GOLDER

REPORT

Engineering Design and Operations Plan

Jackson County Landfill

Jackson County, Colorado

COLORADO LICENSED PROFESSIONAL ENGINEER
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1/11/21

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19124320-6-R-2

January 2021

Record of Issue

Document Number	Revision	Date Issued
19124320-6-R-0	Revision 0	July 24, 2020
19124320-6-R-1	Revision 1	July 31, 2020
19124320-6-R-2	Revision 2	January 8, 2021

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1.0 SIGNATURE BLOCK

Jackson County acknowledges that compliance with this Engineering Design and Operations Plan (EDOP) is required, and that the provisions of this EDOP are enforceable by the Colorado Department of Public Health and Environment (CDPHE), under Colorado's Solid Waste Act and Regulations. While this EDOP is intended to capture all of the requirements under the Solid Waste Act and Regulations, Jackson County is aware that other environmental regulations, such as air quality and water quality regulations, as regulated by the Water Quality Control Division (WQCD) and Air Pollution Control Division (APCD), respectively, also apply.

____________________________ ______________

Name, Title Date

____

Organization Name for Owner

____________________________ ______________

Name, Title Date

____

Organization Name for Operator

2.0 DEFINITIONS

Air Pollution Control Division (APCD): the division of the CDPHE responsible for issuance of burn permits.

Alternative daily cover (ADC): other non-soil materials approved by the CDPHE for use as daily cover on a site-specific basis.

Asbestos: the asbestiform varieties of serpentinite (chrysotile), riebeckite (crocidolite), amosite (cummingtonite-grunerite), anthophyllite, actinolite, and tremolite.

Asbestos-containing material (ACM): any material that contains more than 1% asbestos.

Asbestos waste: any ACM, whether it contains friable or non-friable asbestos, that is not intended for further use. This term includes, but is not limited to, asbestos mill tailings, asbestos from pollution control devices, and containers that contain asbestos.

Certificate of designation (CD): a document issued by the governing body having jurisdiction authorizing the use of the land as a solid waste disposal site and facility pursuant to the Solid Waste Act.

Department: the CDPHE Hazardous Materials and Waste Management Division, Solid Waste and Materials Management Program. In those instances where reference is being made to other CDPHE authorities, such as the Water Quality Control Division (WQCD) and Air Pollution Control Division (APCD), those divisions will be specified.

Owner/operator: the entity that owns or operates the solid waste disposal site and facility.

Engineering Design and Operations Plan (EDOP): the “Engineering Design and Operations Report” as that term is used in the Solid Waste Act and Section 3 of the Solid Waste Regulations. “Engineering Design and Operations Plan” is the term commonly used by the regulated community and regulators when referring to the information required by the Department pursuant to the Solid Waste Act, C.R.S. § 30-20-103(1), CRS. The abbreviation, EDOP, is in common usage as well. The EDOP includes all attachments and any stand-alone plans approved by the Department.

Friable asbestos-containing material (friable ACM): any material that contains asbestos, and when dry can be crumbled, pulverized, or reduced to powder by hand pressure and that contains more than 1% asbestos by weight, area, or volume. The term includes non-friable forms of asbestos after such previously non-friable material becomes damaged to the extent that when dry can be crumbled, pulverized, or reduced to powder by hand pressure as determined in the field by a certified asbestos building instructor (CABI).

Friable asbestos waste: any asbestos waste that has been or can be pulverized or reduced to powder by hand pressure when dry.

Leak tight: such that solids, liquids, or gases cannot escape or spill out. Leak tight also indicates dust tight in this document.

Non-friable asbestos waste: any asbestos waste other than friable asbestos waste.

Non-regulated asbestos-contaminated soil (Non-RACS): soil or debris that contains only:

1) Intact non-damaged, non-friable ACM; or

2) Damaged non-friable ACM(s) that do not have a high probability to release fibers based on the forces expected to act upon the material during disturbance as determined in the field by a CABI(s) through a "RACS determination." The following ACM(s) are predetermined to be Non-RACS:

   a. Resin-based materials, including, but not limited to, phenolic plastic (bakelite), used in electrical and mechanical parts

   b. Resilient flooring (vinyl, asphalt, rubber) excluding non-tar-impregnated friable felt backing on sheet vinyl flooring (linoleum)

   c. Tar impregnated or asphaltic materials in good condition that have not become brittle

   d. Elastic, pliable, or rubberized materials, including, but not limited to:

      i. Pliable duct sealant

      ii. Pliable fiberglass insulation sealant

      iii. Pliable fire-stop caulking/sealants

      iv. Pliable window and door caulking

   e. Extremely hard materials, coatings, and sealants, including, but not limited to:

      i. Laboratory countertops and sinks

      ii. Epoxy-type concrete masonry unit (CMU) coatings

      iii. Epoxy type panel adhesive

      iv. Duct sealant

      v. Ceiling tile adhesive

   f. Other ACM(s) as approved by the Department at the request of the owner or person disturbing debris, to not have a high probability to release fibers.

Regulated asbestos-contaminated soil (RACS): soil, ash, or debris (plus six inches in all directions of surrounding soil or other matrix material) containing:

1) Friable ACM as determined in the field by a certified asbestos building inspector (CABI) through a RACS determination

2) Previously non-friable ACM(s) that have been rendered friable as determined in the field by a CABI(s) through a RACS determination

3) Non-friable ACM(s) that have a high probability of releasing fibers based on the forces expected to act upon the material during soil disturbance as determined in the field by a CABI(s) through a RACS determination

4) Deteriorated non-friable ACM(s) that are in poor condition resulting in a high probability to release fibers due to weathering, historical mechanical impact, fire damage (by evidence of ACM within an ash layer), or other factors as determined in the field by a CABI(s) through a RACS determination

5) The following broken, resized, or damaged ACM(s) are RACS:

    a. Asbestos cement materials
    b. Plaster
    c. Brittle caulking, glazing, and sealants
    d. Powdery CMU sealant
    e. Powdery floor leveling compound
    f. Drywall/wallboard and associated joint compound material
    g. Firebrick
    h. Other material as determined by the Department, at the request of the owner or person disturbing debris, to have a high probability to release fibers

6) Soil or ash known to contain non-visible asbestos based on documented evidence

Solid Waste Act: the Solid Wastes Disposal Sites and Facilities Act, C.R.S. 30-20-100.5 *et. seq.*

Solid Waste Regulations: the Regulations Pertaining to Solid Waste Sites and Facilities, 6 CCR 1007-2, Part 1.

Working face: that portion of a facility for solid waste disposal where solid wastes are actively unloaded, placed, compacted and covered at any time of operation.

3.0 SCOPE AND PURPOSE AND GENERAL PROVISIONS

This EDOP is for the Jackson County Landfill (JCL) and its purpose is to describe the design and operations of the JCL so the facility can meet the requirements of the Solid Waste Act and Regulations. This plan was developed primarily based on the CDPHE template for the small rural landfill sector, which is specifically for sites already permitted under a previous certificate of designation application. Because Jackson County does not have a permitted landfill, the CDPHE template does not include certain sections that are necessary for a new site undergoing its original application and permitting. For the JCL, this EDOP includes additional sections to address that missing information as follows:

- Geologic and Hydrologic Data, Geotechnical Investigation Summary, and Location-Specific Standards Compliance (Section 5.0)
- Environmental Monitoring Plan (Appendix C)
- Asbestos Management Plan (Appendix B)

Section 5.0 will provide information on siting criteria and site characterization relating to site soils, lithology, characteristics of the uppermost aquifer, etc., and will include the pertinent findings from the recently completed Geotechnical Investigation (Appendix H). The Environmental Monitoring Plan will address the procedures needed to monitor groundwater and landfill gas at the site to be compliant with the Regulations. The Asbestos Management Plan will be used to allow for asbestos waste to be disposed at the site in a manner compliant with applicable regulations and to keep the public and JCL safe.

The Plan is enforceable under the CD per Section 1.3.9 of the Solid Waste Regulations and §30-20-113(1), CRS. The Department may revise the EDOP or approve revisions proposed by the owner/operator without requiring issuance of a new CD, so long as such revisions do not conflict with the CD.

3.1 Owner and Operator Information

Facility Name: Jackson County Landfill

Owner(s): Jackson County, Colorado

Operator: Jackson County, Colorado

Contact person(s): county manager, (970) 723-4660

Owner contact: county manager

Operator contact: Ed Downing, (970) 723-4660

3.2 Facility Location and Hours of Operation

Physical Address: 651 County Road 51 A, Walden, Colorado 80480

Mailing Address: P.O. Box 1019, Walden, Colorado 80480

Metes-and-Bounds Survey (legal description of certificate of designation boundary):

> A portion of the N1/2 of the SE1/4 of Section 9, T. 9 N., R. 79 W., 6th PM, Jackson County, Colorado, more particularly described as follows:
>
> Commencing at the Point of Beginning a found GLO brass cap stamped 1933 at the true point for the 1/4 between Sections 9 and 10; thence along the line between Sections 9 and 10 South 00°40'04" West, a distance of 1,332.31 feet to a found rebar with red plastic cap stamped “PLS2903” at the true point for the S 1/16 between Sections 9 and 10; thence along the northerly line of the S1/2 of the SE1/4 of Section 9 South 89°46'45" West, a distance of 2,665.32 feet to a point witnessed by a found rebar with red plastic cap found 13.1' northerly on the north-south mid-section line of Section 9; thence on the north-south mid-section line of Section 9 North 00°31'33" East, a distance of 312.97 feet; thence South 89°28'27" East, a distance of 600.00 feet; thence North 00°31'33" East, a distance of 600.00 feet; thence North 89°28'27" West, a distance of 600.00 feet; thence on the north-south mid-section line of Section 9 North 00°31'33" East, a distance of 426.90 feet to a found rebar with aluminum cap stamped “PLS24303” at the true point for the C1/4 of Section 9; thence along the northerly line of the N1/2 of the SE1/4 of Section 9 North 89°56'32" East, a distance of 2,668.53 feet to the Point of Beginning.
>
> Containing 73.53 Acres, more or less.
>
> BASIS OF BEARINGS MEASURED BETWEEN FOUND MONUMENTS FOR THE EASTERLY LINE OF THE SE1/4 OF SECTION 9 AT N00°40'04"E.

A map of the property boundary is provided in Appendix G.

The hours of operation will be 7:30 a.m. to 12:00 p.m., 1:00 p.m. to 5:00 p.m. Tuesday through Friday; and 9:00 a.m. to 3:00 p.m. on Saturday.

3.3 Facility Type and Activities

The JCL will be primarily a municipal solid waste landfill. In addition, the facility will serve as a waste tire collection facility, and a drop off location for recyclable steel, electronics, car batteries, and recycling. Finally, the site will collect slash (yard waste, tree branches, and clean wood) for burning during the winter.

3.4 Waste Streams Accepted

The landfill will accept only household waste, construction debris, and commercial waste. See Section 7.0 for a more detailed description of acceptable and prohibited wastes.

3.5 Facility Personnel

The owner/operator will employ a facility manager authorized to take action on behalf of the facility to ensure compliance with the Solid Waste Regulations. The facility manager is Ed Downing, (970) 723-4660.

The facility is always attended during times when the facility is open for receipt of waste. There will be at least one employee on site at any given time during operations: a gate attendant/equipment operator. This employee has the training, authority, and responsibility to oversee the acceptance of waste in compliance with the Waste Characterization Plan (see Section 7.0).

The county manager has overall responsibility for all aspects of environmental compliance with respect to this EDOP and the Solid Waste Act and Regulations. The entire Board of County Commissioners has the ultimate authority and responsibility for the facility. No party or representative from the County shall alter operations, procedures, or policies that directly affect compliance with this EDOP and/or the Solid Waste Act and Regulations.

Table 1: Facility Equipment

No.	Description	Model	Uses
1	310D John Deere 310D loader/backhoe	1997	Earthwork
2	S185 diesel bobcat skid steer	2003	Earthwork, recyclables
3	Compactor (to be purchased)		Waste moving and compaction
4	Tanker (to be purchased)		Water supply for site

3.6 Modifications

The Department may make modifications to this EDOP at any time during the life of the facility, including during the post-closure care period.

The facility owner/operator can request a modification to this EDOP at any time. Modifications are effective only on Department approval.

3.7 Renewal

This EDOP shall be effective for a term not to exceed 10 years. The owner/operator must conduct a review of this EDOP to ensure that all of its provisions remain current. No later than 90 days prior to the expiration of the effective term, the owner/operator must submit a revised EDOP reflecting current site conditions to the

Department for review and approval. The prior plan will remain in effect while the Department is conducting its review of the revised EDOP. In addition, the Department may require updates or modifications to this EDOP.

3.8 Expiration

The expiration date for this Plan is July 2030.

3.9 Transfer of Owner or Operator or Revocation

This EDOP will be issued to the owner and operator listed on the CD. Change to the entity listed on the CD requires issuance of a new or revised EDOP prior to the change in ownership or operation of the facility by a new entity. Neither changes to the owner or operator in the EDOP, nor changes to the CD, relieve any responsible party of the obligation to comply with all provisions of the approved EDOP. In the event that the CD is revoked, the facility will cease acceptance of waste, but other provisions of this EDOP remain in effect, including, but not limited to, obligations related to financial assurance, monitoring, contingency, closure, and post-closure care.

4.0 FINANCIAL ASSURANCE

In accordance with Section 4 of the Solid Waste Regulations, the owner/operator will establish financial assurance, subject to Department approval, prior to commencing operations, and will maintain financial assurance throughout the operating life of the facility, and for the duration of the post-closure care period. Financial assurance will be established to cover the costs of closure, post-closure care, and corrective action (if necessary). The owner/operator will comply with Section 4 of the Solid Waste Regulations. Financial assurance coverage will be provided continuously until a release is granted by the Department.

4.1 Cost Estimates

The owner/operator will maintain written closure and post-closure care cost estimates for purposes of financial assurance that are subject to approval by the Department in accordance Section 4 of the Solid Waste Regulations. These estimates will be based on the cost of completing the closure and post-closure care activities described in Sections 12.0 and 13.0 of this EDOP, respectively, and provided under separate cover to the CDPHE. Cost estimates for corrective action will also be prepared, if required by the Department, and are also subject to Department approval. The owner/operator will prepare these estimates using current unit costs for hiring a third party to complete the activities. Third-party costs will not be estimated on the basis of costs provided by a parent company to a subsidiary, or vice versa. The estimate will assume closure of the largest area of the facility requiring closure in the next five years or when the extent and manner of the operation would make closure the most expensive. The estimate will be detailed and provide assumptions for volumes, areas, distances, number of events, etc., and the reference materials used for developing the unit costs.

These comprehensive cost estimates for closure, post-closure, and corrective action will be updated and resubmitted every five years. The owner or operator will submit the closure, post-closure, and any corrective action cost estimates, and all annual, five-year revised cost estimates, or other revisions, to the Department and the local governing authority.

4.2 Annual Update

The owner/operator will annually adjust the closure, post-closure, and any corrective action cost estimates for inflation and submit the revised estimate to the Department for approval. The owner/operator will submit the adjusted estimate to the Division and local governing authority by September 1 each year for review and approval. The submittal will include documentation as evidence that adequate funding has been provided, or if the annual adjustment has caused an underfunded financial assurance mechanism, the owner/operator will make up the difference according to Subsection 4.3. The annual submittals and approvals will be retained in the Operating Record.

4.3 Adjustments to Financial Assurance Mechanism

Whenever the current closure, post-closure, and corrective action cost estimates increase to an amount greater than the current amount of the financial assurance mechanism, the owner/operator, within 60 days after the increase, will either increase the value of the mechanism and submit evidence of such increase to the Department and local governing authority or obtain other financial assurance to cover the increase. Any additional financial assurance required following the five-year revision is triggered on the date of the Department's approval of the revised cost estimate.

5.0 GEOLOGIC AND HYDROLOGIC DATA, GEOTECHNICAL INVESTIGATION SUMMARY, AND LOCATION-SPECIFIC STANDARDS COMPLIANCE

5.1 Geologic and Hydrologic Data and Geotechnical Investigation Summary

All portions of the facility design and investigations have been reviewed and sealed by a Colorado professional engineer (PE) or reviewed by a professional geologist (PG), as appropriate.

5.1.1 Geologic Data

The site is underlain by younger gravel-bearing terrace alluvium (upper Pleistocene). This alluvium is characterized by sand and silt overlying pebble to small-cobble gravel containing a few beds and lenses of sand 0.1 to 1 meter (m) thick. These deposits are present at the site and extend to the west along the Michigan River. Most of the gravel is clast supported, is 3 to 15 m thick, and is overlain by a cover of sandy alluvium that is commonly 0.5 to 1.5 m thick. In the area of the site, the unit is associated with a distinct terrace that, in most places, is 8 to 12 m above the main stream and is equivalent to the 12-m terrace described by Eschman (1955, 1957) along the Michigan River.

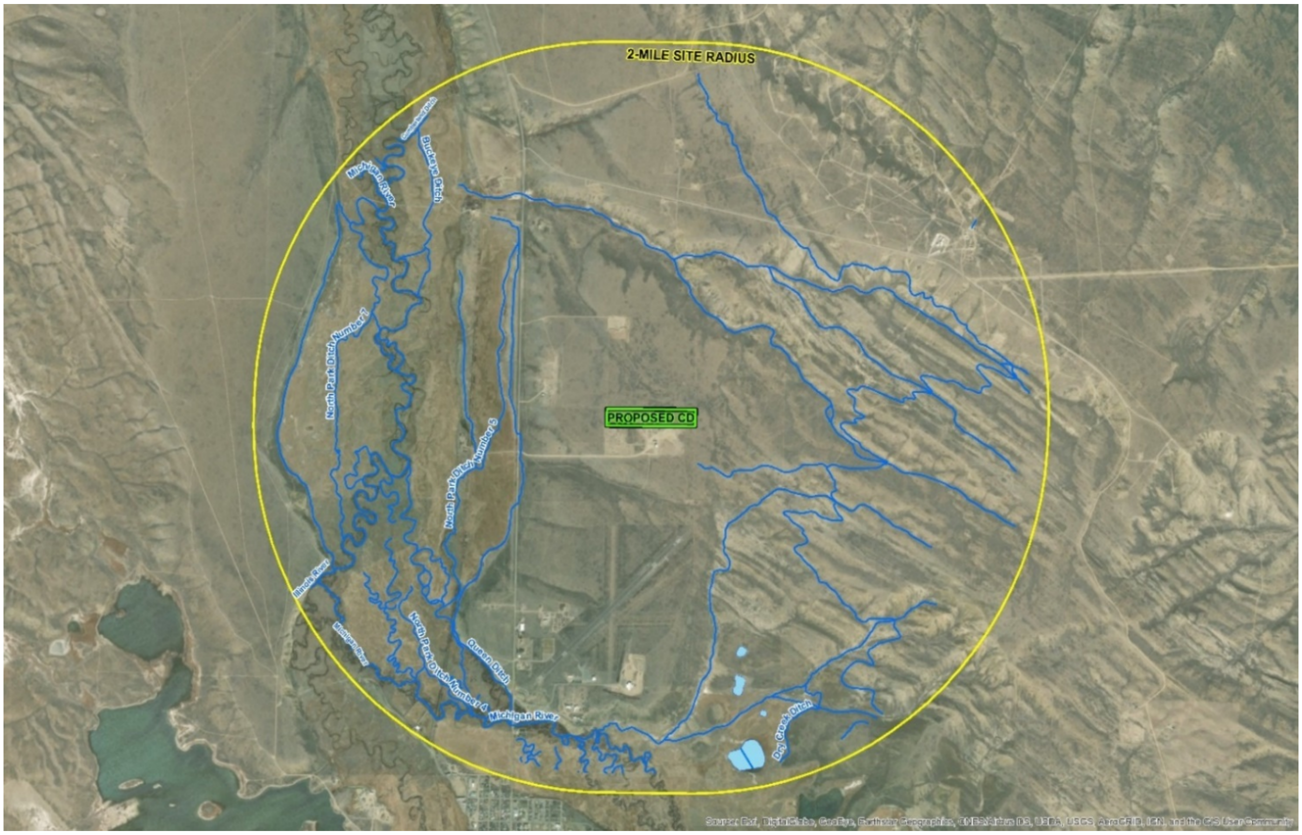
The bedrock underlying the alluvium is Tertiary age and consists of the North Park and White River Formations, which are underlain by the Coalmont Formation. These rock formations consist of volcanic and terrigenous clastic sediments that were derived from the erosion of nearby sedimentary and crystalline rock terrains. These formations lie unconformably upon Cretaceous and older strata in the region. The pre-Tertiary rocks were subjected to considerable tectonic movements and were erosionally bevelled across the region prior to the accumulation of the Tertiary rocks. The North Park and White River Formations and Coalmont Formation are approximately 12,000 feet thick in the North Park area.

The North Park Basin lies obliquely across the axis of the northwest–southeast-trending ancestral Front Range uplift. Palezoic rocks are absent in this paleo highland by erosion or non-deposition except in the extreme northeast part of North Park. The North Park region, since late Cretaceous time, has been subjected to several epochs of compressional and extensional tectonics as well as magmatic intrusive and extrusive events. The Larimide orogeny, between about 70 million years (MY) ago and 40 MY ago, comprises two major compressional events. The early Laramide compression was along a northeast–southwest axis and resulted in northwest–southeast folds and faults. The late Laramide compression was directed east–west and resulted in north–south folds and faults. Subsequent tectonics, principally during Oliogocene and Miocene (about 5 MY to 33 MY ago), have been primarily north–south compression and complimentary east–west extension resulting in faulting that includes some thrusting and folding along approximately east–west trends, and graben and horst formation by normal faulting along approximately north–south trends.

From the literature, inspection of the site and on-site drilling, there appears to be minimal potential for geologic hazards such as faulting and folding (see Section 5.2.3), rock fall, landslides, subsidence, or erosion potential that would affect the design and operation of the landfill. Because the landfill is in an area just above criteria for a seismic impact zone (see Section 5.2.4), calculations to show that the landfill slopes can remain stable during a potential seismic event are included in the calculation package (Appendix I-2 of this EDOP).

5.1.2 Hydrologic Data

The engineering design and operations report shall include, as a minimum, the following hydrological data. The surface water features, including, lakes, rivers, streams, springs, or bogs near the site, are shown in Figure 1. The closest mapped surface water feature is an un-named, mad-made canal/ditch over 1,000 feet southeast of the site. The site is located on an elevated portion of land that is well away from any surface water features that could influence the design and operation of the landfill.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 1: Surface Water Features Near Site

The depth to water at the site is approximately 22 feet to 26 feet below ground surface based on wells drilled at the site. The water table occurs within the weathered upper portion of the bedrock encountered during drilling. Based on on-site data, the first encountered groundwater at this site occurs under unconfined conditions and appear to be a part of the alluvial system that flows along the Michigan River located to the west of the site. The bedrock aquifers beneath the site are a part of the North Park Basin (see Figure 2).

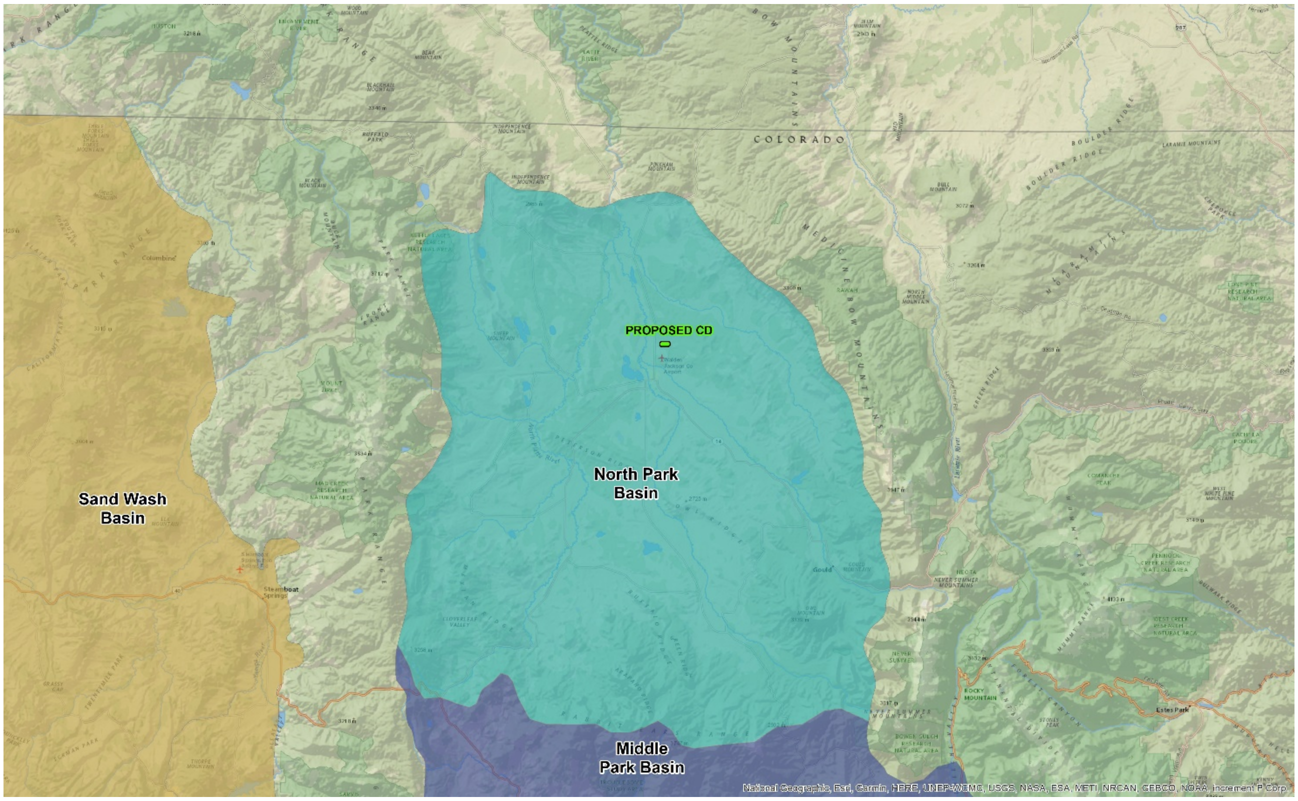


Figure 2: North Park Basin Lateral Extent

The location of wells within one mile of the site are shown in Figure 3. There are five wells and the information on those wells are provided in Table 2.

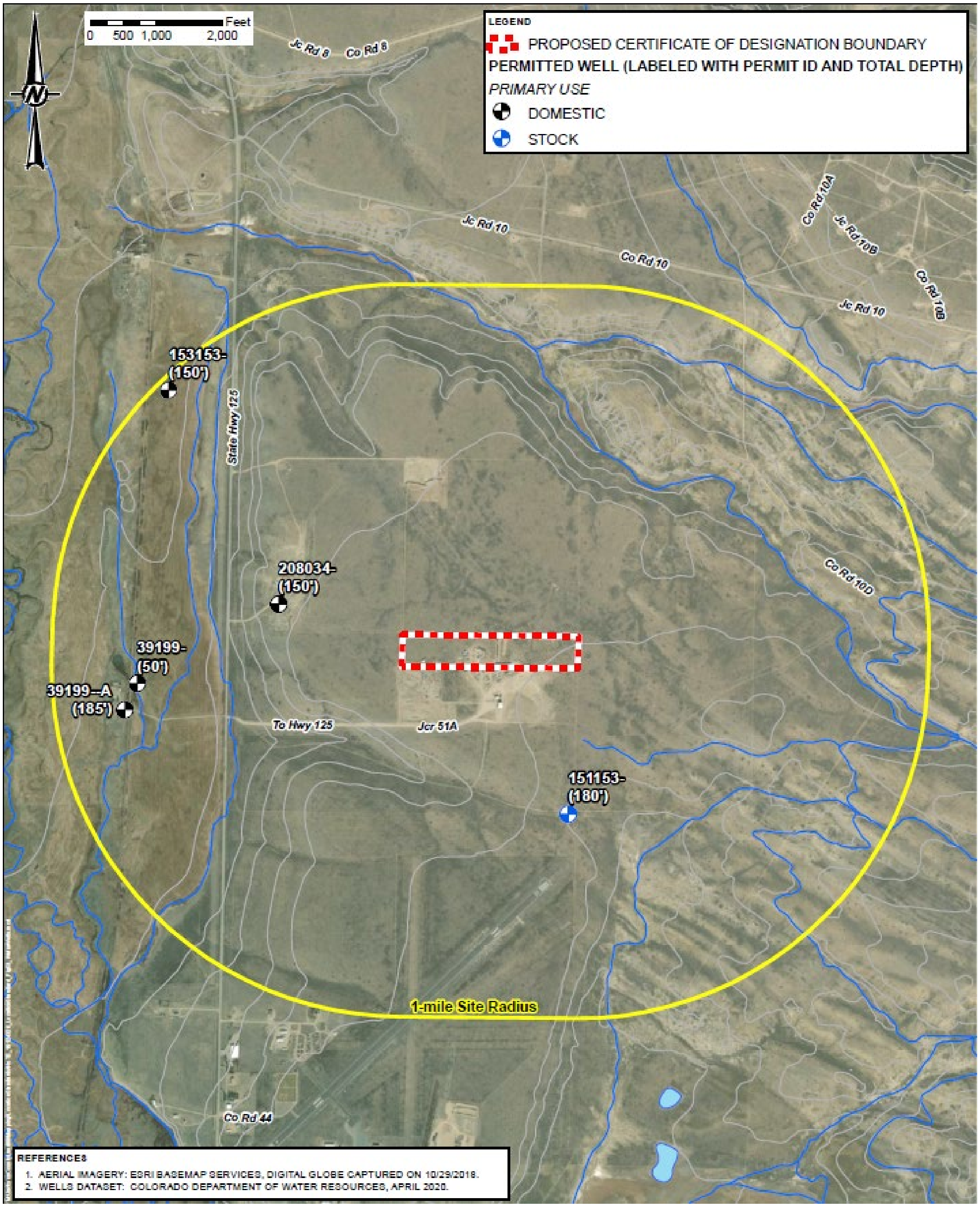


Figure 3: Water Wells within One Mile of Jackson County CD

Table 2: Well Information

Well Permit ID	Well Info Link
151153-	https://dwr.state.co.us/Tools/WellPermits/0287522C
153153-	https://dwr.state.co.us/Tools/WellPermits/0295050
39199-A	https://dwr.state.co.us/Tools/WellPermits/0300311
208034-	https://dwr.state.co.us/Tools/WellPermits/0429165
39199-	https://dwr.state.co.us/Tools/WellPermits/9118853

The materials present in the uppermost aquifer consist mostly unconsolidated sandy material with varying degrees of silt and gravel. The water table is present in the uppermost zone of the bedrock that is weathered sandstone at the site. The water table surface and gradient are shown in the water table map in Figure 4. The permeability of these materials typically range from about 1×10^{-4} to 1×10^{-2} centimeters per second (cm/sec), which results in groundwater flow velocities of .02 to 2 feet per day at gradients of 0.02 feet per feet (ft/ft) and a porosity of 0.3.

