so as to provide for expansion and contraction as recommended by the manufacturer. The pipe shall lay free on the base with no induced strain. Where there is evidence of induced pipe strain, the Contractor shall be required to eliminate the strain. The Contractor shall also remove and replace any fitting which induces a torque or strain to the pipe.

Pipe shall be cut in a manner so as to ensure square ends. Burrs at cut ends shall be removed prior to installation so that a smooth unobstructed flow will be obtained.

Installation of HDPE fittings and joints shall conform to manufacturer's recommendations.

Slotted HDPE pipe may be joined with compatible couplings secured with round head self-tapping screws, flexible band seal couplings, or butt fusion welded. No glues or adhesives

shall be used for any piping. Joints for solid HDPE riser pipe shall be butt-fusion welded as recommended by the manufacturer.

The pipe shall not be concealed until a final record survey has been completed and the Engineer has approved the pipe installation.

Pipe and fittings shall be held firmly in position and protected from damage while drainage gravel or backfill is being placed. All pipe and fittings shall be clean upon installation and kept so during the progress of the work.

Any pipe that becomes either partially or fully clogged and/or damaged before final acceptance shall be cleaned/repaired to the satisfaction of the Engineer, and/or replaced at the Contractor's expense.

3.2 Geotextile

Geotextile shall be installed as detailed on the Drawings. Prior to installation, the receiving surface shall be cleaned of loose material and any sharp objects or protrusions that may damage the geotextile.

Geotextile shall be sewn, welded or lapped in accordance with Section E of these Specifications and as detailed on the Drawings.

Contractor shall take precautions to protect the geotextile during placement of the low-permeability material and gravel. Any portion of the geotextile damaged during the project will be repaired or replaced at Contractor's expense.

3.3 Gravel Placement

Gravel for the floor of the lined cell shall be placed to the limits and minimum depths indicated on the Drawings.

Gravel shall not be placed on the geotextile/geomembrane until the installation and testing of the appropriate sections of the composite liner are complete and accepted by the Engineer.

The Contractor shall submit to the Engineer a plan which indicates the proposed sequence of work, estimated schedule, method of depth verification, both during and after installation, and the type of equipment to be utilized in the gravel placement operation. Equipment used to place, spread, or fine grade the LCRS gravel shall be identified as Low Ground Pressure (LGP) equipment and shall not exceed 5.0 psi maximum ground pressure. Contractor shall submit proposed equipment to be used to place LCRS gravel.

The gravel shall be placed in a manner and with appropriate equipment such that damage does not occur to the underlying geotextile/geomembrane. The Contractor shall sequence the gravel placement so that spreading equipment does not operate on less than 12 inches of gravel overlying the geotextile/geomembrane. The method of placement shall be such that it will not cause segregation of particle sizes. The Contractor shall place the gravel parallel to or perpendicular to the direction of any geotextile lapped seams to avoid trapping gravel between the geotextile and geomembrane.

When placing soil or gravel over the geomembrane/geotextile, temperature changes or creep may cause wrinkles to develop in the geomembrane. The Contractor shall sequence gravel placement operations to minimize the development of wrinkles. Any wrinkles which could potentially fold over shall be repaired either by cutting out excess material or, if possible, allowing the geomembrane to contract due to temperature reduction. In no case shall material be placed over the geomembrane/geotextile which could result in the geomembrane folding. All folded geomembrane shall be removed at no additional expense to the District. No material shall be placed in areas where the underlying geomembrane/GCL is not in contact with the supporting subgrade.

Gravel shall not be placed closer than 6 feet from the edge of geomembrane sheets where seaming of additional geomembrane to the edge has to be performed pursuant to the Drawings. Temporary access across such edges shall be subject to approval of the Engineer.

Any damage to the geomembrane/GCL/geotextile caused, in the opinion of the Engineer, during placement of the gravel, shall be repaired at the Contractor's expense before proceeding with further placement. The Contractor shall maintain the integrity of the gravel layer until it has been covered by overlying layers of the composite liner system and has been accepted by the Engineer.

Any material displaced by any action of the Contractor shall be replaced at the Contractor's expense to the lines and grades shown on the Drawings.

The gravel shall be placed to a tolerance of minus 0.00 feet to plus 0.10 feet.

3.4 LCRS Outlet System:

A. LCRS storage tanks shall be installed in accordance with the manufacturer's Installation Manual and shop drawings.

B. All appurtenances provided as part of the tank, or to be attached to the tanks shall be installed in accordance with the manufacturer's instructions and the details on the drawings.

C. Earthwork and concrete improvements associated with the Outlet System shall be constructed in accordance with the applicable sections of these Specifications.

D. All PVC piping and valves shall be installed in accordance with the manufacturer's instructions.

E. Upon completing installation of all tank components and associated piping, the entire installation shall be hydro tested for a minimum of 24 hours.

F. A manufacturer's trained technician shall conduct an onsite inspection of installation. Inspection will verify chemical application, plumbing connections, venting, and applicable ancillary equipment such as ladders, restraints, etc. A

verification of proper installation certificate will be supplied when equipment passes the manufacturer's installation checklist.

G. Manufacturer to provide 1 hour training session to prepare operators to service and maintain the tank system. Three training manuals will be provided during the training session.

4.0 MEASUREMENT AND PAYMENT

4.1 6" HDPE LCRS Mainline

The contract unit price for 6" HDPE LCRS Mainline shall include full compensation for all labor, material, and equipment required to construct the LCRS mainline in accordance with the Drawings, Specifications, and manufacturer's recommendations.

All excavation, pipes, fittings, supporting gravel bed and gravel below the plane of the bottom composite liner, clean-out detail, connections, and other appurtenances shall be considered as incidental to completing the Work and shall be included in the Contractor's unit price.

Final pay quantities shall be determined from an as-built survey indicating the actual lineal footage installed to the limits indicated on the drawings. LCRS Mainline pipe installed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.2 6" HDPE LCRS Laterals

The contract unit price for LCRS laterals shall include full compensation for all labor, material, and equipment required to construct the LCRS laterals and mainline junctions in accordance with the Drawings, Specifications, and manufacturer's recommendations.

All pipes, fittings, supporting gravel bed and other appurtenances shall be considered as incidental to completing the Work and shall be included in the Contractor's unit price.

Final pay quantities shall be determined from an as-built survey indicating the actual lineal footage installed to the limits indicated on the drawings. LCRS Laterals installed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.3 18" LCRS Riser

The contract unit price for the LCRS riser shall include full compensation for all labor, material, and equipment required to construct the riser in accordance with the Drawings Specifications, and manufacturer's recommendations.

All pipes, fittings, supports, and other appurtenances shall be considered as incidental to completing the Work and shall be included in the Contractor's unit price.

Final pay quantities shall be determined from an as-built survey indicating the actual lineal footage installed to the limits indicated on the drawings. LCRS Risers installed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.4 9-Inch Thick LCRS Gravel Layer

The contract unit price for 9-inch thick LCRS Gravel Layer shall include full compensation for all labor, material, and equipment required to furnish and place the gravel in accordance with the Drawings, Specifications, and manufacturer's recommendations.

Final pay quantities shall be determined by computing the actual surface area of gravel placed to the limits indicated on the drawings, and by point-over-point survey verification of the material depth. LCRS gravel placed beyond those limits will not be compensated unless previously authorized by the Engineer.

OR

4.5 18-Inch Thick Coarse Sand Layer

The Contract unit price for 18-inch thick Coarse Sand Layer Detail 2/C-501 shall include full compensation for all labor, material, and equipment required to furnish and place the coarse sand layer in accordance with the Drawings, Specifications, and manufacturer's recommendations.

Final pay quantities shall be determined by computing the actual surface area of coarse sand placed to the limits indicated on the drawings, and by point-over-point survey verification of the material depth. Coarse sand placed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.6 LCRS Storage Facility

The contract Lump Sum price for LCRS Storage Facility shall include full compensation for all labor, material, and equipment required to construct the LCRS Storage Facility in accordance with the Drawings, Specifications, and manufacturer's recommendations.

All excavation, fill placement, grading, compaction, concrete tank foundation slab and secondary containment walls, storage tanks and all tank appurtenances, pipes, fittings, supports, electrical and instrumentation, or other incidentals required to provide for a fully operational LCRS storage facility shall be considered as included in the Contractor's lump sum price.

Final payment shall be determined from by field verification that the work has been completed in accordance with the drawings, specifications, and manufacturer’s instructions.

END OF SECTION F

SECTION G
PROTECTIVE SOIL COVER

1.0 GENERAL

This section sets forth the requirements for construction of the protective cover soil (PCS). See also Section B for processing requirements.

1.1 Work Included

Screen, process, transport, and place PSC material to the line, grade, depth, and limits as shown on the Drawings and as referenced in these Specifications.

1.2 Submittals Required

The Contractor shall thoroughly review the Specifications and identify all required project submittals. The submittals listed below are intended as a general summary of the submittal items contained in this section. This submittal requirement does not release the Contractor from the responsibility of identifying and providing all information requested. A Placement Plan will be required from the contractor at least two (2) weeks prior to construction.

2.0 MATERIAL

2.1 Protective Soil Cover Material

Protective soil cover material shall be process and screened in accordance with the requirements of Section B 2.2 of these Specifications.

Protective soil cover material shall not contain rock particles in excess of 1-inch in the greatest dimension per ASTM D422 within 12 inches of geosynthetic materials. The upper 12 inches of the PSC shall not contain rock particles in excess of three (3) inches in the greatest dimension.

If material is imported, borrow source testing shall be conducted in accordance with the following table:

Test Description	Test Designation	Minimum Test Frequency	Property
Particle Size Analysis	ASTM D422	1 per 1,500 CY (conducted on samples retrieved for laboratory permeability testing)	Max particle size of 1-inch
Processed Moisture Content (following moisture conditioning)	ASTM D 4643 (microwave) or ASTM D 216 (oven)	2 per production day (minimum)	
Moisture/Density Relationship	ASTM D 1557	1 per 10,000 CY or 1 per materials type	Optimum
Visual Inspection	ASTM D 2488	Daily while stockpiling	

2.1.1 Protective Soil Cover Construction Testing

During construction of the PSC layer, the following tests shall be conducted:

Test Description	Test Designation	Minimum Test Frequency	Result
Particle Size Analysis	ASTM D 422	1 per 1,500 CY (conducted on samples retrieved for laboratory permeability testing)	Max particle size of 1-inch
Optimum Moisture Density Relationship	ASTM D 1557	2 or 1 per materials type, whichever is greater	Optimum
In-Place Moisture Density Relationship (Drive Cylinder and Nuclear Gage)	ASTM D 2937 ASTM D 6938	1 per 1000 CY Minimum 10 tests total.	85% to 87% Compaction in lower 12- inches, on slopes, and 9-inches on base. 90% in the upper 12-inches on slope and 9-inches on base

In addition, interface shear testing shall be conducted as described in section 2.2.8 of Specification Section D.

3.0 CONSTRUCTION METHOD

3.1 General

The PSC shall be placed to the lines and grades shown on the Drawings in accordance with these Specifications.

3.2 Slope Area PSC

Placement of PSC on slope areas shall proceed upward, from the toe of slope, to the top of the PSC limits. Care shall be taken during placement to avoid damaging the underlying composite liner components. Folds present in the geomembrane/geotextile shall be removed and the liner repaired prior to placement of the PSC. Any damage to the geomembrane or geotextile shall be repaired by the Contractor at no additional cost to the OWNER. The Contractor is responsible for all work associated with placement of the slope area PSC.

3.3 Floor Area PSC

Care shall be taken during placement of the floor area PSC. to avoid damaging the LCRS or overlying geotextile. Any damage to underlying LCRS components, or geotextiles, shall be repaired by the Contractor at no additional cost to the OWNER.

3.4 Placement

PSC material shall be placed in a manner, and with appropriate equipment, such that damage does not occur to the underlying surface or materials. Equipment shall spread

materials by lifting the blade and pushing forward. Downward pushing of the blade will not be allowed. Small radius or quick turns, spins, and heavy braking of the equipment will also not be allowed.

The Contractor shall submit to the Engineer a plan which indicates the proposed sequence of work, estimated schedule, and type of equipment to be utilized in the PSC placement operation.

Equipment loading shall not exceed that indicated in the following table.

Maximum Allowable Ground Pressure (Equipment) (psi)	Thickness of Fill Overlying Geosynthetics (feet)
<5	<0.75
<6	1.0
<10	1.5
<20	2.0
>20	3.0

3.6 Compaction

For slope areas, the lower 12-inches of the PSC shall be compacted to a minimum 85 to 87-percent of the maximum dry density as determined by ASTM D1557. The upper 12-inches of PSC shall be compacted to a minimum 90-percent of the maximum dry density as determined by ASTM D1557.

For base liner areas, the lower 9-inches of the PSC shall be compacted to a minimum 85 to 87-percent of the maximum dry density as determined by ASTM D1557. The upper -inches of PSC shall be compacted to a minimum 90-percent of the maximum dry density as determined by ASTM D1557.

The direct shear testing shall be performed on the PCS in accordance with ASTM D3080 "Standard Method for Direct Shear Test of Soils under Consolidated Drained Conditions." Samples will be remolded at the minimum 85 and 90 percent relative compaction (per ASTM D 1557). A one point direct shear test shall be performed for each sample under a normal stress of 250 pounds per square foot. The shear strength of the tested samples shall exceed the measured strength envelope defined by the combination of the shear strength and cohesion parameters defined in the table below. One direct shear test should be performed for every 10,000 cubic yards of soil placed on the side slopes.

PCS Material	Peak Shear Strength (per ASTM D 3080)	Relative Compaction (per ASTM D 1557)
Placed during construction	C = 50 psf, ∅ = 30 degrees	90 percent (upper lift)

4.0 MEASUREMENT AND PAYMENT

4.1 18-Inch Thick Protective Soil Cover Base Liner

The contract unit price for 18-Inch Thick Protective Soil Cover Base Liner placement shall include full compensation for all labor, material, and equipment required to process, transport, place, and compact the PSC, as represented by the Contract Documents.

Final pay quantities shall be determined by computing the actual surface area of PSC placed to the limits indicated on the drawings, and by point-over-point survey verification of the material depth. PSC placed beyond those limits will not be compensated unless previously authorized by the Engineer.

4.2 24-Inch Thick Protective Soil Cover Slope

The contract unit price for 24-Inch Thick Protective Soil Cover Slope placement on slopes shall include full compensation for all labor, material, and equipment required to process, transport, place, and compact the PSC, as represented by the details on the drawings and these specifications.

Final pay quantities shall be determined by computing the actual surface area of PSC placed to the limits indicated on the drawings, and by point-over-point survey verification of the material depth. PSC placed beyond those limits will not be compensated unless previously authorized by the Engineer.

END OF SECTION G

SECTION H
MISCELLANEOUS CIVIL IMPROVEMENTS

1.0 GENERAL

This section sets forth the requirements for miscellaneous civil improvements indicated on the Drawings.

1.1 Work Included

In general, miscellaneous civil improvements shall include construction of Portland Cement Concrete (PCC) for the LCRS Outfall System and Storage Facility, crushed aggregate base material access roads and asphalt pavement over crushed aggregate base access roads.

1.2 Submittals Required

The Contractor shall thoroughly review the Specifications and identify all required project submittals. The submittals listed below are intended as a general summary of the submittal items contained in this section. This submittal list does not release the Contractor from the responsibility of identifying and providing all information requested.

- PCC Mix Designs
- Asphalt Paving mix designs
- Gradation for CAB and Asphalt Pavement
- Certificates of Compliance for reinforcing steel
- Certificates of Compliance for welded wire mesh
- Certificates of Compliance for curing compound
- Manufacturer's data sheets for water stop
- Manufacturer's data sheets for joint sealant materials
- Certificates of Compliance (as required)

2.0 MATERIAL

2.1 Portland Cement Concrete (PCC)

Portland Cement Concrete shall conform to the requirements of APWA, Utah Manual of Standard Specifications (UMSS) 03 30 04. PCC for the Leachate Storage Facility foundation slab(s) and containment walls shall be Class 3000. Cement shall be Type II/V. Contractor shall submit the proposed mix design for the approval of the Engineer.

2.2 Reinforcing Steel

Reinforcing steel for concrete structures shall be furnished in accordance with UMSS 03 20 00), and shall conform to ASTM A 615 Grade 60, unless otherwise shown. The Contractor

shall submit Certificates of Compliance representative of the reinforcing steel to be used on the project.

2.3 Welded Wire Mesh Reinforcement (WWM)

WWM shall be 6-inch x 6-inch, W1.4 x W1.4 conforming to the requirements of UMSS 03 20 00.The Contractor shall submit Certificates of Compliance representative of the WWM to be used on the project.

2.4 Curing Compound

Curing compounds for concrete improvements shall conform to the requirements of UMSS 03 39 00). The Contractor shall submit a Certificate of Compliance for the proposed curing compound to be used.

2.5 Water Stop

Provide flexible PVC (polyvinyl chloride) ribbed center bulb waterstop as manufactured by Sika, or an approved equal.

The PVC waterstop shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material or pigment.

Performance requirements as follows:

PROPERTY	TEST METHOD	REQUIRED LIMITS
Water absorption	ASTM D570	0.15% max
Tear Resistance	ASTM D624	300 lb/in (52.5 kN/m) min.
Ultimate Elongation	ASTM D638	350% min.
Tensile Strength	ASTM D638	2000 psi (13.78 Mpa) min.
Low Temperature Brittleness	ASTM D746	No Failure @ -35°F (-37°C)
Stiffness in Flexure	ASTM D747	1000 psi (4.82 Mpa) min.
Specific Gravity	ASTM D792	1.38 max.
Hardness, Shore A	ASTM D2240	79 ± 3
Tensile Strength after accelerated extraction	CRD-C 572	1600 psi (9.54 Mpa) min.
Elongation after accelerated extraction	CRD-C 572	300% min.
Effect of Alkalies after 7 days: Weight Change Hardness Change	CRD-C 572	Between -0.10% / +0.25% ± 5 points

2.6 Joint Sealant

Sealing PCC joints shall consist of installation of a backer rod and applying an epoxy sealant material. Backer rod shall conform to the requirements of UMSS Section 32 13 73 – 2.4A Type 1. Joint sealant shall conform to the requirements of UMSS Section 32 13 73 - 2.7 E. The Contractor shall submit manufacturer's literature and certificate of compliance indicating that the proposed material meets the requirements of the Standard Specifications.

2.7 Crushed Aggregate Base (CAB)

Crushed aggregate base material shall conform to the requirements of UMSS Section 32 11 23 for Grade1. The Contractor shall submit a certificate of compliance indicating that the proposed material meets the gradation requirements of the Standard Specifications.

2.7 Asphalt Concrete (AC)

Asphalt concrete pavement shall be furnished in conformance with the requirements of UMSS Section 32 12 16 and shall be PG 64-22 DM ¾ Class III

3.0 CONSTRUCTION METHODS

3.1 Portland Cement Concrete (PCC)

The Contractor shall place and finish concrete to the lines and grades indicated on the Drawings and the following Sections of the Utah Manual of Standard Specifications.

1. Forms for PCC shall be installed in accordance with the applicable portions of UMSS Section 03 11 00 - Concrete Forming.
2. Reinforcing steel shall be installed in accordance with the applicable portions of UMSS Section 03 20 00.
3. PCC shall be placed in accordance with the applicable portions of UMSS Sections 03 30 10-Placement, 03 35 00-Finishing, and 03 39 00-Curing, as required.
4. Water stops shall be installed in accordance with the manufacturer's instructions.
5. Joint sealant shall be installed in accordance with UMSS Sections 32 13 73.

3.2 Crushed Aggregate Base

CAB shall be placed to the line and grades indicated on the Drawings and in accordance with the provisions of UMSS Section 32 05 10.

The material shall be compacted to a relative density of 95 percent as determined by ASTM D 1557.

3.3 Asphalt Concrete Pavement (AC)

AC pavement shall be constructed to the lines and grades indicated on the Drawings and in accordance with UMSS Section 32 12 16.

4.0 MEASUREMENT AND PAYMENT

Full compensation for all labor, material, and equipment required to furnish and construct the miscellaneous civil improvements as represented by the Contract Documents shall be included in the Contractor's unit price as referenced below.

Improvements placed beyond the limits indicated on the drawings will not be compensated unless authorized by the Engineer prior to installation.

4.1 Crushed Aggregate Base

All grading, untreated base material, and other appurtenances as required, shall be considered as included in the Contractor's unit price.

Final pay quantities shall be determined from field verification of the actual square footage of road placed in accordance with the Drawings.

4.2 Asphalt Pavement (X" AC/X" CAB)

All grading, crushed aggregate base material, asphalt pavement, and other appurtenances as required, shall be considered as included in the Contractor's unit price.

Final pay quantities shall be determined from field verification of the actual square footage paved in accordance with the Drawings.

4.3 LCRS Storage Tank Facility:

All earthwork, compaction, base material, reinforcing steel, concrete, and water proofing for the LCRS Storage Tank Facility foundation slab and secondary containment wall shall be compensated under the Contractor's Lump Sum cost for the Storage Tank Facility as referenced in Section F of these Specifications.

END OF SECTION H

SECTION I
EROSION CONTROL

1.0 GENERAL

This section sets forth the requirements for furnishing and installing erosion control improvements associated with the Cell 1 construction.

1.1 Work Included

Provide all labor, materials, and equipment necessary to install erosion control improvements as reflected on the Drawings and as herein. The proposed improvements include the following:

1. Erosion Control Blankets
2. Silt Fences
3. Fiber Rolls
4. Gravel Bag Check Dams

1.2 Submittals Required

The Contractor shall thoroughly review the Specifications and identify all required project submittals. The submittals listed below are intended as a general summary of the submittal items contained in this section. This submittal list does not release the Contractor from the responsibility of identifying and providing all information requested.

- Manufacturer's Literature and Catalog Cut Sheets for the Erosion Control Blanket
- Manufacturer's Literature and Catalog Cut Sheets for Silt Fence
- Manufacturer's Literature and Catalog Cut Sheets for Fiber Rolls (Straw Wattles)
- Manufacturer's Literature and Catalog Cut Sheets for Gravel Bag Check Dams

2.0 MATERIALS

2.1 Erosion Control Blanket

Erosion control blankets shall consist of 100-percent mattress grade coconut fiber mechanically bound and covered on both sides by netting. The fiber shall be homogeneously blended and evenly distributed throughout the blanket. The netting shall be UV stabilized polypropylene with mesh openings of approximately ⅝ inch by ⅝ inch. The blanket shall be sewn on approximately 2-inch centers with photodegradable polypropylene thread. The erosion control blanket shall be Landlok C2, or an approval equal, meeting the following minimum requirements.

Erosion Control Blanket

Property	Test	Value
Mass/Units	ASTM D 6475	11.44 oz/yd^2
Thickness	ASTM D 6525	264 mils
Tensile Strength	ASTM D 6818	250 x 180 lbs/ft
Elongation	ASTM D 6818	25%
Functional Longevity	Observed	Up to 36 months

2.2 Silt Fence

Silt fence fabric shall be woven polypropylene with a minimum width of 36 inches and shall conform to the following requirements. Contractor shall submit certificate of compliance for the proposed material.

Silt Fence Fabric

Property	Test	Value	
		Woven	Nonwoven
Grab breaking load, 1-inch grip, lb min, in each direction	ASTM D 4632	120	120
Apparent elongation, percent min, in each direction	ASTM D 4632	15	50
Water flow rate, gal per minute/sq ft min and max average roll value	ASTM D 4491	10–100	100–150
Permittivity, sec^{-1} min	ASTM D 4491	0.1	1.1
Apparent opening size, inches max average roll value	ASTM D 4751	0.023	0.023
Ultraviolet resistance, percent min retained grab breaking load, 500 hours	ASTM D 4355	70	70

Stakes shall be commercial quality of the size and shape shown on the plans. Hog rings used to fasten the fence fabric to the stakes shall be provided in accordance with the manufacturer's recommendations.

2.3 Fiber Rolls

Fiber rolls, i.e. fiber wattles, shall be 9-inches in diameter, and shall be manufactured from certified 100-percent weed-free rice straw and wrapped in a tubular plastic netting. Fiber rolls shall be as manufactured by Earth Saver, or an approved equal.

2.4 Gravel Filled Bags

2.4.1 Bag Material:

Bags should be woven polypropylene, polyethylene or polyamide fabric or burlap, minimum unit weight of 4 ounces/yd2 conforming to the following requirements. Contractor shall submit certificate of compliance for the proposed material.

Gravel-Filled Bag

Property	Test	Value
Grab breaking load, lb, 1-inch grip min, in each direction	ASTM D 4632	205
Water flow rate, gal per minute/sq ft min and max average roll value	ASTM D 4491	80–150
Permittivity, sec^{-1} min	ASTM D 4491	0.2
Apparent opening size, inches max average roll value	ASTM D 4751	0.016
Ultraviolet resistance, percent min. retained grab breaking load, 500 hours	ASTM D 4355	70

Each gravel-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.

2.4.2 Fill Material

Fill material should be 0.5 to 1 in. crushed rock, clean and free from clay, organic matter, and other deleterious material, or other suitable open graded, non-cohesive, porous gravel.

3.0 CONSTRUCTION METHODS

3.1 Erosion Control Blanket

Erosion control blankets shall be installed in accordance with the manufacturer's recommendations and the details on the drawings.

3.2 Silt Fence

Silt fences shall be installed in accordance with the manufacturer's recommendations and the details on the drawings.

3.3 Fiber Rolls

Fiber rolls shall be installed in accordance with the manufacturer's recommendations, at the locations indicated on the drawings. Minor adjustments may be made, with the approval of the CM, to accommodate field conditions.

3.4 Gravel Fill Bags

Gravel Filled Bags shall be placed at the locations indicated, and in accordance with the details on the drawings.

4.0 MEASUREMENT AND PAYMENT

4.1 Erosion Control Blanket

The contract unit price for installation of Erosion Control Blanket shall include full compensation for all labor, material, and equipment required to furnish and install the erosion control blanket in accordance with the Drawings, these Specifications, and supplier's recommendations.

Final pay quantities will be determined by field verification, by the Construction Manager of the actual square footage of erosion control blanket installed to the dimensions indicated on the drawings. Material placed beyond these limits will not be compensated unless authorized by the Engineer.

4.2 Silt Fence

The contract unit price for installation of silt fence shall include full compensation for all labor, material, and equipment required to furnish and install the fencing fabric and posts in accordance with the Drawings, these Specifications, and supplier's recommendations.

Final pay quantities will be determined by field verification, by the Construction Manager of the actual lineal footage of silt fence installed to the dimensions indicated on the drawings. Material placed beyond these limits will not be compensated unless authorized by the Engineer.

4.3 Fiber Rolls

The Contract Unit Price to furnish and install fiber rolls shall include full compensation for all labor, material, and equipment required to complete the installations as indicated on the Drawing and in accordance with these Specifications.

Final pay quantities will be determined by field verification of the actual lineal footage of fiber rolls installed in accordance with the drawing. No additional payment will be made for material placed beyond the limits indicated on the Drawings unless authorized by the Engineer.

4.4 Gravel Filled Bags

The Contract Unit Price to furnish and install gravel filled bag Surround shall include full compensation for all labor, material, and equipment required to complete the installations as indicated on the Drawing and in accordance with these Specifications.

Final pay quantities will be determined by field verification of the actual number of gravel bag chevrons installed in accordance with the drawing. No additional payment will be made for material placed beyond the limits indicated on the Drawings unless authorized by the Engineer.

END OF SECTION I

APPENDIX D

DESIGN CALCULATIONS

LINER AND LCRS PIPE CALCULATIONS

- **Geotextile Cushion**
- **LCRS Pipe Strength**
- **LCRS Pipe Capacity and LCRS Pipe Spacing**

Geotextile Cushion

PROMONTORY POINT LANDFILL
PHASE 1
Geotextile
Calculations

Job Number : 2015-0112
Calculated By: PV
Checked By: CHM
Date: 4-26-2016

DESIGN CALCULATION REQUIRED

Evaluate that the proposed geotextile is sufficient in providing puncture protection for the geomembrane from the LCRS gravel.

RESULTS

The 12 oz/sy geotextile on the base liner will protect the geomembrane. The results are as follows:

p_{act}=	required pressure due to the landfill contents (or surface impoundment)	p_{act}=	165.01 psi	
p_{allow}=	allowable pressure using different types of geotextiles and site-specific conditions	p_{allow}=	202.33 psi	
FS=	$\frac{\text{allowable pressure}}{\text{actual pressure}}$	FS=	1.23	**OK**

CALCULATIONS

Actual and Allowable Pressure on Geotextile

p_{act}=	required pressure due to the landfill contents (or surface impoundment)	p_{act}=	165.01	psi	
p_{allow}=	allowable pressure using different types of geotextiles and site-specific conditions	p_{allow}=	1395.38	kPa	*Specs Appendix C*
		p_{allow}=	202.33	psi	

$$p_{allow} = \left(50 + 0.00045\frac{M}{H^2}\right)\left[\frac{1}{MF_S \times MF_{PD} \times MF_A}\right]\left[\frac{1}{RF_{CR} \times RF_{CBD}}\right]$$

Refer. 1

M=	geotextile mass per unit area	M=	406.87	g/m^2	
		M=	12	oz/sy	
H=	protusion height	H=	0.009525	m	*Specs Appendix C*
		H=	0.375	in	
MF_S=	modification factor for protusion shape	MF_S=	1.0		*Refer. 1*
MF_{PD}=	modification factor for packing density	MF_{PD}=	1.0		
MF_A=	modifciation factor for arching in solids	MF_A=	1.0		
RF_{CR}=	reduction factor for long-term creep	RF_{CR}=	1.0		
RF_{CBD}=	reduction factor for long-term chemical/biological degradation	RF_{CBD}=	1.5		*Assumes harsh leachate*

PRISM LOAD				
Layer	Unit Weight pcf	Thickness ft	Pressure psf	
Final Cover	120	5	600	
MSW	80	286	22880	
Operations	120	1.5	180	
LCRS Gravel	135	0.75	101.25	
		Total	23761.25	psf
			165.0087	psi

Factor of Safety

$$FS = \frac{p_{allow}}{p_{actual}}$$

Refer. 1

FS=	factor of safety (against geomembrane puncture)	FS=	1.23	**OK**

REFERENCES

1. "Designing with Geosynthetics, 6th Edition". Robert M. Koerner, 2012.

LCRS Pipe Strength

PROMONTORY POINT LANDFILL
PHASE 1
LCRS Pipe Strength Calculations

Job Number : 2015-0112
Calculated By: PV
Checked By: CHM
Date: 4-26-2016

DESIGN CALCULATION REQUIRED

Determine if the proposed leachate collection pipes possess sufficient strength to support the overlying landfill materials considering the following failure modes:

1- Deflection
2- Wall Crushing
3- Wall Buckling

RESULTS

The proposed 6 inch HDPE leachate collection pipe will withstand against deflection, wall crushing, and wall buckling. The results are as follows:

Maximum Prism Load over LCRS Pipe=	165.01	psi	
(Approximately 200' fill over pipe)	23,761.25	psf	
Deflection			
Percent deflection=	1.87	%	
Allowable deflection =	2.70	%	**OK**
Wall Crushing			
FS= compressive yield strength / actual compressive stress	= 1.21		**OK**
Wall Buckling			
FS= critical buckling / prism load	= 11.14		**OK**

CALCULATIONS

Deflection

Modified Iowa Formula

$$\Delta Y = \frac{D_L K P r^3}{EI + 0.061 E' r^3}$$

Refer. 1

ΔY=	vertical deflection, in	ΔY=	0.1120	in	
D_L=	deflection lag factor	D_L=	1		*Refer. 1*
K=	bedding constant	K=	0.083		*Refer. 1*
P=	γH = pressure due to weight of soil at depth H (prism load), psi	P=	165.01	psi	*Refer. 1*
γ=	unit weight of soil, lb/ft^3				
H=	depth of pipe				
r=	(D-2t_{min})/2 = means radius of pipe, in.	r=	2.398	in	
D=	pipe outer diameter, in	D=	6	in	*LCRS Mainline*
t_{min}=	minimum wall thickness of pipe, in	t_{min}=	0.602	in	*for SDR 11*
E=	modulus of elasticity of pipe material, lb/in^2	E=	14,000	psi	
I=	(t_{min}^3)/12 = moment of inertia of pipe wall per unit length, in^3	I=	0.0182	in^3	
E'=	modulus of soil reaction, psi	E'=	2,000	psi	*Refer. 1* *assume coarse-grained soils no fines*

To determine E, find stress

$$\sigma_{rc} = \frac{SDR - 1}{2} P$$

		σ_{rc}=	825.04	psi	*Refer. 1, Attachment 1*
		Therefore E≈	14,000	psi	*Refer. 1*
σ_{rc}=	ring compressive stress, psi				*for long term of 50 years*
SDR=	standard dimension ratio	SDR=	11		

PRISM LOAD				
Layer	Unit Weight pcf	Thickness ft	Pressure psf	
Final Cover	120	5	600	
MSW	80	286	22880	
Operations	120	1.5	180	
LCRS Gravel	135	0.75	101.25	
		Total	23761.25	psf
			165.0087	psi

Pipe Stiffness

$$\frac{F}{\Delta y} = 0.559\mathrm{E}\left(\frac{t}{r}\right)^3 = \frac{6.7EI}{r^3}$$

F= force, lb/in

F/Δy=	123.8174	*Refer. 1*
(F/Δy)(SR)=	92.86307	
EI=	191.1242	

Strength Reduction Factor

SR= (no. slots per foot-slot width x no. slots per foot) / 12

SR=	0.7500		*Refer. 5*
slot width=	0.25	in	
no. slots per foot=	12		

Percent Deflection

$$\%\Delta Y = \frac{\Delta Y}{OD}100$$

%ΔY=	1.87	%	
Allowable %ΔY=	2.70	%	*For SDR 11*
	OK		

Wall Crushing

Factor of safety against wall crushing

$$FS = \frac{\sigma}{\sigma_{rc}}$$

FS= 1.21 **OK**

Refer. 3

σ= compressive yield strength, psi	σ=	1000	psi
σ_{rc}= actual ring compressive stress, psi	σ_{rc}=	825.04	psi

Wall Buckling

$$P_{cb} = 1.15\sqrt{E'P_{cr}}$$ *Refer. 1*

$$P_{cr} = \frac{2E}{1-v^2}\frac{t^3}{D}$$ *Refer. 1*

P_{cb}= critical buckling soil pressure at top of pipe	P_{cb}=	1837.577	psi
P_{cr}= critical buckling force in burried pipe	P_{cr}=	1276.632	psi
E= modulus of elasticity of pipe material, lb/in^2	E=	14,000	
E'= modulus of soil reaction, psi	E'=	2,000	
t= pipe thickness	t=	0.602	in
D= pipe diameter	D=	6	in
v = Poisson's ratio for pipe	v =	0.45	*for HDP pipe*

Factor of safety against wall buckling

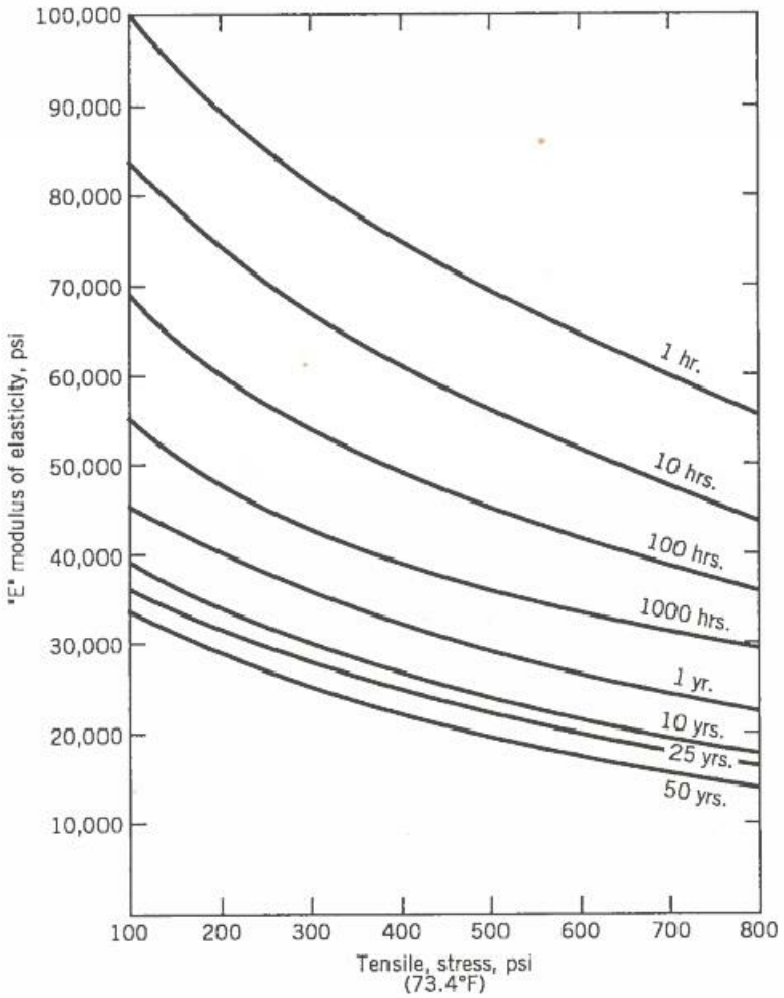
$$FS = \frac{P_{cb}}{P}$$

FS= 11.14 **OK**

P= pressure due to weight of soil at depth H (prism load), psi	P=	165.01	psi

REFERENCES

1. "Waste Containment Systems, Waste Stabilization and Landfills", Hari D. Sharmen and Sangeeta P. Lewis, 1994.
2. "Driscopipe Technical Note 21: HDPE Pipe Bending , Coiling, and Kind Resistance", May 1996.
3. Plastics Pipe Institute® Handbook of Polyethylene Pipe.
4. Isco Industries, LLC; Isco HDPE Product Catalog, 2013.
5. "Design Tables for Leachate Collection Pipe Spacing and Loading", Mark A. Swyka and James H. Fitzsimmons, September 1991.



NOTE: The short term modulus of elasticity of Driscopipe per ASTM D 638 is approximately 100,000 psi. Due to the cold flow (creep) characteristic of the pipe material, this modulus is dependent upon the stress intensity and the time duration of the applied stress.

Figure 9.35 Modulus of elasticity for PE pipe. (From Driscopipe, 1988.)

load and adding any significant live loads. A factor of safety of 2 is recommended by Moser (1990) and Driscopipe (1988), although both acknowledge that the critical buckling pressure equations produce conservative results.

9.3.4 Filtration and Clogging

Geotextiles are used in LCRSs to provide filtration and separation functions. As shown on Figure 9.36, geotextiles are typically placed above the drainage layer to maintain its permeability and to separate it from the overlying components. The

LCRS Pipe Capacity and LCRS Pipe Spacing

PROMONTORY POINT LANDFILL
PHASE 1
LCRS
Calculations

Job Number : 2015-0112
Calculated By: PV
Checked By: CHM
Date: 04-27-2016

DESIGN CALCULATION REQUIRED

Determine that the proposed LCRS pipe spacing are adequate for the site leachate generation as well as limits the leachate head to 12 inches or less. Insure the LCRS pipe and pipe perforations will convey the leachate sufficiently and clogging will not occur.

RESULTS

The proposed leachate collection pipe size, perforations, and spacing meet all requirements. The results are as follows:

Pipe Spacing at every 200' on center

maximum leachate head (in)	≤	12 inches	
3.914	≤	12	**OK**

Perforations of .25" Diameter Holes Against Clogging

50% size of filter material / slot width		≥	1	
	1	≥	1	**OK**

Perforations of .25" Diameter Holes Flow Capacity

allowable flow through perforations		>	actual flow through perforations	
	0.05572 cfs	>	9.29E-04 cfs	**OK**

Pipe Capacity

	full flow discharge	>	twice max leachate flow	
6" HDPE SDR 11 LCRS	0.55 cfs	>	0.13752 cfs	**OK**

CALCULATIONS

HELP Model Results

Used Worst Case Models for Base and Slope

Drainage Area			Max Head	Leachate Collected Per Acre			Total Leachate Collected	
Area	sf	acre	in	cf/day	cfs	gpm	cfs	gpm
Base	949,544	21.80	1.035	503.66	0.005829	2.616419	0.127072	57.03405
Slope	137,090	3.15	3.914	286.75	0.003319	1.489602	0.010445	4.68799
				Total	0.009148	Total	0.137517	61.72204

Pipe Spacing

Per Subtitle D regulations, depth of leachate over liner must be less than 12 inches. *Refer. 2*

h_{HELP} (in)	<	12	in	
3.914	<	12	in	**OK**

Pipe Perforations Against Clogging

$$\frac{\text{50\% size of filter material}}{\text{perf diameter}} = \frac{d_{50}}{D_{perf}} \geq 1$$ *Refer. 3*

$$1 \geq 1 \quad \textbf{OK}$$

d_{50}= 0.25 in *Specs Appendix C*

D_{perf}= 0.25 in

Perforation Size

Orifice Flow Equation

$$Q = Ca\sqrt{2gh}$$ *Refer. 4*

Q=	flow, cfs	Q=	0.05572	cfs
C=	orifice dishcarge coefficient	C=	0.6	*Refer. 4*
a=	area of perforation, sf	a=	0.01636	sf
g=	gravitational constant, ft/sec^2	g=	32.2	ft/sec^2
h=	hydraulic head, ft (pipe fully submerged)	h=	0.5	ft
D_{perf}=	Perf Diameter, ft	D_{perf}=	0.0208	ft
$\#_{perfs}$=	number of perfs per foot	$\#_{perfs}$=	12	
Q_{perf}=	allowable flow through perforations, cfs/ft	Q_{perf}=	0.6686	cfs/ft
Q_{help}=	maximum leachate flow from HELP model	Q_{help}=	0.137517	cfs
L_{pipe}=	critical pipe length, ft	L_{pipe}=	148	ft
q_{act}=	actual flow through perforations, cfs/ft	q_{act}=	0.000929	cfs/ft

allowable flow through perforations	>	actual flow through perforations	
0.05572	>	9.29E-04	**OK**

Pipe Capacity

Flowmaster Results for 6" HDPE SDR 11 LCRS pipe

Q_{flow}= full flow discharge, cfs Q_{flow}= 0.55 cfs

full flow discharge	>	max leachate flow	
0.55	>	0.13752	**OK**
cfs		cfs	

Note: Used maximum area going to each LCRS pipe size per plans

REFERENCES

1. "Leachate Flow Mound Equations for Steady-State Flow Over a Landfill Geosynthetic Bottom Liner". T. Masada, Geosynthetics International Vol. 5 No. 4, 1998.
2. "Waste Containment Systems, Waste Stabilization and Landfills", Hari D. Sharmen and Sangeeta P. Lewis, 1994.
3. "Checklist for Hazardous Waste Landfill Cover Design Technical Letter No. 1110-1-162", US Army Corps of Engineers, September 2001.
4. "Handbook of Hydraulics for the Solution of Hydraulic Engineering Problems" Sixth Edition. Brater and King, 1963.

HYDROLOGIC AND HYDRAULIC CALCULATIONS FOR STORMWATER DRAINAGE SYSTEMS

PROMONTORY POINT LANDFILL
PHASE 1
Hydrology
Calculations

Job Number : 2015-0112
Calculated By: JSN
Checked By: CHM
Date: 5-02-2016

Hydrology Method Used:

Design Event is the 25-year, 24-hour storm
Rational Method with SCS soil values

Site Size

Western Tribuatry = 15.67 Acres
Southern Tributary = 32.28 Acres
Total Tributary Area = 47.95 Acres

Approximate Size of Phase 1A = 20.6 Acres

Methodology Used

The TR55 software was developed by the USDA and uses the Soil Conservation Science method. TR55 was used to generate the Rational Method and determe runoff values. The time of concentration calculations were performed outside of the TR55 software using excel. Mannings equation velocities were calculated using Flowmaster software.

Rainfall Data

Obtained from NOAA website rainfall data for Atlas 14, Volume 1, Version 5.
The 2 year, 24 hour cumulative rainfall value is 1.37 inches.
The 25 year, 24 hour cumulative rainfall value is 2.25 inches.

SCS Rainfall Distribution

Type II based on site location - Intense Short Duration Rainfall

Soil Data

Native onsite soils contains various mixtures of silt, sand, and gravel. The web soil survey was used to determine boundaries between the various hydrological soil types. The interim run-on takes into account the areas of type A and type D soil. The native vegetation is sparse and the region is arid. The cover is described as desert shrub with poor condition.

Calculations

The time of concentration calculations were performed using information based on site conditions. The formulas used to determine time of concentration were Kirpich's and Manning's equations for overland sheet flow, shallow concentrated flow and channelized flow respectively

Assumptions

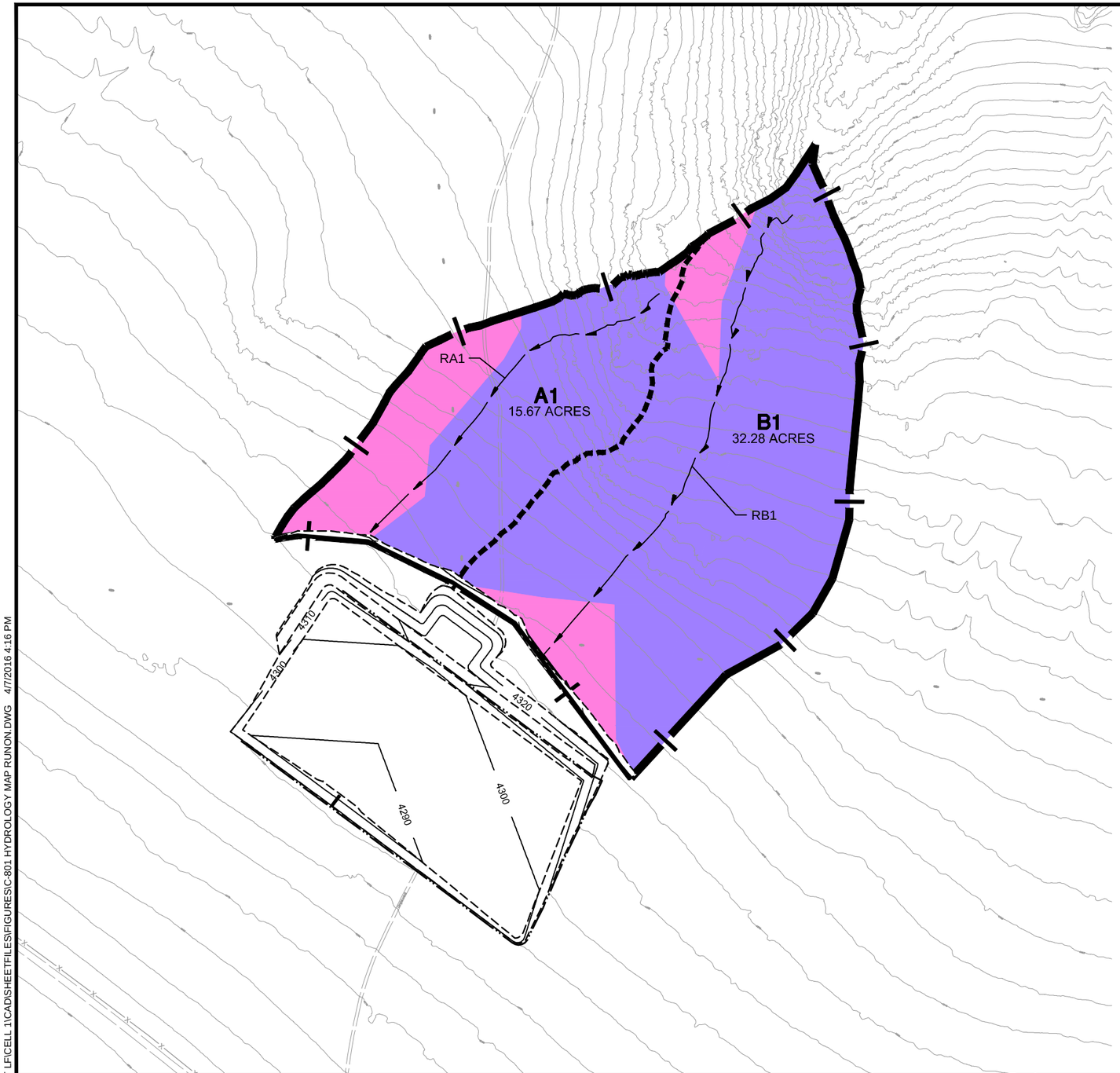
The undeveloped portions of land drains to large open areas with shallow flow. Native flows are intercepted by the diversion swales which prevent runon into the intial landfill cell. The diversion swales are sized to convey the eintire 25-yr, 24-hour storm event away from the landfill.

Runoff from within the landfill cell will be directed around the refuse mass and towards a ponding area to the north. The pond is sized to contain the entire volume during the 2-year event. The total area of the cell is 8.5 acres x 1.37 inches = 0.97 Acre-Feet which assumes complete runoff of the entire 2-year volume. The pond volume is approximately 1 acre-foot which exceeds the runoff from the 2-year event.

Soil Type A&D - Desert Shrub - Poor Cover- CN = 63 and 88 respectively; weighted based on area

Conclusion

The diversion channels are sized for the 48 acres of trihbutary run-on in the 25-year, 24-hour event. As additional cells are built, the diversion channel will be reconstructed above the cell expansion. As the landfill proceeds to the north, the tributary area becomes less and the channels remain appropriately sized.



25 - YEAR RUNOFF SUMMARY TABLE

SUBAREA	SUBAREA AREA Ac	SUBAREA RUNOFF (cfs)
A1	15.67	14.68
B1	32.28	41.72

N

0 200 400

SCALE:1"= 400'

LEGEND

- 50 — PROPOSED MAJOR CONTOUR
- 50 — EXISTING CONTOUR
- ULTIMATE LANDFILL GRADING
- FLOWLINE
- DRAINAGE TRIBUTARY AREA
- DRAINAGE SUB-AREA
- A1 — SUB-AREA LABEL
- RA1 — REACH IDENTIFIER
- 10.0AC — AREA IN ACRES
- HYDROLOGIC SOIL TYPE A
- HYDROLOGIC SOIL TYPE D

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
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PROMONTORY POINT, LLC

HYDROLOGY MAP (RUNON)

DESIGNED BY : DLL/VHY	FILE : C-801 Hydrology Map Runon.dwg		
DRAWN BY : PV / ANP	DATE : 12-2015	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 12-2015	FIGURE D-1	
APPROVED BY : CHM	DATE : 12-2015		

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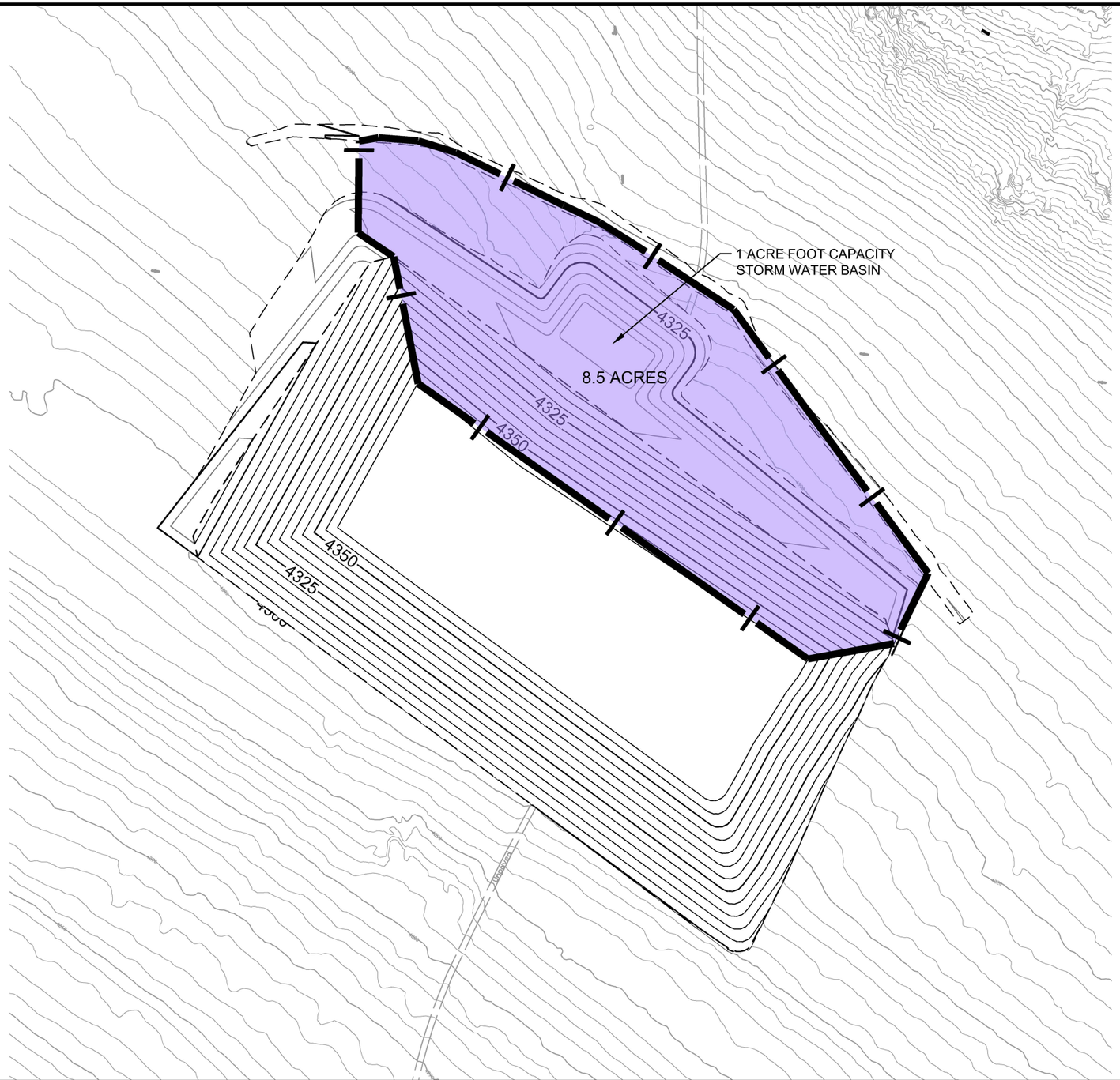

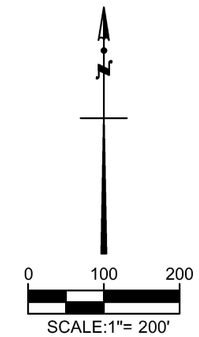

LEGEND

- 50 — EXISTING CONTOUR
- DAYLIGHT / GRADE BREAK
- DRAINAGE TRIBUTARY AREA
- HYDROLOGIC SOIL TYPE D

2 YEAR, 24 HOUR DEPTH = 1.37 INCHES
8.5 x 1.37 IN/12 = 0.97 ACRE FEET

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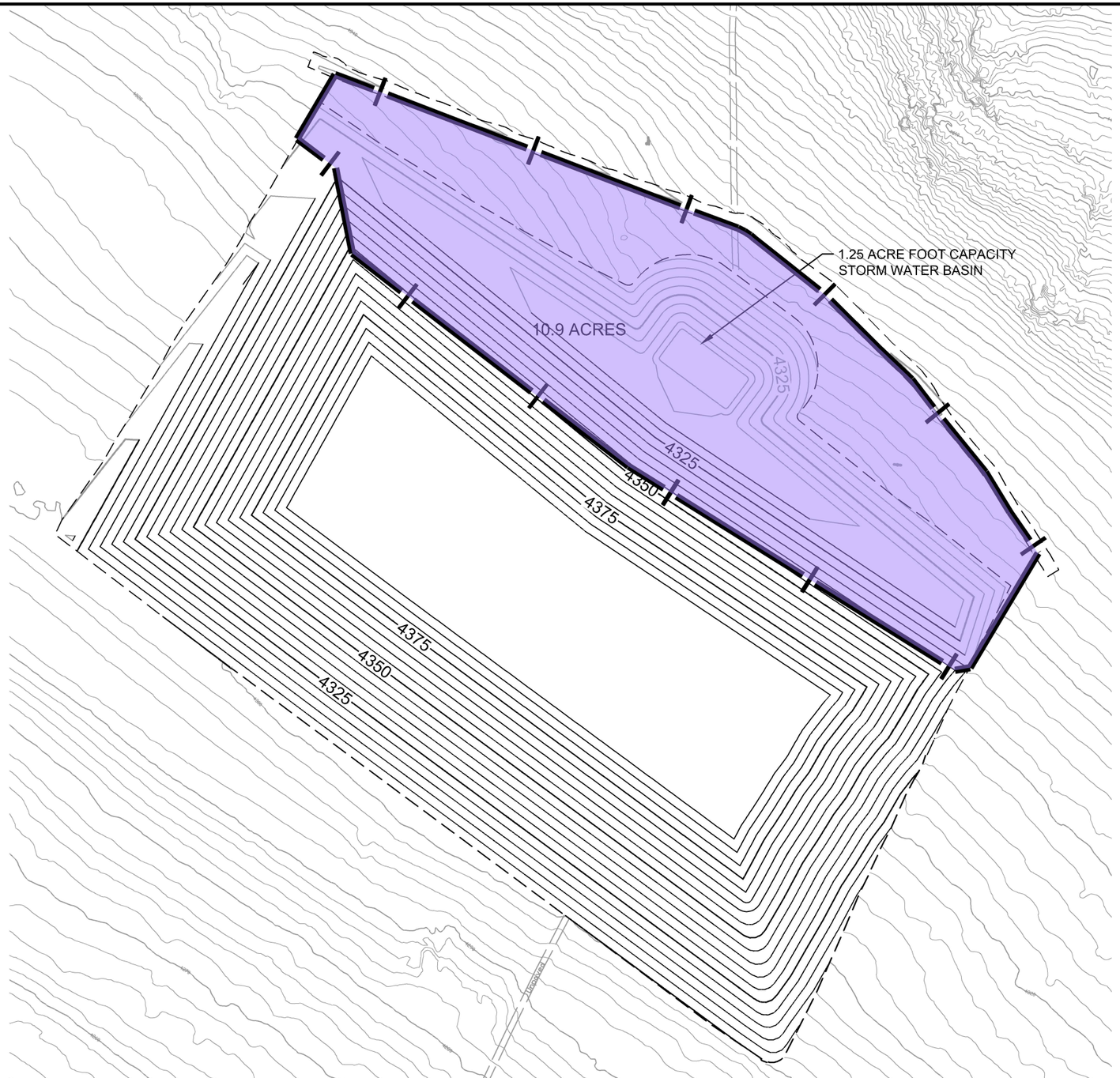
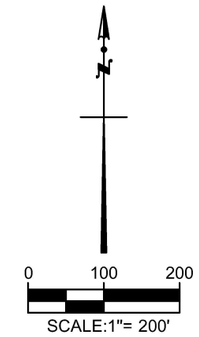
PROMONTORY POINT, LLC

HYDROLOGY MAP (PHASE 1A)

DESIGNED BY : DLL	FILE : C-802 Hydrology Map (PHASE 1A).dwg		
DRAWN BY : PV	DATE : 04-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 04-2016	FIGURE D-2	
APPROVED BY : CHM	DATE : 04-2016		





LEGEND

- 50 — EXISTING CONTOUR
- DAYLIGHT / GRADE BREAK
- DRAINAGE TRIBUTARY AREA
- HYDROLOGIC SOIL TYPE D

2 YEAR, 24 HOUR DEPTH = 1.37 INCHES
10.9 x 1.37 IN/12 = 1.24 ACRE FEET

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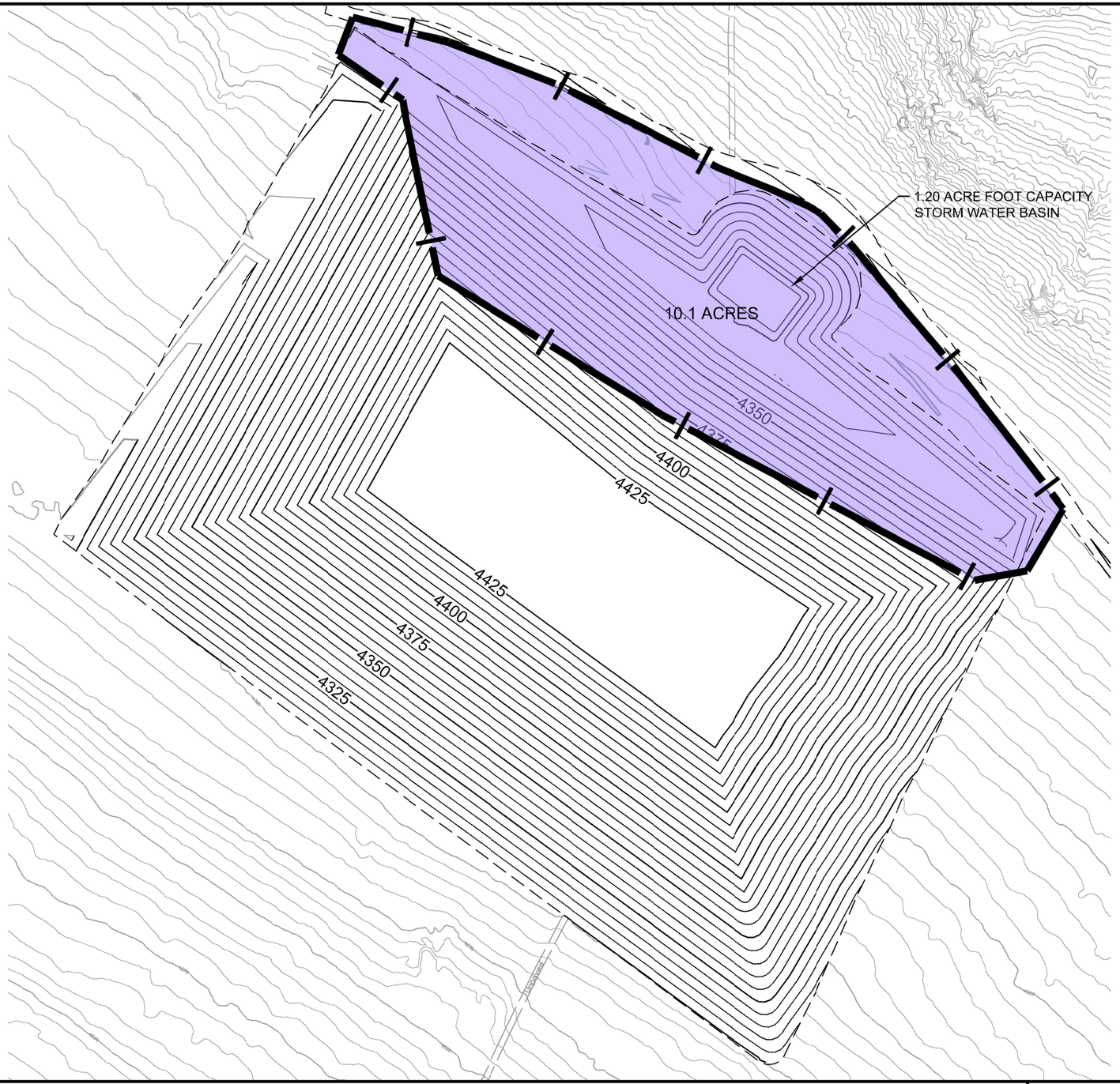
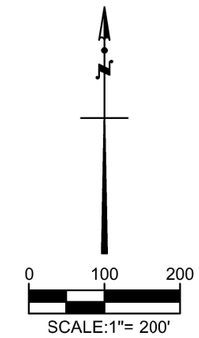
PROMONTORY POINT, LLC

HYDROLOGY MAP (PHASE 1B)

DESIGNED BY : DLL	FILE : C-803 Hydrology Map (PHASE 1B).dwg		
DRAWN BY : PV	DATE : 04-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 04-2016	FIGURE D-3	
APPROVED BY : CHM	DATE : 04-2016		





LEGEND

- 50 — EXISTING CONTOUR
- DAYLIGHT / GRADE BREAK
- DRAINAGE TRIBUTARY AREA
- HYDROLOGIC SOIL TYPE D

2 YEAR, 24 HOUR DEPTH = 1.37 INCHES
10.1 x 1.37 IN/12 = 1.16 ACRE FEET

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PROMONTORY POINT, LLC

HYDROLOGY MAP (PHASE 1C)

DESIGNED BY : DLL	FILE : C-804 Hydrology Map PH1C.dwg		
DRAWN BY : PV	DATE : 04-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 04-2016	FIGURE D-4	
APPROVED BY : CHM	DATE : 04-2016		

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NOAA Atlas 14, Volume 1, Version 5
Location name: Corinne, Utah, US*
Latitude: 41.2488°, Longitude: -112.4573°
Elevation: 5215 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.121 (0.106-0.140)	0.153 (0.135-0.178)	0.210 (0.184-0.244)	0.263 (0.228-0.306)	0.349 (0.296-0.408)	0.429 (0.352-0.506)	0.524 (0.417-0.624)	0.635 (0.487-0.771)	0.815 (0.592-1.01)	0.979 (0.680-1.25)
10-min	0.185 (0.161-0.214)	0.233 (0.205-0.271)	0.319 (0.279-0.371)	0.401 (0.347-0.466)	0.532 (0.450-0.622)	0.653 (0.537-0.771)	0.797 (0.635-0.950)	0.966 (0.741-1.17)	1.24 (0.901-1.54)	1.49 (1.03-1.90)
15-min	0.229 (0.199-0.265)	0.289 (0.254-0.336)	0.396 (0.346-0.460)	0.497 (0.430-0.577)	0.659 (0.557-0.771)	0.810 (0.665-0.955)	0.988 (0.786-1.18)	1.20 (0.919-1.46)	1.54 (1.12-1.92)	1.85 (1.28-2.35)
30-min	0.308 (0.268-0.357)	0.389 (0.342-0.452)	0.534 (0.467-0.620)	0.669 (0.580-0.778)	0.888 (0.751-1.04)	1.09 (0.896-1.29)	1.33 (1.06-1.59)	1.61 (1.24-1.96)	2.07 (1.50-2.58)	2.49 (1.73-3.17)
60-min	0.381 (0.331-0.441)	0.481 (0.423-0.559)	0.660 (0.577-0.767)	0.828 (0.717-0.962)	1.10 (0.929-1.28)	1.35 (1.11-1.59)	1.65 (1.31-1.96)	2.00 (1.53-2.43)	2.56 (1.86-3.19)	3.08 (2.14-3.92)
2-hr	0.481 (0.430-0.546)	0.601 (0.535-0.684)	0.783 (0.695-0.890)	0.955 (0.836-1.09)	1.24 (1.06-1.42)	1.49 (1.25-1.73)	1.80 (1.46-2.11)	2.16 (1.69-2.58)	2.74 (2.02-3.37)	3.26 (2.31-4.12)
3-hr	0.555 (0.503-0.623)	0.687 (0.621-0.774)	0.865 (0.779-0.974)	1.03 (0.921-1.16)	1.30 (1.14-1.47)	1.54 (1.32-1.76)	1.84 (1.53-2.14)	2.19 (1.77-2.59)	2.76 (2.13-3.40)	3.28 (2.43-4.16)
6-hr	0.724 (0.665-0.795)	0.888 (0.814-0.978)	1.08 (0.993-1.20)	1.26 (1.15-1.40)	1.53 (1.37-1.70)	1.75 (1.55-1.96)	2.01 (1.74-2.28)	2.31 (1.95-2.66)	2.88 (2.35-3.44)	3.38 (2.68-4.20)
12-hr	0.910 (0.838-0.993)	1.11 (1.03-1.22)	1.35 (1.24-1.48)	1.56 (1.43-1.71)	1.86 (1.68-2.06)	2.11 (1.88-2.35)	2.38 (2.08-2.68)	2.67 (2.29-3.04)	3.13 (2.60-3.65)	3.51 (2.85-4.23)
24-hr	1.11 (0.993-1.24)	1.37 (1.23-1.54)	1.67 (1.50-1.87)	1.91 (1.71-2.15)	2.25 (2.00-2.52)	2.51 (2.23-2.81)	2.78 (2.45-3.12)	3.04 (2.67-3.43)	3.41 (2.97-3.86)	3.70 (3.19-4.27)
2-day	1.27 (1.15-1.42)	1.57 (1.42-1.76)	1.91 (1.72-2.14)	2.19 (1.97-2.45)	2.58 (2.30-2.88)	2.88 (2.56-3.22)	3.19 (2.81-3.58)	3.51 (3.07-3.95)	3.94 (3.41-4.45)	4.27 (3.66-4.86)
3-day	1.37 (1.24-1.53)	1.70 (1.53-1.89)	2.07 (1.86-2.31)	2.37 (2.13-2.65)	2.79 (2.49-3.12)	3.13 (2.78-3.50)	3.47 (3.06-3.89)	3.83 (3.34-4.30)	4.30 (3.72-4.87)	4.68 (4.00-5.33)
4-day	1.47 (1.33-1.64)	1.82 (1.64-2.02)	2.22 (2.00-2.47)	2.56 (2.29-2.85)	3.01 (2.69-3.36)	3.38 (3.00-3.77)	3.76 (3.31-4.21)	4.14 (3.62-4.66)	4.67 (4.04-5.29)	5.09 (4.34-5.80)
7-day	1.70 (1.53-1.89)	2.10 (1.90-2.34)	2.56 (2.31-2.87)	2.94 (2.64-3.29)	3.46 (3.09-3.87)	3.87 (3.43-4.33)	4.29 (3.78-4.81)	4.71 (4.13-5.30)	5.28 (4.58-5.99)	5.72 (4.92-6.52)
10-day	1.88 (1.69-2.11)	2.33 (2.10-2.61)	2.84 (2.55-3.18)	3.25 (2.90-3.64)	3.79 (3.37-4.25)	4.21 (3.73-4.72)	4.63 (4.08-5.20)	5.05 (4.42-5.69)	5.60 (4.86-6.35)	6.02 (5.18-6.86)
20-day	2.39 (2.15-2.64)	2.96 (2.67-3.28)	3.57 (3.23-3.97)	4.05 (3.65-4.50)	4.66 (4.19-5.17)	5.11 (4.58-5.68)	5.55 (4.96-6.18)	5.97 (5.31-6.67)	6.52 (5.76-7.31)	6.91 (6.08-7.79)
30-day	2.86 (2.58-3.18)	3.54 (3.19-3.93)	4.27 (3.85-4.75)	4.83 (4.34-5.38)	5.56 (4.98-6.20)	6.10 (5.45-6.81)	6.63 (5.89-7.42)	7.14 (6.32-8.03)	7.80 (6.85-8.81)	8.29 (7.22-9.40)
45-day	3.48 (3.16-3.85)	4.30 (3.91-4.75)	5.16 (4.67-5.68)	5.81 (5.25-6.40)	6.63 (5.98-7.32)	7.23 (6.50-7.98)	7.81 (7.00-8.64)	8.36 (7.46-9.27)	9.04 (8.02-10.1)	9.53 (8.41-10.7)
60-day	4.11 (3.71-4.53)	5.07 (4.59-5.59)	6.06 (5.48-6.68)	6.81 (6.15-7.51)	7.76 (6.97-8.56)	8.44 (7.57-9.33)	9.10 (8.13-10.1)	9.73 (8.64-10.8)	10.5 (9.28-11.7)	11.1 (9.72-12.4)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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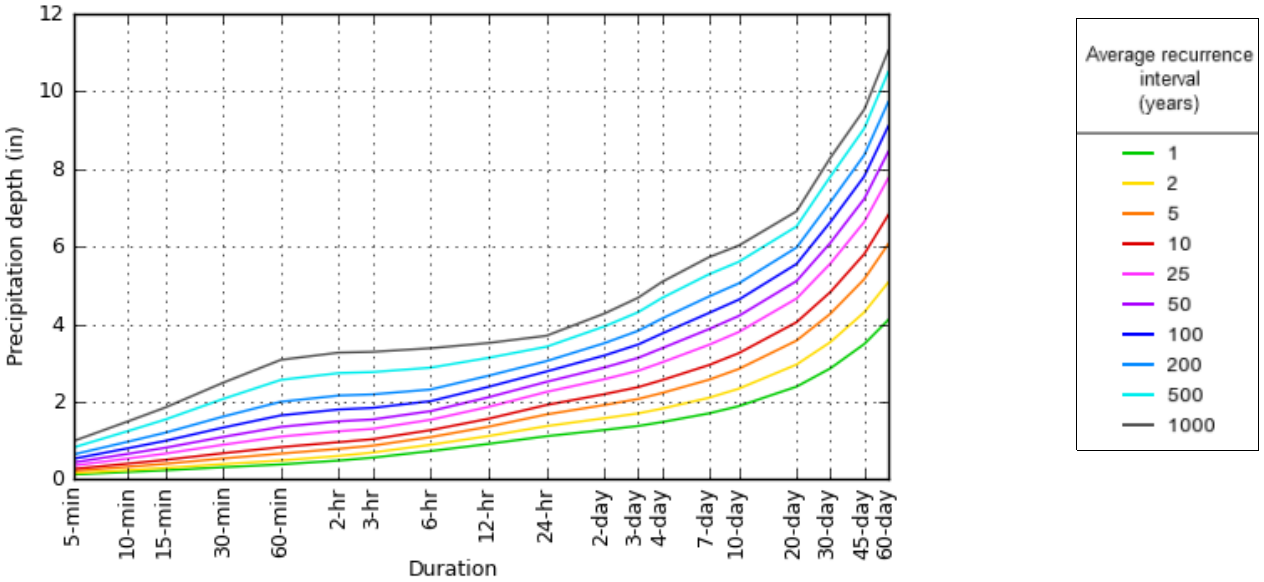
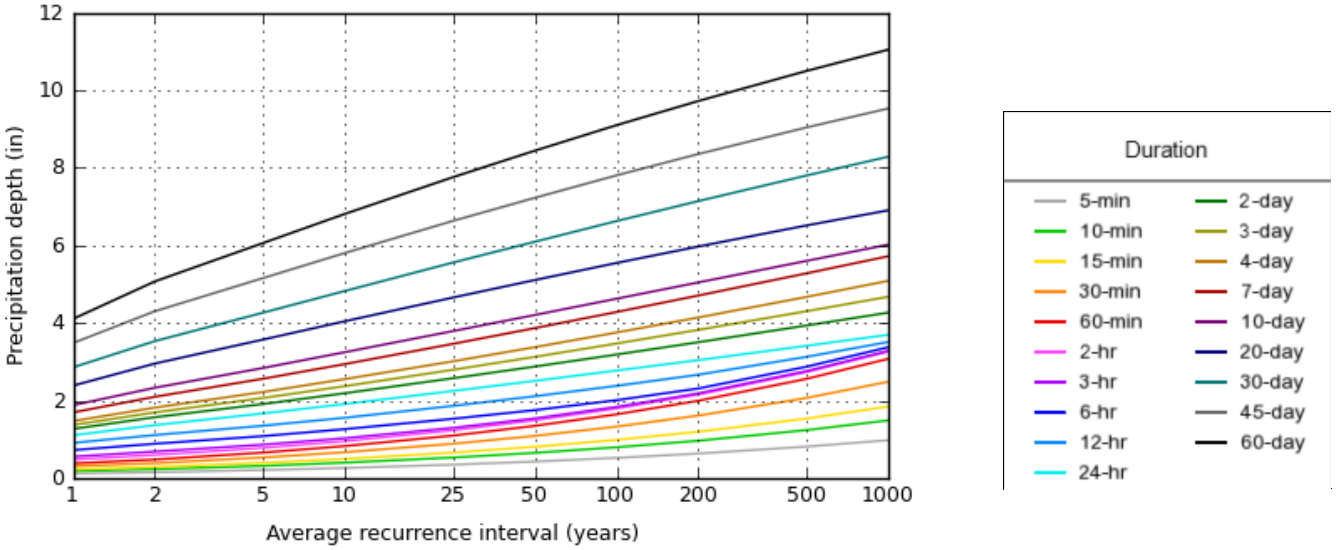
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 41.2488°, Longitude: -112.4573°





NOAA Atlas 14, Volume 1, Version 5 Created (GMT): Wed Mar 23 22:14:05 2016

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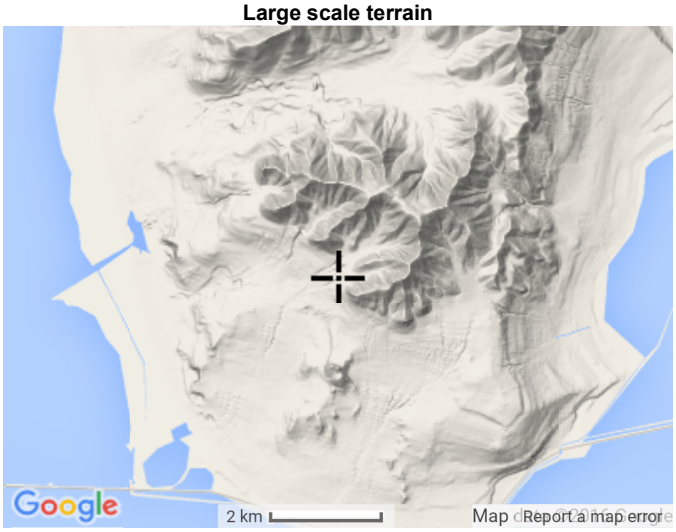
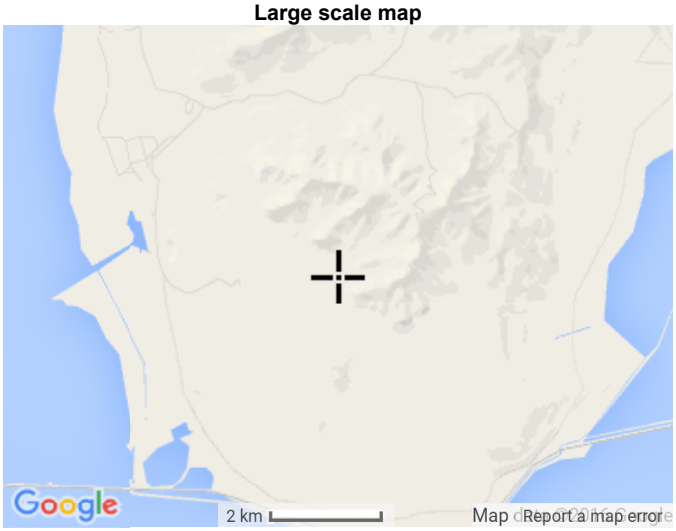
Maps & aerials

Small scale terrain

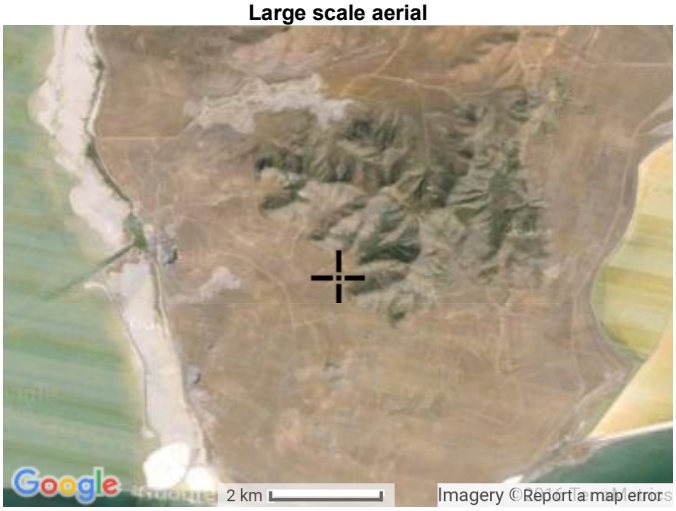
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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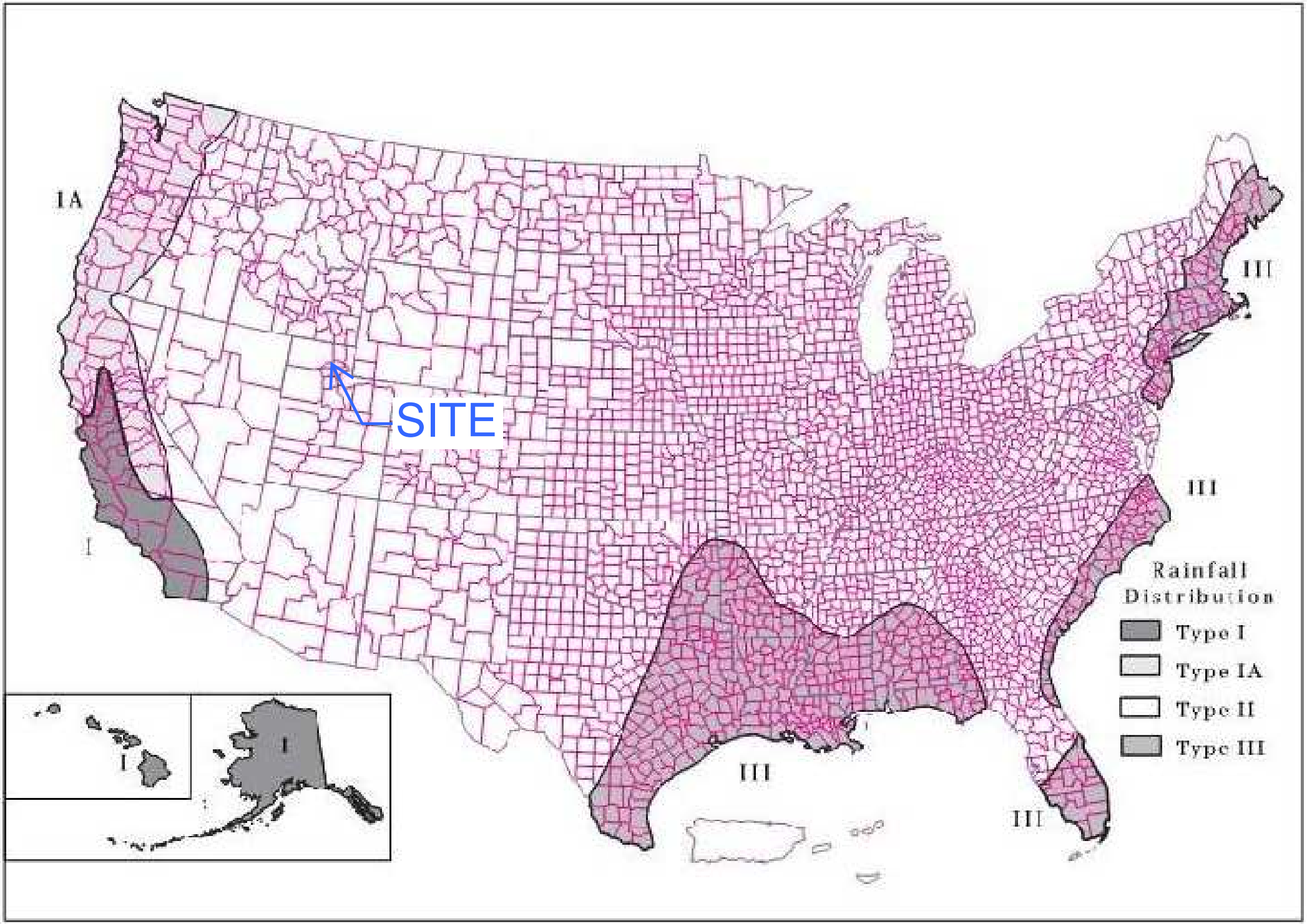
IA
III
SITE
III
I
Rainfall
Distribution
Type I
Type IA
Type II
Type III
III
III
I
I

United States Department of Agriculture
Natural Resources Conservation Service
Web Soil Survey
Contact Us | Subscribe | Archived Soil Surveys | Soil Survey Status | Glossary | Preferences | Link | Logout | Help
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Open All | Close All
Soil Chemical Properties
Soil Erosion Factors
Soil Physical Properties
Soil Qualities and Features
AASHTO Group Classification (Surface)
Depth to a Selected Soil Restrictive Layer
Depth to Any Soil Restrictive Layer
Drainage Class
Frost Action
Frost-Free Days
Hydrologic Soil Group
View Description | View Rating
View Options
Map
Table
Description of Rating
Rating Options
Detailed Description
Advanced Options
Aggregation Method Dominant Condition
Component Percent Cutoff
Tie-break Rule Lower Higher
View Description | View Rating
Map Unit Name
Parent Material Name
Representative Slope
Unified Soil Classification (Surface)
Water Features
Legend
Map — Hydrologic Soil Group
Scale (not to scale)

Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Box Elder County, Utah, Eastern Part (UT602)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
ABE	Abela gravelly loam, 10 to 20 percent slopes	B	511.4	2.8%
AEE	Abela stony loam, 6 to 20 percent slopes	C	198.2	1.1%
BgE	Blue Star gravelly loam, 6 to 20 percent slopes	A	1,479.4	8.0%
Bp	Borrow pits		49.0	0.3%
ETB	Etil loamy sand, 1 to 6 percent slopes	A	39.3	0.2%
Gp	Gravel pits		699.1	3.8%
HpB	Hupp gravelly silt loam, 1 to 6 percent slopes	A	1,077.1	5.8%
HpD	Hupp gravelly silt loam, 6 to 10 percent slopes	A	802.9	4.3%
KeB	Kearns silt loam, 1 to 3 percent slopes	B	214.9	1.2%
PAB	Palisade silt loam, 1 to 6 percent slopes	C	101.0	0.5%
PeD	Parleys silt loam, 6 to 10 percent slopes	C	461.1	2.5%
POE	Pass Canyon-Rock outcrop complex, 6 to 30 percent slopes	C	1,548.5	8.4%
RS	Rock land		713.0	3.8%
RT	Rock outcrop		97.4	0.5%
RWG	Rozlee-Rock outcrop complex, 30 to 70 percent slopes	C	66.3	0.4%
SA	Saltair silty clay loam, 0 to 1 percent slopes	C/D	32.1	0.2%
SGG	Sandall-Promo association, steep	C	1,433.4	7.7%
SHE	Sandall-Rock outcrop complex, 3 to 30 percent slopes	C	19.4	0.1%
SJG	Sandall-Rozlee association, steep	C	1,660.4	9.0%
SpF3	Sheeprock gravelly loam, 10 to 40 percent slopes, severely eroded	A	1,009.1	5.4%
SvB	Stingal loam, 1 to 6 percent slopes	B	592.2	3.2%
Sx	Stony alluvial land		65.3	0.4%
ToC	Timpanogos silt loam, 6 to 10 percent slopes	B	50.6	0.3%
W	Water		66.6	0.4%
WS	Water, saline		4,972.8	26.8%
YHG	Yeates Hollow cobbly clay loam, 30 to 60 percent slopes	D	584.1	3.1%
Totals for Area of Interest			**18,544.6**	**100.0%**

Description — Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options — Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

PROMONTORY POINT - Phase 1 Tributary Run-on Areas

Tributary Area by Soil Type

	Type A (acres)	Type B (acres)	Type C (acres)	Type D (acres)	Total Area
A1	5.15	0.00	0.00	10.52	15.67
B1	4.12	0.00	0.00	28.16	32.28
Total	9.27	0.00	0.00	38.68	47.95

Promontory Point Landfill Hydrology Calculations

Kirpich + Mannings Time of Concentration Calculations

Cell 1 Diversion Channel Interim Condition

$$t_c = 0.0078 \left(\frac{L \times L}{S}\right)^{0.385}$$ Sheet Flow

$$V = 16.1345 \, (s)^{0.5}$$ Shallow Concentrated Flow

$$V = 1.49 \frac{R^{0.66} \, S^{0.50}}{n}$$ Channelized Flow

L = Longest Flow Path (ft)
S = Slope (ft/ft)
R = Hydraulic Radius (ft)
n = Mannings Roughness Coefficient
V = Velocity (ft/sec)
K = Kirpich Method
M = Mannings Method

	A (Acres)	Method	L			S	Velocity (ft/s)	t_c (min.)				t_c (hr.)
A1	15.67	K	100'	4522-4512 / 100	=	0.1000		0.66 min	x	1 hr / 60 min	=	0.0109 hr.
		M	150'	4512-4506 / 150	=	0.0400	3.23	0.77 min	x	1 hr / 60 min	=	0.0129 hr.
		M	1,350'	4506-4330 / 1350	=	0.1304	2.36	9.53 min	x	1 hr / 60 min	=	0.1589 hr.
		M	290'	4330-4320 / 290	=	0.0345	5.87	0.82 min	x	1 hr / 60 min	=	0.0137 hr.
B1	33.24	K	100'	4654-4644 / 100	=	0.1000		2.30 min	x	1 hr / 60 min	=	0.0383 hr.
		M	150'	4644-4600 / 150	=	0.2933	8.74	0.29 min	x	1 hr / 60 min	=	0.0048 hr.

TETRA TECH
BAS

Promontory Point Landfill Hydrology Calculations

Kirpich + Mannings Time of Concentration Calculations

Cell 1 Diversion Channel Interim Condition

M	1,810'	$\frac{4600-4337}{1810}$	=	0.1453	3.68	8.20 min	x	$\frac{1\ hr}{60\ min}$	=	0.1366 hr.
M	500'	$\frac{4337-4332}{500}$	=	0.0100	5.11	1.63 min	x	$\frac{1\ hr}{60\ min}$	=	0.0272 hr.

TETRA TECH
BAS

Tc Calc - Reach RA1 Upper

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.13040	ft/ft
Left Side Slope	20.00	ft/ft (H:V)
Right Side Slope	20.00	ft/ft (H:V)
Bottom Width	100.00	ft
Discharge	14.68	ft^3/s

Results

Normal Depth	0.06	ft
Flow Area	6.21	ft^2
Wetted Perimeter	102.46	ft
Hydraulic Radius	0.06	ft
Top Width	102.45	ft
Critical Depth	0.09	ft
Critical Slope	0.04051	ft/ft
Velocity	2.36	ft/s
Velocity Head	0.09	ft
Specific Energy	0.15	ft
Froude Number	1.69	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.06	ft
Critical Depth	0.09	ft
Channel Slope	0.13040	ft/ft

Tc Calc - Reach RA1 Upper

GVF Output Data

Critical Slope	0.04051	ft/ft

Tc Calc - Reach RA1 Lower

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03000	ft/ft
Discharge	14.68	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
1+00	1.67
1+10	0.15
1+11	0.00
1+15	1.67

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00, 1.67)	(1+10, 0.15)	0.020
(1+10, 0.15)	(1+15, 1.67)	0.025

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.75	ft
Elevation Range	0.00 to 1.67 ft	
Flow Area	2.50	ft²
Wetted Perimeter	6.91	ft
Hydraulic Radius	0.36	ft
Top Width	6.70	ft
Normal Depth	0.75	ft
Critical Depth	0.92	ft

Tc Calc - Reach RA1 Lower

Results

Critical Slope		0.00974	ft/ft
Velocity		5.87	ft/s
Velocity Head		0.53	ft
Specific Energy		1.28	ft
Froude Number		1.69	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.75	ft
Critical Depth	0.92	ft
Channel Slope	0.03000	ft/ft
Critical Slope	0.00974	ft/ft

Tc Calc - Reach RB1 Upper

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.14530	ft/ft
Left Side Slope	20.00	ft/ft (H:V)
Right Side Slope	20.00	ft/ft (H:V)
Bottom Width	100.00	ft
Discharge	41.72	ft^3/s

Results

Normal Depth	0.11	ft
Flow Area	11.33	ft^2
Wetted Perimeter	104.44	ft
Hydraulic Radius	0.11	ft
Top Width	104.43	ft
Critical Depth	0.17	ft
Critical Slope	0.03237	ft/ft
Velocity	3.68	ft/s
Velocity Head	0.21	ft
Specific Energy	0.32	ft
Froude Number	1.97	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.11	ft
Critical Depth	0.17	ft
Channel Slope	0.14530	ft/ft

Tc Calc - Reach RB1 Upper

GVF Output Data

Critical Slope	0.03237	ft/ft

Tc Calc - Reach RB1 Lower

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Discharge	41.72	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
1+00	1.67
1+10	0.15
1+11	0.00
1+15	1.67

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+00, 1.67)	(1+10, 0.15)	0.020
(1+10, 0.15)	(1+15, 1.67)	0.025

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.35	ft
Elevation Range	0.00 to 1.67 ft	
Flow Area	8.17	ft²
Wetted Perimeter	12.48	ft
Hydraulic Radius	0.65	ft
Top Width	12.11	ft
Normal Depth	1.35	ft
Critical Depth	1.40	ft

Tc Calc - Reach RB1 Lower

Results

Critical Slope		0.00822	ft/ft
Velocity		5.11	ft/s
Velocity Head		0.41	ft
Specific Energy		1.75	ft
Froude Number		1.10	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.35	ft
Critical Depth	1.40	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00822	ft/ft

WinTR-55 Current Data Description

--- Identification Data ---

User: JSN
Project: Promontory Point
SubTitle:
State: Utah
County: Box Elder
Filename: P:\Prom Pt LLC\Prom Pt LF\Cell 1\SupportDocs\Calcs\Hydro\Promontory 25 yr Phase 1.w55

Date: 4/7/2016
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
A1	West Channel	Outlet	15.67	80	0.196
B1	East Channel	Outlet	32.28	85	0.207

Total area: 47.95 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1000-Yr (in)
1.37	1.67	1.91	2.25	2.51	2.78	3.7

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

JSN Promontory Point

Box Elder County, Utah

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1000-Yr (in)
1.37	1.67	1.91	2.25	2.51	2.78	3.7

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

JSN Promontory Point

Box Elder County, Utah

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 25-Yr (cfs)
SUBAREAS	
A1	14.68
B1	41.72
REACHES	
OUTLET	56.38

JSN Promontory Point

Box Elder County, Utah

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 25-Yr (cfs)	(hr)
SUBAREAS		
A1	14.68	12.03
B1	41.72	12.03
REACHES		
OUTLET	56.38	

JSN Promontory Point

Box Elder County, Utah

Structure Output Table

Reach Identifier	Peak Flow (PF), Storage Volume (SV), Stage (STG) by Rainfall Return Period
Structure Identifier	25-Yr

JSN Promontory Point

Box Elder County, Utah

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
A1	15.67	0.196	80	Outlet	West Channel
B1	32.28	0.207	85	Outlet	East Channel

Total Area: 47.95 (ac)

JSN Promontory Point

Box Elder County, Utah

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
A1							
User-provided							0.196
					Time of Concentration		0.196
B1							
User-provided							0.207
					Time of Concentration		0.207

Box Elder County, Utah

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
A1	Desert shrub	(poor)	A	5.15	63
	Desert shrub	(poor)	D	10.52	88
	Total Area / Weighted Curve Number			15.67	80
				=====	==
B1	Desert shrub	(poor)	A	4.12	63
	Desert shrub	(poor)	D	28.16	88
	Total Area / Weighted Curve Number			32.28	85
				=====	==

Promontory Point Landfill

Shear Stress Calculation

Diversion Channel - Cell 1

Uniform Flow Calculation

West Channel

$\tau = \gamma \times d \times s$

τ =	shear stress		
γ =	unit weight of water =	62.4	lb/ft^3
d =	depth of flow =	0.92	ft
s =	channel slope =	0.03	

τ = **1.722** lb/ft2

v = velocity 6.77 ft/s

Max Erosion Control Blanket Shear Stress 3 psf

F.S. = **1.74**

East Channel

τ =	shear stress		
γ =	unit weight of water =	62.4	lb/ft^3
d =	depth of flow =	1.47	ft
s =	channel slope =	0.01	

East Channel

τ = **0.917** lb/ft2

v = velocity 5.41 ft/s

Max Erosion Control Blanket Shear Stress 3 psf

F.S. = **3.27**

LEACHATE GENERATION – HELP MODELING

```
WARNING:  TEMPERATURE FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR    1

WARNING:  SOLAR RADIATION FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR    1

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\data4.D4
TEMPERATURE DATA FILE:      C:\HELP3\data7.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\data13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\data11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\base2.D10
OUTPUT DATA FILE:           C:\HELP3\run9.OUT


TIME:  12:12     DATE:   4/27/2016


******************************************************************************

     TITLE:  PROMONTORY POINT   BASE OPTION 1 - INTERMEDIATE CONDITION

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  22
          THICKNESS                   =     12.00   INCHES
          POROSITY                    =      0.4190 VOL/VOL
          FIELD CAPACITY              =      0.3070 VOL/VOL
          WILTING POINT               =      0.1800 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.3875 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.189999992000E-04 CM/SEC
```

```
                         LAYER  2
                         --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
THICKNESS                   =    240.00   INCHES
POROSITY                    =      0.6710 VOL/VOL
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2919 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                         LAYER  3
                         --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  22
THICKNESS                   =     18.00   INCHES
POROSITY                    =      0.4190 VOL/VOL
FIELD CAPACITY              =      0.3070 VOL/VOL
WILTING POINT               =      0.1800 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.3093 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.189999992000E-04 CM/SEC


                         LAYER  4
                         --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  21
THICKNESS                   =      9.00   INCHES
POROSITY                    =      0.3970 VOL/VOL
FIELD CAPACITY              =      0.0320 VOL/VOL
WILTING POINT               =      0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0335 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.300000012000     CM/SEC
SLOPE                       =      3.00   PERCENT
DRAINAGE LENGTH             =    200.0    FEET


                         LAYER  5
                         --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.60   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      3.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD
```

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                              LAYER  6
                              --------

                   TYPE 3 - BARRIER SOIL LINER
                   MATERIAL TEXTURE NUMBER  51
   THICKNESS                    =      0.50   INCHES
   POROSITY                     =      0.5500 VOL/VOL
   FIELD CAPACITY               =      0.4000 VOL/VOL
   WILTING POINT                =      0.2000 VOL/VOL
   INITIAL SOIL WATER CONTENT   =      0.5500 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.999999972000E-09 CM/SEC


           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #22 WITH BARE
          GROUND CONDITIONS, A SURFACE SLOPE OF  2.% AND
          A SLOPE LENGTH OF 2000. FEET.

SCS RUNOFF CURVE NUMBER             =     96.50
FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =     16.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      5.801  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      7.712  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.468  INCHES
INITIAL SNOW WATER                  =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =     80.856  INCHES
TOTAL INITIAL WATER                 =     80.856  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR


            EVAPOTRANSPIRATION AND WEATHER DATA
            -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          SALT LAKE CITY        UTAH

     STATION LATITUDE                        =  40.76 DEGREES
     MAXIMUM LEAF AREA INDEX                 =   0.00
     START OF GROWING SEASON (JULIAN DATE)   =    117
     END OF GROWING SEASON (JULIAN DATE)     =    289
     EVAPORATIVE ZONE DEPTH                  =  16.0  INCHES
     AVERAGE ANNUAL WIND SPEED               =   8.80 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  67.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  48.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  39.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  65.00 %


 NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
```

COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.38	1.84	3.19	3.34	3.26	0.70
1.54	3.42	4.05	2.48	2.47	6.26

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	34.10	40.70	49.20	58.80	68.30
77.50	74.90	65.00	53.00	39.70	30.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH
AND STATION LATITUDE = 40.76 DEGREES

WARNING: TEMPERATURE FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR 1

WARNING: SOLAR RADIATION FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR 1

****

ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.03	112638.922	100.00
RUNOFF	12.967	47069.223	41.79
EVAPOTRANSPIRATION	16.823	61066.055	54.21
DRAINAGE COLLECTED FROM LAYER 4	1.3180	4784.453	4.25
PERC./LEAKAGE THROUGH LAYER 6	0.000002	0.007	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0142		
CHANGE IN WATER STORAGE	-0.077	-280.852	-0.25
SOIL WATER AT START OF YEAR	80.856	293507.344	
SOIL WATER AT END OF YEAR	80.779	293226.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

ANNUAL WATER BUDGET BALANCE	0.0000	0.036	0.00

****

WARNING: TEMPERATURE FOR YEAR 1975 USED WITH PRECIPITATION FOR YEAR 2

WARNING: SOLAR RADIATION FOR YEAR 1975 USED WITH PRECIPITATION FOR YEAR 2

****

ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.04	138085.219	100.00
RUNOFF	17.624	63974.258	46.33
EVAPOTRANSPIRATION	17.555	63724.527	46.15
DRAINAGE COLLECTED FROM LAYER 4	2.2290	8091.142	5.86
PERC./LEAKAGE THROUGH LAYER 6	0.000002	0.009	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0241		
CHANGE IN WATER STORAGE	0.632	2295.285	1.66
SOIL WATER AT START OF YEAR	80.779	293226.500	
SOIL WATER AT END OF YEAR	79.763	289539.719	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.648	5982.059	4.33
ANNUAL WATER BUDGET BALANCE	0.0000	-0.001	0.00

****

WARNING: TEMPERATURE FOR YEAR 1976 USED WITH PRECIPITATION FOR YEAR 3

WARNING: SOLAR RADIATION FOR YEAR 1976 USED WITH PRECIPITATION FOR YEAR 3

****

ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	22.72	82473.617	100.00

RUNOFF	5.355	19437.057	23.57
EVAPOTRANSPIRATION	14.207	51571.297	62.53
DRAINAGE COLLECTED FROM LAYER 4	0.8203	2977.853	3.61
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.004	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0087		
CHANGE IN WATER STORAGE	2.338	8487.372	10.29
SOIL WATER AT START OF YEAR	79.763	289539.719	
SOIL WATER AT END OF YEAR	78.928	286507.062	
SNOW WATER AT START OF YEAR	1.648	5982.059	7.25
SNOW WATER AT END OF YEAR	4.822	17502.084	21.22
ANNUAL WATER BUDGET BALANCE	0.0000	0.035	0.00

****

WARNING: TEMPERATURE FOR YEAR 1977 USED WITH PRECIPITATION FOR YEAR 4

WARNING: SOLAR RADIATION FOR YEAR 1977 USED WITH PRECIPITATION FOR YEAR 4

****

ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.21	142332.312	100.00
RUNOFF	22.764	82632.008	58.06
EVAPOTRANSPIRATION	18.582	67452.437	47.39
DRAINAGE COLLECTED FROM LAYER 4	0.7476	2713.805	1.91
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.005	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0080		
CHANGE IN WATER STORAGE	-2.883	-10465.972	-7.35
SOIL WATER AT START OF YEAR	78.928	286507.062	
SOIL WATER AT END OF YEAR	79.926	290131.219	
SNOW WATER AT START OF YEAR	4.822	17502.084	12.30
SNOW WATER AT END OF YEAR	0.940	3411.956	2.40
ANNUAL WATER BUDGET BALANCE	0.0000	0.020	0.00

****

WARNING: TEMPERATURE FOR YEAR 1978 USED WITH PRECIPITATION FOR YEAR 5

WARNING: SOLAR RADIATION FOR YEAR 1978 USED WITH PRECIPITATION FOR YEAR 5

****

ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	26.31	95505.312	100.00
RUNOFF	10.057	36506.867	38.22
EVAPOTRANSPIRATION	14.597	52987.602	55.48
DRAINAGE COLLECTED FROM LAYER 4	1.3574	4927.304	5.16
PERC./LEAKAGE THROUGH LAYER 6	0.000002	0.006	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0147		
CHANGE IN WATER STORAGE	0.298	1083.544	1.13
SOIL WATER AT START OF YEAR	79.926	290131.219	
SOIL WATER AT END OF YEAR	79.763	289540.437	
SNOW WATER AT START OF YEAR	0.940	3411.956	3.57
SNOW WATER AT END OF YEAR	1.401	5086.283	5.33
ANNUAL WATER BUDGET BALANCE	0.0000	-0.010	0.00

****

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.92	1.96	3.53	2.25	3.25	0.70
	1.07	5.17	3.18	2.21	1.48	5.73
STD. DEVIATIONS	0.84	0.93	0.54	1.11	1.86	0.48
	0.20	3.80	1.58	1.28	0.61	1.43

```
RUNOFF
------
  TOTALS                  1.366    0.968    1.407    0.627    1.214    0.041
                          0.155    2.951    1.562    0.915    0.440    2.106

  STD. DEVIATIONS         1.942    0.890    0.614    0.807    0.941    0.081
                          0.083    2.703    0.998    0.829    0.382    1.992

EVAPOTRANSPIRATION
------------------
  TOTALS                  0.411    1.118    2.269    2.122    2.447    0.672
                          0.629    2.189    1.904    0.969    0.889    0.734

  STD. DEVIATIONS         0.230    0.570    0.383    0.725    1.094    0.151
                          0.240    1.368    0.423    0.702    0.411    0.111

LATERAL DRAINAGE COLLECTED FROM LAYER  4
----------------------------------------
  TOTALS                  0.0838   0.1260   0.4922   0.4794   0.0963   0.0010
                          0.0003   0.0011   0.0018   0.0005   0.0002   0.0119

  STD. DEVIATIONS         0.1589   0.1044   0.3017   0.4348   0.1794   0.0009
                          0.0005   0.0018   0.0035   0.0009   0.0005   0.0264

PERCOLATION/LEAKAGE THROUGH LAYER  6
-------------------------------------
  TOTALS                  0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


DAILY AVERAGE HEAD ON TOP OF LAYER  5
-------------------------------------
  AVERAGES                0.0106   0.0176   0.0623   0.0627   0.0122   0.0001
                          0.0000   0.0001   0.0002   0.0001   0.0000   0.0015

  STD. DEVIATIONS         0.0201   0.0147   0.0382   0.0569   0.0227   0.0001
                          0.0001   0.0002   0.0005   0.0001   0.0001   0.0033
*******************************************************************************


*******************************************************************************

    AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH    5
-------------------------------------------------------------------------------
                                     INCHES            CU. FEET       PERCENT
                                 -------------------  -------------   ---------
 PRECIPITATION                    31.46    (   7.184)     114207.1     100.00

 RUNOFF                           13.753   (  6.7266)      49923.89     43.713

 EVAPOTRANSPIRATION               16.353   (  1.8922)      59360.39     51.976

 LATERAL DRAINAGE COLLECTED        1.29447 (  0.59196)      4698.911    4.11438
```

```
  FROM LAYER  4

 PERCOLATION/LEAKAGE THROUGH     0.00000 (  0.00000)         0.006     0.00001
   LAYER  6

 AVERAGE HEAD ON TOP             0.014 (    0.006)
   OF LAYER  5

 CHANGE IN WATER STORAGE         0.062   (  1.8878)        223.88      0.196
******************************************************************************


******************************************************************************

              PEAK DAILY VALUES FOR YEARS    1 THROUGH    5
   ------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                              3.26         11833.800

      RUNOFF                                     2.662         9662.6523

      DRAINAGE COLLECTED FROM LAYER  4           0.13875        503.65906

      PERCOLATION/LEAKAGE THROUGH LAYER  6       0.000000         0.00021

      AVERAGE HEAD ON TOP OF LAYER  5            0.544

      MAXIMUM HEAD ON TOP OF LAYER  5            1.035

      LOCATION OF MAXIMUM HEAD IN LAYER  4
            (DISTANCE FROM DRAIN)                9.7 FEET

      SNOW WATER                                 5.56         20170.4160


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.3737

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1583

       ***  Maximum heads are computed using McEnroe's equations.  ***

            Reference:  Maximum Saturated Depth over Landfill Liner
                        by Bruce M. McEnroe, University of Kansas
                        ASCE Journal of Environmental Engineering
                        Vol. 119, No. 2, March 1993, pp. 262-270.

******************************************************************************


******************************************************************************

                  FINAL WATER STORAGE AT END OF YEAR    5
    ------------------------------------------------------------------
                   LAYER        (INCHES)       (VOL/VOL)
```

1	4.2165	0.3514
2	69.4577	0.2894
3	5.5260	0.3070
4	0.2880	0.0320
5	0.0000	0.0000
6	0.2750	0.5500
SNOW WATER	1.401	

****
****

```
WARNING:  TEMPERATURE FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR    1

WARNING:  SOLAR RADIATION FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR    1

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\data4.D4
TEMPERATURE DATA FILE:      C:\HELP3\data7.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\data13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\data11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\run1.D10
OUTPUT DATA FILE:           C:\HELP3\run1.OUT


TIME:  11:15     DATE:   4/27/2016


******************************************************************************

     TITLE:  PROMONTORY POINT     BASE OPTION 2 - INTERMEDIATE CONDITION

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  22
          THICKNESS                   =     12.00   INCHES
          POROSITY                    =      0.4190 VOL/VOL
          FIELD CAPACITY              =      0.3070 VOL/VOL
          WILTING POINT               =      0.1800 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.3875 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.189999992000E-04 CM/SEC
```

```
                         LAYER  2
                         --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
THICKNESS                   =    240.00   INCHES
POROSITY                    =      0.6710 VOL/VOL
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2919 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                         LAYER  3
                         --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =     18.00   INCHES
POROSITY                    =      0.4170 VOL/VOL
FIELD CAPACITY              =      0.0450 VOL/VOL
WILTING POINT               =      0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0453 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000001000     CM/SEC
SLOPE                       =      3.00   PERCENT
DRAINAGE LENGTH             =    200.0    FEET


                         LAYER  4
                         --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.60   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      3.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                         LAYER  5
                         --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  51
THICKNESS                   =      0.50   INCHES
POROSITY                    =      0.5500 VOL/VOL
FIELD CAPACITY              =      0.4000 VOL/VOL
WILTING POINT               =      0.2000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.5500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.999999972000E-09 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #22 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 2000. FEET.

SCS RUNOFF CURVE NUMBER	=	96.50	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	16.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	5.801	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.712	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.468	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	75.804	INCHES
TOTAL INITIAL WATER	=	75.804	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM SALT LAKE CITY UTAH

STATION LATITUDE	=	40.76	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	117	
END OF GROWING SEASON (JULIAN DATE)	=	289	
EVAPORATIVE ZONE DEPTH	=	16.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	8.80	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	48.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	39.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	65.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.38	1.84	3.19	3.34	3.26	0.70
1.54	3.42	4.05	2.48	2.47	6.26

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	34.10	40.70	49.20	58.80	68.30
77.50	74.90	65.00	53.00	39.70	30.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH
AND STATION LATITUDE = 40.76 DEGREES

WARNING: TEMPERATURE FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR 1

WARNING: SOLAR RADIATION FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR 1

****

ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.03	112638.922	100.00
RUNOFF	12.967	47069.223	41.79
EVAPOTRANSPIRATION	16.823	61066.055	54.21
DRAINAGE COLLECTED FROM LAYER 3	1.2673	4600.424	4.08
PERC./LEAKAGE THROUGH LAYER 5	0.000003	0.013	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0434		
CHANGE IN WATER STORAGE	-0.027	-96.821	-0.09
SOIL WATER AT START OF YEAR	75.804	275167.937	
SOIL WATER AT END OF YEAR	75.777	275071.125	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.027	0.00

****

WARNING: TEMPERATURE FOR YEAR 1975 USED WITH PRECIPITATION FOR YEAR 2

WARNING: SOLAR RADIATION FOR YEAR 1975 USED WITH PRECIPITATION FOR YEAR 2

****

ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.04	138085.219	100.00
RUNOFF	17.624	63974.258	46.33
EVAPOTRANSPIRATION	17.555	63724.527	46.15
DRAINAGE COLLECTED FROM LAYER 3	2.2315	8100.265	5.87
PERC./LEAKAGE THROUGH LAYER 5	0.000005	0.017	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0721		
CHANGE IN WATER STORAGE	0.630	2286.118	1.66
SOIL WATER AT START OF YEAR	75.777	275071.125	
SOIL WATER AT END OF YEAR	74.759	271375.187	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.648	5982.059	4.33
ANNUAL WATER BUDGET BALANCE	0.0000	0.034	0.00

****

WARNING: TEMPERATURE FOR YEAR 1976 USED WITH PRECIPITATION FOR YEAR 3

WARNING: SOLAR RADIATION FOR YEAR 1976 USED WITH PRECIPITATION FOR YEAR 3

****

ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	22.72	82473.617	100.00
RUNOFF	5.355	19437.057	23.57
EVAPOTRANSPIRATION	14.207	51571.297	62.53
DRAINAGE COLLECTED FROM LAYER 3	0.8203	2977.850	3.61
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0270		
CHANGE IN WATER STORAGE	2.338	8487.372	10.29
SOIL WATER AT START OF YEAR	74.759	271375.187	
SOIL WATER AT END OF YEAR	73.924	268342.531	

SNOW WATER AT START OF YEAR	1.648	5982.059	7.25
SNOW WATER AT END OF YEAR	4.822	17502.084	21.22
ANNUAL WATER BUDGET BALANCE	0.0000	0.034	0.00

****

WARNING: TEMPERATURE FOR YEAR 1977 USED WITH PRECIPITATION FOR YEAR 4

WARNING: SOLAR RADIATION FOR YEAR 1977 USED WITH PRECIPITATION FOR YEAR 4

****

ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.21	142332.312	100.00
RUNOFF	22.764	82632.008	58.06
EVAPOTRANSPIRATION	18.582	67452.437	47.39
DRAINAGE COLLECTED FROM LAYER 3	0.7476	2713.802	1.91
PERC./LEAKAGE THROUGH LAYER 5	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0240		
CHANGE IN WATER STORAGE	-2.883	-10465.972	-7.35
SOIL WATER AT START OF YEAR	73.924	268342.531	
SOIL WATER AT END OF YEAR	74.922	271966.687	
SNOW WATER AT START OF YEAR	4.822	17502.084	12.30
SNOW WATER AT END OF YEAR	0.940	3411.956	2.40
ANNUAL WATER BUDGET BALANCE	0.0000	0.019	0.00

****

WARNING: TEMPERATURE FOR YEAR 1978 USED WITH PRECIPITATION FOR YEAR 5

WARNING: SOLAR RADIATION FOR YEAR 1978 USED WITH PRECIPITATION FOR YEAR 5

****

ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	26.31	95505.312	100.00
RUNOFF	10.057	36506.867	38.22
EVAPOTRANSPIRATION	14.597	52987.602	55.48
DRAINAGE COLLECTED FROM LAYER 3	1.3574	4927.293	5.16
PERC./LEAKAGE THROUGH LAYER 5	0.000003	0.012	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0438		
CHANGE IN WATER STORAGE	0.298	1083.544	1.13
SOIL WATER AT START OF YEAR	74.922	271966.687	
SOIL WATER AT END OF YEAR	74.759	271375.906	
SNOW WATER AT START OF YEAR	0.940	3411.956	3.57
SNOW WATER AT END OF YEAR	1.401	5086.283	5.33
ANNUAL WATER BUDGET BALANCE	0.0000	-0.005	0.00

****

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.92	1.96	3.53	2.25	3.25	0.70
	1.07	5.17	3.18	2.21	1.48	5.73
STD. DEVIATIONS	0.84	0.93	0.54	1.11	1.86	0.48
	0.20	3.80	1.58	1.28	0.61	1.43
RUNOFF						
TOTALS	1.366	0.968	1.407	0.627	1.214	0.041
	0.155	2.951	1.562	0.915	0.440	2.106
STD. DEVIATIONS	1.942	0.890	0.614	0.807	0.941	0.081
	0.083	2.703	0.998	0.829	0.382	1.992
EVAPOTRANSPIRATION						
TOTALS	0.411	1.118	2.269	2.122	2.447	0.672
	0.629	2.189	1.904	0.969	0.889	0.734
STD. DEVIATIONS	0.230	0.570	0.383	0.725	1.094	0.151
	0.240	1.368	0.423	0.702	0.411	0.111

```
  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS                 0.1056   0.3197   0.5240   0.3136   0.0057   0.0008
                           0.0004   0.0010   0.0019   0.0005   0.0002   0.0115

    STD. DEVIATIONS        0.2328   0.3776   0.3282   0.5946   0.0101   0.0008
                           0.0005   0.0016   0.0035   0.0009   0.0003   0.0252

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               0.0401   0.1341   0.1990   0.1230   0.0022   0.0003
                           0.0001   0.0004   0.0007   0.0002   0.0001   0.0044

    STD. DEVIATIONS        0.0884   0.1589   0.1246   0.2333   0.0038   0.0003
                           0.0002   0.0006   0.0014   0.0004   0.0001   0.0096
*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH    5
-------------------------------------------------------------------------------
                                      INCHES            CU. FEET       PERCENT
                                  -------------------  -------------   ---------
 PRECIPITATION                     31.46    (   7.184)     114207.1     100.00

 RUNOFF                            13.753   (  6.7266)      49923.89     43.713

 EVAPOTRANSPIRATION                16.353   (  1.8922)      59360.39     51.976

 LATERAL DRAINAGE COLLECTED         1.28483 (  0.59289)      4663.927    4.08375
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH        0.00000 (  0.00000)         0.012     0.00001
   LAYER  5

 AVERAGE HEAD ON TOP                0.042 (    0.019)
   OF LAYER  4

 CHANGE IN WATER STORAGE            0.071   (  1.8868)        258.85      0.227
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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	3.26	11833.800
RUNOFF	2.662	9662.6523
DRAINAGE COLLECTED FROM LAYER 3	0.10642	386.30197
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00049
AVERAGE HEAD ON TOP OF LAYER 4	1.253	
MAXIMUM HEAD ON TOP OF LAYER 4	2.287	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	17.2 FEET	
SNOW WATER	5.56	20170.4160

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3737

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1583

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	4.2165	0.3514
2	69.4577	0.2894
3	0.8100	0.0450
4	0.0000	0.0000
5	0.2750	0.5500
SNOW WATER	1.401	

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WARNING:  TEMPERATURE FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR    1

WARNING:  SOLAR RADIATION FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR    1

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\ZHELP3W\prom\DATA4.D4
TEMPERATURE DATA FILE:      C:\ZHELP3W\prom\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\ZHELP3W\prom\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\ZHELP3W\prom\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\ZHELP3W\prom\slope2r.D10
OUTPUT DATA FILE:           C:\ZHELP3W\prom\slope2r.OUT


TIME:  18:32     DATE:   3/15/2016


******************************************************************************

     TITLE:  PROMONTORY POINT - Slope Liner - Interim Condition

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  22
           THICKNESS                  =     12.00   INCHES
           POROSITY                   =      0.4190 VOL/VOL
           FIELD CAPACITY             =      0.3070 VOL/VOL
           WILTING POINT              =      0.1800 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.3875 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.189999992000E-04 CM/SEC
```

```
                         LAYER  2
                         --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
THICKNESS                   =    240.00   INCHES
POROSITY                    =      0.6710 VOL/VOL
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2919 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                         LAYER  3
                         --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   6
THICKNESS                   =     24.00   INCHES
POROSITY                    =      0.4530 VOL/VOL
FIELD CAPACITY              =      0.1900 VOL/VOL
WILTING POINT               =      0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1958 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.720000011000E-03 CM/SEC
SLOPE                       =     33.33   PERCENT
DRAINAGE LENGTH             =     33.0    FEET


                         LAYER  4
                         --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.60   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      3.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                         LAYER  5
                         --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  51
THICKNESS                   =      0.50   INCHES
POROSITY                    =      0.5500 VOL/VOL
FIELD CAPACITY              =      0.4000 VOL/VOL
WILTING POINT               =      0.2000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.5500 VOL/VOL
```

EFFECTIVE SAT. HYD. COND. = 0.999999972000E-09 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #22 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 2000. FEET.

SCS RUNOFF CURVE NUMBER	=	96.50	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	16.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	5.801	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.712	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.468	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	79.686	INCHES
TOTAL INITIAL WATER	=	79.686	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM SALT LAKE CITY UTAH

STATION LATITUDE	=	40.76	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	117	
END OF GROWING SEASON (JULIAN DATE)	=	289	
EVAPORATIVE ZONE DEPTH	=	16.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	8.80	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	48.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	39.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	65.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.38	1.84	3.19	3.34	3.26	0.70
1.54	3.42	4.05	2.48	2.47	6.26

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SALT LAKE CITY UTAH

SLOPE2R

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	34.10	40.70	49.20	58.80	68.30
77.50	74.90	65.00	53.00	39.70	30.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH
AND STATION LATITUDE = 40.76 DEGREES

WARNING: TEMPERATURE FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR 1

WARNING: SOLAR RADIATION FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR 1

****

ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.03	112638.922	100.00
RUNOFF	12.967	47069.223	41.79
EVAPOTRANSPIRATION	16.823	61066.055	54.21
DRAINAGE COLLECTED FROM LAYER 3	1.3709	4976.248	4.42
PERC./LEAKAGE THROUGH LAYER 5	0.000006	0.022	0.00
AVG. HEAD ON TOP OF LAYER 4	0.1009		
CHANGE IN WATER STORAGE	-0.130	-472.693	-0.42
SOIL WATER AT START OF YEAR	79.686	289259.687	
SOIL WATER AT END OF YEAR	79.556	288787.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.066	0.00

****

WARNING: TEMPERATURE FOR YEAR 1975 USED WITH PRECIPITATION FOR YEAR 2

WARNING: SOLAR RADIATION FOR YEAR 1975 USED WITH PRECIPITATION FOR YEAR 2

****

ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.04	138085.219	100.00
RUNOFF	17.624	63974.258	46.33
EVAPOTRANSPIRATION	17.555	63724.527	46.15
DRAINAGE COLLECTED FROM LAYER 3	2.2599	8203.615	5.94
PERC./LEAKAGE THROUGH LAYER 5	0.000009	0.031	0.00
AVG. HEAD ON TOP OF LAYER 4	0.1683		
CHANGE IN WATER STORAGE	0.601	2182.789	1.58
SOIL WATER AT START OF YEAR	79.556	288787.000	
SOIL WATER AT END OF YEAR	78.509	284987.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.648	5982.059	4.33
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

****

WARNING: TEMPERATURE FOR YEAR 1976 USED WITH PRECIPITATION FOR YEAR 3

WARNING: SOLAR RADIATION FOR YEAR 1976 USED WITH PRECIPITATION FOR YEAR 3

****

ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	22.72	82473.617	100.00
RUNOFF	5.355	19437.057	23.57
EVAPOTRANSPIRATION	14.207	51571.297	62.53
DRAINAGE COLLECTED FROM LAYER 3	0.8204	2977.885	3.61
PERC./LEAKAGE THROUGH LAYER 5	0.000004	0.013	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0601		
CHANGE IN WATER STORAGE	2.338	8487.316	10.29
SOIL WATER AT START OF YEAR	78.509	284987.750	

SOIL WATER AT END OF YEAR	77.674	281955.031	
SNOW WATER AT START OF YEAR	1.648	5982.059	7.25
SNOW WATER AT END OF YEAR	4.822	17502.084	21.22
ANNUAL WATER BUDGET BALANCE	0.0000	0.049	0.00

****

WARNING: TEMPERATURE FOR YEAR 1977 USED WITH PRECIPITATION FOR YEAR 4

WARNING: SOLAR RADIATION FOR YEAR 1977 USED WITH PRECIPITATION FOR YEAR 4

****

ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.21	142332.312	100.00
RUNOFF	22.764	82632.008	58.06
EVAPOTRANSPIRATION	18.582	67452.437	47.39
DRAINAGE COLLECTED FROM LAYER 3	0.7476	2713.796	1.91
PERC./LEAKAGE THROUGH LAYER 5	0.000004	0.015	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0551		
CHANGE IN WATER STORAGE	-2.883	-10465.972	-7.35
SOIL WATER AT START OF YEAR	77.674	281955.031	
SOIL WATER AT END OF YEAR	78.672	285579.187	
SNOW WATER AT START OF YEAR	4.822	17502.084	12.30
SNOW WATER AT END OF YEAR	0.940	3411.956	2.40
ANNUAL WATER BUDGET BALANCE	0.0000	0.019	0.00

****

WARNING: TEMPERATURE FOR YEAR 1978 USED WITH PRECIPITATION FOR YEAR 5

WARNING: SOLAR RADIATION FOR YEAR 1978 USED WITH PRECIPITATION FOR YEAR 5

****

ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	26.31	95505.312	100.00
RUNOFF	10.057	36506.867	38.22
EVAPOTRANSPIRATION	14.597	52987.602	55.48
DRAINAGE COLLECTED FROM LAYER 3	1.3574	4927.292	5.16
PERC./LEAKAGE THROUGH LAYER 5	0.000006	0.020	0.00
AVG. HEAD ON TOP OF LAYER 4	0.1004		
CHANGE IN WATER STORAGE	0.298	1083.544	1.13
SOIL WATER AT START OF YEAR	78.672	285579.187	
SOIL WATER AT END OF YEAR	78.509	284988.406	
SNOW WATER AT START OF YEAR	0.940	3411.956	3.57
SNOW WATER AT END OF YEAR	1.401	5086.283	5.33
ANNUAL WATER BUDGET BALANCE	0.0000	-0.012	0.00

****

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.92	1.96	3.53	2.25	3.25	0.70
	1.07	5.17	3.18	2.21	1.48	5.73
STD. DEVIATIONS	0.84	0.93	0.54	1.11	1.86	0.48
	0.20	3.80	1.58	1.28	0.61	1.43
RUNOFF						
TOTALS	1.366	0.968	1.407	0.627	1.214	0.041
	0.155	2.951	1.562	0.915	0.440	2.106
STD. DEVIATIONS	1.942	0.890	0.614	0.807	0.941	0.081
	0.083	2.703	0.998	0.829	0.382	1.992
EVAPOTRANSPIRATION						
TOTALS	0.411	1.118	2.269	2.122	2.447	0.672
	0.629	2.189	1.904	0.969	0.889	0.734
STD. DEVIATIONS	0.230	0.570	0.383	0.725	1.094	0.151

```
                                  SLOPE2R
                          0.240    1.368    0.423    0.702    0.411    0.111

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS                0.0765   0.0926   0.4245   0.4849   0.1875   0.0337
                          0.0021   0.0009   0.0020   0.0005   0.0002   0.0058

    STD. DEVIATIONS       0.1139   0.0937   0.2908   0.3523   0.1734   0.0505
                          0.0038   0.0015   0.0035   0.0009   0.0002   0.0124

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS       0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES              0.0665   0.0891   0.3691   0.4356   0.1630   0.0303
                          0.0019   0.0007   0.0018   0.0005   0.0001   0.0050

    STD. DEVIATIONS       0.0990   0.0903   0.2528   0.3165   0.1507   0.0453
                          0.0033   0.0013   0.0031   0.0008   0.0002   0.0108
*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH    5
-------------------------------------------------------------------------------
                                      INCHES            CU. FEET       PERCENT
                                  -------------------  -------------   ---------
 PRECIPITATION                     31.46    (   7.184)     114207.1     100.00

 RUNOFF                            13.753   (  6.7266)      49923.89     43.713

 EVAPOTRANSPIRATION                16.353   (  1.8922)      59360.39     51.976

 LATERAL DRAINAGE COLLECTED         1.31123 (  0.60506)      4759.767    4.16766
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH        0.00001 (  0.00000)         0.020     0.00002
   LAYER  5

 AVERAGE HEAD ON TOP                0.097 (    0.045)
   OF LAYER  4

 CHANGE IN WATER STORAGE            0.045   (  1.8866)        163.00      0.143
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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	3.26	11833.800
RUNOFF	2.662	9662.6523
DRAINAGE COLLECTED FROM LAYER 3	0.07899	286.74750
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00087
AVERAGE HEAD ON TOP OF LAYER 4	2.129	
MAXIMUM HEAD ON TOP OF LAYER 4	3.914	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	5.56	20170.4160

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3737

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1583

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	4.2165	0.3514
2	69.4577	0.2894
3	4.5600	0.1900
4	0.0000	0.0000
5	0.2750	0.5500
SNOW WATER	1.401	

****

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\defualt.D4
TEMPERATURE DATA FILE:      C:\HELP3\defualt.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\defualt.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\defualt.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\base2f.D10
OUTPUT DATA FILE:           C:\HELP3\run10.OUT


TIME:  12:56     DATE:   4/27/2016


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     TITLE:  PROMONTORY POINT        BASE OPTION 1 - FINAL CONDITION

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  22
          THICKNESS                    =     12.00   INCHES
          POROSITY                     =      0.4190 VOL/VOL
          FIELD CAPACITY               =      0.3070 VOL/VOL
          WILTING POINT                =      0.1800 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.3079 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.189999992000E-04 CM/SEC


                                  LAYER  2
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
```

```
              MATERIAL TEXTURE NUMBER  18
THICKNESS                    =   2400.00   INCHES
POROSITY                     =      0.6710 VOL/VOL
FIELD CAPACITY               =      0.2920 VOL/VOL
WILTING POINT                =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2917 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                        LAYER  3
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  22
THICKNESS                    =     18.00   INCHES
POROSITY                     =      0.4190 VOL/VOL
FIELD CAPACITY               =      0.3070 VOL/VOL
WILTING POINT                =      0.1800 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.3070 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.189999992000E-04 CM/SEC


                        LAYER  4
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  21
THICKNESS                    =      9.00   INCHES
POROSITY                     =      0.3970 VOL/VOL
FIELD CAPACITY               =      0.0320 VOL/VOL
WILTING POINT                =      0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0320 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.300000012000     CM/SEC
SLOPE                        =      3.00   PERCENT
DRAINAGE LENGTH              =    200.0    FEET


                        LAYER  5
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.60   INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      3.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                        LAYER  6
                        --------
```

```
                    TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  51
   THICKNESS                    =      0.50   INCHES
   POROSITY                     =      0.5500 VOL/VOL
   FIELD CAPACITY               =      0.4000 VOL/VOL
   WILTING POINT                =      0.2000 VOL/VOL
   INITIAL SOIL WATER CONTENT   =      0.5500 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.999999972000E-09 CM/SEC


              GENERAL DESIGN AND EVAPORATIVE ZONE DATA
              ----------------------------------------

    NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
             SOIL DATA BASE USING SOIL TEXTURE #22 WITH BARE
             GROUND CONDITIONS, A SURFACE SLOPE OF  2.% AND
             A SLOPE LENGTH OF 2000. FEET.

   SCS RUNOFF CURVE NUMBER              =     96.50
   FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
   EVAPORATIVE ZONE DEPTH               =     16.0    INCHES
   INITIAL WATER IN EVAPORATIVE ZONE    =      4.147  INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE   =      7.712  INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE   =      2.468  INCHES
   INITIAL SNOW WATER                   =      0.175  INCHES
   INITIAL WATER IN LAYER MATERIALS     =    709.868  INCHES
   TOTAL INITIAL WATER                  =    710.043  INCHES
   TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR


               EVAPOTRANSPIRATION AND WEATHER DATA
               -----------------------------------

    NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
             SALT LAKE CITY        UTAH

       STATION LATITUDE                        =  41.12 DEGREES
       MAXIMUM LEAF AREA INDEX                 =   0.00
       START OF GROWING SEASON (JULIAN DATE)   =    117
       END OF GROWING SEASON (JULIAN DATE)     =    289
       EVAPORATIVE ZONE DEPTH                  =  16.0  INCHES
       AVERAGE ANNUAL WIND SPEED               =   8.80 MPH
       AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  67.00 %
       AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  48.00 %
       AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  39.00 %
       AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  65.00 %


    NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
             COEFFICIENTS FOR    SALT LAKE CITY      UTAH

             NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
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1.35	1.33	1.72	2.21	1.47	0.97
0.72	0.92	0.89	1.14	1.22	1.37

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	34.10	40.70	49.20	58.80	68.30
77.50	74.90	65.00	53.00	39.70	30.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH
AND STATION LATITUDE = 41.12 DEGREES

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.09	43886.703	100.00
RUNOFF	1.371	4975.396	11.34
EVAPOTRANSPIRATION	10.645	38641.395	88.05
DRAINAGE COLLECTED FROM LAYER 4	0.0044	15.850	0.04
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.004	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	0.070	254.127	0.58
SOIL WATER AT START OF YEAR	709.868	2576822.250	
SOIL WATER AT END OF YEAR	709.938	2577076.500	
SNOW WATER AT START OF YEAR	0.175	634.989	1.45
SNOW WATER AT END OF YEAR	0.175	634.989	1.45
ANNUAL WATER BUDGET BALANCE	0.0000	-0.066	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.65	56809.504	100.00
RUNOFF	3.580	12996.839	22.88
EVAPOTRANSPIRATION	12.037	43695.969	76.92
DRAINAGE COLLECTED FROM LAYER 4	0.5141	1866.151	3.28
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.003	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0056		
CHANGE IN WATER STORAGE	-0.482	-1749.424	-3.08
SOIL WATER AT START OF YEAR	709.938	2577076.500	
SOIL WATER AT END OF YEAR	709.631	2575962.000	
SNOW WATER AT START OF YEAR	0.175	634.989	1.12
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.034	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.33	37497.898	100.00
RUNOFF	0.911	3307.456	8.82
EVAPOTRANSPIRATION	9.705	35230.320	93.95
DRAINAGE COLLECTED FROM LAYER 4	0.0086	31.396	0.08
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.003	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	-0.295	-1071.401	-2.86
SOIL WATER AT START OF YEAR	709.631	2575962.000	
SOIL WATER AT END OF YEAR	708.390	2571455.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.946	3434.860	9.16
ANNUAL WATER BUDGET BALANCE	0.0000	0.125	0.00

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                          ANNUAL TOTALS FOR YEAR    4
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                                          INCHES          CU. FEET     PERCENT
                                         --------        ----------    -------
  PRECIPITATION                            18.28          66356.406    100.00
  RUNOFF                                    4.894         17765.891     26.77
  EVAPOTRANSPIRATION                       12.782         46399.676     69.92
  DRAINAGE COLLECTED FROM LAYER  4          0.0147           53.379      0.08
  PERC./LEAKAGE THROUGH LAYER  6            0.000001          0.004      0.00
  AVG. HEAD ON TOP OF LAYER  5              0.0002
  CHANGE IN WATER STORAGE                   0.589          2137.392      3.22
  SOIL WATER AT START OF YEAR             708.390       2571455.750
  SOIL WATER AT END OF YEAR               709.878       2576857.000
  SNOW WATER AT START OF YEAR               0.946          3434.860      5.18
  SNOW WATER AT END OF YEAR                 0.047           170.899      0.26
  ANNUAL WATER BUDGET BALANCE               0.0000            0.061      0.00
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                          ANNUAL TOTALS FOR YEAR    5
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                                          INCHES          CU. FEET     PERCENT
                                         --------        ----------    -------
  PRECIPITATION                            12.76          46318.797    100.00
  RUNOFF                                    2.244          8146.176     17.59
  EVAPOTRANSPIRATION                       10.779         39126.605     84.47
  DRAINAGE COLLECTED FROM LAYER  4          0.3274         1188.610      2.57
  PERC./LEAKAGE THROUGH LAYER  6            0.000001          0.003      0.00
  AVG. HEAD ON TOP OF LAYER  5              0.0035
  CHANGE IN WATER STORAGE                  -0.590         -2142.540     -4.63
  SOIL WATER AT START OF YEAR             709.878       2576857.000
  SOIL WATER AT END OF YEAR               709.335       2574885.500
  SNOW WATER AT START OF YEAR               0.047           170.899      0.37
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SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.056	0.00

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	17.91	65013.285	100.00
RUNOFF	2.950	10707.841	16.47
EVAPOTRANSPIRATION	13.816	50152.711	77.14
DRAINAGE COLLECTED FROM LAYER 4	0.0061	22.239	0.03
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.003	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	1.138	4130.588	6.35
SOIL WATER AT START OF YEAR	709.335	2574885.500	
SOIL WATER AT END OF YEAR	709.598	2575842.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.874	3174.124	4.88
ANNUAL WATER BUDGET BALANCE	0.0000	-0.096	0.00

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.95	54268.508	100.00
RUNOFF	2.372	8610.200	15.87
EVAPOTRANSPIRATION	13.599	49365.020	90.96
DRAINAGE COLLECTED FROM LAYER 4	0.0134	48.703	0.09
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.003	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		

CHANGE IN WATER STORAGE	-1.035	-3755.394	-6.92
SOIL WATER AT START OF YEAR	709.598	2575842.000	
SOIL WATER AT END OF YEAR	708.891	2573273.750	
SNOW WATER AT START OF YEAR	0.874	3174.124	5.85
SNOW WATER AT END OF YEAR	0.547	1986.805	3.66
ANNUAL WATER BUDGET BALANCE	0.0000	-0.026	0.00

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.22	44358.602	100.00
RUNOFF	2.150	7805.254	17.60
EVAPOTRANSPIRATION	9.559	34700.344	78.23
DRAINAGE COLLECTED FROM LAYER 4	0.0120	43.671	0.10
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.003	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	0.498	1809.228	4.08
SOIL WATER AT START OF YEAR	708.891	2573273.750	
SOIL WATER AT END OF YEAR	709.814	2576623.250	
SNOW WATER AT START OF YEAR	0.547	1986.805	4.48
SNOW WATER AT END OF YEAR	0.123	446.525	1.01
ANNUAL WATER BUDGET BALANCE	0.0000	0.101	0.00

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	17.05	61891.504	100.00
RUNOFF	5.506	19986.871	32.29
EVAPOTRANSPIRATION	11.884	43137.484	69.70

DRAINAGE COLLECTED FROM LAYER 4	0.0798	289.731	0.47
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.004	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0009		
CHANGE IN WATER STORAGE	-0.419	-1522.630	-2.46
SOIL WATER AT START OF YEAR	709.814	2576623.250	
SOIL WATER AT END OF YEAR	709.517	2575547.250	
SNOW WATER AT START OF YEAR	0.123	446.525	0.72
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.041	0.00

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.16	51400.805	100.00
RUNOFF	2.719	9870.747	19.20
EVAPOTRANSPIRATION	11.071	40186.289	78.18
DRAINAGE COLLECTED FROM LAYER 4	0.0106	38.598	0.08
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.004	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	0.360	1305.176	2.54
SOIL WATER AT START OF YEAR	709.517	2575547.250	
SOIL WATER AT END OF YEAR	709.583	2575787.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.294	1065.450	2.07
ANNUAL WATER BUDGET BALANCE	0.0000	-0.010	0.00

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.61	60294.309	100.00
RUNOFF	3.522	12786.551	21.21
EVAPOTRANSPIRATION	13.015	47245.652	78.36
DRAINAGE COLLECTED FROM LAYER 4	0.0190	69.148	0.11
PERC./LEAKAGE THROUGH LAYER 6	0.000002	0.006	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0002		
CHANGE IN WATER STORAGE	0.053	193.012	0.32
SOIL WATER AT START OF YEAR	709.583	2575787.000	
SOIL WATER AT END OF YEAR	709.875	2576846.750	
SNOW WATER AT START OF YEAR	0.294	1065.450	1.77
SNOW WATER AT END OF YEAR	0.055	198.752	0.33
ANNUAL WATER BUDGET BALANCE	0.0000	-0.059	0.00

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.10	47552.996	100.00
RUNOFF	2.210	8020.559	16.87
EVAPOTRANSPIRATION	11.274	40925.930	86.06
DRAINAGE COLLECTED FROM LAYER 4	0.0813	295.173	0.62
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.004	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0009		
CHANGE IN WATER STORAGE	-0.465	-1688.761	-3.55
SOIL WATER AT START OF YEAR	709.875	2576846.750	
SOIL WATER AT END OF YEAR	709.288	2574714.750	
SNOW WATER AT START OF YEAR	0.055	198.752	0.42
SNOW WATER AT END OF YEAR	0.177	641.818	1.35
ANNUAL WATER BUDGET BALANCE	0.0000	0.093	0.00

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                         ANNUAL TOTALS FOR YEAR   13
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                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                          13.47          48896.113    100.00
  RUNOFF                                  2.405          8728.725     17.85
  EVAPOTRANSPIRATION                     10.338         37526.016     76.75
  DRAINAGE COLLECTED FROM LAYER  4        0.0052           18.851      0.04
  PERC./LEAKAGE THROUGH LAYER  6          0.000001          0.003      0.00
  AVG. HEAD ON TOP OF LAYER  5            0.0001
  CHANGE IN WATER STORAGE                 0.722          2622.664      5.36
  SOIL WATER AT START OF YEAR           709.288       2574714.750
  SOIL WATER AT END OF YEAR             710.143       2577817.750
  SNOW WATER AT START OF YEAR             0.177           641.818      1.31
  SNOW WATER AT END OF YEAR               0.045           161.567      0.33
  ANNUAL WATER BUDGET BALANCE             0.0000           -0.144      0.00
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                         ANNUAL TOTALS FOR YEAR   14
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                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                          14.01          50856.309    100.00
  RUNOFF                                  2.225          8075.483     15.88
  EVAPOTRANSPIRATION                     11.241         40803.820     80.23
  DRAINAGE COLLECTED FROM LAYER  4        0.3750         1361.245      2.68
  PERC./LEAKAGE THROUGH LAYER  6          0.000001          0.004      0.00
  AVG. HEAD ON TOP OF LAYER  5            0.0040
  CHANGE IN WATER STORAGE                 0.170           615.692      1.21
  SOIL WATER AT START OF YEAR           710.143       2577817.750
  SOIL WATER AT END OF YEAR             709.699       2576207.750
  SNOW WATER AT START OF YEAR             0.045           161.567      0.32
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SNOW WATER AT END OF YEAR	0.658	2387.319	4.69
ANNUAL WATER BUDGET BALANCE	0.0000	0.064	0.00

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.68	49658.410	100.00
RUNOFF	3.044	11049.048	22.25
EVAPOTRANSPIRATION	10.448	37926.371	76.37
DRAINAGE COLLECTED FROM LAYER 4	0.0903	327.887	0.66
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.005	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0010		
CHANGE IN WATER STORAGE	0.098	354.900	0.71
SOIL WATER AT START OF YEAR	709.699	2576207.750	
SOIL WATER AT END OF YEAR	710.455	2578950.000	
SNOW WATER AT START OF YEAR	0.658	2387.319	4.81
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0001	0.200	0.00

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.35	52090.496	100.00
RUNOFF	2.275	8259.178	15.86
EVAPOTRANSPIRATION	12.267	44528.434	85.48
DRAINAGE COLLECTED FROM LAYER 4	0.5724	2077.765	3.99
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.005	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0061		

CHANGE IN WATER STORAGE	-0.764	-2774.788	-5.33
SOIL WATER AT START OF YEAR	710.455	2578950.000	
SOIL WATER AT END OF YEAR	709.690	2576175.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.097	0.00

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.02	50892.617	100.00
RUNOFF	2.978	10809.608	21.24
EVAPOTRANSPIRATION	10.376	37664.680	74.01
DRAINAGE COLLECTED FROM LAYER 4	0.0082	29.874	0.06
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.003	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	0.658	2388.522	4.69
SOIL WATER AT START OF YEAR	709.690	2576175.250	
SOIL WATER AT END OF YEAR	709.886	2576888.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.462	1675.771	3.29
ANNUAL WATER BUDGET BALANCE	0.0000	-0.068	0.00

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.81	57390.305	100.00
RUNOFF	4.733	17181.945	29.94
EVAPOTRANSPIRATION	11.060	40148.012	69.96

DRAINAGE COLLECTED FROM LAYER 4	0.2764	1003.185	1.75
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.003	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0030		
CHANGE IN WATER STORAGE	-0.260	-942.858	-1.64
SOIL WATER AT START OF YEAR	709.886	2576888.000	
SOIL WATER AT END OF YEAR	710.088	2577620.750	
SNOW WATER AT START OF YEAR	0.462	1675.771	2.92
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.017	0.00

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ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.07	32924.102	100.00
RUNOFF	1.715	6225.418	18.91
EVAPOTRANSPIRATION	7.806	28335.131	86.06
DRAINAGE COLLECTED FROM LAYER 4	0.2230	809.562	2.46
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.004	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0024		
CHANGE IN WATER STORAGE	-0.674	-2446.021	-7.43
SOIL WATER AT START OF YEAR	710.088	2577620.750	
SOIL WATER AT END OF YEAR	709.082	2573968.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.332	1206.356	3.66
ANNUAL WATER BUDGET BALANCE	0.0000	0.007	0.00

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ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	18.14	65848.203	100.00
RUNOFF	4.243	15403.295	23.39
EVAPOTRANSPIRATION	12.534	45496.820	69.09
DRAINAGE COLLECTED FROM LAYER 4	0.0067	24.229	0.04
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.003	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0001		
CHANGE IN WATER STORAGE	1.356	4923.700	7.48
SOIL WATER AT START OF YEAR	709.082	2573968.500	
SOIL WATER AT END OF YEAR	710.771	2580098.500	
SNOW WATER AT START OF YEAR	0.332	1206.356	1.83
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.156	0.00

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ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.37	52163.109	100.00
RUNOFF	3.040	11035.248	21.16
EVAPOTRANSPIRATION	11.705	42490.180	81.46
DRAINAGE COLLECTED FROM LAYER 4	0.7946	2884.418	5.53
PERC./LEAKAGE THROUGH LAYER 6	0.000002	0.006	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0087		
CHANGE IN WATER STORAGE	-1.170	-4246.591	-8.14
SOIL WATER AT START OF YEAR	710.771	2580098.500	
SOIL WATER AT END OF YEAR	709.447	2575293.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.154	558.107	1.07
ANNUAL WATER BUDGET BALANCE	0.0000	-0.149	0.00

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                          ANNUAL TOTALS FOR YEAR   22
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                                          INCHES          CU. FEET     PERCENT
                                         --------        ----------    -------
  PRECIPITATION                            16.01          58116.309    100.00
  RUNOFF                                    2.865         10401.759     17.90
  EVAPOTRANSPIRATION                       11.518         41812.020     71.95
  DRAINAGE COLLECTED FROM LAYER  4          0.0090           32.647      0.06
  PERC./LEAKAGE THROUGH LAYER  6            0.000001          0.004      0.00
  AVG. HEAD ON TOP OF LAYER  5              0.0001
  CHANGE IN WATER STORAGE                   1.617          5869.884     10.10
  SOIL WATER AT START OF YEAR             709.447       2575293.750
  SOIL WATER AT END OF YEAR               709.920       2577009.500
  SNOW WATER AT START OF YEAR               0.154           558.107      0.96
  SNOW WATER AT END OF YEAR                 1.298          4712.249      8.11
  ANNUAL WATER BUDGET BALANCE               0.0000           -0.008      0.00
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                          ANNUAL TOTALS FOR YEAR   23
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                                          INCHES          CU. FEET     PERCENT
                                         --------        ----------    -------
  PRECIPITATION                            20.48          74342.391    100.00
  RUNOFF                                    5.161         18732.779     25.20
  EVAPOTRANSPIRATION                       15.680         56919.027     76.56
  DRAINAGE COLLECTED FROM LAYER  4          0.9905         3595.644      4.84
  PERC./LEAKAGE THROUGH LAYER  6            0.000002          0.006      0.00
  AVG. HEAD ON TOP OF LAYER  5              0.0106
  CHANGE IN WATER STORAGE                  -1.351         -4905.062     -6.60
  SOIL WATER AT START OF YEAR             709.920       2577009.500
  SOIL WATER AT END OF YEAR               709.725       2576301.000
  SNOW WATER AT START OF YEAR               1.298          4712.249      6.34
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SNOW WATER AT END OF YEAR	0.142	515.729	0.69
ANNUAL WATER BUDGET BALANCE	0.0000	-0.004	0.00

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ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.44	56047.203	100.00
RUNOFF	3.043	11046.833	19.71
EVAPOTRANSPIRATION	11.787	42788.227	76.34
DRAINAGE COLLECTED FROM LAYER 4	0.0287	104.314	0.19
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.003	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0003		
CHANGE IN WATER STORAGE	0.581	2107.791	3.76
SOIL WATER AT START OF YEAR	709.725	2576301.000	
SOIL WATER AT END OF YEAR	710.191	2577992.000	
SNOW WATER AT START OF YEAR	0.142	515.729	0.92
SNOW WATER AT END OF YEAR	0.257	932.592	1.66
ANNUAL WATER BUDGET BALANCE	0.0000	0.036	0.00

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ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.57	52889.109	100.00
RUNOFF	2.313	8395.006	15.87
EVAPOTRANSPIRATION	12.198	44277.676	83.72
DRAINAGE COLLECTED FROM LAYER 4	0.5739	2083.177	3.94
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.004	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0062		

CHANGE IN WATER STORAGE	-0.514	-1866.767	-3.53
SOIL WATER AT START OF YEAR	710.191	2577992.000	
SOIL WATER AT END OF YEAR	709.755	2576409.000	
SNOW WATER AT START OF YEAR	0.257	932.592	1.76
SNOW WATER AT END OF YEAR	0.179	648.633	1.23
ANNUAL WATER BUDGET BALANCE	0.0000	0.012	0.00

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.10	58443.000	100.00
RUNOFF	3.853	13986.772	23.93
EVAPOTRANSPIRATION	12.021	43634.883	74.66
DRAINAGE COLLECTED FROM LAYER 4	0.1860	675.319	1.16
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.003	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0020		
CHANGE IN WATER STORAGE	0.040	145.873	0.25
SOIL WATER AT START OF YEAR	709.755	2576409.000	
SOIL WATER AT END OF YEAR	709.973	2577203.500	
SNOW WATER AT START OF YEAR	0.179	648.633	1.11
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.151	0.00

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ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.00	58080.008	100.00
RUNOFF	3.170	11506.007	19.81
EVAPOTRANSPIRATION	11.985	43507.340	74.91

DRAINAGE COLLECTED FROM LAYER 4	0.0977	354.608	0.61
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.004	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0010		
CHANGE IN WATER STORAGE	0.747	2712.042	4.67
SOIL WATER AT START OF YEAR	709.973	2577203.500	
SOIL WATER AT END OF YEAR	710.233	2578144.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.488	1771.530	3.05
ANNUAL WATER BUDGET BALANCE	0.0000	0.006	0.00

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ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.69	60584.715	100.00
RUNOFF	3.586	13018.449	21.49
EVAPOTRANSPIRATION	11.376	41295.465	68.16
DRAINAGE COLLECTED FROM LAYER 4	1.4665	5323.557	8.79
PERC./LEAKAGE THROUGH LAYER 6	0.000002	0.007	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0156		
CHANGE IN WATER STORAGE	0.261	947.240	1.56
SOIL WATER AT START OF YEAR	710.233	2578144.250	
SOIL WATER AT END OF YEAR	710.615	2579534.250	
SNOW WATER AT START OF YEAR	0.488	1771.530	2.92
SNOW WATER AT END OF YEAR	0.366	1328.718	2.19
ANNUAL WATER BUDGET BALANCE	0.0000	-0.001	0.00

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ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.66	60475.812	100.00
RUNOFF	3.663	13296.327	21.99
EVAPOTRANSPIRATION	13.655	49569.465	81.97
DRAINAGE COLLECTED FROM LAYER 4	0.9169	3328.425	5.50
PERC./LEAKAGE THROUGH LAYER 6	0.000002	0.006	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0098		
CHANGE IN WATER STORAGE	-1.575	-5718.439	-9.46
SOIL WATER AT START OF YEAR	710.615	2579534.250	
SOIL WATER AT END OF YEAR	709.406	2575144.500	
SNOW WATER AT START OF YEAR	0.366	1328.718	2.20
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.032	0.00

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ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.38	44939.406	100.00
RUNOFF	2.047	7430.911	16.54
EVAPOTRANSPIRATION	9.915	35990.453	80.09
DRAINAGE COLLECTED FROM LAYER 4	0.0016	5.696	0.01
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.002	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	0.417	1512.352	3.37
SOIL WATER AT START OF YEAR	709.406	2575144.500	
SOIL WATER AT END OF YEAR	709.823	2576656.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.007	0.00

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         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 1.16     1.20     1.95     2.04     1.30     1.03
                           0.69     0.85     0.84     1.05     1.31     1.46

    STD. DEVIATIONS        0.60     0.54     0.77     0.87     0.68     0.74
                           0.48     0.80     0.61     0.82     0.73     0.59

  RUNOFF
  ------
    TOTALS                 0.260    0.520    0.520    0.406    0.195    0.144
                           0.102    0.180    0.110    0.229    0.205    0.156

    STD. DEVIATIONS        0.331    0.445    0.369    0.364    0.194    0.218
                           0.175    0.296    0.132    0.308    0.249    0.276

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.554    0.639    2.014    1.894    1.229    0.955
                           0.648    0.659    0.736    0.797    0.736    0.741

    STD. DEVIATIONS        0.256    0.320    0.630    0.693    0.569    0.601
                           0.369    0.500    0.519    0.566    0.319    0.180

  LATERAL DRAINAGE COLLECTED FROM LAYER  4
  ----------------------------------------
    TOTALS                 0.0120   0.0083   0.1040   0.1047   0.0068   0.0044
                           0.0022   0.0005   0.0009   0.0009   0.0003   0.0121

    STD. DEVIATIONS        0.0375   0.0335   0.1784   0.1509   0.0160   0.0138
                           0.0079   0.0008   0.0015   0.0015   0.0006   0.0656

  PERCOLATION/LEAKAGE THROUGH LAYER  6
  -------------------------------------
    TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  5
  -------------------------------------
    AVERAGES               0.0015   0.0012   0.0132   0.0137   0.0009   0.0006
                           0.0003   0.0001   0.0001   0.0001   0.0000   0.0015
```

```
STD. DEVIATIONS        0.0047   0.0047   0.0226   0.0197   0.0020   0.0018
                       0.0010   0.0001   0.0002   0.0002   0.0001   0.0083

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     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                     INCHES            CU. FEET       PERCENT
                                 -------------------  -------------   ---------
 PRECIPITATION                    14.88    (   2.435)      54009.6     100.00

 RUNOFF                            3.026   (  1.1012)      10985.42     20.340

 EVAPOTRANSPIRATION               11.603   (  1.5241)      42117.37     77.981

 LATERAL DRAINAGE COLLECTED        0.25714 (  0.37060)       933.435    1.72828
   FROM LAYER  4

 PERCOLATION/LEAKAGE THROUGH       0.00000 (  0.00000)         0.004     0.00001
   LAYER  6

 AVERAGE HEAD ON TOP               0.003 (    0.004)
   OF LAYER  5

 CHANGE IN WATER STORAGE          -0.007   (  0.7832)        -26.68     -0.049
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              PEAK DAILY VALUES FOR YEARS    1 THROUGH   30
   ------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                              1.66          6025.800

      RUNOFF                                     1.016         3689.6743

      DRAINAGE COLLECTED FROM LAYER  4           0.05610        203.64479

      PERCOLATION/LEAKAGE THROUGH LAYER  6       0.000000         0.00010

      AVERAGE HEAD ON TOP OF LAYER  5            0.220

      MAXIMUM HEAD ON TOP OF LAYER  5            0.429

      LOCATION OF MAXIMUM HEAD IN LAYER  4
            (DISTANCE FROM DRAIN)                4.9 FEET

      SNOW WATER                                 2.96         10734.5068


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.3489

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1543
```

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***  Maximum heads are computed using McEnroe's equations.  ***

     Reference:  Maximum Saturated Depth over Landfill Liner
                 by Bruce M. McEnroe, University of Kansas
                 ASCE Journal of Environmental Engineering
                 Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	3.6975	0.3081
2	700.0363	0.2917
3	5.5260	0.3070
4	0.2880	0.0320
5	0.0000	0.0000
6	0.2750	0.5500
SNOW WATER	0.000	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\defualt.D4
TEMPERATURE DATA FILE:      C:\HELP3\defualt.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\defualt.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\defualt.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\run5.D10
OUTPUT DATA FILE:           C:\HELP3\run5.OUT


TIME:  11:36     DATE:   4/27/2016


******************************************************************************

     TITLE:  PROMONTORY POINT        BASE OPTION 2 - FINAL CONDITION

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  22
          THICKNESS                   =     12.00   INCHES
          POROSITY                    =      0.4190 VOL/VOL
          FIELD CAPACITY              =      0.3070 VOL/VOL
          WILTING POINT               =      0.1800 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.3079 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.189999992000E-04 CM/SEC


                                  LAYER  2
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
```

```
              MATERIAL TEXTURE NUMBER  18
THICKNESS                   =   2400.00   INCHES
POROSITY                    =      0.6710 VOL/VOL
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2917 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
```

LAYER 3

```
            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =     18.00   INCHES
POROSITY                    =      0.4170 VOL/VOL
FIELD CAPACITY              =      0.0450 VOL/VOL
WILTING POINT               =      0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0450 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000001000     CM/SEC
SLOPE                       =      3.00   PERCENT
DRAINAGE LENGTH             =    200.0    FEET
```

LAYER 4

```
            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.60   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      3.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD
```

LAYER 5

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              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  51
THICKNESS                   =      0.50   INCHES
POROSITY                    =      0.5500 VOL/VOL
FIELD CAPACITY              =      0.4000 VOL/VOL
WILTING POINT               =      0.2000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.5500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.999999972000E-09 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #22 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 2000. FEET.

SCS RUNOFF CURVE NUMBER	=	96.50	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	16.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	4.147	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.712	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.468	INCHES
INITIAL SNOW WATER	=	0.175	INCHES
INITIAL WATER IN LAYER MATERIALS	=	704.864	INCHES
TOTAL INITIAL WATER	=	705.039	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM SALT LAKE CITY UTAH

STATION LATITUDE	=	41.12	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	117	
END OF GROWING SEASON (JULIAN DATE)	=	289	
EVAPORATIVE ZONE DEPTH	=	16.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	8.80	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	48.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	39.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	65.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.35	1.33	1.72	2.21	1.47	0.97
0.72	0.92	0.89	1.14	1.22	1.37

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	34.10	40.70	49.20	58.80	68.30
77.50	74.90	65.00	53.00	39.70	30.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH
AND STATION LATITUDE = 41.12 DEGREES

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.09	43886.703	100.00
RUNOFF	1.371	4975.396	11.34
EVAPOTRANSPIRATION	10.645	38641.395	88.05
DRAINAGE COLLECTED FROM LAYER 3	0.0044	15.846	0.04
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.006	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0001		
CHANGE IN WATER STORAGE	0.070	254.127	0.58
SOIL WATER AT START OF YEAR	704.864	2558657.750	
SOIL WATER AT END OF YEAR	704.934	2558911.750	
SNOW WATER AT START OF YEAR	0.175	634.989	1.45
SNOW WATER AT END OF YEAR	0.175	634.989	1.45
ANNUAL WATER BUDGET BALANCE	0.0000	-0.064	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.65	56809.504	100.00
RUNOFF	3.580	12996.839	22.88
EVAPOTRANSPIRATION	12.037	43695.969	76.92
DRAINAGE COLLECTED FROM LAYER 3	0.5141	1866.150	3.28
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.006	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0165		
CHANGE IN WATER STORAGE	-0.482	-1749.424	-3.08

SOIL WATER AT START OF YEAR	704.934	2558911.750	
SOIL WATER AT END OF YEAR	704.627	2557797.500	
SNOW WATER AT START OF YEAR	0.175	634.989	1.12
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.036	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.33	37497.898	100.00
RUNOFF	0.911	3307.456	8.82
EVAPOTRANSPIRATION	9.705	35230.320	93.95
DRAINAGE COLLECTED FROM LAYER 3	0.0086	31.394	0.08
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.006	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0003		
CHANGE IN WATER STORAGE	-0.295	-1071.401	-2.86
SOIL WATER AT START OF YEAR	704.627	2557797.500	
SOIL WATER AT END OF YEAR	703.386	2553291.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.946	3434.860	9.16
ANNUAL WATER BUDGET BALANCE	0.0000	0.125	0.00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	18.28	66356.406	100.00
RUNOFF	4.894	17765.891	26.77
EVAPOTRANSPIRATION	12.782	46399.676	69.92

DRAINAGE COLLECTED FROM LAYER 3	0.0147	53.376	0.08
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.006	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0005		
CHANGE IN WATER STORAGE	0.589	2137.392	3.22
SOIL WATER AT START OF YEAR	703.386	2553291.250	
SOIL WATER AT END OF YEAR	704.874	2558692.500	
SNOW WATER AT START OF YEAR	0.946	3434.860	5.18
SNOW WATER AT END OF YEAR	0.047	170.899	0.26
ANNUAL WATER BUDGET BALANCE	0.0000	0.062	0.00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.76	46318.797	100.00
RUNOFF	2.244	8146.176	17.59
EVAPOTRANSPIRATION	10.779	39126.605	84.47
DRAINAGE COLLECTED FROM LAYER 3	0.3274	1188.603	2.57
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.005	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0104		
CHANGE IN WATER STORAGE	-0.590	-2142.540	-4.63
SOIL WATER AT START OF YEAR	704.874	2558692.500	
SOIL WATER AT END OF YEAR	704.331	2556720.750	
SNOW WATER AT START OF YEAR	0.047	170.899	0.37
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.051	0.00

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT

PRECIPITATION	17.91	65013.285	100.00
RUNOFF	2.950	10707.841	16.47
EVAPOTRANSPIRATION	13.816	50152.711	77.14
DRAINAGE COLLECTED FROM LAYER 3	0.0061	22.242	0.03
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.006	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0002		
CHANGE IN WATER STORAGE	1.138	4130.588	6.35
SOIL WATER AT START OF YEAR	704.331	2556720.750	
SOIL WATER AT END OF YEAR	704.594	2557677.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.874	3174.124	4.88
ANNUAL WATER BUDGET BALANCE	0.0000	-0.101	0.00

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.95	54268.508	100.00
RUNOFF	2.372	8610.200	15.87
EVAPOTRANSPIRATION	13.599	49365.020	90.96
DRAINAGE COLLECTED FROM LAYER 3	0.0134	48.700	0.09
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.006	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0004		
CHANGE IN WATER STORAGE	-1.035	-3755.394	-6.92
SOIL WATER AT START OF YEAR	704.594	2557677.250	
SOIL WATER AT END OF YEAR	703.887	2555109.250	
SNOW WATER AT START OF YEAR	0.874	3174.124	5.85
SNOW WATER AT END OF YEAR	0.547	1986.805	3.66
ANNUAL WATER BUDGET BALANCE	0.0000	-0.026	0.00

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.22	44358.602	100.00
RUNOFF	2.150	7805.254	17.60
EVAPOTRANSPIRATION	9.559	34700.344	78.23
DRAINAGE COLLECTED FROM LAYER 3	0.0120	43.669	0.10
PERC./LEAKAGE THROUGH LAYER 5	0.000001	0.005	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0004		
CHANGE IN WATER STORAGE	0.498	1809.228	4.08
SOIL WATER AT START OF YEAR	703.887	2555109.250	
SOIL WATER AT END OF YEAR	704.810	2558458.750	
SNOW WATER AT START OF YEAR	0.547	1986.805	4.48
SNOW WATER AT END OF YEAR	0.123	446.525	1.01
ANNUAL WATER BUDGET BALANCE	0.0000	0.101	0.00

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	17.05	61891.504	100.00
RUNOFF	5.506	19986.871	32.29
EVAPOTRANSPIRATION	11.884	43137.484	69.70
DRAINAGE COLLECTED FROM LAYER 3	0.0798	289.728	0.47
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.007	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0026		
CHANGE IN WATER STORAGE	-0.419	-1522.630	-2.46
SOIL WATER AT START OF YEAR	704.810	2558458.750	
SOIL WATER AT END OF YEAR	704.513	2557382.750	
SNOW WATER AT START OF YEAR	0.123	446.525	0.72

SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.041	0.00

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.16	51400.805	100.00
RUNOFF	2.719	9870.747	19.20
EVAPOTRANSPIRATION	11.071	40186.289	78.18
DRAINAGE COLLECTED FROM LAYER 3	0.0106	38.595	0.08
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.007	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0003		
CHANGE IN WATER STORAGE	0.360	1305.176	2.54
SOIL WATER AT START OF YEAR	704.513	2557382.750	
SOIL WATER AT END OF YEAR	704.579	2557622.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.294	1065.450	2.07
ANNUAL WATER BUDGET BALANCE	0.0000	-0.010	0.00

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.61	60294.309	100.00
RUNOFF	3.522	12786.551	21.21
EVAPOTRANSPIRATION	13.015	47245.652	78.36
DRAINAGE COLLECTED FROM LAYER 3	0.0190	69.094	0.11
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0006		
CHANGE IN WATER STORAGE	0.053	193.012	0.32

SOIL WATER AT START OF YEAR	704.579	2557622.250	
SOIL WATER AT END OF YEAR	704.871	2558682.000	
SNOW WATER AT START OF YEAR	0.294	1065.450	1.77
SNOW WATER AT END OF YEAR	0.055	198.752	0.33
ANNUAL WATER BUDGET BALANCE	0.0000	-0.008	0.00

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.10	47552.996	100.00
RUNOFF	2.210	8020.559	16.87
EVAPOTRANSPIRATION	11.274	40925.930	86.06
DRAINAGE COLLECTED FROM LAYER 3	0.0813	295.221	0.62
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0026		
CHANGE IN WATER STORAGE	-0.465	-1688.761	-3.55
SOIL WATER AT START OF YEAR	704.871	2558682.000	
SOIL WATER AT END OF YEAR	704.284	2556550.250	
SNOW WATER AT START OF YEAR	0.055	198.752	0.42
SNOW WATER AT END OF YEAR	0.177	641.818	1.35
ANNUAL WATER BUDGET BALANCE	0.0000	0.042	0.00

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.47	48896.113	100.00
RUNOFF	2.405	8728.725	17.85
EVAPOTRANSPIRATION	10.338	37526.016	76.75

DRAINAGE COLLECTED FROM LAYER 3	0.0052	18.849	0.04
PERC./LEAKAGE THROUGH LAYER 5	0.000001	0.005	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0002		
CHANGE IN WATER STORAGE	0.722	2622.664	5.36
SOIL WATER AT START OF YEAR	704.284	2556550.250	
SOIL WATER AT END OF YEAR	705.139	2559653.250	
SNOW WATER AT START OF YEAR	0.177	641.818	1.31
SNOW WATER AT END OF YEAR	0.045	161.567	0.33
ANNUAL WATER BUDGET BALANCE	0.0000	-0.144	0.00

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.01	50856.309	100.00
RUNOFF	2.225	8075.483	15.88
EVAPOTRANSPIRATION	11.241	40803.820	80.23
DRAINAGE COLLECTED FROM LAYER 3	0.3750	1361.238	2.68
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.006	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0119		
CHANGE IN WATER STORAGE	0.170	615.692	1.21
SOIL WATER AT START OF YEAR	705.139	2559653.250	
SOIL WATER AT END OF YEAR	704.695	2558043.000	
SNOW WATER AT START OF YEAR	0.045	161.567	0.32
SNOW WATER AT END OF YEAR	0.658	2387.319	4.69
ANNUAL WATER BUDGET BALANCE	0.0000	0.068	0.00

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT

PRECIPITATION	13.68	49658.410	100.00
RUNOFF	3.044	11049.048	22.25
EVAPOTRANSPIRATION	10.448	37926.371	76.37
DRAINAGE COLLECTED FROM LAYER 3	0.0903	327.882	0.66
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0029		
CHANGE IN WATER STORAGE	0.098	354.900	0.71
SOIL WATER AT START OF YEAR	704.695	2558043.000	
SOIL WATER AT END OF YEAR	705.451	2560785.250	
SNOW WATER AT START OF YEAR	0.658	2387.319	4.81
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0001	0.202	0.00

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.35	52090.496	100.00
RUNOFF	2.275	8259.178	15.86
EVAPOTRANSPIRATION	12.267	44528.434	85.48
DRAINAGE COLLECTED FROM LAYER 3	0.5724	2077.764	3.99
PERC./LEAKAGE THROUGH LAYER 5	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0181		
CHANGE IN WATER STORAGE	-0.764	-2774.788	-5.33
SOIL WATER AT START OF YEAR	705.451	2560785.250	
SOIL WATER AT END OF YEAR	704.686	2558010.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.100	0.00

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.02	50892.617	100.00
RUNOFF	2.978	10809.608	21.24
EVAPOTRANSPIRATION	10.376	37664.680	74.01
DRAINAGE COLLECTED FROM LAYER 3	0.0082	29.871	0.06
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.006	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0003		
CHANGE IN WATER STORAGE	0.658	2388.522	4.69
SOIL WATER AT START OF YEAR	704.686	2558010.500	
SOIL WATER AT END OF YEAR	704.882	2558723.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.462	1675.771	3.29
ANNUAL WATER BUDGET BALANCE	0.0000	-0.068	0.00

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.81	57390.305	100.00
RUNOFF	4.733	17181.945	29.94
EVAPOTRANSPIRATION	11.060	40148.012	69.96
DRAINAGE COLLECTED FROM LAYER 3	0.2764	1003.183	1.75
PERC./LEAKAGE THROUGH LAYER 5	0.000001	0.005	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0088		
CHANGE IN WATER STORAGE	-0.260	-942.858	-1.64
SOIL WATER AT START OF YEAR	704.882	2558723.250	
SOIL WATER AT END OF YEAR	705.084	2559456.250	
SNOW WATER AT START OF YEAR	0.462	1675.771	2.92

SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.017	0.00

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ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.07	32924.102	100.00
RUNOFF	1.715	6225.418	18.91
EVAPOTRANSPIRATION	7.806	28335.131	86.06
DRAINAGE COLLECTED FROM LAYER 3	0.2230	809.559	2.46
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.007	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0072		
CHANGE IN WATER STORAGE	-0.674	-2446.021	-7.43
SOIL WATER AT START OF YEAR	705.084	2559456.250	
SOIL WATER AT END OF YEAR	704.078	2555803.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.332	1206.356	3.66
ANNUAL WATER BUDGET BALANCE	0.0000	0.007	0.00

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ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	18.14	65848.203	100.00
RUNOFF	4.243	15403.295	23.39
EVAPOTRANSPIRATION	12.534	45496.820	69.09
DRAINAGE COLLECTED FROM LAYER 3	0.0067	24.226	0.04
PERC./LEAKAGE THROUGH LAYER 5	0.000001	0.005	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0002		
CHANGE IN WATER STORAGE	1.356	4923.700	7.48

SOIL WATER AT START OF YEAR	704.078	2555803.750	
SOIL WATER AT END OF YEAR	705.767	2561933.750	
SNOW WATER AT START OF YEAR	0.332	1206.356	1.83
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.157	0.00

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ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.37	52163.109	100.00
RUNOFF	3.040	11035.248	21.16
EVAPOTRANSPIRATION	11.705	42490.180	81.46
DRAINAGE COLLECTED FROM LAYER 3	0.7946	2884.407	5.53
PERC./LEAKAGE THROUGH LAYER 5	0.000003	0.011	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0252		
CHANGE IN WATER STORAGE	-1.170	-4246.591	-8.14
SOIL WATER AT START OF YEAR	705.767	2561933.750	
SOIL WATER AT END OF YEAR	704.443	2557129.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.154	558.107	1.07
ANNUAL WATER BUDGET BALANCE	0.0000	-0.143	0.00

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ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.01	58116.309	100.00
RUNOFF	2.865	10401.759	17.90
EVAPOTRANSPIRATION	11.518	41812.020	71.95

DRAINAGE COLLECTED FROM LAYER 3	0.0090	32.650	0.06
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.007	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0003		
CHANGE IN WATER STORAGE	1.617	5869.884	10.10
SOIL WATER AT START OF YEAR	704.443	2557129.250	
SOIL WATER AT END OF YEAR	704.916	2558845.000	
SNOW WATER AT START OF YEAR	0.154	558.107	0.96
SNOW WATER AT END OF YEAR	1.298	4712.249	8.11
ANNUAL WATER BUDGET BALANCE	0.0000	-0.014	0.00

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ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	20.48	74342.391	100.00
RUNOFF	5.161	18732.779	25.20
EVAPOTRANSPIRATION	15.680	56919.027	76.56
DRAINAGE COLLECTED FROM LAYER 3	0.9905	3595.624	4.84
PERC./LEAKAGE THROUGH LAYER 5	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0321		
CHANGE IN WATER STORAGE	-1.351	-4905.062	-6.60
SOIL WATER AT START OF YEAR	704.916	2558845.000	
SOIL WATER AT END OF YEAR	704.721	2558136.250	
SNOW WATER AT START OF YEAR	1.298	4712.249	6.34
SNOW WATER AT END OF YEAR	0.142	515.729	0.69
ANNUAL WATER BUDGET BALANCE	0.0000	0.012	0.00

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ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT

PRECIPITATION	15.44	56047.203	100.00
RUNOFF	3.043	11046.833	19.71
EVAPOTRANSPIRATION	11.787	42788.227	76.34
DRAINAGE COLLECTED FROM LAYER 3	0.0287	104.326	0.19
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.007	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0009		
CHANGE IN WATER STORAGE	0.581	2107.791	3.76
SOIL WATER AT START OF YEAR	704.721	2558136.250	
SOIL WATER AT END OF YEAR	705.187	2559827.250	
SNOW WATER AT START OF YEAR	0.142	515.729	0.92
SNOW WATER AT END OF YEAR	0.257	932.592	1.66
ANNUAL WATER BUDGET BALANCE	0.0000	0.020	0.00

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ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.57	52889.109	100.00
RUNOFF	2.313	8395.006	15.87
EVAPOTRANSPIRATION	12.198	44277.676	83.72
DRAINAGE COLLECTED FROM LAYER 3	0.5739	2083.173	3.94
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.007	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0182		
CHANGE IN WATER STORAGE	-0.514	-1866.767	-3.53
SOIL WATER AT START OF YEAR	705.187	2559827.250	
SOIL WATER AT END OF YEAR	704.751	2558244.500	
SNOW WATER AT START OF YEAR	0.257	932.592	1.76
SNOW WATER AT END OF YEAR	0.179	648.633	1.23
ANNUAL WATER BUDGET BALANCE	0.0000	0.014	0.00

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.10	58443.000	100.00
RUNOFF	3.853	13986.772	23.93
EVAPOTRANSPIRATION	12.021	43634.883	74.66
DRAINAGE COLLECTED FROM LAYER 3	0.1860	675.316	1.16
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.006	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0059		
CHANGE IN WATER STORAGE	0.040	145.873	0.25
SOIL WATER AT START OF YEAR	704.751	2558244.500	
SOIL WATER AT END OF YEAR	704.969	2559039.000	
SNOW WATER AT START OF YEAR	0.179	648.633	1.11
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.151	0.00

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ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.00	58080.008	100.00
RUNOFF	3.170	11506.007	19.81
EVAPOTRANSPIRATION	11.985	43507.340	74.91
DRAINAGE COLLECTED FROM LAYER 3	0.0976	354.466	0.61
PERC./LEAKAGE THROUGH LAYER 5	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0031		
CHANGE IN WATER STORAGE	0.747	2712.264	4.67
SOIL WATER AT START OF YEAR	704.969	2559039.000	
SOIL WATER AT END OF YEAR	705.229	2559979.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00

SNOW WATER AT END OF YEAR	0.488	1771.530	3.05
ANNUAL WATER BUDGET BALANCE	0.0000	-0.076	0.00

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ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.69	60584.715	100.00
RUNOFF	3.586	13018.449	21.49
EVAPOTRANSPIRATION	11.376	41295.465	68.16
DRAINAGE COLLECTED FROM LAYER 3	1.5882	5765.130	9.52
PERC./LEAKAGE THROUGH LAYER 5	0.000004	0.014	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0507		
CHANGE IN WATER STORAGE	0.139	505.676	0.83
SOIL WATER AT START OF YEAR	705.229	2559979.750	
SOIL WATER AT END OF YEAR	705.490	2560928.250	
SNOW WATER AT START OF YEAR	0.488	1771.530	2.92
SNOW WATER AT END OF YEAR	0.366	1328.718	2.19
ANNUAL WATER BUDGET BALANCE	0.0000	-0.017	0.00

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ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.66	60475.812	100.00
RUNOFF	3.663	13296.327	21.99
EVAPOTRANSPIRATION	13.655	49569.465	81.97
DRAINAGE COLLECTED FROM LAYER 3	0.7953	2886.976	4.77
PERC./LEAKAGE THROUGH LAYER 5	0.000003	0.011	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0252		
CHANGE IN WATER STORAGE	-1.454	-5277.097	-8.73

SOIL WATER AT START OF YEAR	705.490	2560928.250	
SOIL WATER AT END OF YEAR	704.402	2556979.750	
SNOW WATER AT START OF YEAR	0.366	1328.718	2.20
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.133	0.00

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ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.38	44939.406	100.00
RUNOFF	2.047	7430.911	16.54
EVAPOTRANSPIRATION	9.915	35990.453	80.09
DRAINAGE COLLECTED FROM LAYER 3	0.0016	5.695	0.01
PERC./LEAKAGE THROUGH LAYER 5	0.000001	0.003	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	0.417	1512.352	3.37
SOIL WATER AT START OF YEAR	704.402	2556979.750	
SOIL WATER AT END OF YEAR	704.819	2558492.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.007	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.16	1.20	1.95	2.04	1.30	1.03

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                          0.69     0.85     0.84     1.05     1.31     1.46

  STD. DEVIATIONS         0.60     0.54     0.77     0.87     0.68     0.74
                          0.48     0.80     0.61     0.82     0.73     0.59

RUNOFF
------
  TOTALS                  0.260    0.520    0.520    0.406    0.195    0.144
                          0.102    0.180    0.110    0.229    0.205    0.156

  STD. DEVIATIONS         0.331    0.445    0.369    0.364    0.194    0.218
                          0.175    0.296    0.132    0.308    0.249    0.276

EVAPOTRANSPIRATION
------------------
  TOTALS                  0.554    0.639    2.014    1.894    1.229    0.955
                          0.648    0.659    0.736    0.797    0.736    0.741

  STD. DEVIATIONS         0.256    0.320    0.630    0.693    0.569    0.601
                          0.369    0.500    0.519    0.566    0.319    0.180

LATERAL DRAINAGE COLLECTED FROM LAYER  3
----------------------------------------
  TOTALS                  0.0135   0.0100   0.1792   0.0255   0.0034   0.0045
                          0.0023   0.0004   0.0009   0.0010   0.0064   0.0101

  STD. DEVIATIONS         0.0597   0.0409   0.2681   0.0508   0.0062   0.0136
                          0.0081   0.0006   0.0016   0.0015   0.0333   0.0545

PERCOLATION/LEAKAGE THROUGH LAYER  5
-------------------------------------
  TOTALS                  0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


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               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
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DAILY AVERAGE HEAD ON TOP OF LAYER  4
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  AVERAGES                0.0051   0.0042   0.0680   0.0100   0.0013   0.0018
                          0.0009   0.0002   0.0004   0.0004   0.0025   0.0038

  STD. DEVIATIONS         0.0227   0.0171   0.1018   0.0199   0.0024   0.0053
                          0.0031   0.0002   0.0006   0.0006   0.0130   0.0207
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     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                     INCHES            CU. FEET       PERCENT
                                 -------------------   -------------   ---------
 PRECIPITATION                    14.88    (   2.435)      54009.6     100.00
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RUNOFF	3.026	(1.1012)	10985.42	20.340
EVAPOTRANSPIRATION	11.603	(1.5241)	42117.37	77.981
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.25714	(0.37813)	933.432	1.72827
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000	(0.00000)	0.007	0.00001
AVERAGE HEAD ON TOP OF LAYER 4	0.008	(0.012)		
CHANGE IN WATER STORAGE	-0.007	(0.7740)	-26.68	-0.049

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	1.66	6025.800
RUNOFF	1.016	3689.6743
DRAINAGE COLLECTED FROM LAYER 3	0.07116	258.31848
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00032
AVERAGE HEAD ON TOP OF LAYER 4	0.838	
MAXIMUM HEAD ON TOP OF LAYER 4	1.564	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	13.1 FEET	
SNOW WATER	2.96	10734.5068

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3489
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1543

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	3.6975	0.3081
2	700.0363	0.2917
3	0.8100	0.0450
4	0.0000	0.0000
5	0.2750	0.5500
SNOW WATER	0.000	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:    C:\ZHELP3W\prom\DEFUALT.D4
TEMPERATURE DATA FILE:      C:\ZHELP3W\prom\DEFUALT.D7
SOLAR RADIATION DATA FILE:  C:\ZHELP3W\prom\DEFUALT.D13
EVAPOTRANSPIRATION DATA:    C:\ZHELP3W\prom\DEFUALT.D11
SOIL AND DESIGN DATA FILE:  C:\ZHELP3W\prom\SLOPE2F.D10
OUTPUT DATA FILE:           C:\ZHELP3W\prom\RUN14.OUT


TIME:  10:53     DATE:   3/15/2016


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     TITLE:  PROMONTORY POINT - Slope Liner - Final Condition

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   6
          THICKNESS                   =     12.00   INCHES
          POROSITY                    =      0.4530 VOL/VOL
          FIELD CAPACITY              =      0.1900 VOL/VOL
          WILTING POINT               =      0.0850 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.2220 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.720000011000E-03 CM/SEC


                                  LAYER  2
                                  --------
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          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
THICKNESS                    =   1200.00   INCHES
POROSITY                     =      0.6710 VOL/VOL
FIELD CAPACITY               =      0.2920 VOL/VOL
WILTING POINT                =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2915 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
```

LAYER 3

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            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   6
THICKNESS                    =     24.00   INCHES
POROSITY                     =      0.4530 VOL/VOL
FIELD CAPACITY               =      0.1900 VOL/VOL
WILTING POINT                =      0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1900 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.720000011000E-03 CM/SEC
SLOPE                        =     33.33   PERCENT
DRAINAGE LENGTH              =    150.0    FEET
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LAYER 4

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            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.60   INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      3.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD
```

LAYER 5

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              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  51
THICKNESS                    =      0.50   INCHES
POROSITY                     =      0.5500 VOL/VOL
FIELD CAPACITY               =      0.4000 VOL/VOL
WILTING POINT                =      0.2000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.5500 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999972000E-09 CM/SEC
```

RUN14

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 6 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 2000. FEET.