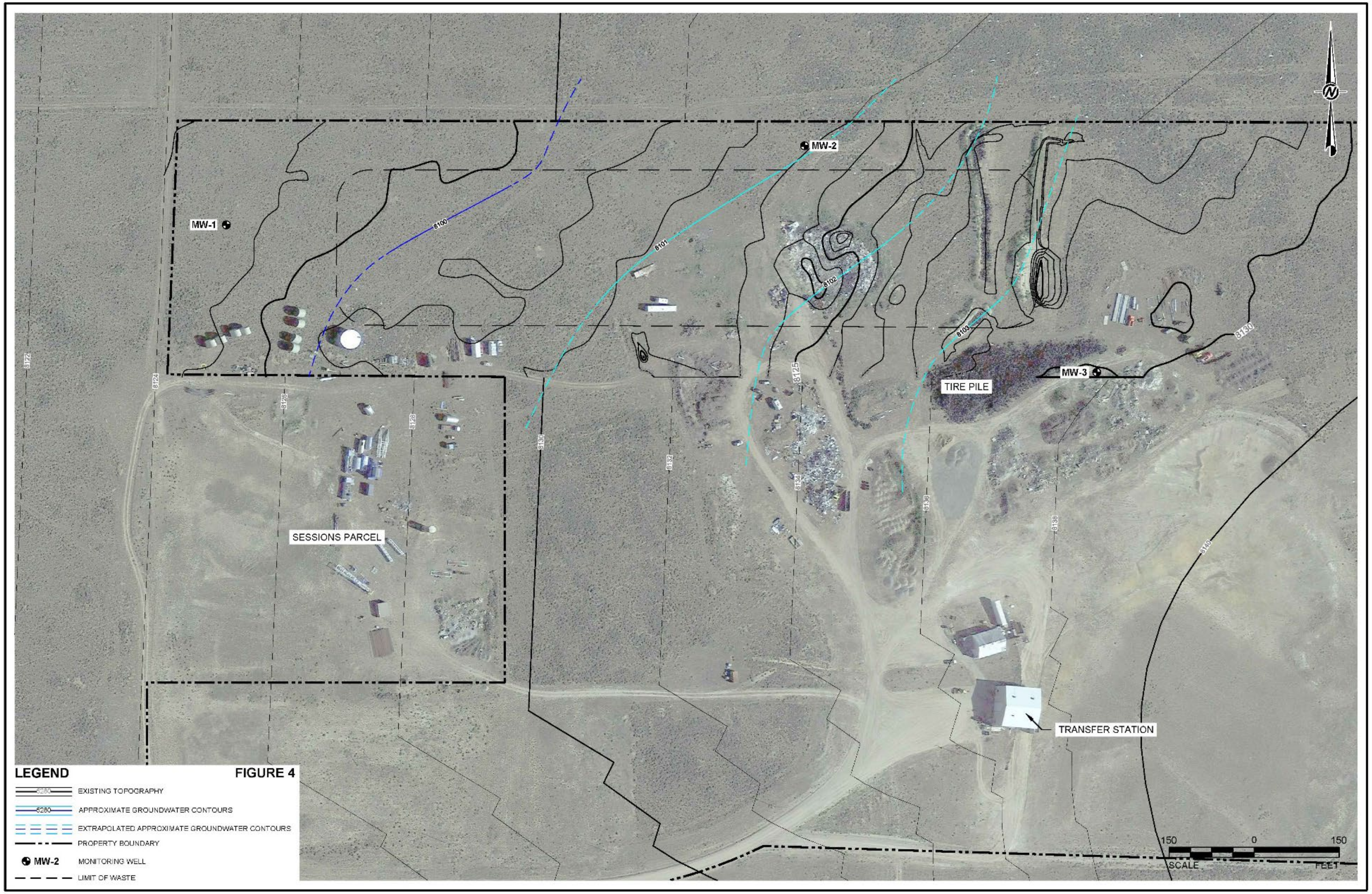


Figure 4: Water Table Map

As discussed in Section 5.2.7 and as shown in Figure 1, the site is well away from significant drainages that could have a floodplain that could impact the design.

5.1.3 Geotechnical Investigation Summary

The geotechnical investigation at the site has consisted of several distinct subsurface investigation activities. These are described in the initial Geotechnical Report and addendum to that report that are provided in Appendix H.

5.2 Location Restrictions and Site Standards

5.2.1 Airport Runway

The landfill will be approximately 3,000 feet from the closest runway at the Walden-Jackson County Airport located to the south of the site (see Figure 5). Because this landfill will accept putrescible wastes, it will be less than the 10,000 feet (3,048 meters) from an airport runway used by turbojet, and less than 5,000 feet (1,523 meters) of an airport runway used by piston-type aircraft. Both turbojet and piston-type aircraft use the airport.

In order to submit reasonable evidence regarding the ability of the landfill to mitigate a bird hazard, Jackson County has developed a Bird Control Plan as provided in Appendix A. This plan is based on, in part, the following:

- Jackson County owns and operates the airport; and
- The airport is infrequently used.

Because of these two factors, the Bird Control Plan is based on coordinating use of the airport with the landfill so that the landfill can take any required actions prior to landing and takeoff of flights in conjunction with ongoing engineering controls to keep birds away from the landfill. The details of this coordination and the actions that will be used as needed to disperse birds at the landfill are provided in Appendix A to mitigate bird hazards. The CDPHE will be notified of the use of the landfill near the airport via this EDOP and the Federal Aviation Administration (FAA) will be notified under separate cover.

Figure 5: Landfill Location Relative to Nearest Airport Runway

5.2.2 Site Location Relative to Wetlands

The facility site is located on an elevated tract of land relative to the surrounding area, and thus has no mapped surface water or wetland features. The closest National Wetland Inventory (NWI) wetland is the riverine wetland that is located greater than 1,000 feet to the southeast of the site (see Figure 6).

Figure 6: Landfill Site Relative to Nearest Wetlands

5.2.3 Location of Site Relative to Faults Active in the Holocene Epoch

The Jackson County Landfill is over 60 miles northeast from the nearest fault active in the Holocene Epoch (see Figure 7); therefore, it meets the minimum offset requirement in the Regulations.

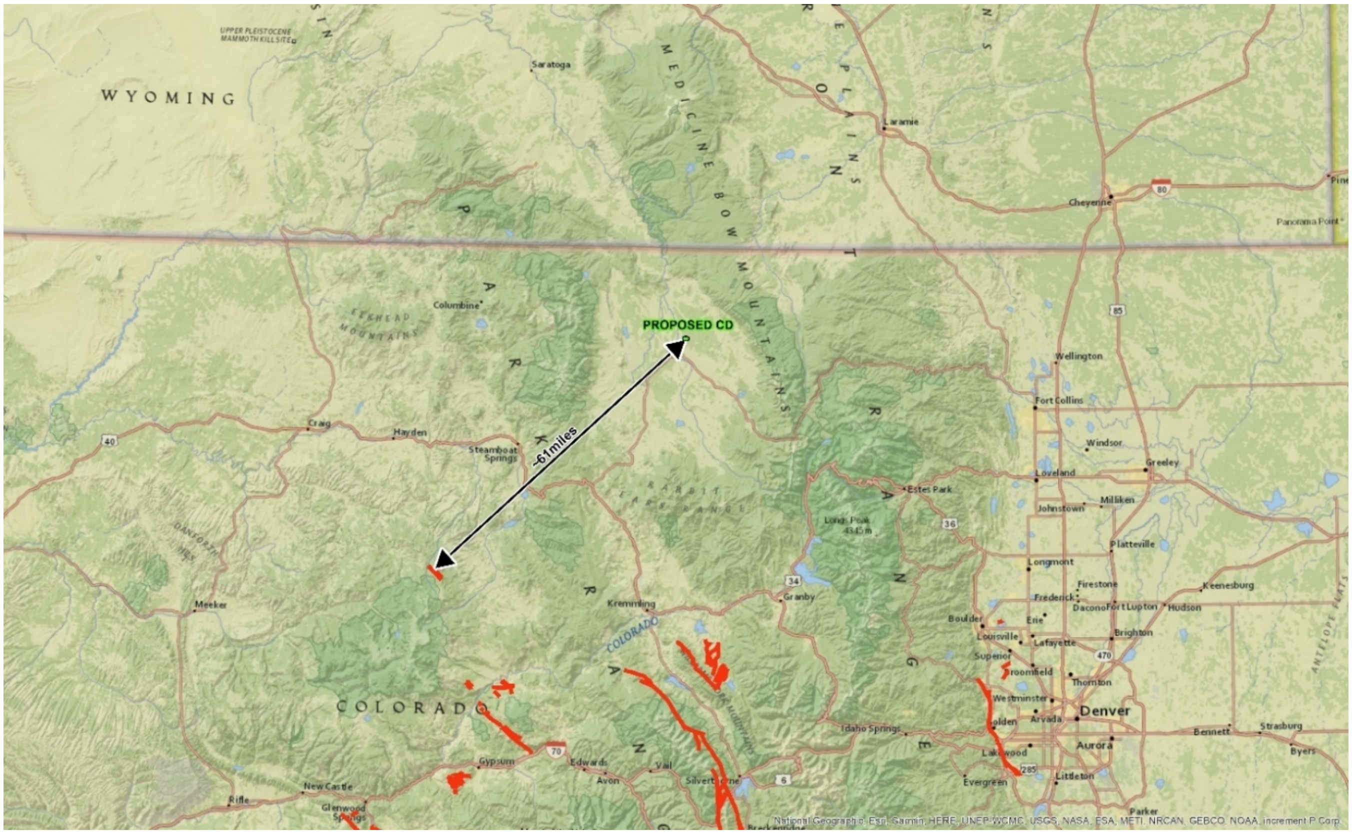


Figure 7: Landfill Location Relative to Nearest Active Holocene Fault

5.2.4 Site Location Relative to Seismic Impact Zones

The site is located just inside a seismic impact zone (an area that has a 10% or greater probability that the maximum horizontal acceleration in lithified earth material will exceed 0.10 g in 250 years, considered equivalent to the 2% probability of exceedance in 50 years) as seen in Figure 8. Calculations have been provided in Appendix I-2 that show that the slopes during landfill construction and closure will be stable (safety factor greater than or equal to 1.0) in this circumstance.

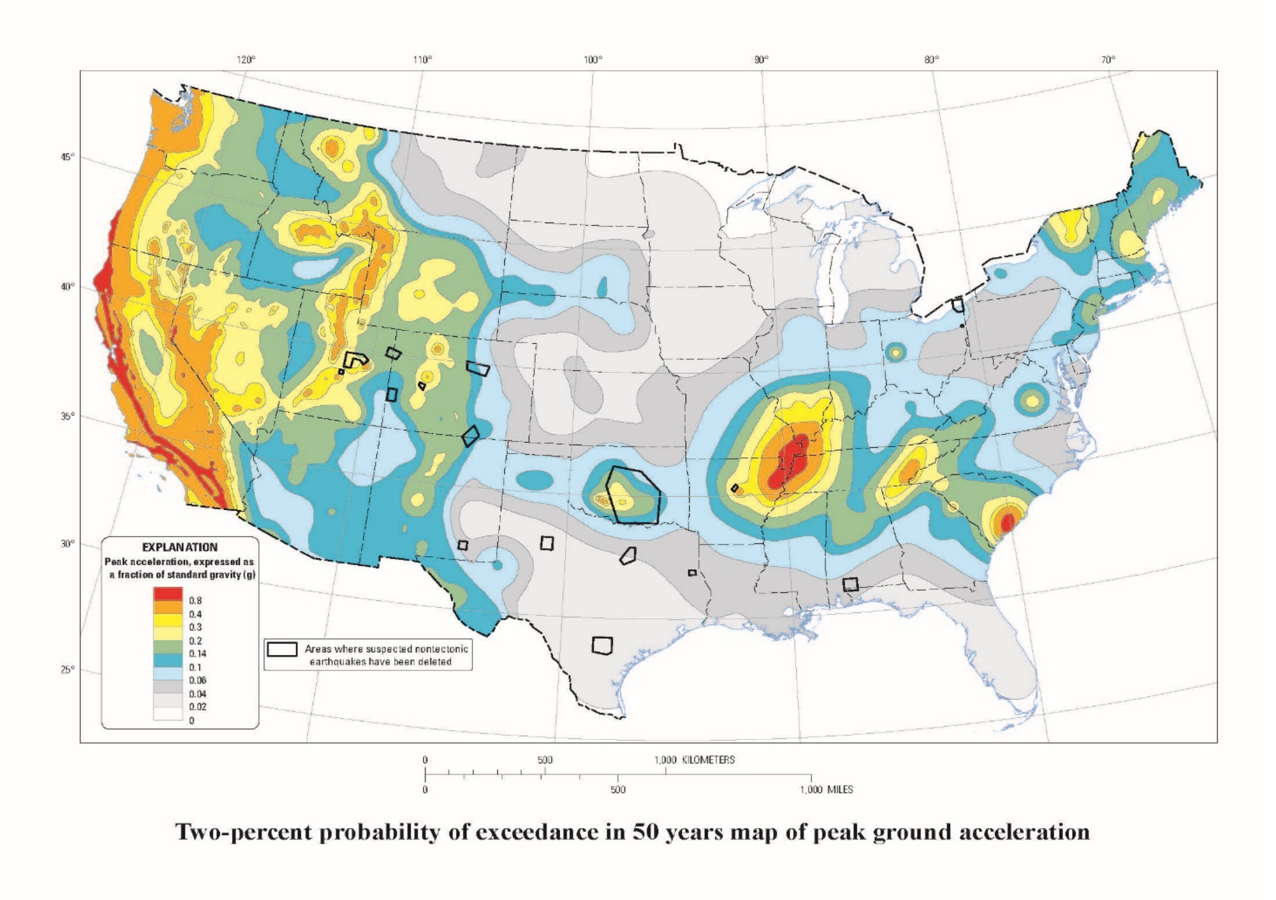


Figure 8: 2014 US Seismic Hazard Long-Term Model (USGS 2019a, 2019b)

5.2.5 Site Location Relative to Unstable Areas

The site is mapped entirely within the Bosler Sandy Loam (see Figure 9), which is underlain by the Younger gravel-bearing terrace alluvium (see Figure 10). The subsurface materials are typically well drained soils of low plasticity to non-plastic, and there is low topographic relief. This is confirmed by logs from on-site drilling during the geotechnical investigation and site inspection. This type of environment will have low susceptibility to differential settling. This data also indicates that there are no known natural geologic or geomorphologic features or that could create unstable conditions for the landfill. From online data and in-person inspection of the site, there are no known man-made features, such as mines, at or near the site that could create unstable conditions.

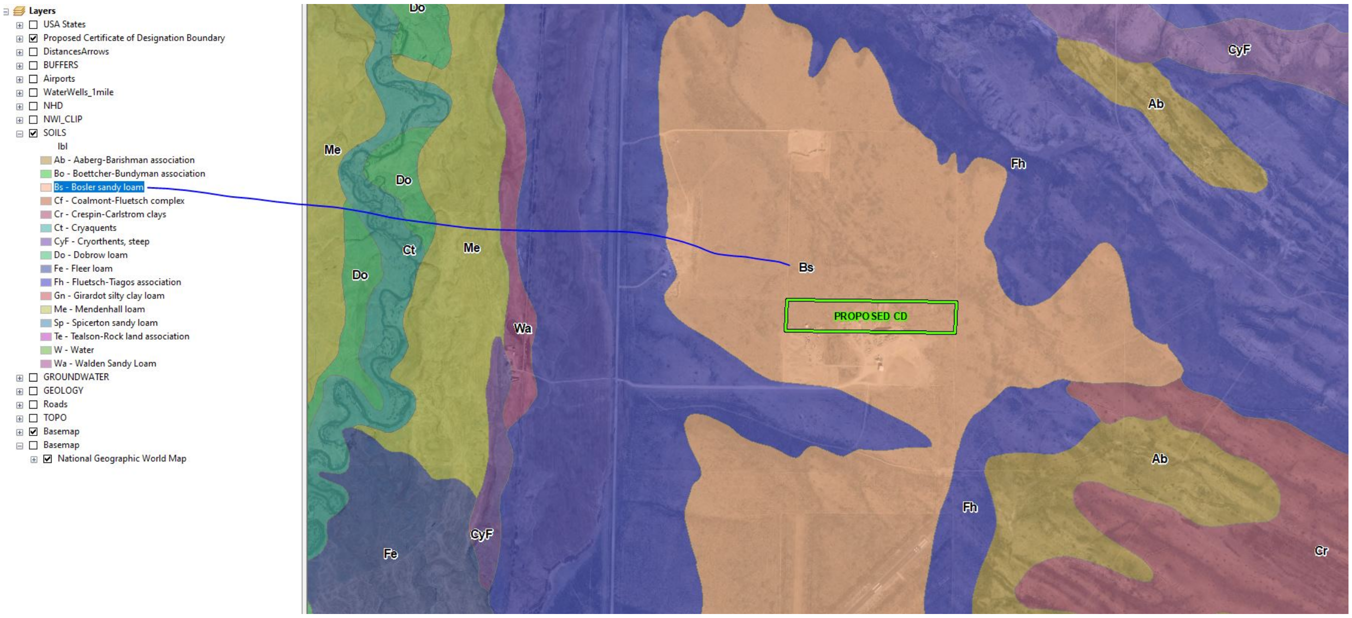


Figure 9: Surficial Soils at Facility Site

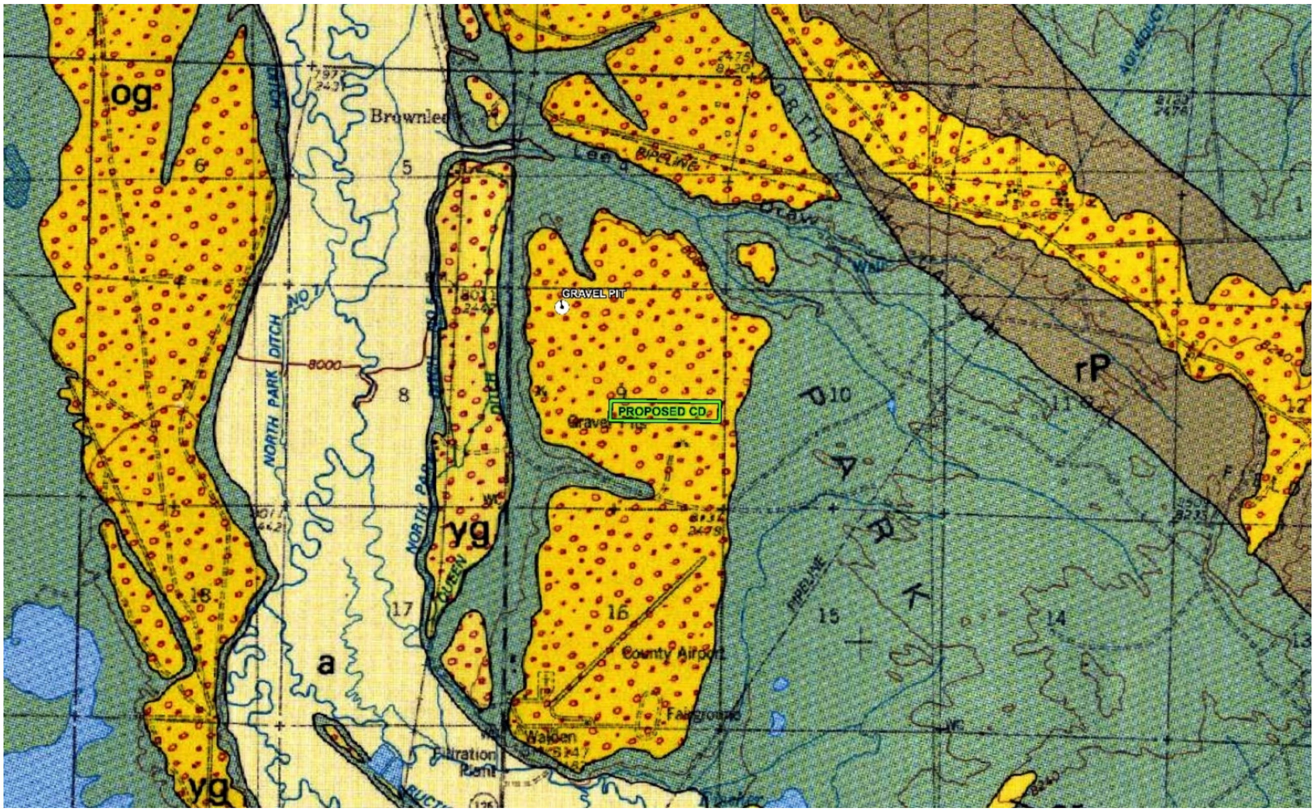
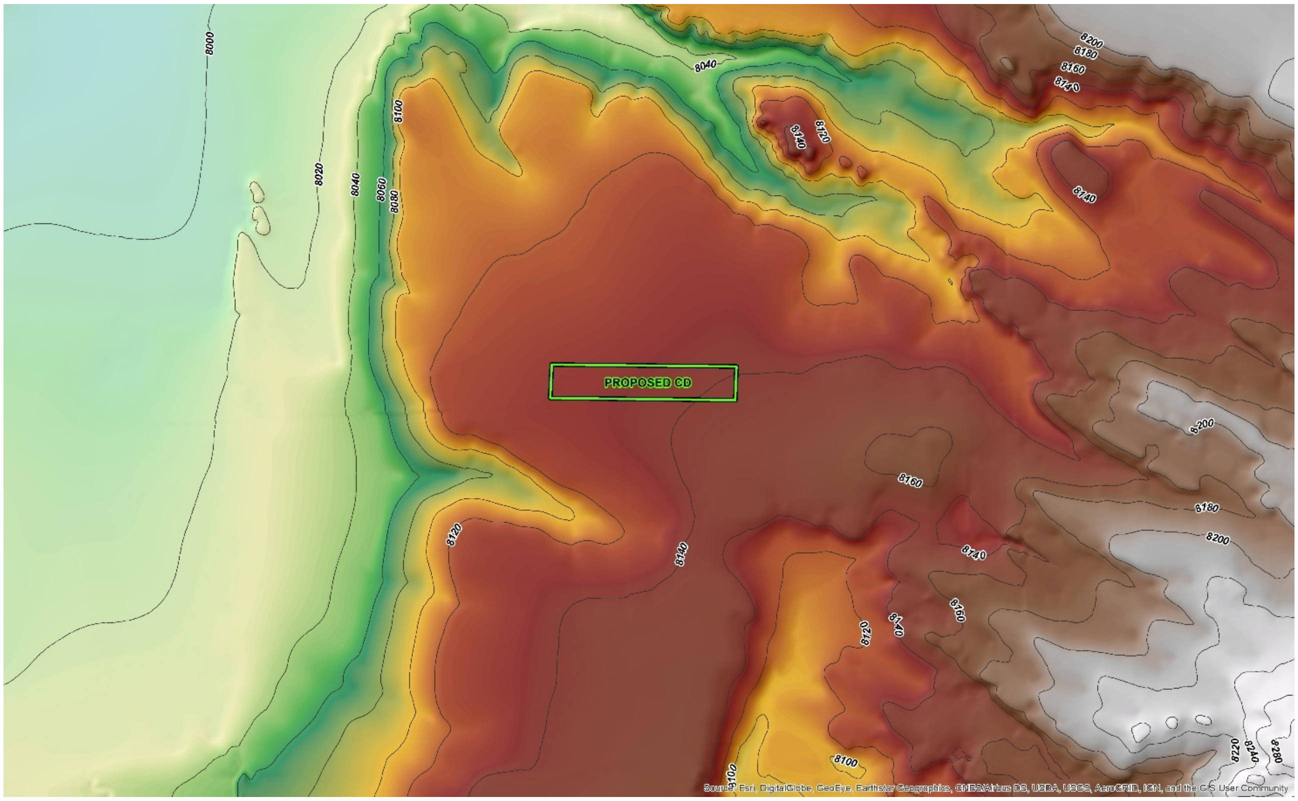


Figure 10: Uppermost Alluvium at Facility Site

5.2.6 Protection against Prevailing Winds and Minimization of Amount of Precipitation Catchment Area Upgradient of the Site

The site is located on an upland area as shown in Figure 11. The prevailing winds at the site are from the west and traverse over the valley to east before reaching the site. The average mean hourly wind speeds are less than eight miles per hour (mph) year-round. Given the site's location, its design to include perimeter berms, and the overall low average wind speeds at the site, the site should have adequate protection from prevailing winds throughout the year in order to operate in accordance with the provisions of this EDOP.

The site sits atop a northwest to southeast trending ridge feature as shown in Figure 11. This ridge feature results in the diversion of surface water runoff around the site to the northeast and southwest to existing drainages and minimizes the precipitation catchment area upgradient of the site.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 11: Site Topography

5.2.7 Site Location Relative to Floodplains

The site area has not been mapped by the Federal Emergency Management Agency (FEMA). It is evident from evaluating the site's location on an upland area and away from drainages that this site is not located in a floodplain.

5.2.8 Landfill Ability to Isolate Wastes from the Public and the Environment

The design and closure of the landfill and are provided in Sections 11.0 and 12.0 of this EDOP, respectively. The design provides for separation from the water table in the uppermost aquifer, a low-permeability soil liner system for construction and debris (C&D) waste, and a composite low-permeability soil liner with flexible membrane liner for municipal solid waste. It also includes a leachate collection system that will allow free liquids migrating to the liner system to be collected and disposed to limit hydraulic head on the liner system. It also includes an alternative final cover that will minimize precipitation infiltration into the landfill after closure and provide a physical barrier from human contact with wastes. These measures will provide isolation of the waste from the public and the environment in compliance with the Regulations and good engineering practice.

5.2.9 Placement of Waste in Surface Water or Groundwater

As shown in the topographic map in Figure 11, the site is located in an upland area along a ridge feature and will not be in an area of existing surface water. The water table map for the site is shown in Figure 4; the landfill has been designed so that the base of the liner is at least 10 feet above the water table surface.

6.0 OPERATIONS PLAN

This Operations Plan describes how the facility will comply with the operational requirements in the Solid Waste Regulations. As such, it specifies operational requirements applicable to this facility.

6.1 Operation of Facility

The owner/operator will construct, maintain, and operate the facility in accordance with this plan, and the entire EDOP. Failure to do so constitutes a violation enforceable through § 30-20-113, CRS of the Regulations.

6.2 Access Control

To control unauthorized access, prevent illegal dumping of wastes, and provide security during and after operating hours, the owner/operator will maintain perimeter fencing and a gate as described herein. The property is surrounded by livestock fencing, which is primarily constructed of continuous barbed wire and metal T-posts. Entry to the property is controlled by a locked gate constructed of four-inch metal pipe. Signage is appropriate as described more herein. Beyond the fence, there is a wide landscape of tall brush that makes unauthorized entry a challenge. Along the highway, there is an irrigation ditch that does not allow for access off the highway, except for on the site road. The perimeter fencing and gate will be inspected monthly and repairs made as necessary.

During all hours of operation, the facility will be attended by appropriately trained operators who will oversee the acceptance of waste and prevent the acceptance of prohibited waste in accordance with the Waste Characterization Plan (see Section 7.0).

Signage will be posted adjacent to the facility entrance gate indicating the hours of operation and an emergency contact telephone number, in addition to signage indicating the types of waste accepted and prohibited (see Section 7.0 for additional details). Additional signage must be posted at the facility to direct users to designated disposal and recycling collection areas.

Signage and/or barricades will be installed where needed to prevent public access to potentially hazardous locations outside of the active waste disposal and recycling collection areas, including inactive internal roads, construction areas, and soil borrow areas.

6.3 Wastes Accepted

In general, the facility is allowed to accept household wastes, C&D debris, and commercial wastes. The owner/operator must not knowingly accept hazardous wastes, as defined in the Colorado Hazardous Waste Regulations, 6 CCR 1007-3. For more details on waste streams accepted and waste acceptance procedures, including load inspections, see Section 7.0.

6.4 Waste Placement

The owner/operator will direct incoming waste loads so that they are disposed at the active working face. The owner/operator will limit the size of the working face so that solid wastes are distributed in the smallest area consistent with the traffic being handled at the facility. The owner/operator will not allow the working face to become larger than what can be compacted and covered at the end of the working day.

For those sites that place waste in lifts:

- Wastes will be placed in lifts approximately 10 feet in thickness
- Compaction of the wastes will be performed with a compactor

The owner/operator will operate so that the first lift of waste, four to eight feet thick, will be placed over the liner and leachate collection system, and is composed of select waste that will not compromise the integrity of the liner and leachate collection system. Waste such as large timbers, beams, concrete, appliances, and stumps will not be allowed in this layer. This bottom lift will be minimally compacted, and compaction equipment will not be allowed directly on the leachate collection layer. Select waste excludes C&D debris and any other waste with the potential to damage these engineered features.

6.5 Waste Covering

The owner/operator will have sufficient amounts of daily cover available throughout the working day, in case wind or other weather conditions necessitate covering waste during the day, and will have an adequate daily cover stockpile available at the end of the day to cover the entire working face. At the end of each working day, the owner/operator will cover the working face with a minimum of six inches of daily cover. Daily cover can be placed so that it can be removed and reused if it does not contain waste and debris.

Tire shreds are allowed for use as ADC in lieu of soil. This ADC will be placed in six-inch lifts. In the event tire shreds are used to supplement soil, soil will be placed as daily cover at least at the end of every working week (which will typically be Saturdays, unless the last working day of the week occurs before then).

For areas of the waste disposal footprint where filling has not occurred for at least one month, but which have not been finally closed, the owner/operator will apply at least one foot of soil. Intermediate cover will be graded to aid in the drainage of runoff and to minimize infiltration and standing water. Intermediate cover will be maintained against cracks, rills, gullies, and depressions until covered with additional waste or final cover. Once waste filling resumes in these temporarily unused areas, intermediate cover may be stripped off and reused for daily cover once again if it does not contain waste and debris. See Section 11.0 of this EDOP for final cover requirements.

6.6 Prohibitions

This EDOP describes those solid waste disposal activities that the owner/operator is permitted to engage in. It is not intended to be a comprehensive list of prohibited activities. Accordingly, the owner/operator is only allowed to conduct the approved activities described in this EDOP. Nonetheless, the following activities warrant special mention in this plan as being activities that are specifically prohibited:

- The owner/operator will not allow the dumping of waste in areas other than the active working face, unless deposited in a stockpile for purposes of conducting an activity approved in this EDOP. For example, wood waste for permitted burning consistent with the description as provided in Section 6.8.6.
- The owner/operator will not allow scavenging at the disposal working face or other locations at the facility.

6.7 Leachate Management

The leachate collection system consists of a leachate collection layer (sand or tire shreds), sump, and riser pipe. This system is shown in Drawing 7. The leachate level will be measured in the sump quarterly and will be recorded in the facility Operating Record. The owner/operator will monitor leachate head levels at least quarterly so that leachate head levels do not exceed one foot of depth over the liner. Jackson County will work with the Department to determine leachate use and/or disposal options based on leachate quality and other site-specific factors. At this time, Jackson County envisions using the leachate for dust suppression on the landfill within the lined area.

6.8 Nuisance Control

Windblown debris, dust, odors, noise, bird hazards and disease vectors, and open burning and fires will not pose a nuisance or present a hazard to human health and must will not exist at or beyond the facility boundary. The following subsections describe actions to reduce nuisance conditions at the facility.

6.8.1 Windblown Debris

To prevent windblown debris at the facility from becoming a nuisance, the owner/operator will implement the following:

- Daily application of adequate soil cover or Department-approved ADC material at the working face;
- Compaction of waste at the working face;
- Limitation of a working face size appropriate for the operations of the landfill;
- Requirement of landfill users to cover loads of loose waste; and
- A system of temporary movable wind screens/fences to capture wind-blown waste from the working face as necessary, with these fences deployed in such a manner that they are moved to be effective based on changes in wind direction.

The measures described as follows shall be used to collect, properly contain, and dispose of scattered windblown waste at the facility:

- The owner/operator will conduct routine daily inspection and removal of windblown litter from the boundary fence, and, if necessary, from adjacent properties.
- The owner/operator will collect windblown waste as needed following weather events that cause an increase in windblown debris.
- The owner/operator will remove litter from adjacent properties within 72 hours of a significant wind event that has caused off-site windblown waste.
- The owner/operator will conduct weekly inspection and retrieval of litter from on-site areas.

The owner/operator will make sure the facility is equipped with a working anemometer at all times. During significant wind events (gusts over 40 mph or sustained winds over 30 mph) for more than 30 minutes, the facility will take wind speed readings hourly and record those readings in the wind log.

The owner/operator will cease disposal operations during high-wind warnings. A high-wind warning is defined in Section 1.2 of the Solid Waste Regulations as sustained winds of 40 mph or greater or when gusts of 55 mph or greater are expected to persist for one hour or longer. Wind speed measurements and facility closures due to high winds are to be documented and are considered part of the facility's Operating Record.

6.8.2 Dust Control

Nuisance levels of dust at the facility and off site may be generated by wind, vehicle movement along access/haul roads, soil excavation, dumping waste at the working face, compacting the waste, applying daily cover, and other activities. To suppress dust, water will be applied at the facility operator's discretion to unpaved access/haul roads, soil borrow areas and soil stockpiles, and other areas where vegetative cover is not sufficient to limit dust movement. Amendments maybe added to the water but will be submitted to and approved by the CDPHE before use. Leachate may be used as dust suppression within the lined area of the landfill.