SCS RUNOFF CURVE NUMBER	=	84.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	16.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.251	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	8.120	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.328	INCHES
INITIAL SNOW WATER	=	0.175	INCHES
INITIAL WATER IN LAYER MATERIALS	=	357.319	INCHES
TOTAL INITIAL WATER	=	357.493	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM SALT LAKE CITY UTAH

STATION LATITUDE	=	41.12	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	117	
END OF GROWING SEASON (JULIAN DATE)	=	289	
EVAPORATIVE ZONE DEPTH	=	16.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	8.80	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	48.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	39.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	65.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.35	1.33	1.72	2.21	1.47	0.97
0.72	0.92	0.89	1.14	1.22	1.37

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	34.10	40.70	49.20	58.80	68.30
77.50	74.90	65.00	53.00	39.70	30.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH
AND STATION LATITUDE = 41.12 DEGREES

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.09	43886.703	100.00
RUNOFF	0.027	97.490	0.22
EVAPOTRANSPIRATION	11.995	43542.973	99.22
DRAINAGE COLLECTED FROM LAYER 3	0.0717	260.240	0.59
PERC./LEAKAGE THROUGH LAYER 5	0.000003	0.013	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0240		
CHANGE IN WATER STORAGE	-0.004	-14.069	-0.03
SOIL WATER AT START OF YEAR	357.319	1297066.370	
SOIL WATER AT END OF YEAR	357.315	1297052.370	
SNOW WATER AT START OF YEAR	0.175	634.989	1.45
SNOW WATER AT END OF YEAR	0.175	634.989	1.45
ANNUAL WATER BUDGET BALANCE	0.0000	0.060	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.65	56809.504	100.00
RUNOFF	0.903	3277.299	5.77
EVAPOTRANSPIRATION	13.725	49823.473	87.70
DRAINAGE COLLECTED FROM LAYER 3	1.7311	6283.762	11.06
PERC./LEAKAGE THROUGH LAYER 5	0.000026	0.094	0.00
AVG. HEAD ON TOP OF LAYER 4	0.5785		

CHANGE IN WATER STORAGE	-0.709	-2575.059	-4.53
SOIL WATER AT START OF YEAR	357.315	1297052.370	
SOIL WATER AT END OF YEAR	356.780	1295112.250	
SNOW WATER AT START OF YEAR	0.175	634.989	1.12
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.066	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.33	37497.898	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	10.396	37738.051	100.64
DRAINAGE COLLECTED FROM LAYER 3	0.0036	13.220	0.04
PERC./LEAKAGE THROUGH LAYER 5	0.000003	0.009	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0012		
CHANGE IN WATER STORAGE	-0.070	-253.410	-0.68
SOIL WATER AT START OF YEAR	356.780	1295112.250	
SOIL WATER AT END OF YEAR	355.764	1291424.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.946	3434.860	9.16
ANNUAL WATER BUDGET BALANCE	0.0000	0.030	0.00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	18.28	66356.406	100.00
RUNOFF	1.599	5803.086	8.75
EVAPOTRANSPIRATION	15.422	55981.797	84.37

DRAINAGE COLLECTED FROM LAYER 3	0.9265	3363.109	5.07
PERC./LEAKAGE THROUGH LAYER 5	0.000014	0.051	0.00
AVG. HEAD ON TOP OF LAYER 4	0.3105		
CHANGE IN WATER STORAGE	0.333	1208.401	1.82
SOIL WATER AT START OF YEAR	355.764	1291424.000	
SOIL WATER AT END OF YEAR	356.996	1295896.370	
SNOW WATER AT START OF YEAR	0.946	3434.860	5.18
SNOW WATER AT END OF YEAR	0.047	170.899	0.26
ANNUAL WATER BUDGET BALANCE	0.0000	-0.042	0.00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.76	46318.797	100.00
RUNOFF	0.606	2199.033	4.75
EVAPOTRANSPIRATION	11.561	41966.145	90.60
DRAINAGE COLLECTED FROM LAYER 3	0.9383	3406.011	7.35
PERC./LEAKAGE THROUGH LAYER 5	0.000014	0.051	0.00
AVG. HEAD ON TOP OF LAYER 4	0.3148		
CHANGE IN WATER STORAGE	-0.345	-1252.543	-2.70
SOIL WATER AT START OF YEAR	356.996	1295896.370	
SOIL WATER AT END OF YEAR	356.698	1294814.750	
SNOW WATER AT START OF YEAR	0.047	170.899	0.37
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.099	0.00

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ANNUAL TOTALS FOR YEAR 6

RUN14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	17.91	65013.285	100.00
RUNOFF	0.661	2397.828	3.69
EVAPOTRANSPIRATION	16.032	58197.066	89.52
DRAINAGE COLLECTED FROM LAYER 3	0.2198	798.054	1.23
PERC./LEAKAGE THROUGH LAYER 5	0.000005	0.019	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0734		
CHANGE IN WATER STORAGE	0.997	3620.341	5.57
SOIL WATER AT START OF YEAR	356.698	1294814.750	
SOIL WATER AT END OF YEAR	356.821	1295261.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.874	3174.124	4.88
ANNUAL WATER BUDGET BALANCE	0.0000	-0.022	0.00

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.95	54268.508	100.00
RUNOFF	0.446	1618.683	2.98
EVAPOTRANSPIRATION	15.335	55664.746	102.57
DRAINAGE COLLECTED FROM LAYER 3	0.1599	580.458	1.07
PERC./LEAKAGE THROUGH LAYER 5	0.000004	0.016	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0536		
CHANGE IN WATER STORAGE	-0.990	-3595.318	-6.63
SOIL WATER AT START OF YEAR	356.821	1295261.000	
SOIL WATER AT END OF YEAR	356.158	1292853.000	
SNOW WATER AT START OF YEAR	0.874	3174.124	5.85
SNOW WATER AT END OF YEAR	0.547	1986.805	3.66
ANNUAL WATER BUDGET BALANCE	0.0000	-0.079	0.00

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.22	44358.602	100.00
RUNOFF	0.145	527.694	1.19
EVAPOTRANSPIRATION	11.206	40678.898	91.70
DRAINAGE COLLECTED FROM LAYER 3	0.1527	554.406	1.25
PERC./LEAKAGE THROUGH LAYER 5	0.000004	0.016	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0512		
CHANGE IN WATER STORAGE	0.716	2597.530	5.86
SOIL WATER AT START OF YEAR	356.158	1292853.000	
SOIL WATER AT END OF YEAR	357.298	1296990.750	
SNOW WATER AT START OF YEAR	0.547	1986.805	4.48
SNOW WATER AT END OF YEAR	0.123	446.525	1.01
ANNUAL WATER BUDGET BALANCE	0.0000	0.056	0.00

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	17.05	61891.504	100.00
RUNOFF	1.850	6714.712	10.85
EVAPOTRANSPIRATION	14.655	53197.207	85.95
DRAINAGE COLLECTED FROM LAYER 3	1.4243	5170.350	8.35
PERC./LEAKAGE THROUGH LAYER 5	0.000021	0.075	0.00
AVG. HEAD ON TOP OF LAYER 4	0.4759		
CHANGE IN WATER STORAGE	-0.879	-3190.848	-5.16
SOIL WATER AT START OF YEAR	357.298	1296990.750	
SOIL WATER AT END OF YEAR	356.542	1294246.370	
SNOW WATER AT START OF YEAR	0.123	446.525	0.72

SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.009	0.00

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.16	51400.805	100.00
RUNOFF	1.119	4060.298	7.90
EVAPOTRANSPIRATION	12.536	45505.633	88.53
DRAINAGE COLLECTED FROM LAYER 3	0.0383	138.887	0.27
PERC./LEAKAGE THROUGH LAYER 5	0.000003	0.011	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0128		
CHANGE IN WATER STORAGE	0.467	1696.003	3.30
SOIL WATER AT START OF YEAR	356.542	1294246.370	
SOIL WATER AT END OF YEAR	356.715	1294877.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.294	1065.450	2.07
ANNUAL WATER BUDGET BALANCE	0.0000	-0.025	0.00

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.61	60294.309	100.00
RUNOFF	0.270	980.422	1.63
EVAPOTRANSPIRATION	15.135	54938.953	91.12
DRAINAGE COLLECTED FROM LAYER 3	0.6868	2493.178	4.14
PERC./LEAKAGE THROUGH LAYER 5	0.000011	0.039	0.00
AVG. HEAD ON TOP OF LAYER 4	0.2291		

CHANGE IN WATER STORAGE	0.518	1881.724	3.12
SOIL WATER AT START OF YEAR	356.715	1294877.000	
SOIL WATER AT END OF YEAR	357.473	1297625.370	
SNOW WATER AT START OF YEAR	0.294	1065.450	1.77
SNOW WATER AT END OF YEAR	0.055	198.752	0.33
ANNUAL WATER BUDGET BALANCE	0.0000	-0.008	0.00

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.10	47552.996	100.00
RUNOFF	0.675	2451.851	5.16
EVAPOTRANSPIRATION	12.551	45561.305	95.81
DRAINAGE COLLECTED FROM LAYER 3	0.7840	2846.015	5.98
PERC./LEAKAGE THROUGH LAYER 5	0.000012	0.043	0.00
AVG. HEAD ON TOP OF LAYER 4	0.2630		
CHANGE IN WATER STORAGE	-0.911	-3306.243	-6.95
SOIL WATER AT START OF YEAR	357.473	1297625.370	
SOIL WATER AT END OF YEAR	356.440	1293876.120	
SNOW WATER AT START OF YEAR	0.055	198.752	0.42
SNOW WATER AT END OF YEAR	0.177	641.818	1.35
ANNUAL WATER BUDGET BALANCE	0.0000	0.026	0.00

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.47	48896.113	100.00
RUNOFF	0.636	2307.979	4.72
EVAPOTRANSPIRATION	12.056	43761.613	89.50

DRAINAGE COLLECTED FROM LAYER 3	0.1876	681.122	1.39
PERC./LEAKAGE THROUGH LAYER 5	0.000005	0.017	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0628		
CHANGE IN WATER STORAGE	0.591	2145.428	4.39
SOIL WATER AT START OF YEAR	356.440	1293876.120	
SOIL WATER AT END OF YEAR	357.163	1296501.750	
SNOW WATER AT START OF YEAR	0.177	641.818	1.31
SNOW WATER AT END OF YEAR	0.045	161.567	0.33
ANNUAL WATER BUDGET BALANCE	0.0000	-0.046	0.00

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.01	50856.309	100.00
RUNOFF	0.361	1310.438	2.58
EVAPOTRANSPIRATION	12.765	46335.176	91.11
DRAINAGE COLLECTED FROM LAYER 3	0.7630	2769.552	5.45
PERC./LEAKAGE THROUGH LAYER 5	0.000012	0.042	0.00
AVG. HEAD ON TOP OF LAYER 4	0.2555		
CHANGE IN WATER STORAGE	0.122	441.105	0.87
SOIL WATER AT START OF YEAR	357.163	1296501.750	
SOIL WATER AT END OF YEAR	356.671	1294717.120	
SNOW WATER AT START OF YEAR	0.045	161.567	0.32
SNOW WATER AT END OF YEAR	0.658	2387.319	4.69
ANNUAL WATER BUDGET BALANCE	0.0000	-0.004	0.00

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ANNUAL TOTALS FOR YEAR 15

RUN14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.68	49658.410	100.00
RUNOFF	0.859	3117.032	6.28
EVAPOTRANSPIRATION	12.035	43687.957	87.98
DRAINAGE COLLECTED FROM LAYER 3	0.6002	2178.838	4.39
PERC./LEAKAGE THROUGH LAYER 5	0.000010	0.035	0.00
AVG. HEAD ON TOP OF LAYER 4	0.2011		
CHANGE IN WATER STORAGE	0.186	674.608	1.36
SOIL WATER AT START OF YEAR	356.671	1294717.120	
SOIL WATER AT END OF YEAR	357.515	1297779.000	
SNOW WATER AT START OF YEAR	0.658	2387.319	4.81
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.058	0.00

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.35	52090.496	100.00
RUNOFF	0.500	1815.031	3.48
EVAPOTRANSPIRATION	13.009	47221.340	90.65
DRAINAGE COLLECTED FROM LAYER 3	0.9927	3603.462	6.92
PERC./LEAKAGE THROUGH LAYER 5	0.000015	0.054	0.00
AVG. HEAD ON TOP OF LAYER 4	0.3331		
CHANGE IN WATER STORAGE	-0.151	-549.352	-1.05
SOIL WATER AT START OF YEAR	357.515	1297779.000	
SOIL WATER AT END OF YEAR	357.364	1297229.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.037	0.00

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.02	50892.617	100.00
RUNOFF	0.952	3456.765	6.79
EVAPOTRANSPIRATION	11.722	42551.832	83.61
DRAINAGE COLLECTED FROM LAYER 3	0.7097	2576.321	5.06
PERC./LEAKAGE THROUGH LAYER 5	0.000011	0.040	0.00
AVG. HEAD ON TOP OF LAYER 4	0.2380		
CHANGE IN WATER STORAGE	0.636	2307.653	4.53
SOIL WATER AT START OF YEAR	357.364	1297229.750	
SOIL WATER AT END OF YEAR	357.538	1297861.620	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.462	1675.771	3.29
ANNUAL WATER BUDGET BALANCE	0.0000	0.006	0.00

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.81	57390.305	100.00
RUNOFF	1.784	6474.604	11.28
EVAPOTRANSPIRATION	13.481	48935.004	85.27
DRAINAGE COLLECTED FROM LAYER 3	1.2550	4555.618	7.94
PERC./LEAKAGE THROUGH LAYER 5	0.000018	0.066	0.00
AVG. HEAD ON TOP OF LAYER 4	0.4212		
CHANGE IN WATER STORAGE	-0.709	-2574.963	-4.49
SOIL WATER AT START OF YEAR	357.538	1297861.620	
SOIL WATER AT END OF YEAR	357.290	1296962.370	
SNOW WATER AT START OF YEAR	0.462	1675.771	2.92

SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.027	0.00

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ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.07	32924.102	100.00
RUNOFF	0.975	3539.973	10.75
EVAPOTRANSPIRATION	7.171	26032.176	79.07
DRAINAGE COLLECTED FROM LAYER 3	0.8366	3036.755	9.22
PERC./LEAKAGE THROUGH LAYER 5	0.000013	0.045	0.00
AVG. HEAD ON TOP OF LAYER 4	0.2806		
CHANGE IN WATER STORAGE	0.087	315.141	0.96
SOIL WATER AT START OF YEAR	357.290	1296962.370	
SOIL WATER AT END OF YEAR	357.044	1296071.120	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.332	1206.356	3.66
ANNUAL WATER BUDGET BALANCE	0.0000	0.013	0.00

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ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	18.14	65848.203	100.00
RUNOFF	1.230	4464.271	6.78
EVAPOTRANSPIRATION	14.418	52336.164	79.48
DRAINAGE COLLECTED FROM LAYER 3	0.6342	2302.237	3.50
PERC./LEAKAGE THROUGH LAYER 5	0.000010	0.037	0.00
AVG. HEAD ON TOP OF LAYER 4	0.2119		

CHANGE IN WATER STORAGE	1.858	6745.458	10.24
SOIL WATER AT START OF YEAR	357.044	1296071.120	
SOIL WATER AT END OF YEAR	359.235	1304023.000	
SNOW WATER AT START OF YEAR	0.332	1206.356	1.83
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.039	0.00

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ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.37	52163.109	100.00
RUNOFF	0.743	2697.641	5.17
EVAPOTRANSPIRATION	14.155	51382.547	98.50
DRAINAGE COLLECTED FROM LAYER 3	2.4054	8731.650	16.74
PERC./LEAKAGE THROUGH LAYER 5	0.000035	0.126	0.00
AVG. HEAD ON TOP OF LAYER 4	0.8244		
CHANGE IN WATER STORAGE	-2.934	-10648.831	-20.41
SOIL WATER AT START OF YEAR	359.235	1304023.000	
SOIL WATER AT END OF YEAR	356.148	1292816.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.154	558.107	1.07
ANNUAL WATER BUDGET BALANCE	0.0000	-0.021	0.00

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ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.01	58116.309	100.00
RUNOFF	0.666	2418.083	4.16
EVAPOTRANSPIRATION	12.901	46829.930	80.58

DRAINAGE COLLECTED FROM LAYER 3	0.1330	482.819	0.83
PERC./LEAKAGE THROUGH LAYER 5	0.000004	0.015	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0445		
CHANGE IN WATER STORAGE	2.310	8385.449	14.43
SOIL WATER AT START OF YEAR	356.148	1292816.000	
SOIL WATER AT END OF YEAR	357.313	1297047.370	
SNOW WATER AT START OF YEAR	0.154	558.107	0.96
SNOW WATER AT END OF YEAR	1.298	4712.249	8.11
ANNUAL WATER BUDGET BALANCE	0.0000	0.010	0.00

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ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	20.48	74342.391	100.00
RUNOFF	1.919	6966.560	9.37
EVAPOTRANSPIRATION	17.823	64696.949	87.03
DRAINAGE COLLECTED FROM LAYER 3	1.9146	6949.854	9.35
PERC./LEAKAGE THROUGH LAYER 5	0.000028	0.103	0.00
AVG. HEAD ON TOP OF LAYER 4	0.6416		
CHANGE IN WATER STORAGE	-1.177	-4270.963	-5.74
SOIL WATER AT START OF YEAR	357.313	1297047.370	
SOIL WATER AT END OF YEAR	357.293	1296972.870	
SNOW WATER AT START OF YEAR	1.298	4712.249	6.34
SNOW WATER AT END OF YEAR	0.142	515.729	0.69
ANNUAL WATER BUDGET BALANCE	0.0000	-0.111	0.00

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ANNUAL TOTALS FOR YEAR 24

RUN14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.44	56047.203	100.00
RUNOFF	0.538	1951.255	3.48
EVAPOTRANSPIRATION	12.768	46346.949	82.69
DRAINAGE COLLECTED FROM LAYER 3	1.1562	4197.008	7.49
PERC./LEAKAGE THROUGH LAYER 5	0.000017	0.060	0.00
AVG. HEAD ON TOP OF LAYER 4	0.3881		
CHANGE IN WATER STORAGE	0.978	3551.793	6.34
SOIL WATER AT START OF YEAR	357.293	1296972.870	
SOIL WATER AT END OF YEAR	358.156	1300107.870	
SNOW WATER AT START OF YEAR	0.142	515.729	0.92
SNOW WATER AT END OF YEAR	0.257	932.592	1.66
ANNUAL WATER BUDGET BALANCE	0.0000	0.137	0.00

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ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.57	52889.109	100.00
RUNOFF	0.966	3507.501	6.63
EVAPOTRANSPIRATION	12.572	45637.391	86.29
DRAINAGE COLLECTED FROM LAYER 3	2.0966	7610.510	14.39
PERC./LEAKAGE THROUGH LAYER 5	0.000030	0.108	0.00
AVG. HEAD ON TOP OF LAYER 4	0.7056		
CHANGE IN WATER STORAGE	-1.065	-3866.325	-7.31
SOIL WATER AT START OF YEAR	358.156	1300107.870	
SOIL WATER AT END OF YEAR	357.170	1296525.500	
SNOW WATER AT START OF YEAR	0.257	932.592	1.76
SNOW WATER AT END OF YEAR	0.179	648.633	1.23
ANNUAL WATER BUDGET BALANCE	0.0000	-0.075	0.00

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.10	58443.000	100.00
RUNOFF	0.662	2401.380	4.11
EVAPOTRANSPIRATION	13.151	47736.449	81.68
DRAINAGE COLLECTED FROM LAYER 3	1.6317	5923.214	10.14
PERC./LEAKAGE THROUGH LAYER 5	0.000024	0.088	0.00
AVG. HEAD ON TOP OF LAYER 4	0.5475		
CHANGE IN WATER STORAGE	0.656	2381.943	4.08
SOIL WATER AT START OF YEAR	357.170	1296525.500	
SOIL WATER AT END OF YEAR	358.004	1299556.120	
SNOW WATER AT START OF YEAR	0.179	648.633	1.11
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.075	0.00

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ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.00	58080.008	100.00
RUNOFF	0.441	1601.917	2.76
EVAPOTRANSPIRATION	14.354	52104.402	89.71
DRAINAGE COLLECTED FROM LAYER 3	0.9889	3589.816	6.18
PERC./LEAKAGE THROUGH LAYER 5	0.000015	0.054	0.00
AVG. HEAD ON TOP OF LAYER 4	0.3384		
CHANGE IN WATER STORAGE	0.216	783.605	1.35
SOIL WATER AT START OF YEAR	358.004	1299556.120	
SOIL WATER AT END OF YEAR	357.732	1298568.120	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00

SNOW WATER AT END OF YEAR	0.488	1771.530	3.05
ANNUAL WATER BUDGET BALANCE	0.0001	0.214	0.00

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ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.69	60584.715	100.00
RUNOFF	0.292	1058.453	1.75
EVAPOTRANSPIRATION	11.875	43106.996	71.15
DRAINAGE COLLECTED FROM LAYER 3	2.9371	10661.714	17.60
PERC./LEAKAGE THROUGH LAYER 5	0.000042	0.152	0.00
AVG. HEAD ON TOP OF LAYER 4	0.9831		
CHANGE IN WATER STORAGE	1.586	5757.478	9.50
SOIL WATER AT START OF YEAR	357.732	1298568.120	
SOIL WATER AT END OF YEAR	359.440	1304768.370	
SNOW WATER AT START OF YEAR	0.488	1771.530	2.92
SNOW WATER AT END OF YEAR	0.366	1328.718	2.19
ANNUAL WATER BUDGET BALANCE	0.0000	-0.075	0.00

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ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.66	60475.812	100.00
RUNOFF	0.698	2532.983	4.19
EVAPOTRANSPIRATION	15.814	57405.465	94.92
DRAINAGE COLLECTED FROM LAYER 3	3.1917	11585.952	19.16
PERC./LEAKAGE THROUGH LAYER 5	0.000047	0.169	0.00
AVG. HEAD ON TOP OF LAYER 4	1.0774		

CHANGE IN WATER STORAGE	-3.044	-11048.783	-18.27
SOIL WATER AT START OF YEAR	359.440	1304768.370	
SOIL WATER AT END OF YEAR	356.763	1295048.370	
SNOW WATER AT START OF YEAR	0.366	1328.718	2.20
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.028	0.00

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ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.38	44939.406	100.00
RUNOFF	0.537	1950.864	4.34
EVAPOTRANSPIRATION	11.232	40771.508	90.73
DRAINAGE COLLECTED FROM LAYER 3	0.1127	409.070	0.91
PERC./LEAKAGE THROUGH LAYER 5	0.000004	0.014	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0378		
CHANGE IN WATER STORAGE	0.498	1808.021	4.02
SOIL WATER AT START OF YEAR	356.763	1295048.370	
SOIL WATER AT END OF YEAR	357.261	1296856.370	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.068	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						

TOTALS	1.16	1.20	1.95	2.04	1.30	1.03
	0.69	0.85	0.84	1.05	1.31	1.46
STD. DEVIATIONS	0.60	0.54	0.77	0.87	0.68	0.74
	0.48	0.80	0.61	0.82	0.73	0.59

RUNOFF

TOTALS	0.186	0.345	0.181	0.010	0.000	0.001
	0.001	0.001	0.000	0.005	0.002	0.035
STD. DEVIATIONS	0.264	0.345	0.251	0.026	0.001	0.008
	0.006	0.005	0.000	0.022	0.009	0.105

EVAPOTRANSPIRATION

TOTALS	0.558	0.664	2.177	2.298	1.509	1.055
	0.731	0.804	0.811	0.937	0.824	0.761
STD. DEVIATIONS	0.256	0.360	0.626	0.924	0.714	0.727
	0.496	0.820	0.636	0.688	0.371	0.198

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0623	0.0666	0.0822	0.2730	0.2444	0.1297
	0.0578	0.0230	0.0090	0.0044	0.0084	0.0287
STD. DEVIATIONS	0.1789	0.1564	0.1287	0.2457	0.1922	0.1022
	0.0482	0.0184	0.0071	0.0038	0.0231	0.1071

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.2464	0.2901	0.3249	1.1146	0.9658	0.5297
	0.2283	0.0907	0.0366	0.0173	0.0345	0.1133
STD. DEVIATIONS	0.7069	0.6839	0.5085	1.0033	0.7594	0.4173
	0.1906	0.0726	0.0290	0.0151	0.0945	0.4233

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.88 (2.435)	54009.6	100.00

RUNOFF	0.769	(0.5032)	2790.04	5.166
EVAPOTRANSPIRATION	13.128	(2.0347)	47655.87	88.236
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.98947	(0.85893)	3591.773	6.65025
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00002	(0.00001)	0.055	0.00010
AVERAGE HEAD ON TOP OF LAYER 4	0.333	(0.290)		
CHANGE IN WATER STORAGE	-0.008	(1.1748)	-28.17	-0.052

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	1.66	6025.800
RUNOFF	0.788	2858.8760
DRAINAGE COLLECTED FROM LAYER 3	0.03744	135.90358
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000001	0.00218
AVERAGE HEAD ON TOP OF LAYER 4	4.586	
MAXIMUM HEAD ON TOP OF LAYER 4	8.728	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	2.96	10734.5068

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3111
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0830

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	2.6587	0.2216
2	349.7669	0.2915
3	4.5601	0.1900
4	0.0000	0.0000
5	0.2750	0.5500
SNOW WATER	0.000	

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WARNING:  TEMPERATURE FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR    1

WARNING:  SOLAR RADIATION FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR    1

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:    C:\HELP3\data4.D4
TEMPERATURE DATA FILE:      C:\HELP3\data7.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\data13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\data11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\run4.D10
OUTPUT DATA FILE:           C:\HELP3\run4.OUT


TIME:  11:26     DATE:   4/27/2016


******************************************************************************
                                BASE OPTION 2 - INTERMEDIATE CONDITION
     TITLE:  PROMONTORY POINT
                                MIN HYDRUALIC CONDUCTIVITY
******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  22
          THICKNESS                   =     12.00   INCHES
          POROSITY                    =      0.4190 VOL/VOL
          FIELD CAPACITY              =      0.3070 VOL/VOL
          WILTING POINT               =      0.1800 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.3875 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.189999992000E-04 CM/SEC
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                         LAYER  2
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          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
THICKNESS                   =    240.00   INCHES
POROSITY                    =      0.6710 VOL/VOL
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2919 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                         LAYER  3
                         --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   5
THICKNESS                   =     18.00   INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1503 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
SLOPE                       =      3.00   PERCENT
DRAINAGE LENGTH             =    200.0    FEET


                         LAYER  4
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            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.60   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      3.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                         LAYER  5
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              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  51
THICKNESS                   =      0.50   INCHES
POROSITY                    =      0.5500 VOL/VOL
FIELD CAPACITY              =      0.4000 VOL/VOL
WILTING POINT               =      0.2000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.5500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.999999972000E-09 CM/SEC
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GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #22 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 2000. FEET.

SCS RUNOFF CURVE NUMBER	=	96.50	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	16.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	5.801	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.712	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.468	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	77.692	INCHES
TOTAL INITIAL WATER	=	77.692	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM SALT LAKE CITY UTAH

STATION LATITUDE	=	40.76	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	117	
END OF GROWING SEASON (JULIAN DATE)	=	289	
EVAPORATIVE ZONE DEPTH	=	16.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	8.80	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	48.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	39.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	65.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.38	1.84	3.19	3.34	3.26	0.70
1.54	3.42	4.05	2.48	2.47	6.26

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	34.10	40.70	49.20	58.80	68.30
77.50	74.90	65.00	53.00	39.70	30.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH
AND STATION LATITUDE = 40.76 DEGREES

WARNING: TEMPERATURE FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR 1

WARNING: SOLAR RADIATION FOR YEAR 1974 USED WITH PRECIPITATION FOR YEAR 1

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	31.03	112638.922	100.00
RUNOFF	12.967	47069.223	41.79
EVAPOTRANSPIRATION	16.823	61066.055	54.21
DRAINAGE COLLECTED FROM LAYER 3	0.8884	3224.744	2.86
PERC./LEAKAGE THROUGH LAYER 5	0.000126	0.457	0.00
AVG. HEAD ON TOP OF LAYER 4	2.8611		
CHANGE IN WATER STORAGE	0.352	1278.415	1.13
SOIL WATER AT START OF YEAR	77.692	282023.094	
SOIL WATER AT END OF YEAR	78.044	283301.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.027	0.00

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WARNING: TEMPERATURE FOR YEAR 1975 USED WITH PRECIPITATION FOR YEAR 2

WARNING: SOLAR RADIATION FOR YEAR 1975 USED WITH PRECIPITATION FOR YEAR 2

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.04	138085.219	100.00
RUNOFF	17.624	63974.258	46.33
EVAPOTRANSPIRATION	17.555	63724.527	46.15
DRAINAGE COLLECTED FROM LAYER 3	1.6160	5866.103	4.25
PERC./LEAKAGE THROUGH LAYER 5	0.000264	0.958	0.00
AVG. HEAD ON TOP OF LAYER 4	5.2039		
CHANGE IN WATER STORAGE	1.245	4519.363	3.27
SOIL WATER AT START OF YEAR	78.044	283301.500	
SOIL WATER AT END OF YEAR	77.642	281838.812	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.648	5982.059	4.33
ANNUAL WATER BUDGET BALANCE	0.0000	0.010	0.00

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WARNING: TEMPERATURE FOR YEAR 1976 USED WITH PRECIPITATION FOR YEAR 3

WARNING: SOLAR RADIATION FOR YEAR 1976 USED WITH PRECIPITATION FOR YEAR 3

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	22.72	82473.617	100.00
RUNOFF	5.355	19437.057	23.57
EVAPOTRANSPIRATION	14.207	51571.297	62.53
DRAINAGE COLLECTED FROM LAYER 3	1.2691	4606.785	5.59
PERC./LEAKAGE THROUGH LAYER 5	0.000192	0.696	0.00
AVG. HEAD ON TOP OF LAYER 4	4.0917		
CHANGE IN WATER STORAGE	1.889	6857.761	8.32
SOIL WATER AT START OF YEAR	77.642	281838.812	
SOIL WATER AT END OF YEAR	76.357	277176.562	

SNOW WATER AT START OF YEAR	1.648	5982.059	7.25
SNOW WATER AT END OF YEAR	4.822	17502.084	21.22
ANNUAL WATER BUDGET BALANCE	0.0000	0.022	0.00

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WARNING: TEMPERATURE FOR YEAR 1977 USED WITH PRECIPITATION FOR YEAR 4

WARNING: SOLAR RADIATION FOR YEAR 1977 USED WITH PRECIPITATION FOR YEAR 4

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.21	142332.312	100.00
RUNOFF	22.764	82632.008	58.06
EVAPOTRANSPIRATION	18.582	67452.437	47.39
DRAINAGE COLLECTED FROM LAYER 3	0.9428	3422.320	2.40
PERC./LEAKAGE THROUGH LAYER 5	0.000133	0.483	0.00
AVG. HEAD ON TOP OF LAYER 4	3.0308		
CHANGE IN WATER STORAGE	-3.079	-11174.983	-7.85
SOIL WATER AT START OF YEAR	76.357	277176.562	
SOIL WATER AT END OF YEAR	77.160	280091.687	
SNOW WATER AT START OF YEAR	4.822	17502.084	12.30
SNOW WATER AT END OF YEAR	0.940	3411.956	2.40
ANNUAL WATER BUDGET BALANCE	0.0000	0.039	0.00

****

WARNING: TEMPERATURE FOR YEAR 1978 USED WITH PRECIPITATION FOR YEAR 5

WARNING: SOLAR RADIATION FOR YEAR 1978 USED WITH PRECIPITATION FOR YEAR 5

****

ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	26.31	95505.312	100.00
RUNOFF	10.057	36506.867	38.22
EVAPOTRANSPIRATION	14.597	52987.602	55.48
DRAINAGE COLLECTED FROM LAYER 3	1.1564	4197.734	4.40
PERC./LEAKAGE THROUGH LAYER 5	0.000172	0.625	0.00
AVG. HEAD ON TOP OF LAYER 4	3.7225		
CHANGE IN WATER STORAGE	0.499	1812.496	1.90
SOIL WATER AT START OF YEAR	77.160	280091.687	
SOIL WATER AT END OF YEAR	77.198	280229.875	
SNOW WATER AT START OF YEAR	0.940	3411.956	3.57
SNOW WATER AT END OF YEAR	1.401	5086.283	5.33
ANNUAL WATER BUDGET BALANCE	0.0000	-0.011	0.00

****

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.92	1.96	3.53	2.25	3.25	0.70
	1.07	5.17	3.18	2.21	1.48	5.73
STD. DEVIATIONS	0.84	0.93	0.54	1.11	1.86	0.48
	0.20	3.80	1.58	1.28	0.61	1.43
RUNOFF						
TOTALS	1.366	0.968	1.407	0.627	1.214	0.041
	0.155	2.951	1.562	0.915	0.440	2.106
STD. DEVIATIONS	1.942	0.890	0.614	0.807	0.941	0.081
	0.083	2.703	0.998	0.829	0.382	1.992
EVAPOTRANSPIRATION						
TOTALS	0.411	1.118	2.269	2.122	2.447	0.672
	0.629	2.189	1.904	0.969	0.889	0.734
STD. DEVIATIONS	0.230	0.570	0.383	0.725	1.094	0.151
	0.240	1.368	0.423	0.702	0.411	0.111

```
  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS                 0.0673   0.0686   0.1118   0.1295   0.1308   0.1170
                           0.1117   0.1031   0.0923   0.0881   0.0788   0.0756

    STD. DEVIATIONS        0.0292   0.0185   0.0206   0.0275   0.0393   0.0353
                           0.0337   0.0311   0.0278   0.0264   0.0236   0.0222

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               2.5542   2.8675   4.2441   5.0821   4.9656   4.5901
                           4.2410   3.9132   3.6205   3.3454   3.0902   2.8703

    STD. DEVIATIONS        1.1074   0.7864   0.7815   1.0808   1.4904   1.3830
                           1.2776   1.1809   1.0890   1.0042   0.9271   0.8419
*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH    5
-------------------------------------------------------------------------------
                                      INCHES            CU. FEET       PERCENT
                                  -------------------  -------------   ---------
 PRECIPITATION                     31.46    (   7.184)     114207.1     100.00

 RUNOFF                            13.753   (  6.7266)      49923.89     43.713

 EVAPOTRANSPIRATION                16.353   (  1.8922)      59360.39     51.976

 LATERAL DRAINAGE COLLECTED         1.17453 (  0.29145)      4263.537    3.73316
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH        0.00018 (  0.00006)         0.644     0.00056
   LAYER  5

 AVERAGE HEAD ON TOP                3.782 (    0.940)
   OF LAYER  4

 CHANGE IN WATER STORAGE            0.181   (  1.9239)        658.61      0.577
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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	3.26	11833.800
RUNOFF	2.662	9662.6523
DRAINAGE COLLECTED FROM LAYER 3	0.00676	24.54788
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000001	0.00452
AVERAGE HEAD ON TOP OF LAYER 4	7.959	
MAXIMUM HEAD ON TOP OF LAYER 4	11.950	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	49.7 FEET	
SNOW WATER	5.56	20170.4160

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3737

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1583

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	4.2165	0.3514
2	69.4577	0.2894
3	3.2491	0.1805
4	0.0000	0.0000
5	0.2750	0.5500
SNOW WATER	1.401	

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APPENDIX E

SLOPE STABILITY EVALUATION

Appendix E – Phase 1 Slope Stability Evaluation

TO:	COMPANY:	DATE:
Stephen Prows	Promontory Point Resources (PPR)	May 2, 2016
FROM:	**PROJECT NUMBER:**	**PHONE NUMBER:**
Peter Skopek, Ph.D. Fernando Cuenca, Ph.D.	BAS 15-99E	909-860-7777

RE:
Slope Stability Evaluation
Promontory Point Landfill Phase 1 (Subphases 1A, 1B, and 1C)
Ogden, Utah

INTRODUCTION

Presented in this Appendix E are the results of the slope stability analyses performed for the design of Phase 1 (Subphases 1A, 1B, and 1C) of the proposed Promontory Point Landfill, and preliminary analyses of the conceptual final configuration of the landfill. The analyses were performed based on site-specific data contained in the following primary sources (other relevant data sources are listed on the back of this memorandum):

- Promontory Landfill LLC, Class I Landfill, Permit Application, by Advanced Environmental Engineering (AEE), August 2008.
- Geotechnical Data Summary and Preliminary Geologic Map, Promontory Point Landfill, Box Elder County, Utah, by Tetra Tech BAS GeoScience, October 2015.
- Grading and design plans for the slope and base liners provided in Appendix B – "Construction Plans," Sheets C-100 to C-106, C-301, C-401, and C-501 to C-504.

SLOPE STABILITY EVALUATION

Slope stability analyses were performed using SLOPE/W (Geo Slope Office, 2012), using a two-dimensional analysis with Spencer's method, and considering initially a specified non-circular slip surface, and subsequently allowing for optimization of the slip surface. The analyzed cross-section is labeled as Cross-Section A on drawing Sheets C-101 through C-106, and it is shown on Sheet C-301 (see Appendix B – Construction Plans). For the stability analyses this cross-section was conservatively modified to incorporate a more critical configuration where the excavation to the landfill bottom was shallower, at about 8 feet below the toe of the landfill, which is characteristic of the landfill Phase 1 configuration about 290 feet to the east of the Cross-Section A location.

Additionally, analyses were performed on a conceptual landfill final configuration considered by Tetra Tech, the project landfill designer, to preliminarily assess feasibility of the overall design.

Design Shear Strength and Unit Weight

The following paragraphs provide the summary of design shear strength and unit weight parameters and the basis for their selection for the different materials and liner components affecting the stability of the landfill.

- **Native Alluvium**

Strength parameters and unit weight selected for the stability analyses were based on the material description and penetration blowcounts for the alluvial materials from the Advanced Environmental Engineering Report (2008) and are presented in Table 1 below.

- **Municipal Solid Waste**

The MSW shear strength parameter values utilized in the analyses are based on the lower end of the range presented in the references provided in Table 1, although similar results can be frequently found elsewhere, e.g., Dixon & Jones, 2005. The utilized values are commonly accepted by the design community for typical waste streams and are considered appropriate and conservative for this project recognizing that an accurate prediction of the material properties for the presently unknown anticipated heterogeneous waste stream is not possible at this point.

Table 1
Summary of Design Parameters used in Slope Stability Analyses
BULK MATERIALS

Material	Shear strength	Unit weight	Note
MSW Fill	$\varphi = 30^o$ c = 200 psf	$\gamma = 90$ pcf	Based on Kavazanjian, 1995 and 2001, and Singh and Murphy, 1990.
Native alluvium	$\varphi = 34^o$ c = 50 psf	$\gamma = 120$ pcf	Based on correlations with blowcounts from MW-1 (AEE, 2008). Not used in analyses.

- **Liner Components**

The parameters utilized in the analyses for the various landfill liner components and liner component interfaces, as well as the basis for their selection are summarized in Tables 2, and 3a through 3e. The material properties of the liner components and liner component interfaces used in the analyses are based on our collection of previous data and other published data. No laboratory testing of the liner components was performed for the preparation of this report. The intent of the parameter selection was to utilize achievable values that will be verified during construction. The assumed liner component shear strength parameters are therefore considered prescriptive and will need to be verified as a part of the Construction Quality Control/Assurance (CQC/CQA) program.

Base and slope liner systems for the Promontory Landfill Phase 1 - Subphases 1A through 1C are proposed to consist of the following components from top to bottom as listed in Table 2.

Table 2
Base and Slope Liner Components (top to bottom)

Base Liner		**Slope Liner**
Option 1	**Option 2**	
18-inch Coarse Sand Layer	18-inch Protective Soil Layer	24-inch Protective Soil Layer
	8-oz/sy Separation Geotextile	
	9-inch LCRS Gravel Layer	
	12-oz/sy Cushion Geotextile	16-oz/sy Cushion Geotextile
60-mil HDPE Geomembrane textured on both sides	60-mil HDPE Geomembrane textured on both sides	60-mil HDPE Geomembrane textured on both sides
Geosynthetic Clay Liner (GCL)	Geosynthetic Clay Liner (GCL)	Geosynthetic Clay Liner (GCL)

Note: LCRS … leachate collection and recovery system

It is common practice that the lowest peak interface shear strength is used for the base liner and the lowest large displacement interface shear strength for the slope liner (Stark, et. al., 2004; and Koerner, 2005). Large displacement shear strength is usually defined as shear strength at 25 percent strain, i.e., 3 inches of deformation for a 12-inch square sample. It is recommended that a static Factor of Safety of at least 1.5 be obtained for this condition. It is also customary to perform a final check in which the lowest large displacement shear strength parameters for both the slope liner and the base liner are considered in the slope stability analysis to ensure that the system has a Factor of Safety greater than unity (Stark, et. al., 2004). This practice was followed in the selection of the parameters for slope stability analyses.

The considered liner components and liner component interfaces are summarized below in:

- Tables 3a and 3b for base liner Option 1 and Option 2, respectively, for peak strength;
- Tables 3c and 3d for base liner Option 1 and Option 2, respectively, for large displacement strength;
- Table 3e for slope liner for large displacement strength.

Table 3a
Summary of Design Parameters used in Slope Stability Analyses
OPTION 1 BASE LINER COMPONENTS PEAK STRENGTH

Material	Shear strength utilized in stability analyses **Peak shear strength parameters**	Unit weight (pcf)	Note
Interface: 18-inch Coarse Sand Layer & 60-mil HDPE Geomembrane textured on both sides	Not used in the analyses / not considered to be governing interface strength	120	Not used in the analyses. Based on Koerner, 2005, peak shear strength estimated to be: For granular soil: $\varphi = 34^o$, c = 0 psf.
Interface: 60-mil HDPE Geomembrane textured on both sides & GCL			Not used in the analyses. Based on Koerner, 2005, peak shear strength estimated to be $\varphi = 23^o$, c = 167 psf.
Internal : GCL	**$\varphi = 23.5^o$** **c = 0 psf**		Peak shear strength estimated from in-house database and Koerner, 2005. **This is the anticipated governing strength at normal stresses <~ 5,360 psf (less than approximately 60 feet of MSW)** for all slip surfaces along the slope liner.
	$\varphi = 16^o$ **c = 794 psf**		Peak shear strength estimated from in-house database and Koerner, 2005. **This is the anticipated governing strength at normal stresses >~5,360 psf (more than approximately 60 feet of MSW)** for all slip surfaces along the slope liner.

Table 3b
OPTION 2 BASE LINER COMPONENTS PEAK STRENGTH

Material	Shear strength utilized in stability analyses **Peak shear strength parameters**	Unit weight (pcf)	Note
Interface: Protective/Operations layer & 8-oz nonwoven Geotextile	Not used in the analyses / not considered to be governing interface strength	120	Not used in the analyses. Based on Koerner, 2005, peak shear strength estimated to be: For granular soil: φ = 33º, c = 0 psf; For cohesive soil: φ = 30º, c = 104 psf.
Interface: 8-oz nonwoven Geotextile & 9-inch LCRS Gravel Layer			Not used in the analyses. Based on Koerner, 2005, peak shear strength estimated to be: For granular soil: φ = 33º, c = 0 psf;
Interface: 9-inch LCRS Gravel Layer &12-oz nonwoven Cushion Geotextile			Not used in the analyses. Based on Koerner, 2005, peak shear strength estimated to be: For granular soil: φ = 33º, c = 0 psf;
Interface: 12-oz Cushion Geotextile & 60-mil HDPE Geomembrane textured on both sides			Not used in the analyses. Based on Koerner, 2005, peak shear strength estimated to be φ = 25º, c = 167 psf.
Interface: 60-mil HDPE Geomembrane textured on both sides & GCL			Not used in the analyses. Based on Koerner, 2005, peak shear strength estimated to be φ = 23º, c = 167 psf.
Internal : GCL	**φ = 23.5º** **c = 0 psf**		Peak shear strength estimated from in-house database and Koerner, 2005. **This is the anticipated governing strength at normal stresses <~ 5,360 psf (less than approximately 60 feet of MSW)** for all slip surfaces along the slope liner.
	φ = 16º **c = 794 psf**		Peak shear strength estimated from in-house database and Koerner, 2005. **This is the anticipated governing strength at normal stresses >~5,360 psf (more than approx. 60 feet of MSW)** for all slip surfaces along the slope liner.

Table 3c
OPTION 1 BASE LINER COMPONENTS LARGE DISPLACEMENT STRENGTH

Material	Shear strength utilized in stability analyses Large displacement shear strength parameters	Unit weight (pcf)	Note
Interface: 18-inch Coarse Sand Layer & 60-mil HDPE Geomembrane textured on both sides	Not used in the analyses / not considered to be governing interface strength	120	Not used in the analyses. Based on Koerner, 2005, large displacement shear strength estimated to be: For granular soil: $\varphi = 31^o$, c = 0 psf.
Interface: 60-mil HDPE Geomembrane textured on both sides & GCL			Not used in the analyses. Based on Koerner, 2005, large displacement shear strength estimated to be $\varphi = 13^o$, c = 0 psf.
Internal : GCL	**$\varphi = 8^o$** **c = 0 psf**		Large displacement shear strength estimated from in-house database and Koerner, 2005. **This is the anticipated governing strength at normal stresses <~ 7,055 psf (less than approx. 80 feet of MSW)** for all slip surfaces along the slope liner.
	$\varphi = 6^o$ **c = 250 psf**		Large displacement shear strength estimated from in-house database and Koerner, 2005. **This is the anticipated governing strength at normal stresses >~7,055 psf (more than approx. 80 feet of MSW)** for all slip surfaces along the slope liner.

Table 3d
OPTION 2 BASE LINER COMPONENTS LARGE DISPLACEMENT STRENGTH

Material	Shear strength utilized in stability analyses Large displacement shear strength parameters	Unit weight (pcf)	Note
Interface: Protective/Operations layer & 8-oz nonwoven Geotextile	Not used in the analyses / not considered to be governing interface strength	120	Not used in the analyses. Based on Koerner, 2005, large displacement shear strength estimated to be: For granular soil: φ = 33º, c = 0 psf; For cohesive soil: φ = 21º, c = 0 psf.
Interface: 8-oz nonwoven Geotextile & 9-inch LCRS Gravel Layer			Not used in the analyses. Based on Koerner, 2005, large displacement shear strength estimated to be: For granular soil: φ = 33º, c = 0 psf.
Interface: 9-inch LCRS Gravel Layer &12-oz nonwoven Cushion Geotextile			Not used in the analyses. Based on Koerner, 2005, large displacement shear strength estimated to be: For granular soil: φ = 33º, c = 0 psf.
Interface: 12-oz Cushion Geotextile & 60-mil HDPE Geomembrane textured on both sides			Not used in the analyses. Based on Koerner, 2005, large displacement shear strength estimated to be φ = 17º, c = 0 psf.
Interface: 60-mil HDPE Geomembrane textured on both sides & GCL			Not used in the analyses. Based on Koerner, 2005, large displacement shear strength estimated to be φ = 13º, c = 0 psf.
Internal : GCL	**φ = 8º** **c = 0 psf**		Large displacement shear strength estimated from in-house database and Koerner, 2005. **This is the anticipated governing strength at normal stresses** <~ **7,055 psf (less than approx. 80 feet of MSW)** for all slip surfaces along the slope liner.
	φ = 6º **c = 250 psf**		Large displacement shear strength estimated from in-house database and Koerner, 2005. **This is the anticipated governing strength at normal stresses >~7,055 psf (more than approx. 80 feet of MSW)** for all slip surfaces along the slope liner.

Table 3e
SLOPE LINER COMPONENTS LARGE DISPLACEMENT STRENGTH

Material	Shear strength utilized in stability analyses Large displacement shear strength parameters	Unit weight (pcf)	Note
Interface: 24-inch Protective Soil Cover & 8-oz Geotextile	Not used in the analyses / not considered to be governing interface strength	120	Not used in the analyses. Based on Koerner, 2005, large displacement shear strength estimated to be: For granular soil: φ = 33º, c = 0 psf; For cohesive soil: φ = 21º, c = 0 psf.
Interface: 16-oz Geotextile & 60-mil HDPE Geomembrane textured on both sides			Not used in the analyses. Based on Koerner, 2005, large displacement shear strength estimated to be φ = 17º, c = 0 psf.
Interface: 60-mil HDPE Geomembrane textured on both sides & GCL			Not used in the analyses. Based on Koerner, 2005, large displacement shear strength estimated to be φ = 13º, c = 0 psf.
Internal : GCL	**φ = 8º** **c = 0 psf**		Large displacement shear strength estimated from in-house database and Koerner, 2005. **This is the anticipated governing strength at normal stresses <~ 7,055 psf (less than approx. 80 feet of MSW)** for all slip surfaces along the slope liner.
	φ = 6º **c = 250 psf**		Large displacement shear strength estimated from in-house database and Koerner, 2005. **This is the anticipated governing strength at normal stresses >~7,055 psf (more than approx. 80 feet of MSW)** for all slip surfaces along the slope liner.

- For the base liner, the governing (weakest) peak interface shear strength for Options 1 and 2 is expected to be within the GCL. Accordingly, the following shear strength parameters obtained were used in the slope stability analyses (see Tables 3a and 3b):

  - for normal pressures less than about 5,360 psf (equivalent to about 60 feet of MSW) an angle of friction of 23.5 degrees with no cohesion intercept;
  - for normal pressures greater than 5,360 psf, an angle of friction of 16 degrees and a cohesion intercept of 794 psf.

- Similarly, for the base liner, the governing (weakest) large displacement interface shear strength for Options 1 and 2 is expected to be within the GCL. Accordingly, the following shear strength parameters were used in the slope stability analyses (see Tables 3c and 3d):

  - for normal pressures less than about 7,055 psf (equivalent to about 80 feet of MSW) an angle of friction of 8 degrees with no cohesion intercept;
  - for normal pressures greater than 7,055 psf, an angle of friction of 6 degrees and a cohesion intercept of 250 psf.

- For the slope liner system, the governing (weakest) large displacement shear strength is expected to be within the GCL. Accordingly, the following shear strength parameters obtained from our experience and published data (Koerner, 2005) were used in the slope stability analyses (see Table 3e):

  - for normal pressures less than about 7,055 psf an angle of friction of 8 degrees with no cohesion intercept;
  - for normal pressures greater than 7,055 psf, an angle of friction of 6 degrees and a cohesion intercept of 250 psf.

The assumed shear strength parameters presented in Tables 3a through 3e are considered prescriptive and therefore must be verified prior to construction so that the measured values exceed the considered values herein. It should be noted that, in general, all considered shear strength parameters, i.e., not just the anticipated governing strength parameters, need to be verified to confirm that the anticipated governing strength remains the governing one.

Low Permeability Clay Layer Consideration

It is understood that, if feasible, a low permeability clay layer may be installed as a part of the liner system instead of the GCL component described in Table 2 above. Considering that a typical shear strength (both internal and at the interface) of the low permeability clay material is likely to be greater than the critical internal shear strength of the GCL material utilized in the analyses herein, the presented stability analyses remain applicable also in the case that the low permeability clay is used. However, if the low permeability clay is used, its shear strength properties must be verified (both internal and at the interface) and the stability analyses presented herein need to be updated.

Groundwater

Because of the presence of the Leachate Collection and Recovery System (LCRS) system, the analyses did not consider pore pressure build-up within the MSW materials. Also, no groundwater conditions were considered in the analyses for the alluvial materials since the groundwater in observation wells MW-1 and MW-2 during the AEE (2008) exploration at the site was encountered at elevations 4,205 and 4,210 feet, i.e., about at least 80 feet below the landfill bottom proposed at elevations between 4,284 and 4,306 feet.

Static Slope Stability

The static stability of Cross-Section A shown on Sheet C-301 in Appendix B was initially considered. However, this cross-section was slightly modified so that the base liner elevation would match the shallower depth of excavation on the eastern side of the landfill (about 290 feet to the east of Cross-Section A) which was considered to be more critical; this modified cross-section is referred herein as the "Design Cross-Section". The shallower depth of excavation below the toe of the landfill is deemed more critical, because the favorable ascending inclination of the failure surface which follows the weakest liner component is shorter. The Design Cross-Section was first analyzed using large displacement shear strength parameters for the slope liner and peak shear strength parameters for the base liner. The computed static Factors of Safety for the Design Cross-Section for the three Subphases 1A through 1C are included in Table 4 and range from 2.04 for Subphase 1A to 1.88 for Subphase 1C (see Attachment 1, Figures B-1 through B-3). These Factors of Safety are all greater than the target minimum required static Factor of Safety of 1.5.

Subsequently, the static stability for the Design Cross-Section was analyzed using large displacement shear strength parameters for both the slope and base liner. The computed static Factors of Safety for the Design Cross-Section for the three Subphases 1A through 1C are included in Table 4 and range from 1.23 for Subphase 1A to 1.09 for Subphase 1C (see Attachment 1, Figures B-5 through B-7). These Factors of Safety are all greater than the target minimum required static Factor of Safety of 1.0.

The future final configuration of the landfill was also preliminarily considered herein based on the preliminary unpublished configuration plans. Although the precise geometry of this final configuration is not known at the present time the following anticipated configuration parameters were considered in the analyses:

- The maximum landfill deck will be at elevation of about 5,350 feet (about 1,050 feet higher than the elevation at the toe of the Cell 1 analyzed herein);
- The existing grade is sloping upwards from the Phase 1 - Subphase 1A toe, roughly at a grade of 6 percent;
- The base liner of the landfill cells will be sloped generally at a 3 percent slope but the excavation below the existing grade will not exceed about 50 feet. Therefore, 10 feet high steps spaced about 300 to 500 feet will be constructed to limit the depth of the excavation. For these preliminary analyses the bottom of the landfill was simplified and conservatively assumed to be sloped at a uniform grade of 4.7 percent.

The static stability of the assumed final landfill configuration (see Figure B-4) was analyzed using large displacement shear strength parameters for the slope liner and peak shear strength parameters for the base liner. The computed static Factor of Safety for this cross-section is 1.52, which is slightly larger than the minimum required of 1.5, and therefore it is considered acceptable

Table 4
Static Factors of Safety for the Design Cross Section

Subphase	Shear strength Parameters	Factor of Safety	Attachment 1 Figure Number
Subphase 1A	- Slope Liner – large displacement shear strength - Base Liner – peak shear strength	2.04	Figure B-1
Subphase 1B		1.93	Figure B-2
Subphase 1C		1.88	Figure B-3
Assumed Final Configuration		1.52	Figure B-4
Subphase 1A	- Slope Liner – large displacement shear strength - Base Liner – large displacement shear strength	1.23	Figure B-5
Subphase 1B		1.15	Figure B-6
Subphase 1C		1.09	Figure B-7

Permanent Seismic Displacement Analyses

The Resource Conservation and Recovery Act (RCRA) Subchapter I, Code of Federal Regulations (CFR) Title 40 Subpart D (40CFR Subchapter I Part 258 Subpart D) requires that landfills receiving municipal solid waste be designed for seismic conditions if the facility is located within a Seismic Impact Zone. A Seismic Impact Zone is defined in Section 2.6.1 of the 40CFR Part 258 as an area having a 10 percent or greater probability in 250 years, i.e., 2,373-year return period, that the maximum horizontal acceleration will exceed 0.1g. For such a case the landfill should be designed using the maximum horizontal bedrock acceleration.

From Figure 2.6 in Section 2.6 (40CFR Part 258) the site is located in an area where the peak horizontal bedrock acceleration at the site is estimated to be about 0.5g and therefore is located within a Seismic Impact Zone and the seismic risk at the site needs to be addressed.

First, the site seismic demand at the site with coordinates N41.218741, W-112.473848 was determined using the deaggregation analysis tool from the USGS Seismic Hazard Interactive Deaggregation website (https://geohazards.usgs.gov/deaggint/2008/). The seismic demand was determined for a site class B/C (v_s= 2,500 ft/sec) for the design seismic event with a mean return period of 2,475 years, i.e., slightly greater seismic event than the 2,373-year return period event required by 40CFR Part 258. This ground motion corresponds to a predominant earthquake magnitude of M_w6.97 located at a distance of approximately 2.6 km. These ground motion parameters were used to estimate the mean period of the design earthquake T_m of 0.5 seconds, and the predominant period T_p of 0.32 seconds.

Then the shear wave velocities were estimated for Subphases 1A to 1C taking into consideration different thicknesses of the landfill waste sliding wedge for each subphase. The shear wave velocities were estimated using Kavazanjian (1996), and are presented in Table 5. The estimated natural period T_s of the landfill sliding waste material prism is also included in Table 5.

For the Phase 1 design, The Seismic Design Guidance for RCRA Subtitle D (258) (1995) provides guidelines and establishes a simplified method to convert the peak horizontal bedrock acceleration at a site (from Figure 2.6) to a free field peak ground acceleration of 0.5g that accounts for local site conditions (Figure 4.5). Considering the T_p and T_s determined above, the maximum horizontal equivalent acceleration (MHEA) of the waste mass can be estimated from Figure 4.8 by substituting the peak horizontal bedrock acceleration with the free field peak ground acceleration. It is noted that the free field peak ground acceleration in this case happens to be equal to the peak bedrock horizontal acceleration. These MHEAs are presented in Table 5 for Subphases 1A through 1C.

Table 5
Shear Wave Velocity and Natural Period of the Landfill Sliding Waste Mass

Subphase	Approximate Effective Thickness (ft)	Average Shear Wave Velocity v_s (m/sec)	Natural Period Ts (seconds)	MHEA (from Figure 4.8)
Subphase 1A	50	195	0.34	0.38g
Subphase 1B	70	200	0.47	0.30g
Subphase 1C	100	212	0.68	0.13g
Assumed Final Configuration	650	415	4.4	0.03g

Given the recent advances in seismology and earthquake engineering and for verification purposes, the peak horizontal bedrock acceleration was also estimated using the USGS Hazard curve application (http://geohazards.usgs.gov/hazardtool/application.php) for the same site coordinates as given above for the same site class B/C (v_s= 2,500 ft/sec) as 0.496g matching well the value of 0.5g from Figure 2.6 discussed above. The MHEAs were subsequently computed for Subphases 1A, 1B, and 1C using the methodology by Bray and Rathje (1998) considering the underlying materials as soft-rock. These MHEAs, presented in Table 6, are lower than those estimated based on the Seismic Design Guidance for RCRA Subtitle D (258) (1995) presented in Table 5 above, which is herein deemed overly conservative and not consistent with the current state of practice.

The yield accelerations (horizontal seismic coefficient that would yield a pseudo-static Factor of Safety of 1.0) for the Design Cross-Section for Subphases 1A through 1C, were computed with SLOPE/W are summarized in Table 6 and shown in Figures B-8 through B-10. Since the MHEAs computed using Bray and Rathje (1998) and presented in Table 6 are larger than the yield acceleration for Subphase 1A, then permanent seismic displacements are anticipated for this subphase. As the MHEA is almost equal to the yield acceleration for Subphase B and even lower

than the yield acceleration for Subphase C, the permanent displacements are expected to be negligible for these two subphases.

The earthquake-induced deviatoric slope displacements were computed using the Bray and Travasarou method (2007) using the spectral acceleration from the UHRS for 2,373 years (http://geohazards.usgs.gov/hazardtool/application.php) at the degraded period of $1.5T_s$ for each subphase of Phase 1 (see Attachment 2). The earthquake-induced deviatoric slope displacements for Subphases 1A, 1B, and 1C are summarized in Table 6. The displacements are less than the maximum acceptable deformation for landfills of 12 inches, and thus the deformations are considered acceptable.

Table 6
Earthquake-induced Slope Displacement Data

Subphase	Sliding Waste Mass MHEA (Bray and Rathje)	Yield Acceleration	Attachment 1 Figure Number	Deviatoric Slope Displacements (Bray and Travasarou) (inches)
Subphase 1A	0.334g	0.28g	Figure B-8	2.8
Subphase 1B	0.256g	0.25g	Figure B-9	2.2
Subphase 1C	0.194g	0.24g	Figure B-10	0.4
Assumed Final Configuration	0.045g	0.13g	Figure B-11	negligible

For the preliminary evaluation of the future conceptual final configuration of the landfill, the estimated average height of the landfill sliding mass was estimated to be about 650 feet. The average shear wave velocity v_s for such a landfill sliding waste mass was estimated from Kavazanjian (1996) as 415 m/sec the associated natural period T_s is about 4.4 sec. The MHEA was computed using the methodology by Bray and Rathje (1998) as 0.045g for the underlying soft bedrock foundation materials. The yield acceleration for the assumed final landfill configuration cross-section was computed as 0.135g (see Figure B-10). Since the yield acceleration is much larger than the MHEA, then the seismic induced deviatoric slope displacements are expected to be negligible (see Attachment 2).

It is noted that the estimated earthquake-induced deviatoric slope displacements are the largest for the initial Subphase 1A, then decrease in magnitude for the subsequent Subphases 1B and 1C, and are negligible for the assumed final landfill configuration. This is due to the fact that as the landfill height changes the natural period of the potential sliding mass also changes and so does the spectral acceleration at the degraded period which controls the permanent seismic displacement estimate. Eventually, for the large thickness of the final landfill configuration, the controlling degraded period increases in such a way that the associated spectral acceleration is taken from the far and low end of the acceleration response spectra and therefore the calculated permanent seismic displacement is negligible.

CONCLUSIONS

The following conclusions can be drawn from the slope stability and deformation analyses:

- The static Factors of Safety for the proposed Phase 1-Subphases 1A through 1C landfill configurations are above the minimum required of 1.5 using the lowest large displacement shear strength for the slope liner components and the lowest peak shear strength for the base liner.

- The static Factors of Safety for the proposed Phase 1-Subphases 1A through 1C landfill configurations are above the minimum required of 1.0 using the lowest large displacement shear strength parameters for both the slope and base liner components.

- The static Factor of Safety for the assumed final configuration of the landfill is above the minimum required of 1.5 using the lowest large displacement shear strength for the slope liner and the lowest peak shear strength parameters for the base liner.

- The maximum design earthquake-induced permanent seismic displacement for the proposed landfill Phase 1 is estimated to be about 2.8 inches for the Subphase 1A configuration, which is considered acceptable.

- The design earthquake-induced permanent seismic displacement is estimated to be negligible for the assumed final landfill configuration of the whole landfill.

CLOSURE

We appreciate the opportunity to provide our professional services on this project. If you have any questions regarding this report or if we can be of further service, please do not hesitate to contact us.

Respectfully submitted,
Tetra Tech

Fernando Cuenca, Ph.D.
Project Engineer

Peter Skopek, Ph.D.
Principal Engineer

Attachments: Attachment 1 – Slope Stability Analyses
Attachment 2 – Seismic Slope Deformation Analyses

Filename: Appendix E Promontory LF- Phase 1 Slope Sability Evaluation 2016-04-26.docx

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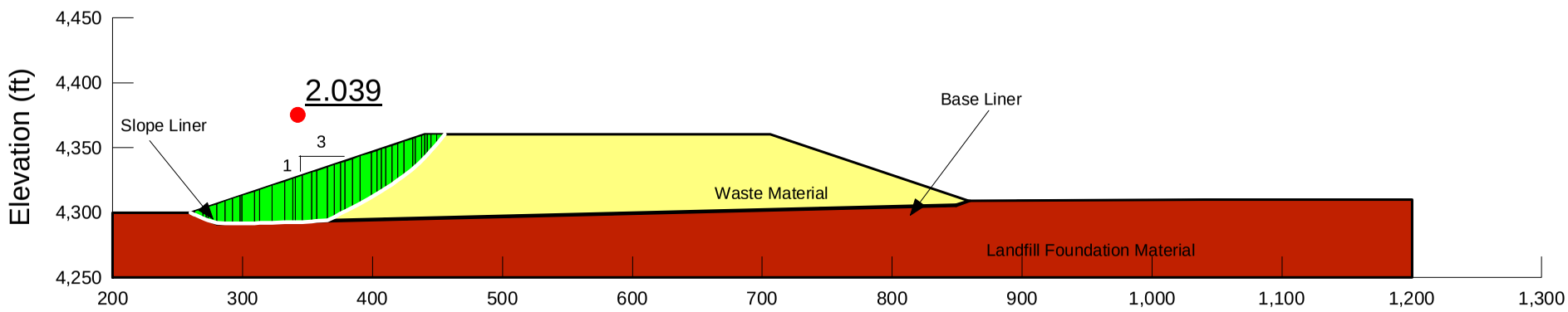
Attachment 1
Slope Stability Analyses

Name: 01 Promontory Phase 1A - Design Cross-section
Method: Spencer
PWP Conditions Source: (none)
Slip Surface Option: Fully-Specified
Optimize Critical Slip Surface Location: Yes
Horz Seismic Coef.: 0



Name: Waste Material
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 200 psf
Phi': 30 °

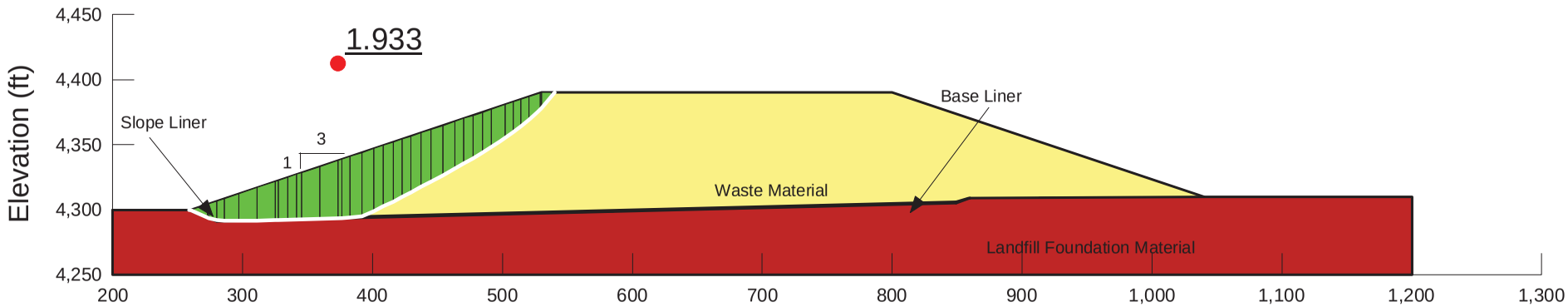
Name: Slope Liner (Large Displacement Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 250 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Base Liner (Peak Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 23.5 °
Phi 2: 16 °
Bilinear Normal: 5,362 psf

Name: Landfil Foundation
Model: Bedrock (Impenetrable)

Figure B-1

Name: 01 Promontory Phase 1B - Design Cross-section
Method: Spencer
PWP Conditions Source: (none)
Slip Surface Option: Fully-Specified
Optimize Critical Slip Surface Location: Yes
Horz Seismic Coef.: 0



Name: Waste Material
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 200 psf
Phi': 30 °

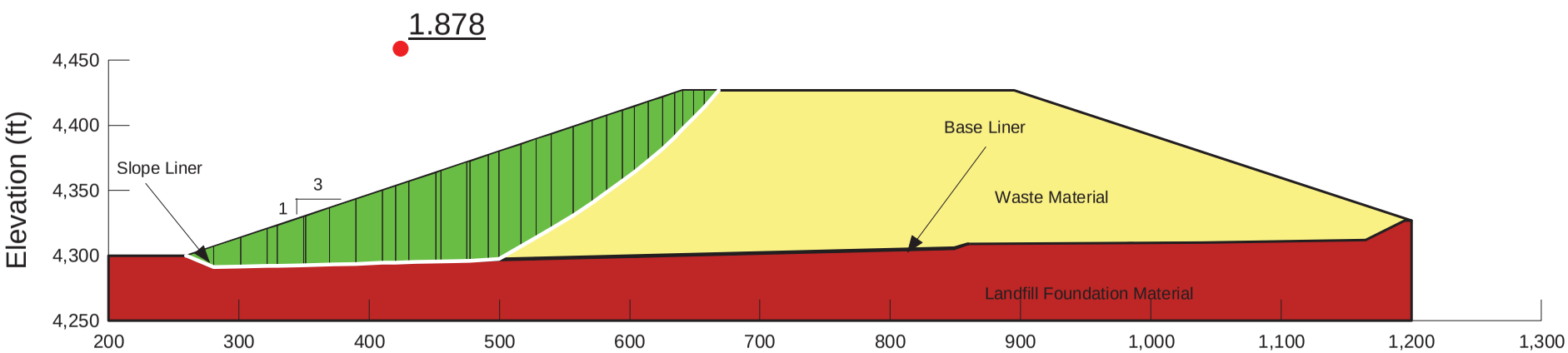
Name: Slope Liner (Large Displacement Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 250 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Base Liner (Peak Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 23.5 °
Phi 2: 16 °
Bilinear Normal: 5,362 psf

Name: Landfil Foundation
Model: Bedrock (Impenetrable)

Figure B-2

Name: 01 Promontory Phase 1C - Design Cross-section
Method: Spencer
PWP Conditions Source: (none)
Slip Surface Option: Fully-Specified
Optimize Critical Slip Surface Location: Yes
Horz Seismic Coef.: 0



Name: Waste Material
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 200 psf
Phi': 30 °

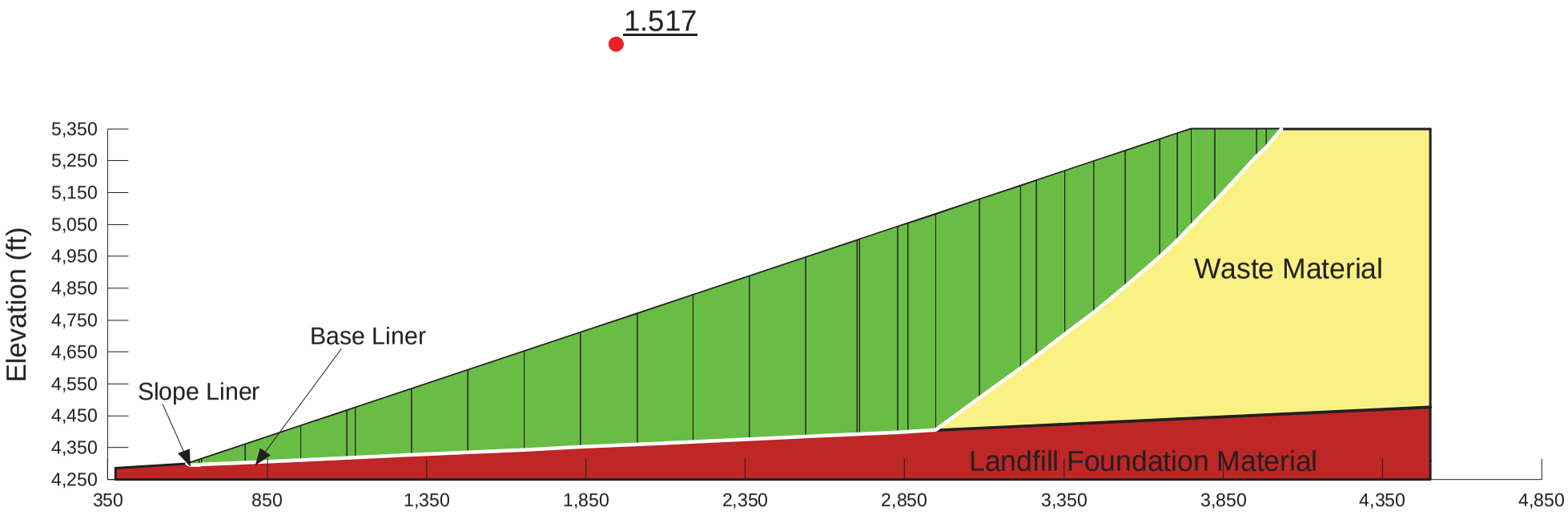
Name: Slope Liner (Large Displacement Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 250 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Base Liner (Peak Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 23.5 °
Phi 2: 16 °
Bilinear Normal: 5,362 psf

Name: Landfil Foundation
Model: Bedrock (Impenetrable)

Figure B-3

Name: 01 Promontory - Assumed Final Configuration
Method: Spencer
PWP Conditions Source: (none)
Slip Surface Option: Fully-Specified
Optimize Critical Slip Surface Location: Yes
Horz Seismic Coef.: 0



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Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 200 psf
Phi': 30 °

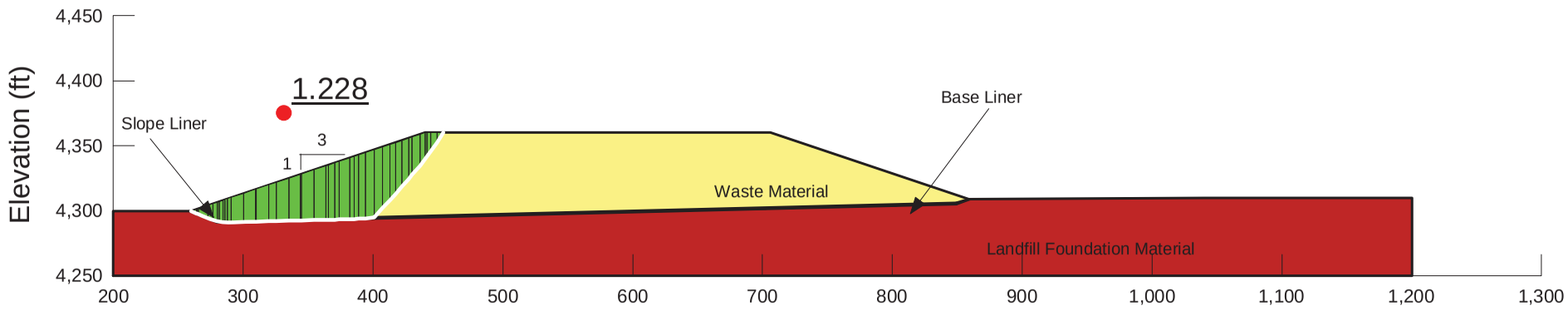
Name: Slope Liner (Large Displacement Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 250 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Base Liner (Peak Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 23.5 °
Phi 2: 16 °
Bilinear Normal: 5,362 psf

Name: Landfill Foundation
Model: Impenetrable

Figure B-4

Name: 02 Promontory Phase 1A - Design Cross-section
Method: Spencer
PWP Conditions Source: (none)
Slip Surface Option: Fully-Specified
Optimize Critical Slip Surface Location: Yes
Horz Seismic Coef.: 0



Name: Waste Material
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 200 psf
Phi': 30 °

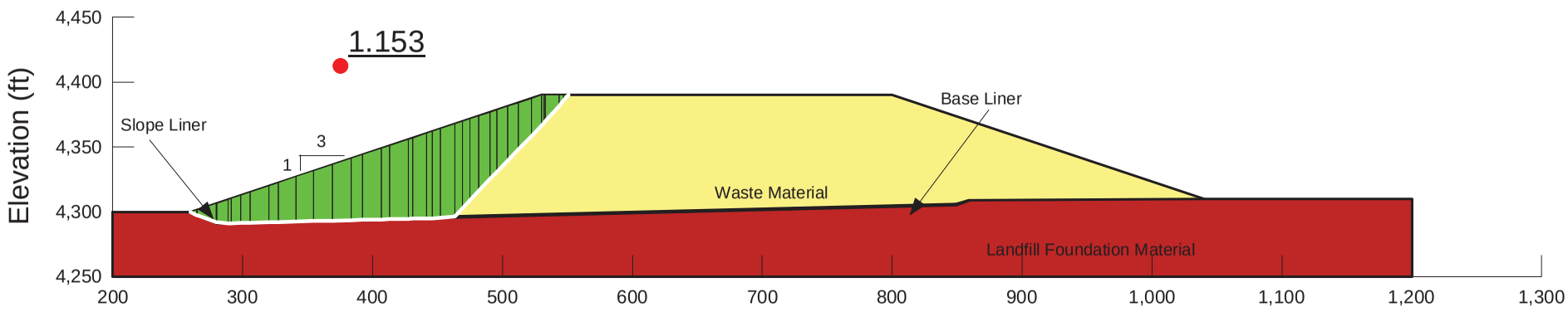
Name: Slope Liner (Large Displacement Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 250 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Base Liner (Large Displacement)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Landfil Foundation
Model: Bedrock (Impenetrable)

Figure B-5

Name: 02 Promontory Phase 1B - Design Cross-section
Method: Spencer
PWP Conditions Source: (none)
Slip Surface Option: Fully-Specified
Optimize Critical Slip Surface Location: Yes
Horz Seismic Coef.: 0



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Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 200 psf
Phi': 30 °

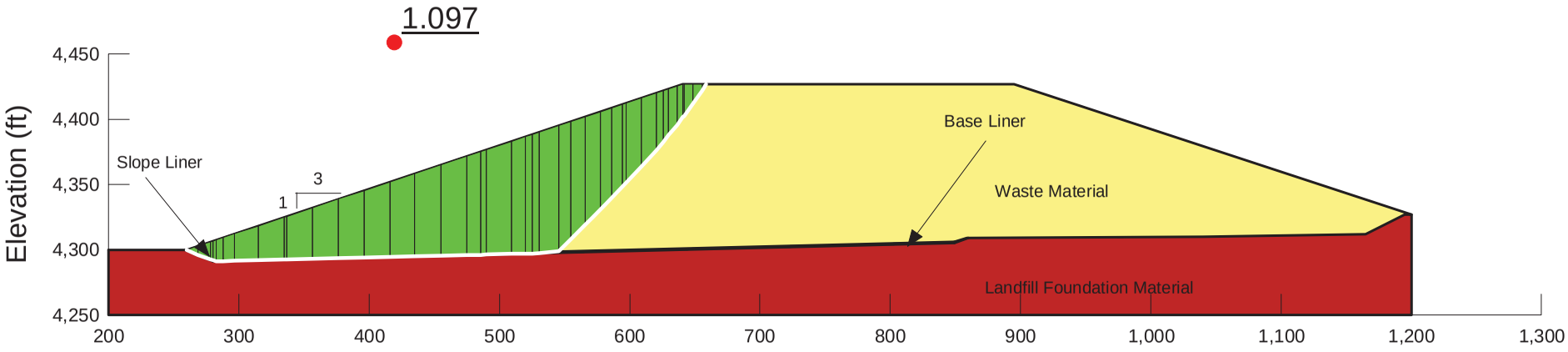
Name: Slope Liner (Large Displacement Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 250 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Base Liner (Large Displacement)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Landfil Foundation
Model: Bedrock (Impenetrable)

Figure B-6

Name: 02 Promontory Phase 1C - Design Cross-section
Method: Spencer
PWP Conditions Source: (none)
Slip Surface Option: Fully-Specified
Optimize Critical Slip Surface Location: Yes
Horz Seismic Coef.: 0



Name: Waste Material
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 200 psf
Phi': 30 °

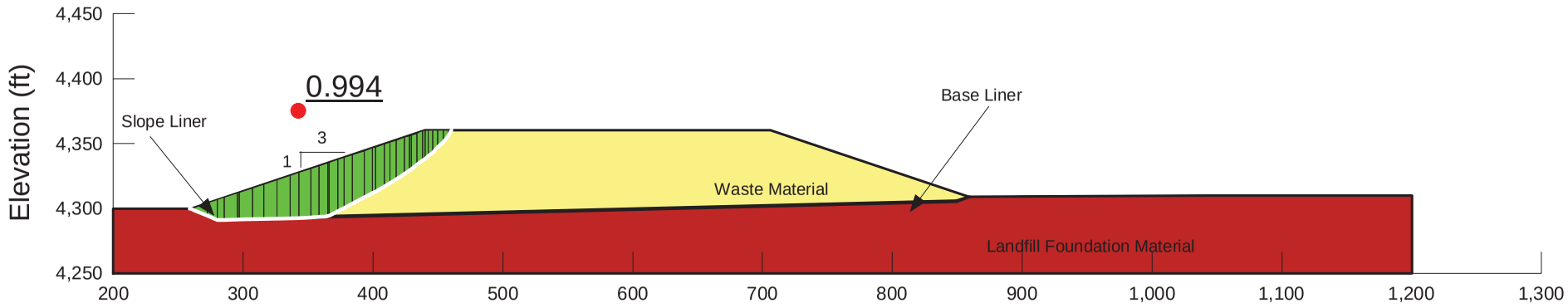
Name: Slope Liner (Large Displacement Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 250 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Base Liner (Large Displacement)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Landfil Foundation
Model: Bedrock (Impenetrable)

Figure B-7

Name: 01 Promontory Phase 1A - Design Cross-section ky
Method: Spencer
PWP Conditions Source: (none)
Slip Surface Option: Fully-Specified
Optimize Critical Slip Surface Location: Yes
Horz Seismic Coef.: 0.28



Name: Waste Material
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Unit Weight: 90 pcf
Cohesion': 200 psf
Phi': 30 °

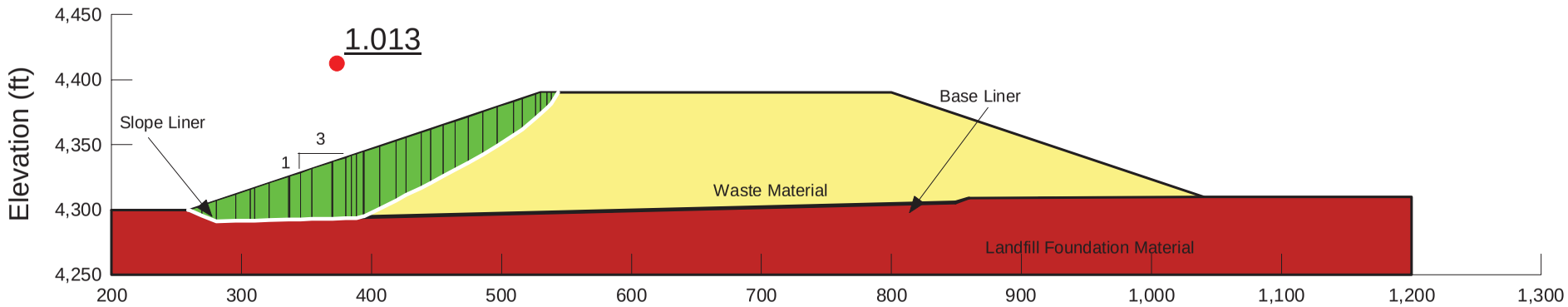
Name: Slope Liner (Large Displacement Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 250 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Base Liner (Peak Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 23.5 °
Phi 2: 16 °
Bilinear Normal: 5,362 psf

Name: Landfil Foundation
Model: Bedrock (Impenetrable)

Figure B-8

Name: 01 Promontory Phase 1B - Design Cross-section ky
Method: Spencer
PWP Conditions Source: (none)
Slip Surface Option: Fully-Specified
Optimize Critical Slip Surface Location: Yes
Horz Seismic Coef.: 0.25



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Unit Weight: 90 pcf
Cohesion': 200 psf
Phi': 30 °

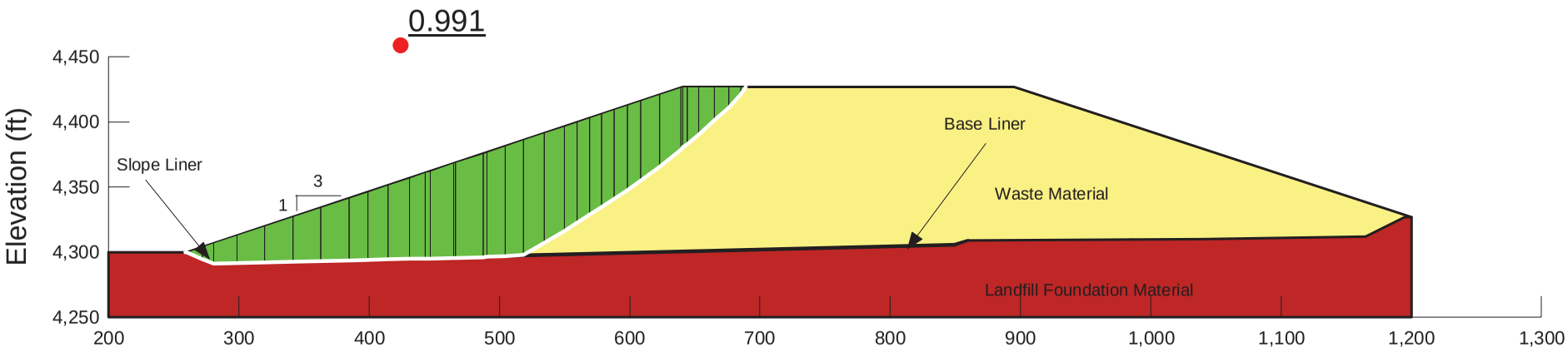
Name: Slope Liner (Large Displacement Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 250 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Base Liner (Peak Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 23.5 °
Phi 2: 16 °
Bilinear Normal: 5,362 psf

Name: Landfil Foundation
Model: Bedrock (Impenetrable)

Figure B-9

Name: 01 Promontory Phase 1C - Design Cross-section ky
Method: Spencer
PWP Conditions Source: (none)
Slip Surface Option: Fully-Specified
Optimize Critical Slip Surface Location: Yes
Horz Seismic Coef.: 0.24



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Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 200 psf
Phi': 30 °

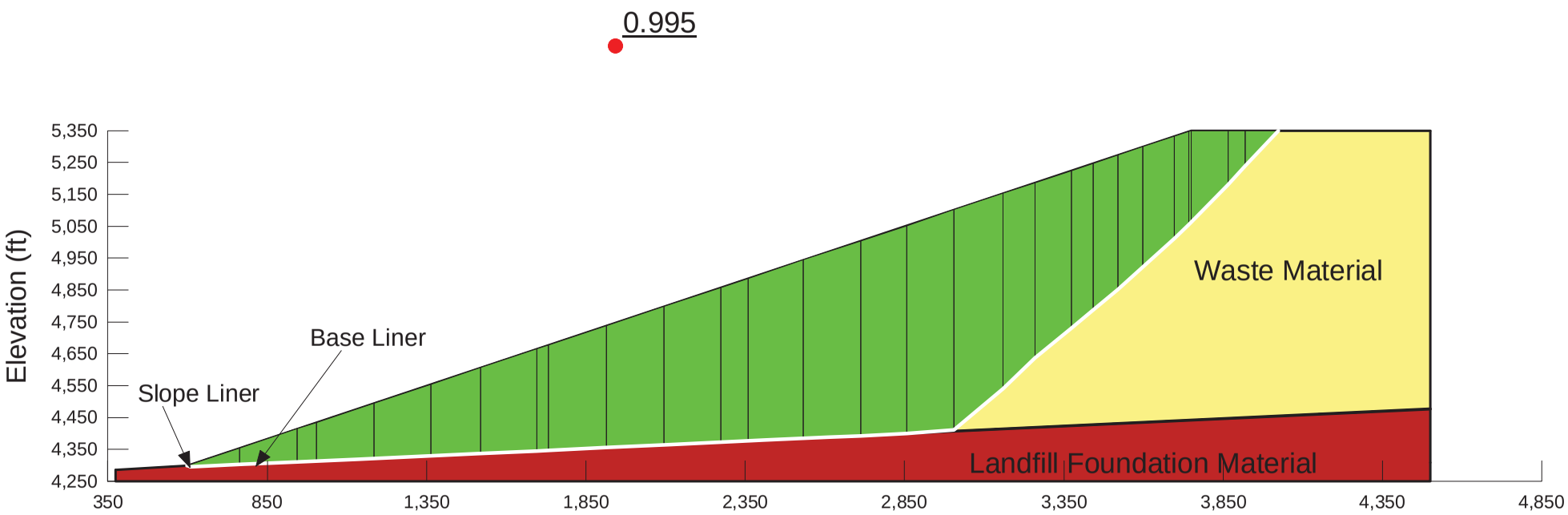
Name: Slope Liner (Large Displacement Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 250 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Base Liner (Peak Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 23.5 °
Phi 2: 16 °
Bilinear Normal: 5,362 psf

Name: Landfil Foundation
Model: Bedrock (Impenetrable)

Figure B-10

Name: 01 Promontory - Assumed Final Configuration' ky
Method: Spencer
PWP Conditions Source: (none)
Slip Surface Option: Fully-Specified
Optimize Critical Slip Surface Location: Yes
Horz Seismic Coef.: 0.135



Name: Waste Material
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion': 200 psf
Phi': 30 °

Name: Slope Liner (Large Displacement Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 250 psf
Phi 1: 8 °
Phi 2: 6 °
Bilinear Normal: 7,055 psf

Name: Base Liner (Peak Strength)
Model: Bilinear
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi 1: 23.5 °
Phi 2: 16 °
Bilinear Normal: 5,362 psf

Name: Landfill Foundation
Model: Impenetrable

Figure B-11

Attachment 2
Seismic Slope Deformation Analyses

$\mathbf{MHA_r} := \mathbf{MHA} = 0.5$ ... maximum horizontal acceleration for berdock soil condition

$\mathbf{M} = 6.97$

$\mathbf{r} = 2.6 \cdot \mathbf{km}$

... mode magnitude and distance of desing earthquake as detemined in Step 2
(no differece for distances less than 10 km)

3. Prepration calculations

$\mathbf{D_{5\_95}}$ Median Dobry duration (time required to build up the central 90 percent of the Arias intensity) of significant shaking on rock in seconds of the earthquake event (Abrahamson and Silva (1996), SP117 eq.10.1a and 1b/p.74)

$$\mathbf{D_{5\_95}} := \exp\left[\begin{array}{l} \ln\left[\dfrac{\left[\dfrac{\exp[5.204 + 0.851\cdot(\mathbf{M} - 6)]}{10^{1.5\cdot\mathbf{M}+16.05}}\right]^{\frac{-1}{3}}}{15.7\cdot 10^{6}} + 0.063\cdot\left(\dfrac{\mathbf{r}}{\mathbf{km}} - 10\right)\right] + 0.8664 \quad \text{if} \quad \mathbf{r} > 10\cdot\mathbf{km} \\ \ln\left[\dfrac{\left[\dfrac{\exp[5.204 + 0.851\cdot(\mathbf{M} - 6)]}{10^{1.5\cdot\mathbf{M}+16.05}}\right]^{\frac{-1}{3}}}{15.7\cdot 10^{6}}\right] + 0.8664 \quad \text{if} \quad \mathbf{r} \le 10\cdot\mathbf{km} \end{array}\right]\cdot\mathbf{sec}$$

$\mathbf{D_{5\_95}} = 13.9\cdot\mathbf{sec}$

$\mathbf{NRF}$ factor accounting for non-linear ground acceleration response as shear waves propagate vertically through the materials above slide plane (SP117 eq.11.3/p.81)

- valid for $0.1 < \mathbf{MHA_r} < 0.8$

(per Blake (personal communication) for slides with cross-section area > 25,000ft^2 multiply NRF by 0.8)

$$\mathbf{NRF} := 0.6225 + 0.9196\cdot\exp\left(\frac{-\mathbf{MHA_r}}{0.4449}\right) \qquad \mathbf{NRF} = 0.921$$

5. Perfom deformation analysis

If the screening analysis indicates seismic instability and deformation analysis is required, calculate yield seismic coefficicient $k_{eq.yield}$ which is also the yield acceleration for displacement analyses:

$k_{eq.yield} := 0.28$ ... sesimic coefficient for FS = 1, i.e., at yield

Determine **Maximum Horizontal EQUIVALENT Acceleration** **MHEA** (a spatially averaged peak acceleration acting in the landslide mass due to design seismic event) required for Newmark or Bray analyses to represent the seismic impact causing the slope movement (p.83/last paragraph), i.e., no movement happens if yield seismic coeffcient $k_{eq.yield}$ is greater than **MHEA**. **MHEA** is calculated based on the geometry of the moving mass above the slip plane and converting the accelaration AT THE BASE of the landslide to the acceleration experienced IN the landslide, i.e., for conventional landslides the base acceleration will be bedrock, for landfills it could be either bedrock or alluvium.

$H := 50 \cdot ft$ ... maximum thickness of sliding mass

Average (= notice the 0.5 in the equation) MSW small strain shear wave velocity (Bray & Rathje, 1998 from Kavazanjian 1995)

$$avgV_s := \left(175 + 0.5 \cdot 2.43 \cdot \frac{H}{m}\right) \cdot \frac{m}{sec} \qquad avgV_s = 193.5 \cdot \frac{m}{sec}$$

Fundamental period of sliding mass T_s (SP117 eq.11.5/p.84)

$$T_s := \frac{4 \cdot H}{avgV_s} \qquad T_s = 0.339 \cdot sec$$

Mean period of the earthquake T_m (SP117 eq.10.2/p.74)

$$T_m := \begin{cases} \left[0.411 + 0.0837 \cdot (M - 6) + 0.00208 \cdot \frac{r}{km}\right] \cdot sec & \text{if } M \le 7.25 \\ \left(0.411 + 0.0837 \cdot 1.25 + 0.00208 \cdot \frac{r}{km}\right) \cdot sec & \text{if } 7.25 < M \le 8 \\ \text{"no solution"} & \text{otherwise} \end{cases} \qquad T_m = 0.498\ s$$

$$\frac{T_s}{T_m} = 0.681$$

Maximum Horizontal EQUIVALENT Acceleration **MHEA** for use in Newmark or Bray analysis (SP117 eq.11.7/p.84)
i.e., no movement happens if yield seismic coeffcient is greater than **MHEA**
- check Figure 11.2/p.85 of SP117 for sites on soft bedrock; if T_s/T_m<0.5, MHEA=MHAr x NRF
- check Figure 7 of Bray & Rathje, 1998 for sites on sand if T_s/T_m<0.7, MHEA=0.7 x MHA_r x NRF
- check Figure 7 of Bray & Rathje, 1998 for sites on clay; if T_s/T_m<0.5, MHEA=0.5 x MHA_r x NRF

$$\mathbf{MHEA} := \begin{cases} \mathbf{MHA_r}\cdot\mathbf{NRF}\cdot\exp\left(-0.624-0.7831\cdot\ln\left(\frac{\mathbf{T_s}}{\mathbf{T_m}}\right)\right) & \text{if } \exp\left(-0.624-0.7831\cdot\ln\left(\frac{\mathbf{T_s}}{\mathbf{T_m}}\right)\right)\le 1 \wedge \mathbf{Underlying\_Geology} = \text{"soft b} \\ \mathbf{MHA_r}\cdot\mathbf{NRF} & \text{if } \exp\left(-0.624-0.7831\cdot\ln\left(\frac{\mathbf{T_s}}{\mathbf{T_m}}\right)\right) > 1 \wedge \mathbf{Underlying\_Geology} = \text{"soft bedrock"} \\ \frac{0.90976\cdot\mathbf{MHA_r}\cdot\mathbf{NRF}}{\frac{\mathbf{T_s}}{\mathbf{T_m}}+1.11166} & \text{if } \frac{0.90976}{\frac{\mathbf{T_s}}{\mathbf{T_m}}+1.11166} \le 0.7 \wedge \mathbf{Underlying\_Geology} = \text{"sand"} \\ 0.7\cdot\mathbf{MHA_r}\cdot\mathbf{NRF} & \text{if } \frac{0.90976}{\frac{\mathbf{T_s}}{\mathbf{T_m}}+1.11166} > 0.7 \wedge \mathbf{Underlying\_Geology} = \text{"sand"} \\ \frac{0.70347\cdot\mathbf{MHA_r}\cdot\mathbf{NRF}}{\frac{\mathbf{T_s}}{\mathbf{T_m}}+1.21784} & \text{if } \frac{0.70347}{\frac{\mathbf{T_s}}{\mathbf{T_m}}+1.21784} \le 0.5 \wedge \mathbf{Underlying\_Geology} = \text{"clay"} \\ 0.5\cdot\mathbf{MHA_r}\cdot\mathbf{NRF} & \text{if } \frac{0.70347}{\frac{\mathbf{T_s}}{\mathbf{T_m}}+1.21784} > 0.5 \wedge \mathbf{Underlying\_Geology} = \text{"clay"} \end{cases}$$

$\mathbf{Underlying\_Geology} = \text{"soft bedrock"}$

$\mathbf{MHEA} = 0.334$

$\mathbf{k_{eq.yield}} = 0.28$

Displacement = "will ocurr ... MHEA> k_yield"

Method #2: BRAY-TRAVASAROU displacement as a function of degraded fundamental site period $1.5 \cdot T_s$

$1.5 \cdot T_s = 0.508\ s$ — Degraded fundamental period of sliding mass used for selection of spectral acceleration.

$S_{a1.5Ts} := 0.8$ — 5% damped elastic spectral acceleration (g) of the design ground motion at a period of $1.5T_s$ [from 0.002 to 2.7g]; obtain from ARS Online or USGS deaggregation website; if T_s < 0.05 sec, then use PGA

$Num_\sigma := 0$ — Number of standard deviations to use for initial (design) displacement estimate

use: mean ± 0.00 σ .....50% of non-zero displacements will be more, 50% will be less => 50% probability of exceedance

mean ± 1.00 σ .... captures 68% of values => 16% probability of exceedance, (100-68)/2=16

mean ± 1.28 σ .... captures 80% of values => 10% probability of exceedance

mean ± 1.65 σ .... captures 90% of values => 5% probability of exceedance

mean ± 2.32 σ .... captures 98% of values => 1% probability of exceedance

$\varepsilon := Num_\sigma \cdot 0.66 = 0$ — Error term (ε) expressed as a number of standard deviations (σ = 0.66) used for design displacement estimate ($D_{median} + Num_\sigma{}^* \varepsilon$)

a. Displacement probability distribution calculations

Probability of ZERO DISPLACEMENT, i.e., displacement <1 cm

- the remaining probability is the probability of non-zero displacement which gets further distributed as shown below

$$P_{D0} := 1 - pnorm\left(-1.76 - 3.22 \cdot \ln(k_{eq.yield}) - 0.484 \cdot \frac{T_s}{sec} \cdot \ln(k_{eq.yield}) + 3.52 \cdot \ln(S_{a1.5Ts}), 0, 1\right) = 3.90 \cdot \%$$

Probability of $P_{D0} = 3.9 \cdot \%$ that there will be zero (<1 cm) displacement .. so, conversely, there is a probability of $1 - P_{D0} = 96.1 \cdot \%$ that there will be non-zero displacement

Probability and magnitude of MEDIAN DISPLACEMENT (50% of non-zero displacements will be less / 50% will be more)

$$D_{median} := \begin{cases} \exp\left[-1.10 - 2.83 \cdot \ln(k_{eq.yield}) - 0.333 \cdot \ln(k_{eq.yield})^2 + 0.566 \cdot \ln(k_{eq.yield}) \cdot (\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04 \cdot \ln(S_{a1.5Ts}) - 0.244 \cdot (\ln(S_{a1.5Ts}))^2 + 1.50 \cdot \frac{T_s}{sec} + 0.278 \cdot (M - 7)\right] & \text{if } T_s \geq 0.05 sec \\ \exp\left[-0.22 - 2.83 \cdot \ln(k_{eq.yield}) - 0.333 \cdot \ln(k_{eq.yield})^2 + 0.566 \cdot \ln(k_{eq.yield}) \cdot (\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04 \cdot \ln(S_{a1.5Ts}) - 0.244 \cdot (\ln(S_{a1.5Ts}))^2 + 0.278 \cdot (M - 7)\right] & \text{if } T_s < 0.05 sec \end{cases} \cdot cm = 6.90$$

$$PD_{median} := (1 - P_{D0}) \cdot \left(1 - pnorm\left(\frac{\ln\left(\frac{D_{median}}{cm}\right) - \ln\left(\frac{D_{median}}{cm}\right)}{0.66}, 0, 1\right)\right) = 48.05 \cdot \%$$

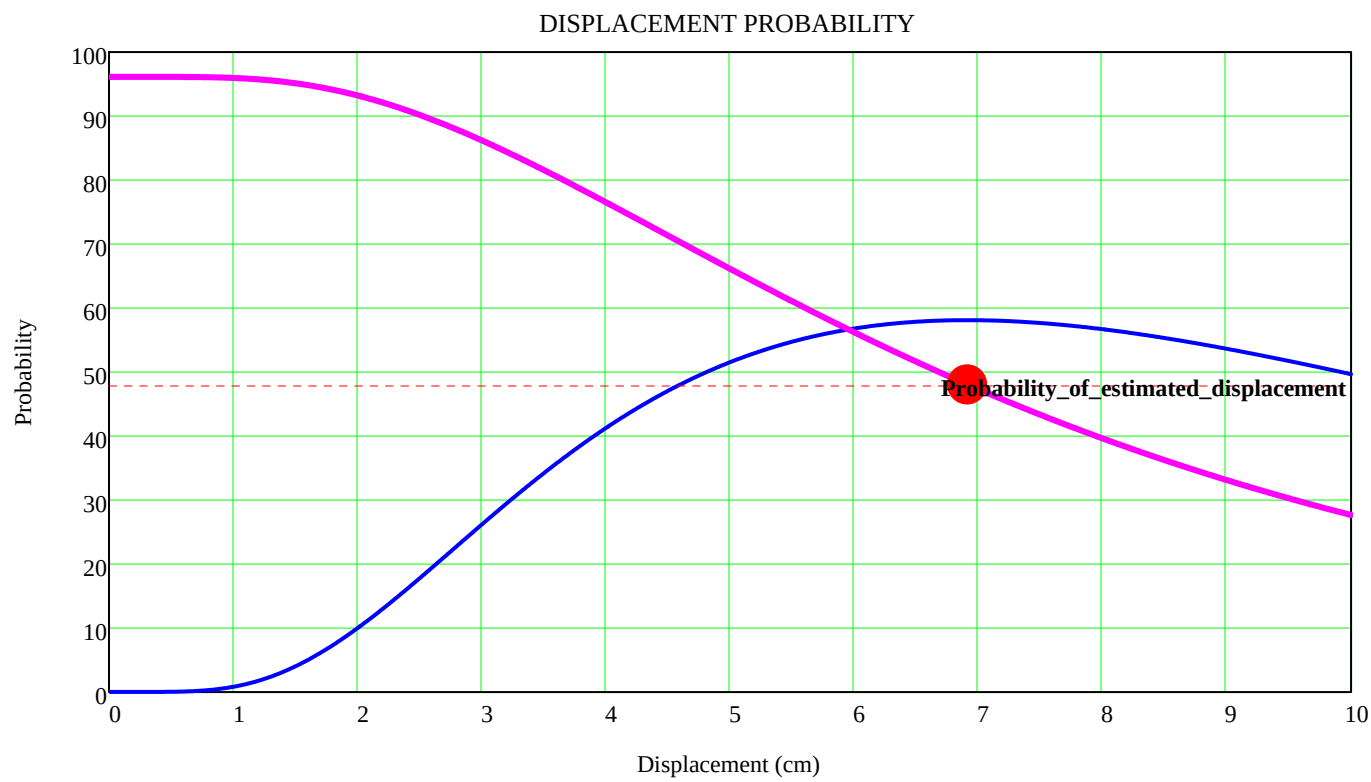
Probability of $PD_{median} = 48 \cdot \%$ that the actual displacement will exceed the median displacement of $D_{median} = 6.909 \cdot cm$

b. Probability and magnitude of ESTIMATED / DESIGN DISPLACEMENT selected se mean + $\mathbf{Num_\sigma} = 0$

$$\mathbf{D_{estimate}} := \begin{cases} \exp\left[-1.10 - 2.83\cdot\ln(k_{eq.yield}) - 0.333\cdot\ln(k_{eq.yield})^2 + 0.566\cdot\ln(k_{eq.yield})\cdot(\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04\cdot\ln(S_{a1.5Ts}) - 0.244\cdot(\ln(S_{a1.5Ts}))^2 + 1.50\cdot\frac{T_s}{sec} + 0.278\cdot(M-7) + \varepsilon\right] & \text{if } T_s \geq 0.05sec \\ \exp\left[-0.22 - 2.83\cdot\ln(k_{eq.yield}) - 0.333\cdot\ln(k_{eq.yield})^2 + 0.566\cdot\ln(k_{eq.yield})\cdot(\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04\cdot\ln(S_{a1.5Ts}) - 0.244\cdot(\ln(S_{a1.5Ts}))^2 + 0.278\cdot(M-7) + \varepsilon\right] & \text{if } T_s < 0.05sec \end{cases} \cdot cm = 6.90$$

$$\mathbf{PD_{estimate}} := (1 - P_{D0})\left(1 - \mathrm{pnorm}\left(\frac{\ln\left(\frac{D_{estimate}}{cm}\right) - \ln\left(\frac{D_{median}}{cm}\right)}{0.66}, 0, 1\right)\right) = 48.05\cdot\%$$

Probability of $\mathbf{PD_{estimate}} = 48\cdot\%$ that the actual displacement will exceed the the estimated (design) displacement of $\mathbf{D_{estimate}} = 6.909\cdot cm$



pink ... probability that the given displacement will be exceeded (probability distribution)

blue... probability of non-zero displacement (probability density)

PHASE 1 - Subphase 1B

$\mathbf{MHA_r} := \mathbf{MHA} = 0.5$ ... maximum horizontal acceleration for berdock soil condition

$\mathbf{M} = 6.97$

$\mathbf{r} = 2.6 \cdot \mathbf{km}$

... mode magnitude and distance of desing earthquake as detemined in Step 2
(no differece for distances less than 10 km)

3. Prepration calculations

$\mathbf{D_{5\_95}}$ Median Dobry duration (time required to build up the central 90 percent of the Arias intensity) of significant shaking on rock in seconds of the earthquake event (Abrahamson and Silva (1996), SP117 eq.10.1a and 1b/p.74)

$$\mathbf{D_{5\_95}} := \exp\left[\begin{array}{l} \ln\left[\dfrac{\left[\dfrac{\exp[5.204 + 0.851\cdot(\mathbf{M} - 6)]}{10^{1.5\cdot\mathbf{M}+16.05}}\right]^{\frac{-1}{3}}}{15.7\cdot 10^{6}} + 0.063\cdot\left(\dfrac{\mathbf{r}}{\mathbf{km}} - 10\right)\right] + 0.8664 \quad \text{if} \quad \mathbf{r} > 10\cdot\mathbf{km} \\ \ln\left[\dfrac{\left[\dfrac{\exp[5.204 + 0.851\cdot(\mathbf{M} - 6)]}{10^{1.5\cdot\mathbf{M}+16.05}}\right]^{\frac{-1}{3}}}{15.7\cdot 10^{6}}\right] + 0.8664 \quad \text{if} \quad \mathbf{r} \le 10\cdot\mathbf{km} \end{array}\right]\cdot\mathbf{sec}$$

$\mathbf{D_{5\_95}} = 13.9\cdot\mathbf{sec}$

$\mathbf{NRF}$ factor accounting for non-linear ground acceleration response as shear waves propagate vertically through the materials above slide plane (SP117 eq.11.3/p.81)

- valid for $0.1 < \mathbf{MHA_r} < 0.8$

(per Blake (personal communication) for slides with cross-section area > 25,000ft^2 multiply NRF by 0.8)

$$\mathbf{NRF} := 0.6225 + 0.9196\cdot\exp\left(\frac{-\mathbf{MHA_r}}{0.4449}\right) \qquad \mathbf{NRF} = 0.921$$

5. Perfom deformation analysis

If the screening analysis indicates seismic instability and deformation analysis is required, calculate yield seismic coefficicient $k_{eq.yield}$ which is also the yield acceleration for displacement analyses:

$k_{eq.yield} := 0.25$ ... sesimic coefficient for FS = 1, i.e., at yield

Determine **Maximum Horizontal EQUIVALENT Acceleration** **MHEA** (a spatially averaged peak acceleration acting in the landslide mass due to design seismic event) required for Newmark or Bray analyses to represent the seismic impact causing the slope movement (p.83/last paragraph), i.e., no movement happens if yield seismic coeffcient $k_{eq.yield}$ is greater than **MHEA**. **MHEA** is calculated based on the geometry of the moving mass above the slip plane and converting the accelaration AT THE BASE of the landslide to the acceleration experienced IN the landslide, i.e., for conventional landslides the base acceleration will be bedrock, for landfills it could be either bedrock or alluvium.

$H := 70 \cdot ft$ ... maximum thickness of sliding mass

Average (= notice the 0.5 in the equation) MSW small strain shear wave velocity (Bray & Rathje, 1998 from Kavazanjian 1995)

$$avgV_s := \left(175 + 0.5 \cdot 2.43 \cdot \frac{H}{m}\right) \cdot \frac{m}{sec} \qquad avgV_s = 200.9 \cdot \frac{m}{sec}$$

Fundamental period of sliding mass T_s (SP117 eq.11.5/p.84)

$$T_s := \frac{4 \cdot H}{avgV_s} \qquad T_s = 0.474 \cdot sec$$

Mean period of the earthquake T_m (SP117 eq.10.2/p.74)

$$T_m := \begin{cases} \left[0.411 + 0.0837 \cdot (M - 6) + 0.00208 \cdot \frac{r}{km}\right] \cdot sec & \text{if } M \le 7.25 \\ \left(0.411 + 0.0837 \cdot 1.25 + 0.00208 \cdot \frac{r}{km}\right) \cdot sec & \text{if } 7.25 < M \le 8 \\ \text{"no solution"} & \text{otherwise} \end{cases} \qquad T_m = 0.498\ s$$

$$\frac{T_s}{T_m} = 0.953$$

Jibson_recommended_analysis = "use decoupled: rigid block unconservative; decoupled conservative"

Wartman, 2003:

Wartman_recommended_analysis = "use decoupled analysis"

Maximum Horizontal EQUIVALENT Acceleration **MHEA** for use in Newmark or Bray analysis (SP117 eq.11.7/p.84)
i.e., no movement happens if yield seismic coeffcient is greater than **MHEA**
- check Figure 11.2/p.85 of SP117 for sites on soft bedrock; if $T_s/T_m<0.5$, MHEA=MHAr x NRF
- check Figure 7 of Bray & Rathje, 1998 for sites on sand if $T_s/T_m<0.7$, MHEA=0.7 x MHA_r x NRF
- check Figure 7 of Bray & Rathje, 1998 for sites on clay; if $T_s/T_m<0.5$, MHEA=0.5 x MHA_r x NRF

$$\mathbf{MHEA} := \begin{cases} \mathbf{MHA_r}\cdot\mathbf{NRF}\cdot\exp\left(-0.624-0.7831\cdot\ln\left(\frac{\mathbf{T_s}}{\mathbf{T_m}}\right)\right) & \text{if } \exp\left(-0.624-0.7831\cdot\ln\left(\frac{\mathbf{T_s}}{\mathbf{T_m}}\right)\right)\le 1 \wedge \mathbf{Underlying\_Geology} = \text{"soft b} \\ \mathbf{MHA_r}\cdot\mathbf{NRF} & \text{if } \exp\left(-0.624-0.7831\cdot\ln\left(\frac{\mathbf{T_s}}{\mathbf{T_m}}\right)\right) > 1 \wedge \mathbf{Underlying\_Geology} = \text{"soft bedrock"} \\ \frac{0.90976\cdot\mathbf{MHA_r}\cdot\mathbf{NRF}}{\frac{\mathbf{T_s}}{\mathbf{T_m}}+1.11166} & \text{if } \frac{0.90976}{\frac{\mathbf{T_s}}{\mathbf{T_m}}+1.11166}\le 0.7 \wedge \mathbf{Underlying\_Geology} = \text{"sand"} \\ 0.7\cdot\mathbf{MHA_r}\cdot\mathbf{NRF} & \text{if } \frac{0.90976}{\frac{\mathbf{T_s}}{\mathbf{T_m}}+1.11166} > 0.7 \wedge \mathbf{Underlying\_Geology} = \text{"sand"} \\ \frac{0.70347\cdot\mathbf{MHA_r}\cdot\mathbf{NRF}}{\frac{\mathbf{T_s}}{\mathbf{T_m}}+1.21784} & \text{if } \frac{0.70347}{\frac{\mathbf{T_s}}{\mathbf{T_m}}+1.21784}\le 0.5 \wedge \mathbf{Underlying\_Geology} = \text{"clay"} \\ 0.5\cdot\mathbf{MHA_r}\cdot\mathbf{NRF} & \text{if } \frac{0.70347}{\frac{\mathbf{T_s}}{\mathbf{T_m}}+1.21784} > 0.5 \wedge \mathbf{Underlying\_Geology} = \text{"clay"} \end{cases}$$

$\mathbf{Underlying\_Geology} = \text{"soft bedrock"}$

$\mathbf{MHEA} = 0.256$

$\mathbf{k_{eq.yield}} = 0.25$

Displacement = "will ocurr ... MHEA> k_yield"

Method #2: BRAY-TRAVASAROU displacement as a function of degraded fundamental site period $1.5 \cdot T_s$

$1.5 \cdot T_s = 0.711\ s$ Degraded fundamental period of sliding mass used for selection of spectral acceleration.

$S_{a1.5Ts} := 0.63$ 5% damped elastic spectral acceleration (g) of the design ground motion at a period of $1.5T_s$ [from 0.002 to 2.7g]; obtain from ARS Online or USGS deaggregation website; if T_s < 0.05 sec, then use PGA

$Num_\sigma := 0$ Number of standard deviations to use for initial (design) displacement estimate

use: mean ± 0.00 σ .....50% of non-zero displacements will be more, 50% will be less => 50% probability of exceedance

mean ± 1.00 σ .... captures 68% of values => 16% probability of exceedance, (100-68)/2=16

mean ± 1.28 σ .... captures 80% of values => 10% probability of exceedance

mean ± 1.65 σ .... captures 90% of values => 5% probability of exceedance

mean ± 2.32 σ .... captures 98% of values => 1% probability of exceedance

$\varepsilon := Num_\sigma \cdot 0.66 = 0$ Error term (ε) expressed as a number of standard deviations ($\sigma = 0.66$) used for design displacement estimate ($D_{median} + Num_\sigma{}^* \varepsilon$)

a. Displacement probability distribution calculations

Probability of ZERO DISPLACEMENT, i.e., displacement <1 cm

- the remaining probability is the probability of non-zero displacement which gets further distributed as shown below

$$P_{D0} := 1 - pnorm\left(-1.76 - 3.22 \cdot \ln(k_{eq.yield}) - 0.484 \cdot \frac{T_s}{sec} \cdot \ln(k_{eq.yield}) + 3.52 \cdot \ln(S_{a1.5Ts}), 0, 1\right) = 8.14 \cdot \%$$

Probability of $P_{D0} = 8.1 \cdot \%$ that there will be zero (<1 cm) displacement .. so, conversely, there is a probability of $1 - P_{D0} = 91.9 \cdot \%$ that there will be non-zero displacement

Probability and magnitude of MEDIAN DISPLACEMENT (50% of non-zero displacements will be less / 50% will be more)

$$D_{median} := \begin{cases} \exp\left[-1.10 - 2.83 \cdot \ln(k_{eq.yield}) - 0.333 \cdot \ln(k_{eq.yield})^2 + 0.566 \cdot \ln(k_{eq.yield}) \cdot (\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04 \cdot \ln(S_{a1.5Ts}) - 0.244 \cdot (\ln(S_{a1.5Ts}))^2 + 1.50 \cdot \frac{T_s}{sec} + 0.278 \cdot (M - 7)\right] & \text{if } T_s \geq 0.05 sec \\ \exp\left[-0.22 - 2.83 \cdot \ln(k_{eq.yield}) - 0.333 \cdot \ln(k_{eq.yield})^2 + 0.566 \cdot \ln(k_{eq.yield}) \cdot (\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04 \cdot \ln(S_{a1.5Ts}) - 0.244 \cdot (\ln(S_{a1.5Ts}))^2 + 0.278 \cdot (M - 7)\right] & \text{if } T_s < 0.05 sec \end{cases} \cdot cm = 6.00$$

$$PD_{median} := (1 - P_{D0}) \cdot \left(1 - pnorm\left(\frac{\ln\left(\frac{D_{median}}{cm}\right) - \ln\left(\frac{D_{median}}{cm}\right)}{0.66}, 0, 1\right)\right) = 45.93 \cdot \%$$

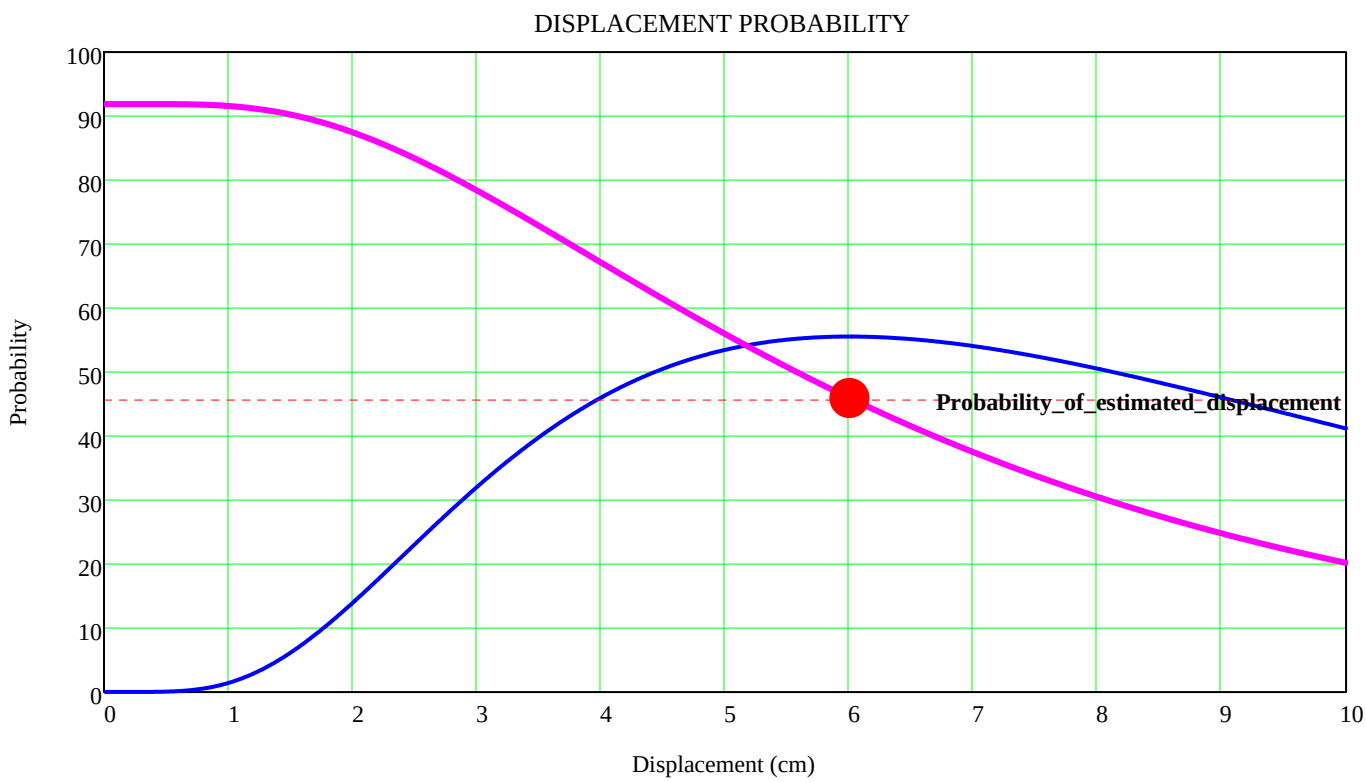
Probability of $PD_{median} = 45.9 \cdot \%$ that the actual displacement will exceed the median displacement of $D_{median} = 6.001 \cdot cm$

b. Probability and magnitude of ESTIMATED / DESIGN DISPLACEMENT selected se mean + $\mathbf{Num_\sigma} = 0$

$$\mathbf{D_{estimate}} := \begin{cases} \exp\left[-1.10 - 2.83\cdot\ln(k_{eq.yield}) - 0.333\cdot\ln(k_{eq.yield})^2 + 0.566\cdot\ln(k_{eq.yield})\cdot(\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04\cdot\ln(S_{a1.5Ts}) - 0.244\cdot(\ln(S_{a1.5Ts}))^2 + 1.50\cdot\frac{T_s}{sec} + 0.278\cdot(M-7) + \varepsilon\right] & \text{if } T_s \geq 0.05sec \\ \exp\left[-0.22 - 2.83\cdot\ln(k_{eq.yield}) - 0.333\cdot\ln(k_{eq.yield})^2 + 0.566\cdot\ln(k_{eq.yield})\cdot(\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04\cdot\ln(S_{a1.5Ts}) - 0.244\cdot(\ln(S_{a1.5Ts}))^2 + 0.278\cdot(M-7) + \varepsilon\right] & \text{if } T_s < 0.05sec \end{cases} \cdot cm = 6.00$$

$$\mathbf{PD_{estimate}} := (1 - P_{D0})\left(1 - \mathrm{pnorm}\left(\frac{\ln\left(\frac{D_{estimate}}{cm}\right) - \ln\left(\frac{D_{median}}{cm}\right)}{0.66}, 0, 1\right)\right) = 45.93\cdot\%$$

Probability of $\mathbf{PD_{estimate}} = 45.9\cdot\%$ that the actual displacement will exceed the the estimated (design) displacement of $\mathbf{D_{estimate}} = 6.001\cdot cm$



pink ... probability that the given displacement will be exceeded (probability distribution)

blue... probability of non-zero displacement (probability density)

PHASE 1 - Subphase 1C

$\mathbf{MHA_r} := \mathbf{MHA} = 0.5$ ... maximum horizontal acceleration for berdock soil condition

$\mathbf{M} = 6.97$

$\mathbf{r} = 2.6 \cdot \mathbf{km}$

... mode magnitude and distance of desing earthquake as detemined in Step 2
(no differece for distances less than 10 km)

3. Prepration calculations

$\mathbf{D_{5\_95}}$ Median Dobry duration (time required to build up the central 90 percent of the Arias intensity) of significant shaking on rock in seconds of the earthquake event (Abrahamson and Silva (1996), SP117 eq.10.1a and 1b/p.74)

$$\mathbf{D_{5\_95}} := \exp\left[\begin{array}{l} \ln\left[\dfrac{\left[\dfrac{\exp[5.204 + 0.851\cdot(\mathbf{M} - 6)]}{10^{1.5\cdot\mathbf{M}+16.05}}\right]^{\frac{-1}{3}}}{15.7\cdot 10^{6}} + 0.063\cdot\left(\dfrac{\mathbf{r}}{\mathbf{km}} - 10\right)\right] + 0.8664 \quad \text{if} \quad \mathbf{r} > 10\cdot\mathbf{km} \\ \ln\left[\dfrac{\left[\dfrac{\exp[5.204 + 0.851\cdot(\mathbf{M} - 6)]}{10^{1.5\cdot\mathbf{M}+16.05}}\right]^{\frac{-1}{3}}}{15.7\cdot 10^{6}}\right] + 0.8664 \quad \text{if} \quad \mathbf{r} \le 10\cdot\mathbf{km} \end{array}\right]\cdot\mathbf{sec}$$

$\mathbf{D_{5\_95}} = 13.9\cdot\mathbf{sec}$

$\mathbf{NRF}$ factor accounting for non-linear ground acceleration response as shear waves propagate vertically through the materials above slide plane (SP117 eq.11.3/p.81)

- valid for $0.1 < \mathbf{MHA_r} < 0.8$

(per Blake (personal communication) for slides with cross-section area > 25,000ft^2 multiply NRF by 0.8)

$$\mathbf{NRF} := 0.6225 + 0.9196\cdot\exp\left(\frac{-\mathbf{MHA_r}}{0.4449}\right) \qquad \mathbf{NRF} = 0.921$$

5. Perfom deformation analysis

If the screening analysis indicates seismic instability and deformation analysis is required, calculate yield seismic coefficicient $k_{eq.yield}$ which is also the yield acceleration for displacement analyses:

$k_{eq.yield} := 0.24$ ... sesimic coefficient for FS = 1, i.e., at yield

Determine **Maximum Horizontal EQUIVALENT Acceleration** **MHEA** (a spatially averaged peak acceleration acting in the landslide mass due to design seismic event) required for Newmark or Bray analyses to represent the seismic impact causing the slope movement (p.83/last paragraph), i.e., no movement happens if yield seismic coeffcient $k_{eq.yield}$ is greater than **MHEA**. **MHEA** is calculated based on the geometry of the moving mass above the slip plane and converting the accelaration AT THE BASE of the landslide to the acceleration experienced IN the landslide, i.e., for conventional landslides the base acceleration will be bedrock, for landfills it could be either bedrock or alluvium.

$H := 100 \cdot ft$ ... maximum thickness of sliding mass

Average (= notice the 0.5 in the equation) MSW small strain shear wave velocity (Bray & Rathje, 1998 from Kavazanjian 1995)

$$avgV_s := \left(175 + 0.5 \cdot 2.43 \cdot \frac{H}{m}\right) \cdot \frac{m}{sec} \qquad avgV_s = 212 \cdot \frac{m}{sec}$$

Fundamental period of sliding mass T_s (SP117 eq.11.5/p.84)

$$T_s := \frac{4 \cdot H}{avgV_s} \qquad T_s = 0.677 \cdot sec$$

Mean period of the earthquake T_m (SP117 eq.10.2/p.74)

$$T_m := \begin{cases} \left[0.411 + 0.0837 \cdot (M - 6) + 0.00208 \cdot \frac{r}{km}\right] \cdot sec & \text{if } M \le 7.25 \\ \left(0.411 + 0.0837 \cdot 1.25 + 0.00208 \cdot \frac{r}{km}\right) \cdot sec & \text{if } 7.25 < M \le 8 \\ \text{"no solution"} & \text{otherwise} \end{cases} \qquad T_m = 0.498\ s$$

$$\frac{T_s}{T_m} = 1.361$$

Jibson_recommended_analysis = "soft/thick slides = use rigid block and decoupled (both conservative)"

Wartman, 2003:

Wartman_recommended_analysis = "same as Jibson"

Maximum Horizontal EQUIVALENT Acceleration **MHEA** for use in Newmark or Bray analysis (SP117 eq.11.7/p.84)
i.e., no movement happens if yield seismic coeffcient is greater than **MHEA**
- check Figure 11.2/p.85 of SP117 for sites on soft bedrock; if T_s/T_m<0.5, MHEA=MHAr x NRF
- check Figure 7 of Bray & Rathje, 1998 for sites on sand if T_s/T_m<0.7, MHEA=0.7 x MHA_r x NRF
- check Figure 7 of Bray & Rathje, 1998 for sites on clay; if T_s/T_m<0.5, MHEA=0.5 x MHA_r x NRF

$$\mathbf{MHEA} := \begin{cases} \mathbf{MHA_r}\cdot\mathbf{NRF}\cdot\exp\left(-0.624 - 0.7831\cdot\ln\left(\frac{\mathbf{T_s}}{\mathbf{T_m}}\right)\right) & \text{if } \exp\left(-0.624 - 0.7831\cdot\ln\left(\frac{\mathbf{T_s}}{\mathbf{T_m}}\right)\right) \le 1 \wedge \mathbf{Underlying\_Geology} = \text{"soft b} \\ \mathbf{MHA_r}\cdot\mathbf{NRF} & \text{if } \exp\left(-0.624 - 0.7831\cdot\ln\left(\frac{\mathbf{T_s}}{\mathbf{T_m}}\right)\right) > 1 \wedge \mathbf{Underlying\_Geology} = \text{"soft bedrock"} \\ \frac{0.90976\cdot\mathbf{MHA_r}\cdot\mathbf{NRF}}{\frac{\mathbf{T_s}}{\mathbf{T_m}} + 1.11166} & \text{if } \frac{0.90976}{\frac{\mathbf{T_s}}{\mathbf{T_m}} + 1.11166} \le 0.7 \wedge \mathbf{Underlying\_Geology} = \text{"sand"} \\ 0.7\cdot\mathbf{MHA_r}\cdot\mathbf{NRF} & \text{if } \frac{0.90976}{\frac{\mathbf{T_s}}{\mathbf{T_m}} + 1.11166} > 0.7 \wedge \mathbf{Underlying\_Geology} = \text{"sand"} \\ \frac{0.70347\cdot\mathbf{MHA_r}\cdot\mathbf{NRF}}{\frac{\mathbf{T_s}}{\mathbf{T_m}} + 1.21784} & \text{if } \frac{0.70347}{\frac{\mathbf{T_s}}{\mathbf{T_m}} + 1.21784} \le 0.5 \wedge \mathbf{Underlying\_Geology} = \text{"clay"} \\ 0.5\cdot\mathbf{MHA_r}\cdot\mathbf{NRF} & \text{if } \frac{0.70347}{\frac{\mathbf{T_s}}{\mathbf{T_m}} + 1.21784} > 0.5 \wedge \mathbf{Underlying\_Geology} = \text{"clay"} \end{cases}$$

$\mathbf{Underlying\_Geology} = \text{"soft bedrock"}$

$\mathbf{MHEA} = 0.194$

$\mathbf{k_{eq.yield}} = 0.24$

Displacement = "does not ocurr ... MHEA< k_yield"

Method #2: BRAY-TRAVASAROU displacement as a function of degraded fundamental site period $1.5 \cdot T_s$

$1.5 \cdot T_s = 1.016\ s$ — Degraded fundamental period of sliding mass used for selection of spectral acceleration.

$S_{a1.5Ts} := 0.4$ — 5% damped elastic spectral acceleration (g) of the design ground motion at a period of $1.5T_s$ [from 0.002 to 2.7g]; obtain from ARS Online or USGS deaggregation website; if T_s < 0.05 sec, then use PGA

$Num_\sigma := 0$ — Number of standard deviations to use for initial (design) displacement estimate

use: mean ± 0.00 σ .....50% of non-zero displacements will be more, 50% will be less => 50% probability of exceedance

mean ± 1.00 σ .... captures 68% of values => 16% probability of exceedance, (100-68)/2=16

mean ± 1.28 σ .... captures 80% of values => 10% probability of exceedance

mean ± 1.65 σ .... captures 90% of values => 5% probability of exceedance

mean ± 2.32 σ .... captures 98% of values => 1% probability of exceedance

$\varepsilon := Num_\sigma \cdot 0.66 = 0$ — Error term (ε) expressed as a number of standard deviations ($\sigma = 0.66$) used for design displacement estimate ($D_{median} + Num_\sigma{}^* \varepsilon$)

a. Displacement probability distribution calculations

Probability of ZERO DISPLACEMENT, i.e., displacement <1 cm

- the remaining probability is the probability of non-zero displacement which gets further distributed as shown below

$$P_{D0} := 1 - pnorm\left(-1.76 - 3.22 \cdot \ln(k_{eq.yield}) - 0.484 \cdot \frac{T_s}{sec} \cdot \ln(k_{eq.yield}) + 3.52 \cdot \ln(S_{a1.5Ts}), 0, 1\right) = 46.90 \cdot \%$$

Probability of $P_{D0} = 46.9 \cdot \%$ that there will be zero (<1 cm) displacement .. so, conversely, there is a probability of $1 - P_{D0} = 53.1 \cdot \%$ that there will be non-zero displacement

Probability and magnitude of MEDIAN DISPLACEMENT (50% of non-zero displacements will be less / 50% will be more)

$$D_{median} := \begin{cases} \exp\left[-1.10 - 2.83 \cdot \ln(k_{eq.yield}) - 0.333 \cdot \ln(k_{eq.yield})^2 + 0.566 \cdot \ln(k_{eq.yield}) \cdot (\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04 \cdot \ln(S_{a1.5Ts}) - 0.244 \cdot (\ln(S_{a1.5Ts}))^2 + 1.50 \cdot \frac{T_s}{sec} + 0.278 \cdot (M - 7)\right] & \text{if } T_s \geq 0.05 sec \\ \exp\left[-0.22 - 2.83 \cdot \ln(k_{eq.yield}) - 0.333 \cdot \ln(k_{eq.yield})^2 + 0.566 \cdot \ln(k_{eq.yield}) \cdot (\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04 \cdot \ln(S_{a1.5Ts}) - 0.244 \cdot (\ln(S_{a1.5Ts}))^2 + 0.278 \cdot (M - 7)\right] & \text{if } T_s < 0.05 sec \end{cases} \cdot cm = 2.76$$

$$PD_{median} := (1 - P_{D0}) \cdot \left(1 - pnorm\left(\frac{\ln\left(\frac{D_{median}}{cm}\right) - \ln\left(\frac{D_{median}}{cm}\right)}{0.66}, 0, 1\right)\right) = 26.55 \cdot \%$$

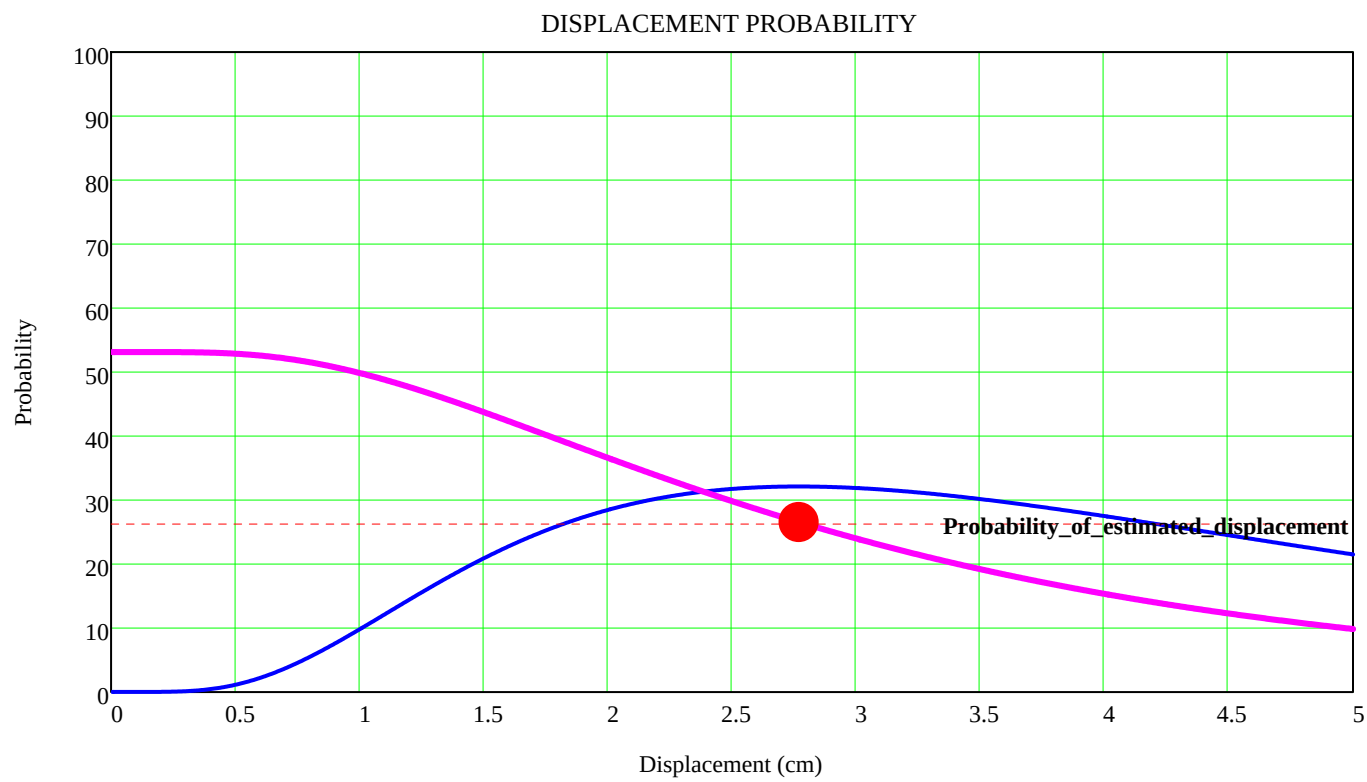
Probability of $PD_{median} = 26.6 \cdot \%$ that the actual displacement will exceed the median displacement of $D_{median} = 2.767 \cdot cm$

b. Probability and magnitude of ESTIMATED / DESIGN DISPLACEMENT selected se mean + $\mathbf{Num_{\sigma}} = 0$

$$\mathbf{D_{estimate}} := \begin{cases} \exp\left[-1.10 - 2.83\cdot\ln(k_{eq.yield}) - 0.333\cdot\ln(k_{eq.yield})^2 + 0.566\cdot\ln(k_{eq.yield})\cdot(\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04\cdot\ln(S_{a1.5Ts}) - 0.244\cdot(\ln(S_{a1.5Ts}))^2 + 1.50\cdot\frac{T_s}{sec} + 0.278\cdot(M-7) + \varepsilon\right] & \text{if } T_s \geq 0.05sec \\ \exp\left[-0.22 - 2.83\cdot\ln(k_{eq.yield}) - 0.333\cdot\ln(k_{eq.yield})^2 + 0.566\cdot\ln(k_{eq.yield})\cdot(\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04\cdot\ln(S_{a1.5Ts}) - 0.244\cdot(\ln(S_{a1.5Ts}))^2 + 0.278\cdot(M-7) + \varepsilon\right] & \text{if } T_s < 0.05sec \end{cases} \cdot cm = 2.76$$

$$\mathbf{PD_{estimate}} := (1 - P_{D0})\left(1 - \mathrm{pnorm}\left(\frac{\ln\left(\frac{D_{estimate}}{cm}\right) - \ln\left(\frac{D_{median}}{cm}\right)}{0.66}, 0, 1\right)\right) = 26.55\cdot\%$$

Probability of $\mathbf{PD_{estimate}} = 26.6\cdot\%$ that the actual displacement will exceed the the estimated (design) displacement of $\mathbf{D_{estimate}} = 2.767\cdot cm$



pink … probability that the given displacement will be exceeded (probability distribution)

blue… probability of non-zero displacement (probability density)

$\mathbf{MHA_r} := \mathbf{MHA} = 0.5$ ... maximum horizontal acceleration for berdock soil condition

$\mathbf{M} = 6.97$

$\mathbf{r} = 2.6 \cdot \mathbf{km}$

... mode magnitude and distance of desing earthquake as detemined in Step 2
(no differece for distances less than 10 km)

3. Prepration calculations

$\mathbf{D_{5\_95}}$ Median Dobry duration (time required to build up the central 90 percent of the Arias intensity) of significant shaking on rock in seconds of the earthquake event (Abrahamson and Silva (1996), SP117 eq.10.1a and 1b/p.74)

$$\mathbf{D_{5\_95}} := \exp\left[\begin{array}{l} \ln\left[\dfrac{\left[\dfrac{\exp[5.204 + 0.851\cdot(\mathbf{M} - 6)]}{10^{1.5\cdot\mathbf{M}+16.05}}\right]^{\frac{-1}{3}}}{15.7\cdot 10^{6}} + 0.063\cdot\left(\dfrac{\mathbf{r}}{\mathbf{km}} - 10\right)\right] + 0.8664 \quad \mathbf{if} \quad \mathbf{r} > 10\cdot\mathbf{km} \\ \ln\left[\dfrac{\left[\dfrac{\exp[5.204 + 0.851\cdot(\mathbf{M} - 6)]}{10^{1.5\cdot\mathbf{M}+16.05}}\right]^{\frac{-1}{3}}}{15.7\cdot 10^{6}}\right] + 0.8664 \quad \mathbf{if} \quad \mathbf{r} \le 10\cdot\mathbf{km} \end{array}\right]\cdot\mathbf{sec}$$

$\mathbf{D_{5\_95}} = 13.9\cdot\mathbf{sec}$

NRF factor accounting for non-linear ground acceleration response as shear waves propagate vertically through the materials above slide plane (SP117 eq.11.3/p.81)

- valid for $0.1 < \mathbf{MHA_r} < 0.8$

(per Blake (personal communication) for slides with cross-section area > 25,000ft^2 multiply NRF by 0.8)

$$\mathbf{NRF} := 0.6225 + 0.9196\cdot\exp\left(\frac{-\mathbf{MHA_r}}{0.4449}\right) \qquad \mathbf{NRF} = 0.921$$

5. Perfom deformation analysis

If the screening analysis indicates seismic instability and deformation analysis is required, calculate yield seismic coefficicient $k_{eq.yield}$ which is also the yield acceleration for displacement analyses:

$k_{eq.yield} := 0.135$ ... sesimic coefficient for FS = 1, i.e., at yield

Determine **Maximum Horizontal EQUIVALENT Acceleration** $MHEA$ (a spatially averaged peak acceleration acting in the landslide mass due to design seismic event) required for Newmark or Bray analyses to represent the seismic impact causing the slope movement (p.83/last paragraph), i.e., no movement happens if yield seismic coeffcient $k_{eq.yield}$ is greater than $MHEA$. $MHEA$ is calculated based on the geometry of the moving mass above the slip plane and converting the accelaration AT THE BASE of the landslide to the acceleration experienced IN the landslide, i.e., for conventional landslides the base acceleration will be bedrock, for landfills it could be either bedrock or alluvium.

$H := 650 \cdot ft$ ... maximum thickness of sliding mass

Average (= notice the 0.5 in the equation) MSW small strain shear wave velocity (Bray & Rathje, 1998 from Kavazanjian 1995)

$$avgV_s := \left(175 + 0.5 \cdot 2.43 \cdot \frac{H}{m}\right) \cdot \frac{m}{sec} \qquad avgV_s = 415.7 \cdot \frac{m}{sec}$$

Fundamental period of sliding mass T_s (SP117 eq.11.5/p.84)

$$T_s := \frac{4 \cdot H}{avgV_s} \qquad T_s = 4.403 \cdot sec$$

Mean period of the earthquake T_m (SP117 eq.10.2/p.74)

$$T_m := \begin{cases} \left[0.411 + 0.0837 \cdot (M - 6) + 0.00208 \cdot \frac{r}{km}\right] \cdot sec & \text{if } M \le 7.25 \\ \left(0.411 + 0.0837 \cdot 1.25 + 0.00208 \cdot \frac{r}{km}\right) \cdot sec & \text{if } 7.25 < M \le 8 \\ \text{"no solution"} & \text{otherwise} \end{cases} \qquad T_m = 0.498\ s$$

$$\frac{T_s}{T_m} = 8.848$$

Maximum Horizontal EQUIVALENT Acceleration **MHEA** for use in Newmark or Bray analysis (SP117 eq.11.7/p.84)
i.e., no movement happens if yield seismic coeffcient is greater than **MHEA**
- check Figure 11.2/p.85 of SP117 for sites on soft bedrock; if T_s/T_m<0.5, MHEA=MHAr x NRF
- check Figure 7 of Bray & Rathje, 1998 for sites on sand if T_s/T_m<0.7, MHEA=0.7 x MHA_r x NRF
- check Figure 7 of Bray & Rathje, 1998 for sites on clay; if T_s/T_m<0.5, MHEA=0.5 x MHA_r x NRF

$$\mathbf{MHEA} := \begin{cases} \mathbf{MHA_r}\cdot\mathbf{NRF}\cdot\exp\left(-0.624 - 0.7831\cdot\ln\left(\frac{\mathbf{T_s}}{\mathbf{T_m}}\right)\right) & \text{if } \exp\left(-0.624 - 0.7831\cdot\ln\left(\frac{\mathbf{T_s}}{\mathbf{T_m}}\right)\right) \le 1 \wedge \mathbf{Underlying\_Geology} = \text{"soft b} \\ \mathbf{MHA_r}\cdot\mathbf{NRF} & \text{if } \exp\left(-0.624 - 0.7831\cdot\ln\left(\frac{\mathbf{T_s}}{\mathbf{T_m}}\right)\right) > 1 \wedge \mathbf{Underlying\_Geology} = \text{"soft bedrock"} \\ \frac{0.90976\cdot\mathbf{MHA_r}\cdot\mathbf{NRF}}{\frac{\mathbf{T_s}}{\mathbf{T_m}} + 1.11166} & \text{if } \frac{0.90976}{\frac{\mathbf{T_s}}{\mathbf{T_m}} + 1.11166} \le 0.7 \wedge \mathbf{Underlying\_Geology} = \text{"sand"} \\ 0.7\cdot\mathbf{MHA_r}\cdot\mathbf{NRF} & \text{if } \frac{0.90976}{\frac{\mathbf{T_s}}{\mathbf{T_m}} + 1.11166} > 0.7 \wedge \mathbf{Underlying\_Geology} = \text{"sand"} \\ \frac{0.70347\cdot\mathbf{MHA_r}\cdot\mathbf{NRF}}{\frac{\mathbf{T_s}}{\mathbf{T_m}} + 1.21784} & \text{if } \frac{0.70347}{\frac{\mathbf{T_s}}{\mathbf{T_m}} + 1.21784} \le 0.5 \wedge \mathbf{Underlying\_Geology} = \text{"clay"} \\ 0.5\cdot\mathbf{MHA_r}\cdot\mathbf{NRF} & \text{if } \frac{0.70347}{\frac{\mathbf{T_s}}{\mathbf{T_m}} + 1.21784} > 0.5 \wedge \mathbf{Underlying\_Geology} = \text{"clay"} \end{cases}$$

$\mathbf{Underlying\_Geology} = \text{"soft bedrock"}$

$\mathbf{MHEA} = 0.045$

$\mathbf{k_{eq.yield}} = 0.135$

Displacement = "does not ocurr ... MHEA< k_yield"

Method #2: BRAY-TRAVASAROU displacement as a function of degraded fundamental site period $1.5 \cdot T_s$

$1.5 \cdot T_s = 6.604\ s$ Degraded fundamental period of sliding mass used for selection of spectral acceleration.

$S_{a1.5Ts} := 0.01$ 5% damped elastic spectral acceleration (g) of the design ground motion at a period of $1.5T_s$ [from 0.002 to 2.7g]; obtain from ARS Online or USGS deaggregation website; if T_s < 0.05 sec, then use PGA

$Num_\sigma := 0$ Number of standard deviations to use for initial (design) displacement estimate

use: mean ± 0.00 σ .....50% of non-zero displacements will be more, 50% will be less => 50% probability of exceedance

mean ± 1.00 σ .... captures 68% of values => 16% probability of exceedance, (100-68)/2=16

mean ± 1.28 σ .... captures 80% of values => 10% probability of exceedance

mean ± 1.65 σ .... captures 90% of values => 5% probability of exceedance

mean ± 2.32 σ .... captures 98% of values => 1% probability of exceedance

$\varepsilon := Num_\sigma \cdot 0.66 = 0$ Error term (ε) expressed as a number of standard deviations ($\sigma = 0.66$) used for design displacement estimate ($D_{median} + Num_\sigma{}^* \varepsilon$)

a. Displacement probability distribution calculations

Probability of ZERO DISPLACEMENT, i.e., displacement <1 cm

- the remaining probability is the probability of non-zero displacement which gets further distributed as shown below

$$P_{D0} := 1 - pnorm\left(-1.76 - 3.22 \cdot \ln(k_{eq.yield}) - 0.484 \cdot \frac{T_s}{sec} \cdot \ln(k_{eq.yield}) + 3.52 \cdot \ln(S_{a1.5Ts}), 0, 1\right) = 100.00 \cdot \%$$

Probability of $P_{D0} = 100 \cdot \%$ that there will be zero (<1 cm) displacement ..

so, conversely, there is a probability of $1 - P_{D0} = 2 \times 10^{-11} \cdot \%$ that there will be non-zero displacement

Probability and magnitude of MEDIAN DISPLACEMENT (50% of non-zero displacements will be less / 50% will be more)

$$D_{median} := \begin{cases} \exp\left[-1.10 - 2.83 \cdot \ln(k_{eq.yield}) - 0.333 \cdot \ln(k_{eq.yield})^2 + 0.566 \cdot \ln(k_{eq.yield}) \cdot (\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04 \cdot \ln(S_{a1.5Ts}) - 0.244 \cdot (\ln(S_{a1.5Ts}))^2 + 1.50 \cdot \frac{T_s}{sec} + 0.278 \cdot (M - 7)\right] & \text{if } T_s \geq 0.05 sec \\ \exp\left[-0.22 - 2.83 \cdot \ln(k_{eq.yield}) - 0.333 \cdot \ln(k_{eq.yield})^2 + 0.566 \cdot \ln(k_{eq.yield}) \cdot (\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04 \cdot \ln(S_{a1.5Ts}) - 0.244 \cdot (\ln(S_{a1.5Ts}))^2 + 0.278 \cdot (M - 7)\right] & \text{if } T_s < 0.05 sec \end{cases} \cdot cm = 0.01$$

$$PD_{median} := (1 - P_{D0}) \cdot \left(1 - pnorm\left(\frac{\ln\left(\frac{D_{median}}{cm}\right) - \ln\left(\frac{D_{median}}{cm}\right)}{0.66}, 0, 1\right)\right) = 1.00 \times 10^{-11} \cdot \%$$

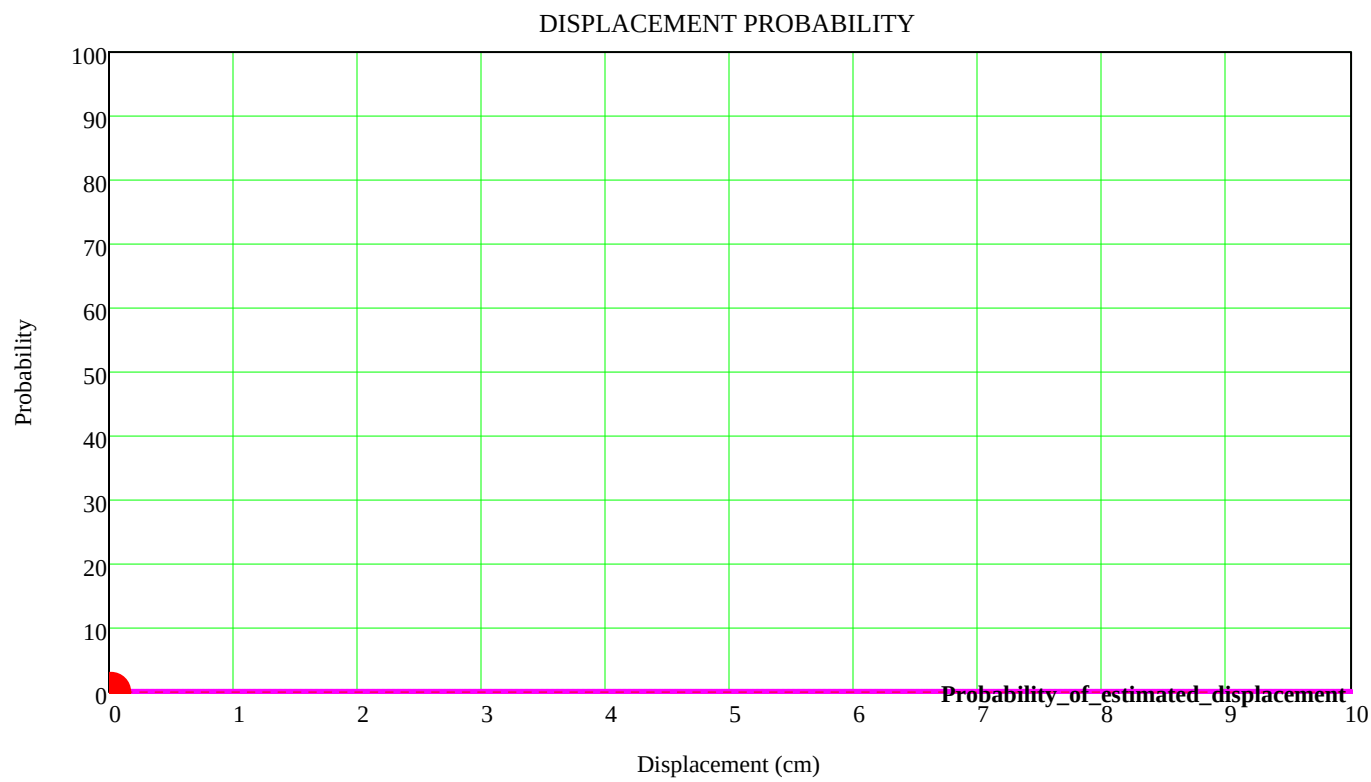
Probability of $PD_{median} = 1 \times 10^{-11} \cdot \%$ that the actual displacement will exceed the median displacement of $D_{median} = 0.016 \cdot cm$

b. Probability and magnitude of ESTIMATED / DESIGN DISPLACEMENT selected se mean + $\mathbf{Num_\sigma} = 0$

$$\mathbf{D_{estimate}} := \begin{cases} \exp\left[-1.10 - 2.83\cdot\ln(k_{eq.yield}) - 0.333\cdot\ln(k_{eq.yield})^2 + 0.566\cdot\ln(k_{eq.yield})\cdot(\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04\cdot\ln(S_{a1.5Ts}) - 0.244\cdot(\ln(S_{a1.5Ts}))^2 + 1.50\cdot\frac{T_s}{sec} + 0.278\cdot(M-7) + \varepsilon\right] & \text{if } T_s \geq 0.05sec \\ \exp\left[-0.22 - 2.83\cdot\ln(k_{eq.yield}) - 0.333\cdot\ln(k_{eq.yield})^2 + 0.566\cdot\ln(k_{eq.yield})\cdot(\ln(S_{a1.5Ts})) \ldots \right. \\ \left. + 3.04\cdot\ln(S_{a1.5Ts}) - 0.244\cdot(\ln(S_{a1.5Ts}))^2 + 0.278\cdot(M-7) + \varepsilon\right] & \text{if } T_s < 0.05sec \end{cases} \cdot cm = 0.01$$

$$\mathbf{PD_{estimate}} := (1 - P_{D0})\left(1 - \mathrm{pnorm}\left(\frac{\ln\left(\frac{D_{estimate}}{cm}\right) - \ln\left(\frac{D_{median}}{cm}\right)}{0.66}, 0, 1\right)\right) = 1.00\times10^{-11}\cdot\%$$

Probability of $\mathbf{PD_{estimate}} = 1\times10^{-11}\cdot\%$ that the actual displacement will exceed the the estimated (design) displacement of $\mathbf{D_{estimate}} = 0.016\cdot cm$



pink … probability that the given displacement will be exceeded (probability distribution)

blue… probability of non-zero displacement (probability density)

APPENDIX F

CONSTRUCTION QUALITY CONTROL AND CONSTRUCTION QUALITY ASSURANCE PLAN

CONSTRUCTION QUALITY CONTROL/ QUALITY ASSURANCE PLAN
PROMONTORY CLASS 1 LANDFILL
PHASE 1 GROUNDWATER PROTECTION PROJECT

Box Elder County, Utah

May 2016

197-2015-0112

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PROMONTORY CLASS 1 LANDFILL – PHASE 1
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1.0 INTRODUCTION AND PURPOSE

1.1 Purpose

This Construction Quality Assurance (CQA) Manual has been prepared for Promontory Point Resources, LLC for Phases 1A, 1B, and 1C liner construction project at the Promontory Class 1 Landfill.

In accordance with the requirements of the Utah Solid and Hazardous Waste Control Board Solid Waste Permit Renewal No. 0202R1 for the Promontory Class I Landfill, effective September 1, 2011, construction design drawings and a Construction Quality Control and Construction Quality Assurance (CQC/CQA) Plan are to be submitted to the Executive Secretary for approval. This manual outlines the specific field and laboratory testing and monitoring procedures required to demonstrate that the composite liner systems for the Phase 1 expansion areas are constructed in accordance with the permit requirements.

Following construction of the Phase 1 composite liner systems, the Quality Assurance/ Quality Control (QA/QC) Consultant will prepare a final CQA Report documenting the construction operations and the CQA testing completed during construction. The CQA Report shall be submitted to the Owner within 10 days of construction completion. The purpose of the CQA Report is to document that the materials and construction processes comply with the Phase 1 design and regulatory requirements. As-built drawings shall also be included.

1.2 Project Description

Tetra Tech BAS was contracted by Promontory Point Resources, LLC (PPR) to design the Phase 1 composite liner systems and in accordance with the Utah Solid Waste Permitting and Management Rules (UAC R315-301 thru 320), as well as applicable state and federal regulations. The Phase 1 expansion area will be constructed in accordance with the Construction Drawings, prepared by TTBAS.

The composite liner system will be composed of earth and geosynthetic materials to form the containment system for the waste management area. The composite liner system for the floor of Phase 1 will be composed of the following components from bottom to top:

1. Prepared native subgrade.
2. Geosynthetic Clay Liner (GCL)
3. 60-mil High Density Polyethylene (HDPE) geomembrane liner textured on both sides.
4. A 12-ounce non-woven cushion geotextile.
5. A 9-inch thick leachate collection layer composted of select drainage gravel graded to drain to collection pipes.
6. A 8-ounce non-woven filter geotextile.
7. A 18-inch thick protective cover soil layer (operations layer) composted of select on-site soil materials with a maximum dimension less than or equal to 1 inch.

OR, in lieu of items 5, 6, and 7, Install only Item 8.

8. 18-inch coarse sand layer

The composite liner system for the side slopes of Phase 1 will be composed of the following components from bottom to top:

1. Prepared native subgrade.
2. Geosynthetic Clay Liner (GCL)
3. A 60-mil thick, double sided, textured HDPE geomembrane layer
4. A 16-ounce non-woven geotextile cushion.
5. A 2-foot thick protective cover soil layer (operations layer) composted of select on-site soil materials with a maximum dimension less than or equal to 1 inch.

All materials used to construct the composite liner system must meet or exceed the criteria established in this CQA document and Project Plans and Specifications. Any deviation from these criteria must be pre-approved by the Engineer and the Geotechnical CQA Consultant.

1.3 Reference Documents

The following reference documents provide background information and support this CQA plan for construction:

1. *Design and Construction Documents for the Promontory Class 1 Landfill Phase 1 Groundwater Protection System.*
2. *ASTM International (formerly American Society for Testing and Materials) Annual Book of ASTM Standards.*
3. *Phase 1 Slope Stability Evaulation, Tetra Tech*

1.4 Definitions

Whenever the terms listed below are used, the intent and meaning shall be interpreted as indicated.

ASTM. ASTM International, formerly known as the American Society for Testing and Materials.

Construction Manager. The construction manager is an individual or firm responsible for administering the construction contract and providing overall construction management for the project. The construction manager is the primary contact on the project site representing the owner.

Construction Quality Assurance (CQA). CQA consists of a planned and systematic pattern of procedures and documentation designed to provide confidence that the elements of work or services meet the requirements of the contract documents. CQA includes verifying that the Contractor is performing quality control requirements of the specifications.

CQA Consultant. The CQA Consultant is the entity is responsible for the overall performance of the CQA program.

CQA Officer. The CQA Officer is the authorized representative of the CQA Consultant responsible for the day-to-day, on-site management of the CQA program.

CQA Monitors. CQA Monitors are authorized representatives of the CQA Consultant, responsible for observing and documenting activities related to CQA during construction, and reporting to the CQA Officer.

CQA Certifying Engineer. The CQA Certifying Engineer is an authorized representative of the CQA Consultant. He/she is a Professional Engineer (P.E.), registered in the State of California that is responsible for certifying that construction was performed in accordance with the intent of the contract documents and design.

Construction Quality Control (CQC). CQC consists of those actions which provide a means to measure and regulate the characteristics of an item or service to comply with the requirements of the contract documents. CQC shall be performed by the Contractor, except where otherwise designated in the Specifications.

Construction Drawings. Construction drawings are the official plans, profiles, typical cross-sections, elevations, and details, as well as their amendments and supplemental drawings, which show the locations, character, dimensions, and details of the work to be performed.

Contract Documents. Contract documents are composed of the official set of documents issued by the owner, which includes bidding requirements, contract forms, contract conditions, specifications, contract drawings, addenda, and contract modifications.

Contractor. The Contractor is the firm engaged as an independent Contractor that has entered into a contract with the owner, and who is referred to throughout the contract documents by singular number and masculine gender.

Contract Specifications. The Contract Specifications include the qualitative requirements for products, materials, and workmanship upon which the contract is based.

Earthwork. A construction activity involving the use of soil materials as defined in the construction specifications and Section 3 of this CQA Plan.

Geosynthetics Supplier(s). The Geosynthetics Suppliers are the manufacturers of the various geosynthetics being provided for installation in the project. A separate supplier may be responsible for the supply of each geosynthetic material (i.e., geomembranes, geotextiles, and geonet).

Geosynthetics Installer. The Geosynthetics Installer is the Contractor, or a sub-contractor to the Contractor, that is responsible for the handling, deployment, joining, testing, and completion of all geosynthetics at the site.

GRI. GRI is the Geosynthetics Research Institute, in Folsom, Pennsylvania.

Non-conformance. Non-conformance constitutes a deficiency, with regard to the specifications or other project requirements, in a characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. Examples of

non-conformance include, but are not limited to, physical defects, test failures, and inadequate documentation.

Testing Laboratory. The Independent Testing Laboratory is a laboratory or laboratories capable of conducting the tests on soils and/or geosynthetics, as required by this CQA Plan and the specifications. The Independent Testing Laboratory shall be certified by the Geosynthetic Accreditation Institute (GAI) in the specific tests to be performed and will perform all conformance testing of geosynthetics and all destructive laboratory testing of field seams.

Geotechnical CQA Organization. The Geotechnical CQA Team will be composed of design and field personnel with specific experience in the inspection and Geotechnical CQA monitoring of earthwork, low-permeability liner and cover soils, and geosynthetic materials specifically related to landfill liner and cover construction. The principal categories of personnel assigned to the Geotechnical CQA Team are presented below.

Geotechnical Project Director. The Geotechnical Project Director shall be a representative of the Geotechnical CQA Consultant and shall have overall responsibility for all geotechnical CQA activities.

The Geotechnical Project Director will be responsible for reviewing all earthwork or geosynthetic issues which may arise during construction. The Geotechnical Project Director's approval will be required for any earth or geosynthetic material modifications or for any design modifications which may impact the performance of the earth or geosynthetic materials.

Geotechnical CQA Manager. The Geotechnical CQA Manager will serve as the Geotechnical Project Director's on-site representative. All Geotechnical CQA functions will be his/her direct responsibility. All coordination, reporting and issues related to non-compliance will be reported through the Construction Manager. In addition, he/she will participate with the City, Engineer and Geotechnical Project Director in all decisions related to design issues which arise during the course of construction.

The Geotechnical CQA Manager shall be responsible for overall review, observation, sampling, and testing of activities utilized for CQA. Specific duties of the CQA Manager include:

1. Review of all designs, Project Plans, and Specifications.
2. Implementation of the Geotechnical CQA program including: assignment and management of all Geotechnical CQA personnel, review of all field reports, and review of all Geotechnical CQA related issues.
3. Review of design changes and coordination of such changes with the Engineer.
4. Serving as the on-site representative of the Geotechnical Project Director.
5. Familiarization of all Geotechnical CQA Monitors with the site and the Geotechnical CQA requirements of the project.
6. Attendance at all Geotechnical CQA related meetings (i.e., preconstruction, progress, and special meetings as required).
7. Review of all Liner Manufacturer and Liner Subcontractor certifications and documentation and development of appropriate recommendations.

8. Designation of a senior Geotechnical CQA Monitor to act on his/her behalf at the site while he/she is absent and operations are ongoing.
9. Notation of any on-site activities that could result in damage to the geosynthetics.
10. Review of the Subcontractor's personnel qualifications for conformance with project requirements.
11. Selection of locations for destructive test sampling (liner).
12. Oversight of the ongoing preparation of "As-Built" Plan(s).
13. Review of all Geotechnical CQA Monitors daily reports and logs.
14. Reporting to the Construction Manager and logging in his/her daily report any relevant observations reported to him by the Geotechnical CQA Monitors.
15. Oversight of the marking, packaging and shipping of all laboratory test samples.
16. Review of the results of laboratory testing and presentation of appropriate recommendations.
17. Preparation of a monthly summary of Geotechnical CQA activities.
18. Reporting of any unresolved deviations from the Geotechnical CQA Plan to the Construction Manager.
19. Preparation of the final “As-Built” report for all completed geosynthetic construction activities.

Field Engineer/Field Geologist. The Field Engineer/Field Geologist will be a representative of the Geotechnical CQA Consultant and will be responsible for evaluating whether earth and/or synthetic materials conform to the requirements of the Project Drawings and Specifications. Duties of the Field Engineer/Field Geologist will include the following:

1. Subgrade inspection, review, testing and documentation.
2. Review of the adequacy of all clearing, grubbing, stripping and preparation of areas to receive fill.
3. Monitoring and evaluation of any soil blending, mixing and processing operations.
4. Evaluation of the engineering characteristics of the processed and constructed earth materials.
5. Observation and evaluation of all cuts which may be impacted by geologic conditions.

Geotechnical CQA Technicians. Geotechnical CQA Technicians will be representatives of the Geotechnical CQA Consultant and will continuously observe all grading and geosynthetic operations to provide a basis for concluding that construction is carried out in conformance with the Project Drawings and Specifications. The duties of the Geotechnical CQA Technicians include monitoring, observing and testing all earthwork as well as monitoring, logging and documenting all geosynthetic installation operations.

The operations to be monitored observed and/or tested for the earthwork include:

1. Observation of subgrade surface preparation.
2. Verification that liner and cover soils are derived from appropriate sources.
3. Visual evaluation of the soil physical properties for consistency with the Project Drawings and Specifications.
4. Evaluation of all moisture conditioning and processing operations to evaluate uniformity of material and moisture content.

5. Evaluation of constructed low-permeability soils for conformance with the Project Drawings and Specifications.
6. Identification of deleterious materials or other deficiencies in soil characteristics to minimize the possibility that these materials are incorporated into the composite liner system.
7. Monitoring of activities for the removal and/or disaggregation of all oversize material.
8. Observation of uniformity of coverage of compaction equipment, especially at fill edges, turnaround areas and on slope faces.
9. Monitoring of lift thickness.
10. Observation of the active fill pad at the beginning of each grading day and establishment of requirements for wetting/drying and/or processing of exposed surfaces prior to placement of additional fill.
11. Undertaking field tests including but not limited to BAT permeability and field moisture/density testing at the minimum frequencies noted herein or at any time that a deficiency is suspected.
12. Recovery of samples for laboratory testing.
13. Completion, evaluation and documentation of laboratory testing of the permeability, grain size distribution, Atterberg Limits, in-place moisture content and density of the low-permeability layer materials in accordance with the requirements of the Specifications (including retests, if necessary).
14. Confirmation that the test results are in accordance with the Project Specifications (including retests of any previously failed areas).

The operations to be observed and monitored for all geosynthetics include:

1. Material delivery.
2. Unloading and on-site transport and storage.
3. Placement/deployment operations.
4. Joining and/or seaming operations.
5. Repair operations.

Specifically, the seaming operations to be monitored include:

1. Trial seams.
2. Seam preparation.
3. Seaming.
4. Nondestructive seam testing.
5. Sampling for destructive seam testing.
6. Laboratory test sample marking.
7. Repair operations.
8. Reviewing the final certification of seams.

In addition to these specific duties, the Geotechnical CQA Technicians shall be responsible for:

1. Observing the condition of sheets as placed.
2. Selecting samples for conformance testing by the Independent Testing Laboratory.
3. Marking samples for conformance testing.

4. Notation of any on-site activities that could result in damage to the geosynthetics.

All observations shall be reported in a timely manner to the Construction Manager.

2.0 CQA ADMINISTRATION

2.1 Responsible Parties

The responsible parties for the closure cover construction are as follows:

- Project Owner
  Promontory Point Resources, LLC
  32 East Exchange Place, Suite 100
  Salt Lake City, UT 84111
  Contact Name: Stephen Prows

- Construction Manager
  TBD

- Landfill Engineer
  Tetra Tech BAS
  1360 Valley Vista Drive
  Diamond Bar, CA 91765
  Caleb H. Moore, P.E.
  (909) 860-7777, x256

- CQA Consultant
  TBD

2.2 Meetings

In order to facilitate construction, and to clearly define construction goals and activities, close coordination between the CQA Officer, Construction Manager, and the Contractor is essential. To meet this objective, pre-construction and progress meetings will be held.

2.2.1 Pre-construction Kickoff Meeting

Following award, and preceding the commencement of construction activities at the site, a Pre-construction Kickoff Meeting will be held at the site. The purpose of this meeting, with mandatory attendance by responsible representatives of the Owner, Construction Manager, Contractor, design engineers, CQA Officer, agencies, and others designated by the owner, will be (at least) to:

1. Review the construction drawings, specifications, CQA Plan, work area security, health and safety procedures, and related issues;
2. Provide all parties with relevant project documents;
3. Review responsibilities and qualifications of each party;
4. Define lines of communication and authority;
5. Review of work area security and safety protocol.
6. Establish reporting and documenting procedures;
7. Review procedures for handling submittals;
8. Review testing equipment and procedures;
9. Review procedures for field directives and change orders;
10. Review of procedures for field and laboratory CQA testing.
11. Establish testing protocols and procedures for correcting and documenting construction or non-conformance;
12. Establish weekly meeting schedule;
13. Conduct a site inspection to discuss work areas, stockpile areas, lay down areas, access roads, haul roads, and related items;
14. Review the project schedule and critical path items; and
15. Review Contractor's work plan.

The meeting will be documented by the Construction Manager. Copies of the minutes and relevant documents will be prepared and provided to all parties. Separate pre-construction kickoff meetings may be held for the soils and geosynthetics components of the work, as these may be accomplished by different contracting or subcontracting parties.

2.2.2 Daily Progress Meetings

Informal progress meetings will be held each morning before the start of work. At a minimum, this meeting will be attended by the CQA Officer or his designated representative and the Contractor's designated site superintendent. The purpose of this meeting is to:

1. Conduct a site safety briefing – in addition, the Contractor shall be expected to conduct a site safety briefing for all personnel each day before start of work;
2. Discuss problems and resolutions;
3. Review test data;
4. Discuss the Contractor's personnel and equipment assignments for the day;
5. Review the previous day's activities and accomplishments; and
6. Resolve any outstanding problems or disputes.

2.2.3 Weekly Progress Meetings

Weekly scheduled progress meetings will be held throughout construction. The Construction Manager, the CQA Officer, and the Contractor will be present. The meetings will be held to discuss progress, problems, construction schedule, changes, test data, safety, environmental issues, review laboratory and field test data, discuss Contractor's personnel and equipment assignments, review previous week's activities and accomplishments, and any other issues necessary. The Construction Manager will prepare the agenda for each meeting and prepare meeting minutes for distribution to all parties.

2.2.4 Geosynthetic Material Pre-Installation Meeting

A Geosynthetic Material Pre-Installation Meeting shall be held at the site before installation of the geosynthetic materials. At a minimum, the meeting shall be attended by the Construction Manager, CQA Consultant, the General Contractor, the Geosynthetic Installation Subcontractor, and the CQA Officer and designated CQA staff. The Pre-Installation Meeting should be conducted when all Manufacturer Certifications required by the Project Specifications and this CQA Plan are received, reviewed, and approved.

Specific items to be addressed at this meeting include:

1. Submittal and review of relevant documents.
2. Definition of appropriate modifications to the geosynthetic CQA requirements.
3. Development of a format for site specific documentation.
4. Definition of the responsibilities of each party.
5. Definition of the lines of authority and communication.
6. Review of work area security and safety protocols.
7. Definition of methods for documenting and reporting, including distributions.
8. Selection of welding equipment and procedures.
9. A field welded seam(s) demonstration.
10. Identification of testing equipment and procedures, including peel and shear tests, and procedures for communicating laboratory test results.
11. Identification of procedures for correcting and documenting construction deficiencies.
12. A site inspection to discuss storage areas, work areas, stockpile areas, laydown areas, access roads, haul roads, and related items.
13. Review of the project schedule.

The meeting shall be documented by the Construction Manager and minutes shall be distributed to all appropriate parties.

2.2.5 Other Meetings

Special meetings will be conducted as required to discuss any problems or deficiencies. At a minimum, these meetings will be attended by the City (or designated representative), Construction Manager, appropriate Geotechnical CQA staff and the Contractor. If correction of a problem requires a design modification, the Landfill Engineer and the Geotechnical Project Director will also be present. The purpose of these meetings is to:

1. Define and discuss any problems or deficiencies in the Project.
2. Review possible corrective actions or solutions.
3. Implement an action plan to resolve the problems or deficiencies.

Special meetings shall be documented by the Construction Manager or his/her representative and minutes shall be distributed to all parties.

2.2.6 Geosynthetic Pre-installation Meeting

A Geosynthetic Material Pre-installation Meeting shall be held at the site before installation of the geosynthetics. At a minimum, the meeting shall be attended by the Construction Manager, the Engineer, the Contractor, the Liner Subcontractor, and Geotechnical CQA staff. The Pre-Installation Meeting will not be conducted until all Manufacturer Certifications required by the Project Specifications and this document are received, reviewed and approved.
Specific items to be addressed at this meeting include:

1. Submittal and review of relevant documents.
2. Definition of appropriate modifications to the Geosynthetic Geotechnical CQA requirements.
3. Development of a format for site specific documentation.
4. Definition of the responsibilities of each party.
5. Definition of lines of authority and communication.
6. Review of work area security and safety protocol.
7. Definition of methods for documenting and reporting, including distributions.
8. Selection of welding equipment and procedures.
9. A field welded seam(s) demonstration.
10. Identification of testing equipment and procedures, including peel and shear tests, and procedures for communicating laboratory test results.
11. Identification of procedures for correcting and documenting construction deficiencies.
12. A site inspection to discuss storage areas, work areas, stockpile areas, laydown areas, access roads, haul roads, and related items.
13. Review of the project schedule.

The meeting shall be documented by the Construction Manager and minutes shall be distributed to all parties.

2.3 Responsibilities of Construction Quality Assurance Personnel

2.3.1 Communications with the Construction Subcontractor

Only the individuals assigned to this project, as defined in this CQA Plan, may communicate with the Contractor. Communications of an official nature must be clear, direct, and professional. When written communications are required, they must be documented on the appropriate forms. Formal letters to the Contractor should normally be signed by the CQA Certifying Engineer and reviewed by the Owner.

2.3.2 Communications with the Owner

Only those individuals assigned to this project, as defined in this CQA Plan, may communicate with representatives of the owner. All communications must be through proper channels as defined in the project organization chart. Communications of an official nature must be written, clear, direct, and professional.

2.3.3 Responsibilities of the CQA Certifying Engineer

The CQA Certifying Engineer shall be responsible for documenting and certifying to Construction Manager that construction was performed in accordance with the intent of the design and the contract documents.

2.3.4 Responsibilities of the CQA Monitors

The CQA Monitors shall implement the CQA program under the direction of the CQA Officer. The CQA Monitors shall perform all construction monitoring and construction materials testing. The CQA Monitors shall maintain all documentation and test data summaries related to construction monitoring and construction material testing. The CQA monitors shall report directly to the CQA Officer.

The CQA Monitors personnel will work under the supervision and guidance of the CQA Officer. CQA Monitors will perform onsite inspections of the construction and determine whether the work meets the requirements of the Construction Drawings and Specifications. Field tests and visual observations will be used to evaluate construction practices. If CQA Monitors observe poor construction practices, the CQA Officer will be notified immediately. CQA Monitors personnel will be responsible for verifying that all testing is conducted in accordance with ASTM standards or other specified test methods and that the proper test equipment is used. The results of all inspections, including work that is unacceptable, will be reported to the CQA Officer.

2.3.5 Responsibilities of the Design Engineer

The Design Engineer shall represent his organization and be responsible for site engineering services related to their design. Those services include reviewing Contractor submittals, resolving technical issues related to construction, providing interpretation of the drawings and specifications, and approving substantial design modifications and technical revisions.

2.3.6 Responsibilities of the Construction Subcontractor

The Construction Subcontractor coordinates testing with the Independent Testing Laboratories and maintains record Drawings. The Construction Subcontractor shall perform all construction geosynthetic materials testing, under supervision of CQA personnel.

2.4 Control of Documents, Records, and Forms

2.4.1 Project Control of Contract Documents

Contract documents, including specifications, drawings, and change orders, are controlled by the Construction Manager. The Construction Manager shall maintain one or more copies of the most current set of contract documents for use by the CQA personnel. Upon issuance of new copies or revisions, it is the responsibility of the Construction Manager to notify the Contractor of the revisions, provide revised contract documents, and order the recall of all unrevised copies of the contract documents. The Construction Manager shall also provide the latest revised set of contract documents to the CQA Consultant. The Construction Manager

collects, distributes, and addresses the disposition of Contractor submittals approved by the design engineers.

2.4.2 Project Control of As-Built Information

As-built documentation generated by the Contractor and the CQA Consultant is controlled by the CQA Officer. During the progress of the work, the CQA Officer obtains as-built information provided from the CQA Monitors, the Contractor, Surveyors, or others, and compiles all as-built data onto one set of drawings. At the completion of the project, this information is used to prepare final drawings for the final CQA Certification Report. The as-built drawing set must be maintained on site and be clearly marked as Record Drawings.

2.4.3 Project Control of Forms

Daily report forms, test report forms, and other project forms are controlled by the CQA Officer, who shall maintain a master of each form for copies. Upon issuance of a new form, the CQA Officer shall recall and remove all superseded copies along with the master, notify the CQA Monitors, and provide new copies for their use.

2.4.4 Processing Daily Reports

A daily summary report shall be prepared by the CQA Officer, or designated staff for all construction activities. At a minimum, the report shall include:

1. The date;
2. Summary of weather conditions;
3. Summary of locations where work is occurring;
4. Equipment and personnel on the project;
5. Summary of any meeting held and attended;
6. Description of all material used and references or results of testing;
7. Calibration and recalibration of test equipment;
8. Daily inspection reports from each inspector.

Additionally, daily inspectors' reports shall include:

1. The location of the work tested;
2. Type of inspection;
3. Procedure(s) used;
4. Test data;
5. Results of the activity;
6. Personnel involved in the inspection and sampling activities;
7. Photographic records shall also be included as deemed necessary.

These daily reports are reviewed by the CQA Officer for legibility, clarity, traceability, correctness, and completeness. The review must be evidenced by signature. Daily reports are submitted to the Construction Manager on a daily basis and are maintained at the site. A