6.8.3 Odor Control

The owner/operator will limit the potential for nuisance odors resulting from acceptance of putrescible waste by limiting the volume of these types of waste accepted at any given time, limiting the size of the working face, applying adequate daily cover or Department-approved ADC material, and compacting waste adequately. Loads of waste that exhibit unusually strong odors will be screened prior to placement in the working face to determine whether they contain hazardous wastes per Section 7.0 of this EDOP and may require immediate application of soil cover or approved ADC to control nuisance odors.

6.8.4 Noise

To limit nuisance noise at the facility and on nearby properties, equipment at the facility will be maintained in good condition and operated to minimize noise levels. The operator will operate with mufflers and other noise limiting devices on facility equipment and check that they are in proper operating condition. When possible, excavation, grading, compaction, and other equipment-intensive activities will be conducted during regular business hours to limit off-site noise levels.

6.8.5 Birds and Disease Vectors

The facility will manage operations so that attraction, breeding, and emergence of birds, insects, rodents, and other disease vectors do not constitute a nuisance or health hazard.

The facility will limit disease vectors by limiting the volume of waste accepted at one time; limiting the size of the working face; applying adequate daily cover, intermediate cover, and final cover or Department-approved ADC materials; and compacting waste adequately.

The facility will use bird-discouraging devices, rodent traps, rodent bait, pesticides, or a professional animal/pest control service if needed to control vector nuisances. The facility will notify all applicable government agencies and obtain necessary permits prior to use of any restricted chemicals or devices to control vectors. To help control mosquitos, ponding of water will be minimized at the facility. In addition, highly putrescible wastes will be covered immediately at the working face.

Jackson County has prepared a Bird Mitigation Plan (Appendix A) with specific intent to mitigate any bird hazards associated with the County-owned airport just to the south of the site. As described in Section 5.0, the closest runway is about 3,000 feet from the landfill site. Because this airport is not used extensively and is owned by

Jackson County, the Bird Mitigation Plan involves coordinating use of the airport with actions to be taken at the landfill before arrival and departure of planes to mitigate any bird hazards.

6.8.6 Open Burning and Fire

Fire protection equipment as described herein shall be available at all times. To minimize the potential for fire or explosion at the facility, applicable safety procedures shall be followed. These procedures include inspecting each waste load received for signs of fire prior to disposal (e.g., smoke, burning odors, hot spots, etc.) to limit potential "hot loads," limiting the volume of moist stockpiled green/organic waste that may spontaneously combust, cutting vegetation at the facility regularly and as needed, maintaining fire extinguishers on all facility vehicles, maintaining a water source and/or soil source at the facility for potential fire suppression, limiting smoking to designated safe areas, and maintaining facility equipment to prevent potential sparks as an ignition source.

The nearest/local fire department shall be contacted every five years for inspections and consultation. The phone numbers for the fire department will be posted at the facility office. See Section 9.0, Contingency Plan.

To control small fires that do not require waste excavation and covering, all facility equipment operators will keep fire extinguishers in good working condition on their equipment. A suitable number of fire extinguishers and smoke detectors in good working order shall be kept in facility buildings. The nearest source of water for this facility is the Michigan River and a tanker will be kept full on site to provide a reliable water source.

Hot loads will be immediately isolated and contained/extinguished, with assistance from the fire department if necessary, in areas away from the working face, buildings, fuel tanks, and other potential fuel sources.

Open burning of green waste will be conducted under a current APCD or APCD-approved open burning permit and in accordance with all local ordinances. At this time, it is envisioned that the burn pit will be located just to the east of the landfill cell to provide a wind screen and obscure it from traffic located west of the site.

6.8.7 Stormwater Management

Stormwater control features are designed to control runoff and run-on during operations and after site closure. Components of the surface water control system are detailed in Section 11.0, the Engineering Design and Construction Quality Assurance/Quality Control Plan. Stormwater controls are shown in Drawings 4 and 8. The owner/operator must maintain these surface water features in accordance with the approved design.

7.0 WASTE CHARACTERIZATION PLAN

The purpose of this Waste Characterization Plan (WCP) is to specify the procedural requirements necessary to ensure that the facility does not accept or dispose of hazardous wastes, polychlorinated biphenyl wastes (PCBs), or other unacceptable wastes. This section serves as the "Waste Characterization and Disposal Plan" required in Section 2.1.2 of the Solid Waste Regulations.

7.1 Acceptable Wastes

Wastes permitted to be accepted for disposal include:

- Household wastes, meaning any solid waste generated by households, including single and multiple residences, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas.

- Commercial wastes, meaning all solid wastes generated by stores, motels, hotels, markets, offices, restaurants, warehouses, and other non-manufacturing activities, excluding community and industrial wastes.
- C&D wastes, meaning waste that is generated from construction, remodeling, repairs, or demolition of buildings and pavements. This site also plans to accept asbestos waste.

To the extent that these acceptable waste categories overlap with prohibited wastes, the prohibition will control.

7.2 Unacceptable Wastes

The owner/operator must refuse, and is not permitted to accept, anything not listed in Subsection 7.1. Accordingly, this section is not intended to be a comprehensive list of prohibited items. However, the owner/operator has deemed that the following waste streams warrant mentioning as being specifically prohibited:

- Regulated hazardous wastes, as defined by the Colorado Hazardous Waste Regulations, 6 CCR 1007-3.
- Biosolids.
- Bulk liquid wastes (i.e., wastes that fail the paint filter test).
- Discarded or off specification chemical products.
- Waste electronic devices will not be allowed for landfilling but will be accepted at the facility for recycling with a Colorado-licensed recycler.
- Exploration and production wastes.
- Explosives.
- Fly ash or other coal combustion residuals.
- Incinerator ash.
- Industrial wastes, meaning all solid wastes, including mill tailing and mining wastes, resulting from the manufacture of products or goods by mechanical or chemical processes that are not a hazardous waste regulated under 6 CCR 1007-3 of the Colorado Hazardous Waste Regulations.
- Lead acid batteries will not be accepted for landfilling but will be accepted for recycling.
- Mechanical equipment.
- Medical waste from non-household sources that is untreated.
- Mercury-containing switches or devices.
- PCBs.
- Rendering wastes/slaughterhouse wastes.
- Technologically-enhanced naturally-occurring radioactive materials (TENORM) or other radioactive materials. (Note: A rulemaking process to be completed by December 31, 2020, will likely affect the details of this prohibition.)

- Transformers.
- Used oil.
- Sludges.
- Waste tires will not be accepted for landfilling but will be accepted for recycling (see Appendix E, Tire Collection EDOP).

7.3 Generator Responsibility

Per Section 2.1.2 of the Solid Waste Regulations, it is the generator's responsibility to make a hazardous waste determination, and to characterize the waste being presented for disposal. The generator will be required to make a hazardous waste determination under Part 261 of 6 CCR 1007-3 of the Regulations based on representative testing or process knowledge. Nevertheless, it will be the responsibility of the owner/operator to evaluate the determinations made by generators and to prevent the acceptance and disposal of hazardous wastes in the facility.

7.4 Waste Accepted for Recycling

Section 7.2 includes some waste streams that, although not permitted for disposal at the working face, may be accumulated for purposes of recycling. Requirements for management of these wastes vary by waste type. For the JCL, the following wastes will be accepted for recycling:

- waste tires
- lead acid batteries
- electronic wastes
- recycled steel
- appliances

Batteries, electronic wastes, and appliances will be kept inside in the former Transfer Station building and the tires and steel will be stockpiled in dedicated areas outside. JCL personnel are trained to drain freon from appliances, and after draining, they will be either hauled for scrap or taken to an authorized disposal location.

7.5 Waste Exclusion Procedures

The owner/operator of the facility will implement the following waste screening procedures to ensure that hazardous wastes and other unacceptable wastes are not disposed of at the landfill.

7.5.1 Preliminary Gate Screening

Gate attendants will have verbal communication with haulers. Inquiry will be made regarding anything suspicious. Haulers and generators that have presented with unacceptable waste in the past will receive additional scrutiny. Specific industries of concern, such as auto repair shops or demolition contractors, may also warrant specific scrutiny.

7.5.2 Routine Waste Unloading Screening

The operator at the working face will be vigilant for suspicious wastes. The operator will get a good visual observation of every load dumped.

7.5.3 Random Load Inspections

In addition to routine visual screening, random load inspections will be implemented. Section 2.1.2 of the Solid Waste Regulations requires random load inspections, which are a more detailed and systematic check of the contents of a sample of loads. The term “random,” as used here, means on a surprise or unpredictable basis, and does not mean such loads must literally be selected at random. These inspections are meant to eliminate predictability that a customer could use to escape detection of unacceptable wastes. As such, conducting random load inspections on the same day of the week is a practice that will be avoided. Jackson County will bias these inspections toward haulers with commercial waste loads that have the potential to contain hazardous or industrial wastes and toward haulers that have caused problems in the past. Random load inspection will not focus strictly on residential loads, unless that is the only type of waste accepted for significant periods of time.

Random load inspections must be conducted in a dedicated area located away from the working face, where there is room to spread out waste with a rake, shovel, and/or front-end loader. Appropriate personal protective equipment (PPE) will be worn by the operator performing the inspection.

Because Jackson County will accept less than 50 commercial loads per week, the frequency of random load inspections will be biweekly, or once every two weeks.

Random load inspections will be documented in the Operating Record.

7.5.4 Signage

The owner/operator will post a sign at the facility entrance to communicate prohibited wastes. The sign will be periodically reviewed for completeness and updated as necessary.

7.5.5 Education of Haulers

The owner/operator will meet with any companies using the facility frequently on an annual basis to discuss the key elements of the facility’s waste screening program and let the collection companies know they will be subject to random inspections. The companies will be provided the list of prohibited wastes. The facility will consider having frequent users sign a form stating that they are not knowingly bringing prohibited wastes to the landfill. Facility personnel may reach out to generators such as auto shops or dry cleaners that are known to directly generate hazardous waste to educate them on prohibited wastes.

7.5.6 Education of the General Public

Residents must be educated on the residential wastes banned from landfill disposal and which wastes will be accepted for recycling at the facility. The means for accomplishing this will be determined in consultation with the Department.

7.6 Special Handling Wastes

Special handling wastes, listed in the following subsections, are those wastes requiring facility personnel to alter the standard waste receipt procedures or landfilling practices for safety, health, regulatory, or environmental reasons.

7.6.1 Household and Treated Medical Wastes

Household and treated medical wastes will be immediately covered at the working face. In accordance with Section 13.9.2 of the Solid Waste Regulations, treated medical waste may be disposed of at the landfill working face with documentation of proper treatment of the waste by the treatment facility. Treated medical waste should be kept separate from the public, or covered immediately, to allay any public concerns about exposure to infectious waste.

7.6.2 Construction and Demolition Debris

C&D waste will be managed to minimize the generation of dust that can be a nuisance to the public using the landfill. Commercial demolition waste will be accompanied by a certification signed by an asbestos building inspector that it is asbestos-free.

C&D waste containing asbestos will be accepted by the landfill in accordance with the provisions of Appendix B.

7.6.3 Animal Carcasses

Animal carcasses will be disposed in a prepared area of the disposal footprint away from the public working face and will be covered immediately. Disposal of carcasses will not be permitted at the landfill working face.

7.6.4 Highly Odorous Wastes

Highly odorous wastes will be disposed in an area away from the public disposal area and will be covered immediately.

7.7 Contingency for Handling Unacceptable Wastes

This section concerns actions to be taken in the event that hazardous or other unacceptable wastes are discovered at the facility, whether by routine waste unloading screening or through random load inspection. This subsection is specific to management of unacceptable wastes. For other emergencies unrelated to receipt of wastes, see Section 9.0, Contingency Plan.

7.7.1 Hazardous Wastes

The facility will retain hazardous waste, or suspected hazardous waste, on site until proper disposal. The hazardous waste retention area will be secured and isolated from entry by the general public. If conditions dangerous to life and health are suspected, the site will be evacuated and the designated emergency response authority, the county manager in the Administrator’s Office, called.

If the situation does not pose an emergency and the hauler is identified, the hauler will be notified of the situation and the hauler’s help will be enlisted to both identify the generator and determine a proper disposal option. The waste will not be returned to the hauler. Whether the hauler can be identified or not, the facility will isolate and retain the waste on site until a hazardous waste transporter can pick up the waste for proper disposal. The facility will take measures to ensure that the hazardous waste retention area is protected from stormwater run-on and does not impact stormwater runoff. The facility will retain a copy of the manifest as the waste load leaves the site and obtain a copy of the completed manifest following proper disposal.

The owner/operator will notify the Department’s Hazardous Materials and Waste Management Division within 24 hours of discovery of the acceptance of hazardous wastes. In addition, the owner/operator will submit a written report within seven days summarizing activities conducted, any generator-identifying information, and proof of proper disposal, if available. If not available within seven days, a subsequent report regarding proper disposal, including a copy of the hazardous waste manifest completed by the disposal facility, must be submitted to the Department within 60 days of the hazardous waste discovery.

7.7.2 Other Prohibited Wastes

When discovered, non-hazardous prohibited wastes will be returned to the hauler within two business days. If the hauler cannot be identified or the prohibited waste cannot be returned to the hauler within two business days, the facility will segregate the waste into a safe area. The facility will handle asbestos waste in accordance with Appendix B.

7.7.3 Radioactive Waste

If the landfill discovers a suspected radiation source or other waste labeled so as to raise a radiation concern, the landfill operator will call the Hazardous Materials and Waste Management Division Radiation 24 Hour Line at (303) 877-9757. The Division will not take possession of the material, but may provide advice on safe interim storage until an appropriate radioactive material licensee can take possession of the material.

7.8 Training

The owner/operator will train facility personnel in the recognition and management of hazardous and prohibited waste, as outlined in Section 10.0, Training Plan.

7.9 Records Related to Waste Acceptance

The owner/operator will maintain all required waste acceptance and characterization records in accordance with Section 14.0, Recordkeeping and Reporting. The standard load inspection form used for random load inspections is found in Attachment 1 to this EDOP.

8.0 ENVIRONMENTAL MONITORING PLAN

The Environmental Monitoring Plan for the site has been developed and is provided in Appendix C. The Environmental Monitoring Plan consists of a Groundwater Sampling and Analysis Plan and a Methane Gas Sampling and Analysis Plan for implementation at the facility.

9.0 CONTINGENCY PLAN

The facility will perform all contingency activities in accordance with applicable portions of Sections 2 and 3 of the Solid Waste Regulations.

This plan describes the procedures to be followed in the event of a release to surface water, leachate release, spills, fire, or other upset conditions at the facility that prevents the placement of waste.

9.1 Emergency Contacts

The following is a list of contacts to be used for response and notification in the event of an emergency.

Table 3: Emergency Contacts

Contact	Phone Number
Facility Contacts	
Administrator’s Office Road and Bridge	(970) 723-4660 (970) 723-4481
Local and State Contacts	
Fire Department	(970) 723-4747
Sheriff’s Department	(970) 723-4242
Hospital	(970) 723-8220
CDPHE Spill Line	(877) 518-5608
CDPHE Radiation 24-Hour Response Line	(303) 877-9757
CDPHE Hazardous Materials and Waste Management Division	(303) 692-3320

9.2 Spills and Releases

9.2.1 Spills

If a spill occurs at the facility in a quantity greater than 25 gallons, even within the waste disposal area, it will be reported to the CDPHE Spill Line. The spill will be cleaned up as soon as practicable. All spills and spill responses will be recorded in the facility Operating Record.

The facility will evaluate spills for their potential to cause a release to groundwater and inform the Department of the results of such evaluation by providing a written notice documenting the nature and location of the release, immediate actions taken, recommendation for additional corrective actions, and a schedule for completing the corrective actions. Such written notice and evaluation will be provided to the Department and Jackson County within 10 calendar days. Proposed corrective actions could include modification to the site’s groundwater monitoring program or other appropriate actions.

9.2.2 Releases to Surface Water

Releases to surface water will be reported to the CDPHE Spill Line. The owner/operator will follow the direction of the CDPHE Water Quality Control Division.

9.3 Fire

The facility will close upon the discovery of a fire to limit public exposure. Fires at the working face will be controlled primarily through the application of soil cover. If chemically compatible, water, soil, or other suitable materials may be used to extinguish a fire as deemed necessary by facility personnel coordinating with the local fire control authority. Water will be used only if necessary as directed by the local fire control authority. The facility will reopen only after the local fire authority has deemed it safe to do so. The Hazardous Materials and Waste Management Division will be contacted within 24 hours of the start of the fire and record of the fire will be placed in the Operating Record within 10 days of it being extinguished. The facility's source of firefighting water is water from the Michigan River that will be pumped into the water tanker and kept on site.

Hot loads will be placed in a designated area isolated from other fuel sources, controlled through application of water or via fire extinguisher, and allowed to sit until it no longer poses a fire hazard. Once fire risk is eliminated, the load will be transferred to the working face.

9.4 Upset Conditions

If a situation arises that prevents the facility from accepting waste, waste haulers arriving at the gate will be directed to another approved commercial landfill. Waste will not be stockpiled at the facility during periods of shutdown. Alternate disposal locations include:

- Milner Landfill, Milner, Colorado; and
- Larimer County Landfill, Fort Collins, Colorado.

10.0 TRAINING PLAN

The owner/operator will develop and implement a training program that complies with Section 3.3.8 of the Solid Waste Regulations. A copy of the EDOP will be available at the facility at all times for use by the operator and other facility personnel.

10.1 Introductory Training

All employees at the landfill will receive training in the following areas within six months of being initially employed at the facility:

- The recognition of hazardous waste and PCBs
- The operational requirements of this EDOP
- The safety training elements that include hazard awareness, accident avoidance, and emergency response procedures to be taken in the event of an emergency.

This initial training will be at a level of depth sufficient to ensure that someone unfamiliar with these topics becomes thoroughly familiar with them and is able to work unsupervised in their position.

10.2 Annual Training

Annual training will be conducted and will include training in the topics noted in Subsection 10.3. The annual training is intended to refresh each employee's existing knowledge in the different topic areas and update that knowledge for any changes that have occurred in the last year. It will occur at least once every calendar year and no later than 15 months from the anniversary date of each facility employee or when last taken by each employee.

10.3 Roles and Responsibilities

The facility manager is responsible for all recordkeeping and all facility operations. The owner/operator will ensure that the facility manager receives training in the recognition of hazardous wastes and in the requirements of this

EDOP. Ideally, the facility manager will be experienced in solid waste management, equipment operations, health and safety, and Department Regulations pertaining to solid waste disposal.

Other facility personnel will be trained, as appropriate for their job duties, in:

- The operation of the site equipment;
- Disposal operations;
- Monitoring and maintenance of the leachate collection system;
- Site maintenance;
- Identifying prohibited materials;
- Emergency procedures;
- Reporting procedures for prohibited materials (i.e., hazardous wastes);
- Explosive gas monitoring and groundwater monitoring (unless explosive gas monitoring and groundwater monitoring services are contracted out to a qualified consulting or engineering firm);
- Health and safety;
- Content of the facility's EDOP;
- Applicable CDPHE Regulations; and
- Other relevant topics.

The facility manager will ensure that at least one operator meeting the above qualifications is employed by the facility, and at least one other person familiar with all facility operations is on staff. Training may be conducted by facility staff, if appropriately qualified, or by other qualified trainers.

10.4 Documentation

The owner/operator will maintain the following documentation related to training (both introductory and annual) and make it available at the time of inspection:

- Names, job titles, and job duties for each trainee;
- Description of initial training, date, and trainer qualifications;
- Description of annual training, date, and trainer qualifications; and
- Documentation that each person being trained did not work unsupervised until after the initial training was given.

These training records and qualifications of facility personnel will be placed in the Operating Record.

11.0 ENGINEERING DESIGN AND CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL PLAN

11.1 Facility Design

The attached drawings graphically depict the layout, development, and design of the landfill and include the following drawings:

- Drawing 1: Existing Conditions
- Drawing 2: Subgrade
- Drawing 3: C&D Liner
- Drawing 4: Final Cover
- Drawing 5: Sections
- Drawing 6: Detail Sheet (1 of 3)
- Drawing 7: Detail Sheet (2 of 3)
- Drawing 8: Detail Sheet (3 of 3)

11.2 Facility Configuration

The facility has been designed to serve as a repository for on-site C&D material stockpiled by the County in addition to an ongoing MSW landfill. An estimated 15,000 cubic yards (cy) of C&D material is currently housed on the site and is a mixture of asphalt, concrete, soil, and incinerator product. As discussed previously, tires present on site may be recycled off-site or used as protective cover and/or ADC. Additionally, tire shreds may be used as a leachate collection layer within the lined C&D cell. The C&D cell is designed with a three-foot-thick low-permeability soil liner ($k \leq 1x10^{-7}$ cm/s), which will be covered with a piggyback liner system following waste placement immediately after cell construction. The remaining landfill footprint will hold both MSW and C&D waste as needed based on the county's needs. The MSW landfill will be lined with a composite one-foot-thick low-permeability soil liner ($k \leq 1x10^{-7}$ cm/s), overlain by a 60-mil double-sided textured high-density polyethylene (HDPE) liner. All waste was designed with a minimum 10-foot separation between the bottom of liner and observed groundwater levels noted in Appendix H of this EDOP. The HDPE liner will be placed in an anchor trench two feet wide by two feet deep based on the available bucket size on site. This anchor trench is considered adequately sized based on calculations performed by Golder on similar landfills in Colorado.

Tires stored on site will be separated into discrete piles not to exceed 100 tires each to minimize risk of potential fires spreading. Once shredded, piles will be segregated to piles not to exceed 50 tires each. Tire piles will be separated by a minimum of 25 feet.

The C&D cell will consist of approximately 1.25 acres of waste disposal footprint located directly east of the existing comingled C&D waste pile shown in Drawing 1. Following construction of this cell, all material from the comingled C&D waste pile, in addition to the material in the remaining C&D waste piles, will be placed in the cell and covered with one foot of intermediate cover. The C&D cell will include a temporary sump for use while the next portion of the landfill is constructed.

An exception to this C&D material will be made for inert material. Inert material currently stored on site in above-ground stockpiles will be placed in one or more unlined cells within the County-owned property parcel. Cells will be designed and located to maintain at least 10 feet of separation from groundwater. Inert material will be covered with a cap at least two feet thick composed of on-site soil or off-site soil of similar soil properties. Cover material will be graded to establish a minimum 5% slope to ensure adequate surface water control following potential settlement. Only inert material will be allowed in unlined cells. Minorly impacted material that can be rendered inert by removing non-inert material (e.g., asbestos), may be placed within the unlined cells following segregation.

The MSW landfill will consist of approximately 7 acres of waste disposal footprint, 1.25 acres of which will overlay the C&D cell. The waste disposal footprint of the landfill is limited by a minimum 90-foot offset from the property boundary to the north as shown in Drawing 2. Currently, no discrete phases are planned for the MSW landfill; however, this may change as the County develops more precise estimations of annual waste acceptance rates. Any phasing following placement of intermediate cover on the C&D cell will include development of the permanent sump.

11.3 Site Access and Facilities

The site is accessed by travelling east on Jackson County Road 51A located 1.8 miles north of Walden, Colorado. Existing site facilities include a transfer station and facility office. No new structures are anticipated to be required to support the new MSW landfill. A new scale house and/or scale may be constructed in the future with a location to be determined based on placement operations.

11.4 Design Calculations

The approximate total capacity of the combined C&D and MSW landfill is 280,000 cy, which is estimated to have a site life of 26.5 years based on an estimated annual waste acceptance of 10,000 cy. This is estimated using waste acceptance records from the Jackson County Transfer Station for the 2017 calendar year. This is a conservative estimate given as the 2017 USEPA estimate for individual municipal waste generation was 4.51 pounds per person, per day, equating to 1,310 cy of annual waste for the county with a population of 1,400 people (assuming a waste density of 65 pounds per cubic foot [pcf]).

Calculations supporting the design of the landfill (shown in the Drawings) are included in Appendix I of this EDOP. The calculations include demonstrations for head-on-liner less than one foot (Appendix I-1), global slope stability under static and seismic loading conditions (Appendix I-2), differential settlement (Appendix I-3), leachate flow times less than 365 days (pre- and post-settlement; Appendix I-4), and surface water channel sizing (Appendix I-5). An Alternative Cover Demonstration/Design is provided Appendix F.

11.5 Landfill Construction

A CQA Plan has been developed for construction of the landfill and is included in Appendix J.

12.0 CLOSURE PLAN

The owner/operator will perform all closure activities in accordance with this Closure Plan and ensure closure is conducted in accordance with the approved design. See Drawing 4 for the approved closure drawing and Drawings 6 and 7 for details.

This Closure Plan will include all necessary activities needed to close the site at any point during its active life. Therefore, during the active life of the facility, the owner/operator will be required to revise this Closure Plan whenever there are significant changes to the facility that will change this plan's requirements.

Prior to the closure of each landfill phase, the owner/operator will evaluate the approved Closure Plan to make sure it remains implementable given the facility configuration at that time. Such evaluation should be done far enough in advance of reaching final grade on each landfill phase such that plan revisions, if necessary, can be submitted and approved in time to allow the owner/operator to begin constructing the cover within 30 days of reaching final grade in accordance with Section 2.5.9 of the Solid Waste Regulations.

If the owner/operator or the Department determines that the approved closure plan requires modification to account for changed conditions, the owner/operator will revise the Closure Plan and obtain Department approval for the revised Closure Plan prior to implementation of the next phase. For this section, premature closure or any other circumstance necessitating that final cover be constructed at elevations different from the approved design grades constitutes a changed condition requiring the owner/operator to develop and submit a revised Closure Plan and obtain Department approval prior to construction.

12.1 Approved Design Drawings and Specifications for Final Cover and Stormwater Control Features

The final closure grades, final cover section, and stormwater control for closure conditions are shown in Drawings 4, 6, and 7.

12.2 Phased Closure

The Solid Waste Regulations require the owner/operator to begin application of final cover for each landfill phase within 30 days of reaching final grade (Section 2.5.9 of the Solid Waste Regulations), and to finish applying final cover to each landfill phase within 180 days of waste elevations reaching final grade. The owner/operator will not exceed the waste elevations in the approved closure plan. Once final cover placement is complete and the cover is surveyed, the owner/operator will submit a final cover construction quality assurance certification report to the Department for approval. Reaching final grade for a given phase or area will be recorded in the Operating Record and the Department will be notified within 30 days.

12.3 Final Closure Notifications

At least 60 days in advance of the proposed final closure date (date of last waste acceptance) for the facility, the owner/operator will notify the Department and Jackson County in writing, in accordance with Section 2.5.2 of the Solid Waste Regulations, and place this notice of the intent to close in the Operating Record.

In addition, at least 60 days in advance of the proposed final closure date, the facility will notify the general public of the proposed final closure date by placing signs of suitable size to be easily read from the public right-of-way at the entrance to the site. On the day of closure, the site and facility will be gated and locked and other adequate precautions taken to prevent further use for waste disposal. The locations of alternate approved commercial disposal facilities will be noted on signs easily read from the nearest public right of way.

12.4 Final Closure Activities

Once each phase reaches final elevation, the owner/operator will:

- Construct the final cover system and the stormwater control system according to the design grading depicted in Drawing 4, details in Drawings 6 and 7, and in accordance with Section 11.0, Engineering Design and Construction Quality Assurance/Quality Control Plan; and

- Revegetate the final cover to resist erosion meeting the requirements of the local agricultural service recommendations.

At final closure, the owner/operator will:

- Ensure that final cover specifications comply with Section 3.5 of the Solid Waste Regulations, and stormwater control features comply with Section 2.5.7, of the Solid Waste Regulations;
- Install and maintain access controls; and
- Ensure that the facility is left in a condition of orderliness and good aesthetic appearance capable of blending with the surrounding area.

12.5 Final Closure Documentation Report

The owner/operator will submit a report, signed by a Colorado registered PE, to the Department documenting that the closure has been completed in accordance with Section 11.0, the Engineering Design and Construction Quality Assurance/Quality Control Plan. This report will be submitted to the Department within 60 calendar days of completion of the final step of the closure process (typically, either revegetation or surveying), or no later than one year from the date of initial facility closure notice made to the Department (see Subsection 12.3). To meet this requirement, the owner/operator will ensure that the certifying engineer is involved in the construction project at an early stage and to the extent necessary throughout the project to support making the above-noted certification.

12.6 Deed Notation and Environmental Covenant

In accordance with Section 3.4.1 of the Solid Waste Regulations, following the completion of final closure, the owner/operator will record a notation on the deed for the landfill property. In addition, per Section 3.6.1(A)(7) of the Solid Waste Regulations and the environmental covenant (EC) statute, §25-15-320 C.R.S., at closure, the owner/operator will create an EC or the Department will issue a restrictive notice (RN). The notation and EC or RN shall, in perpetuity, notify any potential purchaser of the property that the land has been used as a solid waste landfill and that its use is restricted.

Within 90 days of Department approval of the Closure Certification Report, the owner/operator must place the deed notation on the property deed and in the facility Operating Record and provide a copy to the Department.

13.0 POST-CLOSURE CARE PLAN

The objective of this Post-Closure Plan is to ensure that all post-closure activities are performed in accordance with applicable portions of Sections 2.6 and 3.6 of the Solid Waste Regulations and as necessary to protect human health and the environment.

This plan describes the steps to properly perform the necessary maintenance and monitoring required during the post-closure care period, including the inspection and maintenance program, access control, documentation of post-closure activities, and post-closure cost estimates for financial assurance.

13.1 Post-Closure Care and Maintenance

Following the completion of closure activities at the facility and approval from the Department that closure has been completed, the owner/operator will conduct post-closure care in accordance with applicable current Solid Waste Regulations and in accordance with this Post-Closure Plan. Post-closure care starts on the date of the Department's approval of the Closure Certification Report.

13.1.1 Post-Closure Care Period

The owner/operator will perform post-closure care and maintenance of the facility for a minimum of 30 years, unless determined otherwise by the Department. Post-closure care obligations do not automatically end at 30 years, but continue to run until release from post-closure care is granted by the Department. However, per Section 3.6 of the Regulations, the post-closure care period may be either lengthened or shortened by the Department at its discretion, in consultation with Jackson County.

13.1.2 Post-Closure Care Maintenance Activities

Post-closure care maintenance activities and requirements are listed in the Post-Closure Checklist (Appendix D) and listed as follows:

- The owner/operator will prevent nuisance conditions. Examples include exposed trash or uncontained leachate, odors, animal or vector attraction, ponding of water, etc.
- The owner/operator will maintain the integrity and effectiveness of the landfill cover and the stormwater run-on and runoff control structures. The owner/operator will maintain these engineered features per the surface contours in the approved closure design. Required maintenance activities include making repairs to correct the effects of settlement, subsidence, ponding, erosion, burrowing animals, and other events.
- The owner/operator will maintain the groundwater monitoring system and monitor groundwater according to the approved Environmental Monitoring Plan.
- The owner/operator will maintain and operate the leachate collection system in accordance with the approved Environmental Monitoring Plan to ensure that the leachate level is maintained in accordance with Section 3.2.5(D) of the Solid Waste Regulations.
- The owner/operator will maintain the gas monitoring system and monitor for landfill gas according to the approved Environmental Monitoring Plan. The owner/operator will take the steps outlined in Section 2.3.3 of the Solid Waste Regulations when the limits in Section 2.3.1 are exceeded.
- The owner/operator will control access to the facility during the post-closure care period. The owner/operator will maintain a lockable gate, which shall be kept locked except during inspections and maintenance activities, and maintain perimeter fencing.

13.1.3 Post-Closure Care Prohibitions

Post-closure care prohibitions include the following:

- The owner/operator shall not conduct solid waste disposal and must take steps to prevent disposal by others. Nothing in this paragraph shall be interpreted to preclude any of the approved post-closure land uses in Subsection 13.8 of this section.
- The owner/operator shall not burn solid waste, except as such activity may be approved in Subsection 13.8 of this EDOP.
- The owner/operator shall not disturb the integrity of the final cover, stormwater controls, or other components of the waste containment system, and ensure that the function and operation of the monitoring systems is not disturbed. The only exception to this prohibition is on specific approval from the Department in accordance with Section 3.6.1(A)(7) of the Solid Waste Regulations, based on a demonstration by the

owner/operator that such disturbance will not increase the potential threat to human health or the environment.

- The owner/operator will not allow any of the prohibited activities and land uses prescribed in the EC.

During the post-closure care period, the County of Jackson will be responsible for the facility. The facility may be contacted at:

County Administrator
P.O. Box 1019
Walden, Colorado 80480
(970) 723-4660

Following the post-closure care period, Jackson County will notify the Department and have a certification prepared by a Colorado registered PE verifying that post-closure care has been completed in accordance with this EDOP. This certification will be placed into the Operating Record. This certification is subject to approval by the Department and Jackson County. Post-closure care does not end until both agencies approve.

13.2 Inspections

Pursuant to the Solid Waste Regulations, the owner/operator will conduct post-closure care inspections to ensure compliance with this EDOP and the Solid Waste Regulations. Specifically, the purpose of such inspections is to ensure the facility’s compliance with the required post-closure care activities and requirements in subsection 13.1.2 and the post-closure care prohibitions in subsection 13.1.3. Therefore, such inspections will verify compliance with this Plan and where non-compliance issues are found, those must be corrected according to timelines specified in this plan.

13.3 Documentation

The owner/operator will document all inspections by completing the Closed Landfill Inspection Checklist (see Appendix D) and taking photographs of features inspected with problems identified. The owner/operator will place all inspection documentation in the Operating Record within 30 calendar days of the inspection. The owner/operator will document all corrective actions and repairs undertaken with a follow-up technical memorandum or report provided to the Department within 30 calendar days of the corrective action being taken.

13.4 Reporting

During post-closure care, the owner/operator will submit an annual post-closure inspection report to the Department by March 31 of the following year. The report will include a summary of activities and events for that monitoring year and will include inspection results, maintenance activities, and results of groundwater, explosive gas monitoring, and leachate monitoring.

13.5 Facility Inspection Frequency

During the post-closure period, the owner/operator will conduct routine inspections of the facility at least quarterly, and such inspections will include observation of the items specified on the Closed Landfill Inspection Checklist (Appendix D of this EDOP). In addition to the routine inspections, the owner/operator will inspect the facility within 14 days following a major precipitation event, which is defined as a one inch in 24-hour storm event. If favorable inspection results are achieved in the first three years of post-closure, the facility may request a reduction in inspection frequency.

13.6 Facility Maintenance and Corrective Actions

The owner/operator will maintain and make repairs to the final cover and stormwater features in response to the following problems, within three months of the inspection date when such problems are identified:

- Signs of erosion, settlement, subsidence, burrowing, and any other damage noted that impacts the integrity and effectiveness of the cover.
- Siltation and accumulation of debris in a stormwater feature sufficient to reduce its capacity below the design capacity.
- Damage to gates or perimeter fencing.
- Noxious weeds or vegetative distress that kills vegetation necessary for the performance of the final cover.
- Illegal waste dumping.

The Department will determine corrective actions in writing in response to problem areas. The owner/operator will conduct corrective actions, which may include, but are not limited to, the following in response to corrective actions required by the Department:

- Repair areas of the final cover affected by erosion damage (cuts, rills, ruts, gullies, etc.) and cracking and reseed these areas.
- Refill areas affected by settlement, subsidence, etc. with suitable soil (as specified in the approved Closure Plan).
- For areas needing to be reseeded, because they no longer meet the vegetation specification in the approved Closure Plan, the owner/operator must reseed using the seed mixture in the approved Closure Plan during the appropriate time of year.
- Following reseeding, the owner/operator will apply straw mulch (certified weed free) at the rate of two tons per acre or, for hydraulic applications of tackifier, 2,500 pounds per acre.
- The owner/operator will respond to illegal waste dumping by removing the waste and hauling it to an approved disposal facility.

Groundwater corrective actions will be in accordance with Appendix B of the Solid Waste Regulations. These include, but are not limited to:

- The owner/operator will implement assessment monitoring in conformance with Appendix B, Section B5, of the Solid Waste Regulations if statistically significant increases (SSIs) in groundwater concentrations over background have been determined.
- The owner/operator will conduct an assessment of interim measures and corrective measures in conformance with Appendix B, Section B6, of the Solid Waste Regulations if SSIs of groundwater constituents are verified.
- The owner/operator will select a groundwater remedy and implement the corrective action program in accordance with Appendix B, Sections B7 and B8, of the Solid Waste Regulations.

- The owner/operator will contain, control, and correct leachate seeps to prevent water pollution occurring beyond the point of compliance.

13.7 Groundwater and Explosive Gas Monitoring

The Department may impose additional environmental monitoring requirements, including the installation of additional groundwater wells and/or gas probes to the monitoring network as outlined in Appendix C.

13.8 Post-Closure Land Uses

The following land uses are currently planned for the landfill property during the post-closure care period:

- Recyclables collection
- Use of the burn pit up to twice a year

All of the above uses will be conducted on areas of the site off the landfill footprint, final cover, and areas not adversely affecting site stormwater control features. The owner/operator must not conduct other uses at the property without prior approval from the Department.

Any proposed disturbance of the landfill final cover or stormwater controls will be subject to prior review and approval by the Department.

13.9 Post-Closure Cost Estimate and Financial Assurance

In accordance with Section 4.3.1 of the Solid Waste Regulations, prior to operating, the facility will have a detailed cost estimate for required post-closure care activities. This will be provided to the CDPHE under separate cover from this EDOP.

14.0 RECORDKEEPING AND REPORTING

In accordance with Sections 2.4 and 3.4 of the Solid Waste Regulations, the owner/operator will maintain the operating record that will include, at a minimum, the following documents:

- The facility's CD issued by Jackson County.
- Documentation showing the detail underlying volumes used for payment of the Solid Waste User Fee in accordance with Section 1.7.4 of the Solid Waste Regulations, as well as proof of payment.
- This EDOP, including modifications and amendments.
- Location restriction demonstrations required by Section 3.1 of the Solid Waste Regulations.
- Records of inspections that are required by this EDOP, including, but not limited to, inspections of incoming waste to evaluate potential prohibited wastes, and other required inspections of the facility.
- Evidence of fulfillment of all required reporting under this EDOP.
- Records documenting introductory and annual employee training.
- Groundwater monitoring and explosive gas monitoring results and any remediation plans required by Section 2.3 of the Solid Waste Regulations.
- Design documentation for controlling leachate.

- Leachate depth, column length, volume measurements, and leachate testing and disposal documentation.
- Demonstrations, certifications, findings, data, or documents required by Section 2.2 of the Solid Waste Regulations relating to groundwater monitoring.
- Closure and post-closure care plans and any monitoring, testing, or analytical data as required by Sections 2.5 and 2.6 of the Solid Waste Regulations.
- Revised closure and post-closure cost estimates that are required every five years (known as the "Revised Cost Estimate" or "RCE") and annual financial assurance documentation required by Section 4 of the Solid Waste Regulations.
- Information demonstrating compliance with waivers as required by Section 1.5 of the Solid Waste Regulations.
- Waste screening documentation, including analytical reports for wastes requiring review and approval prior to acceptance.
- Daily incoming waste volumes.
- Daily records documenting wind speeds at the facility and any facility closures due to excessive winds in accordance with the EDOP.
- If applicable, copies of current Burn Permits issued by Colorado's APCD for open burning of untreated wood, including brush and tree branches.
- If waste tires are to be collected at the facility for recycling in accordance with Section 10 of the Solid Waste Regulations, a decal issued by the Department showing that the facility has a Certificate of Registration as a Waste Tire Collection Facility.
- Facility construction record drawing and survey as-builts, including construction certification and quality assurance reports.
- Variations from the facility's approved EDOP.

The facility shall notify the Department and the local governing body when monitoring reports and documentation required in this section are placed in, or added to, the operating record. All information included in the operating record must be furnished upon request at reasonable times to the local governing body or Department representatives.

15.0 REFERENCES

United States Geological Survey (USGS). 2019a. 2014 United States (Lower 48) Seismic Hazard Long-term Model. Available online: https://www.usgs.gov/natural-hazards/earthquake-hazards/science/2014-united-states-lower-48-seismic-hazard-long-term?qt-science_center_objects=0#qt-science_center_objects (accessed July 9, 2020)

USGS. 2019b. Data Release for the 2014 National Seismic Hazard Model for the Conterminous U.S. Available online: https://www.sciencebase.gov/catalog/item/5db9be62e4b06957974eb5ca (accessed July 9, 2020)

Signature Page

Golder Associates Inc.

https://golderassociates.sharepoint.com/sites/110066/project files/6 deliverables/reports/6-r-edop/6-r-2/19124320-6-r-2-jackson_county_landfill_edop_08jan21.docx

Tables

Table 4: Small Landfill Operations Matrix

Schedule	Type of Activity	EDOP Section	Documentation, Notification, or Reporting
Daily			
	Routine load inspections	Operations Plan	Document unacceptable loads
	Compact waste and cover	Operations Plan	
	Secure the site	Operations Plan	
Weekly/Every Other Week			
	Random load screening	Operations Plan	Use screening log and put into Operating Record
	Inspect site for wind-blown debris, nuisances & other problems	Operations plan	Notation into facility log in Operating Record
Within 14 days of major precipitation event (see Section 12.5 of the EDOP)	Inspect ditches/ponds	Operations Plan	Repair within 3 months Document into Operating Record
Monthly			
	Inspect perimeter fencing, gates, wells, ditches, ponds	Operations Plan	Use form and put into Operating Record
Quarterly			
	Groundwater monitoring	Monitoring Plan	Notify CDPHE for exceedances
	Explosive gas monitoring	Monitoring Plan	Notify CDPHE for exceedances
	Leachate monitoring (if applicable)	Monitoring Plan	Use form and put into Operating Record
	Inspect storm-water controls and repair	Operations Plan	Use Form and put note into Facility log in Operating Record
	Pay solid waste user fee (HSRF)	Operations Plan	Submit form and payment to CDPHE

Schedule	Type of Activity	EDOP Section	Documentation, Notification, or Reporting
Annually			
	Staff Training	Operations Plan	Document training in Operating Record
Before April 1	monitoring report	Monitoring Plan	Submit report to the CDPHE
	Adjust closure and post-closure cost	Financial Assurance	Submit to the CDPHE and fund mechanism accordingly
Every 5 years	Recalculate post- closure cost estimate	Financial Assurance	Submit to CDPHE for review/approval, adjust funding accordingly
	Fire Department inspection and plan review	Operations Plan	Add to facility log in Operating Record
As needed	Waste not accepted	Operations Plan	Facility log
	Contingency Plan actions	Contingency Plan	
24 hours	Fire at working face	Contingency Plan	Call the CDPHE and document in the Operating Record
24 hours	Large spill > 25 gal	Contingency Plan	Call the CDPHE or haz mat and document actions
24 hours	Potential release to surface water or groundwater	Contingency Plan	Call theCDPHE and document actions
Within 72 hours of high-wind event	Inspect for nuisances, damage and wind-blown debris	Operations Plan	Facility log in Operating Record

Schedule	Type of Activity	EDOP Section	Documentation, Notification, or Reporting
Closure & Post-Closure			
		Closure Plan	Notify the CDPHE and the public
		Closure Plan	Notify the CDPHE
		Closure Plan	Submit certification report within 60 days of closure completion
		Closure Plan	Notify the CDPHE and provide documentation
Quarterly	Monitoring methane	Post-Closure Plan	Annual monitoring report
	Post-closure inspections	Post-Closure Plan	Repair within 3 months and document into Operating Record
Frequency varies	Monitoring groundwater	Post-Closure Plan	Annual monitoring report
Annually	Monitoring report	Monitoring Plan	Exceedances and reportable results
	Adjust closure and post-closure cost	Financial Assurance	Report to the CDPHE and fund accordingly
Every 5 years	Recalculate post- closure cost estimate	Financial Assurance	Submit to the CDPHE for review/approval, adjust funding accordingly

Drawings

LEGEND

▨	EXISTING GROUND (SEE NOTE 1)
—·—·—	PROPERTY BOUNDARY
◐ **MW-1**	MONITORING WELLS (SEE NOTE 2)

NOTE(S)

1. EXISTING TOPOGRAPHY IS A COMPOSITE OF GROUND SURVEY PROVIDED TO GOLDER BY JACKSON COUNTY ON MARCH 27, 2020 PERFORMED BY NORTH PARK ENGINEERING & CONSULTING, INC. MARCH 2020 AND USGS CONTOURS.
2. MONITORING WELL LOCATIONS ARE APPROXIMATE.
3. AERIAL IMAGERY: ESRI BASEMAP SERVICES, DIGITAL GLOBE CAPTURED ON 10/29/2018.
4. ELEVATION DATA SET: USGS NATIONAL ELEVATION DATA SET 1 ARC-SECOND

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1" = 80' FEET

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DRAFT

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2020-10-16	DRAFT	AA	SIB	ALB	MEM

SEAL

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BOARD OF COMMISSIONERS
JACKSON COUNTY, CO

CONSULTANT
GOLDER

GOLDER ASSOCIATES
7245 W ALASKA DRIVE
SUITE 200
LAKEWOOD, CO 80226
(303) 980-0540
www.golder.com

PROJECT
JACKSON COUNTY
C&D AND MSW LANDFILL CELLS
WALDEN, CO

TITLE
EXISTING CONDITIONS

PROJECT NO. 19124320
REV. 2
1 of 8
DRAWING 1

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▨	EXISTING GROUND (SEE NOTE 1)
▨	SUBGRADE GRADES
◐ MW-1	MONITORING WELLS (SEE NOTE 2)
—··—··—	PROPERTY BOUNDARY
——	LIMIT OF WASTE

NOTE(S)

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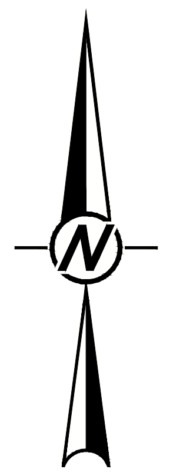
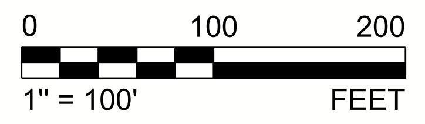
4. ELEVATION DATA SET: USGS NATIONAL ELEVATION DATA SET 1 ARC-SECOND





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PROJECT
JACKSON COUNTY
C&D AND MSW LANDFILL CELLS
WALDEN, CO

TITLE
SUBGRADE

PROJECT NO.
19124320

REV.
2

2 of 8

DRAWING
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1" = 50' FEET

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LEGEND

▨	EXISTING GROUND (SEE NOTE 1)
🟩	C&D LINER GRADES
● **MW-1**	MONITORING WELLS (SEE NOTE 2)
-··-··-	PROPERTY BOUNDARY

NOTE(S)

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REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2020-10-16	DRAFT	AA	SIB	ALB	MEM

SEAL

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PROJECT
JACKSON COUNTY
C&D AND MSW LANDFILL CELLS
WALDEN, CO

TITLE
C&D LINER

PROJECT NO. 19124320
REV. 2
3 of 8
DRAWING 3

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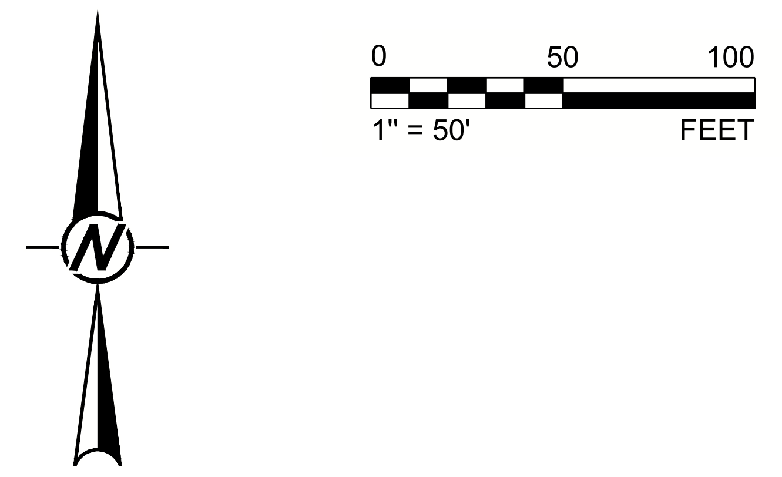
SURFACE WATER CROSSING AND RIPRAP LINED DOWNCHUTE TO BE DESIGNED PRIOR TO PERIMETER BERM CONSTRUCTION



LEGEND

▨	EXISTING GROUND (SEE NOTE 1)
▨	FINAL COVER GRADES
● MW-1	MONITORING WELLS (SEE NOTE 2)
— · · —	PROPERTY BOUNDARY
<	PERIMETER CHANNEL

NOTE(S)

1. EXISTING TOPOGRAPHY IS A COMPOSITE OF GROUND SURVEY PROVIDED TO GOLDER BY JACKSON COUNTY ON MARCH 27, 2020 PERFORMED BY NORTH PARK ENGINEERING & CONSULTING, INC. MARCH 2020 AND USGS CONTOURS.
2. MONITORING WELL LOCATIONS ARE APPROXIMATE.
3. AERIAL IMAGERY: ESRI BASEMAP SERVICES, DIGITAL GLOBE CAPTURED ON 10/29/2018.
4. ELEVATION DATA SET: USGS NATIONAL ELEVATION DATA SET 1 ARC-SECOND

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2020-10-16	DRAFT	AA	SIB	ALB	MEM

SEAL

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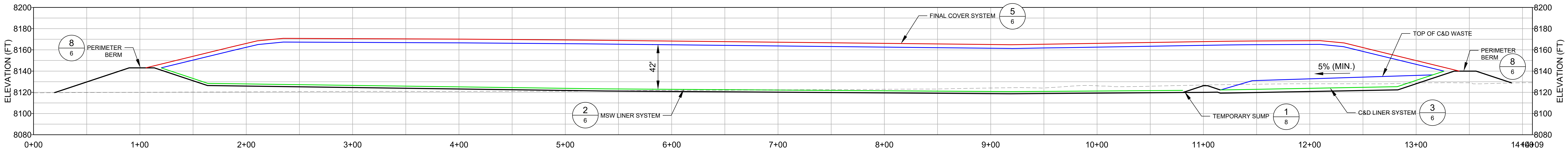
WALDEN, CO

TITLE
FINAL COVER GRADES

PROJECT NO.	REV.		DRAWING
19124320	2	4 of 8	4



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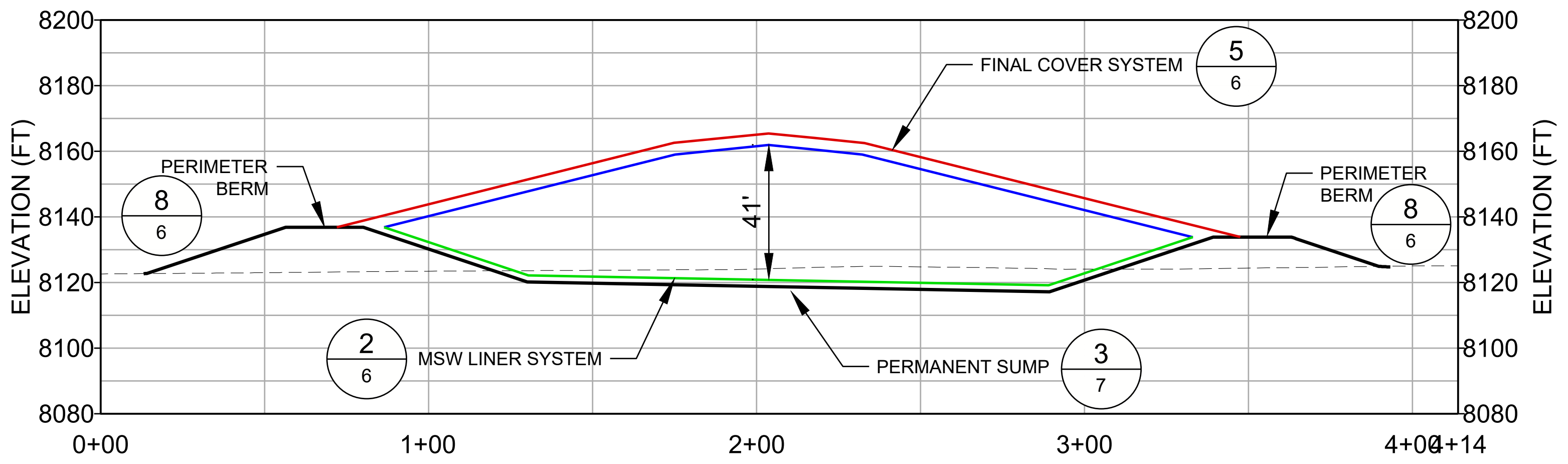

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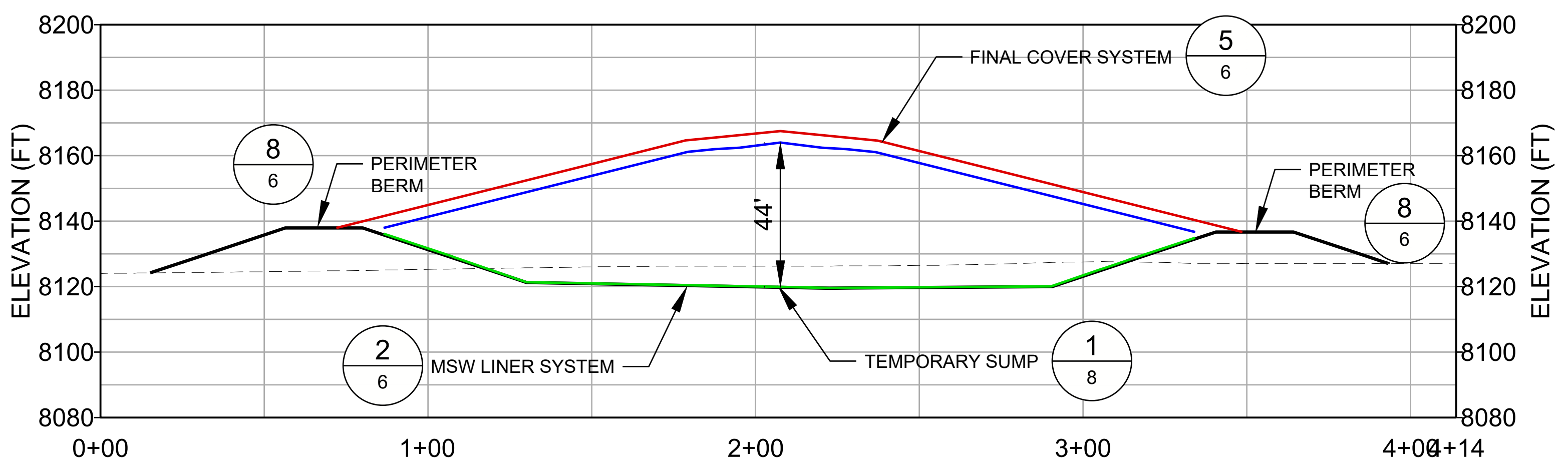


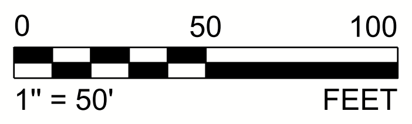
AL - C

SCALE 1" = 50' B / 5 B-B'

SCALE 1" = 50' C / 5 C-C'

LEGEND

- FINAL COVER
- TOP OF WASTE
- EXISTING GROUND
- TOP OF LINER
- MSW LINER



NOT FOR CONSTRUCTION

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REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2020-10-16	DRAFT	AA	SIB	ALB	MEM

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PROJECT
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C&D AND MSW LANDFILL CELLS
WALDEN, CO

TITLE
SECTIONS

PROJECT NO.
19124320

REV.
2

5 of 8

DRAWING
5

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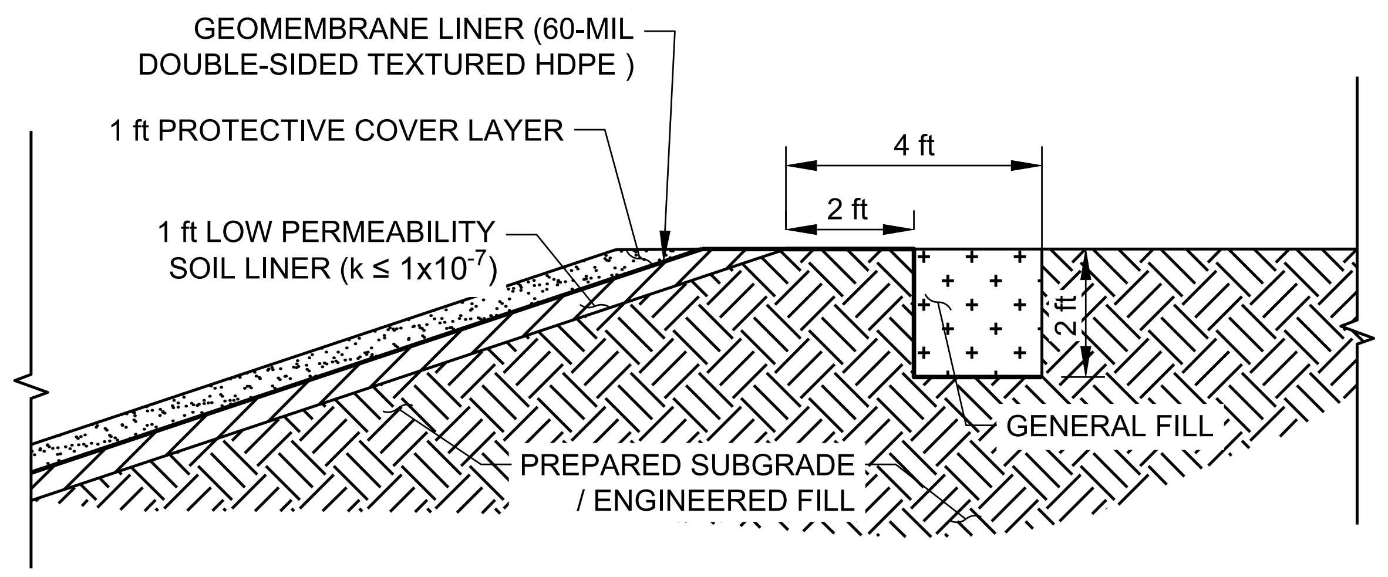

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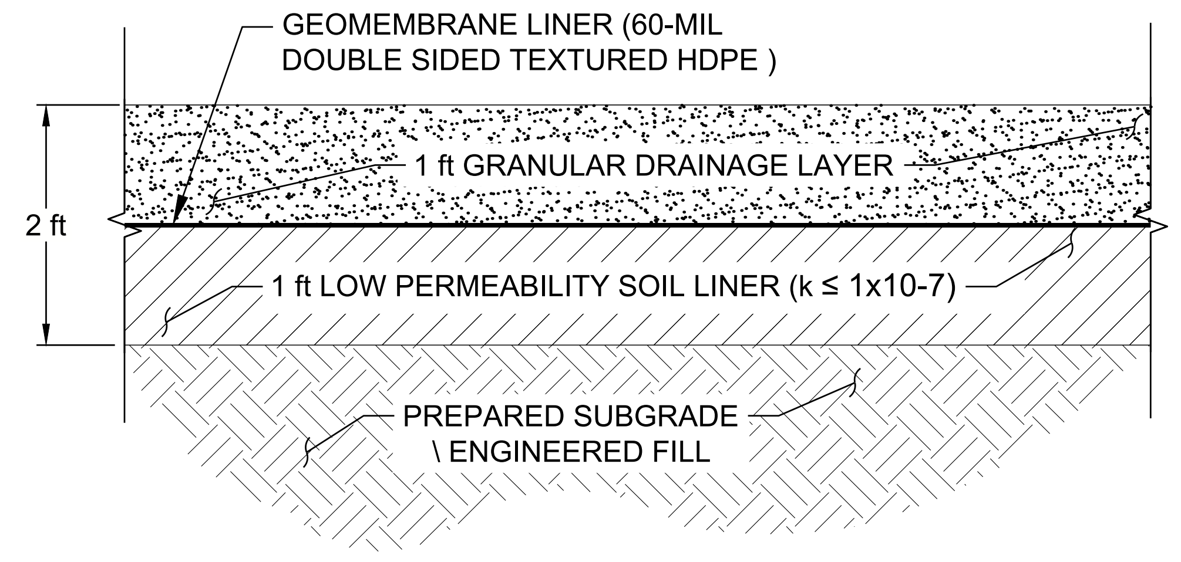

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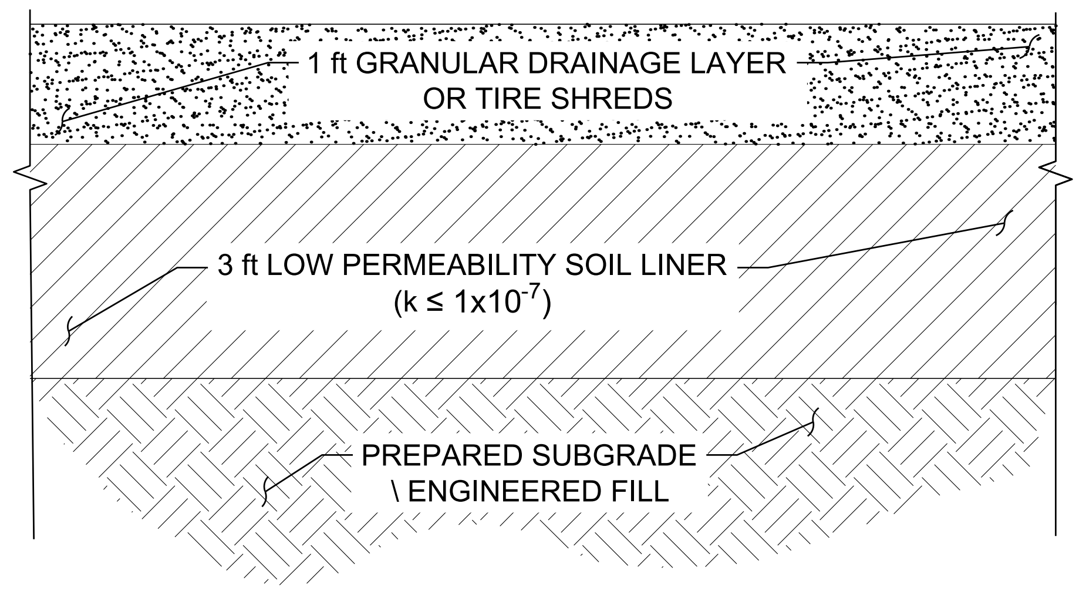

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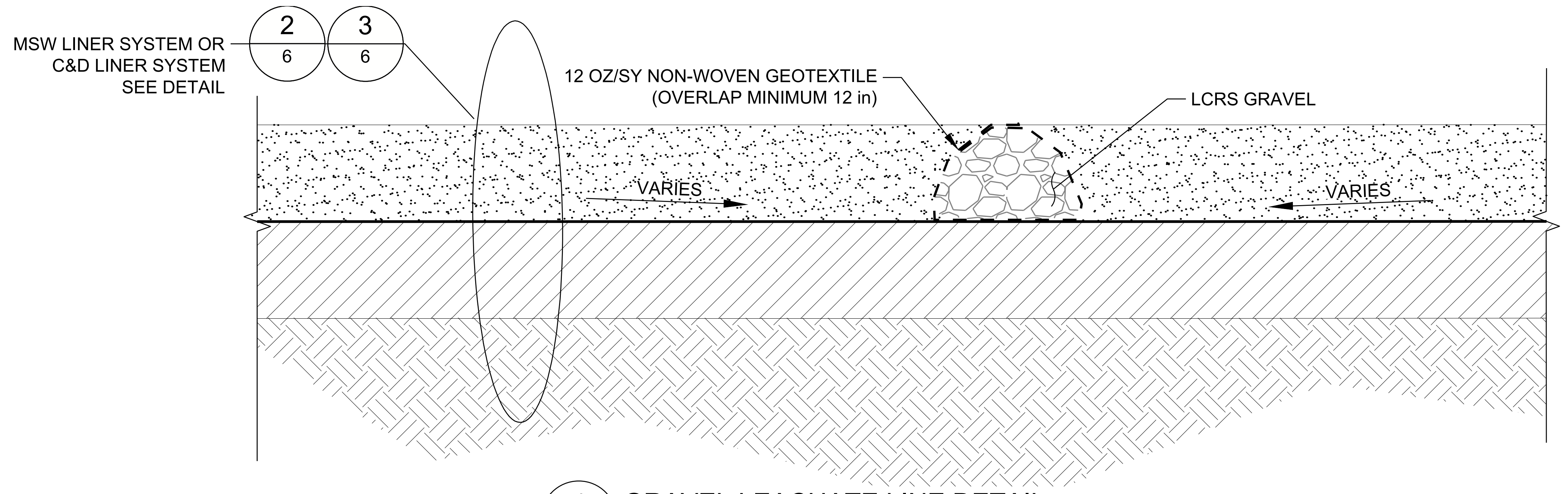