weekly summary CQA report will be prepared by the CQA Officer and submitted to the Construction Manager.

2.4.5 Processing Test Reports

A test report must be completed by the CQA monitors whenever testing is performed. The test reports shall be reviewed by the CQA Officer. The review includes a check for mathematical accuracy, conformance to test requirements, conformance to specifications, and for clarity, legibility, traceability, and completeness. The review must be evidenced by a signature of the reviewer. Test reports (or summaries) from Independent Testing Laboratories will also be transmitted to the CQA Officer for review.

2.4.6 Processing Project Records

Project records are completed as needed. Use of the project records is limited to the scope for which they are intended. The record must be completed by filling in all of the blanks provided on the form, followed by the signature of the individual completing the form. All project records must be maintained at the site.

2.5 Documentation and Control of Non-Conformance

2.5.1 Observation of Non-Conformance

Whenever non-conforming work is discovered or observed in the construction process, product, job-related materials, documentation, or elsewhere, the CQA Officer and CQA Monitors shall first notify the foreman or superintendent supervising the work in question. The CQA Officer shall then notify the Construction Manager.

2.5.2 Determining Extent of Non-Conformance

Whenever non-conforming work is discovered or observed in the construction process, product, job-related materials, documentation, or elsewhere, the CQA organization will determine the extent of the deficiency, determined by additional sampling, testing, observations, review of records, or any other means deemed appropriate.

2.5.3 Documenting Non-Conformance

All non-conforming work shall be documented in writing on the daily records, logs, and elsewhere, as appropriate. The documentation must occur immediately upon determining the extent of the deficiency. For non-conforming work that is considered serious or complex in nature, or which requires an engineering evaluation, a Non-conformance Report will be prepared and issued to the Construction Manager and Contractor.

2.5.4 Corrective Measures

For a simple or routine element of non-conformance, corrective measures will be determined by specification direction, or if none exists, the Construction Manager, CQA Officer and

Contractor shall discuss standard construction methods to correct the deficiency. For Non-conformance Reports which require an engineering evaluation, the Design Engineer shall determine appropriate corrective measures. A copy of the Non-conformance Report, with the Design Engineer's corrective measure determination, will be forwarded to the Construction Manager, CQA Officer, and Contractor for implementation of the corrective action.

2.5.5 Verification of Corrective Measures

Upon notification by the Contractor that a corrective measure is complete, the CQA Officer shall verify its completion. The verification must be accomplished by observations or retesting and documented photographically. Written documentation of the corrective measures shall be made by the CQA Officer on daily reports, logs, and forms, and, if applicable, the Non-conformance Report. Verification of corrective measures shall be reviewed by the Construction Manager. Corrective action measures that require an engineering evaluation will be reviewed and verified by the Design Engineer.

2.6 Construction Monitoring

2.6.1 Monitoring Priorities

Before commencement of construction, the CQA Officer shall establish a list of monitoring priorities. The list shall include the various construction activities and the monitoring priority of those activities. The monitoring priorities may change during construction, based upon Contractor performance or Owner request. Changes in the monitoring priorities must be approved by the CQA Officer.

2.6.2 Discrepancies

CQA testing must be conducted in accordance with this CQA Plan and the Project Specifications. In cases of differences in the requirements, the document that requires the most frequent tests or has more stringent test requirements will govern, unless otherwise specified by the CQA Officer.

2.7 Materials Quality Verification

2.7.1 General

Material sources will be identified and samples tested to determine if the material meets project specifications for specific work elements. Definitions and requirements of materials are provided in the technical specifications. Test samples will be obtained in accordance with applicable ASTM and/or GRI standards. Archive samples and test results of the test samples will be maintained and stored at the project site. The CQA Monitors will establish and maintain a materials quality verification list. The list will include material sources, sample locations, testing requirements, test results, and verification action items.

2.7.2 Materials Submittals

Material submittals may be used by the CQA Consultant to establish the acceptability of materials. When sample submittals are required, they will be made available to the CQA Consultant by the Contractor. Acceptance and proper review of submittals are the responsibility of the CQA Officer.

2.7.3 Certificates of Compliance and Conformance

Certificates of compliance and conformance may be used by the CQA Officer to establish the acceptability of materials. Those certificates generally state that the material is in compliance or conformance with a particular code, standard, or specification. The certificate may be used for acceptance of a product before or in lieu of testing, if allowed by the specifications.

2.7.4 Manufacturing Plant Visit(s)

The Liner Subcontractor shall make arrangements with the Liner Manufacturer(s) to allow the Geotechnical CQA Manager or his/her designee to visit the geosynthetics manufacturing plant(s) during manufacture of the liner material for this project and to observe manufacturing methods and quality control of manufactured materials. If appropriate, the Geotechnical CQA Manager or his/her designee shall review the manufacturing process, quality control, laboratory facilities and testing procedures.

During the plant visit, those visiting shall:

1. Observe that the geosynthetic properties presented in the Liner Manufacturer's certification documents meet the Project Specifications.
2. Verify that the measurements of properties by the Liner Manufacturer are properly documented and test methods used are acceptable.
3. Spot inspect some of the geomembrane rolls and verify that they are free of holes, blisters, or any sign of contamination by foreign matter.
4. Review packaging and transportation procedures to verify that these procedures are not damaging the geosynthetics.
5. Observe that roll packages have a label indicating the name of the Liner Manufacturer, type of geosynthetic, its roll/panel number and other required information.
6. Verify that extrusion rods and/or beads are derived from the same base resin type as the geomembrane.

2.8 Equipment Control

2.8.1 Equipment List

Before the start of construction, the CQA Officer shall complete a list of all measuring, sampling, and testing equipment to be used at the site. As new equipment becomes available during the course of the project, it must be added to the list. When more than one of any type of equipment is available, a unique number will be affixed to each piece to maintain its

identity. The equipment list shall be maintained in the project files and shall contain the following information:

1. Type of equipment (name, model);
2. Serial number or identifying number;
3. Date item received at site;
4. Use of the equipment; and
5. Date removed from service.

2.8.2 Calibration of Equipment and Materials

Before placing a piece of testing equipment into service, its accuracy must be established and calibrated by the CQA Officer. Types of equipment requiring calibration include: nuclear gauges, sand cone devices, sand to be used in sand cones, and scales. The calibration procedures and frequencies must be in accordance with the Manufacturer's instructions or ASTM standards. Whenever the equipment is suspected of inaccuracy, or is producing questionable results, it must be removed from service immediately and re-calibrated.

3.0 CONSTRUCTION QUALITY ASSURANCE FOR EARTHWORKS

Construction of the composite liner system shall be performed in accordance with the Project Drawings and Specifications and shall be continuously observed, and routinely sampled and tested by the Geotechnical CQA Monitors for the physical parameters described in this section.

The testing frequency presented herein is a minimum. Additional tests will be conducted by the Geotechnical CQA Monitor for retests and at any time that in the opinion of the Geotechnical CQA Monitor, additional testing is required and/or a deficiency is suspected. Retests of previously failed areas will be performed at the discretion of the Geotechnical CQA Monitor when, in his/her opinion, sufficient reworking of the area has been performed to warrant a retest.

3.1 Introduction

This section describes the CQA procedures for earthwork operations. The scope of earthwork and related CQA activities include the following elements:

1. Site and Subgrade Preparation
2. Excavation
3. General Earthfill
4. Low-Permeability Soil Material (Optional in lieu of GCL)
5. Leachate Collection and Removal System (LCRS) Gravel Material

The testing frequencies presented in the specifications are a minimum. Additional tests will be conducted by the CQA Monitor for retests and at any time that in the opinion of the CQA Monitor, additional testing is required and/or a deficiency is suspected. Retests of previously failed areas will be performed at the discretion of the CQA Monitor when, in his opinion, sufficient reworking of the area has been performed by the Contractor to warrant a retest. Following a thorough re-working of a failed area, retesting will be performed by the CQA Monitor to evaluate whether the re-worked area meets the requirements of the project.

3.2 Earthwork Construction Testing

3.2.1 Test Standards

Testing shall be performed in accordance with Specification Section B Earthwork and F for LCRS Gravel.

3.2.2 Test Frequencies

Test frequencies for earthwork CQA are in Specification B – Earthwork. The test frequencies listed establish a minimum number of required tests. Extra testing must be conducted whenever work or materials are suspect, marginal, or of poor quality. Extra testing may also be performed to provide additional data for engineering evaluation. Any re-tests performed as a result of a failing test do not contribute to the total number of tests performed in satisfying the minimum test frequency.

3.2.3 Soil Sample Numbering

The CQA Monitor shall maintain soil sample numbers in a master log maintained at the site. Sample numbers begin with (001) and proceed upward. No sample number can be repeated, and re-tests of a failing sample are given the original number with a letter suffix (i.e., a re-test for a failing sample 021 would be designated as 021A. Information contained in the master log of test samples includes:

1. Sample number;
2. Test(s) to be performed;
3. Dated sampled;
4. Monitor obtaining sample;
5. Location sampled;
6. Location to testing (site vs. offsite);
7. Date sample sent off site;
8. Date test results received;
9. Site testing monitor;
10. Date testing completed at site; and
11. Test results and remarks.

3.2.4 Soil Sample Tagging

The CQA Monitor shall be responsible for maintaining sample identification for all soil samples while on site, from time of sampling through completion of testing. The CQA Monitor must place a sample tag on the soil sample container immediately upon sampling. The tag must remain with the soil sample throughout processing. The tags shall contain the following information:

1. Sample number;
2. Material type;
3. Project name and project number;
4. Sampling monitor;
5. Date sampled; and
6. Test(s) to be performed.

3.2.5 Soil Sample Processing

The CQA Monitor shall be responsible for the timely processing of soil test samples. The CQA Officer shall also determine which samples are tested on site and which are tested off site. The determination is made based on manpower available, equipment available, complexity of test, and time available for results. For expediency, samples to be tested off site shall be shipped the same day as they are obtained.

3.3 Field Density Tests

3.3.1 Test Numbering

The CQA Monitor is responsible for maintaining test numbers and results for field density tests. All other testing is identified through the sample number (Section 3.2.3). The CQA Monitors shall maintain field books that identify soil segments, data tested, CQA Monitor performing the test, and sequential test number. Each soil segment will have a unique series of numbers. No test number can be repeated for a given soil segment and re-tests of failing tests must be given a letter suffix along with the original test number (i.e., re-test for a failing Test #1201 would be: 1201A. Test data and results shall be filled out on the field density test form.

Soil Segment	Test Number Series
Earth Fill	1000-1999
Low-Permeable Soil Material (Optional in lieu of GCL)	2000-2999

3.3.2 Test Locations

The intention of the CQA program is to provide assurance that the earthwork materials and work conform to the technical specifications. To meet this intent, the CQA Monitor shall perform density tests on earth fills during construction. Density tests shall be located at various elevations and uniformly dispersed throughout the entire plan dimensions of the fill. Density test locations must be chosen without bias; however, additional testing can be performed in any areas that are suspect, marginal, or appear to be of poor quality. During the progress of the work, density test locations shall be plotted on a drawing by the CQA Monitor to document that no significant areas are untested. The drawing becomes part of the CQA Certifying Report.

3.4 Monitoring and Testing Requirements

Earthwork components of the construction are summarized in Paragraph 3.1 of this section. Each component has specific construction requirements that must be monitored. The following sections list monitoring requirements for each type of earthwork.

The following sections list monitoring requirements for each type of earthwork.

3.4.1 Clearing, Grubbing, and Stripping

1. Document that erosion and sediment control silt fences, and other measures are securely in place prior to initiating clearing, grubbing, and stripping operations in any area.
2. Document that clearing and stripping in areas required for site access and execution of the work is complete.
3. Document that vegetation, roots, and highly organic soil within marked areas are removed to a minimum depth of 6 inches below the existing ground surface.
4. Document that stockpile subgrades are surveyed prior to stockpiling.

3.4.2 Stockpiling and Soil Management

1. Review contractor's approved work plan submittal. Verifying stockpile locations, stockpile dimensions, haul routes, material segregation procedures, and erosion, sediment and drainage control measures. Determine and note corrective action items, if applicable.
2. Document that stockpile locations have been cleared, grubbed, and stripped in accordance with the clearing, grubbing, and stripping section of this CQA manual and the technical specifications.
3. During excavation, hauling, and stockpiling operations continually identify and verify material classifications in general accordance with ASTM D2488 as necessary to characterize material stockpile designations.
4. Observe that stockpiles are constructed with slopes no greater than 2H:1V (horizontal to vertical) and that the top surface maintains a minimum 5 percent grade. Verify slopes and grades using hand held levels, range poles, and measuring tapes.

3.4.3 Excavations

1. Document that construction staking is performed before work and that survey bench marks with elevations are secured outside the work area.
2. Document that excavated materials are segregated into proper stockpiles.
3. Coordinate with the contractor and contractor's surveyor for the performance of excavation verification surveys upon completion of excavating operations. Verify corrective action measures as determine by verification surveys. Verification surveys will also be used to determine limits of excavation for measurement and payment applications. Submit copy of verification surveys to the construction manager.

3.4.4 Earth Fills

1. Document that clearing, grubbing, and stripping has been completed as required for fill placement.
2. Monitor that construction staking is performed before work and that survey bench marks with elevations are secured outside the work area.
3. Perform visual and manual soil classifications (ASTM D2488) to verify that the material source is suitable for earth fills. Verify that the material is free of organic and oversized materials and perform classifications continually during excavation of borrow materials.
4. Verify that earth fill materials are placed and compacted in accordance with the Specifications. If a sheepsfoot compactor is not used, verify that the top of each compacted lift is scarified in accordance with the specifications.
5. Monitor that soil materials are kept within the specified moisture content range listed in the Specifications. Monitor that soil materials that are wet and over the moisture content specified are properly aerated and processed to bring the moisture content of the material into the acceptable range. Monitor that earth fill soils that are dry and below the moisture content specified are properly moisture conditioned and processed to bring the moisture content into the acceptable range.

6. Monitor that desiccated earth fills are properly repaired or removed before placing subsequent lifts.
7. Monitor that final earth fill surfaces are free of ruts, gouges, and other features that might contribute to erosion and sediment run-off.
8. During earth fill operations field verify lines, grades, and dimensions using hand-held levels, range poles, and measuring tapes.
9. Coordinate with the Contractor and Contractor's surveyor for the performance of verification surveys at the completion of earth fill operations. Verify corrective action measures as determined by verification surveys. Verification surveys will also be used to determine the limits of earth fills for measurement and payment applications. Submit copy of verification surveys to the Construction Manager.

3.4.5 Subgrade Preparation

1. Monitor that the material source is suitable for the subgrade, is free of organic and oversized materials, and meets the grading requirements of the technical specifications.
2. Monitor that grade control construction staking is performed prior to work.
3. Verify that all survey stakes are removed from liner subgrade, and verify that the subgrade is free of irregularities and is steel drum rolled smooth prior to geosynthetics placement.
4. Monitor that the final surface provides continuous and intimate contact with the overlying geosynthetics.
5. Coordinate with the Contractor and Contractor's surveyor for the performance of subgrade verification surveys upon completion of the subgrade preparation. Verify corrective action measures as determined by the verification surveys. Verification surveys will also be used to determine the limits of the subgrade preparation for measurement and payment applications. Submit copy of verification surveys to the Construction Manager.
6. Perform tests to document that each lift is compacted to the 90 percent at a frequency of 3 per day or 1 per 500 cubic yards of material placed, whichever is less.

3.4.6 Low-Permeability Soils Processing (Option)

The low-permeability soils that will be used for Phase 1 will be obtained from on-site soil stockpiles approved by the Geotechnical Consultant, or from off-site sources that have been approved by the Geotechnical Consultant.

These borrow soils will require moisture conditioning and processing on a "processing table" prior to placement as fills. The low-permeability soils will be evaluated by the Geotechnical Consultant according to the minimum testing schedule in Section 2.2.1 in Specification Section B in order to characterize material properties.

3.4.6.1 Earthworks Demonstration Fill

A Demonstration Fill will be constructed prior to actual liner construction to evaluate both the low-permeability soil proposed for construction and the equipment and methods for constructing and maintaining the integrity of the low-permeability liner.

Construction of the Demonstration Fill will be completed a minimum of two weeks prior to the actual low-permeability liner or cover construction. The Demonstration Fill will be constructed using the same earthwork equipment and Specifications to be used for cover and liner construction. Soil sampling will be performed by the Geotechnical CQA Monitor(s) during and after construction of the Demonstration Fill to provide data regarding soil properties obtainable using the proposed design and construction methods. All criteria for Demonstration Fill construction, including low-permeability material processing, amount of compaction, moisture content, etc., will be the same as those required and anticipated for actual liner construction.

The purpose of the Demonstration Fill is to: 1) evaluate the performance of the construction equipment to be used for soil blending, processing, placement and maintaining the low-permeability soils under actual construction conditions; 2) evaluate the field performance of the low-permeability soil material through laboratory and field tests; 3) compare field (BAT) and laboratory permeability test results; and 4) develop a database of test results and performance standards prior to full-scale cover and liner construction in order to substantiate the Construction Specifications. If necessary, the results from the Demonstration Fill construction and testing program will be used to modify the Project Specifications for low permeability liner and cover construction.

The Demonstration Fill will measure roughly 100 feet by 30 feet and will consist of an approximately 24-inch thick section of blended, processed, cured and compacted low-permeability soils. The Demonstration Fill shall be constructed using the methods, materials and equipment to be employed during construction of the actual liner and cover. Processed low-permeability materials will be placed in six to eight inch lifts. Construction will be continuously observed and tested by the Geotechnical CQA Monitor and/or his/her representative.

The testing frequency used in construction and monitoring of the Demonstration Fill will be more stringent than that to be maintained during construction of the actual cover or liner. Minimum testing requirements for Demonstration Fill are in Section 2.2.2 of Specification Section B Earthwork.

3.4.6.2 Low-Permeability Fill Placement for Phase 1

Select import soils shall be screened (if necessary), dried, and/or moisture conditioned until uniformly blended material characteristics and moisture condition are attained. Field and laboratory testing for moisture content, in-place dry density, and engineering and permeability properties during construction of the low-permeability layer of the liner system will be completed according to the minimum schedule Section 2.2.1 of Specification Section B.

3.4.6.3 Acceptance Criteria

Where test results indicate that the lift thickness, maximum particle size, homogeneity of material, cure time, moisture content, density, or permeability of any portion of the work is below the project requirements, that particular portion shall be retested and/or reworked or replaced until the required condition has been attained and the resulting product meets or exceeds the requirements of the Project Specifications. No additional fill shall be placed over an area until the existing fill has been tested horizontally and vertically and determined by the Geotechnical CQA Monitor to meet the Project Earthwork Specifications. The area to be reworked will be verified by survey if in the opinion of the Geotechnical CQA Monitor conditions warrant.

If in the opinion of the Geotechnical CQA Manager or the Senior Geotechnical CQA Technician, low-permeability materials which have been placed and/or are ready to be placed, do not visually have a uniform and homogeneous moisture content throughout the material in question, these materials will be removed, without testing, and will be reprocessed and/or reworked until, in the opinion of the Geotechnical CQA Manager or his/her designated representative, they meet the Project Specifications.

<u>Compaction:</u>
For all fill materials placed, if test results indicate a relative dry density of less than that required or a moisture content outside the limits specified, then the area will be considered inadequate and will be reworked. Any reworked areas will be retested by the Geotechnical CQA Monitor to verify the reworked area meets the density and moisture content requirements.

The Tables in 2.2.1 and 2.2.2 of Specification Section B list the minimum moisture/density requirements for fill materials placed. The in-place moisture content and dry density requirements are relative to the maximum dry density and optimum moisture content as determined by ASTM D1557.

<u>Permeability:</u>
If a BAT or laboratory permeability test results in a value exceeding the defined maximum of 1×10^{-7} cm/sec, two (2) additional tests of the same type will be taken in the immediate vicinity. At the discretion of the Geotechnical CQA Consultant, BAT permeability tests may be taken in lieu of failed laboratory tests to expedite the CQA testing procedure. If either of the additional tests fails to meet the minimum requirements, the area represented by the test will be considered inadequate and will be removed or reprocessed and recompacted.

Lift Thickness and Processing:
If at any time the CQA Monitor observes an uncompacted lift thickness in excess of eight inches or observes material being placed without meeting the requirements for processing, stockpiling and curing, the Contractor shall immediately discontinue placing additional fills in that area. For an over thick lift, the Contractor shall immediately blade the surface to reduce the lift thickness to the Project Specifications prior to compaction. If inadequately mixed materials are placed, the Contractor shall immediately remove these materials and return them to the stockpile/processing area where they will be reprocessed.

3.4.6.4 Geomembrane Subgrade

The CQA Monitor and the geomembrane installation Contractor will observe and approve the geomembrane subgrade prior to geosynthetic material deployment. The finish surface shall be free of abrupt breaks, sharp objects, or other foreign material which may damage the overlying geomembrane. The subgrade shall be unyielding, smooth and uniform and the surface shall not be pebbly or tracked and rutted by equipment.

Immediately prior to geomembrane deployment, all sub grade surfaces (i.e., liner floor and slopes), will be proof-rolled with a steel drum roller weighting not less than 200 pounds per lineal inch of drum width. Geomembrane deployment shall not proceed until the surface has been approved by the CQA Monitor and accepted by the geomembrane installation Contractor.

3.4.7 LCRS Gravel

1. Review the Contractor's approved work plan of proposed methods to place the drainage aggregate above geosynthetics. Determine and note corrective action items if applicable.
2. The CQA Monitor must perform sieve analyses to verify that granular drainage materials are in compliance with material gradation requirements of the technical Specifications (Specifications Section F). Observe that grade control construction staking is performed prior to work.
3. Monitor placement operations to verify that underlying geosynthetics installations are not damaged during placement operations. Mark damaged geosynthetics and verify that the damage is repaired.
4. Document material thickness during placement operations by occasionally digging test holes and checking thickness against grade control stakes.
5. Coordinate with the Construction Subcontractor and Construction Subcontractor's surveyor for the performance of verification surveys of the primary collection layer and trench upon completion of placement operations. Verify corrective action measures as determined by the verification surveys. Verification surveys will also be used to determine the limits of the trenches for measurement and payment applications. Submit copy of verification to the Construction Manager.

3.4.8 Protective Cover Soil

1. Monitor that material source is suitable for the cover soil layer as defined in the material gradation and permeability requirements of the technical Specifications.

2. Monitor that grade control construction staking is performed before work.
3. Verify that the protective cover soil layer is placed in a manner that does not damage underlying drainage layer and geosynthetic installations see specification section B and D.
4. The CQA Monitor must perform moisture-density relationship testing to determine the maximum dry density and optimum moisture content of protective layer materials.
5. The CQA Monitor must perform nuclear moisture-density tests on the upper 12" to document that each lift is compacted to the specified minimum percent of the maximum dry density as described in specification Section B.
6. Prior to construction of each successive layer of the liner, the Construction Subcontractor shall submit a point over point survey to verify the thickness of the in-place soil layers.
7. Coordinate with the Construction Subcontractor and Construction Subcontractor's surveyor for the performance of cover soil layer verification surveys upon completion of placement operations. Verify corrective action measures as determined by the verification surveys. Verification surveys will also be used to determine the limits of the subgrade and cover soil layer for measurement and payment applications. Submit copy of verification surveys to the Construction Manager.

3.4.9 Trenching and Backfilling

1. Monitor that construction staking is performed before work and that survey bench marks with elevations are secured outside the work area.
2. Monitor that trenches are excavated in accordance with the dimensional cross-sections and design elevations shown on the Drawings.
3. Monitor profile surveys conducted by the Contractor during trenching operations.
4. Perform moisture-density relationship testing to determine the maximum dry density and optimum moisture content of earthfill materials that will be used as backfill.
5. Perform nuclear density-moisture tests to verify that backfill materials are moisture conditioned and compacted to a minimum of 90 percent relative density and that the moisture content is ±2 percent of the optimum moisture content per Specifications.

4.0 CONSTRUCTION QUALITY ASSURANCE FOR GEOSYNTHETICS

4.1 General

The objectives of the geosynthetics CQA program are to assure that: (i) proper construction techniques and procedures are used; and (ii) the project is completed in accordance with the project construction drawings and technical specifications.

The intent of the CQA program is to: (i) identify and define problems that may occur during construction; and (ii) document that these problems are corrected before construction is complete.

This section describes CQA procedures for the installation of the geosynthetic components of the capping system. The following types of geosynthetics will be utilized for this project:

1. 60-mil textured HDPE geomembrane
2. Nonwoven Geotextile
3. Geosynthetic Clay Liner

CQA for the geosynthetics installations will be performed to monitor that geosynthetics are installed in accordance with the design drawings and project specifications. To monitor compliance, the CQA Officer will: (i) review the Manufacturers' quality control submittals; (ii) perform material conformance testing; (iii) monitor construction testing; and, (iv) monitor installations. Conformance testing refers to activities that take place before geosynthetics installation. Construction testing includes activities that occur during geosynthetics installation.

All CQA testing will be conducted in accordance with this CQA Plan, and the project construction drawings and specifications. If any discrepancy exists in the testing requirements, the document that requires the most stringent testing will govern.

4.2 Geomembrane

4.2.1 Geomembrane Delivery

Delivery of geomembrane to the site will not be permitted until all required documentation and/or certifications are approved by the CM/Geotechnical CQA Team. It is the responsibility of the Contractor/Subcontractor to ensure that all required documentation and/or certifications are approved prior to shipment. Prior to delivery, all individual roll manufacturer certifications required by this document and/or the Project Specifications must be received and approved by the Construction Manager. Delivery of any unapproved roll will not be allowed and unapproved rolls will be transported off-site at the Contractors expense.

Prior to the delivery of any geosynthetic material, the Liner Manufacturer shall provide the Construction Manager with the following:

1. A properties sheet for the rolls to be delivered including all specified properties measured using test methods indicated in the specifications.
2. The sampling procedure and results of testing.
3. A certification for each roll stating that property values given in the properties sheet are guaranteed by the Liner Manufacturer.

The Geotechnical CQA Manager shall verify that:

1. The property values certified by the Liner Manufacturer meet the project specifications.
2. The measurements of properties by the Liner Manufacturer are properly documented and that the test methods used are acceptable.

Prior to shipment, the Liner Manufacturer shall provide the Construction Manager with a quality control certificate for each roll of geomembrane. The quality control certificate(s) shall be signed by a responsible person employed by the Liner Manufacturer and shall include:

1. Lot and roll numbers and identification.
2. Sampling procedures and results of quality control tests. At a minimum, results shall be given for those properties identified in the Project Specifications.

The Geotechnical CQA Manager shall:

1. Verify that the quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it.
2. Review the quality control certificates and verify that the certified roll properties meet the specifications.

Upon delivery of geomembrane, the CQA monitor will:

1. Examine all geomembrane rolls for damage during shipping and handling. Identify damaged materials and document that damaged materials are set aside.
2. Observe that the geomembrane is stored in accordance with the specifications and is protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasion, excessive heat, direct sunlight, or other damage.
3. Document that all manufacturing certifications required by the specifications has been received.
4. Complete the geosynthetics receipt log form for all geomembrane materials received.

Damaged geomembrane may be rejected. If rejected, document that the material is removed from the site or stored at a location separate from accepted geomembrane. Geomembrane that does not have proper manufacturer's documentation must be stored at a separate location, until all documentation has been received, reviewed and accepted.

4.2.1.1 Transportation and Handling

All transportation and on-site handling of the geomembrane is the responsibility of the Contractor and Liner Subcontractor. The Geotechnical CQA Manager shall observe the

handling equipment used on the site and provide comment on whether it poses any risk of damage to the geomembrane. The Geotechnical CQA Manager will also observe the Contractor and Liner Subcontractor personnel's handling of the geomembrane and provide comment on whether appropriate care is being taken. Finally, the Geotechnical CQA monitor shall verify that all documentation required upon delivery has been received.

Upon delivery at the site, the Contractor, Liner Subcontractor and the Geotechnical CQA Monitor shall complete a surface observation of all rolls for defects and damage. This inspection shall be conducted without unrolling rolls unless defects or damage are found or suspected. The Geotechnical CQA Manager shall report the following to the Construction Manager:

1. Rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws.
2. Rolls which visually include minor repairable flaws.

Any damaged rolls shall be rejected and removed from the site or be stored at a location separate from accepted rolls as designated by the Construction Manager. All rolls which do not have proper Liner Manufacturer's documentation shall be removed from the site at the Contractors expense until all required documentation has been received and approved. A log of all HDPE received shall be maintained by the Geotechnical CQA Monitors as shown on Form B-1 attached.

4.2.1.2 Geomembrane Storage

The Contractor and Liner Subcontractor shall be responsible for storage of the HDPE onsite and shall ensure the storage is consistent with the Manufacturer's recommendations. The Contractor shall coordinate with the City to ensure that storage space is provided in a location (or several locations) such that on-site transportation and handling are minimized. Storage space shall be protected by the Contractor and Liner Subcontractor from theft, vandalism, and damage from actions of man, weather, animals and other sources. The Geotechnical CQA Monitors shall observe that the materials are not stored directly on the ground and storage of the HDPE is completed in a fashion that protects against damage.

4.2.2 Geomembrane Conformance Testing

Conformance testing shall be performed in accordance with Section D of the Specifications.

4.2.2.1 Tests

After delivery the CQA Monitor will obtain geomembrane conformance test samples in accordance with 3.6.1 of Specification Section D of the specifications and forward the samples to the testing laboratory.

Unless otherwise specified, conformance samples shall be taken and tested at a rate of one per lot or one per 50,000 square feet, whichever results in the greater number of tests. Testing for interface shear will be also conducted at a rate of one per 100,000 square feet.

Samples shall be taken across the entire width of the roll and shall not include the first three feet. Unless otherwise specified, samples shall be three (3) feet long by the roll width. The Geotechnical CQA Monitors shall mark the machine direction on the samples with an arrow, and the Liner Manufacturer's roll identification number.

The results of HDPE liner Conformance Testing will be documented on Form B-2 attached. The Geotechnical CQA Manager shall examine all conformance testing results and shall report any non-conformance to the Construction Manager, the Contractor and the Lining Subcontractor.

The Geotechnical CQA Manager shall examine all results from the laboratory conformance testing. All specimens tested shall pass. If any specimen fails, the entire sample shall be considered as a failure and rejected. In this event, the material represented by the sample shall be considered non-conformant to the Specifications, and corrective measures shall be implemented. Corrective measures shall include a rerun of the conformance testing using a portion of the same sample. If the second test passes, the Geotechnical CQA Manager may assume an error was made in the first test and the HDPE material can be accepted. If the second test fails, the Liner Subcontractor shall remove all material represented by the sample from the work area.

All conformance test results must be approved by the Construction Manager prior to the HDPE represented by the test being approved for deployment/installation. The decision of the Construction Manager shall be final.

4.2.3 Geomembrane Installation

4.2.3.1 Surface Preparation

The soil surface must be prepared in accordance with the technical specifications. Before geomembrane installation, the subgrade will be inspected by the CQA Officer and Geosynthetics Installer. The CQA Officer must monitor and document the following:

1. All lines and grades for the prepared soil surface have been verified by the Contractor;
2. The soil surface has been rolled and compacted to be free of surface irregularities, loose soil, and protrusions;
3. The soil surface is firm and does not contain stones or other objects that could damage the geomembrane;
4. The anchor trench dimensions have been checked, and the trenches are free of sharp objects and stones;
5. There are no excessively soft areas;
6. The soil surface is not saturated, and no standing water is present;
7. The soil surface has not become desiccated;
8. All construction stakes have been removed and there is no debris, rocks, or any other objects in or on the soil surface; and
9. The Geosynthetics Installer has certified in writing that the surface on which the geomembrane will be installed is acceptable.

The certificate of acceptance shall be given by the Liner Subcontractor to the Contractor and the Construction Manager prior to commencement of HDPE installation in the area under consideration. The Geotechnical CQA Monitors shall have a copy of this certificate before installation of HDPE commences in any given area.

After the supporting surface has been accepted by the Contractor and Liner Subcontractor, it shall be the Contractor and Liner Subcontractor's responsibility to indicate to the Construction Manager any change in the supporting soil condition that may require repair work. If the Construction Manager concurs with the Contractor and Liner Subcontractor, then the Construction Manager shall coordinate the repair of the supporting surface. The subject area will also be observed by the Geotechnical CQA Monitors who shall have the authority to reject an area even after it has been accepted by the Contractor and Liner Subcontractor.

4.2.3.2 Panel Placement

Before installing any of the geomembrane, the Installer shall submit geomembrane panel layout drawings in accordance with the technical specifications. The drawings shall show the proposed layout of the panels, including panel identification numbers, field seams, and any details that do not conform to the construction drawings.

The CQA Monitor will maintain an up to date panel layout drawing that shows, at least, the following: (i) roll numbers; (ii) panel numbers; (iii) seam numbers; (iv) test locations; (v) repair locations; and (vi) non-destructive testing information.

During panel placement operations, the CQA Monitor will:

1. Record panel numbers and dimensions on the panel/seam log. Panel numbers shall be written in large block letters in the center of each deployed panel. The roll number, date of deployment, and length (gross) should be noted below the panel number. All notes should be made, so that they are easily visible from a distance. On long panels it is beneficial to write information on both ends.
2. Observe the panel surface as it is deployed and record all panel defects and defect corrective actions (repair type and location) on the repair sheet. Verify that corrective actions are performed in accordance with the specifications.
3. Monitor that equipment used during deployment operations does not damage the geomembrane. Verify that equipment used on the geomembrane does not leak lubricants or other contaminants onto the Geomembrane. Verify that appropriate measures are taken to prevent leakage.
4. Verify that the surface beneath the geomembrane has not deteriorated since its previous acceptance. Verify that no stones, construction debris, or other items are beneath the geomembrane that could damage the geomembrane.
5. Monitor that the geomembrane is not dragged across an unprotected surface. If the geomembrane is dragged across an unprotected surface, the geomembrane must be inspected for scratches and repaired or rejected, if necessary.

6. Record weather conditions, including temperature, wind speed and direction, and humidity. Verify that the geomembrane is not deployed in the presence of excess moisture (fog, dew, mist, etc.). In addition, verify that the geomembrane is not placed when the air temperature is above 104^0 F, less than 40^0 F (unless appropriate, pre-approved measures for protection of the geomembrane are implemented), or when standing water or frost is on the ground.
7. Monitor the Geomembrane install to verify that the geomembrane is unrolled using methods that will not damage geomembrane and will protect underlying surface from damage.
8. Place temporary ballast, such as sandbags, on geomembrane that will not damage the geomembrane and to prevent wind uplift.
9. Monitor that crews working on the geomembrane do not smoke, wear shoes that could damage the liner, or otherwise engage in activities that could damage the geomembrane.
10. Monitor that methods used to deploy the geomembrane minimize wrinkles and that panels are properly anchored to prevent movement by the wind. Verify that the Contractor corrects any damage resulting to or from windblown geomembrane.
11. Monitor that only as many panels are deployed than can be seamed on the same day.
12. Do not allow heavy vehicular traffic directly on geomembrane. Rubber tired and tracked ATV's and equipment are acceptable if contact pressure is less than 5 psi (See 3.8 of Specification Section C). Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane. Prior to driving on any geomembrane layer, check for sharp edges, embedded rocks, or other foreign objects that may protrude from the tires and tracks. Path driven on geomembranes shall be as straight as possible with no sharp turns, sudden stops or quick starts. Areas where driving occurs shall be continuously and thoroughly inspected throughout the deployment process by the Contractor and the CQA.
13. The CQA monitor must inform both the Installer and the CQA Officer if any of the above conditions are not met.

4.2.3.3 Field Seaming

Each welder and welding apparatus shall be tested, in accordance with the specifications, to verify that the equipment is functioning properly. This testing shall be performed before the start of geomembrane welding but also periodically during welding operations. At least, one trial weld shall be taken before the start of work and one at mid-shift for each machine. Fusion or wedge welds will always be performed or conducted on samples at least 6 feet long. Extrusion welds will be done on samples at least three (3) feet long. The trial weld sample shall be 12-inches wide, with the seam centered lengthwise.

The CQA Monitor will observe all welding operations and verify that the Installer quantitatively tests each trial weld for peel adhesion (peel) and bonded seam strength (shear strength), in accordance with ASTM D 6392. The purpose of peel and shear tests is to evaluate seam strength. The results of the peel and shear tests will be recorded on the trial weld form. Trial welds must be completed under conditions that are the same as those under which the panels will be welded. Operating temperatures should be monitored while welding. The welding technician should verify that the equipment is capable of maintaining temperature

while welding. If at any time, the CQA Monitor believes that any welding apparatus is not functioning properly, another trial weld shall be performed. If there are wide changes in temperature, humidity, or wind speed during the course of the working day, the CQA Monitor may also require that another trial weld be performed. The trial weld must be allowed to cool to ambient temperature before it is tested.

Cut five 1-inch wide specimens form the trial weld sample using a 1-inch die cutter, so the peel values may be used for qualitative analysis. When cutting coupons from the trial weld samples, the inside and outside tracks on the coupon should be identified to assist in troubleshooting problems later in case the weld fails. The outside track will be defined as the track, which would be peeled if pulling the overlap exposed in a typical installation, or the seam that is closest to the edge of the top sheet. The inside track is the seam closest to the edge of the bottom sheet. Cut only one sample at a time to avoid damaging the die cutter. Samples should be free of sand and grit prior to cutting samples. Inspect the die edge weekly for nicks, dents, or signs of dullness. Remove die when edge has been dulled and lightly reshape it with a medium hand file, when wear is excessive return it for a replacement die. When the cutting board becomes deeply scored and/or interferes weight coupon cutting it should be replaced. To adjust the depth of the die cut into the cutting board, after replacing the cutting board or sharpening the die, 0.015 in washer shims can be added or removed between the cutting ram and the ram extension. Only add shims when cutting is difficult due to lack of depth of cut. Allow coupons to cool prior to testing. Avoid separating the coupon while the sheet is hot to avoid a failed test false reading.

During geomembrane welding operations, the CQA Monitor will:

1. Monitor that the Installer has the number of welding apparatuses and spare parts necessary to perform the work;
2. Monitor that equipment and procedures used for welding do not damage the geomembrane;
3. Monitor that extrusion welders are purged before beginning a weld so that all heat-degraded extrudate is removed from the nozzle of the welder;
4. Monitor that seam grinding is completed less than 1 hour (and preferably, immediately) before seam welding, and that the upper sheet is beveled (extrusion welding only);
5. Monitor that the ambient temperature measured 6 inches above the geomembrane surface is between 40^0 F and 104^0 F;
6. Monitor that the seam is properly heat tacked and abraded prior to extrusion welding.
7. Monitor that ends of extrusion welds that are more than five minutes old, are ground to expose new material before restarting a weld;
8. Monitor that contact surfaces of the panels are clean and free of dust, grease, dirt, debris and moisture before welding;
9. Monitor that welds are free of dust, rocks and other debris;
10. Monitor that cross seams are ground to a smooth incline before welding (fusion welding only);
11. Monitor that all seams are overlapped a minimum of 6 inches or in accordance with the Manufacturer's recommendations, whichever is greater;
12. Monitor that solvents or adhesives are not present in the seam area;

13. Monitor that procedures used to temporarily hold the panels together do not damage the panels and do not interfere with quality control testing;
14. Monitor that strips of geomembrane, wide enough and long enough to protect the hot wedge welder from running on the subgrade, are placed below the geomembrane. These strips may be as long as the seam itself or shorter and moved with the seaming equipment. If necessary, a firm material such as a flat board or similar hard surface may be placed directly under the weld overlap to achieve firm support;
15. Monitor that panels are being welded in accordance with the plans and specifications;
16. Monitor that seams are welded with fewest number of unmatched wrinkles or "fish-mouths";
17. Monitor that there is no free moisture in the weld area; and two (2) hours.

4.2.4 Construction Testing

4.2.4.1 Non-destructive Seam Testing

The purpose of non-destructive geomembrane testing is to detect discontinuities or holes in the seams. Non-destructive geomembrane quality control (QC) tests include vacuum testing and air pressure testing. Non-destructive testing must be performed over the entire length of every seam (i.e., 100% of all production seams for the project shall be non-destructively tested).

It is the Installer's responsibility to perform all non-destructive testing as part of his QC program. The CQA Monitor's responsibility is to observe and document that the Contractor's QC testing is in compliance with the specifications and to document seam defects and repairs. Testing shall continue until all seams have passed non-destructive testing.

Non-destructive testing procedures for vacuum testing (ASTM D5641) are described below:

1. Vacuum testing of welds shall only be carried out on extruded seams, including repairs, or whenever a proper test cannot be completed by other methods.
2. For welds tested by vacuum method, the weld is placed under suction utilizing a vacuum box constructed with rigid sides, a transparent top for viewing the seams, a neoprene rubber gasket attached to the bottom of the rigid sides, a vacuum gauge on the inside, and a valve assembly attached to a vacuum hose connection. The box is placed over a seam section which has been thoroughly saturated with a soapy water solution (1 ounce soap to 1 gallon water). The rubber gasket on the bottom of the box must fit snugly against the soaped seam section of the panel, to ensure a leak-tight seal.
3. A vacuum pump is energized and the vacuum box pressure reduced to approximately 5 psi gauge. Dwell time must not be less than 10 seconds. Any pinholes, porosity or non-bonded areas are detected by the appearance of soap bubbles in the vicinity of the defect. If bubbles are observed, mark the area of the leak for repair and repair in accordance with section 4.2.5.

Non-destructive testing procedures for air pressure testing are described below:

1. Air-pressure testing shall be performed on all double seam fusion welds.
2. Both ends of the air channel must be sealed. A pressure feed device, usually a needle equipped with a pressure gauge, is inserted into one end of the channel. Air is then pumped into the channel to a minimum pressure of 30 psi. The air chamber must sustain the pressure for 5 minutes without losing more than 3 psi. Following a passed pressure test, the opposite end of the tested seam must be punctured to release the air. The pressure gauge must return to zero; if not, a blockage is likely in the seam channel. Locate the blockage and test the seam on both sides of the blockage. The penetration holes must be sealed after testing.
3. If the test fails, follow these procedures:
    a. While channel is under pressure walk the length of the seam listening for a leak.
    b. While channel is under pressure apply a soapy solution to the seam edge and look for bubbles formed by air escaping.
    c. Re-test the seam in smaller increments until the leak is found.
4. Once the leak is found using one of the procedures above, cut out the area and retest the portions of the seams between the leak using the pressure test, continue this procedure until all sections of the seam pass the pressure test.
5. Repair the leak with a patch and vacuum test in accordance with section 4.2.5.

During non-destructive testing, the CQA Monitor will:

1. Review the technical specifications and this CQA Plan regarding test procedures;
2. Monitor that equipment operators are fully trained and qualified to perform their work;
3. Monitor that test equipment meets project specifications;
4. Monitor the entire length of each seam is tested in accordance with the specifications;
5. Observe all continuity testing and record results on the panel/seam log, and the panel layout drawing;
6. Monitor that all testing is completed in accordance with the project specifications;
7. Identify any failed areas, by marking the area with a waterproof marker compatible with geomembrane, inform the Contractor of any required repairs, and record the repair on the panel/seam log;
8. Monitor that all repairs are completed and tested in accordance with the project specifications; and
9. Record all completed and tested repairs on a repair sheet, and the panel layout drawing.

4.2.4.2 Destructive Seam Sampling Procedures and Field Testing

Destructive seam samples will be taken at intervals of at least one test per 500 lineal feet of geomembrane seam. However, additional samples will be taken if the CQA Monitor suspects that a seam does not meet the specification requirements. Reasons for taking additional samples may include, but are not limited to:

1. Wrinkling in seam area;
2. Excess crystallinity;
3. Suspect seaming equipment or techniques;

4. Weld contamination;
5. Insufficient overlap;
6. Adverse weather conditions; and
7. Failing tests.

The CQA Monitor selects the locations where seam samples will be cut for destructive laboratory testing as follows:

1. Testing frequency – Per Specification Section D. This is an average frequency for the entire installation; individual samples may be taken at greater or lesser intervals. The testing frequency will be increased if welding operations were conducted in temperatures below 40^0 F. This increase will be agreed upon by the Construction Manager, CQA Officer, and Contractor.
2. A maximum frequency must be agreed to by the Construction Manager, CQA Officer, and Contractor at the pre-construction meeting. However, if the number of failed samples exceeds 5 percent of the tested samples, this frequency may be increased at the sole discretion of the CQA Officer. Samples taken as the result of failed tests do not count toward the total number of required tests.

The CQA Monitor will not inform the Contractor in advance of selecting the destructive sample locations.

The Contractor shall remove specimens and samples at locations identified by the CQA Monitor and field test the specimens for peel and shear before the samples are shipped off-site for laboratory testing. During sampling procedures the CQA Monitor will:

1. Observe sample cutting;
2. Mark each specimen and sample with an identifying number which contains the seam number, destructive sample test number, welder, and date and time welded;
3. Record sample locations on the panel layout drawing and panel-seam logs; and
4. Record the sample locations, weather conditions, and reasons samples were taken (e.g., random sample, visual appearance, result of a previous failure) on the destructive seam test form.

At each location, obtain two seam specimens that are 44-inches apart. The specimens should be 1-inch wide and 12-inches long with the weld centered across the length of the specimen. The Contractor must test these samples to failure in the field using a tensiometer capable of quantitatively measuring shear and peel strengths. Peal and shear strengths shall meet or exceed the values in 3.4.2 of Specifications Section D. For double wedge welding, the Contractor shall test both welds. The CQA Monitor will observe the tests. Geomembrane seam specimens pass when the break is a ductile FTB. In addition, the seam strength must meet the specified values.

If one or both of the 1-inch specimens fails in either peel or shear, the Contractor can, at his discretion: (1) reconstruct the entire seam between two passed test locations; or (2) take another test sample 10 feet on side of the point of the failed test and repeat this procedure. If these tests pass, then the remaining seam sample portion shall be sent to the QC laboratory

for 5 shear strength and 5 peel adhesion tests in accordance with the QC laboratory's approved procedures, and the Contractor can either reconstruct or cap strip the seam between the two passed test locations. If subsequent tests fail, the sampling and testing procedure is repeated, until the length of the poor quality seam is established. Repeated failures indicate that either the seaming equipment is not performing properly or the operator is not performing properly, and appropriate corrective action must be taken immediately.

Once the field tests specimens have passed, a sample must be recovered for laboratory testing from between the passing field specimen locations. The sample must be 42-inches long and 12-inches wide, with the weld centered along the length of the sample. The sample must be divided into three equal sections: one section for the Contractor, one section for laboratory testing, and one section for the Owner to archive. Record the results of field testing on the destructive seam tests form, and the panel/seam log.

4.2.4.3 Third Party Laboratory Testing

All CQA destructive samples must be shipped to the designated CQA Testing Laboratory to verify seam quality. The laboratory will test five specimens from each sample in each method used. Minimum test values are presented in the Specifications Section D. The testing laboratory must provide verbal test results within 24 hours to the CQA Officer, written certified test results are to be provided within 5 days.

The CQA Officer will immediately notify the Construction Manager and Contractor in the event of failed test results.

If the laboratory test fails in either peel or shear, the Contractor must either reconstruct the entire seam, or recover additional samples at least 10 feet on either side of the failed sample for retesting. This process is repeated until passed tests bracket the failed seam section. All seams must be bounded by locations from which passing laboratory tests have been taken. Laboratory testing governs seam acceptance. In no case can field testing of repaired seams be used for final acceptance.

4.2.5 Repairs

Portions of geomembrane panels and seams that contain: (1) flaws; (2) destructive test cutouts; or (3) nondestructive test cuts or holes, must be repaired in accordance with the specifications. The CQA Monitor will locate and record all repairs on the repair sheet and panel layout drawing. The method of repair shall be subject to the approval of the CQA Monitor. Acceptable repair techniques include the following:

1. Patching: used to repair large holes, tears, large panel defects, undispersed raw materials, welds, contamination by foreign matter, and destructive sample locations. ;
2. Extrusion: used to repair small defects in the panels and seams. In general, this procedure may be used only for defects less than 0.25-inches in the largest dimension;
3. Capping: used to repair failed welds or to cover seams where welds cannot be nondestructively tested; and

4. Removal: used to replace areas with large defects where preceding methods are not appropriate. Also used to remove excess material (wrinkles, fishmouths, intersections, etc.) from the installed geomembrane. Areas of removal shall be patched or capped.

Repair procedures include the following:

1. Abrade geomembrane surfaces to be repaired (extrusion welds only) no more than 1 hour before the repair.
2. Clean and dry all surfaces at the time of repair.
3. Monitor acceptance of the repair procedures, materials and techniques by the CQA monitor in advance of the specific repair.
4. Extend patches or caps at least 6 inches beyond the edge of the defect, and round all corners of material to be patched and the patches to a radius of at least 3 inches. Bevel the top edges of patches before extrusion welding.

Repairs shall be non-destructively tested.

4.2.6 Wrinkles

During placement of materials over the geomembrane, temperature changes or creep may cause wrinkles to develop in the geomembrane. Any wrinkles which can fold over must be repaired either by cutting out excess material or, if possible, by allowing the geomembrane to contract by temperature reduction. In no case can material be placed over the geomembrane which could result in the geomembrane folding. The CQA Monitor must monitor geomembrane for wrinkles and notify the CQA Officer and Contractor in the event that wrinkles are being covered by soil. The CQA Monitor is then responsible for documenting corrective action to remove the wrinkles.

4.2.7 Folded Material

All folded geomembrane must be removed or smoothed out to the satisfaction of the CQA Officer.

4.2.8 Geomembrane Anchor Trench

Anchor trenches shall be excavated to the lines and widths shown on the Project Drawings, prior to HDPE placement. The Geotechnical CQA Monitors shall observe that the anchor trenches have been constructed according to the project documents.

Slightly rounded corners shall be provided where the HDPE adjoins the trench so as to avoid sharp bends in the HDPE. No loose soil shall be allowed to underlie the HDPE in the anchor trench.

The geomembrane anchor trench should be left open until seaming is completed. Expansion and contraction of the geomembrane should be accounted for in the liner placement. The anchor trench should be backfilled in the morning when temperatures are coolest to reduce

bridging of the geomembrane. Trench and backfill material shall be placed and compacted per the Specifications.

Anchor trench backfill shall be compacted to at least 90 % relative compaction (ASTM D 1557) as outlined in the Specifications.

Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane. If damage occurs, it shall be repaired prior to backfilling.

4.2.9 Geomembrane Acceptance

The Contractor retains all ownership and responsibility for the geomembrane until acceptance by the owner. In the event the Contractor is responsible for placing cover over the geomembrane, the Contractor retains all ownership and responsibility for the geomembrane until all required documentation is complete and the cover material is placed. After panels are placed, seamed, tested successfully and repairs made, the completed installation will be walked by the CQA Monitor and Contractor. Any damage or defect found during this inspection will be repaired promptly and properly by the Contractor. The installation will not be accepted until it meets the requirements of both parties. In addition, the geomembrane will be recommended for acceptance by the CQA Monitor only when the following have been completed:

1. The installation is finished.
2. All seams have been inspected and verified to be acceptable, and all required laboratory and field tests have been completed, reviewed, and accepted.
3. All required Contractor-supplied documentation has been received, reviewed, and accepted.
4. All Contractor-provided as-built record drawings have been completed and verified by the CQA Monitor to show the true panel dimensions, panel numbers, locations of seams, destructive testing, trenches, pipes, appurtenances, and repairs.

4.3 Geotextiles

The Contractor/Liner Manufacturer shall provide the Construction Manager with the following documentation:

1. A properties sheet which includes all specified properties measured using test methods indicated in the specifications.
2. A description of the sampling procedure and appropriate test results.
3. A certification that values given in the properties sheet are guaranteed by the Liner Manufacturer.

The Geotechnical CQA Manager shall verify that:

1. The property values certified by the Liner Manufacturer meet or exceed the project specifications.

2. The measurement of properties by the Liner Manufacturer are properly documented and the test methods used are acceptable.

Prior to shipment, the Contractor/Liner Manufacturer shall provide the Construction Manager with a quality control certificate for each roll of geotextile. The quality control certificate shall be signed by a responsible person employed by the Liner Manufacturer, and shall include roll number and identification.

The Geotechnical CQA Manager shall:

1. Verify that the quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls to be delivered.
2. Review the quality control certificates and verify that the certified roll properties meet the project specifications.

4.3.1 Delivery

The Contractor/Liner Subcontractor shall submit for approval by the Construction Manager, method(s) for handling and storage of geotextile material(s) prior to installation. During delivery of geotextiles, the CQA Monitor will:

1. Monitor that equipment used to unload the rolls does not damage the geotextile.
2. Monitor that rolls are wrapped in impermeable and opaque protective covers.
3. Monitor that care is used to unload the rolls.
4. Monitor that all documentation required by the specifications has been received.
5. Monitor that each roll is marked or tagged with the following information: Manufacturer's name; project identification; lot number; roll number; roll dimensions. Log this information on the geosynthetic receipt form.
6. Monitor that the geosynthetic receipt form is completed.
7. Monitor that materials are stored in a location that will protect the rolls from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.

Any damaged rolls may be rejected. The CQA Monitor shall ensure that rejected material is removed from the site and stored at a location separate from accepted rolls. Geotextile rolls which do not have proper manufacturer's documentation must also be stored at a separate location, until all documentation has been received and approved.

Upon delivery at the site, the Geotechnical CQA Monitors shall conduct a surface inspection of all rolls for defects and damage. This inspection shall be conducted without unrolling rolls unless defects or damage are found or suspected. The Geotechnical CQA Monitors shall indicate to the Geotechnical CQA Manager any rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws.

Any damaged rolls shall be rejected and removed from the site or stored at a location, designated by the Construction Manager separate from accepted rolls. All rolls which do not have proper documentation from the manufacturer shall also be stored at a separate location

until all documentation has been received and approved. A log of the geotextile material(s) received shall be maintained by the Geotechnical CQA Monitors as shown on Form B-9 attached.

The Construction Manager shall designate storage space in a location (or several locations) on-site. Storage space shall be protected by the Contractor from theft, vandalism, damage from the actions of man, weather, animals and other sources. The Geotechnical CQA Monitors shall observe that the material is not stored directly on the ground and that storage of the geotextile provides protection against damage pursuant to ASTM D4873.

4.3.2 Geotextile Conformance Testing

Upon delivery of the geotextile, the Geotechnical CQA Monitor shall ensure that samples are obtained and forwarded to an Independent Laboratory for testing of conformance with the design specifications. As a minimum, the tests in Section 3.5.1 of Specification Section E will be performed to ensure that geotextile materials are in conformance with the design specifications.

Where optional procedures are noted in the test method, the requirements of the Specifications shall prevail. Updated or alternative ASTM Test Methods may be used to determine the physical properties of the geotextile materials at the discretion of the Construction Manager.

The results of Conformance Testing will be documented by the Geotechnical CQA Manager as shown on Form B-10 attached.

Samples shall be taken across the entire width of the roll and shall not include the first three feet. Unless otherwise specified, samples shall be three feet long by the roll width. The Geotechnical CQA Monitor shall mark the machine direction on the samples with an arrow, and the Manufacturer's roll identification number.

Unless otherwise specified, samples shall be taken at a rate of one per lot or one per 50,000 square feet, whichever results in the greater number of samples.

The Geotechnical CQA Manager shall examine all results from the laboratory conformance testing. All specimens tested shall pass. If any specimen fails, the entire sample shall be considered as a failure and rejected. In this event, the geotextile material represented by the sample shall be considered nonconforming with the Specifications, and corrective measures shall be implemented. Corrective measures shall include a rerun of the conformance testing using a portion of the same sample. If the second test passes, the Geotechnical CQA Manager may assume an error was made in the first test and the geotextile material can be accepted. If the second test fails, the Contractor/Liner Subcontractor shall remove all material represented by the sample from the work area. The decision of the Construction Manager shall be final.

4.3.3 Geotextile Installation

4.3.3.1 Surface Preparation

Before geotextile installation, the CQA Monitor will:

1. Monitor that all lines and grades have been verified by the Contractor.
2. Monitor that the subgrade has been prepared in accordance with the earthwork specifications, and, if placed over a geomembrane, the geomembrane installation, and all associated documentation, has been completed.
3. Monitor that the underlying soil or geomembrane surfaces do not contain stones that could damage the geotextile, or any overlying geomembrane.
4. Monitor that there are no excessively soft areas in soil surfaces that could damage that geotextile, or any overlying geomembrane.
5. Monitor that the underlying granular drainage material has been placed to the required thickness.
6. All construction stakes have been removed.
7. The Contractor/Liner Subcontractor has certified in writing that the surface on which the geotextile will be installed is acceptable.

4.3.3.2 Geotextile Placement and Seaming

The Contractor/Subcontractor shall give each geotextile panel an identification number which shall be agreed to and used by the Geotechnical CQA Monitors and the Contractor/Liner Subcontractor. The Geotechnical CQA Monitor shall establish a chart showing correspondence between roll numbers, certification reports, and panel numbers as shown on Form B-11 attached.

During geotextile placement and seaming operations, the CQA Monitor will:

1. Observe the geotextile as it is deployed and record all defects and defect corrective actions (panel rejected, patch installed, etc.). Verify that corrective actions are performed in accordance with the specifications.
2. Monitor that equipment used does not damage the geotextile by handling, equipment transit, leakage of hydrocarbons, or other means.
3. Monitor that crews working on the geotextile do not smoke, wear shoes that could damage the geotextile, or engage in activities that could damage the geotextile.
4. Monitor that the geotextile is securely anchored in an anchor trench and is temporarily anchored to prevent movement by the wind.
5. Monitor that adjacent panels are overlapped and seamed in accordance with the specifications.
6. Monitor that the geotextile was not exposed to direct sunlight for more than 5 days.
7. Examine the geotextile after installation to ensure that no potentially harmful foreign objects are present.
8. The CQA monitor must inform both the CQA Officer and Contractor if the above conditions are not met.

The Contractor/Liner Subcontractor shall provide the Construction Manager with a panel layout plan, and shall update this plan daily as the job proceeds. No geotextile shall be placed

until the panel layout plan has been approved by the Construction Manager. During geotextile placement, the Geotechnical CQA Monitors shall observe that:

1. The geotextile is cut only with an approved geotextile cutter, and is not torn or ripped.
2. The thread and sewing machinery meet the Project requirements (if sewing is the elected method of joining panels).
3. The panels are being overlapped or joined in accordance with the Project Plans and Specifications.
4. Any roll of geotextile with a tear exceeding 10 % of roll width is removed and replaced.

4.3.4 Repairs

Any necessary repairs to the geotextile shall be made with the geotextile material itself, using approved overlaps or sewing systems, equipment and techniques. The patch size shall be 18 inches or larger in all directions than the area to be patched and all corners shall be rounded.

Repair procedures include:

1. Patching: used to repair large holes, tears, and small defective areas.

Removal: used to replace large defective areas where the preceding method is not appropriate.

4.4 Geosynthetic Clay Liner (GCL)

The Contractor/Liner Manufacturer shall provide the Construction Manager with the following documentation:

1. A properties sheet which includes all specified properties measured using test methods indicated in specification Section C, Table 2.4.1.
2. A description of the sampling procedure and appropriate test results.
3. A certification that values given in the properties sheet are guaranteed by the Manufacturer.

The CQA Officer shall monitor:

1. The property values certified by the Manufacturer meet or exceed the project specifications.
2. The measurement of properties by the Manufacturer are properly documented and the test methods used are acceptable.

Prior to shipment, the Contractor/Liner Manufacturer shall provide the Construction Manager with a quality control certificate for each roll of geocomposite. The quality control certificate shall be signed by a responsible person employed by the Liner Manufacturer, and shall include roll number and identification.

The Geotechnical CQA Manager shall:

1. Verify that the quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls to be delivered.
2. Review the quality control certificates and verify that the certified roll properties meet the project specifications.

4.4.1 Delivery

During delivery of the geocomposite, the CQA Monitor will:

1. Monitor that equipment used to unload the rolls does not damage the GCL material.
2. Monitor that rolls are wrapped in impermeable and opaque protective covers.
3. Monitor that care is used to unload the rolls.
4. Monitor that all documentation required by the specifications has been received.
5. Monitor that each roll is marked or tagged with the following information: Manufacturer's name; project identification; lot number; roll number; roll dimensions. Log this information on the geosynthetic receipt form.
6. Monitor that the geosynthetic receipt form is completed.
7. Monitor that materials are stored in a location that will protect the rolls from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.

Any damaged rolls may be rejected. The CQA Monitor shall ensure that rejected material is removed from the site and stored at a location separate from accepted rolls. GCL rolls which do not have proper Manufacturer's documentation must also be stored at a separate location, until all documentation has been received and approved.

The Construction Manager shall designate storage space in a location (or several locations) on-site. Storage space shall be protected by the Contractor from theft, vandalism, damage from the actions of man, weather, animals and other sources. The CQA Monitors shall monitor that the material is not stored directly on the ground and that storage of the geocomposite provides protection against damage pursuant to ASTM D4873.

4.4.2 Conformance Testing

After delivery, unless otherwise specified, the CQA Monitor shall obtain samples for conformance testing shall be performed in accordance with specification Section C, Article 3.9 of the specifications.

4.4.2.1 Tests

After delivery, the CQA Monitor will obtain composite conformance test samples in accordance with specification Section C-3.9 of the specifications of the specifications and forward the samples to the testing laboratory.

The CQA Officer will review all test results and report any non-conformance to the Construction Manager.

4.4.2.2 Sampling Procedure

Samples shall be obtained across the entire roll width and shall not include the first three feet. Unless otherwise specified, samples shall be three feet long by the roll width. Unless otherwise specified, samples shall be 3-feet-long by the roll width. On each sample, the CQA Monitor shall mark the machine direction, the manufacturer's roll identification number, and the date the sample was obtained. Any roll that cannot be identified shall be rejected by the CQA Monitor.

Sampling frequencies are in Specification Section C- 3.9

4.4.2.3 Test Results

The Geotechnical CQA Manager shall examine all results from the laboratory conformance testing. All specimens tested shall pass. If any specimen fails, the entire sample shall be considered as a failure ad rejected. In this event, the geocomposite material represented by the sample shall be considered nonconforming with the Specifications and corrective measures shall be implemented.

A conformance sample that yields any tested property less than the specified average minimum roll property will be recorded as a failure and GCL rolls in the lot represented by that conformance sample will be rejected for use on the project. At the GEOSYNTHETICS CONTRACTOR's option, additional conformance samples representing that lot may be tested to evaluate the physical properties of other rolls within the lot and to isolate the non-conformant materials. If only one conformance test fails, the roll that yielded the failure will be rejected and subsequent conformance samples from the same 40,000 or 100,000 square feet or lot will be obtained. If subsequent conformance samples fail the entire lot or 100,000 square feet represented by the test will be rejected for use on the project. If subsequent conformance tests pass, only the rolls which yielded a failure will be rejected for use on the project.

The Contractor/Liner Subcontractor shall remove all rejected material. The decision of the Construction Manager shall be final.

4.4.2.4 Non-Destructive Seam Testing

Non-destructive testing of the GCL seams shall be performed in accordance with "GRI GCL8: IN-SITU TENSILE STRENGTH VERIFICATION GCL SEAMS" at five locations along each

longitudinal panel seam, using a shear force equal to 50% of the GCL's specified tensile strength. The shear force to be applied, along with other aspects of this testing program, may be adjusted by the design engineer in the course of project.

This testing is to be conducted by the geosynthetic installation contractor, observed by the CQA consultant, and results are to be recorded in the panel deployment logs.

4.4.3 GCL Installation

4.4.3.1 Surface Preparation

Before GCL installation, the CQA Monitor will verify that:

1. All lines and grades have been verified by a qualified licensed surveyor.
2. All required testing on the underlying geomembrane have been performed and passing results have been achieved.
3. All documentation for the underling geomembrane has been completed.

4.4.3.2 GCL Placement and Seaming

The Contractor/Subcontractor shall give each GCL panel an identification number which shall be agreed to and used by the Geotechnical CQA Monitors and the Contractor/Liner Subcontractor. The Geotechnical CQA Monitor shall establish a chart showing correspondence between roll numbers, certification reports, and panel numbers.

During GCL panel placement, the CQA Monitor shall:

1. Observe the underlying surface for entrapped particles that may impact the GCL.
2. Observe the surface of the GCL for needles, punctures, tearing, thinning, or other evidence that the material may not meet specification requirements.
3. Inspect GCL for evidence of premature hydration, such as wet areas or swelling. Hydrated areas shall be removed and replaced with dry material.
4. Verify that equipment used in deployment does not damage the GCL.
5. Verify that GCL panels are deployed down, not across slopes.
6. Verify that GCL panels deployed will be covered the same day. GCL must be inspected and approved by CQA Monitor before covering.
7. Verify that the GCL is placed with the correct sides facing up and down as required by Section C of the Specifications.
8. Verify that adequate anchor trenches are constructed on slopes.

The CQA Monitor shall inform the Installer and the Project Manager if the above conditions are not met.

The Contractor/Liner Subcontractor shall provide the Construction Manager with a panel layout plan, and shall update this plan daily as the job proceeds. No GCL shall be placed until the panel layout plan has been approved by the Construction Manager. During GCL placement, the Geotechnical CQA Monitors shall observe that:

1. Monitor that the GCL is cut only with an approved cutter, and is not torn or ripped.
2. GCL seaming equipment meet the Project requirements.
3. Monitor that the panels are being overlapped or joined in accordance with the Project Plans and Specifications.
4. Monitor that any damaged roll of geocomposite is removed and replaced.
5. No horizontal seams are allowed on the slopes.

During GCL Placement, the CQA Monitor shall verify that:

1. The panels are overlapped a minimum of 12-inches along the width.
2. Bentonite is applied at the specified rate (if required).

The CQA Monitor must inform both the CQA Officer and Contractor if the above conditions are not met.

4.4.4 Cover Soil Placement

Prior to placement of a cover soil, a Certification of Acceptance must be signed by the responsible party and an installer's representative.

4.4.5 Repairs

Any portion of the GCL with a flaw shall be repaired consistent with Section C-2.6 of Specifications. The CQA Monitor shall verify that:

1. All punctured, torn, or hydrated material is removed.
2. The GCL "patch" is placed with the same side up as the originally placed material.
3. The patch overlaps the repair area a minimum of 12-inches in all directions.
4. The patch is secured in-place using adhesive tape, if necessary.
5. Bentonite is applied (if required).

4.4.6 Final Moisture Verification

The monitor shall verify that the moisture content of the GCL does not exceed a prescribed maximum allowable value on the day it is covered with a geomembrane. The frequency shall be at least one sample per acre or one sample per day, whichever is greater.

5.0 CONSTRUCTION QUALITY ASSURANCE FOR PE PIPE

5.1 General

This section describes CQA procedures for polyethylene (PE) pipe installations in the leachate collection and subdrain layer. Perforated and solid PE pipe will be utilized to construct the subdrainage system.

CQA for the PE pipe installations will be performed to verify that PE pipe systems are installed in accordance with the design. Construction must be conducted in accordance with the project construction drawings and specifications. To monitor compliance, the CQA program will: (1) review the contractor's quality control submittals; (2) monitor construction testing; and (3) monitor installations.

All construction testing will be conducted in accordance with the project technical specifications.

5.2 Construction Monitoring

The following sections list monitoring requirements during PE pipe operations.

5.2.1 Delivery

1. Monitor that chains, end hooks, cable slings, or any other devices that may scar the pipe are not used to handle pipe. Wide nylon web slings are recommended to handle the pipe.
2. Monitor that the pipe is not damaged during handling operations and that damaged pipe is separated from accepted pipe.
3. Monitor that pipe out-of-roundness will not occur due to excessive stacking heights when the pipe is stored at the site.
4. Monitor that the pipe is not damaged by sharp rocks or excessive abrasion when the pipe is pulled into place during fusion welding and installation operations.
5. The inside of pipes and fittings shall be free of dirt and debris.
6. PE pipe shall conform to properties in specification Section F. The Contractor shall submit two (2) samples of each type of piping proposed for use. The submittal shall also include manufacturer's catalog cut sheets, manufacturer's quality control test results, recommended methods of jointing, and a Certificate of Compliance for each class of pipe.

5.2.2 Fusion Welding

1. Before pipe fusion welding operations and installations verify that perforated pipe, fittings, and flanged couplings comply with product requirements of the technical specifications.
2. Monitor that certified fusion welding operators will be performing the welding.

3. Monitor that caution is taken to prevent water from coming in contact with the pipe and heater plates during welding operations. A shelter may be required for the fusion welding machine to allow operations to continue in adverse weather conditions.
4. Monitor that heater plate surface temperatures are maintained between 375 degrees Fahrenheit and 400 degrees Fahrenheit for both coated plates and uncoated plates. Monitor that operator checks heater plate surface temperatures with pyrometer.
5. Monitor that inside and outside of pipe ends are cleaned to remove dirt, water, grease, and other foreign material.
6. Monitor that pipe ends are squarely faced with the facing tool of the fusion welding machine.
7. Monitor that pipe ends line up in the fusion welding machine and that the pipe ends meet squarely and completely over the entire surface to be welded. Monitor at this point that the pipe is securely clamped into place so that the pipe does not move during the fusion welding process.
8. Monitor that the heater plate is clean and maintains the appropriate temperature. Monitor that the heater plate is inserted between the aligned pipe ends and that the pipe ends are firmly brought into contact with the heater plate. NO PRESSURE should be applied to achieve the melt pattern.
9. Monitor that the pipe ends are allowed to heat and soften. As the pipe heats and softens a melt bead begins to roll back from the contact point of the heater plate and the pipe ends.
10. Monitor that the heater plate is removed quickly and cleanly when the appropriate melt bead is achieved and that no melted pipe material sticks to the heater plate. If melted material sticks to the heater plate, Monitor that this joint is discontinued, the heater plate is cleaned, the pipe ends are re-faced, and that the joint is re-started.
11. Monitor that the melted pipe ends are rapidly joined together and that enough pressure is applied to the joint to form a melt bead 1/8-inch to 3/16-inch in diameter around the entire circumference of the pipe. Pressure is critical to cause the heated material of each pipe end to flow together.
12. Monitor that the joint is allowed to cool and solidify properly before the pipe is released from the fusion welding machine. Cooling and solidification is completed when your finger can remain comfortably on the bead.
13. Examine the joint when the pipe is released from the fusion welding machine to verify that the weld is completely around the entire circumference of the pipe.

5.2.3 Slip Joints

Monitor that all joints extend to the minimum overlap and comply with the requirements of the Specifications. Monitor that there is a snug fit with zero air gaps surrounding the connection.

6.0 DOCUMENTATION

The CQA Plan depends on thorough monitoring and documentation of all construction activities. Therefore, the CQA Officer will document that all quality assurance requirements have been addressed and satisfied. Documentation will consist of daily record keeping, testing and installation reports, non-conformance reports (if necessary), progress reports, photographic records, design and specification revisions, and a construction report. Sample forms for documentation are included at the end of this section.

6.1 Daily Record Keeping

At a minimum, daily records will consist of a daily record of construction progress, daily construction report, observation and test data sheets, and, as needed, non-conformance/corrective measure reports. All forms will have peer review.

6.1.1 Daily Record of Construction Progress

The Daily Field Report will summarize ongoing construction and discussions with the Contractor and will be prepared by the CQA Officer and CQA Monitors. At a minimum, the report will include the following:

1. Date, project name, project number, and location.
2. A unique number for cross-referencing and document control.
3. Weather data.
4. A description of ongoing construction for the day in the area of the monitor's responsibility.
5. An inventory of equipment and personnel utilized by the Contractor.
6. Items of discussion and names of parties involved in discussions.
7. A brief description of tests and observations, identified as passing or failing, or, in the event of failure, a retest.
8. Areas of non-conformance/corrective actions, if any, (non-conformance/corrective action form to be attached).
9. Summary of materials received and quality documentation.
10. Follow-up information on previously reported problems or deficiencies.
11. Record of any site visitors.
12. Signature of CQA Officer or CQA monitor.
13. Signature of the peer reviewer.

6.1.2 Observation and Test Data Sheets

Observation and test data sheets should include the following information as is appropriate for the form being used.

1. Date, Project name, and location.
2. A unique number for cross-referencing and document control.
3. Weather data, as applicable.
4. A reduced scale site plan showing sample and test locations.

5. Test equipment calibrations, if applicable.
6. A summary of test results identified as passing, failing, or, in the event of a failed test, retest.
7. Completed calculations.
8. Signature of the CQA Officer or CQA monitor.
9. Signature of the peer reviewer.

6.1.3 Non-Conformance Reports

In the event of a non-conformance event, a non-conformance verification report form will be included with the daily report. Procedures for implementing and resolving any non-conformity to the contract are outlined in Section 2.5 of this CQA plan.

6.2 Weekly Progress Reports

The CQA Officer will prepare weekly progress reports summarizing construction and quality assurance activities. The weekly progress reports and photographs shall be emailed to Utah Department of Environmental Quality, Waste Management and Radiation Control on a weekly basis. The reports will contain, at a minimum, the following information:

1. The date, project name, and location.
2. A summary of work activities completed in the last week, and those expected to be performed in the next week.
3. A summary of deficiencies and/or defects, and resolutions.
4. Ongoing summary of changed and/or change orders to the work.
5. The signature of the CQA Officer.
6. On the fourth week of each month the report will include a summary on-site and third party laboratory test results.

6.3 Photographs

Construction activities will be photographed. Photographs will include any significant problems encountered and corrective actions, and will document the construction progress. The photographs will be identified by number, location, time, date, and photographer. The photographer should document the subject or the photograph, either on the back of the picture, or in a photograph log and sign the log.

6.4 Design and Specification Changes

Design and specification changes may be required during construction. Design and specification changes will only be made with written agreement of the Design Engineer, Owner, and Contractor. These changes will be made by change order to the contract. When change orders are issued, they will be prepared by the Construction Manager. All changes that affect the integrity of the liner system will require RWQCB staff approval. The Construction Manager will distribute change orders for signature and execution to the required parties.

6.5 Construction Report

At the completion of the project, the CQA Officer and CQA Certifying Engineer will submit a final construction report. This report will document that the work has been performed in compliance with the construction drawings and specifications. At a minimum, the report will contain:

1. A summary of all construction activities.
2. A summary of all laboratory and field test results.
3. Observation and test data sheets.
4. Sampling and testing location drawings.
5. A description of significant construction problems and the resolution of these problems.
6. A list of changes from the construction drawings and specifications and the justifications for these changes.
7. As-built record drawings.
8. A statement of compliance with the construction contract documents and design intent signed and stamped by the CQA Certifying Engineer, a Professional Engineer registered in the State of California.

The as-built record drawings will accurately locate the constructed location of all work items, including the location of piping, anchor trenches, etc. All surveying and base maps required for the development of the record drawings will be prepared by the Contractor. The CQA Officer must review and verify that as-built drawings are correct. As-built drawings will be included in the final CQA Certification Report.

PROMONTORY CLASS 1 LANDFILL
BOX ELDER COUNTY, UT

INVENTORY CHECKOUT LOG							DATE:
CONTRACT NO/PROJECT NO		CELL WORK AREA AND LOCATION					PROJECT NO.
CONTRACTOR		SUPERINTENDENT					CQA PERSONNEL
Roll Number	Product	CQA Personnel	Installer Personnel	Condition	Net Area of Damage	Net Area Accepted	Installer Comments/ Initials

PROMONTORY CLASS 1 LANDFILL
BOX ELDER COUNTY, UT

PANEL DEPLOYMENT LOG						DATE
CONTRACT NO/PROJECT NO			CELL WORK AREA AND LOCATION			PROJECT NO.
CONTRACTOR			SUPERINTENDENT			CQA PERSONNEL
Panel Number	Time	Roll Number	Final Length (Ft)	Width (Ft.)	Final Area (Sq. Ft.)	Comments

PROMONTORY CLASS 1 LANDFILL
BOX ELDER COUNTY, UTA

PANEL REPAIR LOG				DATE	
CONTRACT NO/PROJECT NO		CELL WORK AREA AND LOCATION		PROJECT NO.	
CONTRACTOR		SUPERINTENDENT		CQA PERSONNEL	
AM WEATHER	AM WIND L M H	PM WEATHER	PM WIND L M H	MIN TEMP (F)	MAX TEMP (F)

Panel No. Tech/Unit No.	Weld Rod No. Repair Area	Panel No. Tech/Unit No.	Weld Rod No. Repair Area	Panel No. Tech/Unit No.	Weld Rod No. Repair Area
Vac Test P F	Vac Test P F	Vac Test P F	Vac Test P F	Vac Test P F	Vac Test P F
Vac Test P F	Vac Test P F	Vac Test P F	Vac Test P F	Vac Test P F	Vac Test P F
Time	Total Area	Time	Total Area	Time	Total Area

TETRA TECH
BAS

PROMONTORY CLASS 1 LANDFILL
BOX ELDER COUNTY, UT

GEOMEMBRANE SEAM LOG

				DATE	
CONTRACT NO/PROJECT NO		CELL WORK AREA AND LOCATION		PROJECT NO.	
CONTRACTOR		SUPERINTENDENT		CQA PERSONNEL	
AM WEATHER	AM WIND L M H	PM WEATHER	PM WIND L M H	MIN TEMP (F)	MAX TEMP (F)

Seam Control No.		Overlap	Weld Type/ Rod #	Welding Tech	Welding Unit No.	Machine Temp	Machine Speed	Start Time	Stop Time	Seam Length	Air/ Vacuum Test		
											Start Time PSI	End Time PSI	Pass/Fail
													P F
													P F
													P F
													P F
													P F
													P F
													P F
													P F
													P F
													P F
													P F
													P F
													P F

TETRA TECH
BAS

DAILY FIELD REPORT

Report No.

Project Name: PROMONTORY CLASS 1 LANDFILL	**Project No.:**	
Technician:	Date: M T W Th F Sa Su	
Contractor:	Weather:	
Construction Equipment:		
Total Density Tests Passed:	Failed:	Corrected:

Observations:

Unusual Events:

Time of Arrival:	Technician's Signature:
Time of Departure:	Superintendant's Signature:

Distribution: White (KFM) - Yellow (Client/Agency) - Pink (Contractor)

Acceptance of Soil Subgrade for the Support of Geosynthetic Liner

Project: **Promontory Class 1 Landfill**
Box Elder County, Utah

Liner Installation Contractor:

Area to be Accepted: _____

_____

_____

_____

I, the undersigned, duly authorized representative of the Liner Installation Contractor, do hereby accept the soil subgrade surface for the support of the geosynthetic liner in the aforementioned area. I shall be responsible for maintaining its integrity and suitability, in accordance with the project specifications from this date to completion of the installation in this area. I do not accept any responsibility for the conditions or characteristics of the subsurface soil.

_____	_____	_____	_____
Name (Print)	Signature	Title	Date

Acknowledged by CQA monitor:

_____	_____	_____	_____
Name (Print)	Signature	Title	Date

TETRA TECH
BAS

PROMONTORY CLASS 1 LANDFILL
BOX ELDER COUNTY, UT

TRIAL SEAM LOG

				DATE	
CONTRACT NO/PROJECT NO		CELL WORK AREA AND LOCATION		PROJECT NO.	
CONTRACTOR		SUPERINTENDENT		CQA PERSONNEL	
AM WEATHER	AM WIND L M H	PM WEATHER	PM WIND L M H	MIN TEMP (F)	MAX TEMP (F)

Trial Seam Control No.	Time	Weld Type	Welding Tech	Welding Unit No.	Speed/ Preheat Temp	Machine Temp	Tests					Comments
							Peel Strength		Shear Strength		Lab Results	
											P F	
											P F	
											P F	
											P F	
											P F	
											P F	
											P F	
											P F	
											P F	
											P F	
											P F	
											P F	
											P F	

DAILY FIELD REPORT

Report No.

Project Name: PROMONTORY CLASS 1 LANDFILL	**Project No.:**
Technician:	Date: M T W Th F Sa Su
Contractor:	Weather:
Construction Equipment:	

Total Density Tests Passed:	Failed:	Corrected:

Observations:

Unusual Events:

Time of Arrival:	Technician's Signature:
Time of Departure:	Superintendant's Signature:

Distribution: White (KFM) - Yellow (Client/Agency) - Pink (Contractor)

APPENDIX G

CLOSURE AND POST-CLOSURE COST ESTIMATE

TABLE A
PROMONTORY LANDFILL LLC
PRELIMINARY CLOSURE COST ESTIMATE
PHASE 1A

Item No.	Description	Estimated Quantity		2016 Unit Price	Total
1	**FINAL COVER[1.0]**				
	Mobilization/Demobilization [1.1]	1	ls	$77,000	$77,000
	Preliminary Grading/Subgrade Preparation [1.2]	695,000	sf	$0.10	$69,500
	GCL (Deck)	216,068	sf	$0.75	$162,051
	40 MIL VFPE Liner (Deck)	216,068	sf	$0.80	$172,854
	Geocomposite (Deck)	216,068	sf	$0.65	$140,444
	Final Grading/Vegetative Cover 18" Thick (Deck)	216,068	sf	$0.30	$64,820
	Evapotranspirative Cover (Slopes)[1.3]	50,466	cy	$2.50	$126,164
	Settlement Monument Installation	3	ea	$500	$1,500
	Construction Survey	1	ls	$15,000	$15,000
				Item 1 Subtotal	**$829,333**
2	**FINAL COVER CONSTRUCTION QUALITY ASSURANCE [2.0]**				
	Monitoring, Inspecting, Testing and Reporting	16	ac	$7,500	$120,000
				Item 2 Subtotal	**$120,000**
3	**EROSION CONTROL (REVEGETATION) [3.0]**				
	Drill Seeding	5.0	ac	$2,000	$10,000
	Hydroseeding	11.0	ac	$2,000	$22,000
				Item 3 Subtotal	**$32,000**
4	**ENVIRONMENTAL CONTROL**				
	Monitoring and Control Systems [4.0]	-	-	-	$0
	Raise LFG Well Heads [4.1]	16	ea	$1,200	$19,200
	Synthetic Boots (Deck)	5	ea	$750	$3,720
				Item 4 Subtotal	**$22,920**
5	**DRAINAGE CONTROL SYSTEM**				
	Drainage Control System (incl. berms, downdrains, inlets, etc.) [5.0]	16	ac	$10,000	$160,000
				Item 5 Subtotal	**$160,000**
6	**STRUCTURE REMOVAL/ABANDONMENT**				
	Demolition-Scale House/Salvage Scales [6.0]	1	ls	$50,000	$50,000
	Decommissioning of Environmental Control System [6.1]	-	-	-	$0
				Item 6 Subtotal	**$50,000**
7	**CONSTRUCTION MANAGEMENT**				
	Construction Management [7.0]	16	ac	$10,000	$160,000
				Item 7 Subtotal	**$160,000**
				TOTAL PRELIMINARY CLOSURE COST	**$1,374,253**

Footnotes*:

1.0 Assumes all soil necessary for closure is stockpiled on site.

1.1 Includes necessary permits, health & safety plan, SWPPP, bid bond, office equipment, trailer, utilities, office support, general labor, and miscellaneous charges to be incurred by the contractor. Based on approximately 7% of total construction cost including final cover, gas system modification, drainage improvements and demo.

1.2 Includes: scarifying and recompacting the interim cover and subgrade preparation, assumes 1' of material is in place.

1.3 Evapotranspirative cover is based on a 4-foot thick cover section, volume of earthwork assumes 1-foot of cover is in place.

2.0 Based on the Final Cover CQA procedures included with the permit revision.

3.0 Assumes the usage of native plant species that exhibits low long-term maintenance needs, thus eliminating the need for an irrigation system.

4.0 No cost is included in this category because the gas monitoring system, groundwater monitoring system and leachate collection system will be in-place at closure.

4.1 Assumes one LFG extraction well per acer will need to be extended through the final cover, wells in the liner area will also require a synthetic boot.

5.0 Costs for constructing downdrains, inlets, bench channels and top deck berm. Does not include perimeter drainage and basins, that will be in place prior to closure.

6.0 Cost assumes the removal of scales and the scale house, any required backfill, and disconnecting electrical components.

6.1 Assumes that no environmental control systems will be decommissioned/abandoned at closure.

7.0 Cost (including final report) for construction management services includes third party construction management throughout the duration of construction.

TABLE B
PROMONTORY LANDFILL LLC
PRELIMINARY ANNUAL POST-CLOSURE MAINTENANCE COST ESTIMATE
PHASE 1A

Item No.	Description	Estimated Quantity		2016 Unit Price	Total Annual Cost
1	**EROSION CONTROL/VEGETATIVE LAYER MAINTENANCE**				
	Hydroseeding	0.5	ac	$2,000	$1,000
	Vegetative Layer/Final Grading Maintenance [1.0]	0.25	ac	$68,000	$17,000
	Quarterly Inspections [1.1]	24	hr	$60	$1,440
				Item 1 Subtotal	**$19,440**
2	**GAS COLLECTION/CONTROL/MONITORING SYSTEM [2.0]**				
	Quarterly Inspections	64	hr	$60	$3,840
				Item 2 Subtotal	**$3,840**
3	**LEACHATE REMEDIATION/CONTROL**				
	Leachate Collection/Removal System Sampling [3.0]	2	ea	$1,300	$2,600
	Quarterly Inspections [3.1]	32	hr	$60	$1,920
				Item 3 Subtotal	**$4,520**
4	**GROUNDWATER MONITORING SYSTEM AND SURFACE WATER MONITORING**				
	Groundwater Sampling/Analysis/Inspections				
	Semi-Annual Sampling[4.0]	8	ea	$200	$1,600
	Lab Analysis[4.0]	8	ea	$1,280	$10,240
	Monitoring and Statistical Analysis	40	hr	$60	$2,400
	Surface Water Sampling/Analysis/Inspections [4.1]	40	hr	$60	$2,400
	Repair and Maintenance (assume replacement of a well every 5 years)	1	ls	$10,000	$2,000
				Item 4 Subtotal	**$18,640**
5	**DRAINAGE MAINTENANCE/IMPROVEMENTS**				
	Drainage Maintenance/Improvements	0.5	ac	$10,000	$5,000
				Item 5 Subtotal	**$5,000**
6	**REPORTING**				
	Annual Summary Report [6.0]	80	hrs	$60	$4,800
				Item 6 Subtotal	**$4,800**
7	**CORRECTIVE ACTION**				
	Corrective Action	-	-	-	$0
				Item 7 Subtotal	**$0**
				SUBTOTAL PRELIMINARY ANNUAL POST-CLOSURE MAINTENANCE COST	**$56,240**
				TOTAL 30 YEAR PRELIMINARY POST-CLOSURE MAINTENANCE COST	**$1,687,200**

Footnotes*:

1.0 Cover stabilization, settlement repair and erosion control. Cost based on closure cost estimate, converted to a cost per acre, includes mob, survey, all cover components, CQA and CM.
1.1 Includes cost for quarterly inspections for cover erosion, settlement, fencing and vegetation.
2.0 All monitoring frequencies are in accordance with the Utah Administrative Code Rule R315-303.
3.0 Assumes that leachate generation will be a negligible following closure.
3.1 Cost includes quarterly inspections of the sumps and clean out pipes.
4.0 Assumes groundwater system consists of 4 wells each sampled semi-annually for a total of 8 samples per year. Cost includes semi-annual sampling and lab analysis of the groundwater monitoring system. Refer to Appendix M of the Permit Application for the groundwater monitoring plan and list of constituents.
4.1 Cost includes sampling, analysis and quarterly inspections of the surface water monitoring system.
5.0 Based on closure cost estimate, assumes 0.5 acres of drainage will be repaired each year.
6.0 Cost includes annual reports for gas collection/control system, leachate collection system and groundwater/surface water monitoring system.
7.0 The site is not currently constructed, therefore there are no known releases of contaminants.

APPENDIX H

CONSTRUCTION SWPPP

Stormwater Pollution Prevention Plan

for:

Promontory Facility Landfill
SE Promontory Road
Unincorporated, Box Elder County, Utah
Site Telephone Number:

Operator:

Promontory Point Resources, LLC
Steven Prows
32 East Exchange Place, Suite 100
Salt Lake City, UT 84111
Telephone Number:
Fax/Email:

SWPPP Contact:

Company Name:
Name:
Address:
City, State, Zip Code:
Telephone Number:
Fax/Email:

SWPPP Preparation Date:

05 / 02 / 2016

Estimated Project Dates:

Project Start Date: 01 / 02 / 2017
Project Completion Date: 09 / 30 / 2017

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SECTION 1: CONTACT INFORMATION/ RESPONSIBLE PARTIES

1.1 Owner(s), Operator, Contractors

Owner(s):
Promontory Point Resources, LLC:
Stephen Prows
32 East Exchange Place, Suite 100
Salt Lake City, UT 84111
Telephone Number:
Fax/Email:

Operator(s) & Project Manager(s):
TBD
Company Name:
Name:
Address:
City, State, Zip Code:
Telephone Number:
Fax/Email:

Site Supervisor(s):
Company Name:
Name:
Address:
City, State, Zip Code:
Telephone Number:
Fax/Email:

SWPPP Contact(s):
Company Name:
Name:
Address:
City, State, Zip Code:
Telephone Number:
Fax/Email:

This SWPPP was Prepared by:
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Subcontractor(s):
Company Name:
Name:
Address:
City, State, Zip Code:
Telephone Number:
Fax/Email:

Emergency 24-Hour Contact:
Company or Organization Name:
Name:
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1.2 Storm Water Team

SWPPP Preparer
Civil Engineer
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Role or Responsibility:
Position:
Name:
Telephone Number:
Email:

Insert Role or Responsibility:
Insert Position:
Insert Name:
Insert Telephone Number:
Insert Email:

SECTION 2: SITE EVALUATION, ASSESSMENT, & PLANNING

2.1 Project/Site Information

Project/Site Name: Promontory Facility Landfill
Project Street/Location: SE Promontory Road
City: Unincorporated State: Utah ZIP Code: NA
County or Similar Subdivision: Box Elder County

Latitude/Longitude (Use **one** of three possible formats, and specify method)

Latitude: 41º 12' 58" N (degrees, minutes, seconds)

Longitude: 112º 28' 22" W (degrees, minutes, seconds)

Method for determining latitude/longitude:
☐ USGS topographic map (specify scale: _____) ☐ EPA Web site ☐ GPS
☒ Other (please specify): Google Earth

Is the project located in Indian country? ☐ Yes ☒ No
If yes, name of Reservation, or if not part of a Reservation, indicate "not applicable."_____