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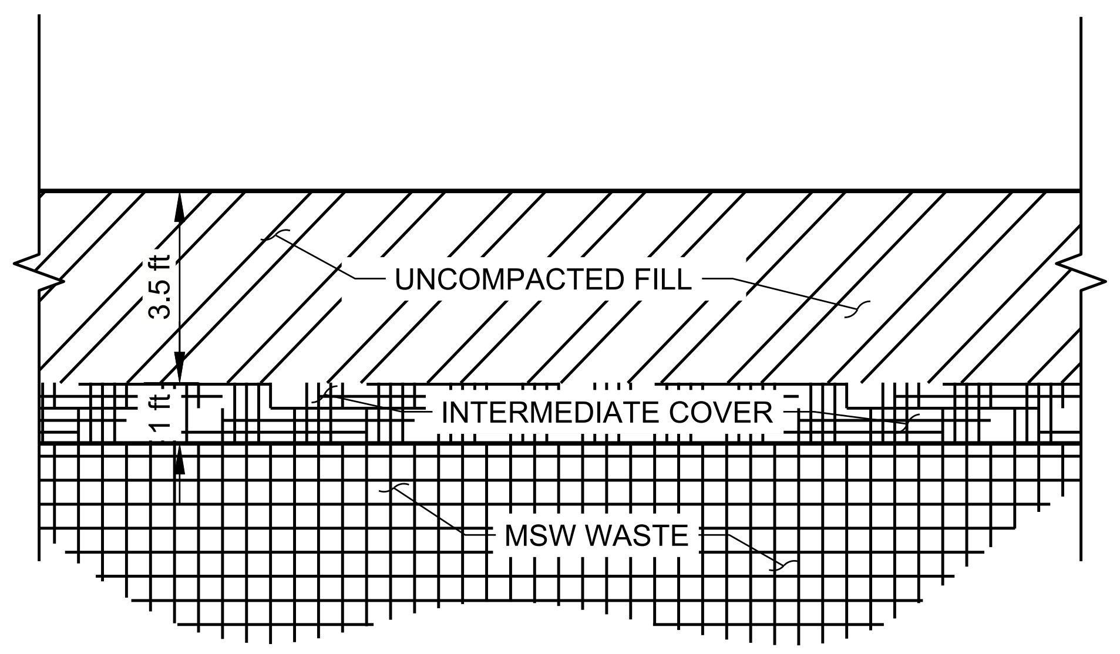

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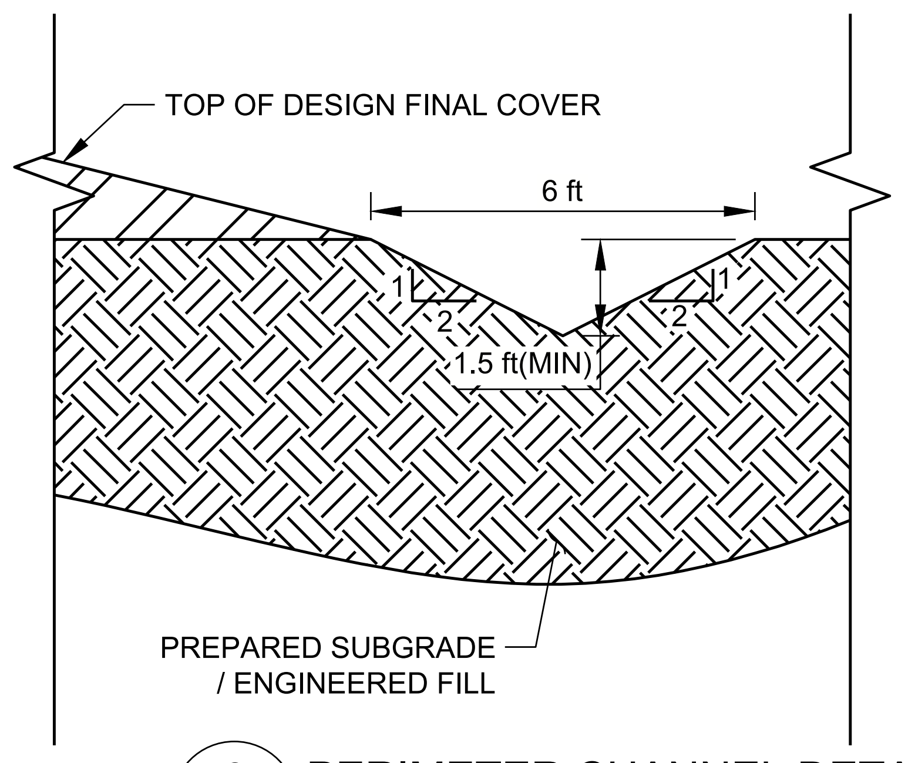

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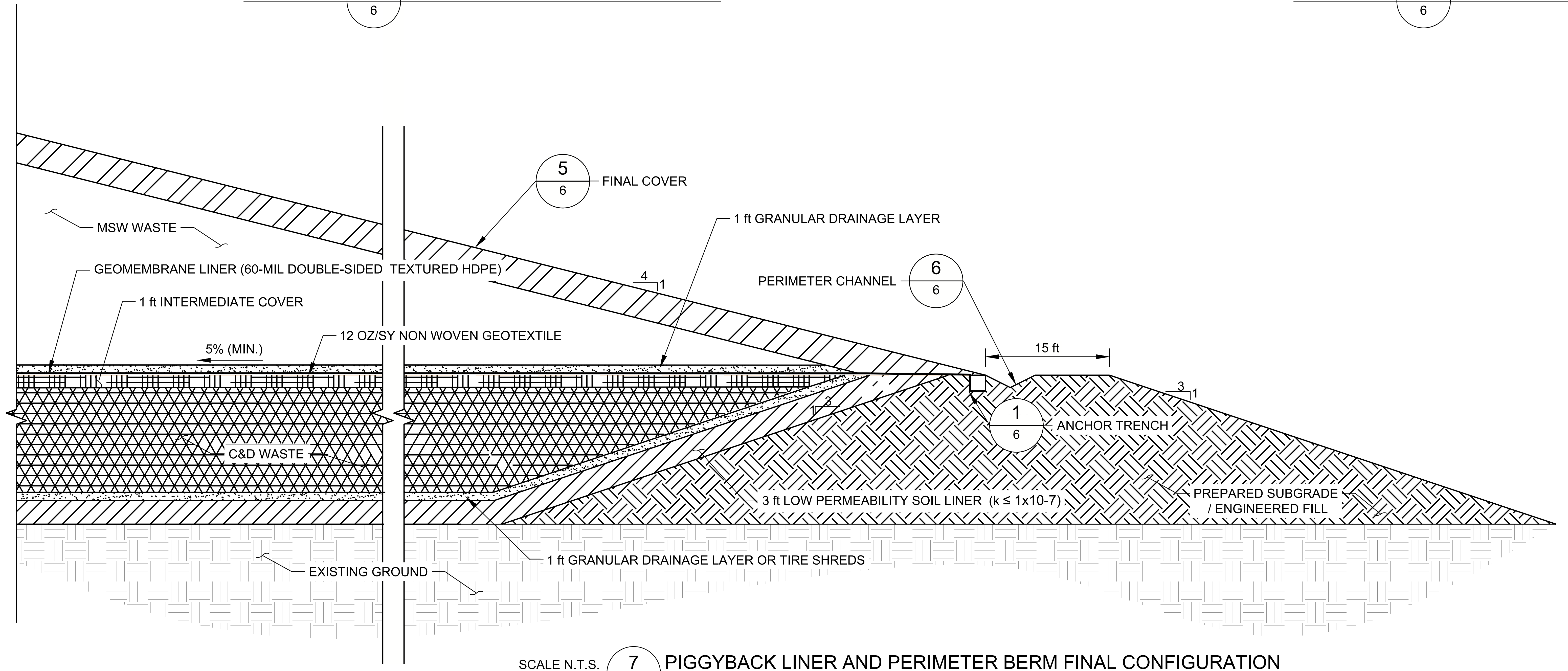

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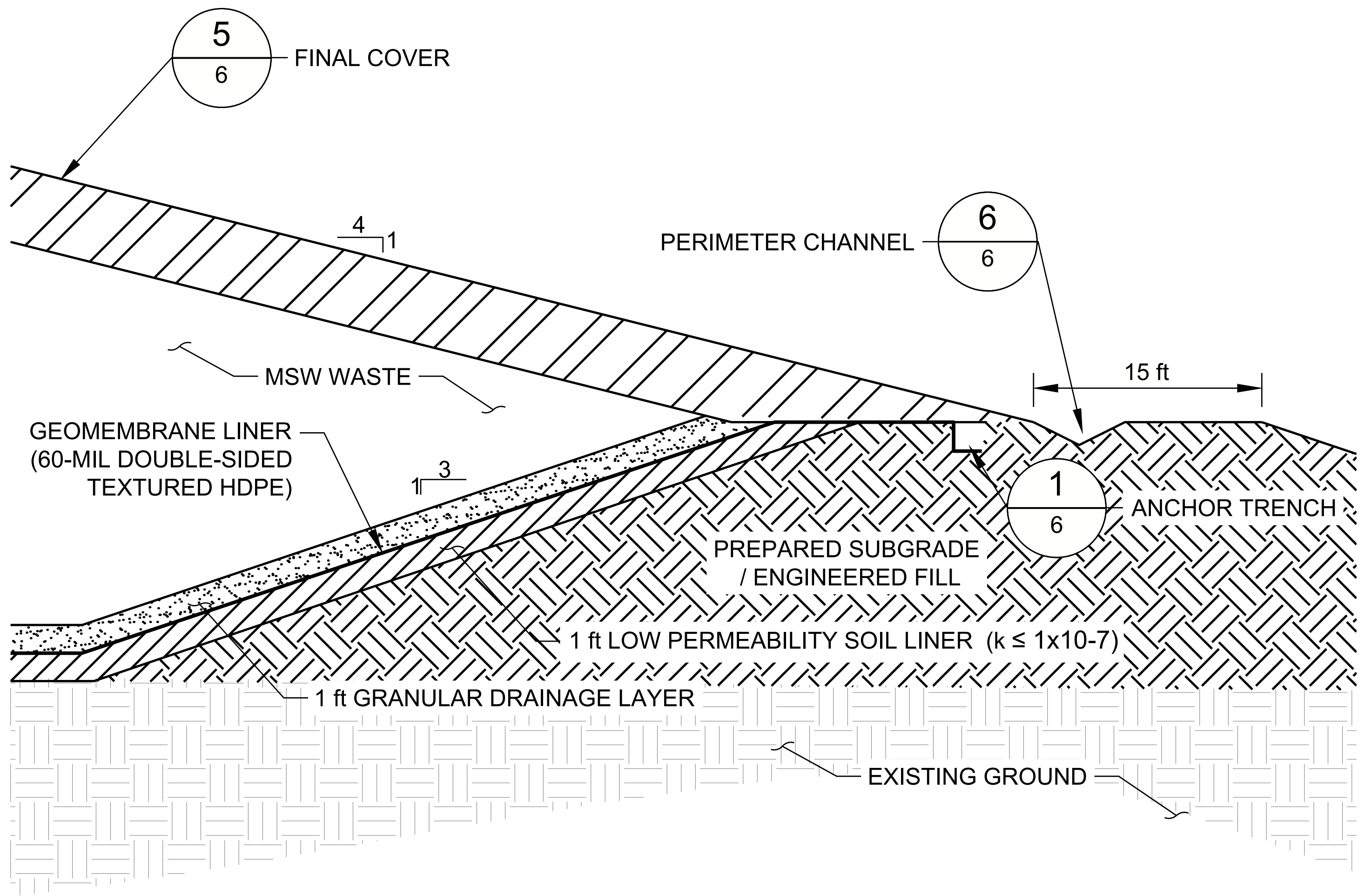

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PROJECT
JACKSON COUNTY
C&D AND MSW LANDFILL CELLS
WALDEN, CO

TITLE
DETAIL SHEET (1 OF 3)

PROJECT NO.	CONTROL	REV.	6 of 8	DRAWING
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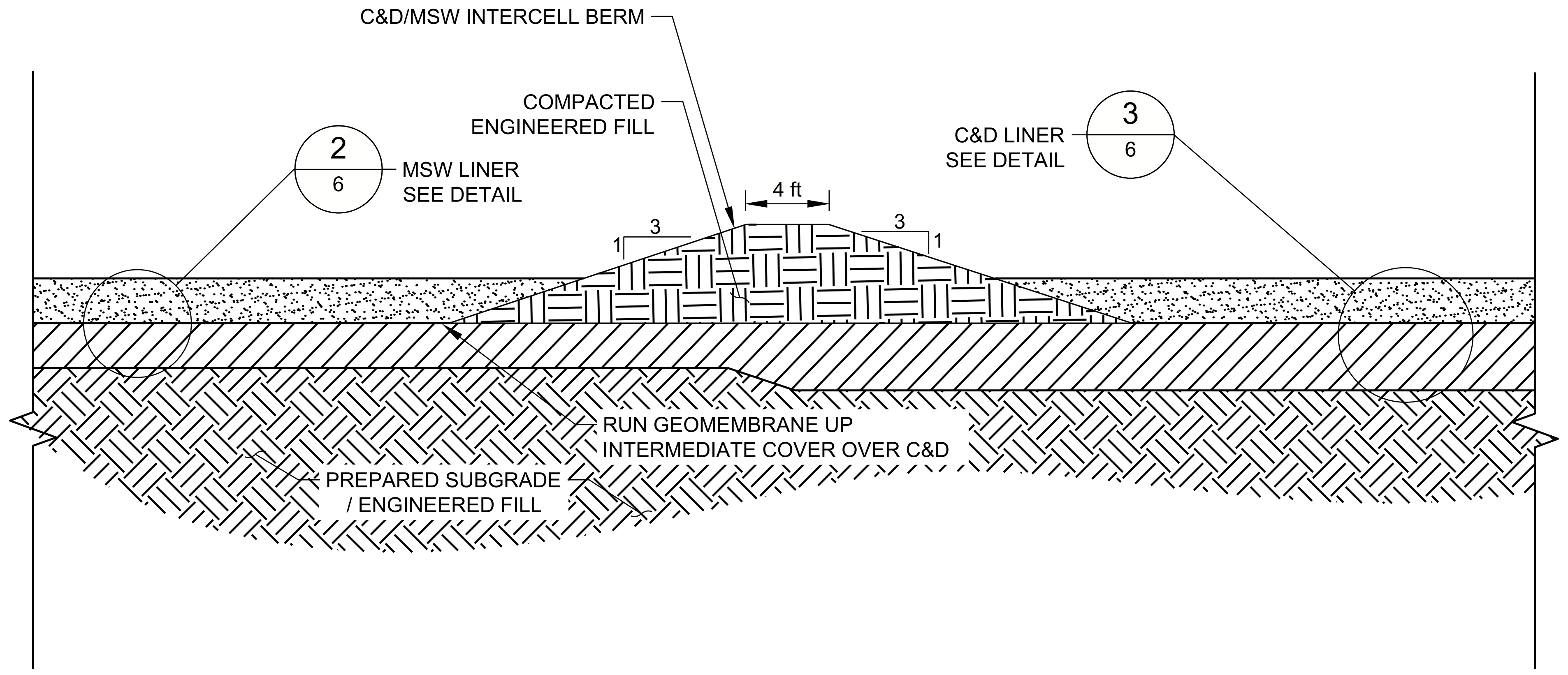

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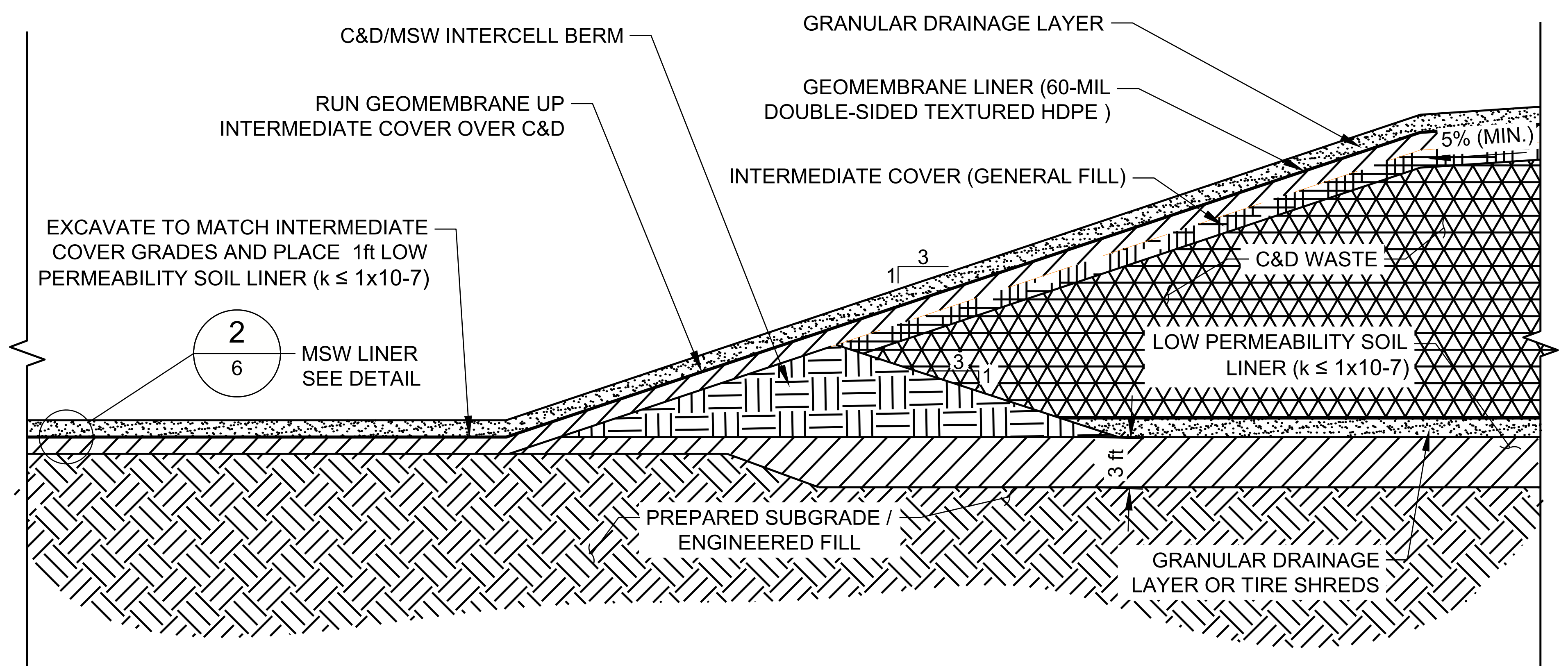

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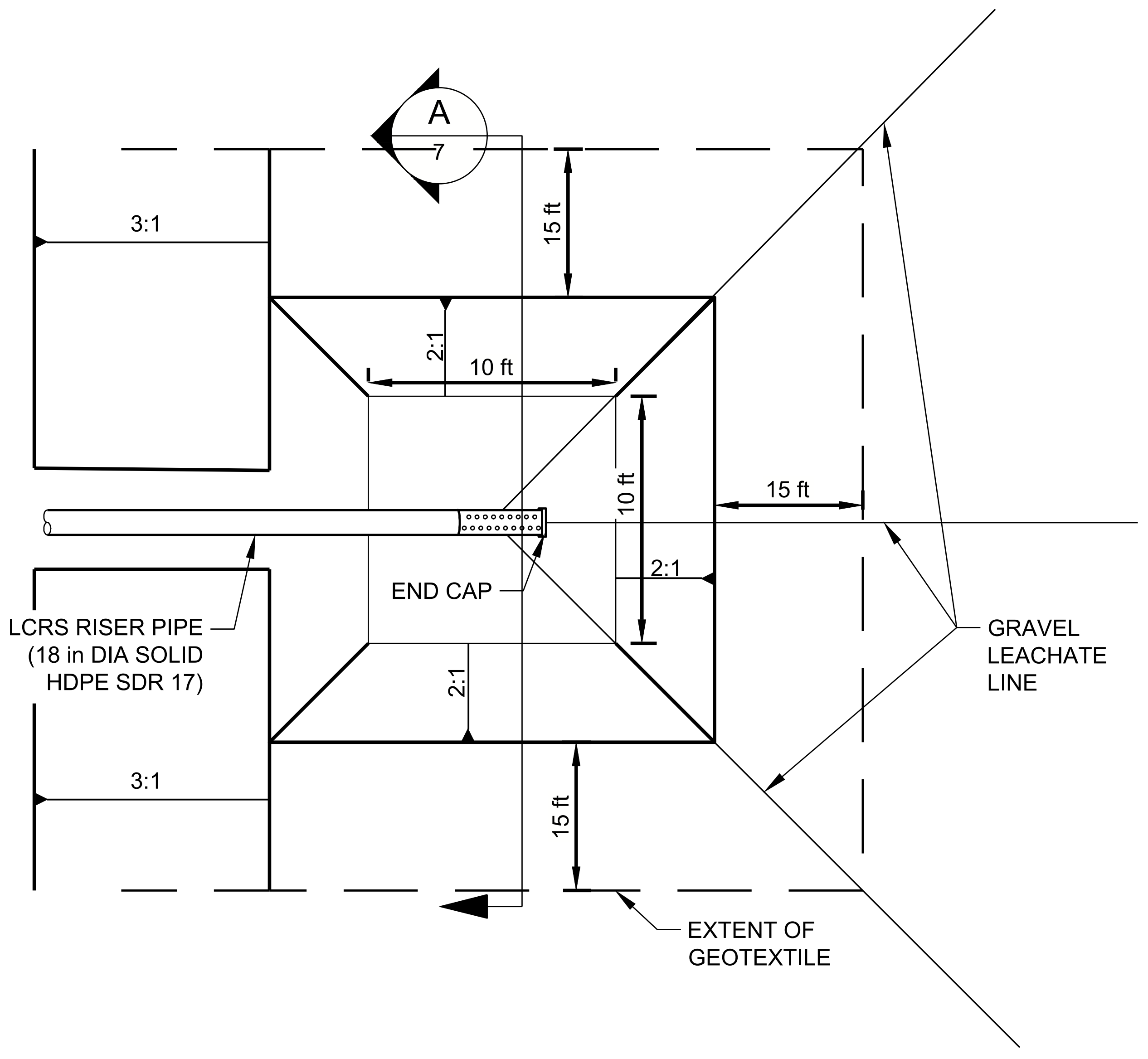
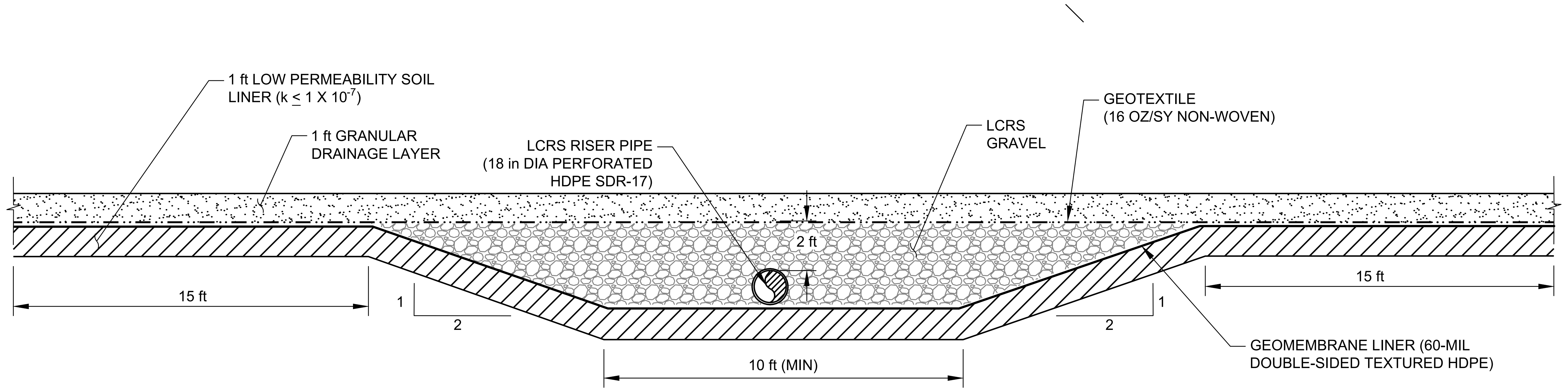


SCALE N.T.S. 3 7 TYPICAL PERMANENT SUMP PLAN VIEW



SCALE N.T.S. A 7 TYPICAL PERMANENT SUMP SECTION

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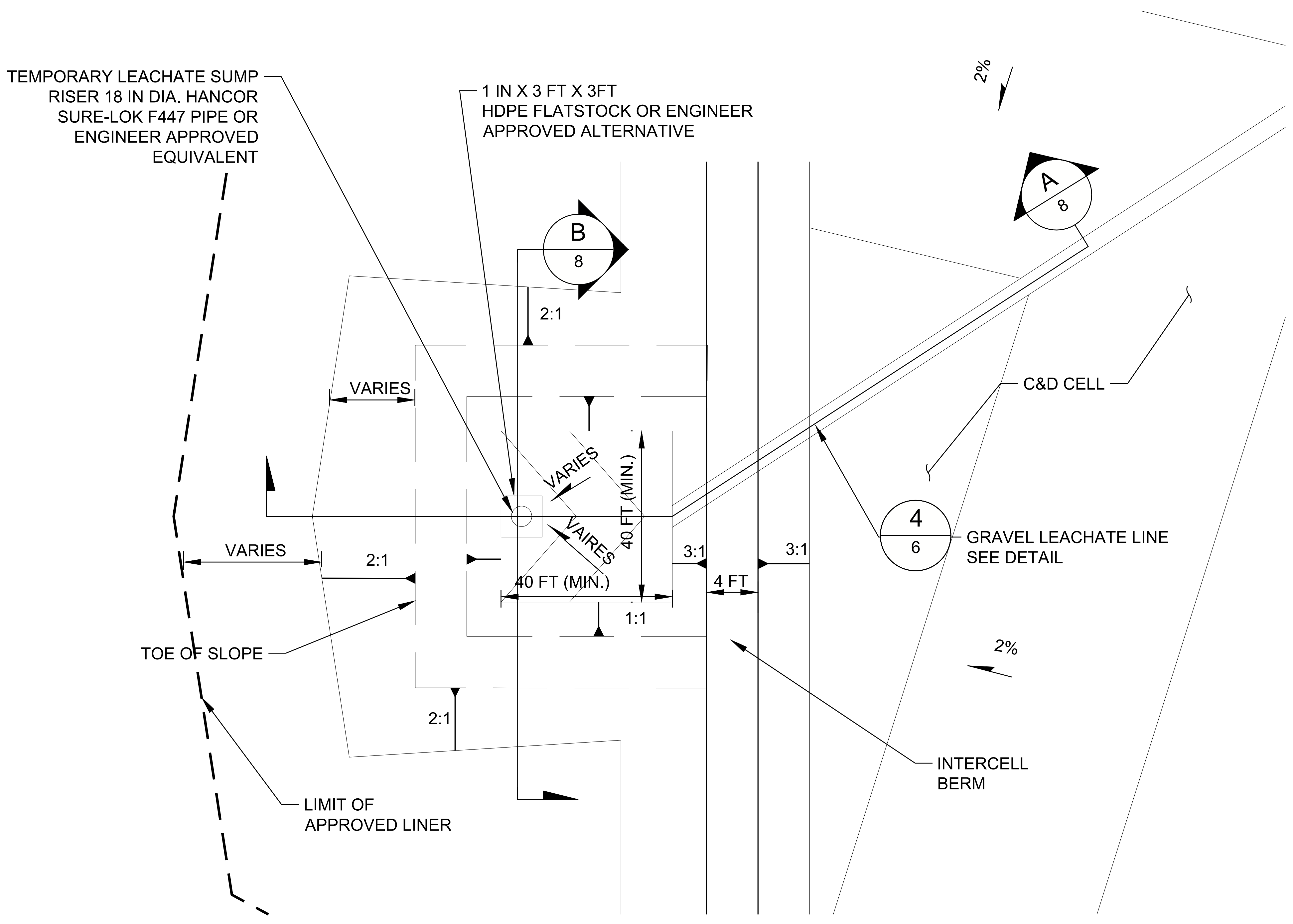
C&D AND MSW LANDFILL CELLS
WALDEN, CO

TITLE
DETAIL SHEET (2 OF 3)

PROJECT NO.	CONTROL	REV.		DRAWING
19124320	A007	2	7 of 8	7



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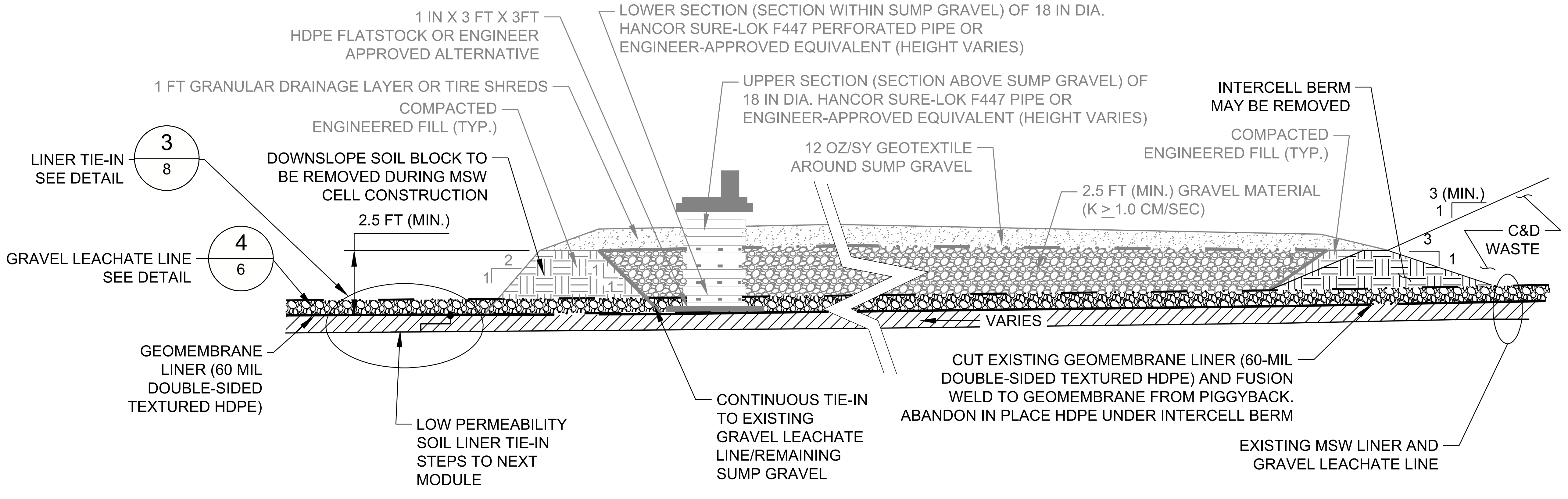
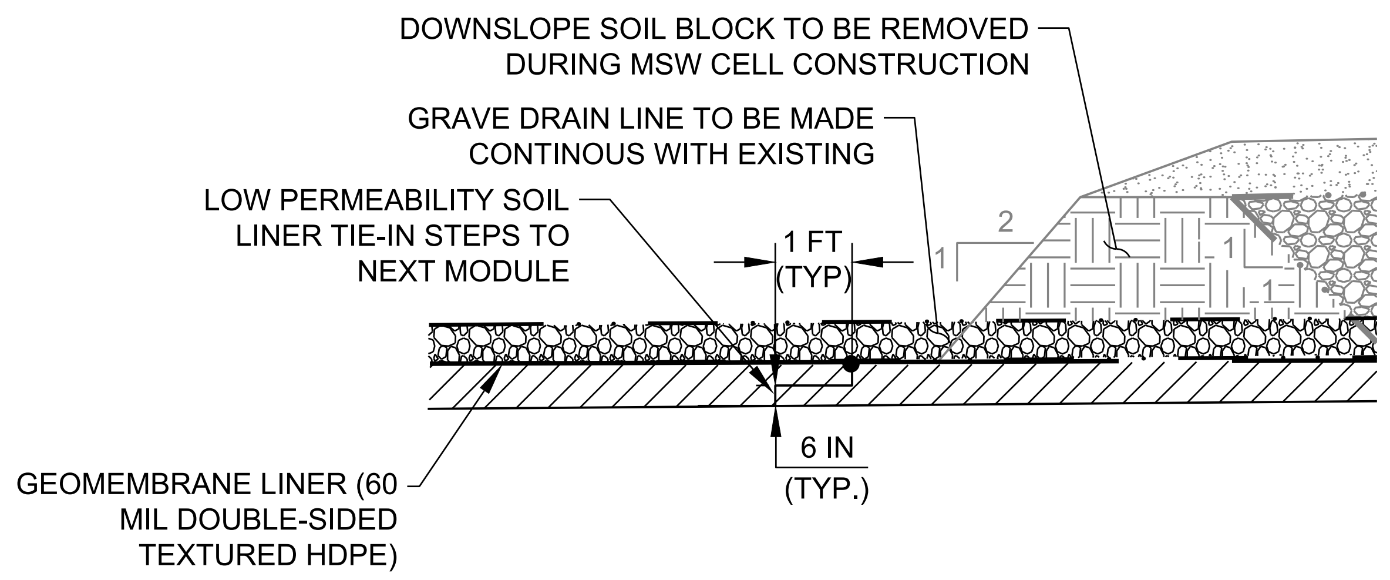