Is this project considered a federal facility? ☐ Yes ☒ No

UPDES project or permit tracking number*:_____

**(This is the unique identifying number assigned to your project by your permitting authority after you have applied for coverage under the appropriate National Pollutant Discharge Elimination System (UPDES) construction general permit.)*

2.2 Nature of Construction Activity

Describe the general scope of the work for the project, major phases of construction, etc:
The initial phase of construction of Cell C-1 of the Promontory Point Landfill involves excavation of 24 acre landfill cell. The cell is to be lined with geosynthetic clay liner and HDPE geomembrane to protect the groundwater resource. A geotextile cushion layer is installed and leachate collection gravel is filled over the geotextile to a depth of 12 inches. The leachate collection system drains to a single point where a pump is used to draw the leachate into a tanker truck for collection and treatment or recirculation over the limit of refuse. A geotextile filter is placed prior to protective cover soil. During the construction of the initial phase, all runoff is contained within the landfill cell and pumped into the site detention basin for desilting prior to discharge. A diversion channel uphill from the cell will be constructed to redirect run-on around the landfill and infrastructure.

What is the function of the construction activity?
☐ Residential ☐ Commercial ☒ Industrial ☐ Road Construction ☐ Linear Utility
☐ Other (please specify):
Estimated Project Start Date: 01 / 02 / 2017
Estimated Project Completion Date: 09 / 30 / 2017

2.3 Construction Site Estimates

The following are estimates of the construction site.

Total project area:	1010+ acres
Construction site area to be disturbed:	32.0 acres
Percentage impervious area before construction:	100%
Runoff coefficient before construction:	88
Percentage impervious area after construction:	100 %
Runoff coefficient after construction	94

2.4 Soils, Slopes, Vegetation, and Current Drainage Patterns

The onsite site soils consist of silt, sand, gravel, and various combinations of the three. Outcroppings of limestone, shale and quartzite are also found within the site boundary. The hydrologic description of these soils varies and consists of Type A, Type B and Type D. The boundaries of the various soils have been determined using data from the soil web survey

website and the areas of various soil types were included in the hydrologic calculations.

The northern slopes of the site are moderately steep at 5:1 and towards the south become more gradual at 6%. Natural drainage patterns across the site consist of sheet flow, shallow channelized sheet flow, and rills formed from erosion caused by surface runoff. Natural channelization is not encountered.

Construction of the landfill cell will involve diverting run-on flows into a temporary channel which flows around the landfill cell. As the landfill expands towards the north, the temporary diversion will be reconstructed and a permanent channel will be built to convey the flows around the perimeter of the final landfill footprint. The permanent diversion channel will convey the flows towards existing pond areas to the north of the Union Pacific rail road. The existing ponds overflow towards the west and discharge into the northern portion of the Great Salt Lake.

Vegetation on the site consists of desert shrub. In the upper northern portions of the tributary area, the vegetation is well developed and becomes sparser towards the south where it is poorly developed in the project boundary.

2.5 Emergency Related Projects

Emergency-Related Project? ☐ Yes ☒ No

2.6 Phase/Sequence of Construction Activity

Phase 1A

- Phase 1A involves excavation of 500,000 cubic yards of material over a 20 acre area. Excavated materials will be stockpiled to the east and a diversion channel will be constructed to protect the disturbed area from run-on coming from the north. A total of approximately 32 acres would be disturbed including an entrance facility, scales, administration building, parking lot, and earthen detention basin.
- The initial phase of construction would begin in January 2017 and be complete by September 2017.
- The initial landfill cell would not discharge stormwater. A holding pond will be constructed at the toe of the northern slope to contain stormwater that collects in the landfill cell. Silts would be allowed to settle and the pond is to be pumped into the detention basin after storm events. Exposed disturbed surface areas, including the stockpile area, will be protected from erosion using fiber rolls, silt fence, and gravel bag chevrons. Erosion control mat is to be used in the flowline of the diversion

channels. Rock rip rap will be used in the ultimate diversion channel and any area where channelized stormwater would encounter erosive velocities.

- Disturbed areas which require temporary stabilization are to be protected using erosion control mattress, or wood mulch.

Phase 1B

- Phase 1B involves excavating to expand the initial cell towards the north and west. The excavation area will be a borrow source for daily cover during refuse placement operations. The diversion channel would be relocated towards the north to protect the disturbed area from run-on coming from the north. A total of approximately 14 acres would be disturbed in Phase 1B.
- The excavation and completion of Phase IB would take place over the course of several years beginning in year 2018.
- The second phase of the landfill cell would not discharge stormwater. A holding pond will be constructed at the toe of the northern slope to contain stormwater that collects in the landfill cell. Silts would be allowed to settle and the pond is to be pumped into the detention basin after storm events. As the landfill is filled, the refuse will be covered with interim cover and drainage conveyances will be directed towards the detention basin. Exposed disturbed surface areas will be protected from erosion using fiber rolls, silt fence, and gravel bag chevrons. Erosion control mat is to be used in the flowline of the diversion channels. Rock rip rap will be used in the ultimate diversion channel and any area where channelized stormwater would encounter erosive velocities.
- Disturbed areas which require temporary stabilization are to be protected using erosion control mattress or wood mulch.

Additional Future Phases

- As the landfill is filled, the refuse will be covered with interim cover and drainage conveyances will be directed towards the detention basin. Additional Phases of the landfill cell are expected to tie into the previous phases and expansion will generally continue in a northwestern direction. The temporary diversion channel will continue to be reconstructed to protect the cell and disturbed areas that are subject to runoff will be protected from erosion using the same BMPs. As the landfill rises vertically, deck berms, benches, and downdrains will be constructed to direct drainage towards the southeastern detention basin. Finalized slopes will be stabilized with final cover and protected from erosion using fiber rolls and hydroseed.

2.7 Site Features and Sensitive Areas to be Protected

The site is ideally located and does not contain any natural streams, wetlands, historic properties or endangered species. Native vegetation is sparse and will be replaced by hydroseed once slopes

are finalized. The native soil is not highly erodible and the slopes are moderate to gradual in steepness. The nearest natural waterbody is the Great Salt Lake. Measures to prevent pollution leaving the site will be taken and all flows will enter the detention basin before being allowed to leave the site.

2.8 Maps

Included site maps are found in Appendix A.

SECTION 3: POLLUTION PREVENTION STANDARDS

Pollution prevention BMPs that will be implemented to control pollutants in stormwater include but are not limited to waste management, material staging and storing areas, concrete washout, stabilized construction entrance, storm drain inlet protection, detention basin maintenance, secondary containment, employee training, good housekeeping, vehicle/equipment maintenance and fueling, clean paved surfaces, spill response, erosion control mats, silt fence, fiber rolls, gravel bag chevrons, hydroseed, mulch, and fugitive dust suppression.

3.1 Potential Sources of Pollution

Potential sources of sediment to stormwater runoff:

Exterior slopes and disturbed areas outside of the landfill cell have the potential to produce sediment in stormwater runoff.

Potential pollutants and sources, other than sediment, to stormwater runoff:

Pollutant-Generating Activity	**Pollutants or Pollutant Constituents** (that could be discharged if exposed to stormwater)	**Location on Site** (or reference SWPPP site map where this is shown)
Industrial Processes	Landfill Gas Condensate and Leachate	
Material Storage	Landfill Gas Condensate and Leachate	
Dust and Particulate Generated Activities	Dust and Particulate Matter	
Significant Spills and Leaks	Landfill Gas Condensate and Leachate	
Soil Erosion	Sediment	

Equipment Maintenance	Oil and Grease	
Solid Waste Disposal	Wind-Blown Litter	
Parking Lot	Oil and Grease	
Equipment and Vehicle Fueling	Fuel	

3.2 Non-Stormwater Discharges

Authorized Non-Storm Water Discharges	Comments
Potable water including line flushing.	When possible pump potable water into a water truck for reuse in dust suppression instead of allowing it to discharge.
Uncontaminated air conditioning condensate.	Keep contaminants clear of air conditioning condensate discharge lines.
Landscape irrigation.	Adjust irrigation to prevent runoff and avoid over application of fertilizers and pesticides.

BMP Description: Non-Stormwater Discharges	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

BMP Description: Spill Prevention, Control, Cleanup	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

3.3 Natural Buffers or Equivalent Sediment Controls

Buffer Compliance Alternatives

Are there any surface waters within 50 feet of your project's earth disturbances? ☐ YES ☒ NO

SECTION 4: EROSION AND SEDIMENT CONTROLS

4.1 Minimize Disturbed Area and Protect Natural Features and Soil

The site boundary contains more than 1,010+ acres. The initial cell consists of 20 acres of excavation area. The remaining 12 acres of disturbed area consist of landfill operations and administrative facilities. The remaining 980+ acre is to remain undisturbed until the time of further buildout and expansion. The undisturbed area is to be fenced off from unauthorized access. Topsoil is preserved by diverting and controlling run-on and run-off in conveyance channels that either discharge into the site detention basin or into existing depression areas with little chance of erosive velocities.

4.2 Establish Perimeter Controls and Sediment Barriers

Silt fence will be installed along the toe of exterior slopes to capture sediments in areas where flow velocities are at a minimum. Fiber rolls are to be installed at regular spacing and equal elevations along slopes to allow continuous sheet flow from becoming shallow concentrated flow in rills and gullies.

BMP Description: Silt Fence	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

BMP Description: Fiber Roll	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

4.3 Retain Sediment On-Site

The site detention basin will begin as an earthen structure with a concrete overflow weir to allow large storm events to pass safely without causing damage to the basin. A perforated standpipe will be used to drain the basin at a rate which allows sediment particles to fall out of suspension within the storm water. As the size of the landfill becomes larger, the basin capacity would need to be expanded and the deposited sediments would need to be removed. In the ultimate condition the basin would be expanded to meet the goals of the closure requirements and the basin would be lined with geomembrane and concrete to allow equipment to remove sediment and maintain the condition of the basin.

BMP Description: Detention Basin	
Installation Schedule:	July 2017
Maintenance and Inspection:	
Responsible Staff:	

4.4 Establish Stabilized Construction Exits

A stabilized construction entrance constructed of wash bars and/or a stone pad will be constructed and maintained at the point where vehicular or construction traffic enters the paved roadway. The location of the construction exit may shift depending on traffic and the phase of construction. It may be necessary to have more than one.

BMP Description: Stabilized Construction Exit	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

4.5 Protect Slopes

Erosion control blankets such as coconut mat will be used to protect the sloped berm and flowline of the temporary diversion channels. For permanent slopes, hydroseed would be used to reestablish native vegetation.

BMP Description: Erosion Control Blankets	
Installation Schedule:	July 2017
Maintenance and Inspection:	
Responsible Staff:	

BMP Description: Hydroseed	
Installation Schedule:	December 2017
Maintenance and Inspection:	
Responsible Staff:	

4.6 Stockpiled Sediment or Soil

Surplus material from excavation of the Phase 1A may need to be stockpiled onsite. A diversion channel will be constructed along the uphill perimeter of the stockpile to allow a drainage path for run-on to flow around the stockpile. The slopes of the stockpile would be protected from erosion using fiber rolls and sediment which does become mobilized will be trapped by silt fence along the toe of slope.

BMP Description: Diversion Channel	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

BMP Description: Fiber Rolls and Silt Fence	
Installation Schedule:	July 2017
Maintenance and Inspection:	
Responsible Staff:	

4.7 Minimize Dust

Access roads, haul routes, excavations, and fill areas are likely sources of dust generation. Water trucks will need to apply water to these working areas at regular intervals to prevent fugitive dust from blowing from the site.

BMP Description: Dust Suppression	
Installation Schedule:	Continuous except for wet weather conditions.
Maintenance and Inspection:	
Responsible Staff:	

4.8 Topsoil

The existing topsoil will be preserved by minimizing the disturbed footprint and utilizing diversion channels to control run-on and runoff. During stockpiling activities, the excavated material should be selected and placed in separate stockpiles of rocky material to be use for interim cover and top soil to be used for final cover and vegetative areas.

BMP Description: Diversion Channel

Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

4.9 Soil Compaction

The site areas that are outside of the initial phases of construction will remain undisturbed to prevent erosion and loss of top soil. Fencing and signage will be installed to prevent unauthorized access into these areas.

BMP Description: Fencing and signage	
Installation Schedule:	January, 2017
Maintenance and Inspection:	
Responsible Staff:	

4.10 High Altitude/Heavy Snows

The high elevation of the site means that snowfall in the winter is a possibility although large snow event are very rare for this region. Detention basin overflows will be size for the additional flow that can occur during melt events such as precipitation over snow.

Date Snow is Expected	Date of High Altitude/Heavy Snow Conditions BMPs to be Installed	Date of First Heavy Snow
November, 2017	Scheduled: September, 2017	
	Actual:	

BMP Description: Detention Basin	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

4.11 Linear Activities

The project is not a linear project and perimeter controls are necessary.

4.12 Chemical Treatment

No treatment chemicals are anticipated to be used during the course of this project.

4.13 Stabilize Soils

BMP Description: Mulch	
☐ ***Permanent***	☒ ***Temporary***
Installation Schedule:	
Maintenance and Inspection:	
Responsible Staff:	

BMP Description: Hydroseed	
☒ ***Permanent***	☐ ***Temporary***
Installation Schedule:	
Maintenance and Inspection:	
Responsible Staff:	

4.14 Final Stabilization

Final stabilization procedures are anticipated to be placement of final cover material followed by hydroseed.

BMP Description: Hydroseed	
Installation Schedule:	
Maintenance and Inspection:	
Responsible Staff:	

SECTION 5: POLLUTION PREVENTION

5.1 Spill Prevention and Response

Any discharges in 24 hours equal to or in excess of the reportable quantities listed in 40 CFR 117, 40 CFR 110, and 40 CFR 302 will be reported to the National Response Center and the Division of Water Quality (DWQ) as soon as practical after knowledge of the spill is known to the permittees. The permittee shall submit within 14 calendar days of knowledge of the release a written description of: the release (including the type and estimate of the amount of material released), the date that such release occurred, the circumstances leading to the release, and measures taken and/or planned to be taken to the Division of Water Quality (DWQ), 288 North 1460 West, P.O. Box 144870, Salt Lake City, Utah 84114-4870. The Storm Water Pollution Prevention Plan must be modified within14 calendar days of knowledge of the release to provide a description of the release, the circumstances leading to the release, and the date of the release. In addition, the plan must be reviewed to identify measures to prevent the reoccurrence of such releases and to respond to such releases, and the plan must be modified where appropriate.

Agency	Phone Number
National Response Center	(800) 424-8802
Division of Water Quality (DWQ) 24-Hr Reporting	(801)-231-1769 (801) 536-4123
Utah Department of Health Emergency Response	(801) 580-6681

Material	Media Released To	Reportable Quantity
Engine oil, fuel, hydraulic & brake fluid	Land	25 gallons
Paints, solvents, thinners	Land	100 lbs (13 gallons)
Engine oil, fuel, hydraulic & brake fluid	Water	Visible Sheen
Antifreeze, battery acid, gasoline, engine degreasers	Air, Land, Water	100 lbs (13 gallons)
Refrigerant	Air	1 lb

5.2 Construction and Domestic Waste

Solid waste is to be handled in accordance to Resource Conservation and Recovery Act section D.

BMP Description: Refuse Disposal	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

5.3 Washing of Applicators and Containers used for Concrete, Paint or Other Materials

Concrete washout can be handled at the working face of the landfill. Prior to development of the landfill, concrete washout should be performed in a leak proof container.

BMP Description: Concrete Washout	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

5.4 Establish Proper Building Material Staging Areas

Hazardous building materials such as paints, solvents, pesticides, fuel, and oil shall be stored in a manner which minimizes risk of exposure to storm water such as indoors or under cover or in an areas with secondary containment to prevent spills from spreading across the site.

BMP Description: Material Storage	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

5.5 Establish Proper Equipment/Vehicle Fueling and Maintenance Practices

Equipment/vehicle fueling and maintenance shall occur only in designated areas.

BMP Description: Vehicle and Equipment Maintenance and Repair	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

BMP Description: Vehicle and Equipment Fueling	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

5.6 Control Equipment/Vehicle Washing

Vehicle and equipment washing shall occur only in designated areas. Wash water containing detergents shall be collected and disposed.

BMP Description: Vehicle and equipment washing	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

5.7 Pesticides, Herbicides, Insecticides, Fertilizers, and Landscape Materials

Pesticides, herbicides, insecticides, and fertilizers shall not be stored in a manner which does not allow contact with stormwater.

BMP Description: Landscaping	
Installation Schedule:	September 2017
Maintenance and Inspection:	
Responsible Staff:	

5.8 Other Pollution Prevention Practices

After placement of refuse, landfill gas will begin to accumulate due to the anaerobic conditions within the landfill. Methane gas will require extraction via wells, collectors, laterals, and headers.

BMP Description: Landfill Gas Well Monitoring	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

SECTION 6: INSPECTIONS & CORRECTIVE ACTIONS

6.1 Inspections

1. Inspection Personnel: Identify the person(s) who will be responsible for conducting inspections and describe their qualifications:

TBD

2. Inspection Schedule and Procedures:

Describe the inspection schedules and procedures you have developed for your site (include frequency of inspections for each BMP or group of BMPs, indicate when you will inspect, e.g., before/during/and after rain events, spot inspections):

TBD

Describe the general procedures for correcting problems when they are identified. Include responsible staff and time frames for making corrections:

TBD

Attach a copy of the inspection report you will use for your site.

Updated July 2014

Click to Add Logo

UPDES STORM WATER INSPECTION EVALUATION FORM FOR SWPPP COMPLIANCE

Inspection #: _____

Site Name: _____ UPDES Permit #: _____

Site Address: _____

Local Jurisdiction or County: _____ Inspection Cycle: High Priority ☐ 7 Days ☐ 14 Days ☐

Permit Effective Date: _____ Permit Expiration Date: _____ Total Project Area: _____ Total Disturbed Area: _____

Project Type: Subdivision ☐ Commercial ☐ Industrial ☐ Linear (Road/Pipe/Power) ☐ Land Disturbance ☐

OPERATOR CONTACT INFORMATION

Operator: _____ Phone: _____ E-mail: _____

On-site Facility Contact: _____ Phone: _____ E-mail: _____

Important Contacts: _____ Phone: _____ E-mail: _____

Important Contacts: _____ Phone: _____ E-mail: _____

SWPPP PRE-SITE REVIEW INFORMATION

1. Has a pre-construction review of the SWPPP been conducted by the appropriate municipal agency?	Yes ☐	No ☐
2. Are contact names, positions, responsibilities, and telephone numbers of the Stormwater Team and all other site Operators listed in the SWPPP?	Yes ☐	No ☐
3. Does the SWPPP include a site map showing storm drains, slopes/surface drainage patterns, SW discharge points, construction boundaries, limits of disturbance, surface waters (name of receiving water), TMDL requirements, buffer zones, structural controls, and does it define/explain non-structural controls?	Yes ☐	No ☐
4. Does the SWPPP have an estimate of the area to be disturbed, a sequence of construction activities, the SW runoff coefficient before and after construction, a description of the soil types, controls for discharges from (asphalt/concrete) batch plants if any, list UIC Class 5 Injection Well activities and use, show wetland areas, and have a description of the nature of the construction activity?	Yes ☐	No ☐
5. Does the SWPPP and site map show erosion and sediment controls placement & details, buffer zone documentation (e.g.erosion blankets, mulch, slope drains, check dams, sediment basins, grass-lined channels, fiber rolls, sediment traps, silt fence, inlet protection, curb cut-back, dust control, chemical treatments etc?)	Yes ☐	No ☐
6. Does the SWPPP and site map show and describe good housekeeping controls and storage areas of polymers, flocculants or other treatment chemicals, spill prevention and mitigation measures, staff training procedures and logs. (e.g. track out pad, street sweeping, material storage, construction waste containment and removal, sanitary waste, concrete washout pits, etc)	Yes ☐	No ☐
7. Are post-construction elements included in the SWPPP? (i.e. grass swales, detention basins, vegetated filter strips, infiltration, depression storage, landscaping/xeriscaping, discontinuous concrete or hard surface SW conveyance, etc.)	Yes ☐	No ☐
8.Are the SWPPP Certifications signed by the proper and responsible officers and parties (see permit Appendix G Part G. 16,1,2 & 1.3)	Yes ☐	No ☐
9. Are the NOI , a copy of the State permit, Appendix logs and forms in the SWPPP?	Yes ☐	No ☐

NOTICE OF TERMINATION (NOT) INSPECTION

Site Name: _____ Evaluation Date: _____

Site Address: _____

Inspected By: _____ Title/Organization: _____

1. Has the site been properly stabilized according to permit requirements?	Yes ☐	No ☐
2. Have all temporary BMPs been removed?	Yes ☐	No ☐
3. Have post-construction (permanent storm water system) elements been constructed and inspected in accordance with approved project drawings?	Yes ☐	No ☐
4. Is the site acceptably clean?	Yes ☐	No ☐

COMMENTS:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated 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 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.

Inspector (*Print Name*) _____ Title: _____ Signature: _____ Date: _____

Operator: (*Print Name*) _____ Title: _____ Signature: _____ Date: _____

Operator: (*Print Name*) _____ Title: _____ Signature: _____ Date: _____

ADDITIONAL COMMENTS AND CORRECTIVE ACTIONS FOR SWPPP COMPLIANCE

By: Date:

Project Name: Project Address:

Reduction in Inspection Frequency (if applicable)

For the reduction in inspections resulting from stabilization:

For reduction in inspections due to frozen conditions: November through April

6.2 Corrective Actions

Corrective Action Log:

6.3 Delegation of Authority

Duly Authorized Representative(s) or Position(s):
Company or Organization Name:
Name:
Position:
Address:
City, State, Zip Code:
Telephone Number:
Fax/Email:

Attach a copy of the signed delegation of authority form in Appendix K.

SECTION 7: TRAINING AND RECORDKEEPING

7.1 Training

Individual(s) Responsible for Training:

Describe Training Conducted:

- General stormwater and BMP awareness training for staff and subcontractors:

- Detailed training for staff and subcontractors with specific stormwater responsibilities:

Training Attendee Name	Title of Training	Duration	Date of Training

Additional training documentation should be included in Appendix J.

7.2 Recordkeeping

Records will be retained for a minimum period of at least 3 years after the permit is terminated.

Date(s) when major grading activities occur:

Date(s) when construction activities temporarily or permanently cease on a portion of the site:

Date(s) when an area is either temporarily or permanently stabilized:

7.3 Log of Changes to the SWPPP

Log of changes and updates to the SWPPP

SECTION 8: WATER QUALTIY

8.1 UIC Class 5 Injection Wells

☐ French Drain
- ☐ Commercially Manufactured pre-cast or pre-built subsurface infiltration system
- ☐ Drywell(s), seepage pit(s), improved sinkhole(s)

Description of your Class V Injection Well:
No injection wells are anticipated as being used on this project.

DWQ contact information:
Name:
Date:
Additional information:

Local Requirements:

8.2 Discharge Information

Does your project/site discharge stormwater into a Municipal Separate Storm Sewer System (MS4)? ☐ Yes ☒ No

- List the MS4 that receives the discharge from the construction project:
-

Are there any surface waters that are located within 50 feet of your construction disturbances?
☐ Yes ☒ No
List the water body:

8.3 Receiving Waters

- Table 1 – Names of Receiving Waters (see http://wq.deq.utah.gov)

Name(s) of the first surface water that receives stormwater directly from your site and/or from the MS4. (note: multiple rows provided where your site has more than one point of discharge that flows to different surface waters)
1.The Great Salt Lake
2.
3.
4.
5.
6.

8.4 Impaired Waters

(see http://wq.deq.utah.gov look in the bottom half of the left hand column)

	Is this surface water listed as "impaired"?	If you answered yes, then answer the following:		
		What pollutant(s) are causing the impairment?	Has a TMDL been completed?	Pollutant(s) for which there is a TMDL
1.	☐ Yes ☒ No		☐ Yes ☐ No	
2.	☐ Yes ☐ No		☐ Yes ☐ No	
3.	☐ Yes ☐ No		☐ Yes ☐ No	
4.	☐ Yes ☐ No		☐ Yes ☐ No	
5.	☐ Yes ☐ No		☐ Yes ☐ No	
6.	☐ Yes ☐ No		☐ Yes ☐ No	

8.5 High Water Quality

- Table 3 – High Water Quality
- (see http://wq.deq.utah.gov look in the bottom half of the left hand column)

	Is this surface water designated as High Water Quality? (see Appendix C)	If you answered yes, specify which category the surface water is designated as?
1.	☐ Yes ☒ No	☐ Category 1 ☐ Category 2
2.	☐ Yes ☐ No	☐ Category 1 ☐ Category 2
3.	☐ Yes ☐ No	☐ Category 1 ☐ Category 2
4.	☐ Yes ☐ No	☐ Category 1 ☐ Category 2
5.	☐ Yes ☐ No	☐ Category 1 ☐ Category 2
6.	☐ Yes ☐ No	☐ Category 1 ☐ Category 2

8.6 Dewatering Practices

Dewatering will be needed within the landfill cell. Runoff from the surrounding slopes will be directed to an earthen basin within the landfill cell and not allowed to comingle with leachate. The water will sit for a period of time to desilt and then pumped into the detention basin.

BMP Description: Dewatering	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

8.7 Control Stormwater Flowing onto and through the Project

All site run-on will be routed through diversion channels and not allowed to comingle with site runoff.

BMP Description*: *Diversion Channels	
***Installation Schedule*:**	January 2017
Maintenance and	

Inspection:	
Responsible Staff:	

8.8 Protect Storm Drain Inlets

The site drainage will be conveyed using open channel drainage. Windblown litter will need to be removed on a regular basis from the channels.

BMP Description: Litter	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

SECTION 9: POST-CONSTRUCTION BMPs

Permanent site BMPs will need to be maintained throughout the life of the project. The detention basin will need to be cleaned free of sediment and resized on an annual basis. Permanent slopes will need to be protected from erosion by constructing permanent drainage features.

BMP Description: Detention Basin	
Installation Schedule:	January 2017
Maintenance and Inspection:	
Responsible Staff:	

BMP Description: Slope Protection	
Installation Schedule:	September 2017
Maintenance and Inspection:	
Responsible Staff:	

SECTION 10: CERTIFICATION

Professional/SWPPP Author

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated 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 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.

Name: Caleb H. Moore Title: Civil Engineer

Signature: _____ Date: 05/02/2016

SWPPP APPENDICES

Attach the following documentation to the SWPPP:

Appendix A – General Location Map

Appendix B – Site Maps

Appendix C – Construction General Permit

Appendix D – NOI and Acknowledgement Letter from EPA/State/MS4

Appendix E – Inspection Reports

Appendix F – Corrective Action Log (or in Part 5.3)

Appendix G – SWPPP Amendment Log (or in Part 6.2)

Appendix H – Subcontractor Certifications/Agreements

Appendix I – Grading and Stabilization Activities Log (or in Part 6.1)

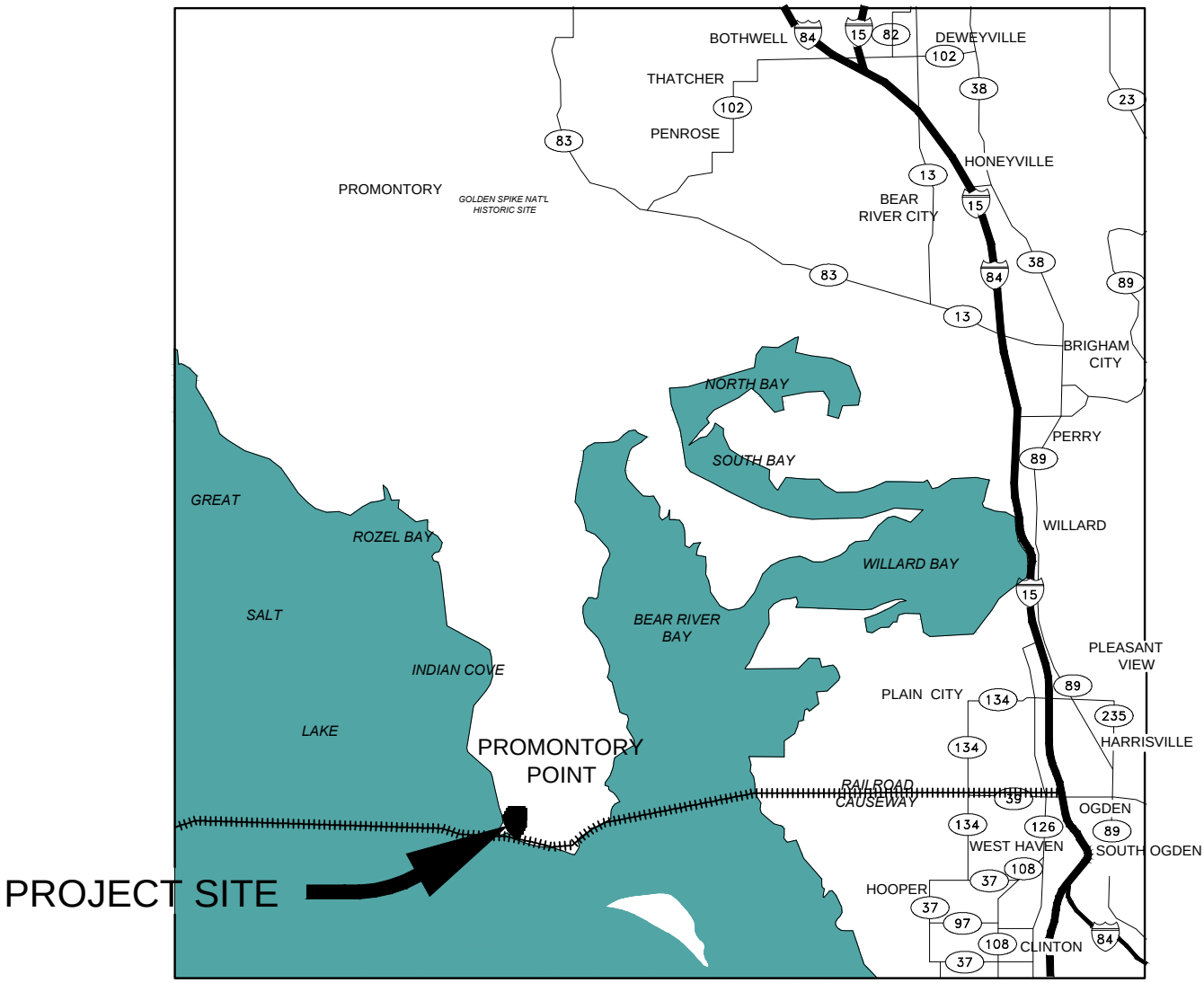
Appendix J – Training Log

Appendix K – Delegation of Authority

Appendix L – Additional Information (i.e., Other permits such as dewatering, stream alteration, wetland; and out of date swppp documents)

Appendix M – BMP Specifications

Appendix A – General Location Map



PROMONTORY POINT LANDFILL

BOX ELDER COUNTY, UTAH

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

VICINITY MAP

APPENDIX A

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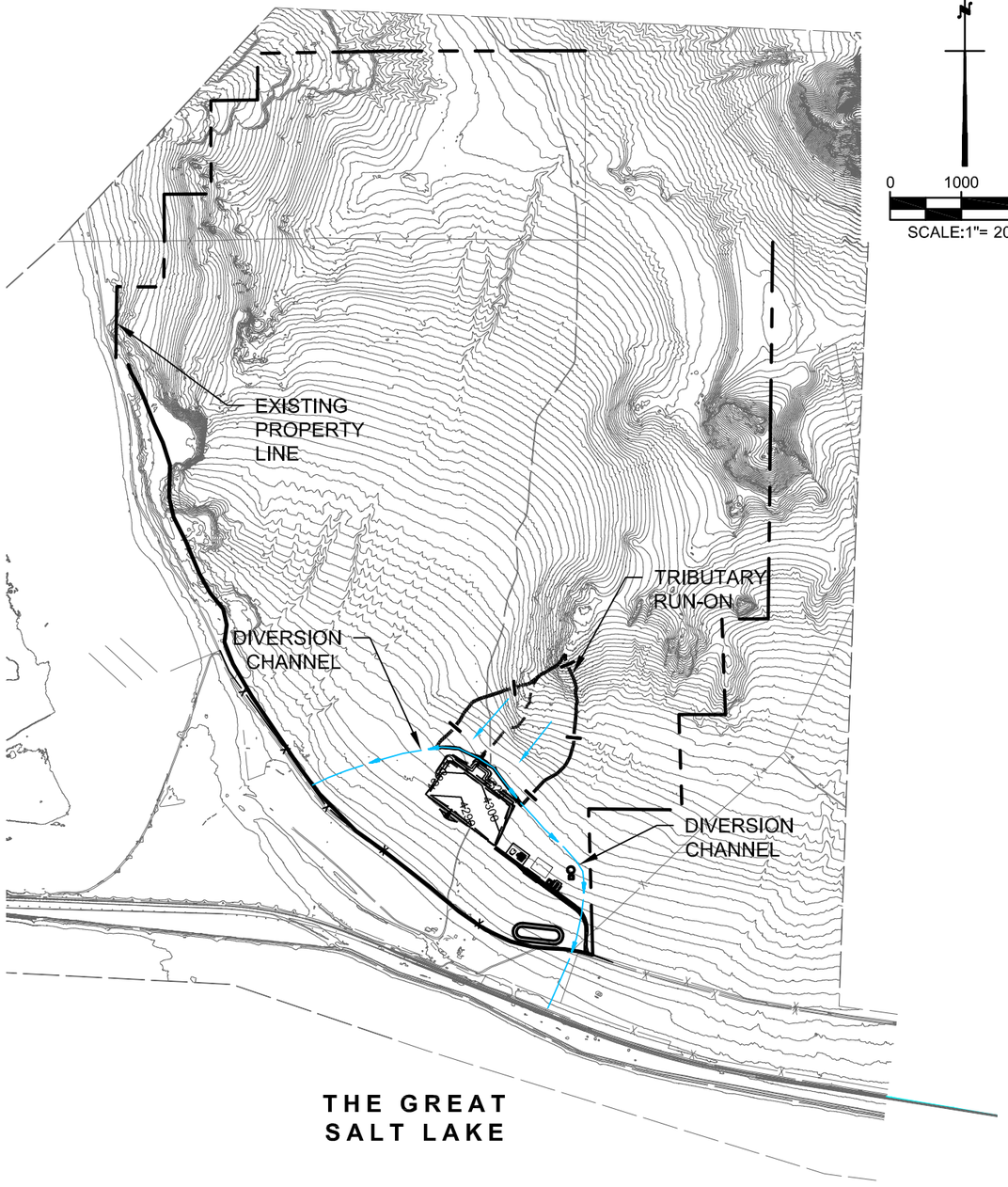
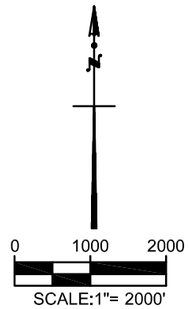
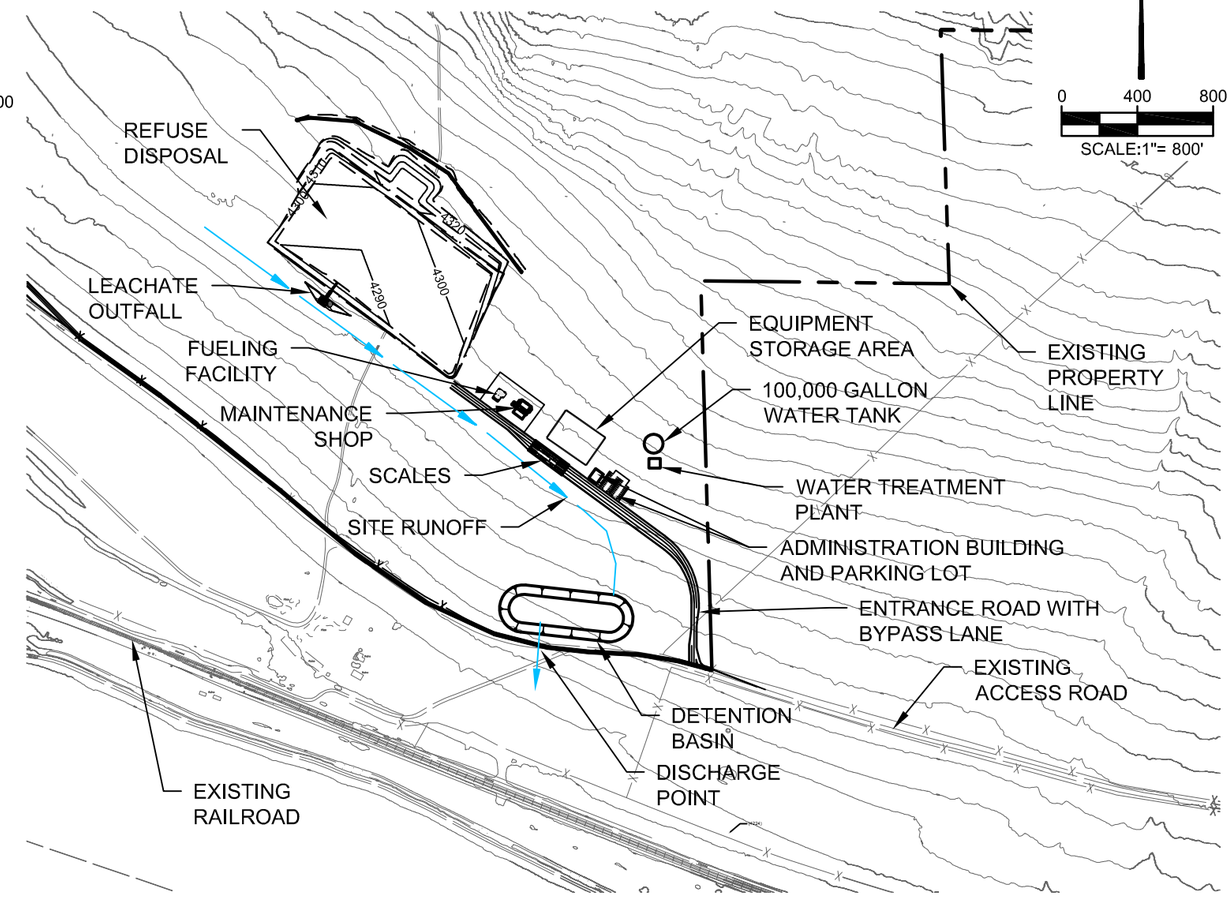
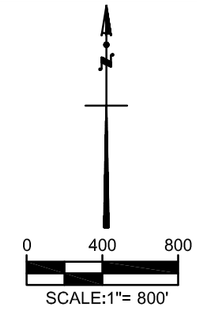
Appendix B – Site Maps









LEGEND

- PROPERTY LINE
- 10 EXISTING CONTOUR
- 10 PROPOSED MAJOR CONTOUR
- DRAINAGE PATTERN

DRAFT

TETRA TECH BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

PROMONTORY POINT, LLC

SWPPP SITE MAP

DESIGNED BY : DLL	FILE : Site Map.dwg		
DRAWN BY : PV / ANP	DATE : 3-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 3-2016	FIGURE 1	
APPROVED BY : CHM	DATE : 3-2016		

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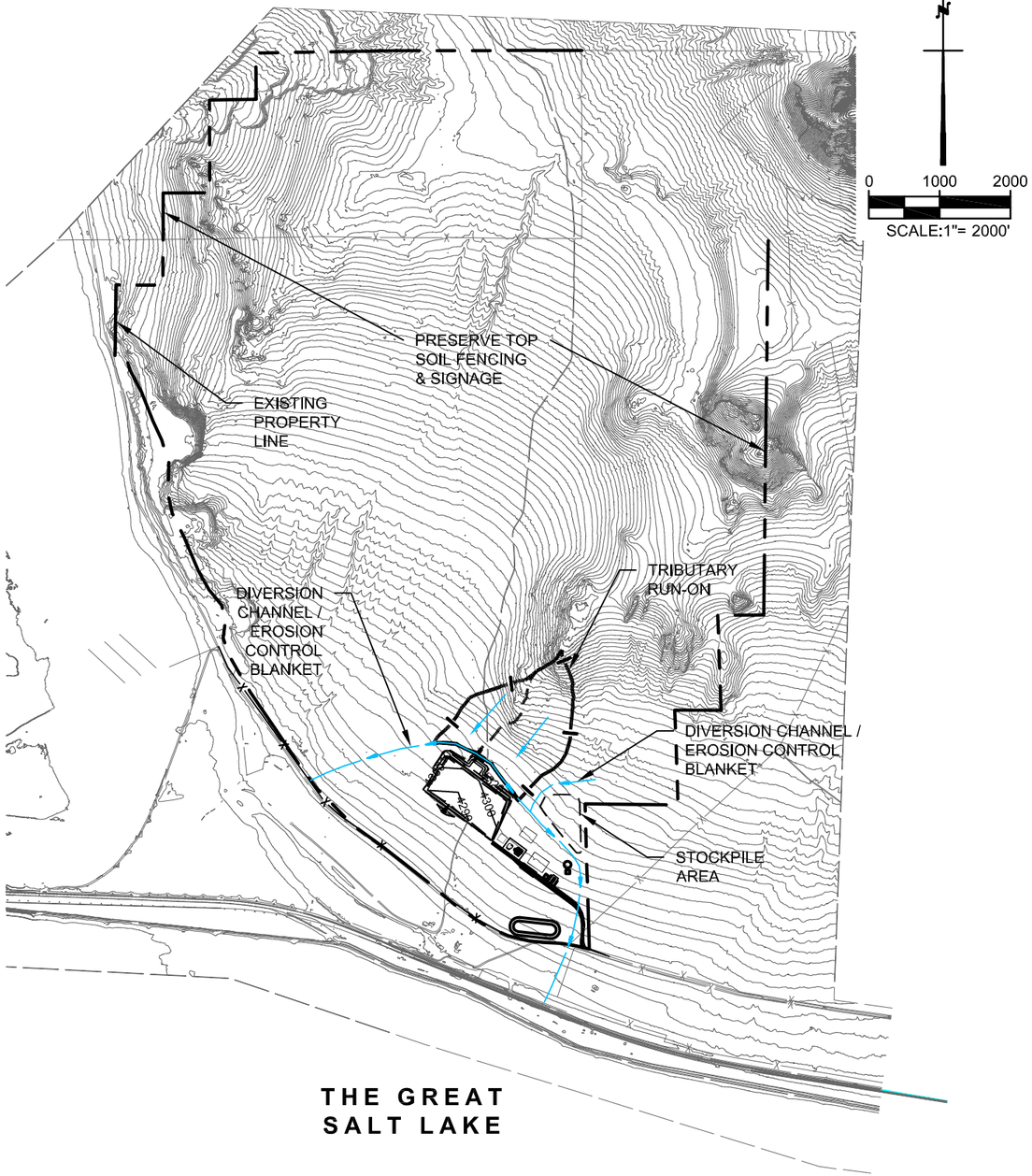

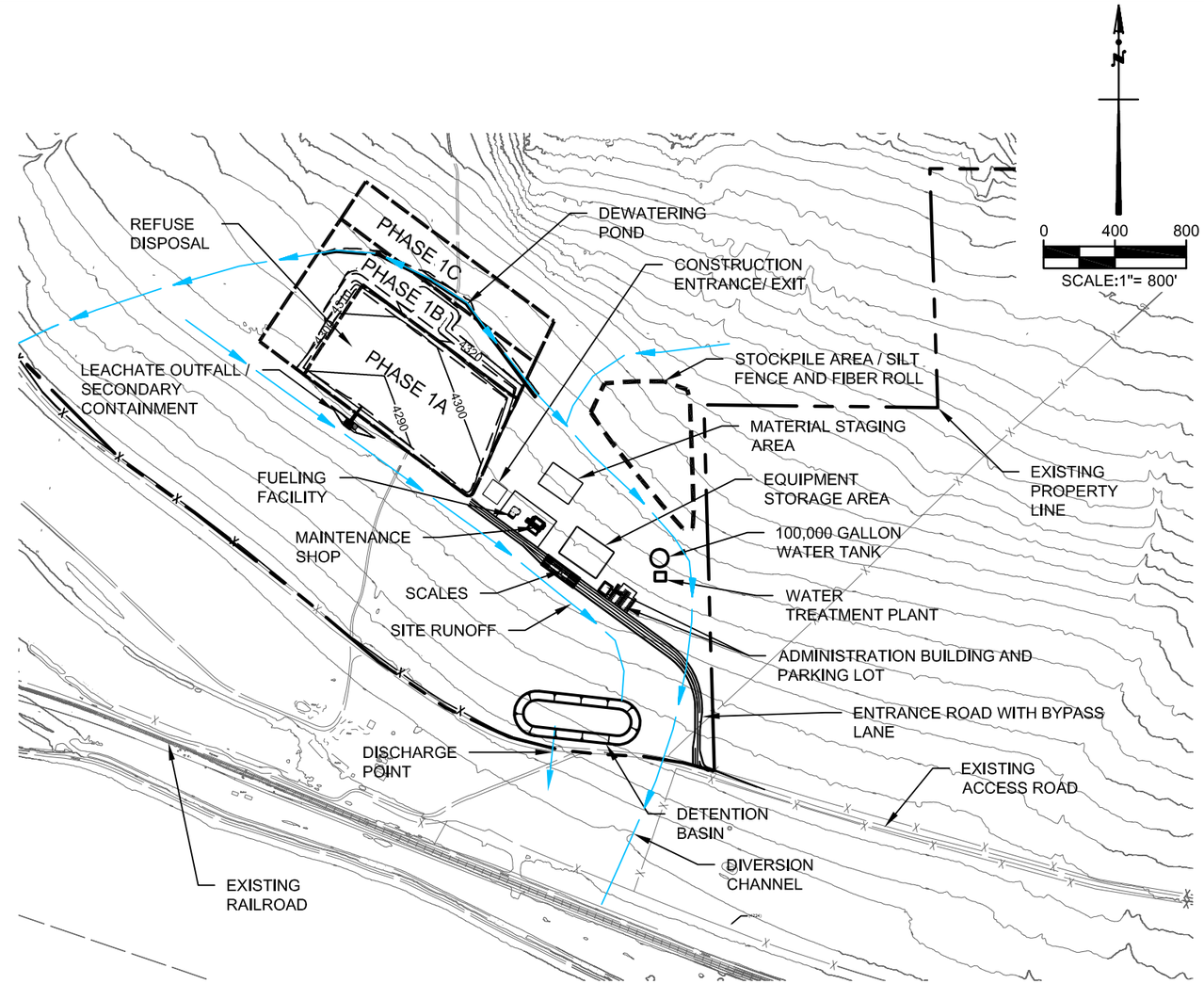

LEGEND

- PROPERTY LINE
- 10 EXISTING CONTOUR
- 10 PROPOSED MAJOR CONTOUR
- DRAINAGE PATTERN

DRAFT

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PROMONTORY POINT, LLC

SWPPP SITE MAP

DESIGNED BY : DLL/VHY	FILE : Site Map.dwg		
DRAWN BY : PV / ANP	DATE : 4-2016	SCALE: AS SHOWN	
CHECKED BY : GES	DATE : 4-2016	FIGURE 2	
APPROVED BY : CHM	DATE : 4-2016		

Appendix C – Construction General Permit

FILE COPY

STATE OF UTAH
DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER QUALITY
Utah Pollutant Discharge Elimination System (UPDES)
General Permit for Discharges from Construction Activities
UPDES Permit No. UTRC00000

This Permit is issued in compliance with the provisions of the Utah Water Quality Act, Title 19, Chapter 5, Utah Code Annotated 2004, as amended (the "Act") and the federal Water Pollution Control Act (33 U.S.c. §§ 1251 et. seq., as amended by the Water Quality Act of 1987, P.L. 100-4), and the rules and Regulations made pursuant to those statutes. This permit authorizes "owners/operators" of construction activities (defined in Part 1.1.1 and Appendix A) that meet the requirements of Part 1. of this Utah Pollutant Discharge Elimination System (UPDES) general permit, to discharge pollutants in accordance with the effluent limitations and conditions set forth herein. Permit coverage is required from the "commencement of earth-disturbing activities" (see Appendix A) until "final stabilization" (see Part 2.2.4).

This permit becomes effective on July1, 2014.

This permit and the authorization to discharge expire at midnight on June 30, 2019.

Signed this 17 day of June, 2014

Walter L. Baker, P.E.
Director

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Appendix K – Erosivity Waiver Form
Appendix L – Example Self-Inspection Form
Appendix M – Notice for New Owner/General Contractor Operations

1. HOW TO OBTAIN PERMIT COVERAGE UNDER THE UTAH CGP.

To be covered under this permit, you must meet the eligibility conditions and follow the requirements for applying for permit coverage in this Part.

Discharges referred to in this permit are discharges that are typical to construction activity, as described in the following section, that outfall to a surface water in the State of Utah. Typical discharges associated with construction activity present a risk of contaminants for soil, sediment, silt, including soil nutrients (phosphorus and possibly nitrogen), and including chemical pollutants (chemicals in the construction process, and/or oils/grease/fuels). The focus of the EPA and DWQ for the most part is risk of pollution to surface waters.

Construction activity that presents risks of fuel and other normal quantities and types of construction chemicals present a risk of pollution of surface and groundwaters.

Construction activity that presents risks of quantities and types of chemicals that are not normal to typical construction activity may need to pursue permit coverage under an individual UPDES permit.

If storm water is contained on the site (coupled with a rational containment plan with calculations to back it up) no permit is necessary because there will be no discharge from the site, excluding those sites that present a risk to groundwater as said above.

1.1. ELIGIBILITY CONDITIONS REQUIRED OF ALL PROJECTS.

Only those parties and projects that meet all of the following eligibility conditions may be covered under this permit:

1.1.1. Parties that must sign the NOI are the parties shown below that are involved with construction activity on a construction project.

a. Owner: The party that owns/leases the land on which the construction activities occur and has ultimate control over the project and the destiny of a project. The owner has control over construction plans and specifications, including the ability to make modifications at the highest level, to those plans and specifications.

b. Operator: The party (usually the general contractor) that has day-to-day operational control of those activities at a project that are necessary to ensure compliance with the permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the permit).

Note: In the case of land development there may be sub-projects (such as construction of a house in a residential development) associated with the main project. In the case that the parcel of land for the subordinate project is sold to another owner, it must be covered under a separate permit and cannot be covered under the same permit for the development. If the developer is the owner of the development and owner of houses being built in the development (this would be for a house(s) built for speculation unless the prospective owner of the house has not secured ownership yet), the house building may continue to be covered under the original development permit provided the SWPPP for the main project covers the details concerning the activities of the subordinate project.

Note: *Only one NOI permit application can provide coverage for one area under one owner and one operator. If a development gets to the point where lots are sold and another party(ies) takes over control and ownership on sub-project(s) in the development, a new permit must cover the area for the new owner. The developer's original permit can no longer cover that area and the original owner/developer must submit a partial NOT for the area that is sold.*

c. **Operators must provide information, coordination, and/or contract obligations** so that all parties involved in the project perform by SWPPP (see Part 7.) and permit requirements.

1.1.2. The Project:

a. A project covered by this permit will **disturb 1 or more acres of land**, or will disturb less than 1 acre of land but be part of a **common plan** of development or sale that will ultimately disturb 1 or more acres of land; or

b. **A project's discharges have been designated** by the Executive Secretary as needing a permit under UAC 317-8-3.9(1)(a)5. or UAC 317-8-3.9(6)(e)2.;

1.1.3. A project is **located within the state of Utah**, except for Indian Country (Storm water permits for Indian Country within the State must be acquired through EPA Region VIII, except for facilities on the Navajo Reservation or on the Goshute Reservation which must acquire storm water permits through EPA Region IX);

1.1.4. **Discharges** from a project area **cannot**;

a. **already have coverage under** the UPDES CGP or an individual storm water permit for construction activity; or

Note: There can be another UPDES wastewater permit for wastewater generated at the site in a discharge separate from the storm water discharge, and/or other industrial storm water permit coverage for industrial storm water discharged at the site. There cannot be double coverage under this CGP for the same area for construction activity.

b. **be in the process of having coverage** under a different UPDES permit for a storm water (from construction activities) discharge denied, terminated, or revoked.[1,2]

1.1.5. *Endangered Species Act (ESA)*: This permit does not diminish from or alter in any way a permittees responsibility under the ESA. It is the permittees responsibility to comply with the ESA as it pertains to your project's construction activities. There are no requirements in this permit concerning the ESA.

---

[1] Parts 1.1.4.a. and 1.1.4.b. do not include sites currently covered under UTR100000 or UTR300000, which are in the process of obtaining coverage under this permit, and sites covered under this permit which are transferring coverage to a different operator.

[2] Notwithstanding a project being made ineligible for coverage under this permit because it falls under the description of Parts 1.1.4.a or 1.1.4.b, above, DWQ may waive the applicable requirement after specific review if it determines that coverage under this permit is appropriate.

1.1.6. *National Historic Preservation Act (NHPA)*:
The permit does not diminish from or alter in any way a permittees responsibility under the NHPA. It is the permittees responsibility to comply with the NHPA as it pertains to your project's construction activities. There are no requirements in this permit concerning the NHPA.

1.2. **ELIGIBILITY CONDITIONS THAT APPLY DEPENDING ON TYPE OF PROJECT.** The following conditions (Parts 1.2.1 through 1.2.4), if applicable, must also be satisfied in order to obtain coverage under this permit.

1.2.1. **Eligibility for Emergency-Related Construction Activities**. If you are conducting earth-disturbing activities in response to a public emergency (e.g., natural disaster, widespread disruption in essential public services), and the related work requires immediate authorization to avoid imminent endangerment to human health, public safety, or the environment, or to reestablish essential public services, your requirements are:

a. If the emergency related activity is accomplished within 30-days you are waived from the normal requirements to submit an NOI and prepare a SWPPP, but you must submit a report to DWQ within 45-days and show:

i. the nature of the emergency work performed,

ii. a description of earth disturbances that occurred,

iii. the proximity of the work to waters of the US, and what was done (if anything) to protect water quality during the emergency work, and

iv. the occurrence of the public emergency must be substantiated.

b. If the emergency activity continues longer than 30-days you are authorized to discharge on the condition that a complete and accurate NOI is submitted within 30 calendar days after commencing earth-disturbing activities establishing that you are eligible under this permit. You are also required to provide documentation in your SWPPP to substantiate the occurrence of the public emergency (see 7.2.3.).

1.2.2. **Water Quality Standards – Eligibility for New Sources**. If you are a "new source" (as defined in Appendix A), you are not eligible for coverage under this permit for discharges that have the reasonable potential to cause, or contribute to an excursion above any applicable water quality standard. Where such a determination is made, DWQ may notify you that an individual permit application is necessary in accordance with Part 1.4.5. However, your coverage under this permit will be acceptable if you have included appropriate controls and implementation procedures designed to bring your discharge into compliance with water quality standards. In the absence of information demonstrating otherwise, DWQ expects that compliance with the storm water control requirements of this permit, including the requirements applicable to such discharges in Part 3.2, will result in discharges that will not cause, have the reasonable potential to cause, or contribute to an excursion above any applicable water quality standard.

1.2.3. **Discharging to Waters with High Water Quality – Eligibility for New Sources.** If you are a "new source" (as defined in Appendix A), you are eligible to discharge to a Category 1 water if your discharge is temporary and limited and where best management practices will be employed to minimize pollution effects, to a Category 2 water only if your discharge will not lower the water quality of the applicable water. In the absence of information demonstrating otherwise, DWQ expects that compliance with the storm water control requirements of this permit, including the requirements applicable to such discharges in Part 3.3.2, will result in discharges that will not lower the water quality of the applicable water. Please refer to Appendix C or look up your receiving waters for water quality information at http://wq.deq.utah.gov/.

Note: *Your project will be considered to discharge to a Category 1 or 2 water if the first surface water to which you discharge is identified by the state as a Category 1 or 2 water. For discharges that enter a storm sewer system prior to discharge, the first surface water to which you discharge is the water body that receives the storm water discharge from the storm sewer system.*

1.2.4. **Use of Cationic Treatment Chemicals**. If you plan to use cationic treatment chemicals (as defined in Appendix A), you are ineligible for coverage under this permit, unless you notify DWQ in advance and DWQ authorizes coverage under this permit (in writing) after you have included appropriate controls and implementation procedures designed to ensure that your use of cationic treatment chemicals will not lead to an impairment of the natural life cycle of any aquatic organism downstream.

1.3. **TYPES OF DISCHARGES AUTHORIZED UNDER THIS PERMIT.**
The following is a list of discharges that are allowed under this permit provided that appropriate storm water controls are designed, installed, and maintained:

1.3.1. **Storm water discharges**, including storm water runoff, snowmelt runoff, and surface runoff and drainage, associated with construction activity under UAC R317-8-3.9(6)(d)10. or UAC R317-8-3.9(6)(e)1.;

1.3.2. Storm water **discharges designated** by DWQ as needing a permit under UAC R317-8-3.9(1)(a)5 or UAC R317-8-3.9(6)(e)2;

1.3.3. Storm water discharges from **construction support activities** (e.g., concrete or asphalt batch plants, equipment staging yards, material storage areas, excavated material disposal areas, borrow areas) provided:

a. The support activity is directly related to the construction site required to have permit coverage for storm water discharges;

b. The support activity does not serve multiple unrelated construction projects;

c. The support activity does not continue to operate beyond the completion of the construction activity at the project it supports; and

d. Storm water controls are implemented in accordance with Part 2 and, if applicable, Part 3, for discharges from the support activity areas.

1.3.4. **The following non-storm water discharges** from your construction activity **are allowed** under this permit, provided that you comply with all applicable requirements for these discharges in Part 2:

a. Discharges from emergency fire-fighting activities;

b. Fire hydrant flushings;

c. Properly managed landscape irrigation;

d. Water used to wash vehicles and equipment, provided that there is no discharge of soaps, solvents, or detergents used for such purposes;

e. Water used to control dust;

f. Potable water including uncontaminated water line flushings;

g. Routine external building washdown that does not use detergents, or that have received chemicals to alter pH;

h. Pavement wash waters provided spills or leaks of toxic or hazardous materials have not occurred (unless all spill material has been removed) and where detergents (including Biodegradable soy bean oils and Biodegradable detergents) are not used. You are prohibited from directing pavement wash waters directly into any surface water, storm drain inlet, or storm water conveyance;

i. Uncontaminated air conditioning or compressor condensate;

j. Uncontaminated, non-turbid discharges of ground water (from natural sources) or spring water;

k. Foundation or footing drains where flows are not contaminated with process materials such as solvents, contaminated ground water, or sediment from construction activity; and

1.3.5. Discharges of storm water listed above in Parts 1.3.1, 1.3.2, and 1.3.3, or authorized non-storm water discharges in Part 1.3.4 above, commingled with a discharge authorized by a different UPDES permit and/or a discharge that does not require UPDES permit authorization.

a. Construction dewatering must be permitted under UTG070000 (Construction Dewatering and Hydrostatic Test Permit), and the MS4 (of jurisdiction) notified of the discharge. It does not need to be permitted under UTG070000 if the construction dewatering does not leave the site (it is percolated into the ground at some place on the project site),

1.4. **SUBMITTING YOUR NOTICE OF INTENT (NOI) AND PERMIT FEE.**
Except for permittees with existing permit coverage (permittees with existing coverage from a CGP that was issued earlier and that has now expired just prior to the issuance of

this permit, who are automatically covered under this permit see 1.4.3.), to be covered under this permit, you must submit to DWQ a complete and accurate NOI and the permit fee prior to commencing construction activity. The permit fee is a yearly fee. To remain covered under the permit the permit fee must be submitted again once every year on the yearly anniversary of the submission date of the NOI along with a permit fee until the project is completed.

The NOI certifies to DWQ that you are eligible for coverage according to Part 1.1 and 1.2, and provides information about your construction operation and discharge.

There is one exception to the requirement. It is for an emergency-related project. For this type of project, the NOI must be submitted within 30 calendar days after the commencement of earth disturbing activities (see Part 1.2.1).

In every case a **Storm Water Pollution Prevention Plan (SWPPP)** consistent with Part 7 **must be completed prior to submitting your NOI** for coverage under this permit. Failure to develop a SWPPP and or have a sufficient SWPPP on site can result in fines and or work stoppages.

All NOI applications and project storm water compliance plans must be coordinated with storm water regulated MS4s (municipalities with storm water jurisdiction that are regulated with a municipal storm water permit, see the list of regulated MS4s in Appendix E). MS4s that are regulated under a municipal storm water permit are required to oversee construction activity on disturbances over an acre (or less than an acre if part of a common plan of development that is over an acre) within their jurisdiction. Utah DWQ directly reviews and inspects permittees in all other areas of Utah (except "Indian country").

1.4.1. **How to Submit Your NOI**. NOIs must be entered on DEQ's electronic NOI and storm water system. This can be done on **https://secure.utah.gov/stormwater.** If you do not have access to the internet or are having continual problems with the use of the NOI (CGP permit application) system, contact the DWQ Office at 801-536-4300, and submit a hard copy of the NOI form which can be found on the DWQ construction storm water web site (http://www.waterquality.utah.gov/UPDES/stormwatercon.htm -- see footnote 3 next page). DWQ advises that at some point you create an account for the on-line storm water permit data base so that you can track your permit and have the options to renew and/or terminate your permit (actions that should be done on-line).

1.4.2. **Start and End of Permit Coverage and Deadlines**. Except for projects initiated for emergency situations (for which either the NOI requirement is waived or the NOI must be submitted within 30-days after the commencement of soil disturbing activities, see paragraph 1.2.1), the construction storm water permit must be obtained before soil disturbing activities can begin on a construction site. This permit will officially cover construction activity on a project site immediately after the NOI has been successfully entered into the storm water data base,[3] and the

[3] All storm water NOIs are electronically entered into the SW data base. The vast majority are entered electronically by permittees in the on-line application process. For cases where a permittee is not able to electronically enter an NOI the permittee must submitted a paper form of the NOI to DWQ where it will be entered electronically by DWQ staff.

permit fee is paid. Coverage will remain active contingent on all of the following conditions:

a. The permittee purposely terminates the permit:

   i. a notice of termination (NOT) is submitted electronically (preferably) or in paper form to DWQ.

   ii. where the permitted site is within a regulated MS4 jurisdiction (see Appendix E) the permittee must contact the local MS4 to inform that the project is completed and request a final inspection,

Note: *Termination of the project is not complete without approval through a final inspection.*

b. the yearly permit fee is kept current and renewed year by year for the period of construction activity,

c. when this general permit (UTRC00000) expires it is assumed at this point that coverages will automatically transfer to a succeeding permit, but if not the permittee will have to apply for continued coverage under a new or reissued replacement permit,

d. coverage under the CGP is rescinded or revoked for the project site for administrative reasons for which the permittee will be notified in writing, or

e. in the case, if or when all storm water discharges for the site are permitted under a different general or individual UPDES permit. For which case this permit is terminated on the day the other permit coverage begins.

1.4.3. **Exception to NOI Deadline for "Existing Permits".** Existing permits are construction activities with soil disturbances which require coverage under a UPDES construction storm water permit, and which projects had active and legitimate coverage under UTR300000 at the time of expiration of that general permit, or that received coverage before this permit was issued. Existing projects are automatically "covered" under this permit. The same permit tracking number given under UPDES general storm water permit UTR300000 will continue to identify permit coverage for an existing project under this permit. **Existing projects have <u>6 months</u>** from the issuance date of this permit to update site storm water controls and the site SWPPP to meet requirements in this permit.

1.4.4. **Continuation of Coverage for 'Existing Permits' After this Permit Expires**. If this permit is not reissued or replaced by the expiration date of the general permit, it will be administratively extended by the Director and remain in force and effect until issuance of a comparable CGP replacement. Permit coverage will continue under this permit until the earliest of:

a. authorization of, and an application process, is provided for coverage under a reissued or replacement version of this permit; or

b. the permittee's submittal of a Notice of Termination; or

c. the issuance of an individual permit or denial of coverage (see part 1.4.5 below) for the project's discharges; or

d. A final permit decision by DWQ not to reissue a general permit, at which time DWQ will identify a reasonable time period for covered dischargers to seek coverage under an alternative general permit or an individual permit. Coverage under this permit will terminate at the end of this time period.

DWQ reserves the right to modify or revoke and reissue this permit under UAC317-8-5.6, in which case you will be notified of any relevant changes or procedures to which you may be subject.

1.4.5. **Procedures for Denial of Coverage**. Following your submittal of a complete and accurate NOI, you may be notified in writing by DWQ that you are not covered, and that you must either apply for and/or obtain coverage under an individual UPDES permit or an alternate general UPDES permit. This notification will include a brief statement of the reasons for this decision and will provide application information. Any interested person may request that DWQ consider requiring an individual permit under this paragraph.

If you are already a permittee with coverage under this permit, the notice will set a deadline to file the permit application, and will include a statement that on the effective date of the individual UPDES permit or alternate general UPDES permit, as it applies to you, coverage under this general permit will terminate. DWQ may grant additional time to submit the application if requested. If you are covered under this permit and fail to submit an individual UPDES permit application or an NOI for an alternate general UPDES permit as required by DWQ, then the applicability of this permit to you is terminated at the end of the day specified by DWQ as the deadline for application submittal. DWQ may take appropriate enforcement action for any unpermitted discharge. If you submit a timely permit application, then when an individual UPDES permit is issued to you or you are provided with coverage under an alternate general UPDES permit, your coverage under this permit is terminated on the effective date of the individual permit or date of coverage under the alternate general permit.

1.5. **REQUIREMENT TO POST A NOTICE OF YOUR PERMIT COVERAGE.** You must post a sign or other notice conspicuously at a safe, publicly accessible location in close proximity to the project site. At a minimum, the notice must include the UPDES Permit tracking number and an operator contact name (or designee) and phone number and/or email address for obtaining additional UPDES permit, SWPPP, and/or project information. The notice must be located so that it is visible from a public access point that is nearest to the active part of the construction site, and it must use a font large enough to be readily viewed from a public right-of-way. The posted contact number must have a person available for response during business hours. An inquiry made to the posted email address must receive a response within 24-hours week days.

2. EFFLUENT LIMITATIONS APPLICABLE TO ALL DISCHARGES FROM CONSTRUCTION SITES (including support activities).

Note: *If your project is an "existing project" (see Part 1.4.3) or if you are a "new owner/operator of an existing project" (see Part 1.4.3), and it is infeasible for you to comply with a specific requirement in this Part because (1) the requirement was not part of the permit you were previously covered under (i.e., the 2003 or 2008 CGP), you are required to document this fact in your SWPPP and are waived from complying with that requirement. This flexibility applies only to the requirements in Parts 2.1, and 2.3.3 through 2.3.5 (except for Parts 2.3.3.a, 2.3.3.b.ii, 2.3.3.c.iii.1), and 2.3.3.d). This only applies to those portions of your site that have already commenced earth-disturbing activities or where storm water controls implemented in compliance with the previous permit have already been installed.*

This section includes the following types of requirements:

- Erosion and Sediment Control Requirements (Part 2.1)
- Stabilization Requirements (Part 2.2)
- Pollution Prevention Requirements (Part 2.3)

2.1. EROSION AND SEDIMENT CONTROL REQUIREMENTS.

Erosion and sediment controls must be designed, installed, and maintained to minimize the discharge of pollutants from earth-disturbing activities.

2.1.1. General Requirements Applicable to All Construction Sites.

a. **Area of Disturbance**. You are required to minimize the amount of disturbed and exposed soil during construction activities.

b. **Design Requirements**.

Note: *Although many aspects of developing a SWPPP do not require a P.E., there are significant portions or items required in the development of a SWPPP that makes it to where many if not all SWPPPs must include a P.E.in its development. It is not required for a P.E. to stamp the entire SWPPP because operators must have the flexibility to modify a SWPPP. There may be facilities in a SWPPP that need to be stamped and would require a review and to be re-stamped by a P.E. again if modifications occur. For the most part SWPPPs should be designed so that operators have the flexibility to make modifications and updates in the field as is necessary so that improvements can be made for the protection of disturbed soils and the quality of storm water runoff if SWPPP plans prove to be ineffective, or if the conditions at the site turn out to be different than expected. A P.E. knows what is not safe without a stamp.*

i. Storm water controls must be installed to handle what is estimated as normally expected for the area including seasonal considerations. Considerations include storm water run-on and run-off, flow from impervious surfaces, slopes, infiltration potential, and site drainage features.

ii. For temporary/permanent sediment basins and channelized flows design must consider the following factors for storm water controls.

1) expected frequency, intensity, and duration of precipitation;

2) peak flowrates and total storm water volume to minimize downstream channel and streambank erosion in the immediate vicinity of the discharge points; and

3) the range of soil particle sizes expected to be present on the site.

iii. The permittee must **preserve naturally vegetated areas where possible** and if feasible use these areas to maximize infiltration and to reduce pollutant discharges. The use of velocity dissipation devices may be necessary to prevent erosion.

c. **Installation Requirements.**

i. Unless infeasible **storm water controls must be installed before commencing each phase of earth-disturbance** (e.g., buffers or equivalent sediment controls, perimeter controls, exit point controls, storm drain inlet protection) that control discharges from the initial site clearing, grading, and excavating.

Note: *Where it is infeasible to install storm water controls prior to the beginning of earth disturbing activities such controls must be installed immediately following the initial earth disturbance.*

ii. All **storm water controls must be installed in accordance with good engineering and construction practices and manufacturer's specifications** including applicable design specifications.

Note: *Design specifications may be found in manufacturer specifications and/or in applicable erosion and sediment control manuals or ordinances. Any departures from such specifications must reflect good engineering practice, good construction practices and must be explained in your SWPPP.*

d. **Maintenance Requirements.**

i. All erosion and sediment controls required in this Part must remain in effective operating condition during permit coverage and be protected from activities that would reduce their effectiveness.

ii. All erosion and sediment controls must be inspected in accordance with the applicable requirements in Part 4.1, For problems discovered during inspections replacement, repairs, or maintenance must be done immediately following the inspection or in a timely manner as identified in the SWPPP. The permittee must maintain all preserved vegetation, erosion and sediment control measures and other protective measures identified in the SWPPP in effective operating condition for all precipitation events, or before if required by DWQ or MS4 oversight inspectors. . If maintenance prior to the next anticipated storm event is impracticable, maintenance must be scheduled and accomplished as soon as practicable.

iii. Maintenance needs identified by means other than inspections shall be accomplished before the next anticipated storm event, or as necessary to

maintain the continued effectiveness of storm water controls. A description of procedures to ensure the timely maintenance of these measures shall be identified in the SWPPP.

2.1.2. **Erosion and Sediment Control Requirements Applicable to All Sites.**

a. **Natural Buffers or Equivalent Sediment Controls.** (These requirements only apply when a surface water is located within 50 feet of your project's earth disturbances, and in the case of intermittent waters, only to surface waters that have visible water flowing or that typically flow continuously more than two months out of the year).

Note: *Areas that you do not own or that are otherwise outside your operational control may be considered areas of undisturbed natural buffer for purposes of compliance with this part.*

You must ensure that any discharges to surface waters through the area between the disturbed portions of the property and any surface waters located within 50 feet of your site are treated by an area of undisturbed natural buffer and/or additional erosion and sediment controls in order to achieve a reduction in sediment load equivalent to that achieved by a 50-foot natural buffer. Refer to Appendix D (Buffer Guidance) for information to assist you in complying with this requirement, and to Part 2.1.2.a.v. for exceptions to this requirement.

i. **Compliance Alternatives**. You can comply with this requirement in one of the following ways:

1) Provide and maintain a 50-foot undisturbed natural buffer; or

Note: *If your earth disturbances are located 50 feet or further from a surface water, then you have complied with this alternative.*

2) Provide and maintain an undisturbed natural buffer that is less than 50 feet that is supplemented by additional erosion and sediment controls, which in combination achieves the sediment load reduction equivalent to a 50-foot undisturbed natural buffer (see Appendix D); or

3) If it is infeasible to provide and maintain an undisturbed natural buffer of any size, you must implement erosion and sediment controls that achieve the sediment load reduction equivalent to a 50-foot undisturbed natural buffer (see Appendix D).

Note: *For the compliance alternatives in Parts 2.1.2.a.i.1) and 2.1.2.a.i.2), you are not required to enhance the quality of the vegetation that already exists in the buffer, or provide vegetation if none exists (e.g., arid and semi-arid areas). You only need to retain and protect from disturbance the natural buffer that existed prior to the commencement of construction. Any preexisting structures or impervious surfaces are allowed in the natural buffer provided you retain and protect from disturbance the natural buffer area outside the preexisting disturbance. Similarly, for alternatives 2.1.2.a.i.2) and 2.1.2.a.i.3), you are required to implement and maintain sediment controls that achieve the sediment load reduction equivalent to the undisturbed natural buffer*

that existed on the site prior to the commencement of construction. In determining equivalent sediment load reductions, you may consider naturally non-vegetated areas and prior disturbances. See Appendix D for a discussion of how to determine equivalent reductions.

You must document the compliance alternative you have selected in your SWPPP, and comply with the applicable additional requirements described in Parts 2.1.2.a.ii. below.

The compliance alternative selected above must be maintained throughout the duration of permit coverage, unless you select a different compliance alternative during your period of permit coverage, in which case you must modify your SWPPP to reflect this change.

ii. **Additional Requirements for the Compliance Alternatives in Parts 2.1.2.a.i.1) and 2.1.2.a.i.2)**. If you choose either of the compliance alternatives in Parts 2.1.2.a.i.1) or 2.1.2.a.i.2) above, throughout your period of coverage under this permit, you must comply with the following additional requirements:

1) Where there is a concentrated storm water discharge leaving the site's disturbed area and crossing the natural buffer area (whether the buffer area is a full 50 feet (2.1.2.a.i.1) or less than 50 feet with additional BMPs (2.1.2.a.i.2)), the concentrated flow must have treatment or BMPs to minimize sediment transport, found in the area generating the flow and not just as it crosses the buffer area. Additionally, velocity dissipation devices must be used where erosion is caused by the flow as it crosses the buffer area;

2) Document in your SWPPP the natural buffer width retained on the property, and show the buffer boundary on your site plan; and;

3) Delineate, and clearly mark off, with flags, tape, or other similar marking device all natural buffer areas.

iii. **Additional Requirements for the Compliance Alternatives in Parts 2.1.2.a.i.2) and 2.1.2.a.i.3)**. For compliance alternatives in Parts 2.1.2.a.i.2) and 2.1.2.a.i.3), you must document in your SWPPP the erosion and sediment control(s) you will use to achieve an equivalent sediment reduction, and any information you relied upon to demonstrate the equivalency.

iv. **Additional Requirement for the Compliance Alternative in Part 2.1.2.a.i.3)**. For compliance alternative in Part 2.1.2.a.i.3), you must also include in your SWPPP a description of why it is infeasible for you to provide and maintain an undisturbed natural buffer of any size.

v. **Exceptions**.

1) If there is no discharge of storm water to surface waters through the area between your site and any surface waters located within 50 feet of your site, you are not required to comply with the requirements in this Part.

This includes situations where you have implemented control measures such as a berm or other barrier that will prevent such discharges.

2) Where no natural buffer exists due to preexisting development disturbances (e.g., structures, impervious surfaces) that occurred prior to the initiation of planning for the current development of the site, you are not required to comply with the requirements in this Part, unless you will remove portions of the preexisting development.

   Where some natural buffer exists but portions of the area within 50 feet of the surface water are occupied by preexisting development disturbances, you are required to comply with the requirements in this Part. For the purposes of calculating the sediment load reduction for either Part 2.1.2.a.i.2) or 2.1.2.a.i.3) above, you are not expected to compensate for the reduction in buffer function from the area covered by these preexisting disturbances. See Appendix D for further information about compliance alternatives in Part 2.1.2.a.i.2) or 2.1.2.a.i.3) above.

   If during your project, you will disturb any portion of these preexisting disturbances, the area disturbed will be deducted from the area treated as natural buffer.

3) For "linear construction projects" (see Appendix A for a definition), you are not required to comply with the requirements in this Part if site constraints (e.g., limited right-of-way) prevent you from meeting any of the compliance alternatives in Part 2.1.2.a.i, provided that, to the extent practicable, you limit disturbances within 50 feet of the surface water and/or you provide supplemental erosion and sediment controls to treat storm water discharges from earth disturbances within 50 feet of the surface water. You must also document in your SWPPP your rationale as to why it is infeasible for you to comply with the requirements in Part 2.1.2.a.i, and describe any buffer width retained and/or supplemental erosion and sediment controls installed.

4) For "small residential lot" construction (i.e., a lot being developed for residential purposes that will disturb less than 1 acre of land, but is part of a common plan of development or sale that will ultimately disturb greater than or equal to 1 acre), you have the option of complying with the requirements in Appendix D, Part D.2.3.

5) The following disturbances within 50 feet of a surface water are exempt from the requirements in this Part:

   - Construction approved under a CWA Section 404 permit; or
   - Construction of a water-dependent structure or water access area (e.g., pier, boat ramp, trail).

   You must document in your SWPPP if any of the above disturbances will occur within the buffer area on your site.

b. **Perimeter Controls**.

i. **Installation Requirements**: You must install sediment controls along those perimeter areas of your site that will receive storm water from areas where earth disturbing activities are occuring[4] **For linear projects** with rights-of-way that restrict or prevent the use of such perimeter controls, you must maximize the use of these controls where practicable and document in your SWPPP why it is impracticable in other areas of the project.

ii. **Maintenance Requirements**: You must remove sediment before it has accumulated to the point where storm water controls becomes ineffective. Often that is one-half of the above-ground height of any perimeter control. The permittee must follow maintenance specifications for the BMP used.

c. **Sediment Track-Out**. You must minimize the track-out of sediment onto off-site streets, other paved areas, and sidewalks from vehicles exiting your construction site. To comply with this requirement, you must:

i. Restrict vehicle use to properly designated exit points;

ii. Use appropriate stabilization techniques[5] at all points that exit onto paved roads so that sediment removal occurs prior to vehicle exit;

iii. Where necessary, use additional controls[6] to remove sediment from vehicle tires prior to exit; and

iv. Where sediment has been tracked-out from your site onto the surface of off-site streets, other paved areas, and sidewalks, you must remove deposited sediment before it accumulates significantly and is tracked beyond the immediate vicinity of the project (that may be several times a day or once a week, whatever is required to control off site tracking). You must remove the track-out by sweeping, shoveling, or vacuuming these surfaces, or by using other similarly effective means of sediment removal. You are prohibited from hosing or sweeping tracked out sediment into any storm water conveyance, storm drain inlet, or surface water.

Note: *DWQ recognizes that some fine grains may remain visible on the surfaces of off-site streets, other paved areas, and sidewalks even after you have implemented sediment removal practices. Such "staining" is not a violation of Part 2.1.2.c.*

d. **Control Discharges from Stockpiled Sediment or Soil**. For any stockpiles or land clearing debris composed, in whole or in part, of sediment or soil

[4] Examples of perimeter controls include, but are not limited to, natural buffer zones (on the site or off); vegetative filter strips; silt fences; filter berms such as staked or weighted straw wattles, other wattles (sand, gravel, or those that are of a proprietary design); and temporary diversion dikes.
[5] Examples of appropriate stabilization techniques include the use of aggregate stone with an underlying geotextile or non-woven filter fabric, or turf mats.
[6] Examples of additional controls to remove sediment from vehicle tires include, but are not limited to, wheel washing, rumble strips, and rattle plates.

Note: *For the purposes of this permit, sediment or soil stockpiles are defined as the storage for multiple days of soil or other sediment material to be used in the construction project. If a sediment or soil pile is used within a short period of time (e.g., a day or three days especially during dry days), it does not fall under the requirements of this part.*

You must comply with the following requirements:

i. Stockpiles must be located outside of any natural buffers established under Part 2.1.2.a.i and physically separated from other storm water controls (such as perimeter controls or inlet protection) implemented in accordance with Part 2.1, but must be contained within the BMP protected area of the site;

ii. Protect from contact with storm water (including run-on) using a temporary perimeter sediment barrier;[7]

iii. Where practicable, provide cover or appropriate temporary stabilization to avoid direct contact with precipitation or to minimize sediment discharge;

Note: *For 2.1.2.d.iii. the objective is to minimize sediment discharge, the best BMP is to cover the pile; the second best BMP is to stabilize the surface of the pile, the third best is to set filter berms, silt fence, or equivalent around the bottom of the pile, maybe there should be 2 of the 3 suggested BMPs applied. The degree of effort must be commensurate to the risk of sediment loss that could affect water quality.*

iv. Do not hose down or sweep soil or sediment accumulated on pavement or other impervious surfaces into any storm water conveyance, storm drain inlet, or surface water; and

v. Where practicable, contain and securely protect from wind.

e. **Minimize Dust**. In order to avoid pollutants from being discharged into surface waters you must minimize the generation of dust through the appropriate application of water or other dust suppression techniques (as required in your air quality permit for those that are required to have air quality permits).

i. Minimize the Disturbance of Steep Slopes. You must minimize the disturbance of "steep slopes" (see definition in Appendix A).

Note: *The permit does not prevent or prohibit disturbance on steep slopes. For some projects, disturbance on steep slopes may be necessary for construction (e.g., a road cut in mountainous terrain). If a disturbance to steep slopes is required for the project, DWQ would recognize that it is not economically achievable to avoid the disturbance to steep slopes. However, in cases where steep slope disturbances are required, minimizing the disturbances to steep slopes consistent with this requirement can be accomplished through the implementation of a number of standard erosion and sediment control practices, such as by phasing disturbances to these areas and using stabilization practices designed to be used on steep grades.*

f. **Preserve Topsoil**. You must preserve native topsoil on your site, unless infeasible. Preserving topsoil is not required where the intended function of a

[7]Examples include berms, dikes, fiber rolls, silt fences, sandbag, gravel bags, or straw bale.

specific area of the site dictates that the topsoil be removed, and/or that the finished surface will be stabilized by a means other than re-vegetation.

Note: *Some projects may be designed to be highly impervious after construction, and therefore little or no vegetation is intended to remain. In these cases, preserving topsoil at the site would not be feasible. Some sites may not have space to stockpile topsoil on site for later use, in which case, it may also not be feasible to preserve topsoil.*

Note: *Stockpiling of topsoil at off-site locations, or transfer of topsoil to other locations, is an example of a practice that is consistent with the requirements in this Part.*

g. **Minimize Soil Compaction**. In areas of your site where final vegetative stabilization will occur or where infiltration practices will be installed, you must either (minimizing soil compaction is not required where the intended function of the specific area of the site dictates that it be compacted):

   i. **Restrict vehicle / equipment use**. Restrict vehicle and equipment use in these locations to avoid soil compaction (except for equipment used for seeding or cat tracking); or

   ii. **Use soil conditioning techniques**. Prior to seeding or planting areas of exposed soil that have been compacted, use techniques that loosen or condition the soils to support vegetative growth, if necessary and feasible.

h. **Protect Storm Drain Inlets**. If you discharge to any storm drain inlet that carries storm water flow from disturbed areas of your site directly to a surface water, and you have authority to access the storm drain inlet, you must:

   i. **Installation Requirements**. Install inlet protection measures[8] that remove sediment from your discharge prior to entry into the storm drain inlet.

Note: *Inlet protection measures can be removed in the event of flood conditions or to prevent erosion.*

   ii. **Maintenance Requirements**. Clean, or remove and replace, storm water protection measures as sediment accumulates, the filter becomes clogged, and/or performance is compromised. Inlet protection measures should be maintained in effective working conditions at all times, but particular attention must be given to prepare inlets for a forecasted precipitation event.

i. **Areas of High Altitude/Heavy Snow Conditions**. You must attempt to prepare for the heavy snows by deploying storm water controls prior to the first heavy snow, and have appropriate storm water control measures designed to handle snow melt before heavy snows occur. Dates when snow is expected should be noted in the SWPPP and updated as construction commences into the snow season. Stabilization measures should be deployed at the same time (see Section 2.2.1.c.).

[8] Examples of inlet protection measures include fabric filters, sandbags, gravel with filter fabric and concrete block barriers, weighted fiber rolls, wattles of filter fabric filled with sand/gravel, and proprietary devices designed for inlet protection.

2.1.3. **Requirements Applicable Only to Sites Using These Specific Storm Water Controls**. You are required to comply with the following requirements if you will install any of the following storm water controls at your site:

a. **Constructed Storm Water Conveyance Channels**. Design storm water conveyance channels to avoid unstabilized areas on the site and to reduce erosion, unless infeasible. Minimize erosion of channels and their embankments, outlets, adjacent streambanks, slopes, and downstream waters during discharge conditions through the use of erosion controls and velocity dissipation devices[9] within and along the length of any constructed storm water conveyance channel, and at any outlet to provide a non-erosive flow velocity.

b. **Sediment Basins**. If you install a sediment basin , you must comply with the following:

i. **Design requirements**:

1) Provide storage for either (1) the calculated volume of runoff from a 2-year, 24-hour storm (see Appendix F), or (2) 3,600 cubic feet per acre drained;

2) When discharging from the sediment basin, utilize outlet structures that withdraw water from the surface in order to minimize the discharge of sediment and floatable pollutants, unless infeasible; (taking water from the top is warmer, so in a case where you have a TMDL or water sensitive to temperature it would be better to take it from the middle)

Note: *DWQ believes that the circumstances in which it is infeasible to design outlet structures in this manner are rare. Exceptions may include areas with extended cold weather, where surface outlets may not be feasible during certain time periods (although it is expected that they would be used during other periods). If you have determined that it is infeasible to meet this requirement, you must provide documentation in your SWPPP to support your determination.*

3) Prevent erosion of (1) the sediment basin using stabilization controls (e.g., erosion control blankets), and (2) the inlet and outlet using erosion controls and velocity dissipation devices; and

4) Sediment basins must be situated outside of surface waters and any natural buffers established under Part 2.1.2.a.i, and must be designed to avoid collecting water from wetlands.

ii. **Maintenance requirements**. Keep basins in effective operating condition and remove accumulated sediment when the basin reaches ½ of the design capacity of the sediment basin.

[9]Examples of velocity dissipation devices include check dams, sediment traps, riprap, or grouted riprap at outlets. Although piped slope drains and geotextile reinforced channels do not control velocity they prevent erosion on slopes.

c. **Use of Treatment Chemicals**. If you plan to use cationic polymers and/or flocculants you must have an approval letter from DWQ. Otherwise you must comply with the following minimum requirements:

i. **Use conventional erosion and sediment controls prior to and after the application of treatment chemicals**. Use conventional erosion and sediment controls prior to chemical addition to ensure effective treatment. Chemicals may only be applied where treated storm water is directed to a sediment control (e.g., sediment basin, perimeter control) prior to discharge.

ii. **Select appropriate treatment chemicals**. Chemicals must be selected that are appropriately suited to the types of soils likely to be exposed during construction and discharged to locations where chemicals will be applied, and to the expected turbidity, pH, and flow rate of storm water flowing into the chemical treatment system or area. If you cannot ensure the appropriate dosage, DWQ will not approve the chemical use.

iii. **Minimize discharge risk from stored chemicals**. Store all treatment chemicals in leak-proof containers that are kept under storm-resistant cover and surrounded by secondary containment structures (e.g., spill berms, decks, spill containment pallets), or provide equivalent measures, designed and maintained to minimize the potential discharge of treatment chemicals in storm water or by any other means (e.g., storing chemicals in covered area or having a spill kit available on site).

iv. **Comply with local requirements**. Comply with relevant local requirements affecting the use of treatment chemicals.

v. **Use chemicals in accordance with good engineering practices and specifications of the chemical provider/supplier**. You must also use treatment chemicals and chemical treatment systems in accordance with good engineering practices, and with dosing specifications and sediment removal design specifications provided by the provider/supplier of the applicable chemicals, or document specific departures from these practices or specifications and how they reflect good engineering practice.

vi. **Ensure proper training**. Ensure that all persons who handle and use treatment chemicals at the construction site are provided with appropriate, product-specific training. Among other things, the training must cover proper dosing requirements.

vii. **Comply with additional requirements for the approved use of cationic chemicals**. If you have been authorized to use cationic chemicals at your site pursuant to Part 1.2.4, and the authorization is conditioned on your compliance with additional requirements necessary to ensure that the use of such chemicals will not impair the life cycle of aquatic organisms downstream.

viii. **Provide proper SWPPP documentation**. You must include documentation in your SWPPP consistent with Parts 7.2.5.h. and 7.2.9.b. on the specific

chemicals and chemical treatment systems you will use, and how you will comply with the requirements in this Part.

d. **Dewatering Practices**. You are prohibited from discharging ground water (or any water, even storm water, see note), that is extracted from excavations, trenches, foundations, vaults, or other similar points of accumulation, unless such waters are covered by the Utah UPDES permit for Construction Dewatering/Hydrostatic Testing. No additional permit is required if the water extracted is allowed to percolate back into the ground or that is otherwise managed where it does not have a surface discharge from the site.

Note: *Water that is present at construction sites, whether it is ground water, storm water, or from where ever, if it is heavily soiled from contact with construction activity it must be covered under the Construction Dewatering/Hydrostatic Testing permit with a total suspended solids limit if it is to be discharged.*

2.2. **STABILIZATION REQUIREMENTS.**

You are required to stabilize exposed portions of your site for all areas with an annual precipitation of over 20 inches in accordance with the requirements of this Part. This Part also includes stabilization and/or other requirements for areas with 20 inches of rainfall per year or less.

Note: *For the purposes of this permit, "exposed portions of your site" means areas of exposed soil that are required to be stabilized. Note that DWQ does not expect that temporary or permanent stabilization measures be applied to areas that are intended to be left unvegetated or unstabilized following construction (e.g., dirt access roads, utility pole pads, areas being used for storage of vehicles, equipment, or materials). However, areas constructed for these kinds of uses should have a finished surface conditioned with placement of a sufficient layer of soil similar to road base (or another kind of structural type soil/gravel layer that is resistant to erosion), and no top soil or organic material, and with compaction (unless gravel is used) to minimize the potential for erosion.*

2.2.1. **Deadlines for Initiating and Completing Stabilization for areas receiving an annual precipitation of more than 20 inches a year**.

a. **Deadline to Initiate Stabilization**. You must initiate soil stabilization measures within 14 days of whenever earth-disturbing activities have permanently or temporarily ceased on any portion of the site.

Note: *Earth-disturbing activities have permanently ceased when clearing and excavation within any area of your construction site that will not include permanent structures has been completed.*

Note: *For the purposes of this permit, DWQ will consider any of the following types of activities to constitute the initiation of stabilization:*

1. *prepping the soil for vegetative or non-vegetative stabilization;*
2. *applying mulch or other non-vegetative product to the exposed area;*
3. *seeding or planting the exposed area;*
4. *starting any of the activities in # 1 to # 3 on a portion of the area to be stabilized, but not on the entire area; and*
5. *finalizing arrangements to have a stabilization product fully installed in compliance with the applicable deadline for completing stabilization in Parts*

2.2.1.b.ii. This list of examples is not exhaustive.

b. **Deadline to Complete Stabilization Activities**. Within 14 calendar days after the initiation of soil stabilization measures consistent with Part 2.2.1.a[10], you are required to have completed:

i. For vegetative stabilization, all activities[11] necessary to initially seed or plant the area to be stabilized; and/or
ii. For non-vegetative stabilization, the installation or application of all such non-vegetative measures.

Note: *During the days (14 days before initiating the process of stabilization) that the permittee has to determine if a section of the project must be temporarily or permanently stabilized, there must be perimeter controls around the area to prevent sediment transport off the site until surface stabilization is in place.*

c. **Stabilization Requirements for High Altitudes and Areas Receiving Heavy Snow**. You must attempt to prepare for the heavy snows by deploying stabilization measures on all disturbed areas prior to the first heavy snow, and have appropriate stabilization measures designed to handle snow melt before heavy snows occur. Dates when snow is expected should be noted in the SWPPP and updated as construction commences into the snow season. Stabilization measures should be deployed at the same time as other runoff controls in anticipation of snow (see Section 2.1.2.i.).

2.2.2. **Stabilization and/or other requirements for areas receiving an annual precipitation of 20 inches of rainfall a year or less (arid and semi-arid areas), drought areas, and areas with seasonally dry periods**.

a. Within 14 calendar days of a temporary or permanent cessation of work in any portion of your site you must initiate installation of one of the following or equivalent. The intensity of the application must be commensurate with the conditions at the site (e.g. soil type, steepness of slopes, weather patterns and seasons, proximity to water body.). The goal is to arrest all sediment transport to within the boundaries of the site up to storms with intensities of ½ inch/hour or greater. The permittee must explain the strategy for stabilization in the SWPPP, and times when higher or lower intense BMPs will be placed and why:

i. Preparation for seeding and seeding or planting (which should be during a wetter season or with irrigation),

Note: *It would be good in arid and semi-arid areas to plan the installation of any irrigation system early in construction sequence so that seeding and planting efforts will be effective.*

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[10] DWQ may determine, based on an inspection carried out under Part 4.2 and corrective actions required under Part 5.3, that the level of sediment discharge on the site makes it necessary to require a faster schedule for completing stabilization. For instance, if sediment discharges from an area of exposed soil that is required to be stabilized are compromising the performance of existing storm water controls, DWQ may require stabilization to correct this problem.

[11] For example, such activities might include, but are not limited to, soil conditioning, application of seed or sod, planting of seedlings or other vegetation, application of fertilizer, and, as deemed appropriate, watering.

Note: *The lists found in 2.2.2.a.ii, iii, iv, and v. is a guideline. It is not necessary to deploy exactly as prescribed, but whatever is deployed must be effective at minimizing erosion and sediment transport from the site.*

ii. For steeper slopes – geotextile blankets staked as necessary with or without seeding (possibly with mulch under the blanket), fiber rolls staked on the contours every 10 ' (or less) apart with mulch applied to the surface between,

iii. Shallower slopes (15% or less):

1) Cat tracking over straw mulch (moist),

2) surface roughening in loose soil or cat tracking (depending on soil, mulch may have to be applied) with fiber rolls staked not more than 15 feet apart on the contours, on very shallow slopes and less distance apart for steeper slopes, (add mulch on steep end),

3) mulch, hydromulch, possibly with seed, with tackifier if needed,

iv. Flat areas:

1) At minimum, loosened soil, surface roughening with larger depression areas (surface roughening should provide many small depressions to collect storm water) to collect storm water, and with peripheral controls. The surface must be reworked if the soil becomes hardened or compacted.

v. Storm water conveyances:

1) piped slope drains, check dams, rip-rap, geotextile channel protection, or other velocity control and channel protection for all storm water conveyance must be deployed on a slope .

b. Within 14 calendar days after the initiation of seeding/ planting, or for application of control measure to initiate surface stabilization on inactive areas of the site, you must complete all activities necessary to initially seed/plant, stabilize, or control the area to protect from sediment transport[12].

2.2.3. **Deadlines for sites discharging to sensitive waters**. For any portion of the site that discharges to a sediment or nutrient-impaired water (see Part 3.2) or to a water that is identified as Category 1 or 2 for antidegradation purposes (see Part 3.3), you are required to complete the stabilization activities specified in Parts 2.2.1. and/or 2.2.2.

[12] Seed germination in the arid and semi-arid areas of Utah generally occurs in spring. Germination can occur in early fall if a wet season (if the "monsoons" come – a weather pattern that brings moist air from the southwest late summer into fall). Late fall is a good time to plant for spring germination. Germination timing is dictated by altitude, latitude, and often by dryer or wetter weather patterns. The application of seed qualifies as stabilization, however to be effective, seeding (hence stabilization) should be delayed until the spring or fall, or where irrigation can be provided.

within 7 calendar days after the temporary or permanent cessation of earth-disturbing activities.

2.2.4. **Criteria for Stabilization**. To be considered adequately stabilized, you must meet the criteria below depending on the type of cover you are using, either vegetative or non-vegetative.

Note: *Stabilization requirements are more difficult the more arid the area. Re-vegetation from seed in arid areas can take more than 3 years to fully develop. This permit allows termination in arid areas even if final stabilization as defined in Appendix A is not met. The terms to do this are spelled out in 2.2.4.a.ii.*

a. **Vegetative Stabilization.**

Note: *Vegetative stabilization measures for all areas, but especially in arid and semi-arid areas, is very important. Practices such as preservation of topsoil, and the use of compatible indigenous fill/borrow material pays off. Good vegetative management such as preserving existing vegetation, protecting natural buffers, and minimizing grading will prove valuable when attempting to stabilize and terminate the site and it will leave a better product.*

i. For all sites, except those located in arid and semi-arid areas (areas with 20 inches or less of precipitation) or on agricultural lands.

1) If you are vegetatively stabilizing any exposed portion of your site through the use of seed or planted vegetation, you must provide established uniform vegetation (e.g., evenly distributed without large bare areas), which provides 70 percent or more of the vegetative cover that was provided by vegetation prior to commencing earth-disturbing activities. You should avoid the use of invasive species;

2) For final stabilization, vegetative cover must be perennial; and

3) Immediately after seeding or planting the area to be vegetatively stabilized, to the extent necessary to prevent erosion on the seeded or planted area, you must select, design, and install non-vegetative erosion controls that provide cover (e.g., mulch, rolled erosion control products) to the area while vegetation is becoming established. Surface roughening or cat tracking perpendicular to the slope may also be used as a non-vegetative measure that can be used with seeding, but must be monitored because it may be susceptible to erosion during heavier storm events.

ii. For sites located in arid and semi-arid areas (20 inches of precipitation or less), or drought-stricken areas, as these terms are defined in Appendix A, you are considered to have completed final stabilization if both of the following criteria are met:

1) You must attempt to reestablish a vegetative cover using topsoil (topsoil preserved from the site and/or with additional (preferably local) topsoil from offsite), mulch, fertilizer, and/or other methods with seeding and planting to establish a perennial vegetative cover (preferably of an

indigenous seed mix) equivalent to the natural background cover, by design, so that permanent stabilization is expected occur by 3 to 3 and a half years after the project is completed with average precipitation; and

2) In addition to seeding or planting the area to be vegetatively stabilized, you must have non-vegetative erosion controls designed and installed either for permanent placement or temporary placement (of which degradation and decomposition is expected to be complete leaving no litter) that provide cover or BMP controls that are selected and designed purposely for protecting the seed and surface from erosion as much as is possible without active maintenance until the natural stabilizing effect of vegetation is established.

iii. For sites located on land used for agriculture. Disturbed areas on land used for agricultural purposes (e.g., pipelines across crop or range land, staging areas for highway construction) that are restored to their preconstruction agricultural use are not subject to these final stabilization criteria. Areas disturbed that were not previously used for agricultural activities, and areas that are not being returned to preconstruction agricultural use, must meet the conditions for stabilization in this Part.

b. **Non-Vegetative Stabilization**. If you are using non-vegetative controls to stabilize exposed portions of your site, or if you are using such controls to temporarily protect areas that are being vegetatively stabilized, you must provide effective non-vegetative cover[13] to stabilize any such exposed portions of your site.

2.3. **POLLUTION PREVENTION REQUIREMENTS**.
You are required to design, install, and maintain effective pollution prevention measures in order to prevent the discharge of pollutants. Consistent with this requirement, you must:

• Eliminate certain pollutant discharges from your site (see Part 2.3.1);
• Properly maintain all pollution prevention controls (see Part 2.3.2); and
• Comply with pollution prevention standards for pollutant-generating activities that occur at your site (see Part 2.3.3).

These requirements apply to all areas of your construction site and any and all support activities covered by this permit consistent with Part 1.3.3.

2.3.1. **Prohibited Discharges**. You are prohibited from discharging the following from your construction site (this list is not a comprehensive list of prohibited discharges but are listed to clarify that although they are common practices on construction sites they are unacceptable to have in a discharge):

a. Wastewater from washout of concrete, (see Part 2.3.2.d);

[13] For temporary stabilization, examples of temporary non-vegetative stabilization methods include, but are not limited to, hydromulch, straw mulch that is crimped in by cat-tracking or netted and staked, and erosion control blankets. For final stabilization, examples of permanent nonvegetative stabilization methods include, but are not limited to, riprap, gravel, gabions, and geotextiles.

b. Wastewater from washout and cleanout of stucco, paint, form release oils, curing compounds and other construction materials, (see Part 2.3.1.d);

c. Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance;

d. Soaps, solvents, or detergents used in vehicle and equipment washing; and

e. Toxic or hazardous substances from a spill or other release.

2.3.2. **General Maintenance Requirements.**

a. You must ensure that all pollution prevention controls installed in accordance with this Part remain in effective operating condition and are protected from activities that would reduce their effectiveness. You must inspect all pollutant-generating activities and pollution prevention controls in accordance with your inspection frequency requirements in Parts 4.1.2 or 3.2.2.a. to avoid situations that may result in leaks, spills, and other releases of pollutants in storm water discharges to receiving waters, and must document your findings in accordance with Part 4.1.7. If you find that controls need to be replaced, repaired, or maintained, you must make the necessary repairs or modifications in accordance with the following:

i. Initiate work to fix the problem immediately after discovering the problem, and complete such work by the close of the next work day, if the problem does not require significant repair or replacement, or if the problem can be corrected through routine maintenance.

ii. When installation of a new pollution prevention control or a significant repair is needed, you must install the new or modified control and make it operational, or complete the repair, by no later than 7 calendar days from the time of discovery, or as directed by the DWQ, MS4, or EPA oversight inspector. If it is infeasible to complete the installation or repair within 7 calendar days, you must document in your records why it is infeasible to complete the installation or repair within the 7 calendar day timeframe and document your schedule for installing the storm water control(s) and making it operational as soon as practicable after the 7 calendar day timeframe. Where these actions result in changes to any of the pollution prevention controls or procedures documented in your SWPPP, you must modify your SWPPP accordingly within 7 calendar days of completing this work.

2.3.3. **Pollution Prevention Standards**. You are required to comply with the pollution prevention standards in this Part if you conduct any of the following activities at your site or at any construction support activity areas covered by this permit (see Part 1.3.3):

- Fueling and maintenance of equipment or vehicles;
- Washing of equipment and vehicles;
- Storage, handling, and disposal of construction materials, products, and wastes; and
- Washing of applicators and containers used for paint, concrete, or other materials.

The pollution prevention standards are as follows:

a. **Fueling and Maintenance of Equipment or Vehicles**. If you conduct fueling and/or maintenance of equipment or vehicles at your site, you must provide an effective means of eliminating the discharge of spilled or leaked chemicals, including fuel, from the area where these activities will take place.[14]

   To **comply** with the prohibition in Part 2.3.1.c, you must:

   i. If applicable, comply with the Spill Prevention Control and Countermeasures (SPCC) requirements in 40 CFR 112 and Section 311 of the CWA.

   ii. Ensure adequate supplies are available at all times to handle spills, leaks, and disposal of used liquids;

   iii. Use drip pans and absorbents under or around leaky vehicles;

   iv. Dispose of or recycle oil and oily wastes in accordance with other federal, state, tribal, or local requirements;

   v. Clean up spills or contaminated surfaces immediately, using dry clean up measures where possible, and eliminate the source of the spill to prevent a discharge or a furtherance of an ongoing discharge; and

   vi. Do not clean surfaces by hosing the area down.

b. **Washing of Equipment and Vehicles**.

   i. You must provide an effective means of minimizing the discharge of pollutants from equipment and vehicle washing, wheel wash water, and other types of washing;[15] and

   ii. To comply with the prohibition in Part 2.3.1.d, for storage of soaps, detergents, or solvents, you must provide either (1) cover (e.g., plastic sheeting or temporary roofs) to prevent these detergents from coming into contact with rainwater, or (2) a similarly effective means designed to prevent the discharge of pollutants from these areas (such as tightly closed containers).

c. **Storage, Handling, and Disposal of Construction Products, Materials, and Wastes**. You must minimize the exposure to storm water of any of the products,

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[14]Examples of effective controls include, but are not limited to, locating activities away from surface waters and storm water inlets or conveyances, providing secondary containment (e.g., spill berms, decks, spill containment pallets)and cover where appropriate, and/or having spill kits readily available.

[15] Examples of effective controls include, but are not limited to, locating activities away from surface waters and storm water inlets or conveyances and directing wash waters to a sediment basin or sediment trap, using filtration devices, such as filter bags or sand filters, or using other similarly effective controls.

materials, or wastes specified below that are present at your site by complying with the requirements in this Part.

Note: *These requirements do not apply to those products, materials, or wastes that are not a source of storm water contamination or that are designed to be exposed to storm water.*

To ensure you **meet** this requirement, you must:

i. For building products[16]: In storage areas, provide either (1) cover (e.g., plastic sheeting or temporary roofs) to prevent these products from coming into contact with rainwater, or (2) a similarly effective means designed to prevent the discharge of pollutants from these areas.

ii. For pesticides, herbicides, insecticides, fertilizers, and landscape materials:

1) In storage areas, provide either (1) cover (e.g., plastic sheeting or temporary roofs) to prevent these chemicals from coming into contact with rainwater, or (2) a similarly effective means designed to prevent the discharge of pollutants from these areas; and

2) Comply with all application and disposal requirements included on the registered pesticide, herbicide, insecticide, and fertilizer label.

iii. For diesel fuel, oil, hydraulic fluids, other petroleum products, and other chemicals:

1) To comply with the prohibition in Part 2.3.1.c, store chemicals in water-tight containers, and provide either (1) cover (e.g., plastic sheeting or temporary roofs) to prevent these containers from coming into contact with rainwater, or (2) a similarly effective means designed to prevent the discharge of pollutants from these areas (e.g., spill kits), or provide secondary containment (e.g., spill berms, decks, spill containment pallets); and

2) Clean up spills immediately, using dry clean-up methods where possible, and dispose of used materials properly. Do not clean surfaces or spills by hosing the area down. Eliminate the source of the spill to prevent a discharge or a continuation of an ongoing discharge.

iv. For hazardous or toxic waste[17]:

1) Separate hazardous or toxic waste from construction and domestic waste;

2) Store waste in sealed containers, which are constructed of suitable materials to prevent leakage and corrosion, and which are labeled in

[16] Some examples of building products that are typically stored at construction sites include, but are not limited to, asphalt sealants, copper flashing, roofing materials, adhesives, concrete admixtures.
[17] Examples of hazardous or toxic waste that may be present at construction sites include, but are not limited to, paints, solvents, waste paints or solvents, petroleum-based products, wood preservatives, additives, curing compounds, acids.

accordance with applicable Resource Conservation and Recovery Act (RCRA) requirements and all other applicable state, or local requirements;

3) Store all containers that will be stored outside within appropriately sized secondary containment (e.g., spill berms, decks, spill containment pallets) to prevent spills from being discharged, or provide a similarly effective means designed to prevent the discharge of pollutants from these areas (e.g., storing chemicals in covered area or having a spill kit available on site);

4) Dispose of hazardous or toxic waste in accordance with the manufacturer's recommended method of disposal and in compliance with federal, state, tribal, and local requirements; and

5) Clean up spills immediately, using dry clean-up methods where possible, and dispose of used materials properly. Do not clean surfaces or spills by hosing the area down. Eliminate the source of the spill to prevent a discharge or a furtherance of an ongoing discharge.

v. For construction and domestic waste[18]: Provide waste containers (e.g., dumpster or trash receptacle) of sufficient size and number to contain construction and domestic wastes. In addition, you must:

1) On work days, clean up and dispose of waste in designated waste containers; and

2) Clean up immediately if containers overflow.

vi. For sanitary waste: Position portable toilets so that they are secure and will not be tipped or knocked over and that they will be positioned at least 10 feet from any storm water conveyance, inlet, curb or gutter; or that they will have secondary containment if tipped.

d. **Washing of Applicators and Containers used for Paint, Concrete, or Other Materials**. To comply with the prohibition in Parts 2.3.1.a and 2.3.1.b, you must provide an effective means of eliminating the discharge of water from the washout and cleanout of stucco, paint, concrete, form release oils, curing compounds, and other construction materials. To comply with this requirement, you must:

i. Direct all washwater into a leak-proof container or leak-proof pit. The container or pit must be designed so that no overflows can occur due to inadequate sizing or precipitation; you must segregate paint waste and oily waste from stucco/concrete washout waste and manage the proper disposal separately.

[18] Examples of construction and domestic waste include, but are not limited to, packaging materials, scrap construction materials, masonry products, timber, pipe and electrical cuttings, plastics, styrofoam, concrete, and other trash or building materials.

ii. Handle washout or cleanout wastes as follows:

1) Do not dump liquid wastes in storm sewers;

2) Dispose of liquid wastes in accordance with applicable requirements in Part 2.3.3.c; and

3) Washout or cleanout activities may be located near the areas where concrete or stucco application takes place (and in accordance with local ordinances), but it should be at least 50 feet and possibly further (where practical) from surface waters, and to the extent practicable, designate areas to be used for these activities and require all conducting such activities to only in these areas.

e. Dispose of hardened concrete waste in ways that are consistent with Utah disposal laws for inert material.

2.3.4. **Emergency Spill Notification**. You are prohibited from discharging toxic or hazardous substances from a spill or other release, consistent with Part 2.3.1.e. Where a leak, spill, or other release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR Part 110, 40 CFR Part 117, or 40 CFR Part 302 occurs during a 24-hour period, you must notify the National Response Center (NRC) at (800) 424-8802 in accordance with the requirements of 40 CFR Part 110, 40 CFR Part 117, and 40 CFR Part 302 (the federal requirement), and 801-536-4123 (for State agencies), but also you must look up numbers for local health departments and MS4 spill and hazardous waste release reporting as soon as you have knowledge of the discharge. You must also, within 7 calendar days of knowledge of the release, provide a description of the release, the circumstances leading to the release, and the date of the release.

2.3.5. **Fertilizer Discharge Restrictions**. You are required to minimize discharges of fertilizers containing nitrogen or phosphorus. To meet this requirement, you must comply with the following requirements:

a. Apply at a rate and in amounts consistent with manufacturer's specifications, or document departures from the manufacturer specifications where appropriate in Part 7.2.6.b of the SWPPP;

b. Apply at the appropriate time of year for your location, and preferably timed to coincide as closely as possible to the period of maximum vegetation uptake and growth;

c. Avoid applying before heavy rains that could cause excess nutrients to be discharged;

d. Never apply to frozen ground;

e. Never apply to storm water conveyance channels with flowing water; and

f. Follow all other state, and local requirements regarding fertilizer application.

3. WATER QUALITY-BASED EFFLUENT LIMITATIONS.

3.1. GENERAL EFFLUENT LIMITATION TO MEET APPLICABLE WATER QUALITY STANDARDS.

Your discharge must be controlled as necessary to meet applicable water quality standards. In the absence of information demonstrating otherwise, DWQ expects that compliance with the conditions in this permit will result in storm water discharges being controlled as necessary to meet applicable water quality standards. If at any time you become aware, or DWQ (or a local inspector representing an MS4) determines, that your discharge is not being controlled as necessary to meet applicable water quality standards, you must take corrective action as required in Part 5.2.1, and document the corrective actions as required in Part 5.2.2 and Part 5.4. DWQ will also impose additional water quality-based limitations on a site-specific basis, or require you to obtain coverage under an individual permit, if information indicates that your discharges are not controlled as necessary to meet applicable water quality standards. This includes situations where additional controls are necessary to comply with a wasteload allocation in a DWQ established TMDL.

3.2. DISCHARGE LIMITATIONS FOR IMPAIRED WATERS.

If you discharge to a surface water that is impaired for (1) sediment or a sediment related parameter, such as total suspended solids (TSS) or turbidity, and/or (2) nutrients, including impairments for nitrogen and/or phosphorus, you are required to comply with the requirements in Part 3.2.2.

Note: *For the purposes of this Part, "impaired waters" are waters identified as impaired on the appropriate CWA Section 303(d) list, or waters with a DWQ and EPA-approved or established TMDL. Your construction site will be considered to discharge to an impaired water if the first surface water to which you discharge is identified by DWQ or the EPA pursuant to Section 303(d) of the CWA as not meeting an applicable water quality standard, or is included in a DWQ and EPA-approved or established total maximum daily load (TMDL). In the future discharges under this permit may be required to meet the requirements of an impaired water that may be somewhere down the line from the first water body that the discharge outfalls into. That time may be when this permit is modified or after it is renewed. For discharges that enter a storm sewer system prior to discharge, the first surface water to which you discharge is the waterbody that receives the storm water discharge from the storm sewer system. If you discharge to an impaired water that is impaired for a parameter other than a sediment-related parameter or nutrients, DWQ will inform you if any additional limits or controls are necessary for your discharge to be controlled as necessary to meet water quality standards, including for it to be consistent with the assumptions of any available wasteload allocation in any applicable TMDL, or if coverage under an individual permit is necessary in accordance with Part 1.4.5. If during your coverage under a previous permit, you were required to install and maintain storm water controls specifically to meet the assumptions and requirements of a DWQ established TMDL (for any parameter) or to otherwise control your discharge to meet water quality standards, you must continue to implement such controls as part of this permit.*

3.2.1. **Identify If You Discharge To An Impaired Water**. If you discharge to an impaired water, you must provide the following information in your SWPPP:

- A list of all impaired waters to which you discharge;
- The pollutant(s) for which the surface water is impaired; and
- Whether a TMDL has been approved or established for the waters to which you

discharge.

3.2.2. **Requirements for Discharges to Sediment or Nutrient-Impaired Waters**. If you discharge to a surface water that is impaired for (1) sediment or a sediment related parameter (e.g., total suspended solids (TSS) or turbidity) and/or (2) nutrients (e.g., nitrogen and/or phosphorus), including impaired waters for which a TMDL has been approved or established for the impairment, you are required to comply with the following storm water control requirements, which supplement the requirements applicable to your site in other corresponding parts of the permit.

a. Frequency **of Site Inspection**. You must conduct inspections at the frequency specified in Part 4.1.3.

b. Deadline **to Complete Stabilization**. You must comply with the deadlines for completing site stabilization as specified in Part 2.2.3.

3.3. DISCHARGES TO WATERS IDENTIFIED AS CATEGORY 1 or 2.

3.3.1. **Identify if You Discharge to a Category 1 or Category 2 Water**. If you discharge to a water identified as a Category 1 or Category 2 water, you must indicate so on your NOI. See Appendix C for information on Utah waters.

Note: *For the purposes of this permit, you are considered to discharge to a Category 1 or 2 water if the first surface water to which you discharge is identified as Category 1 or 2. Category 1 or 2 refer to waters identified by the state as high quality waters. For discharges that enter a storm sewer system prior to discharge, the surface water to which you discharge is the first surface water that receives the storm water discharge from the storm sewer system.*

3.3.2. **Requirements for New Projects Discharging to Category 1 or 2 Waters**. For new projects, if you will discharge to a Category 1 or 2 water, you are required to comply with Parts 4.1.3 (inspection frequencies) and 2.2.3. (stabilization deadlines).

4. INSPECTIONS.

4.1. SITE INSPECTIONS.

4.1.1. Person(s) Responsible for Inspecting the Site.

The person(s) inspecting your site may be a person on your staff or a third party you hire to conduct such inspections. You are responsible for ensuring that the person who conducts inspections is a "qualified person", and currently certified.

Note: *A "qualified person" is a person knowledgeable in the principles and practice of erosion and sediment controls and pollution prevention, who possesses the skills to assess conditions at the construction site that could impact storm water quality, and the skills to assess the effectiveness of any storm water controls selected and installed to meet the requirements of this permit, such as but not limited to the following*:

- Utah Registered Storm Water Inspector (RSI)
- Certified Professional in Erosion and Sediment Control (CPESC)
- Certified Professional in Storm Water Quality (CPSWQ)
- Certified Erosion, Sediment, and Storm Water Inspector (CESSWI)
- Certified Inspector of Sediment and Erosion Control (CISEC)
- National Institute for Certification in Engineering Technologies, Erosion and Sediment Control, Level 3 (NICET)
- Utah Department of Transportation Erosion Control Supervisor (ECS)

4.1.2. **Frequency of Inspections**. At a minimum, you must conduct a site inspection in accordance with one of the two schedules listed below, unless you are subject to Part 4.1.3 or Part 4.1.4:

a. At least once every 7 calendar days; or

b. Once every 14 calendar days and within 24-hours of the occurrence of a storm event of 0.5 inches or greater. To determine if a storm event of 0.5 inches or greater has occurred on your site, you must either keep a properly maintained rain gauge on your site, or obtain the storm event information from a weather station that is representative of your location. For any day of rainfall that measures 0.5 inches or greater, you must record the total rainfall measured for that day in accordance with Part 4.1.7.a.iv.

Note: *Inspections are only required during the project's normal working hours, however a rainfall event can happen after business hours. If a rain event occurs after hours on Friday it does not need to be inspected until Monday.*

Note: *You are required to specify in your SWPPP which schedule you will be following.*

Note: *"Within 24 hours of the occurrence of a storm event" means that you are required to conduct an inspection within 24 hours once a storm event has produced 0.5 inches, even if the storm event is still continuing. Thus, if you have elected to inspect bi-weekly in accordance with Part 4.1.2.b. and there is a storm event at your site that continues for multiple days, and each day of the storm produces 0.5 inches or more of rain, you are required to conduct an inspection*

within 24 hours of the first day of the storm and within 24 hours after the end of the storm. Again, inspections are only required during the projects normal working hours.

4.1.3. **Increase in Inspection Frequency for Sites Discharging to Sensitive Waters**. For any portion of the site that discharges to a sediment or nutrient-impaired water (see Part 3.2) or to a water that is identified as Category 1 or 2 (see Part 3.3), instead of the inspection frequency specified in Part 4.1.2, you must conduct inspections in accordance with the following inspection frequencies:

a. Once every 7 calendar days; and

b. Within 24 hours of the occurrence of a storm event of 0.5 inches or greater. To determine if a storm event of 0.5 inches or greater has occurred on your site, you must either keep a properly maintained rain gauge on your site, or obtain the storm event information from a weather station that is representative of your location. For any day of rainfall that measures 0.5 inches or greater, you must record the total rainfall measured for that day in accordance with Part 4.1.7.a.v

Note: *Inspections are only required during the project's normal working hours, however a rainfall event can happen after business hours. If a rain event occurs after hours on Friday it does not need to be inspected until Monday.*

Note: *"Within 24 hours of the occurrence of a storm event" means that you are required to conduct an inspection within 24 hours once a storm event has produced 0.5 inches, even if the storm event is still continuing. Thus, if there is a storm event at your site that continues for multiple days, and each day of the storm produces 0.5 inches or more of rain, you are required to conduct an inspection within 24 hours of the first day of the storm and within 24 hours after the end of the storm. Again inspections are only required during the projects normal working hours.*

Note: *If you qualify for any of the reduced inspection frequencies in Part 4.1.4, you may conduct inspections in accordance with Part 4.1.4 for any portion of your site that discharges to a sensitive water.*

4.1.4. **Reductions in Inspection Frequency**. Your inspection frequency may be reduced as follows:

a. **For Temporarily Stabilized Areas**. You may reduce the frequency of inspections to once per month in any area of your site where the stabilization steps in Parts 2.2.1.b.i, 2.2.1.b.ii, and 2.2.2.b have been completed. When construction activity resumes in this portion of the site at a later date, the inspection frequency immediately increases to that required in Parts 4.1.2 or 4.1.3, if applicable. You must document the beginning and ending dates of this period in your records.

b. For Permanently Stabilized Areas. If portions of the project area are permanently stabilized before the entire project is completed, stabilized, and terminated, these permanently stabilized areas no longer require an inspection, except in the case of inlet protection for drainage received from surrounding unstabilized areas.

c. **For Frozen Conditions**.

i. If you are suspending earth-disturbing activities due to frozen conditions, you may temporarily suspend inspections on your site until thawing conditions (see Appendix A, "thawing conditions") begin to occur if:

1) Runoff is unlikely due to continuous frozen conditions that are likely to continue at your site for at least 30 days based on historic seasonal averages. However, if unexpected weather conditions (such as above freezing temperatures or rain or snow events) make discharges likely, you must immediately resume your regular inspection frequency as described in Parts 4.1.2 or 4.1.3;

2) Land disturbances have been suspended; and

3) All disturbed areas of the site have been temporarily or permanently stabilized in accordance with Part 2.2.

ii. If you are still conducting earth-disturbing activities during frozen conditions, you may reduce your inspection frequency to once per month if:

1) Runoff is unlikely due to continuous frozen conditions that are likely to continue at your site for at least 30 days based on historic seasonal averages. However, if unexpected weather conditions (such as above freezing temperatures or rain or snow events) make discharges likely, you must immediately resume your regular inspection frequency as described in Parts 4.1.2 or 4.1.3; and

2) Except for areas in which you are actively conducting earth disturbing activities, disturbed areas of the site have been temporarily or permanently stabilized in accordance with Part 2.2.

You must document the beginning and ending dates of this period in your SWPPP.

4.1.5. **Areas that Need to Be Inspected**. During your site inspection, you must at a minimum inspect the following areas of your site:

a. All areas that have been cleared, graded, or excavated and that have not yet completed stabilization consistent with Part 2.2;

b. All storm water controls (including pollution prevention measures) installed at the site to comply with this permit;

c. Material, waste, borrow, or equipment storage and maintenance areas that are covered by this permit;

d. All areas where storm water typically flows within the site, including drainage ways designed to divert, convey, and/or treat storm water;

e. All points of discharge from the site; and

f. All locations where stabilization measures have been implemented.

You are not required to inspect areas that, at the time of the inspection, are considered unsafe for your inspection personnel. You are also not required to inspect areas of the project that are permanently stabilized except for management of storm water flows flowing onto the area coming from other areas that have not been permanently stabilized.

4.1.6. **Requirements for Inspections.** During your site inspection, you must at a minimum:

a. Check whether all erosion and sediment controls and pollution prevention controls are installed, appear to be operational, and are working as intended to minimize pollutant discharges. Determine if any controls need to be replaced, repaired, or maintained in accordance with Parts 2.1.1.d. and 2.3.2;

b. Check for the presence of conditions that could lead to spills, leaks, or other accumulations of pollutants on the site;

c. Identify any locations where new or modified storm water controls are necessary to meet the requirements of Parts 2 and/or 3;

d. At points of discharge and, if applicable, the banks of any surface waters flowing within your property boundaries or immediately adjacent to your property, check for signs of visible erosion and sedimentation (i.e., sediment deposits) that have occurred and are attributable to discharges from your site; and

e. Identify any and all incidents of noncompliance observed.

f. If a discharge is occurring during your inspection, you are required to:

i. Identify all points of the property from which there is a discharge;

ii. Observe and document the visual quality of the discharge, and take note of the characteristics of the storm water discharge, including color; odor; floating, settled, or suspended solids; foam; oil sheen; and other obvious indicators of storm water pollutants (see the form in Appendix J); and

iii. Document whether your storm water controls are operating effectively, and describe any such controls that are clearly not operating as intended or are in need of maintenance.

g. Based on the results of your inspection, initiate corrective action under Part 5.

4.1.7. **Inspection Report.**

a. **Requirement to Complete Inspection Report.** You must complete an inspection report within 24 hours of completing any site inspection. Each inspection report must include the following:

i. The inspection date;

ii. The UPDES CGP permit tracking number;

iii. Names and titles (or position) of personnel making the inspection;

iv. A summary of your inspection findings, covering at a minimum the observations you made in accordance with Part 4.1.6;

v. If you are inspecting your site at the frequency specified in Part 4.1.2.b, Part 4.1.3, or Part 4.1.4.c, and you conducted an inspection because of rainfall measuring 0.5 inches or greater, you must include the applicable rain gauge or weather station readings that triggered the inspection; and

vi. If you have determined that it is unsafe to inspect a portion of your site, you must describe the reason you found it to be unsafe and specify the locations that this condition applied to.

b. **Signature Requirements**. Each inspection report must be signed in accordance with Appendix G, Part G.16 (Signatory Requirements) of this permit.

c. **Recordkeeping Requirements**. You are required to keep a current, copy of all inspection reports at the site or at an easily accessible location, so that it can be made available at the time of an onsite inspection or upon request by DWQ. For purposes of this permit, your inspection reports may be kept electronically if the records are:

i. In a format that can be read in a similar manner as a paper record;

ii. Legally defensible with no less evidentiary value than a paper equivalent; and

iii. Accessible to the inspector during an inspection to the same extent as a paper copy stored at the site would be, if the records were stored in paper form.

Note: *All inspection reports completed for this Part must be retained for at least 3 years from the date that your permit coverage expires or is terminated.*

4.2. **INSPECTIONS BY DWQ OR MS4 OF JURISDICTION**.
You must allow an authorized representative of DWQ, the MS4 of jurisdiction, or the EPA; to conduct the following activities at reasonable times:

4.2.1. Enter onto areas of your site, including any construction support activity areas covered by this permit (see Part 1.3.3.), and onto locations where records are kept under the conditions of this permit;

4.2.2. Access and copy any records that must be kept under the conditions of this permit;

4.2.3. Inspect your construction site, including any construction support activity areas covered by this permit (see Part 1.3.3.) and any storm water controls installed and maintained at the site; and

4.2.4. Sample or monitor for the purpose of ensuring compliance.

4.2.5. Take photographs; videos; measurements; surveying; or other documentation to ensure or document compliance (with consideration to the permittee for legitimate confidentiality concerns, and for security concerns, including national security issues, if there are any).

5. CORRECTIVE ACTIONS.

5.1. "CORRECTIVE ACTIONS" DEFINED.

Corrective actions are actions you take in compliance with this Part to:

- Repair, modify, or replace any storm water control used at the site;
- Clean up and properly dispose of spills, releases, or other deposits; or
- Remedy a permit violation.

5.2. REQUIREMENTS FOR TAKING CORRECTIVE ACTION.

Immediately take all reasonable steps to minimize or prevent the discharge of pollutants until a permanent solution for the problem is installed and made operational.

Note: *In this context, the term "immediately" requires permittees to, on the same day a condition requiring corrective action is found (or as soon afterward as possible considering normal work schedule and task size), take all reasonable steps to minimize or prevent the discharge of pollutants until a permanent solution is installed and made operational.*

5.2.1. Install a new or modified control, make it operational, or complete the repair expeditiously and based on urgency[19] installing the storm water control(s), making them operational, or completing a repair as soon as practicable.

5.3. CORRECTIVE ACTION REQUIRED BY DWQ, THE LOCAL MS4, OR THE EPA INSPECTORS.

You must comply with any corrective actions required by DWQ, the local MS4, or the EPA inspectors as a result of permit violations found during an inspection carried out under Part 4.2.

5.4. TRACKING OF CORRECTIVE ACTION.

For each corrective action taken in accordance with this Part, you must make an entry in a corrective action report/log, inspection reports, or other method the permittee has devised to track corrective action, which includes the applicable information in Parts 5.4.1 and 5.4.2.

5.4.1. Within a day or so of discovering the occurrence of a storm water or pollution control problem at your site, you must make an entry in a report/log or other devise for monitoring corrective action of the following:

a. What condition was identified at your site that required corrective action (BMPs were not installed, installed incorrectly, were not effective, or need repairing);

b. The date and time the condition was identified and how it was identified (inspection report, happened to notice it needed maintenance, etc.).

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[19] What is meant by expeditiously based on urgency is assessing the difficulty of the task, the resources available to complete the task, and the time required to complete the task while considering the urgency of performing the task. A less urgent situation would be placing a storm water control measure in a flat area during a dry season of the year with no precipitation in the forecast and that is a significant distance from a water body or inlet. An urgent situation would be placing a storm water control measure on a slope with precipitation eminent in the forecast and having a water body or inlet close by that would receive the runoff from the area. In any case corrective action should not be put off many days. Direction given during an inspection from DWQ or an MS4 inspector may determine the immediacy needed for the action.

5.4.2. Within 7 calendar days of discovering the occurrence of a problem with a storm water or pollution control measure at your site, you must make an entry in a corrective action report/log (or other corrective action monitoring devise) of the following:

a. Any follow-up actions taken to repair the problem, including the dates such actions occurred;

b. Notice of whether SWPPP modifications are required as a result of the condition identified or corrective action.

5.4.3. **Recordkeeping Requirements**. You are required to keep a current copy of all corrective action entries at the site or at an easily accessible location, so that it can be made available at the time of an onsite inspection or upon request by DWQ or the local jurisdictional MS4. For purposes of this permit, your corrective action entries may be kept electronically if the records are:

a. In a format that can be read in a similar manner as a paper record;

b. Legally defensible with no less evidentiary value than a paper equivalent; and

c. Accessible to the inspector during an inspection to the same extent as a paper copy stored at the site would be, if the records were stored in paper form.

All corrective action entries completed for this Part must be retained for at least 3 years from the date that your permit coverage expires or is terminated.

6. **STAFF TRAINING REQUIREMENTS.**
Prior to the commencement of earth-disturbing activities or pollutant-generating activities, whichever occurs first, you must ensure and document that the following personnel understand the requirements of this permit and their specific responsibilities with respect to those requirements:

- Personnel who are responsible for the design, installation, maintenance, and/or repair of storm water controls (including pollution prevention measures);
- Personnel responsible for the application and storage of treatment chemicals (if applicable);
- Personnel who are responsible for conducting inspections as required in Part 4.1.1; and
- Personnel who are responsible for taking corrective actions as required in Part 5.

Notes: *(1) If the person requiring training is a new employee, who starts after you commence earth-disturbing or pollutant-generating activities, you must ensure that this person has the proper understanding as required above prior to assuming particular responsibilities related to compliance with this permit. (2) For emergency-related construction activities, the requirement to train personnel prior to commencement of earth-disturbing activities does not apply, however, such personnel must have the required training prior to NOI submission.*

You are responsible for ensuring that all activities on the site comply with the requirements of this permit. Although you are not required to provide or document formal training for subcontractors or other outside service providers, you must ensure (through a contract if necessary) that such personnel understand and perform by any requirements of the permit and the SWPPP that may be affected by the work they are subcontracted to perform.

At a minimum, personnel must be trained to understand the following if related to the scope of their job duties (e.g., only personnel responsible for conducting inspections need to understand how to conduct inspections):

- The location of all storm water controls on the site required by this permit, and how they are to be maintained;
- The proper procedures to follow with respect to the permit's pollution prevention requirements; and
- When and how to conduct inspections, record applicable findings, and take corrective actions.

7. STORM WATER POLLUTION PREVENTION PLAN (SWPPP).

7.1. GENERAL REQUIREMENTS.

7.1.1. **Requirement to Develop a SWPPP Prior to Submitting Your NOI**. All owner/operators associated with a construction project to be covered under this permit must develop a SWPPP. You are required to develop your site's SWPPP prior to submitting your NOI. At a minimum, your SWPPP must include the information required in Part 7.2 and as specified in other parts of the permit.[20] You must also update the SWPPP as required in Part 7.4.

Note: *Although many aspects of developing a SWPPP do not require a P.E., there are significant portions or items required in the development of a SWPPP that makes it to where many if not all SWPPPs must include a P.E.in its development. It is not required for a P.E. to stamp the entire SWPPP because operators must have the flexibility to modify a SWPPP. There may be facilities within a SWPPP that need to be stamped and would require a review and to be re-stamped by a P.E. again if modifications occur. For the most part SWPPPs should be designed so that operators have the flexibility to make modifications and updates in the field as is necessary so that improvements can be made for the protection of disturbed soils and the quality of storm water runoff if SWPPP plans prove to be ineffective, or if the conditions at the site turn out to be different than expected. A P.E. knows what is not safe without a stamp.*

Note: *You may develop an electronic SWPPP that is stored on the internet as long as, 1) the SWPPP can be accessed during an inspection, and 2) site personnel know how to, and regularly access the SWPPP to manage and modify the site and SWPPP in accordance with requirements of this permit as if it were as accessible as a hard copy on the site.*

Note: *If your project is an "existing project"[21] or if you are a new owner and/or operator of an existing project", you are not required to meet the requirements of this permit until 6months after this permit has been issued, however, you must meet the requirements of the previous permit (UTR300000) during that 6 month period (see permit 1.4.3).*

7.2. SWPPP CONTENTS.

Your SWPPP must include the following information, at a minimum.

7.2.1. **Storm Water Team**. Each owner/operator, must assemble a "storm water team," which is responsible for overseeing the development of the SWPPP, any later modifications to it, and for compliance with the requirements in this permit.

The SWPPP must identify the personnel (by name or position) that are part of the storm water team, as well as their individual responsibilities. Each member of the storm water team must have ready access to an electronic or paper copy of applicable portions of this permit, the most updated copy of your SWPPP, and other relevant documents or information that must be kept with the SWPPP.

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[20]The SWPPP does not establish the effluent limits that apply to your site's discharges; these limits are established in this permit in Parts 2 and 3.

[21] Your project started before this permit was issued, and you had active and legitimate coverage under UTR300000 at the time of expiration of UTR300000.

7.2.2. **Nature of Construction Activities**. The SWPPP must describe the nature of your construction activities, including the size of the property (in acres) and the total area expected to be disturbed by the construction activities (in acres), construction support activity areas covered by this permit (see Part 1.3.3), and the maximum area expected to be disturbed at any one time.

7.2.3. **Emergency-Related Projects**. If you are conducting earth-disturbing activities in response to a public emergency (see Part 1.2.1), you must document the cause of the public emergency (e.g., natural disaster, extreme flooding conditions, etc.), provide information substantiating its occurrence (e.g., state disaster declaration or similar state or local declaration), and provide a description of the construction necessary to reestablish effected public services.

7.2.4. **Sequence and Estimated Dates of Construction Activities**. The SWPPP must include a description of the intended sequence of construction activities, including a schedule of the estimated start dates and the duration of the activity, for the following activities:

a. Installation of storm water control measures, and when they will be made operational, including an explanation of how the sequence and schedule for installation of storm water control measures complies with Part 2.1.1.c.i. and of any departures from manufacturer specifications pursuant to Part 2.1.1.c.ii.;

b. Commencement and duration of earth-disturbing activities, including clearing and grubbing, mass grading, site preparation (i.e., excavating, cutting and filling), final grading, and creation of soil and vegetation stockpiles requiring stabilization;

c. Cessation, temporarily or permanently, of construction activities on the site, or in designated portions of the site;

d. Final or temporary stabilization of areas of exposed soil. The dates for stabilization must reflect the applicable deadlines to which you are subject in Part 2.2.1 and 2.2.2; and

e. Removal of temporary storm water conveyances/channels and other storm water control measures, removal of construction equipment and vehicles, and cessation of any pollutant-generating activities.

Note: *If plans change due to unforeseen circumstances or for other reasons, the requirement to describe the sequence and estimated dates of construction activities is not meant to "lock in" the permittee to meeting these projections. When departures from initial projections are necessary, this should be documented in the SWPPP itself or in associated records, as appropriate.*

7.2.5. **Site Map**. The SWPPP must include a legible site map, or series of maps, showing the following features of your project:

Note: *Included in the project site are any construction support activities covered by this permit (see Part 1.3.3).*

a. Boundaries of the property and of the locations where construction activities will occur, including:

   i. Locations where earth-disturbing activities will occur, noting any phasing of construction activities;

   ii. Approximate slopes before and after major grading activities. Note areas of steep slopes, as defined in Appendix A;

   iii. Locations where sediment, soil, or other construction materials will be stockpiled;

   iv. Locations of any crossings of surface waters;

   v. Designated points on the site where vehicles will exit onto paved roads;

   vi. Locations of structures and other impervious surfaces upon completion of construction; and

   vii. Locations of construction support activity areas covered by this permit (see Part 1.3.3).

b. Locations of all surface waters, including wetlands, that exist within or in the immediate vicinity of the site. Indicate which water bodies are listed as impaired, and which are identified as Category 1 or 2 waters;

c. The boundary lines of any natural buffers provided consistent with Part 2.1.2.a.i.

d. Topography of the site, existing vegetative cover (e.g., forest, pasture, pavement, structures), and drainage pattern(s) of storm water and authorized non-storm water flow onto, over, and from the site property before and after major grading activities;

e. Storm water and allowable non-storm water discharge locations, including:

   i. Locations of any storm drain inlets on the site and in the immediate vicinity of the site; and

Note: *The requirement to show storm drain inlets in the immediate vicinity of the site on your site map only applies to those inlets that are easily identifiable from your site or from a publicly accessible area immediately adjacent to your site.*

   ii. Locations where storm water or allowable non-storm water will be discharged to surface waters (including storm sewer systems and/or wetlands) on or near the site.

f. Locations of all potential pollutant-generating activities identified in Part 7.2.6;

g. Locations of storm water control measures; and

h. Locations where tackifiers, polymers, flocculants, fertilizers, or other treatment chemicals will be used and stored.

7.2.6. **Construction Site Pollutants**. The SWPPP must include the following:

a. A list and description of all the pollutant-generating activities[22] on your site.

b. For each pollutant-generating activity, an inventory of pollutants or pollutant constituents (e.g., sediment, fertilizers and/or pesticides, paints, solvents, fuels) associated with that activity, which could be exposed to rainfall, or snowmelt, and could be discharged from your construction site. You must take into account where potential spills and leaks could occur that contribute pollutants to storm water discharges. You must also document any departures from the manufacturer's specifications for applying fertilizers containing nitrogen and phosphorus, as required in Part 2.3.5.a.

7.2.7. **Non-Storm water Discharges**. The SWPPP must also identify all sources of allowable non-storm water discharges listed in Part 1.3.4. All non-storm water discharges must be managed or treated to prevent a discharge of pollutants.

Note: Allowable discharges listed in section 1.3.4. must be managed such that they are infiltrated into the ground so sediment and any oil sheen will be filtered out into surface soils appropriately (not overloading soil capacity to degrade pollutants), or be otherwise treated so that pollutants are not discharged with storm water.

7.2.8. **Buffer Documentation**. If you are required to comply with Part 2.1.2.a because a surface water is located within 50 feet of your project's earth disturbances, you must describe which compliance alternative you have selected for your site, and comply with any additional requirements to provide documentation in Part 2.1.2.a.

7.2.9. **Description of Storm water Control Measures**.

a. **Storm water Control Measures to be Used During Construction Activity**. The SWPPP must describe all storm water control measures that are or will be installed and maintained at your site to meet the requirements of Part 2. For each storm water control measure, you must document:

i. Information on the type of storm water control measure to be installed and maintained, including design information;

ii. What specific sediment controls will be installed and made operational prior to conducting earth-disturbing activities in any given portion of your site to meet the requirement of Part 2.1.2.b.i.;

iii. For exit points on your site, document stabilization techniques you will use and any additional controls that are planned to remove sediment prior to vehicle exit consistent with Part 2.1.2.c.; and

[22] Examples of pollutant-generating activities include, but are not limited to: paving operations; concrete, paint, and stucco washout and waste disposal; solid waste storage and disposal; and dewatering operations.

iv. For projects at high altitudes that expect long seasons of heavy snow, you must document in your SWPPP when the snow season is expected so spring runoff controls can be installed before snowfall.

v. For linear projects, where you have determined that the use of perimeter controls in portions of the site is impracticable, document why you believe this to be the case (see Part 2.1.2.b.i.).

b. **Use of Treatment Chemicals**. If you plan to use cationic polymers and/or flocculants, you must have an approval letter from DWQ. Otherwise for treatment chemicals at your site you must include the following in your SWPPP:

i. A listing of all soil types[23] that are expected to be exposed during construction and that will be discharged to locations where chemicals will be applied. Also include a listing of soil types expected to be found in fill material to be used in these same areas, to the extent you have this information prior to construction.

ii. A listing of all treatment chemicals to be used at the site, and why the selection of these chemicals is suited to the soil characteristics of your site;

iii. If you have been authorized by DWQ to use cationic treatment chemicals, include the specific controls and implementation procedures designed to ensure that your use of cationic treatment chemicals will not lead to a violation of water quality standards or a fish kill;

iv. The dosage of all treatment chemicals you will use at the site or the methodology you will use to determine dosage;

v. Information from any applicable Material Safety Data Sheets (MSDS);

vi. Schematic drawings of any chemically-enhanced storm water controls or chemical treatment systems to be used for application of the treatment chemicals;

vii. A description of how chemicals will be stored consistent with Part 2.1.3.c.iii.

viii. References to applicable state or local requirements affecting the use of treatment chemicals, and copies of applicable manufacturer's specifications regarding the use of your specific treatment chemicals and/or chemical treatment systems; and

ix. A description of the training that personnel who handle and apply chemicals have received prior to permit coverage, or will receive prior to use of the treatment chemicals at your site.

c. **Stabilization Practices**. The SWPPP must describe the specific vegetative and/or non-vegetative practices that will be used to comply with the requirements in Part 2.2, including:

[23] Information on soils may be obtained at http://websoilsurvey.nrcs.usda.gov/app/.

i. If you will be complying with the stabilization deadlines specified in Part 2.2.2., you must indicate in your SWPPP the beginning and ending dates of the seasonally dry period and your site conditions; and

ii. For projects at high altitudes that expect long seasons of heavy snow, you must document in your SWPPP when the snow season is expected and so stabilization measures for spring runoff can be installed before snowfall.

7.2.10. **Pollution Prevention Procedures.**

a. **Spill Prevention and Response Procedures.** The SWPPP must describe procedures that you will follow to prevent and respond to spills and leaks consistent with Part 2.3, including:

i. Procedures for expeditiously stopping, containing, and cleaning up spills, leaks, and other releases. Identify the name or position of the employee(s) responsible for detection and response of spills or leaks; and

ii. Procedures for notification of appropriate facility personnel, emergency response agencies, and regulatory agencies where a leak, spill, or other release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity consistent with Part 2.3.4 and established under either 40 CFR Part 110, 40 CFR Part 117, or 40 CFR Part 302, occurs during a 24-hour period. Contact information must be in locations that are readily accessible and available.

You may also reference the existence of Spill Prevention Control and Countermeasure (SPCC) plans developed for the construction activity under Part 311 of the CWA, or spill control programs otherwise required by a UPDES permit for the construction activity, provided that you keep a copy of that other plan onsite.

Note: *Even if you already have an SPCC or other spill prevention plan in existence, your plans will only be considered adequate if they meet all of the requirements of this Part, either as part of your existing plan or supplemented as part of the SWPPP.*

b. **Waste Management Procedures.** The SWPPP must describe procedures for how you will handle and dispose of all wastes generated at your site, including, but not limited to, clearing and demolition debris, sediment removed from the site, construction and domestic waste, hazardous or toxic waste, and sanitary waste.

7.2.11. **Procedures for Inspection, Maintenance, and Corrective Action.** The SWPPP must describe the procedures you will follow for maintaining your storm water control measures, conducting site inspections, and, where necessary, taking corrective actions, in accordance with Part 2.1.1.d., Part 2.3.2, Part 4, and Part 5 of the permit. The following information must also be included in your SWPPP:

a. Personnel responsible for conducting inspections;

b. The inspection schedule you will be following, which is based on whether your site is subject to Part 4.1.2 or Part 4.1.3, and whether your site qualifies for any of the allowances for reduced inspection frequencies in Part 4.1.4. If you will be conducting inspections in accordance with the inspection schedule in Part 4.1.2.b. or Part 4.1.3, the location of the rain gauge on your site or the address of the weather station you will be using to obtain rainfall data;

c. If you will be reducing your inspection frequency in accordance with Part 4.1.4.c., the beginning and ending dates of frozen conditions on your site; and

d. Any inspection or maintenance checklists or other forms that will be used.

e. for each storm water control measure you must describe the strategy and schedule you plan to employ to maintain storm water control measures in effective operating condition for each precipitation event or you will be expected to replace, repair, and/or maintain problems found with storm water control measures immediately after each inspection.

7.2.12. **Staff Training**. The SWPPP must include documentation that the required personnel were trained in accordance with Part 6, and all other relevant training be documented (including training in Section 2 for projects that use treatment chemicals).

7.2.13. **UIC Class 5 Injection Wells.**

a. **Utah Water Quality Act Underground Injection Control (UIC) Program Requirements for Certain Subsurface Storm Water Controls**. If you are using any of the following storm water controls at your site, as they are described below, you must document any contact you have had with DWQ for implementing the requirements for underground injection wells in the Safe Drinking Water Act and DEQ's implementing regulations at UAC R317-7. In addition there may be local requirements related to such structures. Such controls (below) would generally be considered Class V UIC wells and all UIC Class V wells must be reported to DWQ for an inventory:

i. French drains (if storm water is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system);

ii. Commercially manufactured pre-cast or pre-built proprietary subsurface detention vaults, chambers, or other devices designed to capture and infiltrate storm water flow; and

iii. Drywells, seepage pits, or improved sinkholes (if storm water is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system).

Note: *For the State UIC Contact at DWQ call 801-536-4300.*

7.2.14. List of Impaired Waters that Receive a Discharge and the following information (see paragraph 3.2.1):

a. A list of all impaired waters to which you discharge;

b. The pollutant(s) for which the surface water is impaired; and

c. Whether a TMDL has been approved or established for the waters to which you discharge.

7.2.15. **SWPPP Certification**. The owner/operator must sign and date your SWPPP in accordance with Appendix G, Part G.16.1.2 & 1.3.

7.2.16. **Also Included in the SWPPP**. Once you have completed the submission of your on-line NOI (or paper submission for some), you must include the following documents as part of your SWPPP:

a. A copy of your NOI,

b. A copy of this permit (an electronic copy easily available to the storm water team is also acceptable).

7.3. **ON-SITE AVAILABILITY OF YOUR SWPPP.**
You are required to maintain a current copy of the project SWPPP at every active construction site where this permit is required, and where construction workers and construction activity related to the project is occurring. The SW Team and/or site workers must be able to refer to SWPPP and update it as needed to manage the site according to permit requirements and as outlined in the SWPPP (it is not required that the SWPPP be on the site when construction workers leave for the day or when there is no activity occurring on the site, but at all times there must be posted contact information where the SWPPP can be obtained – see paragraph 1.5). The SWPPP must be available within 30 minutes[24] at the request of DWQ, MS4, or EPA inspectors during random inspections at active sites , or immediately for pre-scheduled inspections. Requests for a copy of the SWPPP by a regulatory authority (DWQ, EPA, or an MS4), must be accommodated within 72 hours, or as agreed upon by the permittee and the regulatory authority at the time. DWQ may provide access to portions of the project SWPPP to a member of the public upon request. Confidential Business Information (CBI) may be withheld from the public, but may not be withheld from DWQ, local regulating MS4, or the EPA.

Note: *Information covered by a claim of confidentiality will be disclosed by DWQ only to the extent of, and by means of, the procedures set forth in 40 CFR Part 2, Subpart B. In general, submitted information protected by a business confidentiality claim maybe disclosed to other employees, officers, or authorized representatives of DWQ and/or the EPA. The authorized*

[24] On several occasions for smaller projects it has been noted that the location of site plans happens to be the project manager's vehicle. On larger sites the SWPPP may be in another location not close to the place a permitting authority may appear. Thirty minutes is provided for the case where a permitting authority shows up for an inspection and the SWPPP is on the site a distance from that exact location, or it is with the project manager who has recently left the site for a business reason, inadvertently taking the site plans (including the SWPPP) with him/her. This time allowance is for notification of the person who may have taken the SWPPP, so it can be returned, or to locate the SWPPP on the site and provide it for the permitting authority. It is intended that SWPPPs be maintained at the site when the site is active. The 30-minutes is not for retrieving the SWPPP from another site where it should not be.

representatives, including employees of other executive branch agencies, may review CBI during the course of reviewing draft regulations. If an onsite location is unavailable to keep the SWPPP when no personnel are present, notice of the plan's location must be posted near the main entrance of your construction site.

7.4. REQUIRED SWPPP MODIFICATIONS.

7.4.1. **List of Conditions Requiring SWPPP Modification**. You must modify your SWPPP, including the site map(s), in response to any of the following conditions:

a. Whenever you make changes to your construction plans, storm water control measures, pollution prevention measures, or other activities at your site that are no longer accurately reflected in your SWPPP. This includes changes made in response to corrective actions triggered under Part 5;

b. To reflect areas on your site map where operational control has been transferred due to new ownership or a new operator (and the date of that transfer) since initiating permit coverage;

c. If inspections or investigations by site staff, the MS4, DWQ, or the EPA determine that SWPPP modifications are necessary for compliance with this permit;

d. Where DWQ, the EPA, or the MS4 determines it is necessary to impose additional requirements on your discharge, the following must be included in your SWPPP:

i. A copy of any correspondence describing such requirements; and

ii. A description of the storm water control measures that will be used to meet such requirements.

e. To reflect any revisions to applicable federal, state, or local requirements that affect the storm water control measures implemented at the site; and

f. If applicable, if a change in chemical treatment systems or chemically enhanced storm water control is made, including use of a different treatment chemical, different dosage rate, or different area of application.

7.4.2. **Deadlines for SWPPP Modifications**. You must complete required revisions to the SWPPP within 7 calendar days following the occurrence of any of the conditions listed in Part 7.4.1.

7.4.3. **SWPPP Modification Records**. You are required to maintain records showing the dates of all SWPPP modifications. The records must include the name of the person authorizing each change (see Part 7.2.15 above – this person can be a duly authorized representative as allowed in Appendix G.16.1.2, but should be a member of the storm water team) and a brief summary of all changes.

Note: *In most cases the date the modification was made with the initials of the person making the change is adequate.*

7.4.4. **Certification Requirements**. All modifications made to the SWPPP consistent with Part 7.4 must be authorized by a person identified in Appendix G, Part G.16.1.2.

8. HOW TO TERMINATE COVERAGE.

Until your permit coverage is terminate, you are required to comply with all conditions and effluent limitations in the permit, except that inspections can be suspended if the site has been prepared to meet the stabilization requirements found in Section 2.2. To begin the termination process, you must go to the DWQ on-line Storm Water data base and complete the steps for terminating your permit, or you must submit a complete and accurate Notice of Termination (NOT) form (that can be downloaded from the construction storm water web page for DWQ) to the DWQ and the MS4 (for all MS4s listed in Appendix E, you must submit a paper form to the MS4), which certifies that you have met the requirements for termination in Part 8. At this point the permit status changes to "unconfirmed termination". The termination process is complete when DWQ or the MS4 (of jurisdiction) does a final inspection and the inspection is passed. At this point the status of the permit changes to "confirmed termination" and the permit is fully terminated.

8.1. MINIMUM INFORMATION REQUIRED IN NOT.

You will be required to provide the following in your NOT:

8.1.1. UPDES permit tracking number provided by the DWQ when you received coverage under this permit;

8.1.2. You must indicate if the termination request is:

a. **Partial Site** – If the termination request is for a portion of the total area, on area that is no longer under your ownership, you and the new owner are required to submit an Ownership Transfer Form found in Appendix M, to DWQ (and the MS4 if a regulated MS4, see Appendix E). For a partial termination you must indicate (on the NOT) how many acres (to the hundredths) that will be eliminated as a result of the transfer transaction, and you must describe (in words) the area that will be transferred. A partial termination submission does not result in a change of the permit status (the remaining area is still under your permit tracking number with an active status);

b. **Full Site** -- if the termination request is the entire area, it must be handled as follows:

i. **New Ownership**. A transfer of the entire site to a different owner. For this case you and the new owner are required to submit an Ownership Transfer Form found in Appendix M, to DWQ (and the MS4 if a regulated MS4, see Appendix E). The permit status will be changed from "active" to "unconfirmed termination". DWQ or the MS4 of jurisdiction will change the permit status to "confirmed termination" after an inspection. Another way to transfer is described on the Ownership Transfer Form.

ii. **Project Completion**. The project is completed and stabilized according to section 2.2. The status of the project will change from "active" to "unconfirmed termination" which will change to "confirmed termination" after a final inspection by DWQ or the local MS4 has approve the termination in a final inspection.

8.1.3. Basis for submission of the NOT (see Part 8.2);

8.1.4. Owner/Operator contact information;

8.1.5. Name of project and address (or a description of location if no street address is available); and

8.1.6. NOT certification, and signature (in accordance with Appendix G, G.16.1.1 & 1.3).

8.2. **CONDITIONS FOR TERMINATING PERMIT COVERAGE.**
You must terminate permit coverage if one of the following conditions occurs at your site (either 8.2.1, 8.2.2, or 8.2.3 below):

8.2.1. You have completed all earth-disturbing activities at your site and, if applicable, construction support activities covered by this permit (see Part 1.3.3), and you have met the following requirements:

a. For any areas that (1) were disturbed during construction, (2) are not covered over by permanent structures, you have met the requirements for final vegetative or non-vegetative stabilization in Part 2.2;

b. You have removed and properly disposed of all construction materials, waste and waste handling devices, and have removed all equipment and vehicles that were used during construction, unless intended for long-term use following your termination of permit coverage;

c. You have removed all storm water controls that were installed and maintained during construction, except those that are intended for long-term use following your termination of permit coverage or those that are biodegradable to assist in areas where re-establishment of vegetation is especially difficult; and

d. You have removed all potential pollutants and pollutant-generating activities associated with construction, unless needed for long-term use following your termination of permit coverage; and

e. If within a regulated MS4 (see appendix E), you have notified the MS4 that the site is ready for a final inspection; or

8.2.2. For the entire site or for a part of the site, if ownership changes the portion of the site that changes ownership must be terminated.

a. If ownership changes for the entire site the party selling the site must terminate coverage (see paragraph 8.1.2).

b. If ownership changes for a portion of the site the permit holder must terminate only the portion of the site that changes ownership (see paragraph 8.1.2).

8.2.3. Completed homes that are occupied by home owners where at least temporary sediment and erosion controls are in place are allowed to be terminated without final stabilization. If a home owner buys a newly completed house the permit can be terminated while the property is being transferred to the home owner. The home owner should not be involved in the permit process. If a home owner builds his/her

house, they must terminate the permit when the house is approved for occupancy where temporary storm water controls are in place on the site.

8.2.4. Coverage under an individual or alternative general UPDES permit has been obtained.

8.3. **FINAL INSPECTION ASSOCIATED WITH TERMINATION.**
After submission of an NOT, for most cases, there will be a final inspection by the permitting authority (DWQ or the MS4 with jurisdictional authority for the area). A NOT is not complete until the permitting authority approves the site for termination unless the permitting authority does not perform the inspection within a year of the submission of the NOT after it was submitted.

8.4. **HOW TO SUBMIT YOUR NOT.**

8.4.1. It is preferred that the DWQ "on-line" NOI system be used to submit an electronic NOT.

Access to the DWQ on-line storm water data base is found at the DWQ webpage at http://www.waterquality.utah.gov/UPDES/stormwatercon.htm. A click on Online Application Process and Search for Existing Permits found on that page will take you to the "on line" storm water data base where NOIs and NOTs are submitted. You must logon to the account created when the NOI was submitted and find the terminate (or NOT) button for the permit tracking number when you wish to terminate a coverage. In the case where the permittee does not have access to the account where the NOI was submitted the permittee must either contact DWQ and request account access or fill out and submit to DWQ a paper form of the NOT which can be downloaded from the same DWQ website.

8.5. **DEADLINE FOR SUBMITTING NOT.**
You must submit an NOT within 30 calendar days after any one of the triggering conditions in Part 8.2 occur.

8.6. **EFFECTIVE DATE OF TERMINATION OF COVERAGE.**
Your authorization to discharge under this permit terminates at midnight of the calendar day that a completed NOT is processed (meaning that storm water discharged from the site is not coming from a site involved with construction activity) on the DWQ "on-line" storm water data base, unless the results of the final inspection indicate problems that need addressing.

Appendix A - Definitions and Acronyms

Definitions

"Act" – is a reference to the Utah Water Quality Act, or Utah Code Annotated Title 19, Chapter 5.

"Agricultural Land" - cropland, grassland, rangeland, pasture, and other agricultural land, on which agricultural and forest-related products or livestock are produced and resource concerns may be addressed. Agricultural lands include cropped woodland, marshes, incidental areas included in the agricultural operation, and other types of agricultural land used for the production of livestock.

"Antidegradation Policy" or "Antidegradation Requirements" - the water quality standards regulation that requires maintenance of water quality:

> Waters whose existing quality is better than the established standards for the designated uses will be maintained at high quality unless it is determined by the Board, after appropriate intergovernmental coordination and public participation in concert with the Utah continuing planning process, allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. However, existing instream water uses shall be maintained and protected. No water quality degradation is allowable which would interfere with or become injurious to existing instream water uses.
>
> In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with Section 316 of the Federal Clean Water Act.

Category 1 Waters: Waters which have been determined by the Board to be of exceptional recreational or ecological significance or have been determined to be a State or National resource requiring protection, shall be maintained at existing high quality through designation, by the Board after public hearing, as Category 1 Waters. New point source discharges of wastewater, treated or otherwise, are prohibited in such segments after the effective date of designation. Protection of such segments from pathogens in diffuse, underground sources is covered in R317-5 and R317-7 and the Regulations for Individual Wastewater Disposal Systems (R317-501 through R317-515). Other diffuse sources (nonpoint sources) of wastes shall be controlled to the extent feasible through implementation of best management practices or regulatory programs.

Discharges may be allowed where pollution will be temporary and limited after consideration of the factors in R317-2-3.5.b.4., and where best management practices will be employed to minimize pollution effects.

Waters of the state designated as Category 1 Waters are listed in UAC R317-2-12.1.

Category 2 Waters: Category 2 Waters are designated surface water segments which are treated as Category 1 Waters except that a point source discharge may be permitted provided that the discharge does not degrade existing water quality. Discharges may be allowed where pollution will be temporary and limited after consideration of the factors in UAC R317-2-3.5.b.4., and where best management practices will be employed to

minimize pollution effects. Waters of the state designated as Category 2 Waters are listed in UAC R317-2-12.2.

Category 3 Waters: For all other waters of the state, point source discharges are allowed and degradation may occur, pursuant to the conditions and review procedures outlined in in the paragraph below (Antidegradation Review).

Antidegradation Review (ADR): An antidegradation review will determine whether the proposed activity complies with the applicable antidegradation requirements for receiving waters that may be affected.

An antidegradation review (ADR) may consist of two parts or levels. A Level I review is conducted to insure that existing uses will be maintained and protected.

Both Level I and Level II reviews will be conducted on a parameter-by-parameter basis. A decision to move to a Level II review for one parameter does not require a Level II review for other parameters. Discussion of parameters of concern is those expected to be affected by the proposed activity.

Antidegradation reviews shall include opportunities for public participation, as described in UAC R317-2-3.5e.

"Arid Areas" – areas with an average annual rainfall of 0 to 10 inches.

"Bank" (e.g., stream bank or river bank) – the rising ground bordering the channel of a water of the State of Utah.

"Bluff" – a steep headland, promontory, riverbank, or cliff.

"Borrow Areas" – the areas where materials are dug for use as fill, either onsite or off-site.

"Bypass" – the intentional diversion of waste streams from any portion of a treatment facility. See 40 CFR 122.41(m)(1)(i).

"Category 1, 2, and/or 3 Waters" – see "Antidegradation Policy" or "Antidegradation Requirements".

"Cationic Treatment Chemical" – polymers, flocculants, or other chemicals that contain an overall positive charge. Among other things, they are used to reduce turbidity in storm water discharges by chemically bonding to the overall negative charge of suspended silts and other soil materials and causing them to bind together and settle out. Common examples of cationic treatment chemicals are chitosan and cationic PAM.

"Commencement of Earth-Disturbing Activities" - the initial disturbance of soils (or 'breaking ground') associated with clearing, grading, or excavating activities or other construction-related activities (e.g., stockpiling of fill material).

"Commencement of Pollutant-Generating Activities" – at construction sites (for the purposes of this permit) occurs in any of the following circumstances:

- Clearing, grubbing, grading, and excavation has begun;

- Raw materials related to your construction activity, such as building materials or products, landscape materials, fertilizers, pesticides, herbicides, detergents, fuels, oils, or other chemicals have been placed at your site;

- Use of authorized non-storm water for washout activities, or dewatering activities, have begun; or

- Any other activity has begun that causes the generation of or the potential generation of pollutants.

"Common Plan of Development or Sale" – is a plan to subdivide a parcel of land into separate parts for separate sale. This can be for a residential, commercial, or industrial development. The plan originates as a single parcel which is separated into parts. This usually goes through an approval process by a local governmental unit, but in some cases may not require that process. The original plan is considered the "common plan of development or sale" whether phased or completed in steps. If a further plan is conceived that was not foreseen during the original plan, or the original plan is added onto but the addition was conceived later and was not included in any part of the original plan concept and/or development, and it develops after the completion of the construction of the entire original plan, it would be a separate "common plan of development or sale". More than one owner of developable land can purposely join together and develop a single common plan of development or sale, but without a determined effort and coordinated planning, land owned by different owners would not be considered part of a single common plan of development or sale. For UPDES storm water permit purposes a common plan must have been initiated after October, 1992. A common plan of development or sale remains so until each lot or section of the development has fulfilled its planned purposes (e.g. in a residential development as homes are completed, stabilized, and sold or occupied). As lots or separated sections of the development are completed, the lot or section is stabilized, and the plan purposes are fulfilled for that area, lot, or section; it is no longer part of the common plan of development or sale (e.g. if a home is sold in a development and the owner decides to add a garage somewhere on the lot, that garage project is not part of the common plan of development or sale. In this process a common plan of development or sale may become reduced in size and/or separated by completed areas (which are no longer part of the common plan of development or sale), but all unfinished lots remain part of the same common plan development or sale until they are completed, stabilized, and fulfilled according to the purposes of the plan). Common Plans of Development or Sale can be commercial or industrial also.

"Construction Activities" – earth-disturbing activities, such as the clearing, grading, and excavation of land.

"Construction and Development Effluent Limitations and New Source Performance Standards" (C&D Rule) – as published in 40 CFR § 450 is the regulation requiring effluent limitations guidelines(ELG's) and new source performance standards (NSPS) for controlling the discharge of pollutants from construction sites.

"Construction Site" – the land or water area where construction activities will occur and where storm water controls will be installed and maintained. The construction site includes construction support activities, which may be located at a different part of the property from where the primary construction activity will take place, or on a different piece of property altogether. The construction site is often a smaller subset of the lot or parcel within which the project is taking place.

"Construction Support Activities" – a construction-related activity that specifically supports the construction activity and involves earth disturbance or pollutant-generating activities of its own, and can include activities associated with concrete or asphalt batch plants, equipment staging yards, materials storage areas, excavated material disposal areas, and borrow areas.

"Construction Waste" – discarded material (such as packaging materials, scrap construction materials, masonry products, timber, steel, pipe, and electrical cuttings, plastics, and styrofoam).

"Conveyance Channel" – a temporary or permanent waterway designed and installed to safely convey storm water flow within and out of a construction site.

"Corrective Action" – for the purposes of the permit, any action taken to (1) repair, modify, or replace any storm water control used at the site; (2) clean up and dispose of spills, releases, or other deposits found on the site; and (3) remedy a permit violation.

"CWA" – the Clean Water Act or the Federal Water Pollution Control Act, 33 U.S.C. section 1251 et seq.

"Dewatering" – the act of draining rainwater and/or groundwater from building foundations, vaults, and trenches.

"Director" – the director of the Division of Water Quality.

"Discharge" – it can mean discharge of storm water or "discharge of a pollutant."

"Discharge of a Pollutant" – any addition of any "pollutant" or combination of pollutants to "waters of the State" from any "point source," or any addition of any pollutant or combination of pollutants to the waters of the State. This includes additions of pollutants into waters of the State from: surface runoff which is collected or channeled by man; discharges through pipes, sewers, or other conveyances, leading into privately owned treatment works. See 40 CFR 122.2.

"Discharge Point" – for the purposes of this permit, the location where collected and concentrated storm water flows are discharged from the construction site.

"Discharge-Related Activity" – activities that cause, contribute to, or result in storm water and allowable non-storm water point source discharges, and measures such as the siting, construction, and operation of storm water controls to control, reduce, or prevent pollutants from being discharged.

"Discharge to an Impaired Water" – for the purposes of this permit, a discharge to an impaired water occurs if the first water of the State to which you discharge is identified by DWQ or EPA pursuant to Section 303(d) of the Clean Water Act as not meeting an applicable water quality standard, or is included in an EPA-approved or DWQ established total maximum daily load (TMDL). For discharges that enter a storm sewer system prior to discharge, the water of the State to which you discharge is the first water of the State that receives the storm water discharge from the storm sewer system.

"Domestic Waste" – for the purposes of this permit, typical household trash, garbage or rubbish items generated by construction activities.

"Drainageway" – an open linear depression, whether constructed or natural, that functions for the collection and drainage of surface water.

"Drought-Stricken Area" – for the purposes of this permit, an area in which the National Oceanic and Atmospheric Administration's U.S. Seasonal Drought Outlook indicates for the period during which the construction will occur that any of the following conditions are likely: (1) "Drought to persist or intensify", (2) "Drought ongoing, some improvement", (3) "Drought likely to improve, impacts ease", or (4) "Drought development likely". See http://www.cpc.ncep.noaa.gov/products/expert_assessment/season_drought.gif.

"Earth-Disturbing Activity" or "Land-Disturbing Activity" – actions taken to alter the existing vegetation and/or underlying soil of a site, such as clearing, grading, site preparation (e.g., excavating, cutting, and filling), soil compaction, and movement and stockpiling of top soils.

"Effective Operating Condition" – for the purposes of this permit, a storm water control is kept in effective operating condition if it has been implemented and maintained in such a manner that it is working as designed to minimize pollutant discharges.

"Effluent Limitations" – for the purposes of this permit, any of the Part 2 or Part 3 requirements.

"Effluent Limitations Guideline" (ELG) – defined in 40 CFR § 122.2 as a regulation published by the EPA Administrator under section 304(b) of CWA to adopt or revise effluent limitations.

"Electronic Notice of Intent" – DWQ's online system for submitting electronic Construction General Permit forms.

"Eligible" – for the purposes of this permit, refers to storm water and allowable non-storm water discharges that are authorized for coverage under this general permit.

"Emergency-Related Project" – a project initiated in response to a public emergency (e.g., natural disaster, disruption in essential public services), for which the related work requires immediate authorization to avoid imminent endangerment to human health or the environment, or to reestablish essential public services.

"Excursion" – a measured value that exceeds a specified limit.

"Existing Project" – a construction project that commenced construction activities prior to the issuance date of this permit.

"Existing Permit Coverage" – means for a permittee that he/she had permit coverage under a previous permit (e.g., UTR300000), prior to the issuance of this permit.

"Exit Points" – any points of egress from the construction site to be used by vehicles and equipment during construction activities.

"Exposed Soils" – for the purposes of this permit, soils that as a result of earth-disturbing activities are disturbed and exposed to the elements of weather.

"Final Stabilization" – on areas not covered by permanent structures, either (1) vegetation has been established, or for arid or semi-arid areas, the area has been designed and prepared so that with time it is expected to be established a uniform (e.g., evenly distributed, without large bare

areas) perennial vegetative cover of 70 percent of the natural background vegetative cover, or (2) non-vegetative stabilization methods have been implemented to provide effective cover for exposed portions of the site.

"Groundwater" – water that resides in the ground, even if only temporarily for the time it is in the ground, in the voids and interstitial spaces around soil particles.

"Hazardous Materials" or "Hazardous Substances" or "Hazardous or Toxic Waste" – for the purposes of this permit, any liquid, solid, or contained gas that contain properties that are dangerous or potentially harmful to human health or the environment. See also 40 CFR §261.2.

"Impaired Water" or "Water Quality Impaired Water" or "Water Quality Limited Segment" – for the purposes of this permit, waters identified as impaired on the CWA Section 303(d) list, or waters with an EPA-approved or established TMDL. Your construction site will be considered to discharge to an impaired water if the first water of the state to which you discharge is identified by DWQ pursuant to Section 303(d) of the CWA as not meeting an applicable water quality standard, or is included in an EPA-approved or DWQ established total maximum daily load (TMDL). For discharges that enter a storm sewer system prior to discharge, the first water of the state to which you discharge is the water body that receives the storm water discharge from the storm sewer system.

"Impervious Surface" – for the purpose of this permit, any land surface with a low or no capacity for soil infiltration including, but not limited to, pavement, sidewalks, parking areas and driveways, packed gravel or soil, or rooftops.

"Indian Country" or "Indian Country Lands" – defined at 40 CFR §122.2 as:

1. All land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, and, including rights-of way running through the reservation;

2. All dependent Indian communities within the borders of the United States whether within the originally or subsequently acquired territory thereof; and

3. All Indian allotments, the Indian titles to which have not been extinguished, including rights-of-ways running through the same.

"Infeasible" – for the purpose of this permit, infeasible means not technologically possible or not economically practicable and achievable in light of best industry practices. DWQ notes that it does not intend for any permit requirement to conflict with state water rights law.

"Install" or "Installation" – when used in connection with storm water controls, to connect or set in position storm water controls to make them operational.

"Intermittent (or Seasonal) Stream" – one which flows at certain times of the year when groundwater provides water for stream flow, as well as during and immediately after some precipitation events or snowmelt.

"Jar test" – a test designed to simulate full-scale coagulation/flocculation/sedimentation water treatment processes by taking into account the possible conditions.

"Landward" – positioned or located away from a water body, and towards the land.

"Level Spreader" – a temporary storm water control used to spread storm water flow uniformly over the ground surface as sheet flow to prevent concentrated, erosive flows from occurring.

"Linear Construction Project" – includes the construction of roads, bridges, conduits, substructures, pipelines, sewer lines, towers, poles, cables, wires, connectors, switching, regulating and transforming equipment and associated ancillary facilities in a long, narrow area.

"Minimize" – to reduce and/or eliminate to the extent achievable using storm water controls that are technologically available and economically practicable and achievable in light of best industry practices.

"Municipal Separate Storm Sewer System" or "MS4" – defined at 40 CFR §122.26(b)(8) as a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains):

1. Owned and operated by a state, city, town, county, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or a designated and approved management agency under section 208 of the CWA that discharges to waters of the State;

2. Designed or used for collecting or conveying storm water;

3. Which is not a combined sewer; and

4. Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR §122.2.

"National Pollutant Discharge Elimination System" (NPDES) – defined at 40 CFR §122.2 as the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of CWA. The term includes an 'approved program.'

"Native Topsoil" – the uppermost layer of naturally occurring soil for a particular area, and is often rich in organic matter, biological activity, and nutrients.

"Native Vegetation" – the species of plants that have developed for a particular region or ecosystem and are considered endemic to that region or ecosystem.

"Natural Buffer" – for the purposes of this permit, an area of undisturbed natural cover surrounding surface waters within which construction activities are restricted. Natural cover includes the vegetation, exposed rock, or barren ground that exists prior to commencement of earth-disturbing activities.

"Natural Vegetation" – vegetation that occurs spontaneously without regular management, maintenance or species introductions, removals, and that generally has a strong component of native species.

"New Operator of a New or Existing Project" – an operator that through transfer and/or operation replaces the operator of an already permitted construction project.

"New Project" – a construction project that commences construction activities on or after July 1, 2013.

"New Source" – for the purpose of this permit, a construction project that commenced construction activities on or after the issuance date of this permit.

"New Source Performance Standards (NSPS)" – for the purposes of this permit, NSPS are technology-based standards that apply to construction sites that are new sources under 40 CFR 450.24.

"Non-Storm Water Discharges" – discharges that do not originate from storm events. They can include, but are not limited to, discharges of process water, air conditioner condensate, noncontact cooling water, vehicle wash water, sanitary wastes, concrete washout water, paint wash water, irrigation water, or pipe testing water.

"Non-Turbid" – is a term used in this permit to describe water that appears visually clear and there appears to be no evidence of silt or sediment present in the water.

"Notice of Intent" (NOI) – the form (electronic or paper) required for authorization of coverage under the Construction General Permit.

"Notice of Termination" (NOT) – the form (electronic or paper) required for terminating coverage under the Construction General Permit.

"Operational" – for the purpose of this permit, storm water controls are made "operational" when they have been installed and implemented, are functioning as designed, and are properly maintained.

"Operator" – for the purpose of this permit an operator is the party that has day-to-day operational control of those activities at a project that are necessary to ensure compliance with the permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the permit). Operator in this context is generally is considered to be the general contractor for a project.

"Ordinary High Water Mark" – the line on the shore established by fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, and/or the presence of litter and debris.

"Outfall" – see "Discharge Point."

"Owner" – for the purpose of this permit an owner usually has ownership of property on which construction activity is taking place, but it also includes ownership of a project for which construction activity is occurring on property that is owned or leased. An owner is the party that has ultimate control over construction plans and specifications, including the ability at the highest level to make modifications to those plans and specifications. "Owner" in this context is the party that has ultimate control over the destiny of a project.

"Permittee" – is the owner and/or operator named in the NOI for the project.

"Permitting Authority" – for the purposes of this permit, DWQ, the Executive Secretary for the Utah Water Quality Board, or an authorized representative.

"Point(s) of Discharge" – see "Discharge Point."

"Point Source" – any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural storm water runoff.

"Pollutant" – defined at 40 CFR §122.2. A partial listing from this definition includes: dredged spoil, solid waste, sewage, garbage, sewage sludge, chemical wastes, biological materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial or municipal waste.

"Pollutant-Generating Activities" – at construction sites (for the purposes of this permit), those activities that lead to or could lead to the generation of pollutants, either as a result of earth disturbance or a related support activity. Some of the types of pollutants that are typically found at construction sites are:

- sediment;
- nutrients;
- heavy metals;
- pesticides and herbicides;
- oil and grease;
- bacteria and viruses;
- trash, debris, and solids;
- treatment polymers; and
- any other toxic chemicals.

"Pollution Prevention Measures" – storm water controls designed to reduce or eliminate the addition of pollutants to construction site discharges through analysis of pollutant sources, implementation of proper handling/disposal practices, employee education, and other actions.

"Polymers" – for the purposes of this permit, coagulants and flocculants used to control erosion on soil or to enhance the sediment removal capabilities of sediment traps or basins. Common construction site polymers include polyacrylamide (PAM), chitosan, alum, polyaluminum chloride, and gypsum.

"Prohibited Discharges" – discharges that are not allowed under this permit, including:

1. Wastewater from washout of concrete;
2. Wastewater from washout and cleanout of stucco, paint, form release oils, curing compounds and other construction materials;
3. Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance;
4. Soaps or solvents used in vehicle and equipment washing;
5. Toxic or hazardous substances from a spill or other release; and

6. Waste, garbage, floatable debris, construction debris, and sanitary waste from pollutant generating activities.

"Provisionally Covered Under this Permit" – for the purposes of this permit, DWQ provides temporary coverage under this permit for emergency-related projects prior to receipt of a complete and accurate NOI. Discharges from earth-disturbing activities associated with the emergency-related projects are subject to the terms and conditions of the permit during the period of temporary coverage.

"Receiving Water" – a "Water of the State" is as defined in Utah Administrative Code R317-1-1.34, into which the regulated storm water discharges.

"Regulatory Authority" – as it pertains to this permit means EPA, DWQ, or a local MS4 that oversights construction activity.

"Run-On" – sources of storm water that drain from land located upslope or upstream from the regulated site in question.

"Semi-Arid Areas" – areas with an average annual rainfall of over 10 to 20 inches.

"Site" – for construction activities, the land or water area where earth-disturbing activities take place, including construction support activities.

"Small Construction Activity" – defined at Utah Administrative Code R317-8-3.9(6)(e)1. and incorporated here by reference. A small construction activity includes clearing, grading, and excavating resulting in a land disturbance that will disturb equal to or greater than one (1) acre and less than five (5) acres of land or will disturb less than one (1) acre of total land area but is part of a larger common plan of development or sale that will ultimately disturb equal to or greater than one (1) acre and less than five (5) acres. Small construction activity does not include routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of the site.

"Small Residential Lot" – for the purpose of this permit, a lot being developed for residential purposes that will disturb less than 1 acre of land, but is part of a larger residential project that will ultimately disturb greater than or equal to 1 acre.

"Snowmelt" – the conversion of snow into overland storm water and groundwater flow as a result of warmer temperatures.

"Spill" – for the purpose of this permit, the release of a hazardous or toxic substance from its container or containment.

"Stabilization" – the use of vegetative and/or non-vegetative cover to prevent erosion and sediment loss in areas of disturbed soil exposed from the construction process.

"Steep Slopes" –for this permit steep slopes are defined as those that are 15 percent or greater in grade.

"Storm Sewer System" – a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains) designed or used for collecting or conveying storm water.

"Storm Water" – storm water runoff, snow melt runoff, and surface runoff and drainage.

"Storm Water Control Measure" - refers to any storm water control, BMP, or other method (including narrative effluent limitations) used to prevent or reduce the discharge of pollutants to waters of the state.

"Storm Water Controls" – see "Storm Water Control measure."

"Storm Water Discharge Associated with Construction Activity" – as used in this permit, a discharge of pollutants in storm water to waters of the state from areas where land disturbing activities (e.g., clearing, grading, or excavation) occur, or where construction materials or equipment storage or maintenance (e.g., fill piles, borrow area, concrete truck chute wash down, fueling), or other industrial storm water directly related to the construction process (e.g., concrete or asphalt batch plants), are located.

"Storm Water Inlet" – an entrance or opening to a storm water conveyance system, generally placed below grade so as to receive storm water drainage from the surrounding area.

"Storm Water Team" – the group of individuals responsible for oversight of the development and modifications of the SWPPP, and oversight of compliance with the permit requirements. The individuals on the "Storm water Team" must be identified in the SWPPP.

"Storm Event" – a precipitation event that results in a measurable amount of precipitation.

"Storm Sewer" – a system of pipes (separate from sanitary sewers) that carries storm water runoff from buildings and land surfaces.

"Subcontractor" – for the purposes of this permit, an individual or company that takes a portion of a contract from the general contractor or from another subcontractor.

"Surface Water" – for this permit a surface water is defined all open water bodies, streams, lakes, ponds, marshes, wetlands, watercourses, waterways, springs, drainage systems, and all other bodies or accumulations of water on the surface only. Surface water is visible water, standing or flowing, above the surface of the ground.

"SWPPP" (Storm water Pollution Prevention Plan) – a site-specific, written document that, among other things: (1) identifies potential sources of storm water pollution at the construction site; (2) describes storm water control measures to reduce or eliminate pollutants in storm water discharges from the construction site; and (3) identifies procedures the operator will implement to comply with the terms and conditions of this general permit.

"Temporary Stabilization" – a condition where exposed soils or disturbed areas are provided a temporary vegetative and/or non-vegetative protective cover to prevent erosion and sediment loss. Temporary stabilization may include temporary seeding, geotextiles, mulches, and other techniques to reduce or eliminate erosion until either final stabilization can be achieved or until further construction activities take place to re-disturb this area.

"Thawing Conditions" – for the purposes of this permit, thawing conditions are expected based on the historical likelihood of two or more days with daytime temperatures greater than 32˚F. This date can be determined by looking at historical weather data.

Note: *The estimation of thawing conditions is for planning purposes only. During construction the permittee will be required to conduct site inspections based upon actual conditions (i.e., if thawing conditions occur sooner than expected, the permittee will be required to conduct inspections at the regular frequency).*

"Total Maximum Daily Load" or "TMDL" – the sum of the individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background. If a receiving water has only one point source discharger, the TMDL is the sum of that point source WLA plus the LAs for any nonpoint sources of pollution and natural background sources, tributaries, or adjacent segments. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure.

"Toxic Waste" – see "Hazardous Materials."

"Turbidity" – when the term is used in a narrative it means a condition of water quality characterized by the presence of cloudiness usually caused by suspended solids and/or organic material. It refers to the visual clarity in water and is measured in a test passing light through a sample of water and quantifying the amount of light passing. The measurement is <u>not</u> directly proportional to the quantity of sediment in the water sample it is directly related to the quantity of light that passes through the sample. Particulate size and other factors can affect the amount of light that passes through the sample. This measurement is called nephelometric turbidity units or ntu.

"Uncontaminated Discharge" – a discharge that does not cause or contribute to an exceedence of applicable water quality standards.

"Upland" - the dry land area above and 'landward' of the ordinary high water mark.

"Upset" – Upset means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond your reasonable control. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation. See 40 CFR 122.41(n)(1).

"Water-Dependent Structures" – structures or facilities that are required to be located directly adjacent to a waterbody or wetland, such as a marina, pier, boat ramp, etc.

"Water Quality Standards" –are provisions of State law which consist of a designated use or uses for the waters of the United States, water quality criteria for such waters based upon such uses, and an antidegradation policy to protect highquality waters. Water quality standards protect the public health or welfare, enhance the quality of water and serve the purposes of the Utah Water Quality Act.

"Waters of the State" – means all streams, lakes, ponds, marshes, water-courses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, public or private, which are contained within, flow through, or border upon this state or any portion thereof, except that bodies of water confined to and retained within the limits of private property, and which do not develop into or constitute a nuisance, or a public health hazard, or a menace to fish and wildlife, shall not be considered to be "waters of the state" under this definition (Section 19-5-102).

"Wetland" – those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. On-site evaluations are typically required to confirm the presence and boundaries of wetlands.

"Work day" – for the purposes of this permit, a work day is a calendar day on which construction activities will take place.

Acronyms
C&D – Construction & Development
CGP – Construction General Permit
CFR – Code of Federal Regulations
CPoD – Common Plan of Development or Sale
CWA – Clean Water Act
DEQ – Department of Environmental Quality
DDW – Division of Drinking Water
DWQ – Division of Water Quality
DNR – Department of Natural Resources
DOGM – Department of Oil, Gas, and Mining
EPA – United States Environmental Protection Agency
ESA – Endangered Species Act
FWS – United States Fish and Wildlife Service
MS4 – Municipal Separate Storm Sewer System
MSGP – Multi-Sector General Permit
NHPA – National Historic Preservation Act
NMFS – United States National Marine Fisheries Service
NOI – Notice of Intent
NOT – Notice of Termination
NPDES – National Pollutant Discharge Elimination System
NRC – National Response Center
NRCS – National Resources Conservation Service
POTW – Publicly Owned Treatment Works
SPCC – Spill Prevention Control and Countermeasure
SW – Storm Water
SWMP – Storm Water Management Plan
SWPPP – Storm Water Pollution Prevention Plan
TMDL – Total Maximum Daily Load
UAC – Utah Administrative Code
UCA – Utah Code Annotated
UCGP – Utah Construction General Permit
UDOT – Utah Department of Transportation
USGS – United States Geological Survey
UWQA – Utah Water Quality Act
WQS – Water Quality Standard

Appendix B - Small Construction Waivers and Instructions

These waivers are only available to storm water discharges associated with small construction activities (i.e., construction activity disturbing between 1-5 acres). As the owner/operator of a small construction activity, you may be able to qualify for a waiver in lieu of needing to obtain coverage under this general permit based on a low rainfall erosivity factor. Each owner/operator, otherwise needing permit coverage, must notify DWQ of its intention to employ this waiver. It is the responsibility of those individuals wishing to obtain a waiver from coverage under this general permit to submit a complete and accurate waiver certification as described below. Where the owner/operator changes or another is added during the construction project, the new owner/operator must also submit a waiver certification to be waived.

B.1 RAINFALL EROSIVITY WAIVER

Under this scenario the small construction project's rainfall erosivity factor calculation ("R" in the Revised Universal Soil Loss Equation) is less than 5 during the period of construction activity. The owner/operator must certify to DWQ that construction activity will occur only when the rainfall erosivity factor is less than 5. The period of construction activity begins at initial earth disturbance and ends with final stabilization. Where vegetation will be used for final stabilization, the date of installation of a stabilization practice that will provide interim non-vegetative stabilization can be used for the end of the construction period, provided the owner/operator commits (as a condition of waiver eligibility) to periodically inspect and properly maintain the area until the criteria for final stabilization as defined in the construction general permit have been met. If use of this interim stabilization eligibility condition was relied on to qualify for the waiver, signature on the waiver with its certification statement constitutes acceptance of and commitment to complete the final stabilization process. The owner/operator must submit a waiver certification to DWQ prior to commencing construction activities.

Note: *The rainfall erosivity factor "R" is determined in accordance with Chapter 2 of Agriculture Handbook Number 703, Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE), pages 21–64, dated January 1997; United States Department of Agriculture (USDA), Agricultural Research Service.*

EPA has developed an online rainfall erosivity calculator to help small construction sites determine potential eligibility for the rainfall erosivity waiver. You can access the calculator from EPA's website at:www.epa.gov/npdes/stormwater/lew. The R factor can easily be calculated by using the construction site latitude/longitude or address and estimated start and end dates of construction. This calculator may also be useful in determining the time periods during which construction activity could be waived from permit coverage. You may find that moving your construction activity by a few weeks or expediting site stabilization will allow you to qualify for the waiver. Use this online calculator or the Construction Rainfall Erosivity Waiver Fact Sheet (www.epa.gov/npdes/pubs/fact3-1.pdf) to assist in determining the R Factor for your small construction site.

If you are the owner/operator of the construction activity and are eligible for a waiver based on low erosivity potential, you can submit the erosivity waiver electronically on the DWQ on-line Storm Water data base (https://secure.utah.gov/stormwater) or provide the following information on the waiver certification form in order to be waived from permitting requirements:

1. Name, address and telephone number of the construction site owner/operator(s);

2. Name (or other identifier), address, county, city (if within an incorporated city boundary), and latitude/longitude of the construction project or site;
3. Estimated construction start and completion (i.e., final stabilization) dates, and total acreage (to the nearest quarter acre) to be disturbed;
4. The rainfall erosivity factor calculation that applies to the active construction phase a your project site; and
5. A statement, signed and dated by an authorized representative as provided in Appendix I, Subsection I.11, which certifies that the construction activity will take place during a period when the value of the rainfall erosivity factor is less than five

You can access the waiver certification form from DWQ's website at: (http://www.waterquality.utah.gov/UPDES/stormwatercon.htm). Paper copies of the form must be sent to one of the addresses listed in Part B.2 of this appendix.

Note: *If the R factor is 5 or greater, you cannot apply for the rainfall erosivity waiver, and must apply for UPDES permit coverage.*

If your small construction project continues beyond the projected completion date given on the waiver certification, you must recalculate the rainfall erosivity factor for the new project duration. If the R factor is below five (5), you must update all applicable information on the waiver certification and retain a copy of the revised waiver as part of your records. The new waiver certification must be submitted prior to the projected completion date listed on the original waiver form to assure your exemption from permitting requirements is uninterrupted. If the new R factor is 5 or above, you must obtain UPDES permit coverage.

B.2 WAIVER DEADLINES AND SUBMISSIONS

1. Waiver certifications must be submitted prior to commencement of construction activities.
2. Late Notifications: Owner/Operators are not prohibited from submitting waiver certifications after initiating clearing, grading, excavation activities, or other construction activities. DWQ reserves the right to take enforcement for any unpermitted discharges that occur between the time construction commenced and waiver authorization is granted.

Submittal of a waiver certification is an optional alternative to obtaining permit coverage for discharges of storm water associated with small construction activity (construction activity disturbing 1-5 acres), provided you qualify for the waiver. Any discharge of storm water associated with small construction activity not covered by either a permit or a waiver may be considered an unpermitted discharge under the Clean Water Act. DWQ may notify any owner/operator covered by a waiver that they must apply for a permit. DWQ may notify any owner/operator who has been in non-compliance with a waiver that they may no longer use the waiver for future projects. Any member of the public may petition DWQ to take action under this provision by submitting written notice along with supporting justification. Complete and accurate Rainfall Erosivity waiver certifications not otherwise submitted electronically via DWQ's on-line Storm Water data base system (https://secure.utah.gov/stormwater) must be sent to the following address:

Construction Storm Water Waiver
Utah DWQ
PO Box 144870
Salt Lake City, Utah 84114-4870

Appendix C – List with Information on Utah's Waters

The site http://wq.deq.utah.gov/ has a map of watershed assessment units which can be used to identify waters (rivers, creeks, lakes) and water quality information about them. If you can find the place on the map of the State of Utah and click where your project will occur, information will come up in the window on the left about the watershed assessment unit.

The information available on the watershed assessment unit is:

Name of the watershed assessment unit or water body
Category of water
Beneficial uses of the water body
If the water is impaired
If impaired, what the cause of impairment is
A contact name and phone number to obtain more information.

Appendix D – Buffer Guidance.

The following section was taken (nearly verbatim) from the EPA CGP. The EPA covers the entire US and therefore provides information from across the US. Data and information directly about Utah are not included. DWQ does not have the resources to modify this appendix to generate and include information only for Utah. The entire section is included to provide direction and help for permittees although examples within this treatise may also include areas not similar to Utah. For purposes of the permit it will suffice for a site in Utah to use the data from areas with similar climates (Idaho or New Mexico -- whichever matches the Utah site closest) to make the prescribed calculations.

The purpose of this guidance is to assist you in complying with the requirements in Part 2.1.2.a. of the permit regarding the establishment of natural buffers or equivalent sediment controls. This guidance is organized as follows:

D.1. SITES THAT ARE REQUIRED TO COMPLY WITH PART 2.1.2.a. ····· D-2.

D.1.1. Step 1 - Determine if Your Site is Within 50 Feet of a Surface Water ····· D-2.
D.1.2. Step 2 - Determine if Any Exceptions to the Requirements in Part 2.1.2.a. Apply ··· D-3.

D.2 COMPLIANCE ALTERNATIVES GUIDANCE ····· D-4.

D.2.1. Guidance for Providing and Maintaining Natural Buffers ····· D-4.
D.2.1.1 Buffer Width Measurement ····· D-5.
D.2.1.2 Limits to Disturbance Within the Buffer. ····· D-7.
D.2.1.3 Discharges to the Buffer ····· D-7.
D.2.1.4 SWPPP Documentation ····· D-8.
D.2.2. Guidance for Providing the Equivalent Sediment Reduction as the 50-foot Buffer ··· D-8.
D.2.2.1 Determine Whether it is Feasible to Provide a Reduced Buffer ····· D-8.
D.2.2.2 Design Controls That Provide Equivalent Sediment Reduction as 50-foot Buffer ····· D-9.
a. Step 1 - Estimate the Sediment Reduction from the 50-foot Buffer D-10.
b. Step 2 - Design Controls That Match the Sediment Removal Efficiency of the 50-foot Buffer ····· D-11.
c. Step 3 - Document How Site-Specific Controls Will Achieve the Sediment Removal Efficiency of the 50-foot Buffer ····· D-12.
D.2.3 Small Residential Lot Compliance Alternatives ····· D-13.
D.2.3.1 Step 1 – Determine if You are Eligible for the Small Residential Lot Compliance ····· D-13.
D.2.3.2 Step 2 – Implement the Requirements of the Small Residential Lot Compliance Alternative Selected ····· D-13.
a. Small Residential Lot Compliance Alternative 1 ····· D-13.
b. Small Residential Lot Compliance Alternative 2 ····· D-14.

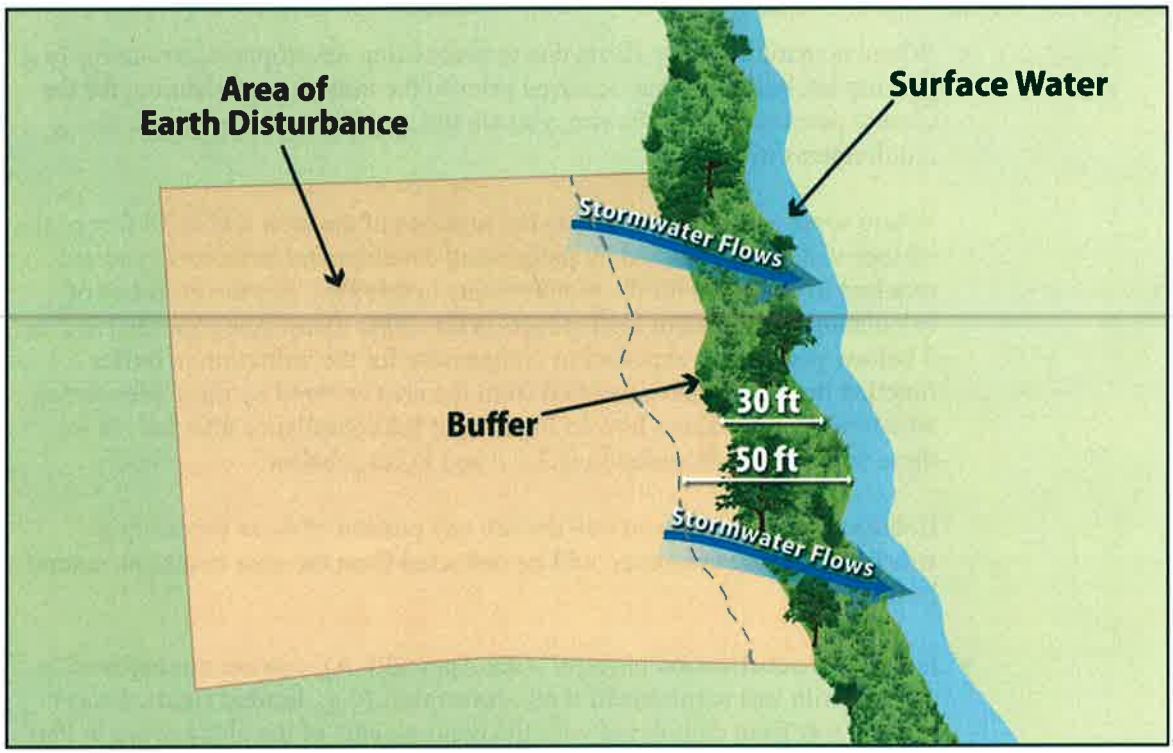
D.1 SITES THAT ARE REQUIRED TO COMPLY WITH PART 2.1.2.a.

The purpose of this part is to help you determine if the requirements in Part 2.1.2.a. apply to your site.

D.1.1 Step 1 - Determine if Your Site is Within 50 Feet of a Surface Water

Part 2.1.2.a. applies to you only if your earth-disturbing activities will occur within 50 feet of a surface water that receives storm water discharges from your site. Figure D – 1 illustrates when a site would be required to comply with the requirements in Part 2.1.2.a. due to their proximity to a surface water. If the surface water is not located within 50 feet of the earth-disturbing activities, Part 2.1.2.a. does not apply.

Figure D - 1. Example of earth-disturbing activities within 50 feet of a surface water.



If you determine that your earth-disturbing activities will occur within 50 feet of a surface water that receives storm water discharges from your site, the requirements in Part 2.1.2.a. apply, except for certain circumstances that are described in Step 2.

Note that where some natural buffer exists but portions of the area within 50 feet of the surface water are occupied by preexisting development disturbances, or if a portion of area within 50 feet of the surface water is owned by another party and is not under your control, the buffer requirements in Part 2.1.2.a. still apply, but with some allowances.

Clarity about how to implement the compliance alternatives for these situations is provided in D.2.1.2 and D.2.2.2 below.

Note that DWQ does not consider designed storm water control features (e.g., storm water conveyance channels, storm drain inlets, storm water basins) that direct storm water to surface waters more than 50 feet from the disturbance to constitute surface waters for the purposes of determining if the buffer requirements apply.

D.1.2 Step 2 - Determine if Any Exceptions to the Requirements in Part 2.1.2.a. Apply.

The following exceptions apply to the requirements in Part 2.1.2.a:

- If there is no discharge of storm water to surface waters through the area between the disturbed portions of the site and any surface waters located within 50 feet of your site, you are not required to comply with the requirements in this Part. This includes situations where you have implemented controls measures, such as a berm or other barrier that will prevent such discharges.

- Where no natural buffer exists due to preexisting development structures (e.g. parking lot, building) that occurred prior to the initiation of planning for the current development of the site, you are not required to comply with the requirements in this Part.