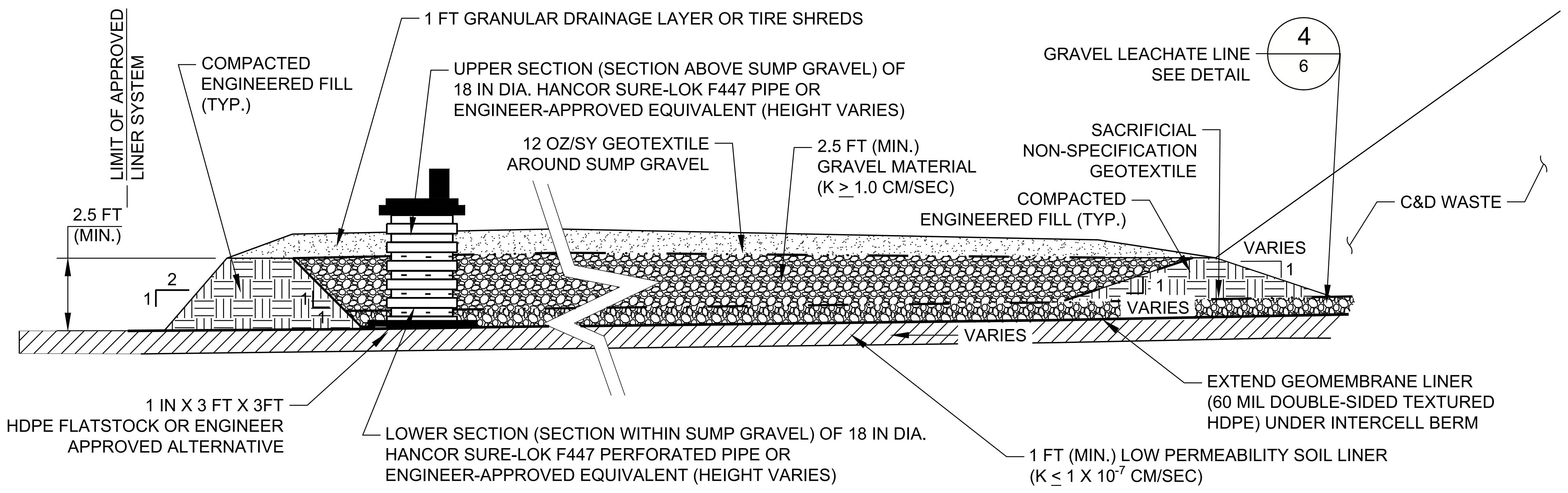
SCALE N.T.S. 2/8 TYPICAL TEMPORARY SUMP TIE-IN DETAIL

NOTE: GRAYED LINEWORK TO BE REMOVED DURING MSW CELL CONSTRUCTION



SCALE N.T.S. 3/8 TYPICAL MSW LINER TIE-IN AT TEMPORARY SUMP

NOTE: GRAYED LINEWORK TO BE REMOVED DURING MSW CELL CONSTRUCTION



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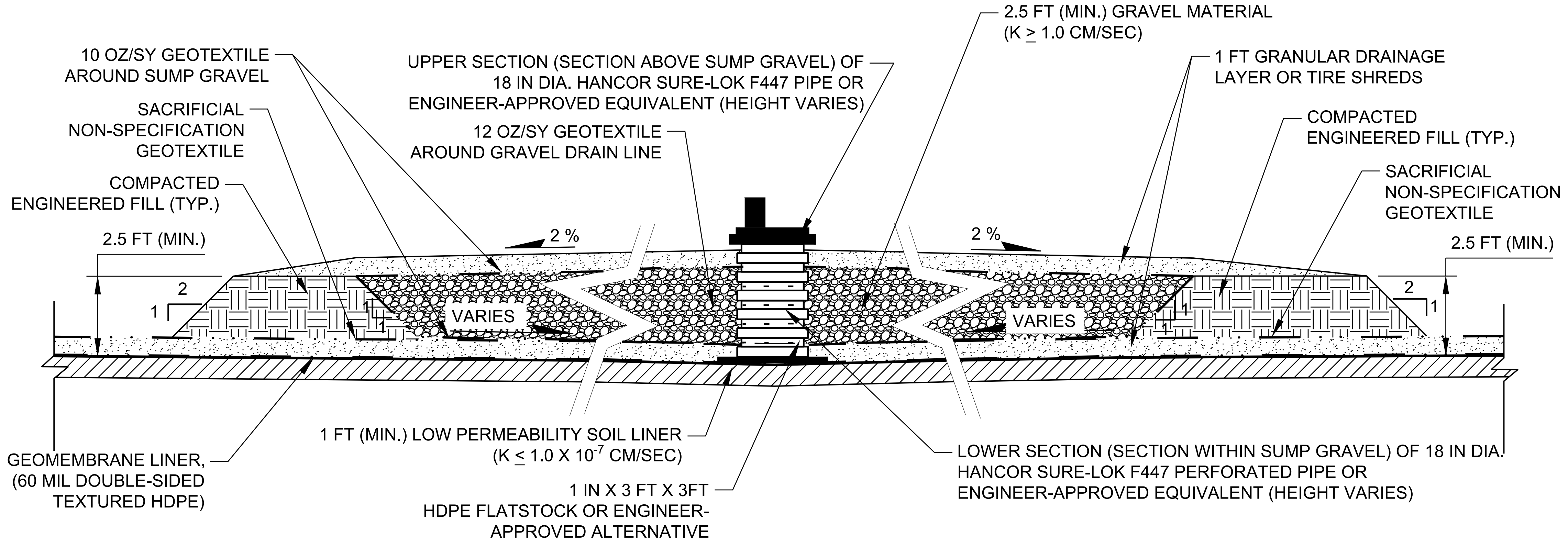

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REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2020-10-16	DRAFT	AA	DVS	ALB	MEM

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JACKSON COUNTY
C&D AND MSW LANDFILL CELLS
WALDEN, CO

TITLE
DETAIL SHEET (3 OF 3)

PROJECT NO.	CONTROL	REV.	8 of 8	DRAWING
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ATTACHMENT 1

Random Inspection Form

RANDOM WASTE SCREENING FORM

GENERAL INFORMATION: (COMPLETED BY TRANSPORTER OR LANDFILL PERSONNEL)

DATE & TIME: ______________________________

LICENSE PLATE: ______________________________

SOURCE OF WASTE: ______________________________

TYPE OF WASTE: ______________________________

INSPECTION OBSERVATIONS: (COMPLETED BY LANDFILL PERSONNEL)

HAZARDOUS WASTE LABELS OR PLACARDS	YES / NO
PCB TRANSFORMERS, LABELS OR PLACARDS	YES / NO
BATTERIES	YES / NO
OIL/GREASE	YES / NO
BULK OR CONTAINERIZED LIQUIDS	YES / NO
SLUDGES, PASTES OR SLURRIES	YES / NO
POWDERS, DUSTS, SMOKE OR VAPORS	YES / NO
PETROLEUM ODERS	YES / NO
UNUSUAL ODORS	YES / NO
UNUSUAL COLORS	YES / NO
OTHER SUSPICIOUS CONDITIONS	YES / NO

IF YES, DESCRIBE:

____

PHOTOS TAKEN YES / NO (ATTACH WHEN AVAILABLE)

WASTE ACCEPTED YES / NO

SIGNATURE INSPECTOR:

____

WHY WAS THE WASTE REJECTED:

____

WHAT HAPPENED TO THE REJECTED WASTE:

____

TRANSPORTER'S PRINTED NAME:

____

SIGNATURE TRANSPORTER:

____

APPENDIX A

Bird Control Plan

REPORT

Bird Control Plan

Appendix A

Submitted to:

Jackson County
PO Box 1019
Walden, Colorado 80840

Submitted by:

Golder Associates Inc.
7245 W Alaska Drive, Suite 200, Lakewood, Colorado, USA 80226

+1 303 980-0540

19124320-6-R-0

July 2020

Table of Contents

1.0 INTRODUCTION

This Bird Control Plan (Plan) for Jackson County Landfill (JCL) has been prepared as a part of the Engineering Design and Operations Plan (EDOP) because the proposed JCL is about 3,000 feet from the closest runway at the Walden/Jackson County Airport located to the south. While the airport is infrequently used, Jackson County is nevertheless committed to implement this Plan that shows how Jackson County will mitigate potential bird hazards to aircraft using the airport. The Plan contains several different techniques that will be used in concert with each other. These techniques include engineering controls to limit the availability of food to birds, controls to limit access of the JCL to birds, and pyrotechnics and monitoring of bird populations to disperse any birds that may be feeding at the site. This Plan will be evaluated on an ongoing basis to optimize the use of these techniques in the Plan as operations of the JCL begin to adopt the approach that provides the most effective mitigation of bird threats to aircraft using the airport.

2.0 ENGINEERING CONTROLS TO LIMIT THE AVAILABILITY OF WASTE TO BIRDS

Engineering controls will be used on an ongoing basis by the JCL to limit the potential access to the JCL waste at the landfill. These controls will consist of the following:

- The working face of the landfill will be limited to 25 feet wide by 10 feet deep (250 square feet) to limit the maximum area upon which birds could feed on incoming waste.
- The working face of the landfill will be covered with six inches of soil or tire shreds at the end of each day.

These provisions will be monitored by the facility manager on an ongoing basis to make sure these provisions are followed. Based on the effectiveness of these measures, changes may be recommended by the facility manager, including changing the working face dimensions or changing the type or application rate of daily cover.

3.0 ENGINEERING CONTROLS TO LIMIT ACCESS OF THE JCL AREA TO BIRDS

Suspended netting systems will be used to enclose the active tipping area. These systems will be mobile so that they can be adjusted each day to the changing working face. This will be feasible because of the small working face, and would only require moving the netting every week or so. These systems will prevent birds from feeding, and hence the birds will not congregate with time as they are not successful in obtaining food from the waste. The concept for the netting would be to create a tunnel over the working face that is accessible from only one end. The netting will be of sufficient height, width, and length to allow for tipping and compacting equipment on the working face, and constructed of portable framing that will be moved by hand or by the available equipment on site. In conjunction with a limited working face area and daily cover, this system will discourage the congregation of birds as they will have very limited success in obtaining food at the landfill.

4.0 PYROTECHNICS AND MONITORING OF BIRD POPULATIONS

The landfill facility manager will coordinate with the Jackson County contact at the airport (currently Kent Crowder, (970) 218-4532) at the beginning of each week to get the flight schedule for departing and arriving aircraft. The facility manager will monitor the landfill each morning that an upcoming flight is due to depart or arrive at the airport. If birds are congregating at the landfill, the facility manager will use pyrotechnics to disperse the birds. The facility manager will monitor the effectiveness of the engineering controls outlined herein and pyrotechnics, if they are required, on a weekly basis and report to the Jackson County airport contact. If the actions outlined herein are not being effective in dispersing any bird populations, the facility manager and airport contact will discuss changes and/or additions to the Plan to mitigate risks to aircraft using the airport. These changes will be documented in written form and kept on file in the Operating Record for the site.

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APPENDIX B

Asbestos Management Plan

REPORT

Asbestos Waste Management Plan

Appendix B

Submitted to:

Jackson County Landfill

Submitted by:

Golder Associates Inc.

7245 W Alaska Drive, Suite 200, Lakewood, Colorado, USA 80226

+1 303 980-0540

19124320-6-R-2

January 2021

Table of Contents

APPENDICES

This plan has been developed to allow for the proper handling, disposal, and other required activities for safe and regulation-compliant asbestos waste management at the Jackson County Landfill (JCL). The plan has been prepared to address Section 5 of the Colorado Regulations Pertaining to Solid Waste Disposal Sites and Facilities (Regulations) as they apply to disposal of asbestos waste. The plan also addresses United States Department of Transportation (USDOT) and National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements for asbestos as these apply to asbestos waste disposal at the JCL. Definitions for key terms have been provided in in Section 2.0 of the main EDOP text.

The JCL requesting authorization to accept friable and non-friable asbestos. The general procedures for accepting all asbestos waste and specific procedures for handling disposal and covering, training, spill contingency plan, records maintenance, and closure/post-closure of non-friable and friable asbestos are provided herein.

1.0 GENERAL ASBESTOS WASTE ACCEPTANCE PROCEDURES

Generators are responsible for ensuring their wastes are compliant with all regulatory requirements and any specific requirements at JCL. JCL will only accept asbestos waste on a specific job basis. Clients will be required to complete a written request for disposal to JCL ahead of time that provides the exact dates of proposed disposal. No asbestos waste without prior approval from JCL will be accepted for disposal. The written request must contain the following information, which should be supplied on the attached Waste Shipment Record (Appendix B-1):

- Generator’s name and mailing address;
- Location/address where asbestos waste is generated;
- Type of asbestos (e.g., friable or non-friable); generator may be asked to provide analytical data or other backup information to substantiate asbestos type;
- Approximate quantity of waste for disposal (cubic yards); and
- Proposed date(s) for shipment.

Once the generator has supplied the above required information, JCL will review it and either approve or deny request for disposal.

All approved asbestos waste is required to be packaged as follows:

- Asbestos waste (friable and non-friable) subject to the requirements of Air Pollution Control Division (APCD) Regulation No. 8 must be contained within leak-tight disposal packaging.
- Friable asbestos and regulated asbestos-containing material (RACM) shall not be accepted for disposal unless it is tightly sealed in at least two 6-mil, leak-tight plastic bags or in a wrapping or other container (structurally rigid containers) deemed equivalent by the CDPHE in accordance with Section 5.3.5(A) of the Regulations.
- Non-friable asbestos not subject to the packaging requirements of APCD Regulation No. 8 shall not be accepted for disposal unless prepared in accordance with Section 5.2 of the Regulations.
- Regulated asbestos-contaminated soil (RACS) containing 1% or greater friable asbestos shall be packaged and disposed of in accordance with friable asbestos requirements. RACS containing less than 1% of friable

asbestos shall be packaged in a leak-tight container and disposed in a manner consistent with non-friable asbestos waste in accordance with Section 5.5.8(A)(c) of the Regulations.

Each package of asbestos or RACM will be marked and labeled with the following information unless transported as a bulk package less than 24 cubic yards and the transport vehicle is placarded with a Class 9 label:

- “RQ Asbestos Class 9 NA2212 PGIII” or USDOT-approved alternative

All packages, including bulk packaging, must have an Occupational Safety and Health Administration (OSHA) warning label in accordance with 29 CFR 1910.10001(j)(4)(ii) and Section 5.3.5 of the Regulations as follows:

CAUTION

CONTAINS ASBESTOS

AVOID OPENING OR BREAKING CONTAINER

BREATHING ASBESTOS IS HAZARDOUS

TO YOUR HEALTH

DANGER

CONTAINS ASBESTOS FIBERS

AVOID CREATING DUST

CANCER AND LUNG DISEASE HAZARD

Asbestos waste must be transported to JCL in an appropriate manner to ensure that containers remain intact and are not compromised. The following procedures will be followed when shipments reach the JCL gate:

- The generator is responsible for ensuring that the transport vehicle is marked appropriately.
- Each shipment of asbestos waste must be accompanied by a completed waste shipment record (WSR).
- The gate attendant at JCL will request the WSR from the transporter and will evaluate it to make sure it is complete.
- A visual inspection of the load (JCL personnel will not open bags to verify that material is asbestos) will be conducted at the gate to ensure the loads generally match the information on the WSR and that it is properly packaged. JCL personnel will note any discrepancies on the WSR. JCL reserves the right to reject any loads that are not properly packaged or that have become damaged in shipment.
- Any discrepancy between the WSR (Items 6 and 7) and the loads at the gate will be noted under Item 12 on the WSR. The generator will be contacted to determine the reason for the discrepancy. Any discrepancy that cannot be resolved within 15 days of the date of disposal will be reported to the CDPHE in accordance with the notification requirements of 40 CFR 61.154(e)(3), including details on the discrepancy, steps taken to reconcile the discrepancy, and a copy of the WSR.

- JCL will complete Items 12 and 13 of the WSR and send a signed copy of the WSR to the generator of the waste within 45 days of waste acceptance.

Asbestos waste will not be accepted at the site until the following have been confirmed by the compliance officer in coordination with the gate attendant:

- A dedicated disposal area is prepared and ready to accept waste.
- An adequate amount of non-asbestos waste or soil cover material and equipment necessary to cover the asbestos waste upon its placement in the asbestos disposal area are prepared and waiting near the trench.
- All unrelated landfill activities within 100 feet of such asbestos disposal areas are stopped during the placement, covering, and compaction of the asbestos waste.
- No non-essential persons are within 100 feet of such asbestos disposal areas during the placement, covering, and compaction of the asbestos waste.

2.0 PROCEDURES FOR HANDLING & DISPOSAL OF ASBESTOS WASTE

Dedicated areas for asbestos waste disposal will be identified prior to arrival of the asbestos for disposal. The areas for disposal will be located so that no friable asbestos wastes will be disposed of within 100 feet of the solid waste disposal site and facility property line. Because asbestos waste disposal is expected to be infrequent, on the order of a couple times a year, the dedicated areas will be prepared within the overall solid waste disposal area, but more than 100 feet from active landfilling area on a case-by-case basis. The area will be prepared by excavating a trench in existing waste that is of a size adequate to accommodate the asbestos waste shipment and can be readily covered in accordance with procedures outlined herein.

All asbestos waste in each pre-approved shipment will be directed to the dedicated area by the gate attendant and shall be disposed in the designated area. The disposal area will have vehicular access to receive the asbestos waste. It will have appropriate fencing (six-foot-high portable chain link fence that will be placed around the dedicated area for asbestos waste) and posted warning signs regarding disposal of asbestos waste at the facility, which will be in accordance with the requirements of Section 5.3.4 of the Regulations. The warning signs will be placed at the entrance of the asbestos disposal area and along the fenced perimeter at intervals of one sign per every 300 liner feet of fencing. The signs will be posted such that the legend can be easily read and in accordance with the specific requirements of Section 5.3.4 of the Regulations.

Customers are responsible for unloading and placing asbestos containers in the disposal area. The customer is required to provide any special equipment (forklift, etc.) required to unload and place the asbestos containers within the disposal area. The asbestos waste will be placed in the area designated for asbestos disposal or at the bottom of the proposed asbestos waste disposal area constructed to receive the asbestos waste. JCL personnel will be responsible for covering the waste. All activities associated with disposal of asbestos waste, including placement in the prepared asbestos waste disposal area, covering the asbestos waste, and compacting the fill, shall be conducted in a manner that prevents the rupture or opening of any bags, wrappers, or any other containers holding the asbestos waste and that prevents the emission of asbestos to the air.

Only authorized JCL personnel and disposal customers will be allowed in the disposal area. Personal protective equipment (PPE) will be worn by authorized JCL personnel and customers within the disposal area unless they are in an enclosed cab or vehicle with windows shut and air handling systems shut off. The PPE shall consist of:

- A half-face or full-face respirator under negative pressure with appropriate cartridges to prevent asbestos exposure;
- Tyvek or other appropriate coveralls, gloves, and foot covers; and
- Safety glasses.

Upon leaving the disposal area, employees and customers are required to remove their coveralls and foot covers and place them in a disposal container near the entrance to the area. Asbestos unloading and disposal will be allowed only when sustained winds are less than 20 miles per hour (mph) and wind gusts are less than 30 mph. Sustained winds will be determined using measurement equipment on site. During wind speed shutdowns, the gate house personnel will inform drivers of the shutdown and either advise them they will have to wait at the entrance to the disposal site or return the shipment to the generator until winds subside. A water truck will be available near the disposal site on days when waste is being disposed in the event a container is breeched during placement and requires wetting prior to covering.

It is not anticipated that storage of asbestos waste will be conducted at the JCL prior to waste burial. However, if asbestos waste storage is conducted, it shall be in accordance with the following requirements:

- Asbestos waste shall be stored only in a rigid container and in a segregated location used solely for the purpose of such storage where asbestos waste packages can be handled, stored, and maintained without being opened or disturbed.
- Asbestos waste shall be stored at an asbestos waste disposal area for no more than 20 calendar days prior to burial.
- A warning sign shall be posted on each side of an area where asbestos waste is stored prior to burial. Such signs shall conform with the Colorado Solid Waste Regulations Section 5.3.4.
- Records shall be maintained that indicate location, depth and area, and quantity of asbestos waste within the disposal site on a map or diagram of the disposal area. Asbestos waste disposal areas will be surveyed to provide a hard copy and electronic as-built survey (such as a chip with a CAD or .pdf file that provides this information) that provides the location, depth, and area of the disposal area. The approximate volume of asbestos waste will be maintained based on the approximate size and number of loads that are placed in each dedicated disposal area. This information will be kept in a dedicated file in the JCL's Operating Record.

2.1 Cover Procedures for Friable Asbestos, RACM, and RACS Containing Greater than 1% Friable Asbestos

JCL personnel will be responsible for covering all asbestos waste. All friable asbestos and RACM wastes received in structural rigid containers will be covered within 72 hours of placement within the active asbestos waste disposal area. Friable asbestos and RACM will be covered immediately after receipt if the packaging breaks open during unloading. If the packaging of friable asbestos or RACM breaks open, immediate measures will be taken, such as application of water or other means to minimize and prevent any air release (see Section 4.0 of this plan). All other friable asbestos, RACM, and RACS wastes will be covered within 24 hours of placement in the disposal area. Cover will consist of a minimum of 9 inches of soil or 18 inches of non-asbestos cover material prior to compaction as required by Section 5.3.7 of the Regulations. JCL operators will minimize the potential for release from and exposure to asbestos waste after placement in the disposal area and will not compact waste prior to application of cover materials. At no time will equipment come into direct contact with asbestos waste, containers, or packaging.

2.2 Cover Procedures for Non-friable Asbestos

All non-friable asbestos wastes will be covered within 24 hours of receipt with a minimum of 9 inches of soil or 18 inches of non-asbestos cover material prior to compaction in accordance with Section 5.2.1 of the Regulations. Non-friable asbestos waste should be treated in such a manner as to minimize the increase in the friability of the waste, especially at its exposed edges. At no time will equipment come into direct contact with asbestos waste, containers, or packaging.

3.0 PERSONNEL TRAINING

Personnel involved with the management of asbestos waste will receive annual training specific to their job function as described previously. This will include gate attendants, compliance officer, and personnel responsible for directing placement of asbestos waste by generators and covering the waste after placement. The compliance officer will coordinate any emergency response, will have certification in the OSHA 1910.120 course (OSHA 40-hour training and appropriate annual refresher trainings as required), and ensure that personnel have had annual training in compliance with this plan. Applicable employees will be trained in respiratory protection requirements, will be fit-tested annually, and subject to medical monitoring. Training and fit test documentation will be maintained in the facility operating record.

The generator/transporter shall provide documentation to JCL that the individual associated with the asbestos waste placement have the proper training and certification prior to the performance of work.

4.0 CONTINGENCY PLAN AND INSPECTIONS

As a part of the training described above, JCL personnel involved in asbestos waste disposal will have specific annual training on emergency procedures (provided below) in the event of an asbestos waste release or spill. The compliance officer will serve as the emergency coordinator. The emergency procedures in the event of a release or spill are as follows:

- The asbestos waste operator will notify the gate house attendant and compliance officer to stop all asbestos customer traffic at the gate;
- The asbestos waste operator will make an evaluation of the seriousness of the event and notify the compliance officer, and indicate the support needed to address the event, if applicable, based on the volume of the release, whether the waste has become airborne, wind speed, and wind direction;
- The asbestos waste operator will immediately mobilize a water truck to the disposal area and spray the spilled asbestos waste in a manner to prevent splattering or exacerbation of the spill condition to sufficiently wet the asbestos waste as to prevent the release of air-born asbestos fibers.
- The asbestos operator will use an asbestos cleanup kit (the asbestos cleanup kit will be located at the disposal site and contain items such as plastic tarps, bags, and shovel) if required to contain the waste by wetting to prevent emissions, and covering as quickly as possible.

- The compliance officer will determine when the site is safe to resume asbestos waste operations and will notify all impacted JCL personnel; and
- The compliance officer will notify appropriate parties for a reportable quantity (greater than one pound of asbestos waste or non-reportable quantity), provide written documentation of the event and response actions and place in the operating record, and perform a debrief of JCL personnel.

Inspections of the asbestos disposal areas will be conducted by JCL personnel on a monthly basis so that disposed asbestos waste is properly covered and otherwise the waste disposal area is compliant with the requirements of this plan. The inspections will be conducted in accordance with the inspection checklist provided in Appendix B-2. Monthly inspections can be waived if no additional asbestos waste has been accepted at the facility since the last monthly inspection. Any uncovered, exposed asbestos waste will be covered immediately in compliance with the above requirements, and, if appropriate, implementation of the emergency procedures to keep the area in compliance.

5.0 RECORD KEEPING

As required by Section 5.3.10 of the Regulations, JCL will maintain the following records:

- Permanent records showing the date and quantity of each load of asbestos waste received (WSRs kept in chronological order); and
- Permanent records showing the location and depth of asbestos within the asbestos waste disposal area. The asbestos waste disposal locations and depths will be noted on a map or diagram of the disposal area, volumes and locations will be logged into a daily logbook, and the boundaries of the waste disposal area will be surveyed.

All records, including records such as training records for JCL, inspections, and emergency response actions, will be kept in the site operating record. The above-described records will be readily available at all times, and will be made available to the CDPHE upon request.

6.0 CLOSURE AND POST-CLOSURE

The activities described herein will take place during the closure of the asbestos waste area and will be conducted in accordance with Section 2.5 of Regulations. A closure documentation report presenting the records discussed in Section 5.0 of this plan and documentation of the completion of the final cover revegetation activities will be prepared and will constitute the final closure of the asbestos waste area.

The final cover of this asbestos waste disposal area will be the same design as that for the JCL and will be constructed in accordance with the Construction Quality Assurance Plan (CQA Plan) in Section 11.0 of the EDOP. Once the final cover has been completed, it will be revegetated in accordance with the provisions for the final cover for the JCL area as outlined in Section 11.0 of the EDOP. Documentation of the construction activities will be completed in the Closure Documentation Report.

Post-closure care for the asbestos waste disposal area will be conducted in accordance with Section 2.6 of the Regulations and the applicable portions of the site Post-Closure Plan in Section 13.0 of the EDOP.

https://golderassociates.sharepoint.com/sites/110066/project files/6 deliverables/reports/6-r-edop/6-r-2/appb/appb-asbestos_waste_management_plan.docx

APPENDIX B-1

Waste Shipment Record (WSR)

REGULATED ASBESTOS MATERIAL
WASTE SHIPMENT RECORD

GENERATOR SECTION

I. Facility Name: __________
Address: __________
City: __________ State: ______ Zip Code: ______
Owner's Name: __________
Telephone: ( ) __________ Fax: ( ) __________

II. Operator's Name: __________
Address: __________
City: __________ State: ______ Zip Code: ______
Telephone: ( ) __________ Fax: ( ) __________

III. Waste Disposal Site (WDS) Name: __________

"on-site" disposal ☐ Yes ☐ No

Physical Location:
Address: __________
City: __________ State: ______ Zip Code: ______
Telephone: ( ) __________ Fax: ( ) __________

Mailing Address:
City: __________ State: ______ Zip Code: ______
Telephone: ( ) __________ Fax: ( ) __________

IV. Responsible Agency (Local, District, State, or EPA Office where notification was sent)
Name: __________
Address: __________
City: __________ State: ______ Zip Code: ______

V. Description of Materials	**VI. Containers**		**VII. Total Quantity** (cubic yards)
	Number	**Type**	

VIII. Special Handling Instructions and Additional Information

IX. Generator's Certification: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled, and are in all respects in proper condition for transport by highway according to applicable international and government regulations.

__________ ______ __________
Signature Date Type or Print Name and Title

REGULATED ASBESTOS MATERIAL
WASTE SHIPMENT RECORD

TRANSPORTER SECTION

X. Transporter 1 (Acknowledgement of receipt of materials)

Name: ______________________________
Address: ______________________________
City: ______________ State: ________ Zip Code: ________
Telephone: ( ) ______________ Fax: ( ) ______________

Signature ______________ Date ________ Type or Print Name and Title ______________

Rejected Materials (if any)	**Destination**

XI. Transporter 2 (Acknowledgement of receipt of materials)

Name: ______________________________
Address: ______________________________
City: ______________ State: ________ Zip Code: ________
Telephone: ( ) ______________ Fax: ( ) ______________

Signature ______________ Date ________ Type or Print Name and Title ______________

Rejected Materials (if any)	**Destination**

DISPOSAL SITE SECTION

XII. Discrepancy indication space

XIII. Waste disposal site owner or operator: Certification of receipt of asbestos materials covered by this manifest except as noted in item 12

Signature ______________ Date ________ Type or Print Name and Title ______________

Form Revised (11/12/97)

APPENDIX B-2

Monthly Asbestos Waste Disposal Area Inspection Checklist

1876

COLORADO DEPARTMENT of PUBLIC HEALTH & ENVIRONMENT
Hazardous Materials and Waste Management Division
SOLID WASTE DISPOSAL SITE AND FACILITY INSPECTION

Page 1 of ______

Inspection Date: ____________

Time In: ____________

Time Out: ___________

Facility Name:____TRIM Code: ____________________

Inspector(s):____

Asbestos Waste Disposal and Storage Areas

Functional Category	Requirement Description	Citation	Violation N/Y P/NI/NA	Note Reference
General Provisions				
Duty to Comply	Comply with SW Regs Sections 1-3, 5 and WQCD, APCD, and Local Rules	5.1.1; 5.1.2		
Operating Requirements	No Visible Emissions	5.1.3		
	Approved Waivers	1.5; 5.3.2		
Non-Friable Asbestos Waste Disposal Areas				
Operating Requirements	Cover Within 24 Hours (9” Soil or 18” Non-Asbestos Cover); Minimize Potential for Release; No Direct Compaction	5.2.1		
	Waste Management with No Change in Friability	5.2.2		
Friable Asbestos Waste Disposal Areas				
Records Review	Facility Approved for Disposal	5.3.1		
	Recordkeeping	5.3.10		
Operating Requirements	No Disposal Within 100 Feet of Property Boundary	5.3.3		
	Warning Signs Posted and Fencing Installed	5.3.4		
	Container and Labeling Requirements	5.3.5		
	Operations to Minimize Container Rupture and Prevent Emissions	5.3.6		
	Cover Within 24 Hours (9” Soil or 18” Non-Asbestos Cover); Minimize Potential for Release; No Direct Compaction	5.3.7		
	Cover for Rigid Containers Within 72 Hours	5.3.8		
	Non-Rigid Container Disposal Requirements	5.3.9		
Storage of Asbestos Waste				
Operating Requirements	Storage in Rigid Containers and Segregated Locations	5.4.1		
	On-Site Storage for No More Than 20 Days	5.4.2		
	Warning Signs Posted	5.4.3		

Site-Specific Design and Operations Plan Requirements:

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White = File Copy, Yellow = Tracking Copy, Pink = Facility Copy

Note/Regulation Reference #	Comments and Deficiency Requests	Request Date	RTC Date

White = File Copy, Yellow = Tracking Copy, Pink = Facility Copy

GOLDER

golder.com

APPENDIX C

Environmental Monitoring Plan

REPORT

Environmental Monitoring Plan

Appendix C

Submitted to:

Jackson County
PO Box 1019
Walden, Colorado 80840

Submitted by:

Golder Associates Inc.
7245 W Alaska Drive, Suite 200, Lakewood, Colorado, USA 80226

+1 303 980-0540

19124320-6-R-2

January 2021

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APPENDICES

1.0 INTRODUCTION

This Environmental Monitoring Plan (Plan) has been prepared for the proposed Jackson County Landfill (JCL) and includes a Groundwater Sampling and Analysis Plan and Landfill Gas Monitoring Plan to meet the requirements of the current Colorado Department of Public Health and Environment (CDPHE) Solid Waste Regulations 6 CCR 1007-2, Part 1 (the Regulations). The primary objective of the Plan is to identify possible impacts of the JCL on the environment and public health, both during operation and the post-closure period.

The JCL is located approximately 1.5 miles north of the town of Walden, Colorado, off State Highway 125. The site was previously a transfer station and there are stockpiles of predominately construction and debris (C&D) waste on site that will be placed in the JCL. The JCL will provide a low-permeability soil liner for C&D waste and a composite liner consisting of a low-permeability soil liner and a 60-mil high-density polyethylene (HDPE) liner for municipal solid waste (MSW). The JCL will also include leachate collection system on top of both liner systems.

This document is organized into the following sections:

- Section 2 describes the groundwater monitoring system;
- Section 3 discusses the sampling and analysis procedures;
- Section 4 describes the detection monitoring program including the parameters, sampling frequency, statistical methodology, and reporting;
- Section 5 provides the details of the assessment monitoring program;
- Section 6 describes the assessment of corrective measures; and
- Section 7 describes the landfill gas monitoring program.

This Plan is intended as a working document that will be adapted as needed to reflect regulatory, technological, or operational changes. The JCL will start detection monitoring for groundwater; if, in the future, the JCL enters into assessment monitoring, this Plan will be modified accordingly. The sampling and analysis procedures described herein are designed to:

- Be in accordance with current Regulations;
- Be consistent with United States Environmental Protection Agency (EPA)-accepted procedures; and
- Confirm that monitoring results provide an accurate representation of site conditions.

Landfill gas monitoring will be conducted to comply with the Regulations and will be implemented in accordance with standard practices used at other solid waste landfills in Colorado.

2.0 GROUNDWATER MONITORING SYSTEM

Initially, there will be three groundwater monitoring wells in the site monitoring network, identified as MW-1, MW-2, and MW-3 as shown in Figure C-1.

Monitoring well MW-1 was installed in 2019. MW-2, and MW-3 were installed in 2020. Quarterly background groundwater sampling will begin in 2020 and extend as required by the CDPHE. After background sampling is concluded, the JCL will initiate semi-annual groundwater detection monitoring using wells MW-1, MW-2, and MW-3.

The geologic setting at the JCL consists of unsaturated and saturated, unconsolidated sandy deposits overlying unsaturated to saturated bedrock as described in the EDOP text.

2.1 Well Placement

The groundwater monitoring system at the JCL consists of a sufficient number of wells, installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer that:

- Represent the quality of background groundwater; and
- Represent the quality of the groundwater passing the downgradient compliance boundary of the solid waste disposal facility.

The three monitoring wells are screened in the uppermost aquifer beneath the site.

2.2 Well Construction

Drilling and installation procedures for groundwater monitoring wells at the site are summarized as follows:

- Monitoring well boreholes were drilled using augering drilling. Potable water was used as necessary to facilitate drilling.
- Drilling and well installation equipment were thoroughly cleaned prior to each use during the well installation program.
- Monitoring wells were cased in a manner that maintained the integrity of the monitoring well boreholes. To enable collection of groundwater samples from the uppermost aquifer, a nominal two-inch polyvinyl chloride (PVC) well screen was installed in the depth interval to be monitored in each well.
- To prevent contamination of groundwater samples and the uppermost aquifer, the annular space above the monitored zone was backfilled with a minimum of two feet of bentonite pellets and crumbled bentonite seal, which was overlain by cement-bentonite grout at MW-1 through MW-3.

These three wells will be operated and maintained to perform as designed during the active life and through the post-closure monitoring period of the site.

The groundwater appears to be part of an unconfined aquifer located within the highly weathered bedrock.

3.0 GROUNDWATER SAMPLING AND ANALYSIS PROCEDURES

The following methodology is considered appropriate for accurately measuring constituents of interest and other pertinent parameters in groundwater samples collected at the JCL. The methodology is also in accordance with the Regulations. Procedures prior to sampling, sample collection, documentation, sample preservation and shipment, chain of custody (COC) control, quality assurance (QA) and quality control (QC), analytical procedures, and data review are described in this section.

3.1 Procedures Prior to Sampling

Prior to each event, sample bottles will be ordered from the contracted analytical laboratory. Sampling personnel will coordinate with the contracted lab so that sample bottles can be ordered in sufficient time for shipping, bottle inspection, and corrections.

Sufficient sample bottles for each parameter group (volatile organic compounds [VOCs], metals, etc.) for each well will be verified upon receipt. Additional bottles for QA/QC samples (e.g., trip blanks) will also be arranged with the laboratory prior to shipment, as necessary.

The laboratory or sampling crew will provide sample labels, COC forms, and COC seals with delivery of the sample bottles. The containers, preservation techniques, and holding times for each parameter group are shown in Table C-1.

Field equipment will be tested before the sampling event (e.g., check batteries and field meter calibration). Field parameters (pH, temperature, and conductivity) will be measured using handheld meters provided by the site. Calibration forms for these meters are included in Appendix C-1, and instructions for calibration are found in the manuals maintained by the site. Proper preparation will reduce the time required in the field by minimizing the number of trips to obtain additional supplies.

Upon arrival at the site, each well will be inspected to determine the condition of the protective casing, well identification markings, security lock, well casing, and water level reference mark. This information will be recorded in a field data sheet or in a field book.

Static water levels will be measured in the monitoring wells prior to groundwater purging and sampling. The water levels for each of the five groundwater monitoring wells will be measured on the same day to avoid temporal variation. In addition to the water levels, total depths will be measured in the wells in the groundwater monitoring network annually. Water level and total depth measurements will be made from the reference mark on the PVC casing; both measurements will be recorded to the nearest 0.01 foot using a portable electronic water level indicator. These measurements will be compared in the field to previous measurements to check for consistency. A new pair of disposable gloves of appropriate material (typically non-powdered nitrile) will be worn at each well to minimize the potential of sample contamination. The water level indicator probe will be cleaned between wells using an initial wash with Liquinox™ or comparable solution, and then rinsed with deionized water.

3.2 Sample Collection

3.2.1 Equipment

Purging and sampling equipment of disposable bailers and ropes. This equipment is constructed of materials that will not alter the quality of groundwater samples.

Other required sampling equipment will include the following:

- Site-provided electronic water level indicator;
- Site-provided pH and conductivity meter;
- Disposable nitrile gloves, or equivalent;
- Deionized or distilled water;
- Phosphate-free environmental detergent such as “Liquinox^{TM}”;
- Plastic sheeting to prevent possible contamination of sampling equipment;
- Paper towels;
- Beaker or graduated cylinder used to hold sample for field parameter measurement;

- Five-gallon plastic buckets for purge volume measurement;
- Sample bottles and sample preservatives;
- Field forms and field book, including piezometer purge/sampling forms, COC forms, custody seals, and sample labels; and
- Coolers with ice or ice packs.

Sampling personnel will wear new disposable gloves constructed of appropriate material while handling the sampling equipment. If equipment decontamination is required, it will be washed with a Liquinox™ or comparable solution and rinsed with deionized or distilled water, as described in the next section.

3.2.2 Decontamination

Any reusable, non-dedicated sampling equipment (e.g., water level indicator probe) will be decontaminated between each sampling location to minimize the potential for cross-contamination. Decontamination will be performed by scrubbing non-dedicated equipment with a Liquinox™, or comparable, solution, followed by a final rinse with deionized or distilled water. Clean or unused sampling equipment will be handled by personnel wearing clean, new, disposable gloves of appropriate material.

3.2.3 Purging

Prior to sample collection, each well will be purged using a new disposable bailer and rope at each site. sampling equipment described previously. During purging, the bailer will be lowered to the bottom of the well to ensure removal of stagnant water and encourage the movement of fresh formation water into the well. Bailing will be performed at a rate that will minimize agitation of recovery waters, and will continue until a minimum of three casing volumes have been purged and field parameters (pH, temperature, and conductivity) have stabilized, or the well is bailed dry. Field parameters will be measured at a frequency no greater than once per casing volume and purging will continue until there is less than ±10% change in three consecutive measurements of temperature and conductivity, and pH readings are within ±0.1 standard units.

The volume of standing water in each well will be calculated using the static water level measurement, the total depth of the well, and the casing diameter. One casing volume will be considered the water present in the well casing. Well depths for the purpose of well volume determination will be obtained from well completion records. The equation for calculation of one casing volume for a two-inch diameter well is:

$V = 0.16 \times h$

Where:
V = volume of water in well casing (gallons)
h = height of water column (total well depth – depth to water) (feet)

Field parameter values will be recorded on a field data sheet or in a field book, along with a description of the sample appearance at the time of field parameter measurement. Water quality meters used to measure field parameters will be calibrated according to manufacturer's recommendations at the start of every sampling day and as necessary thereafter, and will be decontaminated between sampling locations as described in Section 3.2.2 of this Plan. pH calibration will use at least two buffer solutions that bracket the expected pH range for the monitoring wells to be purged.

Purge water generated during the sampling events will be discharged on the ground at or near the well site. If analytical results indicate that groundwater constituent concentrations are elevated above the Basic Standards for Groundwater (BSGW), 5 CCR 1002-41 (CDPHE 2013), purge water will be containerized and disposed in accordance with state and federal regulations.

3.2.4 Sample Withdrawal

After well purging is completed, field personnel will wear a new pair of disposable gloves in preparation for sample collection. Groundwater samples will be collected directly from the discharge end of the bailer. The order of sample collection will be based on parameter sensitivity to volatilization and pH change, as follows:

- VOCs;
- Metals;
- Chloride;
- Nitrate;
- Other inorganics;
- Indicator parameters.

VOC samples will be collected in 40-milliliter (ml) glass vials, while metals, total organic carbon (TOC), and other inorganic samples will be collected in either plastic or glass containers of appropriate capacity. The analytical parameters, required containers, and volume requirements are shown in Appendix IB of 6 CCR 1007-2. Sample containers will be provided by the analytical laboratory and will be pre-cleaned and shipped with sufficient preservative; rinsing before filling will not be necessary. Pursuant to 40 CFR 258.53(b), groundwater samples shall not be field filtered.

Sampling personnel will minimize contact between the bottles and sampling equipment. As an added precaution, contact time of the sample with ambient air will be minimized by replacing caps immediately after the bottles are filled. VOC samples will be collected in a manner that reduces the potential for entrained air bubbles. This will be achieved by adding the sample slowly until a positive meniscus forms at the mouth of the vial (i.e., the vial is slightly overfilled) before replacing the cap. Once the cap is firmly attached, the vial will be inverted and examined for air bubbles.

3.3 Documentation

Where applicable, a minimum of the following information will be recorded on a sampling or monitoring data sheet or in a field notebook for each groundwater sampling location:

- Observations made during the visual inspection of the monitoring well
- Static water level, total well depth, and calculated casing volume
- Equipment used
- Field stabilization readings
- Volume purged, sample appearance, and water level during each field parameter measurement
- Total volume purged, average purge rate

- Date and time of purging and sampling
- Laboratory container review
- Other observations such as sample equipment malfunction, presence of immiscible layers, or other indicators of possible contamination

An example groundwater sampling data sheet is provided in Appendix C-2.

3.4 Sample Preservation and Shipment

Preservatives will either be attached to the sample containers in small vials or will be pre-added to the containers in the laboratory. If they are attached to the sample containers, sampling personnel will add the specified volume of preservative to the container immediately before sampling. VOC samples will be unpreserved.

Filled and capped containers will be wiped clean, appropriately labeled, and stored with ice or frozen ice packs in insulated coolers. Sufficient ice or ice packs will be added to the coolers to maintain sample temperatures near 4ºC. Packing material will be added to the coolers as necessary to prevent breakage of glass containers. An example bottle label is presented in Appendix C-3.

Samples will be transported to the analytical laboratory by an overnight courier to expedite sample arrival at the laboratory and to assist the laboratory in meeting United States Environmental Protection Agency (USEPA) recommended sample hold times. Sample preservation and recommended holding times are summarized in Appendix IB of 6 CCR 1007-2.

3.5 Chain of Custody Control

USEPA-accepted COC procedures will be followed to maintain the integrity of the samples. From the time the sample containers leave the laboratory until the issuing of laboratory results, the samples and/or sample containers will be:

- In sight of the assigned custodian
- Locked in a tamper-proof location
- Sealed with a tamper-proof seal

A written record of sample container possession and transference of samples will be documented in appropriate COC forms. The COC will include the name of the person or persons performing the sample collection and will indicate the method of delivery to the laboratory (e.g., overnight courier). A copy of the COC will be sealed in a Ziploc™ bag, placed in the cooler containing the containers listed in the COC, and shipped/delivered with the samples to the laboratory. An example COC form is presented in Appendix C-4.

3.6 Quality Assurance and Quality Control

Proper QC procedures will be followed so that laboratory preparation, sampling, and transport activities do not potentially bias the results of the chemical analysis. QC samples provide a quantitative basis for validating the analytical data and consist of the following:

- Field blank: A field blank consists of empty sample bottles filled with deionized or distilled water by the field personnel at the sampling site. The field blank will also be analyzed by the laboratory as if it were a real sample. The primary purpose of the field blank is to evaluate possible cross contamination of samples from the field (ambient) conditions that are present at the sampling location.

- Equipment blank: An equipment field blank consists of empty sample bottles filled with deionized or distilled water that have been subjected to contact with decontaminated sampling equipment water at the sample site. The equipment blank will also be analyzed by the laboratory as if it were a real sample and is intended to assess the effectiveness of field equipment decontamination procedures applied to reusable sampling equipment.
- Trip blank for VOCs: A trip blank consists of empty sample bottles filled with deionized or distilled water prepared by the analytical laboratory. The trip blank will accompany the sample container shipment from the laboratory to the field and then back to the lab. At no time will the trip blank container be opened in the field. The trip blank will also be analyzed by the laboratory as if it were a real sample. The trip blank is intended to assess the cleanliness of laboratory analytical method and track any influences on VOC concentrations over the course of a sampling event.

Based on the monitoring program, QC samples will consist of the following:

- One trip blank per sampling cooler will be analyzed for each sampling event.
- One equipment blank will be analyzed per event if non-disposable or non-dedicated equipment is used for sampling. An equipment blank is not necessary if dedicated or new sampling equipment is used at each location.
- One field blank per event will be analyzed for each sampling event.

3.7 Analytical Procedures

VOCs will be analyzed in accordance with methods from USEPA Report SW-846, Test Methods for Evaluating Solid Waste (USEPA 1996), or other appropriate USEPA-approved methods. Practical quantitation limits (PQLs) will be the lowest concentrations that can be reliably achieved within the specified limits of precision and accuracy during routine laboratory operating conditions.

3.8 Analytical Data Review

Upon receipt of the analytical results, general analytical data evaluation will be performed. At a minimum, this evaluation will address the following:

- Overall data completeness
- A review of laboratory-qualified data
- Comparison of QC results to sample results
- Review of cation-anion balances, etc.
- Review of laboratory QC sample results, including comparison of spike recoveries to control limits

Results of the data review will be documented and used to initiate additional review by the laboratory or possibly additional qualifications of the analytical data by the reviewer.

4.0 DETECTION MONITORING PROGRAM

The detection monitoring program consists of four rounds of quarterly sampling that will take place before placement of MSW and a minimum of eight rounds of sampling before the site transitions to semi-annual sample collection during both the active life and post-closure period of the facility unless an alternative schedule is approved by the CDPHE. Additional details of the detection monitoring program are described in this section.

4.1 Parameters

The complete list of detection monitoring analytes is included in Appendix IA and IB of the Regulations (6 CCR 1007-2). In addition to the constituents to be measured by an analytical laboratory, the following measurements and observations are made in the field at the time of well purging and sample collection:

- Depth to water
- Temperature
- pH
- Specific conductance
- Physical characteristics of the sample (e.g., observed color, odor, and clarity)

4.2 Statistical Analysis

The purpose of groundwater monitoring at the Landfill is to determine if on-site wastes are impacting the groundwater. In order to determine if an impact has occurred, baseline and more recent groundwater data from each well will undergo statistical analysis. The statistical methodology outlined herein was selected in accordance with Appendix B of the Regulations, and the Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance (Unified Guidance) (USEPA 2009).

The statistical analysis program consists of establishing a statistical baseline to identify prediction limits, and comparison of future semi-annual groundwater monitoring results to these statistical limits. Currently, the time period of the baseline statistics is anticipated to be quarterly from late 2020 through late 2022 for wells MW-1, MW-2, and MW-3.

The comparative statistical analysis program consists of reviewing/recalculating the statistical limits annually, but for the interim monitoring events, a simple comparison of the new data to the existing statistical limits will identify whether any concentrations are potentially statistically significant. Additionally, the baseline data will be reviewed periodically (approximately every three years) to determine if recent results that are not statistically significant can be incorporated into an updated baseline period (specifics of the baseline update procedure are further described in Section 4.3.6 of this Plan).

With the exception of field parameters (pH, specific conductivity, and temperature), statistical analyses will be performed for each of the parameters listed in Appendix IB of 6 CCR 1007-2. There is a high potential for false positive results with field measurements because of sample collection inconsistency (e.g., changes in field conditions and sampling personnel), equipment calibration variability, and other causes of measurement variation. Additionally, baseline statistical analyses will not be conducted on VOCs because VOCs are generally not naturally occurring. Statistical significance will be determined following the double quantification rule described in Section 6.2.2 of the USEPA's Unified Guidance titled Statistical Analysis of Groundwater Monitoring Data at

RCRA Facilities, March 2009 (Unified Guidance). Under the Unified Guidance, a confirmed exceedance is determined if a constituent that has not been previously detected is reported at a concentration exceeding the reporting limit in two consecutive sampling events. J-flagged values for anthropogenic constituents will also be reported and evaluated for statistical significance as these J-flagged anthropogenic constituent detections that recur with statistically significant regularity could be an indication of a statistically significant increase..

4.3 Baseline Statistical Analysis

Intra-well statistical methods will be used to evaluate the groundwater data for each parameter listed in Appendix IB of 6 CCR 1007-2 (excluding pH, specific conductivity, and temperature). The baseline statistical analysis will consist of a series of steps that are repeated for each inorganic or indicator parameter in each well. These steps will be followed each time the baseline is updated or modified in the future, as further described in Section 4.3.6 of this Plan. These steps include the following:

- Initial data review
- Data distribution (i.e., normality)
- Outlier analysis
- Trend analysis
- Statistical limit

4.3.1 Initial Data Review

The initial data review will determine the frequency of detected and non-detected values for each parameter at each well. Additionally, data will be plotted on time-series graphs to assess the temporal variability of the data and to visually screen for potential outliers. Temporal variability can be caused by seasonality, changes to the analytical method, recalibration of instruments, and anomalies in the sampling method (USEPA 2009).

Prediction limits, which are the statistical methodology proposed in this Plan, assume concentrations do not demonstrate temporal correlation. Thus, prediction limits are not appropriate when temporal trends are present. If temporal trends are present in the dataset, the data will be adjusted to account for the trends (e.g., removal of seasonal trends), the time period used for the baseline will be reassessed, or an alternative statistical method will be used. In some cases, it may be possible that no adjustments or alternative methods are appropriate and a particular parameter may not be considered for statistical analysis.

As recommended in the Unified Guidance, any visually identified outliers will be further evaluated prior to inclusion in the statistical analysis. This evaluation will include reviewing the analytical laboratory reports, laboratory QA/QC information (if available), and any available notes associated with the sampling event and the laboratory report to determine if any systematic errors were responsible for the noted anomalous readings. Occasionally, analytical values for a parameter at a specific well are not consistent with the remainder of the data. When these inconsistent values, or outliers, deviate significantly from the rest of the data, the data point will be removed from the dataset, as described in more detail in Section 4.3.3 of this Plan.

4.3.2 Data Distribution

Most parametric statistical tests are based on the assumption that the data are normally distributed or can be transformed to a normal distribution. The distribution of the data will be tested for normality using the Shapiro–Wilk normality test with a 95% confidence level. Each parameter from each well will be analyzed separately. If necessary and where possible, a log-normal transformation of the data will be performed. No other transformation types (beyond untransformed and log-normal transformation) will be used.

4.3.3 Outlier Analysis

Outliers will be evaluated and identified through visual inspection and USEPA-recommended statistical analysis tests in the Unified Guidance. In accordance with the Unified Guidance, data points will be identified as outliers if the value was an “extreme, unusual-looking measurement” and “inconsistent with the distribution of the remaining measurements” (USEPA 2009). Outliers will be considered extreme measurements and removed if the data point varied by an order-of-magnitude relative to the other values. Outliers will be deemed “inconsistent with the distribution of the remaining measurements” (USEPA 2009) if: 1) inclusion of the outlier creates a non-normal data distribution, but removal of the outlier results in a normal data distribution; 2) the result varied from the dataset and the value was unrealistic for the aquifer type; or 3) the value was visually identified as varying from the dataset.

Outliers will be managed as follows:

- Any suspected outlier identified by the outlier test or visual methods will be reviewed (i.e., reviewing the analytical report, lab narrative, and/or field notes) before removal from the dataset. Rejected data points will not be included in the baseline monitoring dataset.
- The rationale for the removal of any outliers will be documented in the statistical method summary for each well. The majority of the outliers will likely be isolated values that can be attributed to inconsistent sampling or analytical chemistry methodology resulting in laboratory contamination or other anomalies, or errors in the transcription of data values or decimal points.
- If an outlier is removed, the normality test will be rerun to determine if the dataset is normally distributed without the outlier.

4.3.4 Trend Analysis

The Mann-Kendall test is a non-parametric method for determining if an upward or downward trend exists in a dataset. The test involves examining all possible pairs of measurements in the dataset and scoring each pair to determine if a trend exists. The test will be conducted using a target confidence level of 95%. If a statistical limit cannot be established due to trending data, a trend analysis approach in accordance with the Unified Guidance will be used to evaluate the significance of an apparent change in water quality over time for the given parameter and well.

4.3.5 Statistical Limits

Statistical analyses will be conducted using the software package WQStat Plus (Sanitas Technologies 2009), or equivalent, and using a user-defined confidence level based on a calculation of facility-wide false positive rates. For non-parametric prediction limits, the confidence level increases as the number of background observations increases, as described in Unified Guidance, Appendix D, Table 18-1 (USEPA 2009).

Either a parametric or non-parametric method has historically been used and will continue to be used to generate the baseline statistical limit for each constituent. The statistical method will vary between constituents and will be selected based on the percent of baseline non-detects (undetected concentrations) and baseline data distribution for each constituent in accordance with the Unified Guidance (USEPA 2009). In cases where the concentrations of a given analyte are normally or transformed-normally distributed and the well has equal to or greater than 25%

detections, a parametric prediction limit has been and will continue to be used. In cases where the concentrations of a given analyte are not normally or transformed-normally distributed or the concentrations cannot be transformed to a normal distribution, a non-parametric prediction limit has been and will continue to be used. The non-parametric limit will be assigned at the highest detected value (excluding outliers) or the highest reporting limit, whichever is greater.

For the non-detected analytes in current baseline dataset, the laboratory reporting limit was used for statistical analysis rather than one-half of a reporting limit. Depending on the laboratory and analyte, the laboratory reporting limit may have been identified as an instrument detection level (IDL), method detection level (MDL), or PQL. Changes in laboratories and laboratory QC standards can impact the statistical baseline and have a direct impact on the prediction limits established for individual analytes. Thus, due to the resulting wide variation in reporting limits, one half of the reporting limit was not used for statistical evaluations.

Additionally, due to the variability in laboratory IDLs, MDLs, and PQLs, and the variable analytical results from one of the laboratories historically used to analyze samples from the site, a trend analysis was not conducted for the current statistical baseline evaluations, because the trend analysis would not accurately reflect conditions in each well due to the limited number of background samples (8 to 10) combined with abnormally high results for the samples analyzed. Trend analyses will be re-evaluated for future baseline statistical updates, and performed if appropriate. Laboratory variation in reporting limits is not expected to occur in the future because one laboratory is anticipated to be consistently used, and the recent data have been and will continue to be evaluated after each sampling event to ensure that data quality objectives are met and data are reported accurately.

4.3.6 Updating the Baseline Period

The Unified Guidance recommends updating the baseline period every two to three years when the sampling frequency is semi-annual. The baseline update will include a review of any revisions to federal and state regulations and USEPA statistical guidance documents that may have been promulgated since the previous baseline statistical analysis. The facility will provide proposals and rational for proposed updates to each constituent at each well to the CDPHE for review and approval prior to updating the baseline data. The baseline period for a specific parameter will not be updated if verified statistically significant increases (SSIs) have been identified for that parameter.

Prior to inclusion of more recent data in an updated baseline period, a trend analysis and Wilcoxon Rank-Sum test will be conducted. Parameters will be evaluated for increasing trends using methods described previously. Outliers identified in the previous baseline period will be re-incorporated into the dataset and reevaluated as potential outliers during the baseline update, unless the outliers were removed due to sampling, laboratory, or other determinant error.

The Wilcoxon Rank-Sum test, also known as the Mann-Whitney test, determines if measurements from one population are significantly higher or lower than another population. This test is non-parametric, meaning that it does not assume that the data fit a specific distribution, such as a normal distribution. When the baseline period is updated in the future, the Wilcoxon Rank-Sum test will be used to compare data from the current baseline period with the more recent data that are intended to be reclassified and included in the updated baseline period. The test will be conducted at the 95% confidence level. If the two datasets are drawn from the same population, then the results of the test support updating the previous baseline dataset with the recent data. After the new data are incorporated into the dataset, the baseline statistical analysis outlined in Section 4.3 will be conducted.

If the Wilcoxon Rank-Sum test detects a significant difference between the two sample populations or an increasing trend is identified, additional data review will be necessary. The data will be reviewed to determine whether a gradual trend or other change has occurred. It may be necessary to remove some of the earlier baseline data from the updated baseline period to ensure that future statistical analysis is based on current groundwater conditions at the site and not on outdated measures of groundwater chemistry.

4.4 Comparative Statistical Analysis

Once statistical limits have been established for the baseline data, the inorganic and indicator parameter analytical results from each monitoring event will be compared to the statistical limits. When the statistical limit is exceeded, the data point will be identified as potentially statistically significant. Per the Regulations, this comparative analysis will be performed within 30 days of receipt of the final analytical results from the laboratory and completion of data review.

The following definitions will be used in discussion of the comparative statistical analysis:

- SSI: is a statistically significant increase and is defined as an analytical result that exceeds the parametric or non-parametric prediction limit established by the baseline statistical analysis.
- False-positive SSI: is defined as an analytical result that exceeds the prediction limit that can clearly be attributed to laboratory error, changes in analytical precision, or is invalidated through confirmatory re-sampling.
- Confirmatory re-sampling: is designated as the next scheduled sampling event.
- Verified exceedance: is interpreted as two consecutive SSIs (the original sample and the confirmatory re-sample) for the same parameter at the same well.

The comparative statistical analysis will be performed following each semi-annual sampling event to identify whether a concentration is statistically significant. The CDPHE will be notified of any SSIs within 14 days after the completion of the comparison and sample analyses, including any data quality review necessary to address questions concerning the validity of sampling or laboratory analyses. A potential SSI will not be considered a verified exceedance until confirmatory re-sampling is performed and the annual comparative statistical analysis is conducted. Confirmatory sampling will occur during the next scheduled sampling event.

For verified SSIs, a trend test will be performed on data collected over the past four years of monitoring. These tests will be used to determine whether these data have a trend. The selected trend analysis will be in accordance with the Regulations and Unified Guidance. The CDPHE will be notified of any significant increases within 14 days after the completion of the comparison and sample analyses.

4.5 Reporting

Quarterly monitoring reports will be submitted to the CDPHE for the initial eight quarters of monitoring. An annual monitoring report will be prepared and submitted to the CDPHE after the quarterly reports by March 31 of the following year. A copy of the report will also be placed in the operating record. At a minimum, the report will include each of the elements described in the CDPHE Guidance Document: Suggested Minimum Requirements for a Typical Groundwater Report, dated November 7, 2013.

5.0 ASSESSMENT MONITORING

An assessment monitoring program will be required in the event of a verified SSI, unless the JCL makes a successful demonstration of an alternate source for the groundwater contamination or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The assessment monitoring program would be implemented consistent with the requirements of Appendix B Section B5 of 6 CCR 1007-2, Part 1.

6.0 ASSESSMENT OF CORRECTIVE MEASURES

If, within 90 days of detecting one or more Appendix II constituents (or the list approved in accordance with 40 CFR 258.55(C)) at statistically significant levels above the background concentrations, a successful demonstration has not been made to indicate that a source other than the landfill caused the contamination, or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality, an assessment of corrective measures will be initiated, as described in Appendix B of the Regulations, and completed within a reasonable amount of time as determined by the CDPHE.

7.0 LANDFILL GAS MONITORING

Landfill gas monitoring will be conducted within site buildings and at subsurface gas monitoring probes around the perimeter of the facility to comply with Section 2.3 of the Regulations. Quarterly monitoring will be conducted within on-site structures and in on-site probes. The location of the on-site probes is shown in Figure C-1. The boring logs and probe completion details will be appended to this Plan after they are installed. Methane monitoring procedures will meet the general procedural requirements, outlined as follows:

- A portable methane meter will be used for monitoring that is appropriate for the range of methane gas concentrations that are expected. This will generally be methane concentrations that are in the 1% to 5% volume/volume range and can read in both percent volume per volume and percent of the lower explosive limit (LEL);
- The methane meter shall be calibrated to meet the manufacturer's requirements. The calibration data from each monitoring event will be recorded in the designated project field notebook and/or in a field data sheet.
- The methane meter shall be allowed to warm up and ambient air readings shall be taken at each monitoring location prior to sampling in a building or probe.
- The methane meter's hose should be connected to the probe using a quick-connect coupling and the meter should be allowed to pump gas from the interior of the probe for approximately five minutes. When a stable reading is achieved, the date, time, and meter readings in both percent volume by volume and percent of the LEL will be recorded in the designated project field notebook and/or in a field data sheet.

Monitoring records to be maintained on site include the calibration data from each event and all relevant monitoring data. The calibration record will include the meter's manufacturer, model number, and most recent calibration date and data.

Monitoring of buildings will be conducted first thing in the morning after all doors and windows have been closed overnight. The methane meter will be calibrated prior to each monitoring event and an ambient measurement outside the building should be made and recorded. A stable reading should be obtained for each discrete room and confined space within the building. The meter should be held at about three feet above the floor for each reading.

8.0 REFERENCES

Colorado Department of Public Health and Environment (CDPHE). 1994. Regulations Pertaining to Solid Waste Disposal Sites and Facilities, 6 CCR 1007-2, January, as amended

CDPHE. 2013. Water Quality Control Commission, Regulation No. 41, The Basic Standards for Groundwater, 5 CCR 1002-41, January, as amended

Puls, R.W. and M.J. Barcelona. 1996. Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. US Environmental Protection Agency.