  Where some natural buffer exists but portions of the area within 50 feet of the surface water are occupied by preexisting development structures, you are required to comply with the requirements in this Part. For the purposes of calculating the sediment load reduction for either compliance alternative 2 or 3 below, you are not expected to compensate for the reduction in buffer function that would have resulted from the area covered by these preexisting structures. Clarity about how to implement the compliance alternatives for these situations is provided in D.2.1.2 and D.2.2.2 below.

  If during your project, you will disturb any portion of these preexisting structures, the area removed will be deducted from the area treated as natural buffer.

- For "linear construction projects" (see Appendix A), you are not required to comply with this requirement if site constraints (e.g., limited right-of-way) prevent you from complying with the requirements of the alternatives in Part 2.1.2.a.i. provided that, to the extent practicable, you limit disturbances within 50 feet of the surface water and/or you provide supplemental erosion and sediment controls to treat storm water discharges from earth disturbances within 50 feet of the surface water. You must also document in your SWPPP your rationale for why it is infeasible for you to comply with the requirements in Part 2.1.2.a.i., and describe any buffer width retained and/or supplemental erosion and sediment controls installed.

- For "small residential lot" construction (i.e., a lot being developed for residential purposes that will disturb less than 1 acre of land, but is part of a common plan of development or sale that will disturb greater than or equal to 1 acre), you have the option of complying with the requirements in Part D.2.3 of this appendix.

- The following disturbances within 50 feet of a surface water are exempt from the requirements in this Part:
  - Construction approved under a CWA Section 404 permit; or
  - Construction of a water-dependent structure or water access areas (e.g., pier, boat ramp, trail).

  Note that you must document in your SWPPP if any disturbances related to any of the above exceptions occurs within the buffer area on your site.

D.2 COMPLIANCE ALTERNATIVES GUIDANCE.

If in Part D.1 of this guidance you determine that the buffer requirements apply to your site, you have three compliance alternatives from which you can choose:

1. Provide and maintain a 50-foot undisturbed natural buffer (Part 2.1.2.a.i.1));[1] or
2. Provide and maintain an undisturbed natural buffer that is less than 50 feet and is supplemented by additional erosion and sediment controls, which in combination achieves the sediment load reduction equivalent to a 50-foot undisturbed natural buffer (Part 2.1.2.a.i.2));[1] or
3. If it is infeasible to provide and maintain an undisturbed natural buffer of any size, you must implement erosion and sediment controls that achieve the sediment load reduction equivalent to a 50-foot undisturbed natural buffer (Part 2.1.2.a.i.3)).[1]

The compliance alternative selected above must be maintained throughout the duration of permit coverage.

The following provides detailed guidance for how you can comply with each of the compliance alternatives. Part D.2.1. below provides guidance on how to provide and maintain natural buffers consistent with the alternatives 1 and 2, above. Part D.2.2. below provides guidance on how to comply with the requirement to provide a 50-foot buffer equivalent through erosion and sediment controls consistent with alternatives 2 and 3, above.

D.2.1 Guidance for Providing and Maintaining Natural Buffers.

The following guidance is intended to assist you in complying with the requirements to provide and maintain a natural buffer during construction. This part of the guidance

[1] For the compliance alternatives in 1 and 2, you are not required to enhance the quality of the vegetation that already exists in the buffer, or provide vegetation if none exists (e.g., arid and semi-arid areas). You only need to retain and protect from disturbance the natural buffer that existed prior to the commencement of construction. Any preexisting structures or impervious surfaces are allowed in the natural buffer provided you retain and protect from disturbance the natural buffer area outside the preexisting disturbance. Similarly, for alternatives 2 and 3, you are required to implement and maintain sediment controls that achieve the sediment load reduction equivalent to the undisturbed natural buffer that existed on the site prior to the commencement of construction. In determining equivalent sediment load reductions, you may consider naturally non-vegetated areas and prior disturbances. See Part D.2.2 of this Appendix for a discussion of how to determine equivalent reductions.

applies to you if you choose either alternative 1 (50-foot buffer) or alternative 2 (a buffer of < 50 feet supplemented by additional erosion and sediment controls that achieve the equivalent sediment load reduction as the 50-foot buffer), or if you are providing a buffer in compliance with one of the small residential lot compliance alternatives in Part D.2.3 below.

D.2.1.1 Buffer Width Measurement

Where you are retaining a buffer of any size, the buffer should be measured perpendicularly from any of the following points, whichever is further landward from the water:

1. The ordinary high water mark of the water body, defined as the line on the shore established by fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, and/or the presence of litter and debris; or

2. The edge of the stream or river bank, bluff, or cliff, whichever is applicable.

Refer to Figure D – 2 and Figure D - 3. You may find that specifically measuring these points is challenging if the flow path of the surface water changes frequently, thereby causing the measurement line for the buffer to fluctuate continuously along the path of the waterbody. Where this is the case, EPA suggests that rather than measuring each change or deviation along the water's edge, it may be easier to select regular intervals from which to conduct your measurement. For instance, you may elect to conduct your buffer measurement every 5 to 10 feet along the length of the water.

Additionally, note that if earth-disturbing activities will take place on both sides of a surface water that flows through your site, to the extent that you are establishing a buffer around this water, it must be established on both sides. For example, if you choose alternative 1 above, and your project calls for disturbances on both sides of a small stream, you would need to retain the full 50 feet of buffer on both sides of the water. However, if your construction activities will only occur on one side of the stream, you would only need to retain the 50-foot buffer on the side of the stream where the earth disturbance will occur.

Figure D - 2. This image shows buffer measurement from the ordinary high water mark of the water body, as indicated by a clear natural line impressed on the bank, shelving, changes in the character of the soil, destruction of terrestrial vegetation, and/or the presence of litter/debris.

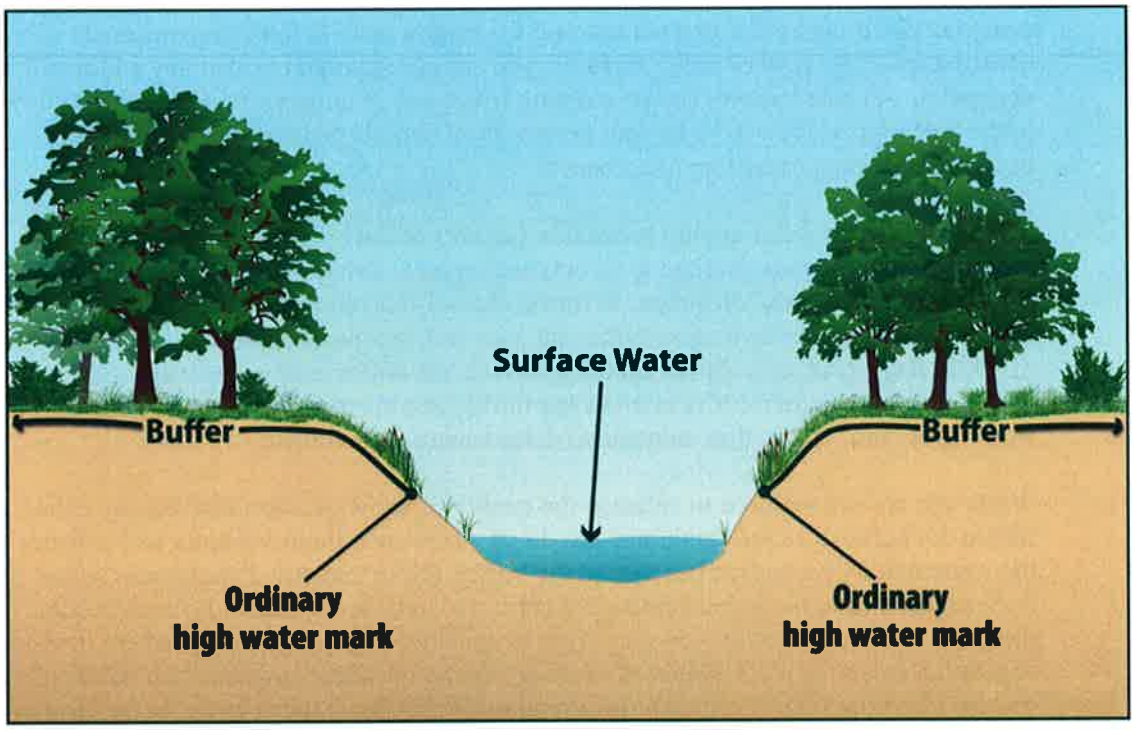
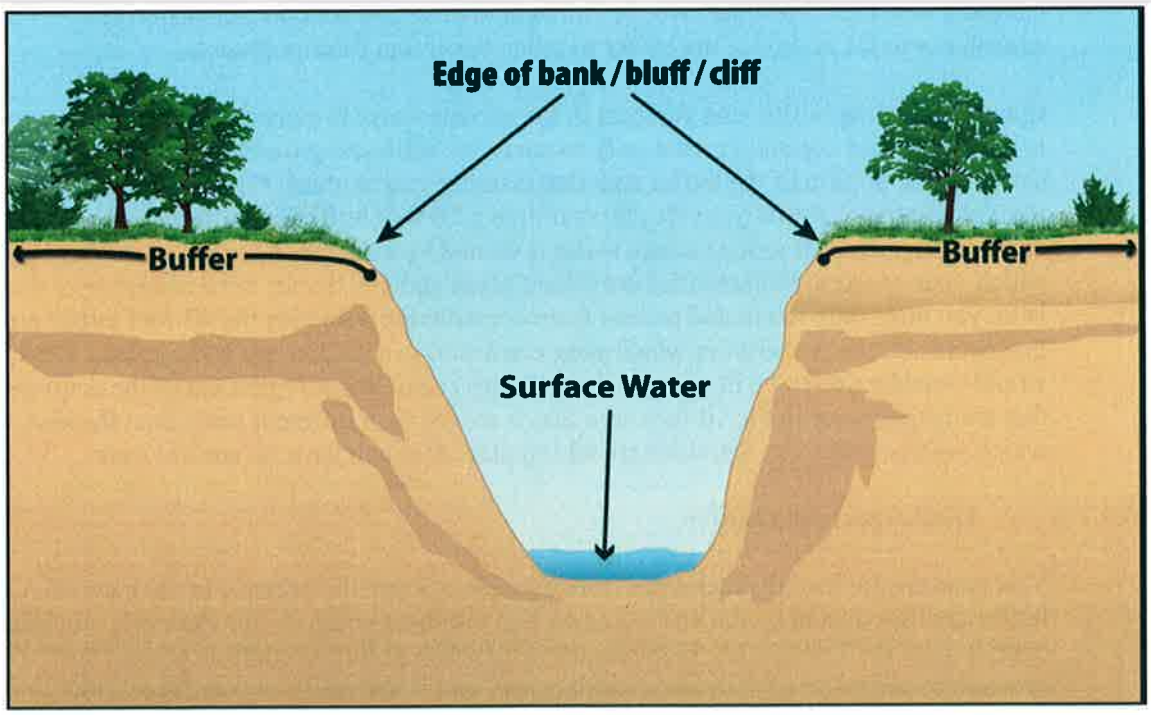


Figure D - 3. This image shows buffer measurement from the edge of the bank, bluff, or cliff, whichever is applicable.



D.2.1.2 Limits to Disturbance Within the Buffer

You are considered to be in compliance with this requirement if you retain and protect from construction activities the natural buffer that existed prior to the commencement of

construction. If the buffer area contains no vegetation prior to the commencement of construction (e.g., sand or rocky surface), you are not required to plant any additional vegetation. As noted above, any preexisting structures or impervious surfaces are allowed in the buffer provided you retain and protect from disturbance the vegetation in the buffer outside the preexisting disturbance.

To ensure that the water quality protection benefits of the buffer are retained during construction, you are prohibited from conducting any earth-disturbing activities within the buffer during permit coverage. In furtherance of this requirement, prior to commencing earth-disturbing activities on your site, you must delineate, and clearly mark off, with flags, tape, or a similar marking device, the buffer area on your site. The purpose of this requirement is to make the buffer area clearly visible to the people working on your site so that unintended disturbances are avoided.

While you are not required to enhance the quality of the vegetation that already exists within the buffer, you are encouraged to do so where such improvements will enhance the water quality protection benefits of the buffer. (Note that any disturbances within the buffer related to buffer enhancement are permitted and do not constitute construction disturbances.) For instance, you may want to consider targeted plantings where limited vegetation exists, or replacement of existing vegetation where invasive or noxious plant species (see http://plants.usda.gov/java/noxiousDriver) have taken over. In the case of invasive or noxious species, you may want to remove and replace them with a diversity of native trees, shrubs, and herbaceous plants that are well-adapted to the climatic, soil, and hydrologic conditions on the site. You are also encouraged to limit the removal of naturally deposited leaf litter, woody debris, and other biomass, as this material contributes to the ability of the buffer to retain water and filter pollutants.

If a portion of the buffer area adjacent to the surface water is owned by another party and is not under your control, you are only required to retain and protect from construction activities the portion of the buffer area that is under your control. For example, if you elect alternative 1 above (provide and maintain a 50-foot buffer), but 10 feet of land immediately adjacent to the surface water is owned by a different party than the land on which your construction activities are taking place and you do not have control over that land, you must only retain and protect from construction activities the 40-foot buffer area that occurs on the property on which your construction activities are taking place. DWQ would consider you to be in compliance with this requirement regardless of the activities that are taking place in the 10-foot area that is owned by a different party than the land on which your construction activities are taking place that you have no control over.

D.2.1.3. Discharges to the Buffer

You must ensure that all discharges from the area of earth disturbance to the natural buffer are first treated by the site's erosion and sediment controls (for example, you must comply with the Part 2.1.2.b. requirement to establish sediment controls around the downslope perimeter of your site disturbances), and if necessary to prevent erosion caused by storm water flows within the buffer, you must use velocity dissipation devices. The purpose of this requirement is to decrease the rate of storm water flow and encourage infiltration so that the pollutant filtering functions of the buffer will be achieved. To comply with this requirement, construction operators typically will use devices that physically dissipate storm water flows so that the discharge entering the buffer is spread out and slowed down.

D.2.1.4 SWPPP Documentation

You are required to document in your SWPPP the natural buffer width that is retained. For example, if you are complying with alternative 1, you must specify in your SWPPP that you are providing a 50-foot buffer. Or, if you will be complying with alternative 2, you must document the reduced width of the buffer you will be retaining (and you must also comply with the requirements in Part 2.1.2.a.iii. to describe the erosion and sediment controls you will use to achieve an equivalent sediment reduction, as described in Part D.2.2 below). Note that you must also show any buffers on your site plan in your SWPPP consistent with Part 7.2.6.c. Additionally, if any disturbances related to the exceptions in Part 2.1.2.a.v. occur within the buffer area, you must document this in the SWPPP.

D.2.2 Guidance for Providing the Equivalent Sediment Reduction as the 50-foot Buffer.

If you are selecting Alternative 2 (provide and maintain a buffer that is less than 50 feet that is supplemented by additional erosion and sediment controls that, together, achieve the equivalent sediment load reduction as the 50-foot buffer) or Alternative 3 (implement erosion and sediment controls that achieve the equivalent sediment load reduction as the 50-foot buffer), the following guidance is intended to assist you in demonstrating that you will achieve the equivalent sediment reduction as the 50-foot buffer.

D.2.2.1 Determine Whether it is Feasible to Provide a Reduced Buffer.

DWQ recognizes that there will be a number of situations in which it will be infeasible to provide and maintain a buffer of any width. While some of these situations may exempt you from the buffer requirement entirely (see D.1.2), if you do not qualify for one of these exemptions, there still may be conditions or circumstances at your site that make it infeasible to provide a natural buffer. For example, there may be sites where a significant portion of the property on which the earth-disturbing activities will occur is located within the buffer area, thereby precluding the retention of natural buffer areas. DWQ believes there are likely to be other examples of situations that make it infeasible to provide any buffer area.

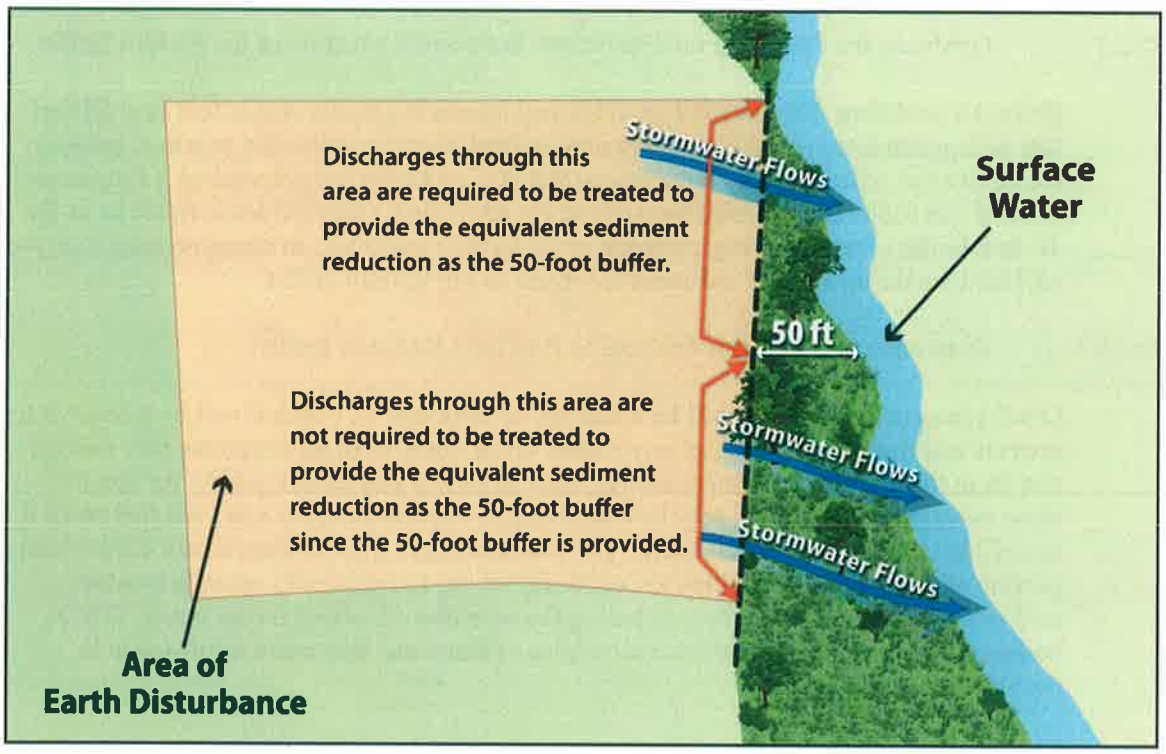
Therefore, in choosing between the 2 different compliance alternatives (Alternative 2 or 3), you should only elect to comply with Alternative 2 if it is feasible for you to retain any natural buffer on your site. (Note: For any buffer width retained, you are required to comply with the requirements in Part D.2.1, above, concerning the retention of vegetation and restricting earth disturbances.) Similarly, if you determine that it is infeasible to provide a natural buffer of any size during construction, you should elect to comply with Alternative 3. After making this determination, you should proceed to Part D.2.2.2 to determine how to provide controls that, together with any buffer areas that is being retained, if applicable, will achieve an equivalent sediment load reduction as the 50-foot buffer.

D.2.2.2 Design Controls That Provide Equivalent Sediment Reduction as 50-foot Buffer

You must next determine what additional controls must be implemented on your site that, alone or in combination with any retained natural buffer, achieve a reduction in sediment equivalent to that achieved by a 50-foot buffer.

Note that if only a portion of the natural buffer is less than 50 feet, you are only required to implement erosion and sediment controls that achieve the sediment load reduction equivalent to the 50-foot buffer for discharges through that area. You would not be required to provide treatment of storm water discharges that flow through 50 feet or more of natural buffer. See Figure D - 4.

Figure D - 4 Example of how to comply with the requirement to provide the equivalent sediment reduction when only a portion of your earth-disturbances discharge to a buffer of less than 50-feet.



To comply with this requirement, you are required to do the following:

Step1 - Estimate the sediment reduction expected from your site if you had retained a 50-foot natural buffer;

Step 2 - Design controls that alone or in combination with any width of buffer retained achieve the equivalent sediment removal efficiency as that expected from the 50-foot buffer; and

Step 3 - Document in your SWPPP how your controls will achieve the equivalent sediment removal efficiency of the 50-foot buffer.

Guidelines to help you work through these requirements are provided below.

a. Step 1 - Estimate the Sediment Reduction from the 50-foot Buffer

In order to design controls that match the sediment removal efficiency of a 50-foot buffer, you first need to know what this efficiency is for your site. The sediment removal efficiencies of natural buffers vary according to a number of site-specific factors, including precipitation, soil type, land cover, slope length, width, steepness, and the types of sediment controls used to reduce the discharge of sediment prior to the buffer. DWQ has adopted EPA calculations concerning this and DWQ has adapted it to Utah. EPA has simplified this calculation by developing buffer performance tables covering a range of vegetation and soil types for the areas in Utah. See Attachment , Tables D – 4 and D - 5. Note: buffer performance values in Tables D – 4 and D - 5 represent the percent of sediment captured through the use of perimeter controls (e.g., silt fences) and 50-foot buffers at disturbed sites of fixed proportions and slopes.[2]

Using Tables D – 4 and D - 5 (see Attachment 1), you can determine the sediment removal efficiency of a 50-foot buffer for your geographic area by matching the vegetative cover type that best describes your buffer area and the type of soils that predominate at your site. For example, if your site is located in moist Utah (see the 3-zone precipitation map of Utah in Appendix F), Table D - 4, and your buffer vegetation corresponds most closely with that of medium density weeds, and the soil type at your site is best typified as sand, your site's sediment removal efficiency would be 28 percent. In this step, you should choose the vegetation type

[2] EPA used the following when developing the buffer performance tables:

- The sediment removal efficiencies are based on the U.S. Department of Agriculture's RUSLE2 ("Revised Universal Soil Loss Equation 2") model for slope profiles using a 100-foot long denuded slopes.
- Sediment removal was defined as the annual sediment delivered at the downstream end of the 50-foot natural buffer (tons/yr/acre) divided by the annual yield from denuded area (tons/yr/acre).
- As perimeter controls are also required by the CGP, sediment removal is in part a function of the reduction due to a perimeter control (i.e., silt fence) located between the disturbed portion of the site and the upstream edge of the natural buffer and flow traveling through a 50-foot buffer of undisturbed natural vegetation.
- It was assumed that construction sites have a relatively uniform slope without topographic features that accelerate the concentration for erosive flows.
- It was assumed that vegetation has been removed from the disturbed portion of the site and a combination of cuts and fills have resulted in a smooth soil surface with limited retention of near-surface root mass

To represent the influence of soil, EPA analyzed 11 general soil texture classifications in its evaluation of buffer performance. To represent different types of buffer vegetation, EPA evaluated 4 or more common vegetative types for each state/territory covered under the permit (DWQ is using only that which is approximately what could be found in Utah or nearby areas). For each vegetation type evaluated, EPA considered only permanent, non-grazed and non-harvested vegetation, on the assumption that a natural buffer adjacent to the surface water will typically be undisturbed. EPA also evaluated slope steepness and found that sediment removal efficiencies present in Tables D -4 and D - 5 are achievable for slopes that are less than nine percent.

in the tables that most closely matches the vegetation that would exist naturally in the buffer area on your site regardless of the condition of the buffer. However, because you are not required to plant any additional vegetation in the buffer area, in determining what controls are necessary to meet this sediment removal equivalency in Step 2 below, you will be able to take credit for this area as a fully vegetated "natural buffer." Similarly, if a portion of the buffer area adjacent to the surface water is owned by another party and is not under your control, you can treat the area of land not under control as having the equivalent vegetative cover and soil type that predominates on the portion of the property on which your construction activities are occurring.

> For example, if your earth-disturbances occur within 50 feet of a surface water, but the 10 feet of land immediately adjacent to the surface water is owned by a different party than the land on which your construction activities are taking place and you do not have control over that land, you can treat the 10 foot area adjacent to the stream as having the equivalent soil and vegetation type as predominates in the 40 foot area under your control. You would then make the same assumption in Step 2 for purposes of determining the equivalent sediment removal.

Alternatively, you may do your own calculation of the effectiveness of the 50-foot buffer based upon your site-specific conditions, and may use this number as your sediment removal equivalency standard to meet instead of using Tables D – 4 and D - 5. This calculation must be documented in your SWPPP.

b. Step 2 - Design Controls That Match the Sediment Removal Efficiency of the 50-foot Buffer

Once you have determined the estimated sediment removal efficiency of a 50-foot buffer for your site in Step 1, you will be required to select storm water controls that will provide an equivalent sediment load reductions. These controls can include the installation of a single designed control, such as a sediment pond, additional perimeter controls, or other type of device. Alternatively, you may elect to install a combination of storm water controls and to retain some amount of a buffer. Whichever control(s) you select, you must demonstrate in your SWPPP that the controls will provide at a minimum the same sediment removal capabilities as the 50-foot buffer (Step 1). You are allowed to take credit for the removal efficiencies of your required perimeter controls in your calculation of equivalency, because these were included in calculating the buffer removal efficiencies in tables D – 4 and D - 5. (Note: You are reminded that the controls must be kept in effective operating condition until you have completed final stabilization on the disturbed portions of the site discharging to the surface water.)

To make the determination that your controls and/or buffer area achieve an equivalent sediment load reduction as the 50-foot buffer, you will need to use a model or other type of calculator. As mentioned above, there are a variety of models available that can be used to support your calculation, including USDA's RUSLE-series programs and the WEPP erosion model, SEDCAD, SEDIMOT, or other models. A couple of examples are provided in Attachment 3 to help illustrate how this determination could be made. If you are retaining a buffer of less than 50 feet, you may take credit for the removal that will occur from the reduced buffer

and only need to provide additional controls to make up the difference between the removal efficiency of a 50 foot buffer and the removal efficiency of the narrower buffer. For example, if you are retaining a 30 foot buffer, you can account for the sediment removal provided by the 30-foot buffer retained, and you will only need to design controls to make up for the additional removal provided by the 20-foot of buffer that is not being provided. To do this, you would plug the width of the buffer that is retained into RUSLE or another model, along with other storm water controls that will together achieve a sediment reduction equivalent to a natural 50-foot buffer. As described in Step 1 above, you can take credit for the area you have retained as a "natural buffer" as being fully vegetated, regardless of the condition of the buffer area.

> For example, if your earth-disturbances occur 30 feet from a surface water, but the 10 feet of land immediately adjacent to the surface water is owned by a different party than the land on which your construction activities are taking place and you do not have control over that land, you can treat the 10-foot area as a natural buffer, regardless of the activities that are taking place in the area. Therefore, you can assume (for purposes of your equivalency calculation) that your site is providing the sediment removal equivalent of a 30-foot buffer, and you will only need to design controls to make up for the additional removal provided by the 20-foot of buffer that is not being provided.

c. Step 3 - Document How Site-Specific Controls Will Achieve the Sediment Removal Efficiency of the 50-foot Buffer

In Steps 1 and 2, you determined both the expected sediment removal efficiency of a 50-foot buffer at your site, and you used this number as a performance standard to design controls to be installed at your site, which alone or in combination with any retained natural buffer, achieves the expected sediment removal efficiency of a 50-foot buffer at your site. The final step is to document in your SWPPP the information you relied on to calculate the equivalent sediment reduction as an undisturbed natural buffer. DWQ will consider your documentation to be sufficient if it generally meets the following:

- For Step 1, refer to the table in Attachment 1 that you used to derive your estimated 50-foot buffer sediment removal efficiency performance. Include information about the buffer vegetation and soil type that predominate at your site, which you used to select the sediment load reduction value in Tables D - 4 and D - 5. Or, if you conducted a site-specific calculation for sediment removal efficiency, provide the specific removal efficiency, and the information you relied on to make your site-specific calculation.

- For Step 2: (1) Specify the model you used to estimate sediment load reductions from your site; and (2) the results of calculations showing how your controls will meet or exceed the sediment removal efficiency from Step 1.

If you choose Alternative 3, you must also include in your SWPPP a description of why it is infeasible for you to provide and maintain an undisturbed natural buffer of any size.

D.2.3 Small Residential Lot Compliance Alternatives

> A small residential lot is a lot or grouping of lots being developed for residential purposes that will disturb less than 1 acre of land, but that is part of a larger residential project that will ultimately disturb greater than or equal to 1 acre.

In this part of Appendix D, EPA provides additional compliance alternatives for owner/operators of small residential lots. In accordance with Part 2.1.2.a.v.4), owner/operators of small residential lots who do not provide a 50-foot buffer are not required to make the demonstration outlined in Part D.2.2.2. Instead, qualifying owner/operators can comply with the buffer requirement by choosing to implement a set of traditional sediment and erosion controls from the menu of practices provided in Part D.2.3.2. DWQ allows the (EPA developed) two different alternatives for compliance. The following steps describe how a small residential lot owner/operator would achieve compliance with these 2 alternatives.

D.2.3.1 Step 1 – Determine if You are Eligible for the Small Residential Lot Compliance Alternatives

In order to be eligible for the small residential lot compliance alternatives, the following conditions must be met:

a. The lot or grouping of lots meets the definition of "small residential lot"; and

b. The owner/operator must comply with all other requirements in Part 2.1.2.a, including:

   i. Ensure that all discharges from the area of earth disturbance to the natural buffer are first treated by the site's erosion and sediment controls, and use velocity dissipation devices if necessary to prevent erosion caused by storm water within the buffer;

   ii. Document in the SWPPP the natural buffer width retained on the property, and show the buffer boundary on your site plan; and

   iii. Delineate, and clearly mark off, with flags, tape, or other similar marking device, all natural buffer areas.

D.2.3.2 Step 2 – Implement the Requirements of the Small Residential Lot Compliance Alternative Selected

You must next choose from one of two small residential lot compliance alternatives and implement the storm water control practices associated with that alternative.

Note: *The compliance alternatives provided below are not mandatory. Owner/Operators of small residential lots can alternatively choose to comply with the any of the options that are available to other sites in Part 2.1.2.a.i, described in Parts D.2.1 and D.2.2 in this appendix.*

a. Small Residential Lot Compliance Alternative 1

Alternative 1 is a straightforward tiered- technology approach that specifies the controls that a small residential lot must implement based on the buffer width retained. To achieve compliance with Alternative 1, you must implement the controls specified in Table D – 1 based on the buffer width to be retained. See footnote 3, below, for a description of the controls you must implement.

For example, if you are an owner/operator of a small residential lot that will be retaining a 35-foot buffer and you choose Small Residential Lot Compliance Alternative 1, you must implement double perimeter controls between earth disturbances and the surface water.

In addition to implementing the applicable control, you must also document in your SWPPP how you will comply with Alternative 1.

Table D - 1. Alternative 1 Requirements[3]

Retain 50-foot Buffer	Retain <50 and >30 foot Buffer	Retain ≤ 30 foot Buffer
No Additional Requirements	Double Perimeter Controls	Double Perimeter Controls and 7-Day Site Stabilization

b. Small Residential Lot Compliance Alternative 2

Alternative 2 specifies the controls that a builder of a small lot must implement based on both the buffer width retained and their risk of sediment discharge. By incorporating the sediment risk, this approach may result in the implementation of controls that are more appropriate for the site's specific conditions.

Step 1 – Determine Your Site's Sediment Risk Level

To meet the requirements of Alternative 2, you must first determine your site's sediment discharge "risk level" based on the site's slope, location, and soil type. To help you to determine your site's sediment risk level, DWQ has adapted table D-2 for areas from moist Utah, semi-arid, or arid; soil type; and different slope conditions. On table D-2, first select the slope; then select the climate (moist, semi-arid, or arid); then select the soil type.

[3] Description of Additional Controls Applicable to Small Residential Lot Compliance Alternatives 1 and 2:

- **No Additional Requirements**: If you implement a buffer of 50 feet or greater, then you are not subject to any additional requirements. Note that you are required to install perimeter controls between the disturbed portions of your site and the buffer in accordance with Part 2.1.2.b.
- **Double Perimeter Control**: In addition to the reduced buffer width retained on your site, you must provide a double row of perimeter controls between the disturbed portion of your site and the surface water spaced a minimum of 5 feet apart.
- **Double Perimeter Control and 7-Day Site Stabilization**: In addition to the reduced buffer width retained on your site and the perimeter control implemented in accordance with Part 2.1.2.b, you must provide a double row of perimeter controls between the disturbed portion of your site and the surface water spaced a minimum of 5 feet apart, and you are required to complete the stabilization activities specified in Parts 2.2.1.b.i or 2.2.2.b within 7 calendar days (in place of what is normally required) of the temporary or permanent cessation of earth-disturbing activities.

All moist and semi-arid risks are low for all soil types. The only moderate risk is arid at 9 % slope to 15 % slope for 3 categories of soil; and arid for loam, silt, sandy loam, or silt loam for all slopes over 3%. The only times for concern of a risk over "low" is when the slope is over 9%, or when the soil is loam, silt, sandy loam, or silt loam.

If you have a site in moist or semi-arid Utah, the risk will always be low. If you have a site in arid Utah where the slope is 5% and the soil is sandy, your risk is "moderate". After you determine the "risk level" (e.g., "low", "moderate", or "high") that corresponds to your site's location and predominant soil type[4] you determine the controls you must apply.

Table D - 2. Risk Levels for Sites Based on the 3-Zone Precipitation Map for Utah (see Appendix F)

Soil Type / Location	Clay	Silty Clay, Loam, or Clay-Loam	Sand	Sandy Clay, Loam, Loamy Sand, or Silty Clay	Loam, Silt, Sandy Loam, or Silt Loam	
Moist & Semi-Arid	Low	Low	Low	Low	Low	Risk Levels for Sites with Average Slopes of ≤ 3 Percent
Arid	Low	Low	Low	Low	Low	
Moist & Semi-Arid	Low	Low	Low	Low	Low	Risk Levels for Sites with Average Slopes of > 3 Percent and ≤ 6 Percent
Arid	Low	Low	Low	Low	Moderate	
Moist & Semi-Arid	Low	Low	Low	Low	Low	Risk Levels for Sites with Average Slopes of > 6 Percent and ≤ 9 Percent
Arid	Low	Low	Low	Low	Moderate	
Moist & Semi-Arid	Low	Low	Low	Low	Low	Risk Levels for Sites with Average Slopes of > 9 Percent and ≤ 15 Percent
Arid	Low	Moderate	Low	Moderate	Moderate	

Step 2 – Determine Which Additional Controls Apply

Once you determine your site's "risk level", you must next determine the additional controls you need to implement on your site, based on the width of buffer you plan

[4] One source for determining your site's predominant soil type is the USDA's Web Soil Survey located at http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

to retain. Table D - 3 specifies the requirements that apply based on the "risk level" and buffer width retained. See footnote 3, above, for a description of the additional controls that are required.

For example, if you are the owner/operator of a small residential lot that falls into the "moderate" risk level, and you decide to retain a 20-foot buffer, using Table D-3 you would determine that you need to implement double perimeter controls to achieve compliance with Part 2.1.2.a.

You must also document in your SWPPP your compliance with Alternative 2.

Table D - 3. Alternative 2 Requirements[2]

Risk Level Based on Estimated Soil Erosion	Retain ≥ 50'Buffer	Retain <50' and >30' Buffer	Retain ≤30' and >10' Buffer	Retain ≤ 10' Buffer
Low Risk	No Additional Requirements	No Additional Requirements	Double Perimeter Control	Double Perimeter Control
Moderate Risk	No Additional Requirements	Double Perimeter Control	Double Perimeter Control	Double Perimeter Control and 7-Day Site Stabilization
High Risk	No Additional Requirements	Double Perimeter Control	Double Perimeter Control and 7-Day Site Stabilization	Double Perimeter Control and 7-Day Site Stabilization

ATTACHMENT 1

Sediment Removal Efficiency Tables[5]

EPA recognizes that very high removal efficiencies, even where theoretically achievable by a 50-foot buffer, may be very difficult to achieve in practice using alternative controls. Therefore in the tables below, EPA has limited the removal efficiencies to a maximum of 90%. Efficiencies that were calculated at greater than 90% are shown as 90%, and this is the minimum percent removal that must be achieved by alternative controls.

D-4. Estimated 50-foot Buffer Performance in Semi-Arid and Moist Areas*

	Estimated % Sediment Removal				
Type of Buffer vegetation**	Clay	Silty Clay Loam or Clay-Loam	Sand	Sandy Clay Loam , Loamy Sand or Silty Clay	Loam, Silt, Sandy Loam or Silt Loam
Tall Fescue Grass	42	52	44	48	85
Medium-density Weeds	28	30	28	26	60
Low-density Warm-season Native Bunch Grass (i.e., Grama Grass)	25	26	24	24	55
Northern Mixed Prairie Grass	28	30	28	26	50
Northern Range Cold Desert Shrubs	28	28	24	26	50

*Applicable for sites with less than nine percent slope.
**Characterization focuses on the under-story vegetation

D-5. Estimated 50-foot Buffer Performance in Arid Areas*

	Estimated % Sediment Removal				
Type of Buffer vegetation**	Clay	Silty Clay Loam or Clay-Loam	Sand	Sandy Clay Loam , Loamy Sand or Silty Clay	Loam, Silt, Sandy Loam or Silt Loam
Tall Fescue Grass	71	85	80	86	90
Medium-density Weeds	56	73	55	66	78
Low-density Warm-season Native Bunch Grass (i.e., Grama Grass)	53	70	51	62	67
Southern Mixed Prairie Grass	53	71	52	63	50
Southern Range Cold Desert Shrubs	56	73	55	65	53

*Applicable for sites with less than nine percent slope.
**Characterization focuses on the under-story vegetation

[5] The buffer performances were calculated based on a denuded slope upgradient of a 50-foot buffer and perimeter controls, as perimeter controls are a standard requirement (see Part 2.1.2.b).

ATTACHMENT 2

Using the Sediment Removal Efficiency Tables – Questions and Answers

- What if my specific buffer vegetation is not represented in Tables D – 4, and D- 5. If you do not see a description of the type of vegetation present at your site, you should choose the vegetation type that most closely matches the vegetation type on your site. You can contact your local Cooperative Extension Service Office (www.csrees.usda.gov/Extension) for assistance in determining the vegetation types that most closely matches your site-specific vegetation.
- What if there is high variability in local soils? EPA recognizes that there may be a number of different soil type(s) on any given construction site. General soil information can be obtained from USDA soil survey reports (http://websoilsurvey.nrcs.usda.gov) or from individual site assessments performed by a certified soil expert. Tables D- 4 through D- 5 present eleven generic soil texture classes, grouping individual textures where EPA has determined that performance is similar. If your site contains different soil texture classes, you should use the soil type that best approximates the predominant soil type at your site.
- What if my site slope is greater than 9 percent after final grade is reached? As indicated in the buffer performance tables, the estimated sediment removal efficiencies are associated with disturbed slopes of up to 9 percent grade. Where your graded site has an average slope of greater than 9 percent, you should calculate a site-specific buffer performance.
- How do I calculate my own estimates for sediment reduction at my specific site? If you determine that it is necessary to calculate your own sediment removal efficiency using site specific conditions (e.g., slopes at your site are greater than 9 percent), you can do so by choosing from a range of available mathematical models that are available to facilitate this calculation, including USDA's RUSLE-series programs and the WEPP erosion model, SEDCAD, SEDIMOT, or other equivalent models.
- What is my estimated buffer performance if my site location is not represented by Tables D-4 through D-5? If your site is located in an area not represented by Tables D-4 through D-5, you should use the table that most closely approximates conditions at your site. You may also choose to conduct a site-specific calculation of the buffer performance.
- What if only a portion of my site drains to the buffer area? If only a portion of your site drains to a surface water, where that water is within 50 feet of your construction activities, you are only required to meet the equivalency requirement for the storm water flows corresponding to those portions of the site. See Example 2 below for an example of how this is expected to work.

ATTACHMENT 3

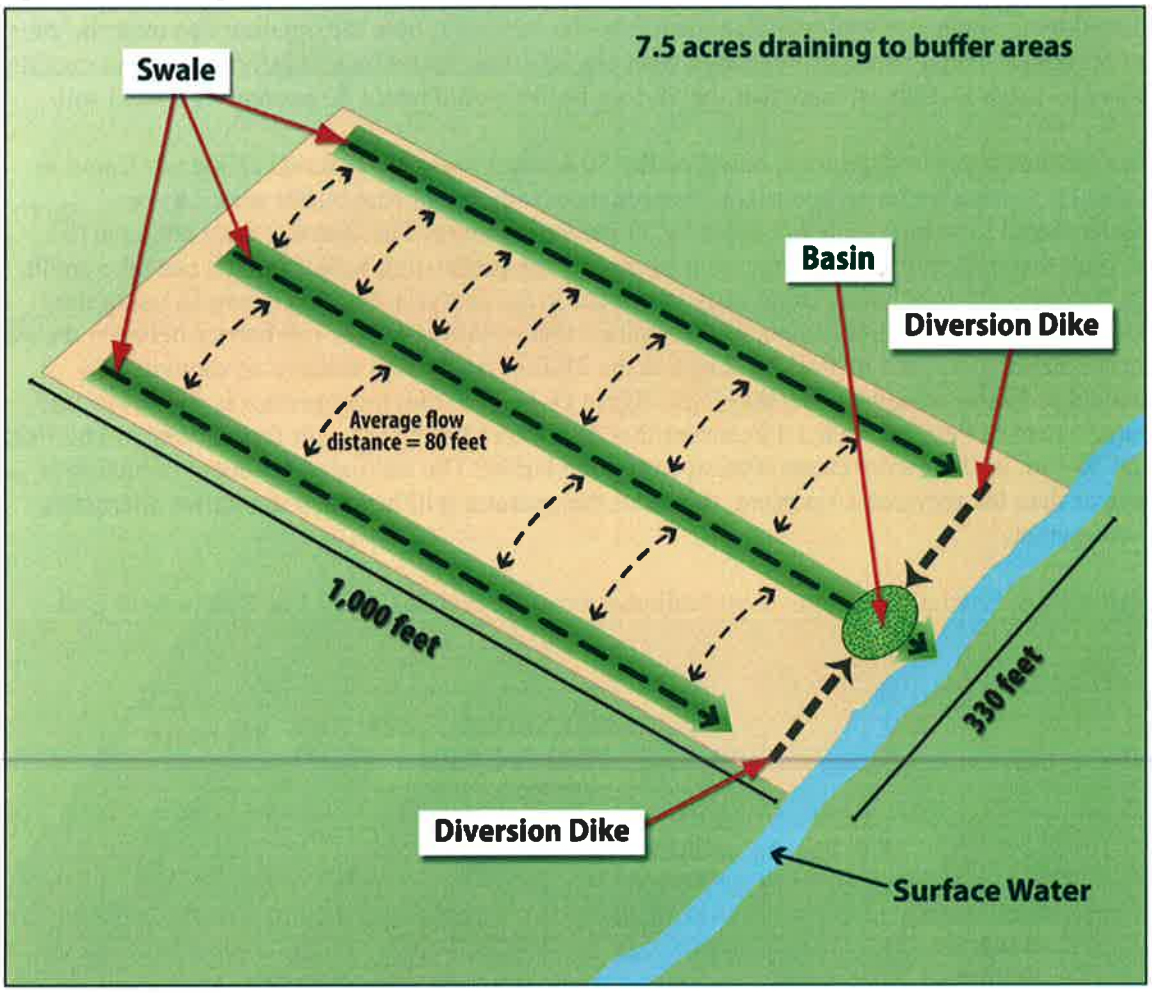
Examples of How to Use the Sediment Removal Efficiency Tables

Example 1. Comparatively Wet Location (7.5 acre site located in Moist Utah)

The operator of a 7.5-acre construction site in Moist Utah has determined that it is infeasible to establish a buffer of any size on their site, and is now required to select and install controls that will achieve an equivalent sediment load reduction as that estimated in Table D- 4 for their site conditions. The first step is to identify what percentage of eroded sediment is estimated to be retained from a 50-foot buffer. For this example, it is assumed that the site has a relatively uniform gentle slope (3 percent), so Table D- 4 can be used to estimate the 50-foot buffer sediment load reduction. If the site's buffer vegetation is best typified by northern mix prairie grass and the underlying soil is of a type best described as loamy sand, the 50-foot buffer is projected to capture 26 percent of eroded sediment from the construction site.

The second step is to determine what sediment controls can be selected and installed in combination with the perimeter controls already required to be implemented at the site (see Part 2.1.2.b), which will achieve the 26 percent sediment removal efficiency from Table D- 4. For this example, using the RUSLE2 profile model, it was determined that installing a pair of shallow sloped diversion ditches to convey runoff to a well-designed and maintained sediment basin provides 99 percent sediment removal. Because the estimated sediment reduction is greater than the required 26 percent that a 50-foot buffer provides, the operator will have met the buffer requirements. See Figure D- 5. The operator could also choose a different set of controls, as long as they achieve at least a 90 percent sediment removal efficiency.

Figure D- 5. Example 1 – Equivalent Sediment Load Reductions at a 7.5 ac Site in moist Utah.



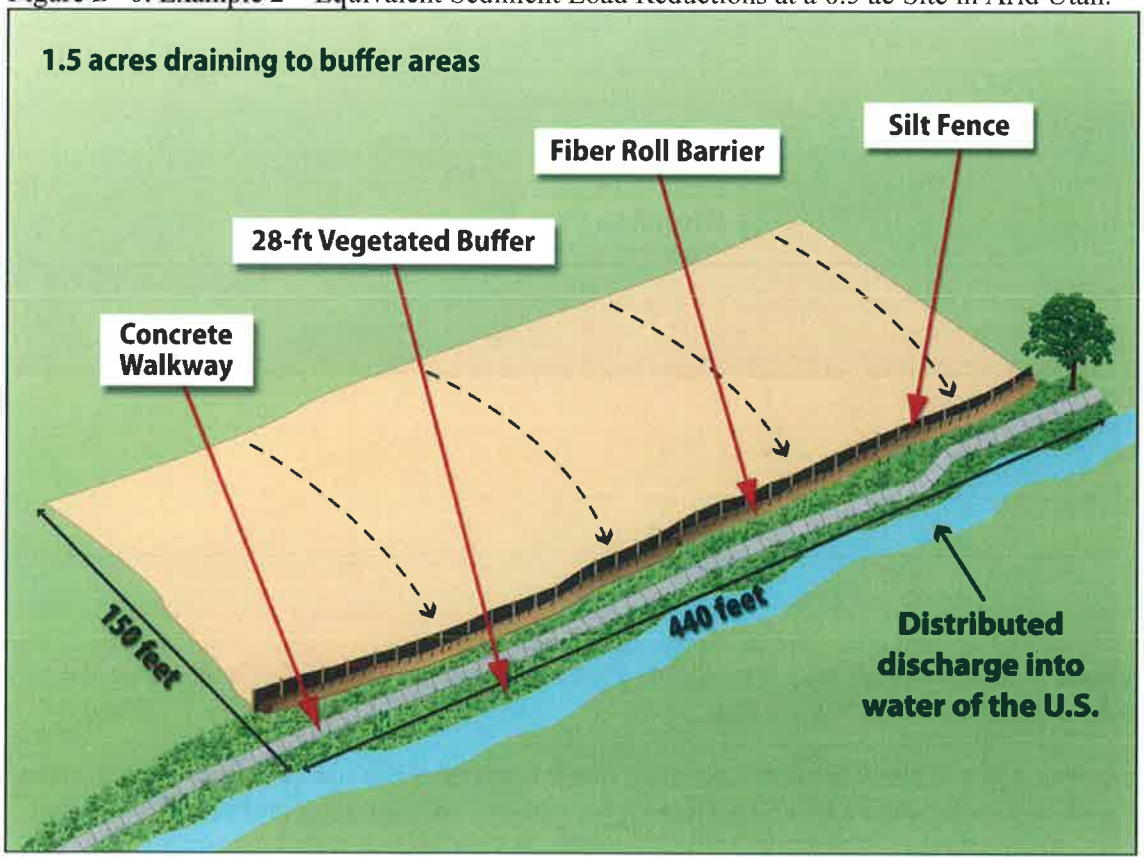
Example 2. Arid Location With Pre-existing Disturbances in the Natural Buffer (6.5 acre site located in Arid Utah)

An operator of a site in Arid Utah determines that it is not practicable to provide a 50-foot buffer, but a 28-foot buffer can be provided. Because the operator will provide a buffer that is less than 50 feet, the operator must determine which controls, in combination with the 28-foot buffer, achieve a sediment load reduction equivalent to the 50-foot buffer. In this example, the project will disturb 6.5 acres of land, but only 1.5 acres of the total disturbed area drains to the buffer area. Within the 28-foot buffer area is a preexisting concrete walkway. Similar to Example 1, the equivalence analysis starts with Step 1 (Part D.2.2.b) with a review of the Arid Utah buffer performance (Table D- 5). The operator determines that the predominate vegetation type in the

buffer area is prairie grass and the soil type is similar to silt, and that the site is of a uniform, shallow slope (e.g., 3 percent grade). Although the operator will take credit for the disturbance caused by the concrete walkway as a natural buffer in Step 2, here the operator can treat the entire buffer area as being naturally vegetated with prairie grass. Based on this information, the operator refers to Table D- 5 to estimate that the 50-foot buffer would retain 50 percent of eroded soil.

The second step is to determine, based on the 50 percent sediment removal efficiency found in Table D- 5, what sediment controls in combination with the 28-foot buffer area, can be implemented to reduce sediment loads by 50 percent or more. The operator does not have to account the reduction in buffer function caused by the preexisting walkway, and can take credit for the entire 28-foot buffer being fully vegetated in the analysis. For this example, using the RUSLE2 profile model, the operator determined that installing a fiber roll barrier between the silt fence (already required by Part 2.1.2.b) and the 28-foot buffer will achieve an estimated 84 percent sediment removal efficiency. See Figure D- 6. Note that this operator is subject to the requirement in Part 2.1.2.a.ii.1.) to ensure that discharges through the silt fence, fiber roll barrier, and 28-foot buffer do not cause erosion within the buffer. The estimated sediment reduction is greater than the required 50 percent; therefore the operator will have met the buffer alternative requirement.

Figure D- 6. Example 2 – Equivalent Sediment Load Reductions at a 6.5 ac Site in Arid Utah.



Appendix E – List of MS4s with Municipal Storm Water Permits

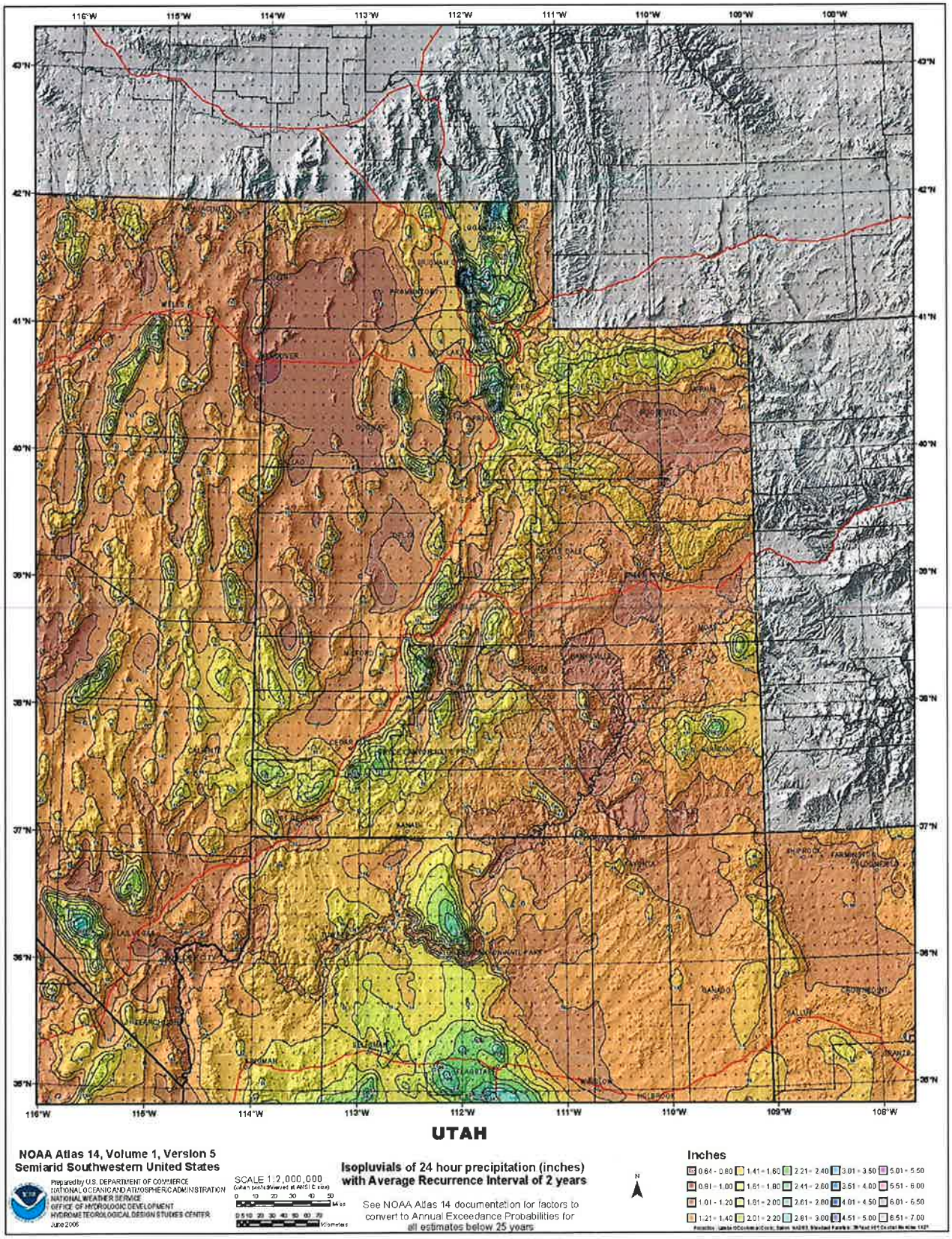
(This appendix is not included in the public notice review as it is for help and assistance to aid compliance and is not regulatory in nature. It may be modified during the term of the permit if the list of MS4s change during the permit term.) The MS4s listed below are regulated by a municipal storm water permit. Under the municipal storm water permit they are required to regulate construction activity in their areas. Areas that are not covered by the MS4s listed below are directly regulated by DWQ.

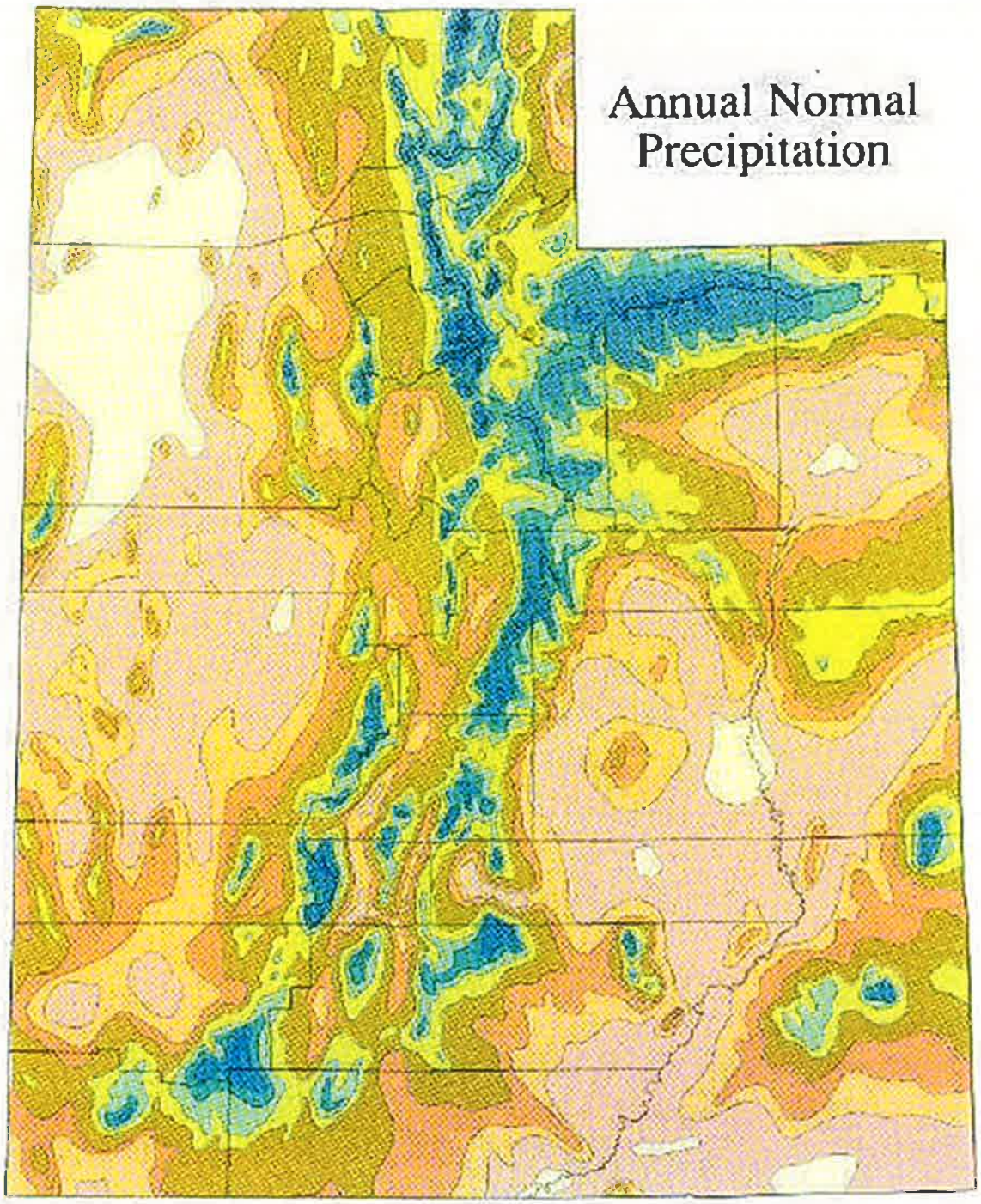
Alpine
American Fork
Bluffdale
Bountiful
Cedar Hills
Centerville
Clearfield
Clinton
Cottonwood Heights
Davis County (unincorporated area)
Draper
Farmington
Farr West City
Fruit Heights
Harrisville
Herriman
Highland
Hill Air Force
Holladay
Hooper
Hyde Park
Hyrum City
Ivins City
Kaysville
Layton
Lehi
Lindon
Logan
Mapleton
Marriott-Slaterville
Midvale
Millville
Murray
Nibley
North Logan City
North Ogden
North Salt Lake
Ogden
Orem
Plain City
Pleasant Grove
Pleasant View
Providence
Provo
River Heights
Riverdale
Riverton
Roy
Salt Lake City
Salt Lake County (unincorporated area)
Sandy
Santa Clara
Smithfield
South Jordan
South Ogden City
South Salt Lake
South Weber
Springville
St. George
Sunset
Syracuse
Taylorsville
UDOT
Uintah City
University of Utah
Utah State Prison
Veterans Affairs Medical Center
Washington
Washington Terrace
Weber County (unincorprated area)
Weber State University
Wellsville
West Bountiful
West Haven
West Jordan
West Point City
West Valley City
Woods Cross

Appendix F – 2-Year, 24-Hour Storm Frequencies in Utah
Average Annual Rainfall in Utah
3 Zone Precipitation Map for Utah

(See next page)

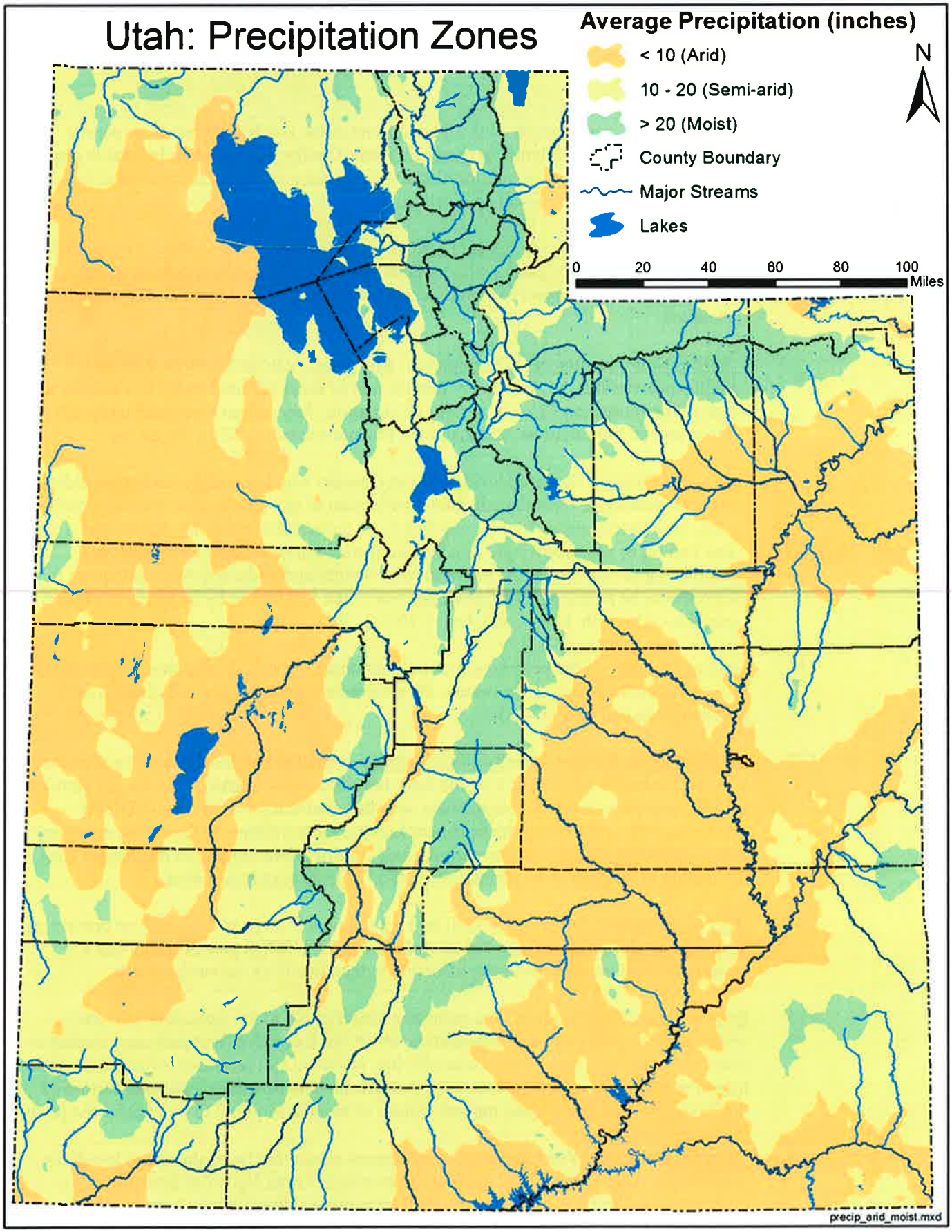
(This appendix is not included in the public notice review as it is for help and assistance to aid compliance and is not regulatory in nature. It may be modified during the term of the permit if it is found that it can be improved on.)


116°W
115°W
114°W
113°W
112°W
111°W
110°W
109°W
108°W
43°N
42°N
41°N
40°N
39°N
38°N
37°N
36°N
35°N
UTAH
NOAA Atlas 14, Volume 1, Version 5
Semiarid Southwestern United States
Prepared by U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
OFFICE OF HYDROLOGIC DEVELOPMENT
HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
June 2006
SCALE 1:2,000,000
Miles
Kilometers
Isopluvials of 24 hour precipitation (inches)
with Average Recurrence Interval of 2 years
See NOAA Atlas 14 documentation for factors to
convert to Annual Exceedance Probabilities for
all estimates below 25 years
N
Inches
0.64 - 0.80
0.81 - 1.00
1.01 - 1.20
1.21 - 1.40
1.41 - 1.60
1.61 - 1.80
1.81 - 2.00
2.01 - 2.20
2.21 - 2.40
2.41 - 2.60
2.61 - 2.80
2.81 - 3.00
3.01 - 3.50
3.51 - 4.00
4.01 - 4.50
4.51 - 5.00
5.01 - 5.50
5.51 - 6.00
6.01 - 6.50
6.51 - 7.00



Legend
Precipitation (In inches)

more than 49.9	25.0-29.9	12.0-15.9	6.0-7.9
40.0-49.9	20.0-24.9	10.0-11.9	less than 6
30.0-39.9	16.0-19.9	8.0-9.9	


Utah: Precipitation Zones
Average Precipitation (inches)
< 10 (Arid)
10 - 20 (Semi-arid)
> 20 (Moist)
County Boundary
Major Streams
Lakes
N
0
20
40
60
80
100
Miles
precip_arid_moist.mxd

Appendix G – Standard Permit Conditions

G.1. Duty to Comply.

1. The permittee must comply with all conditions of the UPDES permit. Any permit noncompliance is a violation of the Utah Water Quality Act, as amended and is grounds for enforcement action; permit termination, revocation and reissuance or modification; or denial of a permit renewal application.

2. Penalties for Violations of Permit Conditions. The Utah Water Quality Act, in 19-5-115, provides that any person who violates the Act, or any permit, rule, or order adopted under it is subject to a civil penalty not to exceed $10,000 per day of such violation.

3. Willful Non-Compliance or Negligence. Any person who willfully or with gross negligence violates the Act, or any permit, rule or order adopted under it is subject to a fine of not more than $25,000 per day of violation. Any person convicted under 19-5-115 a second time shall be punished by a fine not exceeding $50,000 per day.

4. False Statements. The Act provides that any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under the Act, the rules, or this Permit, or who knowingly falsifies, tampers with, or renders inaccurate, any monitoring device or method required to be maintained under the Act shall upon conviction, be punished by a fine of not more than $10,000 or by imprisonment for 6 months, or by both. Utah Code Ann. § 19-5-115(4).

G.2. Duty to Reapply. If the permittee wishes to continue an activity regulated by this permit after the expiration date of the permit, the permittee shall apply for and obtain a new permit as required in R317-8-3.1

G.3. Need to Halt or Reduce Activity Not a Defense. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit. (Upon reduction, loss, or failure of the treatment facility, the permittee, to the extent necessary to maintain compliance with the permit, shall control production of all discharges until the facility is restored or an alternative method of treatment is provided.)

G.4. Duty to Mitigate. The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of the UPDES permit which has a reasonable likelihood of adversely affecting human health or the environment.

G.5. Duty to Provide Information. The permittee shall furnish to the Executive Secretary, within a reasonable time, any information which the Executive Secretary may request to determine whether cause exists for modifying, revoking and reissuing, or terminating the permit or to determine compliance with this permit. The permittee shall also furnish to the Executive Secretary, upon request, copies of records required to be kept by the permit.

G.6. Other Information. When the permittee becomes aware that he or she failed to submit any relevant facts or submitted incorrect information in the Notice of Intent or in any other report to the Director, he or she shall promptly submit such facts or information.

G.7. Oil and Hazardous Substance Liability. Nothing in this Permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities, or penalties to which the Permittee is or may be subject under the "Act".

G.8. Property Rights. The issuance of this Permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to private property nor any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

G.9. Severability. The provisions of this Permit are severable, and if any provision of this Permit, or the application of any provision of this Permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this Permit shall not be affected thereby.

G.10. Records Retention.

1. The Permittee shall retain copies of SWPPPs and all reports required by this Permit, and records of all data used to complete the Notice of Intent to be covered by this Permit, for a period of at least three years from the date that the site is finally stabilized. This period may be extended by request of the Director at any time.

2. After final stabilization of the construction site is complete, the SWPPP is no longer required to be maintained on site, but may be maintained by the Permittee(s) at its primary headquarters. However, access to the SWPPP will continue as described in Part 3.2.

G.11. Addresses. All written correspondence under this permit shall be directed to the Division of Water Quality at the following address:

Department of Environmental Quality
Division of Water Quality
195 North 1950 West
PO Box 144870
Salt Lake City, Utah 84114-4870

G.12. State Laws.

1. Nothing in this Permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Utah Code Ann. § 19-5-117.

2. No condition of this Permit shall release the Permittee from any responsibility or requirements under other environmental statutes or regulations.

G.13. Proper Operation and Maintenance. The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the conditions of this Permit and with the requirements of SWPPPs. Proper operation and maintenance also

includes adequate laboratory controls and appropriate quality assurance procedures. Proper operation and maintenance requires the operation of backup or auxiliary facilities or similar systems, installed by a Permittee only when necessary to achieve compliance with the conditions of the Permit.

G.14. Inspection and Entry. The Permittee shall allow, upon presentation of credentials, the Director or an authorized representative:

1. To enter upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this Permit;

2. Have access to and copy at reasonable times, any records that must be kept under the conditions of this Permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Permit; and

4. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by law, any substances or parameters at any location.

G.15. Reopener Clause.

1. Reopener Due to Water Quality Impacts. If there is evidence indicating that the storm water discharges authorized by this Permit cause, have the reasonable potential to cause or contribute to, a violation of a water quality standard, the discharger may be required to obtain an individual permit or an alternative general permit in accordance with Part 2.3 of this Permit or the Permit may be modified to include different limitations and/or requirements.

2. Reopener Guidelines. Permit modification or revocation will be conducted according to UAC R317-8-5.6 and UAC R317-8-6.2.

3. Permit Actions. This Permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Permittee for a Permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any Permit condition.

G.16. Signatory Requirements.

1. All Notices of Intent, SWPPPs, reports, certifications or information submitted to the Executive Secretary, or that this Permit requires to be maintained by the Permittee, shall be signed as follows:

1.1. All Notices of Intent shall be signed as follows:

1.1.1. For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means: a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or the manager of one or more manufacturing, production or operating facilities employing more than 250 persons or having gross

annual sales or expenditures exceeding $25,000,000 (in second-quarter 1980 dollars) if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

1.1.2. For a partnership of sole proprietorship: by a general partner or the proprietor, respectively; or

1.1.3. For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes (1) the chief executive officer of the agency, or (2) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g. Regional Administrators of EPA).

1.2. All reports required by the Permit and other information requested by the Director or by an authorized representative of the Executive Secretary shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

1.2.1. The authorization is made in writing by a person described above and submitted to the Director; and

1.2.2. The authorization specifies either an individual or a position having responsibility for overall operation of the regulated site, facility or activity, such as the position of manager, operator, superintendent, or position of equivalent responsibility or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position).

1.3. Certification. Any person signing documents under this Part G.16 shall make the following certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated 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 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.

Appendix H – Notice of Intent Form (NOI)

Please Obtain a copy of the NOI from the DWQ web site at
http://www.waterquality.utah.gov/UPDES/stormwatercon.htm

Appendix I – Notice of Termination (NOT)

Please Obtain a copy of the NOT from the DWQ web site at
http://www.waterquality.utah.gov/UPDES/stormwatercon.htm

Appendix J – Visual Monitoring Form

(This appendix is not included in the public notice review as it is for help and assistance to aid compliance and is not regulatory in nature. It may be modified during the term of the permit if it is found that it can be improved on.)

VISUAL MONITORING FORM

Project Name: _____

Project Location: _____

Name of Sample Taker: _____

Date_____ Time_____

Describe the location of where the sample was taken._____

_____

Describe how the sample was collected:

_____

_____

Weather conditions at time of sample taking (circle all that apply):

Snowing Raining Sunny Cloudy Windy Warm Cold Freezing Other __

COLOR (Circle the one that apply):

Black Dark Grey Medium Grey Light Grey Dark Chocolate Brown

Medium Brown Light Brown Tan Yellow Green Other

Comments:

_____

_____

INTENSITY OF COLOR: Very Intense Prominent Moderately Perceptible Hardly Perceptible

Comments:

_____

_____

CLARITY (Circle the right one):

Totally Opaque Slightly Translucent Translucent Nearly Transparent Transparent/Clear

ODOR (Circle the ones that apply):

Diesel Gasoline Petroleum Solvent Musty Sewage Chlorine

Rotten Egg Sulfur No Odor Noxious Other _____

Comments:

_____

_____

_____

FLOATING SOLIDS

Styrofoam beads sticks/leaves/grass scum film floating particles

(Description): _____

_____

_____

SUSPENDED AND SETTLED SOLIDS (Description)

_____

_____

_____

FOAM, OIL, SHEEN OR OTHER OBVIOUS
INDICATORS OF POLLUTION

_____

_____

_____

Appendix K – Erosivity Waiver Form

The EPA has a web site that automatically calculates the "R" factor that web site is:
http://cfpub1.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm

EROSIVITY WAIVER FORM

Owner: _____

Address: _____

City: _____ State: _____ zip: _____

Contact Person: _____ Phone: _____

Email: _____

General Contractor: _____

Address: _____

City: _____ State: _____ zip: _____

Contact Person: _____ Phone: _____

Email: _____

Project Name: _____

Address: _____

City: _____ State: _____ zip: _____

Factors Needed for Calculation of R Factor

Latitude: _____

Longitude: _____

Start Date: _____

End Date: _____

"R" Factor Value: _____

Hand calculated ☐ EPA calculated ☐

The Project Should not Extend Past the End Date

If the project continues beyond the end date submitted in the waiver the owner must recalculate the "R" factor using the new end date. If the new "R" factor is 5 or more the owner must immediately obtain coverage under the UPDES CGP. The waiver should only be used if the owner has confidence the project can be completed within the start and end date submitted in the waiver.

Appendix L – Example Self-Inspection Form

(This appendix is not included in the public notice review as it is for help and assistance to aid compliance and is not regulatory in nature. It may be modified during the term of the permit if it is found that it can be improved on.)

CONSTRUCTION STORM WATER SELF-INSPECTION FORM

Inspection General Information

Project Name	Date
Address/Location	Start Time
City State zip	End Time

Contractor Name	Inspector Name
Address	Inspector Phone
City State zip	Inspector Qualifications

Local Jurisdiction	UPDES Permit No.
Permit Coverage Date	Permit Expiration Date

Weather Conditions

Windy ☐ Hot ☐ Cold ☐ Temperate ☐ Raining ☐ Snowing ☐
Clear ☐ Partly Cloudy ☐ Heavy Clouds ☐ Wet Conditions ☐ Dry Conditions ☐

Precipitation Events Since the Last Inspection

Day of Event _____ Duration of Event _____ Inches of Precip. _____

Inspection Schedule

Weekly ☐ Bi-weekly & after a half inch event ☐ Other (specify) _____

Construction Phase

Clearing/Grubbing ☐ Demolition ☐ Grading/Excavation ☐ Utilities/Foundation Work ☐
Above Ground Erection ☐ Landscaping/Paving ☐

Permit Requirements to Look For

Water Bodies & Buffer Zones ☐ Discharge to High Quality or Sensitive Water ☐

Off site areas of the Project ☐ Areas over 14 days w/o stabilization ☐ Perimeter Controls ☐

Good House Keeping (track out, waste disposal, sanitary, washout areas) ☐ Material Storage ☐

SWPPP planned SW controls ☐ Discharge Points ☐ SWPPP is updated with site ☐

Accumulations of Sediment ☐ Places where SW controls are needed ☐

BMP Designation	Okay	Not Okay	BMP Condition, Corrective Action Required.
Are all pollution sources controlled? Do any other problems exist?			
[BMP # and Name] From SWPPP Template			
[BMP # and Name] From SWPPP Template			
[BMP # and Name] From SWPPP Template			
[BMP # and Name] From SWPPP Template			
[BMP # and Name] From SWPPP Template			
[BMP # and Name] From SWPPP Template			
[BMP # and Name] From SWPPP Template			
[BMP # and Name] From SWPPP Template			
[BMP # and Name] From SWPPP Template			
[BMP # and Name] From SWPPP Template			
[BMP # and Name] From SWPPP Template			

Overall Site Conditions (These pages are suggested if the permittee chooses. They can be deleted if desired)

Concerns to be Checked	Implemented Y/N/NA	Maintained Y/N/NA	Corrective Action	Date Corrected
Are all slopes and disturbed areas not actively being worked properly stabilized?				
Are all water bodies (e.g., streams, wetlands) protected with buffers or similar BMPs?				
Are perimeter controls and sediment controls properly installed and maintained (anchored into soil)?				
Has the sediment build up been removed from BMPs designed to catch sediment?				
Are discharge points and receiving waters free of any sediment deposits?				
Is all sediment that has been deposited off site cleaned up?				
Are storm drain inlets properly protected?				
Does the construction exit have a track out pad (or other BMP)?				
Is the track out pad (or other BMP) effective in preventing sediment from being tracked into the street?				
Is trash/litter from work areas collected and placed in covered dumpsters?				
Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?				
Are vehicle/equipment fueling, cleaning, and maintenance areas managed properly with no illicit discharges?				
Are fuels and construction materials and chemicals that are potential storm water contaminants covered or in secondary containment?				
Are non-storm water discharges (e.g., wash water, dewatering, wheel washing) properly controlled?				
Is run-on prevented or properly managed?				
Are there locations where additional BMP's are necessary?				
Are material piles protected from weather and placed on hard surfaces only day by day for placement and not for storage?				
Are all BMPs and storm water control measures accurately shown and updated on the SWPPP map?				

Corrective Action Log

Date & Time of Inspection or Random Notice of Problem	Inspection or Randomly Noticed	BMP # and Name	Description of BMP Deficiency (or reference the inspection report)	Initial	Correction Date	How the BMP was Corrected	SWPPP Change Y/N

Signature Block

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information contained therein. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information contained is, to 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.	
Print Name of Inspector	Date
Signature	

Appendix M – Notice for New Owner/Operators

Ownership Transfer Form

Upon transfer of ownership or control of the subject property under this Permit (see section 8.2.2.a.) coverage under the UPDES CGP must continue until stabilization requirements are satisfied according to permit requirements. This requirement may be met by either of the following **transfer options** (this form is must be filled out and submitted to DWQ in either case):

1. Obtaining coverage under a new and independent Notice of Intent (NOI – the application process to procure coverage under the UPDES CGP). This results in a new permit tracking number for the new owner.
2. Coordinating with the previous owners and the State of Utah, Department of Environmental Quality, Division of Water Quality where ownership, other information, and signatures (including electronic certifications) contained in the NOI that is current for the property is changed to reflect the change in ownership and responsible parties for conducting construction activities (general contractor). For this step the new owner would assume the responsibilities of the original CGP coverage. This continues the original permit tracking number.

Name of Previous Owner _____ Telephone Number _____

Address of Previous Owner _____ City _____ State _____ Zip _____

Signature of Previous Owner _____ Date _____

Name of New Owner _____ Telephone Number _____

Address of New Owner _____ City _____ State _____ Zip _____

Signature of New Owner _____ Date _____

Name of Previous Operator Telephone Number

Address of Previous Operator City State Zip

Signature of Previous Operator Date

Name of New Operator Telephone Number

Address of New Operator City State Zip

Signature of New Operator Date

PROJECT NAME AND LOCATION

Previous Permit Number Name of Project

Address of Project City State Zip

Longitude Latitude

WHAT KIND OF TRANSFER: PARTIAL OR TOTAL?

Is this a transfer of ownership of partial or total of the permitted area? Partial ☐
Total ☐

If this is a transfer of part of the permitted area to a new owner, describe what part:

_____

_____

_____

Will there be a new SWPPP prepared? YES ☐ NO ☐

Please update the General Contractor Information (see transfer options 1 or 2, first page). If this is a partial transfer the only option is 1.

This form must be submitted to the Municipality of Jurisdiction and DWQ

To submit to DWQ either email to the construction storm water coordinator or,
FAX to 801-535-4301
Or mail to DWQ
PO Box 144870
Salt Lake City, UT 84114-4870

Appendix D – NOI and Acknowledgement Letter

STATE OF UTAH, DEPARTMENT OF ENVIRONMENTAL QUALITY, DIVISION OF WATER QUALITY
195 North 1950 West, P.O. Box 144870, Salt Lake City, Utah 84114-4870 (801) 536-4300

NOI

Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity Under the UPDES General Permit No. UTRC00000. **SEE REVERSE FOR INSTRUCTIONS**

Submission of this Notice of Intent constitutes notice that the party(s) identified in Section I of this form intends to be authorized by UPDES General Permit No. UTRC00000 issued for storm water discharges associated with construction activity in the State of Utah. Becoming a permittee obligates such discharger to comply with the terms and conditions of the permit. ALL NECESSARY INFORMATION MUST BE PROVIDED ON THIS FORM.

Is this NOI seeking continuation for previously expired permit coverage at the same site? Y ☐ N ☐
If yes, what is the number of the previous permit coverage? Permit No. UTR_____

Permit Start Date (automatic) **Permit Expiration Date:** (automatic)

I. OPERATOR INFORMATION

Name (Owner): _____ **Phone:** _____

Address: _____ **Status of Owner/Operator:** _____

City: _____ **State:** _____ **Zip:** _____

Contact Person: _____ **Phone:** _____

Name (Operator): _____ **Phone:** _____

Address: _____ **Status of Owner/Operator:** _____

City: _____ **State:** _____ **Zip:** _____

Contact Person: _____ **Phone:** _____

II. FACILITY SITE / LOCATION INFORMATION

Is the facility located in Indian Country?
Y ☐ N ☐

Name: _____

Project No. (if any): _____

Address: _____ **County:** _____

City: _____ **State:** _____ **Zip:** _____

Latitude: _____ _____ _____ **Longitude:** _____ _____ _____

Method (check one): ☐ **USGS Topo Map, Scale** _____ ☐ **EPA Web site** ☐ **GPS** ☐ **Other** _____

III. SITE INFORMATION

Municipal Separate Storm Sewer System (MS4) Operator Name: _____

Receiving Water Body: _____ **this is known** ✸ **this is a guess** ✸

Estimate of distance to the nearest water body? _____ **ft.** ✸ **miles.** ✸

Is the receiving water an impaired or high quality water body (see http://wq.deq.utah.gov/)? Yes ✸ **No** ✸

List the Number of any other UPDES permits at the site: _____ _____

IV. TYPE OF CONSTRUCTION (Check all that apply)

1. ✸ **Residential** **2.** ✸ **Commercial** **3.** ✸ **Industrial** **4.** ✸ **Road** **5.** ✸ **Bridge** **6.** ✸ **Utility**

7. ✸ **Contouring, Landscaping** **8.** ✸ **Pipeline** **9.** ✸ **Other (Please list)** _____

INSTRUCTIONS

Notice Of Intent (NOI) For Permit Coverage Under the UPDES General Permit For Storm Water Discharges From Construction Activities

Who Must File A Notice Of Intent (NOI) Form State law at UAC R317-8-3.9 prohibits point source discharges of storm water from construction activities to a water body(ies) of the State without a Utah Pollutant Discharge Elimination System (UPDES) permit. The operator of a construction activity that has such a storm water discharge must submit a NOI to obtain coverage under the UPDES Storm Water General Permit. If you have questions about whether you need a permit under the UPDES Storm Water program, or if you need information as to whether a particular program is administered by EPA or a state agency, contact the storm water coordinator at (801) 536-4300.

Where To File NOI Form The preferred method of submitting an NOI to apply for the construction general storm water permit (CGP) is electronically on-line at http://www.waterquality.utah.gov/UPDES/stormwatercon.htm. The fee can be submitted on line also. If on-line is not an option for you send a paper form of the NOI to the following address:

Department of Environmental Quality
Division of Water Quality
P.O. Box 144870
Salt Lake City, UT 84114-4870

Beginning of Coverage CGP coverages are issued immediately after submitting an NOI with the permit fee. The permittee should be aware that though you may not have a permit in hand, if you have submitted a completed NOI with the permit fee you are covered by the conditions in the permit and will be expected to comply with permit conditions. You can print a copy of the CGP from the DWQ web site.

Permit Fees. The permit fee is $150.00 per year. The fee is paid by Visa/Master Card on-line when an NOI is filed (by check if submitted with a paper NOI). If the project continues for more than one year the fee must be submitted again in a renewal process on-line. CGP coverage will not be issued until the fee is paid.

Length of Coverage: CGP coverage starts the day that the NOI and fee is received at DWQ and expires a year from issuance. All CGP coverages must be renewed within 60-days after the yearly expiration date, or be terminated with a notice of termination (NOT) before the expiration date. To terminate the permit the site must meet the permit conditions for final stabilization (see permit definitions), or must continue under a different permit holder. In most cases the DWQ or municipality of jurisdiction will perform a final inspection when a CGP coverage submits an NOT. If the site passes the final inspection the permit is terminated.

The Storm Water General Permit for Construction Activities UTRC00000 will expire on June 30, 2019. The Clean Water Act requires that all UPDES permits be renewed every 5 years. If a project extends beyond the expiration date of the Permit it must continue coverage under the renewed permit that will subsequently be developed to continue the same or similar permit coverage for construction activity.

SECTION I - FACILITY OPERATOR INFORMATION Supply the legal name(s) of the person(s), firm(s), public organization(s), or any other entity(ies) that qualifies as the owner of the project (see permit definitions). Do the same for the operator (most commonly the general contractor) that conducts the construction operation at the facility or site to be permitted. The owner and the general contractor of the project may be the same.

Enter the complete address and telephone number of the owner and operator and a contact person and number for each. Enter the appropriate letter to indicate the legal status of the operator of the facility.
F = Federal M = Public (other than Fed or State) S = State P = Private

SECTION II - FACILITY/SITE LOCATION INFORMATION Enter the facility name or legal name and project number (if any) of the site and complete street address, including city, state and ZIP code. The latitude and longitude of the facility must be included to the approximate centroid of the site, and the method of how the Lat/Long was obtained (USGS maps, GPS, Internet Map sites [such as Google Earth], or other).

Indicate whether the facility is located in Indian Country. If the facility is located in Indian Country, do not complete this NOI, instead submit an application for coverage under a storm water permit to EPA Region VIII except for facilities on the Navajo Reservation or on the Goshute Reservation which should submit an application to EPA Region IX.

SECTION III - SITE ACTIVITY INFORMATION If the storm water discharges to a municipal separate storm sewer system (MS4), enter the name of the operator of the MS4 (e.g., the name of the City or County of jurisdiction) and the receiving water of the discharge from the MS4 if it is known (if it is not known please estimate or guess and indicate so). (An MS4 is defined as a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) that is owned or operated by a state, city, town, county, district, association or other public body which is designed or used for collecting or conveying storm water).

For Impaired Waters: Go to http://wq.deq.utah.gov and identify the water body that will receive the storm water discharge from the permitted site, on the map provided at the web site (zoom in for easier resolution). On the left hand side of the page you will see "**2010 Assessment**" or "**2013 Assessment**" depending on the year you refer to the web site (the assessment is done every 3 years). The **20XX Assessment** the will indicate if the water is impaired. If there is nothing after **20XX Assessment** or the narrative after does not include the word "impaired", your receiving water is not impaired.

For High Quality Waters: On the web page referred to in the paragraph above on the left hand side of the page you will see "**Anti-Degradation Category**". Under **Anti-Degradation Category** you will see the category of the water body. Only categories 1 and 2 are high quality water bodies. Some waters may be both categories 1 and 3. If your water body is both category 1 and 3 it means the headwaters of your water body is within Forest Service boundaries, and because it is within Forest Service boundaries it is category 1. If your project is within Forest Service boundaries then your water body is category 1 and it is "high quality". If your project is not within Forest Service boundaries then your water body is category 3 and is not "high quality". Again, category 1 waters are high quality waters, category 3 waters are not high quality waters.

SECTION IV - TYPE OF CONSTRUCTION Check each type of construction that applies to this application.

SECTION V - BEST MANAGEMENT PRACTICES Check each type of best management practice that will be used to control storm water runoff at the job site.

SECTION VI – GOOD HOUSEKEEPING PRACTICES Check each type of good housekeeping practice that you will use on the site any time during construction activities.

SECTION VII – ADDITIONAL Provide an estimate of the total number of acres of the site on which soil will be disturbed (to the nearest hundredth of an acre). An email address is required of the best contact associated with the project for the communication needs.

SECTION VIII – CERTIFICATION State statutes provide for severe penalties for submitting false information on this application form. State regulations require this application to be signed as follows:

For a corporation: by a responsible corporate officer, which means: (i) president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions, or (ii) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

For a partnership or sole proprietorship: by a general partner or the proprietor; or

For a municipality, state, Federal, or other public facility: by either a principal executive officer or ranking elected official.

POLLUTION PREVENTION PLAN A storm water pollution prevention plan (SWP3) is required to be in hand before the NOI can be submitted. It is important to know SWP3 requirements (contained in the permit) even during the design portion of the project. A copy of the permit can be obtained from the Division of Water Quality's storm water construction web site. Guidance material for developing a SWP3 can be obtained from the Division of Water Quality's storm water construction web site.

V. BEST MANAGEMENT PRACTICES

Identify proposed Best Management Practices (BMPs) to reduce pollutants in storm water discharges (Check all that apply):

1. ☐ Silt Fence/Straw Wattle/Perimeter Controls 2. ☐ Sediment Pond 3. ☐ Seeding/Preservation of Vegetation

4. ☐ Mulching/Geotextiles 5. ☐ Check Dams 6. ☐ Structural Controls (Berms, Ditches, etc.)

7. ☐ Other (Please list) _____

VI. GOOD HOUSEKEEPING PRACTICES

Identify proposed Good Housekeeping Practices to reduce pollutants in storm water discharges (Check all that apply even if they apply only during a part of the construction time):

1. ✸ Sanitary/Portable Toilet 2. ✸ Washout Areas 3. ✸ Construction Chemicals/Building Supplies Storage Area

4. ✸ Garbage/Waste Disposal 5. ✸ Non-Storm Water 6. ✸ Track Out Controls 7. ✸ Spill Control Measures

VII. ADDITIONAL

Estimated Area to be Disturbed (in Acres): _____ Total Area of Plot (in Acres):_____

A storm water pollution prevention plan has been prepared for this site and is to the best of my knowledge in Compliance with State and/or Local Sediment and Erosion Plans and Requirements. Y ☐ N ☐
(A pollution prevention plan is required to be on hand before submittal of the NOI.)

Enter the best e-mail address to contact the permittee: _____

VIII.CERTIFICATION: I certify under penalty of law that I have read and understand the Part 1 eligibility requirements for coverage under the general permit for storm water discharges from construction activities. I further certify that to the best of my knowledge, all discharges and BMPs that have been scheduled and detailed in a storm water pollution prevention plan will satisfy requirements of this permit. I understand that continued coverage under this storm water general permit is contingent upon maintaining eligibility as provided for in Part 1.

I also certify under penalty of law that this document and all attachments were prepared under the direction or supervision of those who have placed their signature(s) below, 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 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.

Print Name (Owner): **Date:**

_____ _____

Signature:

Print Name (Operator): **Date:**

_____ _____

Signature:

Amount of Permit Fee Enclosed: $_____

Appendix E – Inspection Reports

Updated July 2014

UPDES STORM WATER INSPECTION EVALUATION FORM FOR SWPPP COMPLIANCE

Click to Add Logo

Inspection #: _____

Site Name: _____ UPDES Permit #: _____

Site Address: _____

Local Jurisdiction or County: _____ Inspection Cycle: High Priority ☐ 7 Days ☐ 14 Days ☐

Permit Effective Date: _____ Permit Expiration Date: _____ Total Project Area: _____ Total Disturbed Area: _____

Project Type: Subdivision ☐ Commercial ☐ Industrial ☐ Linear (Road/Pipe/Power) ☐ Land Disturbance ☐

OPERATOR CONTACT INFORMATION

Operator: _____ Phone: _____ E-mail: _____

On-site Facility Contact: _____ Phone: _____ E-mail: _____

Important Contacts: _____ Phone: _____ E-mail: _____

Important Contacts: _____ Phone: _____ E-mail: _____

SWPPP PRE-SITE REVIEW INFORMATION

1. Has a pre-construction review of the SWPPP been conducted by the appropriate municipal agency? Yes ☐ | No ☐
2. Are contact names, positions, responsibilities, and telephone numbers of the Stormwater Team and all other site Operators listed in the SWPPP? Yes ☐ | No ☐
3. Does the SWPPP include a site map showing storm drains, slopes/surface drainage patterns, SW discharge points, construction boundaries, limits of disturbance, surface waters (name of receiving water), TMDL requirements, buffer zones, structural controls, and does it define/explain non-structural controls? Yes ☐ | No ☐
4. Does the SWPPP have an estimate of the area to be disturbed, a sequence of construction activities, the SW runoff coefficient before and after construction, a description of the soil types, controls for discharges from (asphalt/concrete) batch plants if any, list UIC Class 5 Injection Well activities and use, show wetland areas, and have a description of the nature of the construction activity? Yes ☐ | No ☐
5. Does the SWPPP and site map show erosion and sediment controls placement & details, buffer zone documentation (e.g.erosion blankets, mulch, slope drains, check dams, sediment basins, grass-lined channels, fiber rolls, sediment traps, silt fence, inlet protection, curb cut-back, dust control, chemical treatments etc?) Yes ☐ | No ☐
6. Does the SWPPP and site map show and describe good housekeeping controls and storage areas of polymers, flocculants or other treatment chemicals, spill prevention and mitigation measures, staff training procedures and logs. (e.g. track out pad, street sweeping, material storage, construction waste containment and removal, sanitary waste, concrete washout pits, etc) Yes ☐ | No ☐
7. Are post-construction elements included in the SWPPP? (i.e. grass swales, detention basins, vegetated filter strips, infiltration, depression storage, landscaping/xeriscaping, discontinuous concrete or hard surface SW conveyance, etc.) Yes ☐ | No ☐
8. Are the SWPPP Certifications signed by the proper and responsible officers and parties (see permit Appendix G Part G. 16,1,2 & 1.3) Yes ☐ | No ☐
9. Are the NOI , a copy of the State permit, Appendix logs and forms in the SWPPP? Yes ☐ | No ☐

NOTICE OF TERMINATION (NOT) INSPECTION

Site Name: _____ Evaluation Date: _____

Site Address: _____

Inspected By: _____ Title/Organization: _____

1. Has the site been properly stabilized according to permit requirements? Yes ☐ | No ☐
2. Have all temporary BMPs been removed? Yes ☐ | No ☐
3. Have post-construction (permanent storm water system) elements been constructed and inspected in accordance with approved project drawings? Yes ☐ | No ☐
4. Is the site acceptably clean? Yes ☐ | No ☐

COMMENTS:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated 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 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.

Inspector (*Print Name*) _____ Title: _____ Signature: _____ Date: _____

Operator: (*Print Name*) _____ Title: _____ Signature: _____ Date: _____

Operator: (*Print Name*) _____ Title: _____ Signature: _____ Date: _____

ADDITIONAL COMMENTS AND CORRECTIVE ACTIONS FOR SWPPP COMPLIANCE

By: Date:

Project Name: Project Address:

Appendix F – Corrective Action Log

Project Name:
SWPPP Contact:

Inspection Date	Inspector Name(s)	Description of BMP Deficiency	Corrective Action Needed (including planned date/responsible person)	Date Action Taken/Responsible person

Appendix G – SWPPP Amendment Log

Project Name: Promontory Point Landfill
SWPPP Contact:

Amendment No.	Description of the Amendment	Date of Amendment	Amendment Prepared by [Name(s) and Title]

Appendix H – Subcontractor Certifications/Agreements

SUBCONTRACTOR CERTIFICATION
STORMWATER POLLUTION PREVENTION PLAN

Project Number: _____

Project Title: _____

Operator(s): _____

As a subcontractor, you are required to comply with the Stormwater Pollution Prevention Plan (SWPPP) for any work that you perform on-site. Any person or group who violates any condition of the SWPPP may be subject to substantial penalties or loss of contract. You are encouraged to advise each of your employees working on this project of the requirements of the SWPPP. A copy of the SWPPP is available for your review at the office trailer.

Each subcontractor engaged in activities at the construction site that could impact stormwater must be identified and sign the following certification statement:

I certify under the penalty of law that I have read and understand the terms and conditions of the SWPPP for the above designated project and agree to follow the BMPs and practices described in the SWPPP.

This certification is hereby signed in reference to the above named project:

Company: _____

Address: _____

Telephone Number: _____

Type of construction service to be provided: _____

_____

_____

Signature: _____

Title: _____

Date: _____

Appendix I – Grading and Stabilization Activities Log

Project Name:
SWPPP Contact:

Date Grading Activity Initiated	Description of Grading Activity	Date Grading Activity Ceased (Indicate Temporary or Permanent)	Date When Stabilization Measures are Initiated	Description of Stabilization Measure and Location

Appendix J – SWPPP Training Log

Stormwater Pollution Prevention Training Log

Project Name:

Project Location:

Instructor's Name(s):

Instructor's Title(s):

Course Location: _____ Date: _____

Course Length (hours): _____

Stormwater Training Topic: *(check as appropriate)*

- ❑ **Erosion Control BMPs**
- ❑ **Emergency Procedures**
- ❑ **Sediment Control BMPs**
- ❑ **Good Housekeeping BMPs**
- ❑ **Non-Stormwater BMPs**

Specific Training Objective:_____

_____

Attendee Roster: *(attach additional pages as necessary)*

No.	Name of Attendee	Company
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Appendix K – Delegation of Authority Form

Delegation of Authority

I, _____ (name), hereby designate the person or specifically described position below to be a duly authorized representative for the purpose of overseeing compliance with environmental requirements, including the Construction General Permit, at the _____ construction site. The designee is authorized to sign any reports, stormwater pollution prevention plans and all other documents required by the permit.

_____ (name of person or position)
_____ (company)
_____ (address)
_____ (city, state, zip)
_____ (phone)

By signing this authorization, I confirm that I meet the requirements to make such a designation as set forth in _____ (Reference State Permit), and that the designee above meets the definition of a "duly authorized representative" as set forth in _____ (Reference State Permit).

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated 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 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.

Name: _____

Company: _____

Title: _____

Signature: _____

Date: _____

Appendix L – Erosivity Calculation

Figure 1. Erosivity Index Zone Map

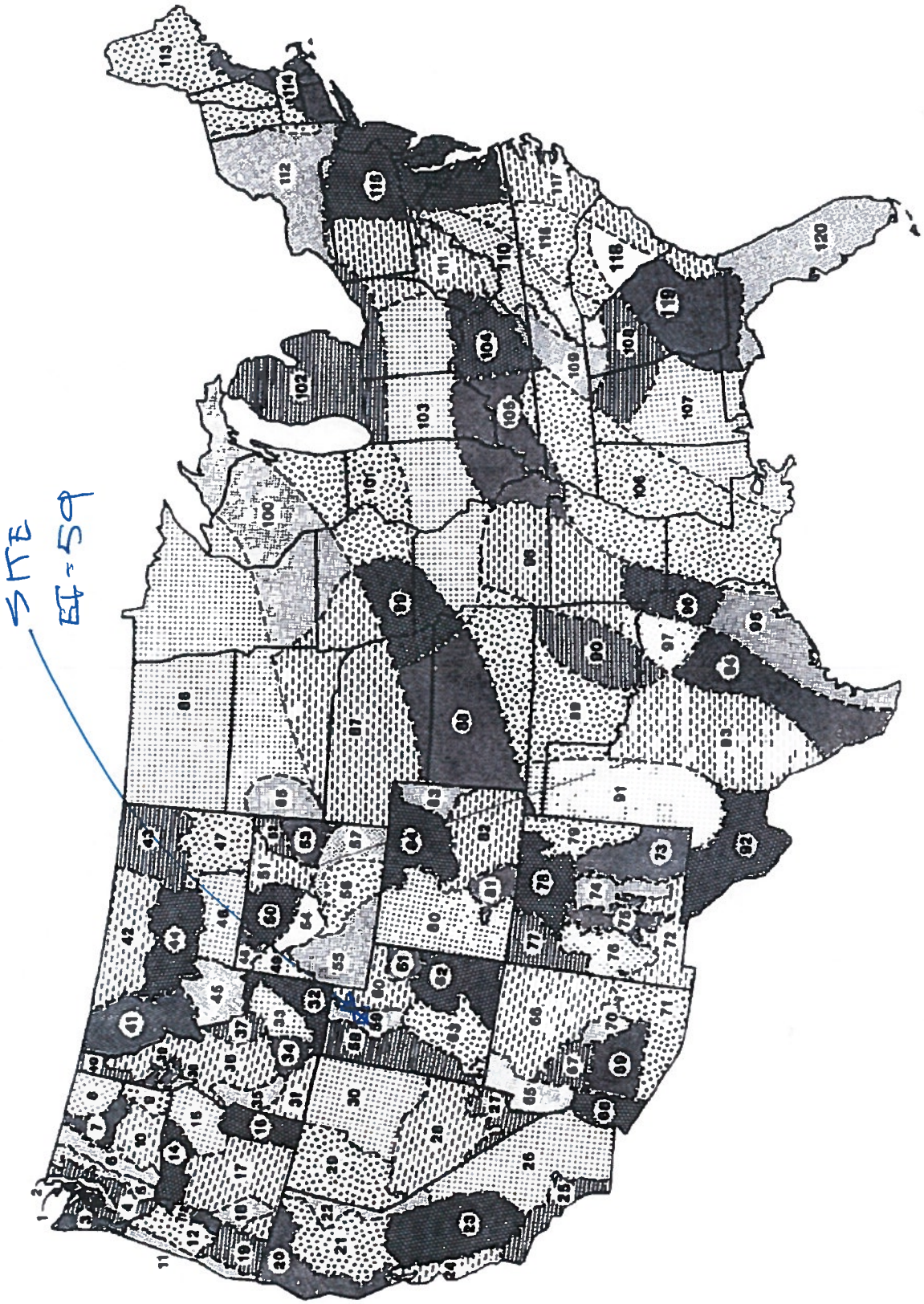
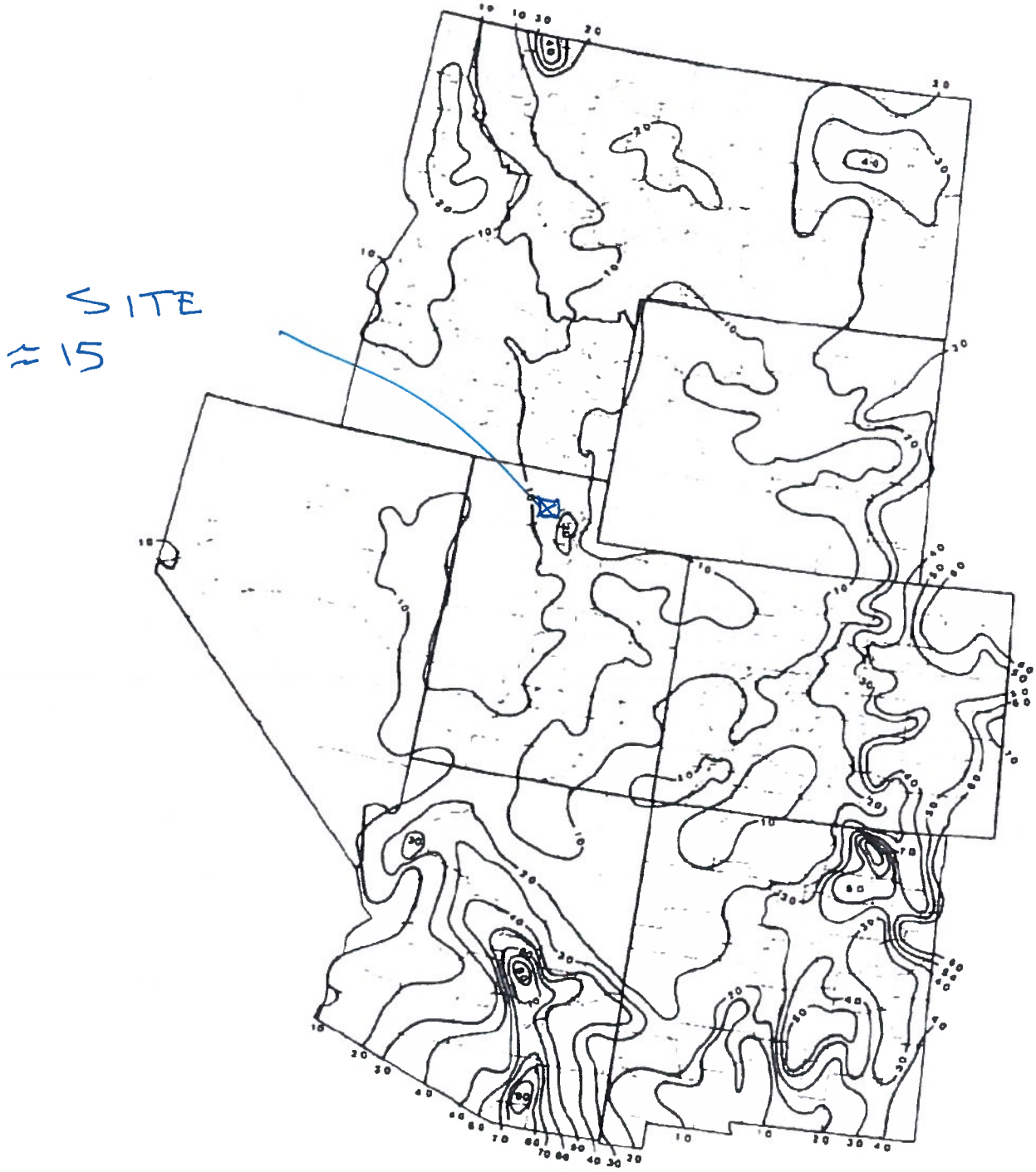


Figure 3. Isoerodent Map of the Western U.S.



Note: Units for all maps on this page are hundreds ft•tonf•in(ac•h•yr)$^{-1}$

Month	Jan	Jan	Jan	Feb	Mar	Mar	Mar	Apr	Apr	May	May	Jun	Jun	Jul	Jul	Aug	Aug	Sept	Sept	Oct	Oct	Nov	Nov	Dec	Dec
Day	1	16	31	15	1	16	31	15	30	15	30	14	29	14	29	13	28	12	27	12	27	11	26	11	31
El Zone																									
36	0	0.0	0.0	0.0	0.0	0.9	3.4	6.7	12.7	18.5	26.6	36.3	46.0	53.5	60.2	68.3	75.8	82.6	88.3	96.3	99.3	99.9	100.0	100.0	100
37	0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.9	9.1	19.1	26.7	36.3	47.9	61.4	75.1	84.5	92.3	96.0	99.1	100.0	100.0	100.0	100.0	100
38	0	0.0	0.0	1.1	4.3	7.2	11.0	13.9	17.9	22.3	30.3	43.1	55.1	61.3	65.7	72.1	77.9	82.6	86.3	90.3	93.8	98.4	100.0	100.0	100
39	0	0.0	0.0	0.0	0.0	1.6	6.5	11.0	17.8	24.7	33.1	42.8	50.3	54.9	59.7	68.9	78.1	83.6	87.5	93.0	96.5	99.2	100.0	100.0	100
40	0	0.0	0.0	0.0	0.0	1.5	6.2	10.1	16.3	23.3	32.5	42.2	50.1	55.6	60.5	67.5	74.3	79.4	84.1	91.1	95.8	99.1	100.0	100.0	100
41	0	0.1	0.2	0.2	0.2	0.2	0.2	0.4	1.1	6.8	22.9	40.1	54.9	63.8	70.7	81.5	89.8	96.3	98.7	99.2	99.3	99.4	99.4	99.7	100
42	0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9	5.2	17.3	33.8	53.2	66.5	75.9	87.6	93.7	97.5	99.0	99.7	100.0	100.0	100.0	100.0	100
43	0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	2.7	9.5	21.9	42.7	58.6	71.1	84.6	91.9	97.1	99.0	99.8	100.0	100.0	100.0	100.0	100
44	0	1.7	2.3	2.4	2.4	2.4	2.4	2.7	3.5	7.6	18.5	34.3	52.5	64.0	72.3	83.3	90.0	95.1	97.3	98.5	98.9	98.9	98.9	99.2	100
45	0	0.2	0.2	0.3	0.3	0.4	0.6	0.8	1.4	3.7	10.2	22.6	41.8	54.0	64.5	78.7	88.4	96.0	98.7	99.4	99.7	99.7	99.8	99.9	100
46	0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	2.6	7.5	19.6	32.9	48.9	63.0	73.5	83.3	89.5	95.6	98.3	99.6	100.0	100.0	100.0	100.0	100
47	0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.6	5.8	17.0	33.0	52.5	66.4	75.7	85.5	91.3	96.5	98.8	100.0	100.0	100.0	100.0	100.0	100
48	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	8.1	15.4	27.8	40.7	52.6	61.1	69.3	82.6	92.0	98.0	100.0	100.0	100.0	100.0	100
49	0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	2.7	8.3	20.0	27.5	35.6	44.6	46.0	70.2	81.3	89.2	93.6	98.5	100.0	100.0	100.0	100.0	100
50	0	0.0	0.0	0.0	0.0	0.1	0.4	2.4	8.2	13.7	23.8	38.8	55.1	66.1	73.6	81.8	87.7	93.8	97.0	99.4	100.0	100.0	100.0	100.0	100
51	0	0.0	0.0	0.0	0.0	0.3	1.0	3.1	8.7	18.8	35.8	49.6	60.4	70.2	77.0	84.0	88.8	93.8	96.6	99.1	100.0	100.0	100.0	100.0	100
52	0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	2.5	6.8	17.5	29.8	46.1	60.5	72.7	86.0	92.8	96.8	98.4	99.7	100.0	100.0	100.0	100.0	100
53	0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	3.0	9.5	24.2	35.3	48.0	63.1	76.1	87.7	93.5	97.2	98.6	99.5	99.8	99.9	100.0	100.0	100
54	0	0.0	0.0	0.0	0.0	0.2	0.7	2.4	7.2	14.7	27.2	37.2	47.3	58.8	67.6	74.0	79.2	86.7	92.6	97.9	99.8	99.9	100.0	100.0	100
55	0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	5.4	13.3	25.5	31.6	38.8	52.5	66.8	75.5	81.2	87.9	92.8	98.3	100.0	100.0	100.0	100.0	100
56	0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	5.1	11.4	22.3	29.5	38.5	51.1	65.2	77.8	85.6	91.7	95.0	98.7	100.0	100.0	100.0	100.0	100
57	0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	3.5	9.2	21.5	31.0	43.5	60.4	75.1	86.1	91.6	96.2	98.1	99.4	99.9	99.9	100.0	100.0	100
58	0	0.0	0.0	0.0	0.0	0.2	0.9	2.9	8.0	13.2	21.0	29.1	38.0	45.9	54.5	65.4	74.8	82.1	87.5	95.4	98.8	99.7	100.0	100.0	100
59	0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	8.9	15.6	24.2	31.1	38.3	46.0	54.9	64.2	73.2	81.9	88.5	95.7	98.6	99.4	99.7	99.7	100
60	0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.5	4.0	9.5	13.3	20.5	33.6	52.8	66.5	76.7	88.1	94.2	98.6	100.0	100.0	100.0	100.0	100
61	0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	5.0	8.5	15.5	29.8	41.8	46.0	49.2	56.0	65.1	71.6	78.6	91.1	97.3	99.3	100.0	100.0	100
62	0	0.0	0.0	0.1	0.3	0.8	2.1	3.6	6.5	9.7	13.7	16.5	20.8	27.3	40.1	56.9	72.6	83.4	89.4	95.5	98.1	99.6	100.0	100.0	100
63	0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	3.7	7.8	13.3	15.8	19.9	29.0	46.8	64.7	78.3	88.8	93.9	98.5	100.0	100.0	100.0	100.0	100
64	0	0.0	0.0	0.7	2.8	7.4	12.4	14.4	15.6	17.3	19.4	21.0	24.4	32.3	48.0	61.4	72.1	81.9	87.0	90.1	92.4	98.1	100.0	100.0	100
65	0	3.6	7.0	9.6	11.4	13.0	14.4	16.3	17.7	18.4	19.3	20.5	23.6	32.0	50.0	66.2	77.2	85.4	88.8	90.4	91.3	92.7	94.8	97.0	100
66	0	0.0	0.0	0.0	0.0	0.1	0.5	1.1	2.2	3.6	6.0	7.6	11.1	19.8	38.9	59.7	74.4	83.2	88.1	94.6	97.7	99.4	100.0	100.0	100
67	0	0.0	0.0	0.0	0.0	0.1	0.4	0.9	1.6	1.9	2.4	5.0	12.1	24.8	48.3	73.6	86.5	92.0	94.3	96.6	97.9	99.5	100.0	100.0	100
68	0	2.3	4.5	7.8	10.4	12.0	13.3	16.3	17.7	18.1	18.2	18.3	18.4	19.9	24.5	35.0	54.4	69.4	78.6	85.7	89.2	91.9	93.9	97.0	100
69	0	2.0	3.7	5.7	7.8	10.5	12.4	13.7	14.3	14.7	15.1	15.7	17.1	22.7	36.7	50.4	63.6	75.0	81.8	87.8	90.8	93.2	94.9	97.5	100
70	0	0.5	0.7	1.0	1.3	1.7	2.2	2.8	3.4	3.9	4.7	5.4	7.4	15.7	36.5	55.8	70.3	80.9	86.4	90.9	93.4	96.4	98.1	99.4	100
71	0	0.7	1.2	1.6	2.1	2.8	3.3	3.6	4.0	4.5	5.6	6.5	9.1	18.5	40.6	59.7	74.0	86.3	91.7	94.7	96.0	96.7	97.3	98.8	100
72	0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.7	0.8	1.3	3.5	9.9	24.7	51.4	71.5	83.6	93.8	97.7	99.2	99.8	99.9	99.9	100.0	100
73	0	0.0	0.1	0.1	0.2	0.2	0.3	0.6	1.3	4.1	11.5	18.1	28.3	40.2	54.1	67.0	77.2	87.7	93.3	97.5	99.1	99.6	99.8	100.0	100
74	0	0.0	0.0	0.0	0.0	0.1	0.2	0.5	1.2	2.7	6.4	10.2	18.4	31.0	50.7	68.7	81.2	91.6	96.1	98.4	99.2	99.8	100.0	100.0	100
75	0	0.1	0.1	0.1	0.2	0.5	1.3	1.9	3.0	4.1	6.6	10.0	17.6	28.3	44.7	59.4	71.6	83.9	90.3	94.7	96.7	98.8	99.6	99.9	100

R= 88.5 x 15 = 1,327.5

Appendix M – BMPs

TOP TEN BMPs

for Pollution Prevention at the Construction Site

1 Preservation of Existing Vegetation

- Minimize clearing and the amount of exposed soil.
- Identify and protect areas where existing vegetation, such as trees, will not be disturbed by construction activity.
- Protect streams, stream barriers, wild wood lands, wetlands, or other sensitive areas from any disturbance or construction activity by fencing or otherwise clearly marking these areas.

2 Construction Phasing

- Sequence construction activities so that the soil is not exposed for long periods of time.
- Schedule or limit grading to small areas.
- Install key sediment control practices before site grading begins.
- Schedule site stabilization activities, such as landscaping, to be completed immediately after the land has been graded to its final contour.

3 Construction Entrances

- Remove mud and dirt from the tires of construction vehicles before they enter a paved roadway.
- Make sure that the construction entrance does not become buried in soil.
- Properly site entrance BMPs for all anticipated vehicles.

4 Silt Fencing

- Inspect and maintain silt fences after each storm.
- Make sure the bottom of the silt fence is buried.
- Securely attach the material to the stakes.
- Don't place silt fences in the middle of a waterway or use them as a check dam.
- Stormwater should not flow around the silt fence.

5 Storm Drain Inlet Protection

- Use rock or other appropriate material to cover the storm drain inlet to filter out trash and debris.
- Make sure the rock size is appropriate (usually 1 to 2 inches in diameter).
- If you use inlet filters, maintain them regularly.

6 Vegetative Buffers

- Protect and install vegetative buffers along waterbodies to slow and filter stormwater run-off.
- Maintain buffers by mowing or replanting periodically to ensure their effectiveness.

7 Site Stabilization

- Vegetate, mulch, or otherwise stabilize all exposed areas as soon as land alterations have been completed.

For more information on Best Management Practices (BMPs), go to DEQ's BMPs for Construction Site at:

www.DEQ.Utah.gov/Business_Assistance/Construction/

For general stormwater questions and assistance, contact the Division of Water Quality at:

801-536-4300

To report an Environmental Emergency, call:

1-800-458-0145

8 Equipment Fueling and Containment

- Use offsite fueling stations as much as possible, or dedicated fueling areas onsite.
- Discourage "topping-off" of fuel tanks.
- Dedicated fueling areas should be level, and in consideration of downstream drainage facilities and watercourses.
- Protect fueling areas with berms and dikes to prevent run-on, run-off, and to contain spills.
- Use vapor recovery nozzles with automatic shutoffs to control drips as well as air pollution.

9 Waste Management

- Collect concrete and wash water in concrete washout facilities, especially when operations are near water resources. Containers must be adequately sized to handle solids, wash water and possible rainfall.
- Choose smaller, covered containers and more frequent collection.
- Do not allow waste to accumulate on-site.
- Separate recyclable materials from waste and keep covered.
- Conduct visual inspections of dumpsters and recycling bins, removing contaminants and keeping containers covered.
- Stockpile processed materials on-site separately. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

10 Fugitive Dust Suppression

- Apply water on haul roads.
- Haul materials in properly tarped or sealed containers.
- Restrict vehicle speeds to 10 mph.
- Cover excavated areas and material after excavation activity ceases.
- Reduce the excavation size and/or number of excavations.
- Water-down equipment and excavation faces.

Environmental

BEST MANAGEMENT PRACTICES

for Construction Sites

Pollution Prevention

Pollution Prevention & the Construction Site

Are you involved in construction projects? Are you an owner, developer, contractor, subcontractor, architect, construction manager, or design engineer? If so, this guide is for YOU to help prevent pollution at the construction site. While the guide can be used during all stages of construction projects, the best time to begin using this guide is BEFORE a project is bid.

Pollution Prevention (P2) is about reducing the amount of any hazardous substance, pollutant, or contaminant released into the environment in order to reduce the hazards to public health and the environment. Pollution Prevention is also about preserving resources through wise use.

Most regulations tell you what you have to do to be in compliance, but they don't explain how to do it. That's where "best management practices," or BMP, come into play. BMP are proven methods that help you to get into compliance and stay there while minimizing waste that can result in cost savings to you!

The Division of Water Quality has modified the U.S. Environmental Protection Agency's (EPA) electronic Stormwater Pollution Prevention Plan (SWPPP) template to fit the needs of Notice of Intent (NOI) applicants in Utah. The template is designed to help guide you through the SWPPP development process and help ensure that your SWPPP addresses all the necessary elements stated in your construction general permit. You can find the DWQ template at:

www.waterquality.utah.gov/UPDES/stormwatercon.htm

Use this guide to start a dialogue with all responsible parties involved to ensure that the requirements are met.

UTAH Department of Environmental Quality
195 North 1950 West
Salt Lake City, Utah 84114-4810
Phone: 801-536-4400

Construction and Best Management Practices

Preconstruction & Planning

The prebid period is the best time to plan Pollution Prevention into your project. You will find that this type of planning will help you conserve resources, reduce your pollution and clean-up costs, and avoid enforcement action–all resulting in cost savings to you!

The best time to begin identifying BMPs is before a project is bid. Remodeling and repair work requires special considerations to ensure worker safety and environmental protection.

Good Housekeeping
- ☐ Environmental Management System (EMS)
- ☐ Traffic Plan and Haul Routes
- ☐ Noise Suppression

Waste & Material Management
- ☐ Material Storage
- ☐ Portable Toilets
- ☐ Recycling of Materials
- ☐ Waste Disposal

Environmental Compliance & Permitting Requirements
- ☐ General Storm Water Permit for Construction Sites
- ☐ Fugitive Dust Control Plan
- ☐ Water Source Protection, Stream Alterations, and Wetlands
- ☐ Waste Oil Recycling
- ☐ Hazardous Waste and Materials

Washdown Areas
- ☐ Vehicles and Equipment
- ☐ Concrete Washout Area
- ☐ Dust Suppressant Watering

Note: Call Utah DWQ at 1-801-536-4300 for assistance, or, to report an environmental emergency, call the DEQ Hotline at:

1-800-458-0145

Mobilization & Site Preparation

Good site preparation will save you both time and money during the course of the project.

Good Housekeeping
- ☐ Establish Jobsite Standard Operating Procedures
- ☐ Water Source Protection
- ☐ Minimize Fugitive Dust

Site Stabilization
- ☐ Preservation of Existing Vegetation
- ☐ Stabilized Construction Entrance / Track-out Pad
- ☐ Sequential Clearing
- ☐ Dust Suppression and Controls / Limit Access Points

Vehicle & Equipment Management
- ☐ Washdown Areas
- ☐ Equipment Fueling and Containment
- ☐ Equipment Cleaning

Waste & Materials Management
- ☐ Material Separation and Recycling
- ☐ Waste Disposal and Management
- ☐ Portable Toilets ☐ Spill Prevention and Containment

Construction Operations & Maintenance

It takes constant vigilance to make sure that BMPs are maintained and operating correctly.

Good Housekeeping
- ☐ BMP Inspection and Maintenance

Site Stabilization
- ☐ Grading and Compaction
- ☐ Construction Road Stabilization
- ☐ Dust Suppression and Controls
- ☐ Erosion Control Blankets
- ☐ Filter Strips ☐ Mulching
- ☐ Seeding and Planting

Vehicle & Equipment Management
- ☐ Washdown Areas
- ☐ Equipment Fueling and Containment
- ☐ Equipment Cleaning
- ☐ Diesel Engine Emissions, Control

Waste & Materials Management
- ☐ Concrete Waste Management
- ☐ Earth Berm Barrier
- ☐ Material Use and Recycling
- ☐ Spill Prevention and Cleanup
- ☐ Waste Containment and Disposal
- ☐ Hazardous Waste Management

Erosion & Run-off Control
- ☐ Check Dams ☐ Benching
- ☐ Diversion Dikes ☐ Slope Drains
- ☐ Temporary Stream Crossings
- ☐ Stormdrain Inlet and Outlet Protection
- ☐ Surface Roughening
- ☐ Silt Fencing ☐ Sediment Traps
- ☐ Vegetative Buffers
- ☐ Straw Bale, or Sand Bag Barriers

Site Cleanup & Restoration

Strive to leave the construction site better than it was when you arrived.

Final Site Stabilization
- ☐ Erosion Control Blankets
- ☐ Filter Strips
- ☐ Mulching
- ☐ Seeding and Planting
- ☐ Restoration of Existing Vegetation

Waste & Materials Management
- ☐ Materials Reuse and Disposal
- ☐ Cleanup and Final Site Reclamation
- ☐ Waste Characterization, Containment, and Disposal

APPENDIX I

INDUSTRIAL SWPPP

Storm Water Pollution Prevention Plan Template

for Storm Water Discharges Associated with Industrial Activities (12-15)

STATE OF UTAH, DEPARTMENT OF ENVIRONMENTAL QUALITY, DIVISION OF WATER QUALITY

195 North 1950 West, P.O. BOX 144870, SALT LAKE CITY, UTAH 84114-4870

This template has been developed to assist facilities in Utah comply with the requirements under Utah's National Pollutant Discharge Elimination System (NPDES) general permit and the requirements for specific industrial sectors (Appendix II). This template is not a substitute for general permit or specific Appendix II requirements. Facilities in Utah that are commonly required to have Storm Water Pollution Prevention Plans (SWPPPs) are mines (including gravel pits), facilities that produce cement products, many wood product facilities, airports, auto salvage, transportation facilities, bulk fueling stations, manufacturing facilities, and scrap recycling facilities. Coverage is dependent on the facility's Standard Industrial Classification (SIC) Code. A complete list of the SIC codes required to obtain permit coverage as well as the SIC specific requirements can be found by selecting Storm Water on the Division of Water Quality's website at: www. waterquality.utah.gov. Upon request, the permittee is required to submit a Notice of Intent and a signed SWPPP to the operators of a municipal separate storm sewer system (MS4) receiving discharges from the permittee's site. The permittee is required to allow inspection and entry by an authorized representative of the municipal operator or the MS4 receiving discharges from the permittee's site. The permittee is also required to submit signed copies of discharge monitoring reports to the operator of a large or medium (serving populations of 100,000 or more) Phase I municipal separate storm sewer system (MS4) receiving discharges from the permittee's site.

A. Facility/Operator Information

1. Name: PROMONTORY POINT RESOURCES, LLC 2. Phone: |_|_|_|_|_|_|_|_|_|_|

3. Mailing Address a. Street: 32 EAST EXCHANGE PLACE, SUITE 100

b. City: SALT LAKE CITY c. State: UT d. Zip Code: 84111

B. Facility/Site Location Information

1. Facility Name: PROMONTORY FACILITY LANDFILL

2. a. Street Address: SE PROMONTORY ROAD

b. City: UNINCORPORATED c. County: BOX ELDER

d. State: UT e. Zip Code: NA

3. Is the facility located on Indian Lands? No X

4. a. Latitude: 41° 12' 58" N b. Longitude: 112° 28' 22" W

5. a. Was the facility or site previously covered under a UPDES storm water permit? No X

b. If yes, enter UPDES Permit number: ______________________________

6. a. SIC/Activity Codes: Primary: 4953 Secondary (if applicable): 3714

C. Contact Information/Responsible Parties

1. **Facility Operator**: PROMONTORY POINT RESOURCES, LLC

2. a. Street Address: 175 S MAIN STREET, SUITE 300

b. City: SALT LAKE CITY c. County: USA

d. State: UT e. Zip Code: 84111

3. Telephone Number: |_|_|_|_|_|_|_|_|_|_|

4. **Facility Owner**: SAME AS FACILITY OPERATOR

5. a. Street Address: |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

b. City: |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| c. County: |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

d. State: |_|_| e. Zip Code: |_|_|_|_|_|_|_|_|_|_|

3. Telephone Number: |_|_|_|_|_|_|_|_|_|_|

D. Storm Water Pollution Prevention Team

Use the following table to identify the staff members that comprise the facility's storm water pollution prevention (P2) team as well as their individual responsibilities.

Name and Title	Responsibility

E. Industrial Activity and Associated Pollutants

Use the SWPPP Worksheet for a comprehensive list of industrial activities exposed to storm water and storm water runoff and the pollutants or pollutant constituents (e.g., motor oil, fuel, battery acid, and cleaning solvents) associated with these activities. Refer to List of Treatment and Pollution Prevention BMP for more information.

F. Site Map

Include a map showing the following information:

- Property boundaries;
- Buildings and impervious surfaces;
- Directions of storm water flow (use arrows);
- Locations of structural control measures;
- Location and name of the nearest defined drainage(s) which could receive runoff from the facility, whether it contains water or not;
- Locations of all storm water conveyances including ditches, pipes, and swales;
- Locations where the following activities are exposed to storm water:
  - -Fixed fueling operations;
  - -Vehicle and equipment maintenance and/or cleaning areas;
  - -Loading/unloading areas;
  - -Waste storage or disposal areas;
  - -Liquid storage tanks;
  - -Process and equipment operating areas;
  - -Storage or disposal areas for significant materials;
  - -Immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste materials, or by-products used or created by the facility;
- Locations where significant spills or leaks have occurred;
- Locations of all analytical and visual storm water monitoring points;
- Locations of storm water inlets and outfalls, with a unique identification code for each outfall and an approximate outline of the areas draining to each outfall;
- Municipal separate storm sewer systems, where your storm water discharges to them;
- Locations of all non-storm water discharges;
- Locations of sources of run-on to your site from adjacent property.

G. Inventory of Exposed Materials

-Refuse
-Leachate
-Oil & Grease
-Fuel
-Dust

Use the following table to provide an inventory of the types of materials handled at the site, during the previous 3 years to the present that potentially may be exposed to precipitation.

Description of Materials	**Location**	**BMPs Used to Minimize Contact with Storm Water Runoff** (Ex: cover with tarps, store materials outside of drainage pathways, etc.)	**Control Measures Used to Reduce Pollutants in Storm Water Runoff** (Ex: oil-water separators, detention/retention ponds, etc.)
Refuse	Working Face.	Waste Management. Storm Drain Inlet Protection. Detention Basin.	Interim and daily cover of refuse. Tarps if needed. Channelize run-on to divert flows away from working face. Place wind screen downwind of operations. Clear channels and drainage paths from wind blown litter. Maintain detention basin on regular basis.
Leachate	Leachate Collection Station.	Secondary Containment. Employee Training. Good Housekeeping.	Secondary containment pad and collection sump. Training for employees to ensure good housekeeping practices.
Oil & Grease	Maintenance Building. Parking Areas. Drive Aisles.	Vehicle/Equipment Maintenance. Covered Storage. Clean Paved Surfaces. Spill Response.	Locate vehicle maintenance materials under covered storage to eliminate contact with stormwater. Sweep and clean parking and drive aisles on a regular basis. Train employees proper spill response procedures.
Fuel	Fueling Station.	Secondary Containment. Spill Response.	Locate fueling area in secondary containment storage area. Train employees proper spill response procedures.
Dust	Haul Road and Access Roads.	Fugitive Dust Suppression.	Water truck to perform dust suppression during dry or windy conditions to prevent fugitive dust emissions from haul road and access points around the site. Site speed limit of 10 mph.

H. Spills and Leaks

Use the following table to provide a list of any significant (25 gallons or more) spills and leaks of oil or hazardous pollutants, that occurred in the prior 3 years, and resulted in a discharge of pollutants in storm water runoff from the permittee's property. Significant spills and leaks are required to be reported to DEQ.

Date	**Description**	**Outfalls**

I. Non-Storm Water Discharges

Use the following table to summarize your non-storm water discharge evaluation results. Examples of non-storm water discharges include: discharges from firefighting activities; fire hydrant flushings; external building washdown that does not use detergents or other compounds, etc.

Date	**Outfall**	**Method** (e.g., visual, smoke test, die test)	**Evaluator**	**Observations**	**Date Corrected**

J. Storm Water Discharge Monitoring Report

Attached is DWQ's Storm Water Discharge Monitoring Report.

K. Employee Training

Use the following table to summarize your plan for training the employees who work in areas where industrial materials or activities are exposed to storm water, or who are responsible for implementing activities necessary to meet the conditions of this SWPPP, including all members of P2 team. Training should be conducted at least one time per year.

Date	Trainer	Topic(s) (Examples: spill response, good housekeeping, material management practices, etc.)	Attendees

L. SWPPP Certification and Certification of Evaluation of Non-Storm Water Discharges

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. I certify under penalty of law that the storm water drainage system in this SWPPP has been tested or evaluated for the presence of non-storm water discharges either by me, or under my direction and supervision. And at the time this plan was completed no unauthorized discharges were present. Based on my inquiry of the person(s) who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to 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 or imprisonment for knowing violations.

Name:_____ **Title:**_____

Signature: _____ **Date:** _____