United States Environmental Protection Agency (USEPA). 1996. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846): 3rd Edition, Update IV, January 2008. Washington D.C.: Office of Solid Waste and Emergency Response. Available online: https://www.epa.gov/hw-sw846 (accessed July 21, 2020)

USEPA. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance. Available online: https://archive.epa.gov/epawaste/hazard/web/pdf/unified-guid.pdf (accessed July 21, 2020)

Tables

Table C-1: Analytical Methods, Containers, Sample Volumes, Preservatives, and Holding Times

Appendix I and II Groundwater Parameters	Method	Container	Recommended Quantity (ml)	Minimum Volume Required (ml)	Preservative	Holding Time
Bicarbonate, Carbonate	310.10	P,G	250	100	4°C	14 days
Anions (Cl, NO3, SO4)	300.00	P,G	250	125	4°C	28 days
Anions (NO2)	300.00	P,G	250	125	4°C	2 days
Metals (including Ca, Mg, Na, K)	6010/6020	P,G	250	100	HNO_3 to pH<2	6 months
pH	150.10	P,G	60	25	none	Immediate
Specific Conductivity	120.10	P,G	250	100	4°C	28 days
Total Organic Carbon	415.20	P,G	100	25	4°C, H_2SO_4 to pH<2	28 days
VOCs	8260.00	G-TLS	3 x 40	40	4°C	14 days

G- Glass

P- Polyethylene

G-TLS- Glass with Teflon© lined septum

Figures

LEGEND

▨	EXISTING GROUND (SEE NOTE 1)
—··—··—	PROPERTY BOUNDARY
◐ MW-1	MONITORING WELLS (SEE NOTE 2)
⌖ GP-1	GAS PROBES (SEE NOTE 2)

NOTE(S)

1. EXISTING TOPOGRAPHY IS A COMPOSITE OF GROUND SURVEY PROVIDED TO GOLDER BY JACKSON COUNTY ON MARCH 27, 2020 PERFORMED BY NORTH PARK ENGINEERING & CONSULTING, INC. MARCH 2020 AND USGS CONTOURS.
2. MONITORING WELL AND GAS PROBE LOCATIONS ARE APPROXIMATE.
3. AERIAL IMAGERY: ESRI BASEMAP SERVICES, DIGITAL GLOBE CAPTURED ON 10/29/2018.
4. ELEVATION DATA SET: USGS NATIONAL ELEVATION DATA SET 1 ARC-SECOND

CLIENT
BOARD OF COMMISSIONERS
JACKSON COUNTY, CO

CONSULTANT
GOLDER

YYYY-MM-DD	2020-10-22
DESIGNED	MEM
PREPARED	CAJ
REVIEWED	ALB
APPROVED	MEM

PROJECT
JACKSON COUNTY TRANSFER STATION
MSW LANDFILL CELL
WALDEN, CO

TITLE
GROUNDWATER AND LANDFILL GAS MONITORING LOCATIONS

PROJECT NO.	REV.	FIGURE
19124320	0	C-1

Path: \\Denver\acad\19\19124320\PRODUCTION\15OCT20_AlexBrown\19124320\19-124320\PRODUCTION\FIGURES\ | File Name: 19124320_C-1_GW AND LFG LOCATIONS.dwg | Last Edited By: cjeffries Date: 2020-10-22 Time:1:46:45 PM | Printed By: CJeffries Date: 2020-10-22 Time:2:54:57 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

0 1 in

APPENDIX C-1

Groundwater Instrument Calibration Form

JACKSON COUNTY LANDFILL

INSTRUMENT CALIBRATION FORM

Project Name: ______________________________ **Project No:** ________________________

Calibration By: ____

Instrument Details

Instrument Name: ____

Serial No.: ____

Model No.: ____

Calibration Details

Calibration Standard: ____

____

Calibration Standard(s) Expiration Date: ____________________________________

Calibration:

Date	Time	**Calibration Standard** Units: ___________	**Instrument Reading** Units: _________

Comments:

APPENDIX C-2

Field Forms

GROUNDWATER SAMPLING DATA SHEET

Project Name: Jackson County Landfill	Sampler Name(s):
Project Number: 19124320	Date:
Monitoring Well I.D.: MW-1	Weather Conditions:
Wellhead Inspection (note conditions):	

Groundwater Measurements and Purge Data:

1. Static Water Level[1] (±0.01ft.)		8. Purge Equipment Used	Grundfos Submersible Pump
2. Bottom of Casing[1] (±0.01ft.)		9. Dedicated? (Yes or No)	Yes
3. Casing Diameter (in.)	2.0	10. Purge Rate (if pump used) (gal/min)	
4. Casing Volume (gallons)		11. Time to Purge Well (min)	
5. 3 x Casing Volume (gallons)		12. Immiscible Layer Observed (yes or no)	
6. Actual Volume of Water Purged		13. Thickness if Immiscible layer (if present)	
7. Water Level Measuring Equip.			

[1] Measured from a defined point on the edge of casing (surveyed top of casing)

Purge Parameters:

Date	Time	Volume Purged (gallons)	Temp (°C)	pH	Specific Conductivity (__S/cm)	Sample Appearance	Water Level

Groundwater Sample Information:

Date	**Time**	**Volume Purged (gallons)**	**Temp (ºC)**	**pH**	**Specific Conductivity (__S/cm)**	**Sample Appearance**	**Water Level**

1. Sampling Equipment Used	Submersible pump, generator, HDPE Tube				**Other Information:**	
2. Pump Rate	325 Hz				**Decontamination Procedures**	Alconox, Distilled Water
3. Sample Appearance**:**	clear ☐	low ☐	medium ☐	high ☐		
Color					**Instrument Calibrations**	Water Quality Meter
4. Odor						
5. Method of Sample Preservation	H_2SO_4, HNO_3, None				**Unusual Occurrences**	

Laboratory Containers:

Sub-Sample	**Analysis Requested**	**Type and Size of Sample Container**	**Filtered (Y/N)**	**Preservative**
1	Standard Method 6020 Standard Method 6010B	500 mL Poly	N	HNO3
2	EPA Method 300.0; Standard Method 4500 H+; Standard Method 2320B (Wet Chemisty)	500 mL Poly	N	None
3	Standard Method 5310B	500 mL Amber Glass	N	H2SO4
4	Standard Method 8260B	40 mL Clear Glass (3 vials)	N	None

GROUNDWATER SAMPLING DATA SHEET

Project Name: Jackson County Landfill	Sampler Name(s):
Project Number: 19124320	Date:
Monitoring Well I.D.: MW-2	Weather Conditions:
Wellhead Inspection (note conditions):	

Groundwater Measurements and Purge Data:

1. Static Water Level[1] (±0.01ft.)		8. Purge Equipment Used	Grundfos Submersible Pump
2. Bottom of Casing[1] (±0.01ft.)		9. Dedicated? (Yes or No)	Yes
3. Casing Diameter (in.)	2.0	10. Purge Rate (if pump used) (gal/min)	
4. Casing Volume (gallons)		11. Time to Purge Well (min)	
5. 3 x Casing Volume (gallons)		12. Immiscible Layer Observed (yes or no)	
6. Actual Volume of Water Purged		13. Thickness if Immiscible layer (if present)	
7. Water Level Measuring Equip.			

[1] Measured from a defined point on the edge of casing (surveyed top of casing)

Purge Parameters:

Date	Time	Volume Purged (gallons)	Temp (ºC)	pH	Specific Conductivity (__S/cm)	Sample Appearance	Water Level

Groundwater Sample Information:

Date	Time	Volume Purged (gallons)	Temp (^oC)	pH	Specific Conductivity (__S/cm)	Sample Appearance	Water Level

1. Sampling Equipment Used	Submersible pump, generator, HDPE Tube				**Other Information:**	
2. Pump Rate	352 Hz				**Decontamination Procedures**	Alconox, Distilled Water
3. Sample Appearance**:**	clear ☐	low ☐	medium ☐	high ☐		
Color					**Instrument Calibrations**	Water Quality Meter
4. Odor						
5. Method of Sample Preservation	H_2SO_4, HNO_3, None				**Unusual Occurrences**	

Laboratory Containers:

Sub-Sample	Analysis Requested	Type and Size of Sample Container	Filtered (Y/N)	Preservative
1	Standard Method 6020 Standard Method 6010B	500 mL Poly	N	HNO3
2	EPA Method 300.0; Standard Method 4500 H+; Standard Method 2320B (Wet Chemisty)	500 mL Poly	N	None
3	Standard Method 5310B	500 mL Amber Glass	N	H2SO4
4	Standard Method 8260B	40 mL Clear Glass (3 vials)	N	None

GROUNDWATER SAMPLING DATA SHEET

Project Name: Jackson County Landfill	Sampler Name(s):
Project Number: 19124320	Date:
Monitoring Well I.D.: MW-3	Weather Conditions:
Wellhead Inspection (note conditions):	

Groundwater Measurements and Purge Data:

1. Static Water Level[1] (±0.01ft.)		8. Purge Equipment Used	Grundfos Submersible Pump
2. Bottom of Casing[1] (±0.01ft.)		9. Dedicated? (Yes or No)	Yes
3. Casing Diameter (in.)	2.0	10. Purge Rate (if pump used) (gal/min)	
4. Casing Volume (gallons)		11. Time to Purge Well (min)	
5. 3 x Casing Volume (gallons)		12. Immiscible Layer Observed (yes or no)	
6. Actual Volume of Water Purged		13. Thickness if Immiscible layer (if present)	
7. Water Level Measuring Equip.			

[1] Measured from a defined point on the edge of casing (surveyed top of casing)

Purge Parameters:

Date	Time	Volume Purged (gallons)	Temp (°C)	pH	Specific Conductivity (__S/cm)	Sample Appearance	Water Level

Groundwater Sample Information:

Date	Time	Volume Purged (gallons)	Temp (°C)	pH	Specific Conductivity (__S/cm)	Sample Appearance	Water Level

1. Sampling Equipment Used	Submersible pump, generator, HDPE Tube				**Other Information:**	
2. Pump Rate	338 Hz				**Decontamination Procedures**	Alconox, Distilled Water
3. Sample Appearance**:**	clear ☐	low ☐	medium ☐	high ☐		
Color					**Instrument Calibrations**	Water Quality Meter
4. Odor						
5. Method of Sample Preservation	H_2SO_4, HNO_3, None				**Unusual Occurrences**	

Laboratory Containers:

Sub-Sample	Analysis Requested	Type and Size of Sample Container	Filtered (Y/N)	Preservative
1	Standard Method 6020 Standard Method 6010B	500 mL Poly	N	HNO3
2	EPA Method 300.0; Standard Method 4500 H+; Standard Method 2320B (Wet Chemisty)	500 mL Poly	N	None
3	Standard Method 5310B	500 mL Amber Glass	N	H2SO4
4	Standard Method 8260B	40 mL Clear Glass (3 vials)	N	None

GROUNDWATER SAMPLING DATA SHEET

Project Name: Jackson County Landfill	Sampler Name(s):
Project Number: 19124320	Date:
Monitoring Well I.D.: MW-4	Weather Conditions:
Wellhead Inspection (note conditions):	

Groundwater Measurements and Purge Data:

1. Static Water Level[1] (±0.01ft.)		8. Purge Equipment Used	Grundfos Submersible Pump
2. Bottom of Casing[1] (±0.01ft.)		9. Dedicated? (Yes or No)	Yes
3. Casing Diameter (in.)	2.0	10. Purge Rate (if pump used) (gal/min)	
4. Casing Volume (gallons)		11. Time to Purge Well (min)	
5. 3 x Casing Volume (gallons)		12. Immiscible Layer Observed (yes or no)	
6. Actual Volume of Water Purged		13. Thickness if Immiscible layer (if present)	
7. Water Level Measuring Equip.			

[1] Measured from a defined point on the edge of casing (surveyed top of casing)

Purge Parameters:

Date	**Time**	**Volume Purged (gallons)**	**Temp (°C)**	**pH**	**Specific Conductivity (__S/cm)**	**Sample Appearance**	**Water Level**

Groundwater Sample Information:

Date	Time	Volume Purged (gallons)	Temp (^oC)	pH	Specific Conductivity (__S/cm)	Sample Appearance	Water Level

1. Sampling Equipment Used	Submersible pump, generator, HDPE Tube				**Other Information:**	
2. Pump Rate	364 Hz				**Decontamination Procedures**	Alconox, Distilled Water
3. Sample Appearance**:**	clear ☐	low ☐	medium ☐	high ☐		
Color					**Instrument Calibrations**	Water Quality Meter
4. Odor						
5. Method of Sample Preservation	H_2SO_4, HNO_3, None				**Unusual Occurrences**	

Laboratory Containers:

Sub-Sample	Analysis Requested	Type and Size of Sample Container	Filtered (Y/N)	Preservative
1	Standard Method 6020 Standard Method 6010B	500 mL Poly	N	HNO3
2	EPA Method 300.0; Standard Method 4500 H+; Standard Method 2320B (Wet Chemisty)	500 mL Poly	N	None
3	Standard Method 5310B	500 mL Amber Glass	N	H2SO4
4	Standard Method 8260B	40 mL Clear Glass (3 vials)	N	None

GROUNDWATER SAMPLING DATA SHEET

Project Name: Jackson County Landfill	Sampler Name(s):
Project Number: 19124320	Date:
Monitoring Well I.D.: MW-5	Weather Conditions:
Wellhead Inspection (note conditions):	

Groundwater Measurements and Purge Data:

1. Static Water Level[1] (±0.01ft.)		8. Purge Equipment Used	Grundfos Submersible Pump
2. Bottom of Casing[1] (±0.01ft.)		9. Dedicated? (Yes or No)	Yes
3. Casing Diameter (in.)	2.0	10. Purge Rate (if pump used) (gal/min)	
4. Casing Volume (gallons)		11. Time to Purge Well (min)	
5. 3 x Casing Volume (gallons)		12. Immiscible Layer Observed (yes or no)	
6. Actual Volume of Water Purged		13. Thickness if Immiscible layer (if present)	
7. Water Level Measuring Equip.			

[1] Measured from a defined point on the edge of casing (surveyed top of casing)

Purge Parameters:

Date	Time	Volume Purged (gallons)	Temp (°C)	pH	Specific Conductivity (__S/cm)	Sample Appearance	Water Level

Groundwater Sample Information:

Date	Time	Volume Purged (gallons)	Temp (^{o}C)	pH	Specific Conductivity (__S/cm)	Sample Appearance	Water Level

1. Sampling Equipment Used	Submersible pump, generator, HDPE Tube				**Other Information:**	
2. Pump Rate	385 Hz				**Decontamination Procedures**	Alconox, Distilled Water
3. Sample Appearance**:**	clear ☐	low ☐	medium ☐	high ☐		
Color					**Instrument Calibrations**	Water Quality Meter
4. Odor						
5. Method of Sample Preservation	H_2SO_4, HNO_3, None				**Unusual Occurrences**	

Laboratory Containers:

Sub-Sample	Analysis Requested	Type and Size of Sample Container	Filtered (Y/N)	Preservative
1	Standard Method 6020 Standard Method 6010B	500 mL Poly	N	HNO3
2	EPA Method 300.0; Standard Method 4500 H+; Standard Method 2320B (Wet Chemisty)	500 mL Poly	N	None
3	Standard Method 5310B	500 mL Amber Glass	N	H2SO4
4	Standard Method 8260B	40 mL Clear Glass (3 vials)	N	None

APPENDIX C-3

Example Sample Label

EXAMPLE BOTTLE LABEL

CLIENT/SITE:
SAMPLE ID:
DATE:
TIME:
ANALYSIS:
PRESERVATIVE:
SAMPLED BY:

APPENDIX C-4

Example Chain of Custody Form

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager:**	**Site Contact:**	**Date:**	COC No:
Your Company Name here	**Tel/Fax:**	**Lab Contact:**	**Carrier:**	_______ of ______ COCs
Address	**Analysis Turnaround Time**			Sampler:
City/State/Zip	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(xxx) xxx-xxxx Phone	TAT if different from Below _________			Walk-in Client:
(xxx) xxx-xxxx FAX	☐ 2 weeks			Lab Sampling:
Project Name:	☐ 1 week			
Site:	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)																		Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for__________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No

Custody Seal No.:

Cooler Temp. (°C): Obs'd:_________ Corr'd:__________ Therm ID No.:____________

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.3, dated 12/05/2013

GOLDER

golder.com

APPENDIX D

Closed Landfill Checklist

Post-Closure Inspection Checklist

Facility Name:		
Address:		
Date:	**Time:**	**Name of Inspector:**

Post-Closure Care Inspection Items (circle Yes* or No)	
Vegetation	
- Are there areas without vegetation (i.e., bare areas)?	Yes* No
- Are there any signs of stressed vegetation?	Yes* No
- Are there any noxious weeds on the final cover?	Yes* No
Erosion	
- Are there rills/gullies > 6” in depth on final cover area?	Yes* No
- Is there exposed waste?	Yes* No
Biota	
- Are there any animal burrows in the final cover area?	Yes* No
Settlement	
- Are there any depressions within the final cover area?	Yes* No
- Is there evidence of standing water on the final cover area?	Yes* No
- Is there evidence of cracking or sloughing of the final cover area?	Yes* No
Surface Water Controls	
- Is there erosion within drainage channels?	Yes* No
- Are there any obstructions in the drainage channels?	Yes* No
- Is there standing water in the drainage channels?	Yes* No
- Is there excess sediment in the drainage channel or pond?	Yes* No
Post-Closure Activities	
- Are there any unapproved activities occurring at the site?	Yes* No
- Are there unapproved activities occurring on the final cover area?	Yes* No
Access Control	
- Is there any damage to the perimeter fence?	Yes* No
- Is there any damage to the signage (i.e., Does the sign clearly state that the landfill is closed)?	Yes* No
***Fill out Page 2 for “Yes” Answers**	

Post-Closure Inspection Checklist

Description of All “Yes” Answers
Description of Required Maintenance and Schedule for Repair/Maintenance
Completed Repair/Maintenance (photos shall be provided as an attachment to this checklist)

APPENDIX E

Tire Collection EDOP

WASTE TIRE COLLECTION FACILITY EDOP
JACKSON COUNTY, COLORADO

Prepared
for:
Jackson County, Colorado
Walden, CO 80480

By:

North Park Engineering & Consulting, Inc.

Randall R. Miller

Randall R. Miller, P.E.

COLORADO REGISTERED PROFESSIONAL ENGINEER
RANDALL R. MILLER
32004
6/19/2019

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1.0 Introduction

The Jackson County Tire Collection Facility (TCF) is located at 651 County Road 51 A, Walden, CO 80480. The designated tire collection area is located on a 72 acre tract of land purchased by Jackson County, Colorado on the 8th day of February' 1988. The Jackson County Transfer Station and a Facility office are also located on this tract of dry uplands located approximately 2 miles from the Town of Walden. The location of the TCF on this 72 acre tract of land is shown on Figure 1. Current Colorado Department of Public Health and the Environment (CDPHE) regulations require registration of the facility as a waste tire collection facility. This document presents the necessary information for an Engineering Design and Operations Plan (EDOP), dated June 19, 201 9. This document addresses a Waste Tire Collection Facility ("TCF" or "storage area") located on the county owned property for temporary storage of waste tires. The information included herein specifically addresses the requirements presented in the Regulations Pertaining to Solid Waste Sites and Facilities, 6 CCR 1007-2, Part 1 (Solid Waste Regulations) (Last amended October 17, 2017, effective March 1, 2018) Section 10 - Waste Tires (Specifically, Sections 10.1,10.2, 10.8. and 10.10). Relevant sections and information requested in Section 10 of the CDPHE Solid Waste Regulations are used in the section headings of this amendment, or within the text as appropriate.

In addition, this Plan addresses the requirements of the International Fire Code, 2015 Edition, First Printing: May 2014 (Copyright 2014 by the International Code Council, Inc. Washington, D.C.), pertaining to outdoor storage of tires. The IFC 2015 Standard is the current set of regulations used by Colorado DFPC for Waste Tire Facilities. An approval letter from North Park Fire Rescue Authority is included in Appendix C.

The facility is designed for the safe and efficient temporary storage of waste tires in accordance with the Facility's Engineering Design and Operations Plan (EDOP), and to comply with applicable local fire codes in accordance with 10.8.2 (K) of the CDPHE Solid Waste Regulations.

Additionally, this document includes the Fire Safely Plan in accordance with Section 10.8.9 of the CDPHE Solid Waste Regulations. A site map showing the facility location.is shown on Figure I.

2.0 Tire Collection Facility

2.1 Design and Closure |Sections 2.5, 2.6, 10.8.2, 10.8.9, and 10.8.10]

2.1.1 Design

The TCF operates in accordance with Section 10.8 of the regulations. Per Section 10.8.2(J), the facility will have no more than 7,500 waste tires onsite at any one time. Tires will be temporarily stored at the designated TCF, and then will be exported periodically for use by tire brokers or tire shredders. Per the CDPHE Solid Waste Regulations, only registered tire haulers and processors will be employed for removal or on-site processing of tires. See Section 2.2.3 for tire acceptance requirements from unregistered haulers.

The location of the TCF in relation to the county property is shown on Figure 1. The storage area is located on undeveloped ground to the west of the office facility, as shown on Figure 2. It occupies an area of approximately .5 acre. Within this area, two 5,000 square foot tire piles can be placed, with a distance of at least forty feet between the piles. It is estimated that two proposed tire piles would be each approximately two feet high to store 7,500 tires. Note that this is not the required geometry of the tire storage piles, but merely a demonstration that the tire storage area has the capacity to hold 7,500 tires. Although there is more than adequate space for 7,500 tires, Jackson County does not plan to hold more than 1500 tires on site. Jackson County anticipates having less than 20,000 square feet of waste tires on site.

The original ground surface at the TCF site was fairly level. In preparing the site for tire storage, the vegetation will be removed and the site graded to provide drainage away from the piles. The surface of the facility will be inspected after significant precipitation events, and any significant erosion of the surface will be repaired to maintain the integrity of the tire storage area.

2.1.2 Closure

Jackson County will "clean close" the TCF, and as a result no post-closure care and maintenance specific to the TCF will be required. Jackson County will close the TCF in accordance with relevant State regulations. Jackson County will notify CDPHE, in writing, 60 calendar days in advance of temporary or permanent closure of the TCF. Jackson County will notify the public on the same schedule via notification signs prominently displayed at the main control gate on County Road 51A that provides access to the TCF and the county property. Within 180 calendar days following the final receipt of waste tires, Jackson County will finish permanent closure activities. Within 60 calendar days of completion of closure, Jackson County will submit a Closure Certification Report (Report) to CDPHE for review and approval. The Report will include summaries of closure activities conducted to support the unrestricted use condition of the facility. The Report will document that Jackson County has achieved all the requirements and conditions of the Closure Plan.

During closure, all remaining tires stored within the storage area will be removed and delivered to another permitted facility. If necessary, surfaces previously used for storage or handling of tires will be cleared of litter in preparation for closure. Waste generated during decommissioning of the TCF will be disposed at a permitted solid waste facility. No tires delivered to the site will remain upon site closure. Since Jackson County will not process tires on site and all tires will be sent off site for further processing, there is no reason to suspect any potential release of materials to soils underlying the Waste Tire Collection Facility that could result in the soils exhibiting hazardous characteristics.

Upon closure, facility surface soils at the Waste Tire Collection Facility will be visually assessed for any staining or other indications of residual contamination. There is no reason to suspect any potential release of materials to soils underlying the storage area that could result in the soils exhibiting hazardous characteristics. Potentially contaminated soils will be assessed for composition and depth of contamination, and disposed in accordance with State and Federal requirements.

Upon approval of this EDOP for the Jackson County Tire Collection Facility, Jackson County will maintain financial assurance for closure and post-closure care and maintenance of the Waste Tire Collection Facility, in accordance with Section 10.8.6 of the CDPHE Solid Waste Regulations. Financial Assurance documentation for Jackson County Waste Tire Collection Facility is presented in Appendix D. The financial assurance cost estimate includes the cost for removal of 7,500 waste tires; however, Jackson County intends to remove tires from the site periodically, so it is highly unlikely that there will ever be 7,500 waste tires on-site. Cost estimates are included in Appendix D for tire removal from site, site reclamation and reseeding, and soil sampling. These costs total $35,050.00.

2.2 Waste Tire Collection Facility Registration Requirements [Sections 10.1.3,10.8.2 (H), 10.8.2 (I), 10.8.3, and 10.8.4]

2.2.1 Certification of Registration

The TCF will operate only with a Certificate of Registration issued by CDPHE. CDPHE issues a Certificate of Registration after a site and facility applies for such via Fonn WT-1 and CDPHE approves the application. Jackson County will maintain the TCF Certificate of Registration at the office facility on site and make it available for inspection. Jackson County will notify CDPHE, in writing, whenever changes occur in the following:

- Ownership
- Mailing Address
- Business Name
- Type of Registration
- Contact Name
- Telephone Number
- Operation Location

2.2.2 Certificate of Registration Application and Decal

An application for a Certificate of Registration also serves as an application for a Waste Tire Collection Facility decal. CDPHE issues the decals (each with a unique number) with the Certification of Registration. Jackson County will post its Waste Tire Facility decal in a prominent location near the TCF, where the decal is visible to waste tire haulers or mobile waste tire processors.

2.2.3 Manifest Requirements

If the TCF accepts 10 or more unmanifested waste tires or 10 or more waste tires from unregistered waste tire haulers, Jackson County will submit to CDPHE within 20 days from the end of the preceding month a Uniform Waste Tire Manifest(s) Form (Form WT-2) for the receipt of unmanifested waste tires. The Uniform Waste Tire Manifest Form must contain the following information:

- Date(s) waste tires were accepted
- The total number of waste tires accepted
- License plate number of unregistered waste tire hauler vehicle used to deliver waste tires
- If available, the name, address, and telephone number of the person who delivered the waste tires
- If possible, the source of the tires.

Jackson County will arrange for the commercial hauling of waste tires with a waste tire hauler or a mobile processor who is registered pursuant to the CDPHE Solid Waste Regulations.

Jackson County will ensure that all waste tires collected at the TCF are delivered to a registered waste tire generator, a registered waste tire hauler, another registered waste tire collection facility, a registered waste tire monofill, a registered waste tire processor, an approved beneficial user of whole waste tires, a municipal or county-owned waste tire collection area, or to a municipal or privately owned solid waste Transfer Station operating in compliance with the Solid Wastes Regulations or processed by a registered mobile processor.

2.3 Used Tire Management Standards [Section 10.10]

The TCF has developed and will maintain on site written criteria for distinguishing waste tires from used tires and will make such criteria available for an inspection. In accordance with Section 1.2 of the CDPHE Solid Waste Regulations;

> "Used Tire" means a tire that was previously used as a tire and is graded and classified for re-use as a tire based on specifications and criteria maintained pursuant to Section 3020-1410 (1) (a), Colorado Revised Statutes.
>
> "Waste Tire" means a tire that is modified from its original specifications but not

processed into a tire-derived product, is no longer being used for its initial intended purpose as a tire and is not a used tire.

For this EDOP, Jackson County adopts the definitions stated above, and the TCF will accept only waste tires, and, therefore, will not accept used tires, whether for sale in Colorado or outside of Colorado.

2.4 Operational Records, Training and Reporting [Sections 2.4,10.8.5, 10.8.7, and 10.8.9]

2.4.1 Operational Records and Training

Operational records will be retained on file in the facility office. Records retained on site will include this document, a log of quantities of tires received, processed, and transported off site; the Fire Safety Plan; a copy of the Certificate of Designation; and variations from approved operating procedures. In addition, a record will be maintained of periodic inspections of the facility by any federal, state, or local personnel authorized to make such inspections. A copy of the findings from each inspection will also be retained on site.

Facility employees will be trained annually on operation of the TCF and the requirements enumerated in this document. The training will be documented, and documentation will include the title of the training, employee names, and the date of the training. These records will be retained for a minimum of 3 years and will be available during inspections.

Operating Records will be retained at the facility office. Prior to tires entering the facility, the quantity of tires will be recorded by Tire Collection Facility personnel. Tire removal is tracked on a CDPHE form. Uniform Waste Tire Manifest (Form WT-2), which is completed by the Tire Hauler each time tires are removed from the facility. The Tire Hauler also completes an invoice for the TCF that specifies the number of tires that are removed.

2.4.2 Annual Report

An annual report will be submitted to CDPHE by April 1 of the following year. The annual report will use the Waste Tire Facility Annual Reporting Form (Form WT-5) and include (by actual count or by actual weight in tons) the following:

- The number of waste tires received at the facility
- The number of waste tires shipped off site from the facility for the preceding calendar year
- The total number of waste tires accepted from unregistered waste tire haulers.

2.4.3 Other Reporting

The TCF will not accept a shipment of 10 or more waste tires from a waste tire hauler without an accompanying manifest properly completed pursuant to Section 10.3.4 of the CDPHE Solid Waste Regulations unless the TCF complies with Section 10.1.3 (E) of the CDPHE Solid Waste

Regulations.

The facility office will retain the manifests for all shipments of waste tires accepted by the TCF and make the manifests available for inspection for three years from the date of delivery. The TCF will not offer a shipment of 10 or more waste tires without an accompanying manifest properly completed by the waste tire hauler in accordance with Section 10.3.4 of the Solid Waste Regulations. The TCF will not offer waste tires for mobile processing without receiving a manifest properly completed by the mobile waste tire processor in accordance with Section 10.7.5 of the CDPHE Solid Waste Regulations. The facility office will maintain the manifests for all shipments of waste tires shipped off site and accepted on site by the TCF and make the manifests available for inspection for three years from the date of delivery.

2.5 Self-Certification [Section 10.8.8]

CDPHE may require the TCF to furnish additional information concerning compliance with the CDPHE Solid Waste Regulations using a self-certification process as described in Section 10.8.8 of the Solid Waste Regulations. Should CDPHE require the TCF to participate in the self-certification process, Jackson County will work in partnership with CDPHE to achieve such status in accordance with requirements in place at that time.

2.6 Access Roads [Section 10.8.2 (A)

The TCF will be accessed using existing property access roads (see Figures 1 and 2). A water truck is available through the Road and Bridge Department to wet roads, if necessary, for dust control. The access roads into the TCF site will be posted as 15 miles per hour. The County Road 51A and the TCF access roads will be maintained and kept accessible in all weather conditions by on-site Jackson County personnel and equipment to allow access to the active operations and to meet the Fire Protection, Training, and Fire-Fighting Plan requirements of Section 10.8.9 (A) (3) of the Solid Waste Regulations. Please refer to the Section A.3 of the Fire Safety Plan for fire department access.

2.7 Litter Control [Section 10.8.2 (B)

Jackson County will maintain the storage area free of debris to avoid a fire hazard or nuisance condition. It is expected that any litter generated by the TCF will be minimal. To minimize potential fuel sources, the TCF will be maintained free and clear of combustible ground vegetation. A distance of 40 feet will be maintained from the stored material to grass and weeds, and 100 feet from the stored product to bushes and trees will be maintained, in accordance with Section A.2 of the Fire Safety Plan.

2.8 Security Measures [Sections 10.8.2 (C), 10.8.9 (A) (1) (e)]

To prevent unauthorized entry, the TCF storage area is located behind a locked gate on the only access road into the property (see Figures), which encompasses approximately 72 acres.

2.9 Signage [Section 10.8.2 (D)]

A sign is posted at the facility entrance, stating hours of operation, types of waste accepted and not accepted and to indicate only waste tires will be accepted at the TCF, and emergency telephone numbers.

2.10 Operational Information

A copy of the Certificate of Designation and the Certificate of Registration will be available at the facility office for inspection. The TCF will be open for business at the same hours of operation as the Transfer Station, Wednesday, Thursday and Friday 8:30 A.M. to 5:00 P.M. and Saturdays: 9:00 A.M. to 3:00 P.M.

Hours of operation are posted at the Facility's front gate and on the Jackson County website at http://iacksoncountvcogov.com/transfer-station/ with hours of operation being subject to change. Incoming waste loads, including those containing waste tires, will be inspected by facility personnel. If tires are included in the waste for storage at the TCF staff will direct the vehicle to the TCF.

2.11 Emergency Information [Sections 10.8.2 and 10.8.9]

A working telephone is maintained by personnel at the facility office.

In the event of an emergency, contact Mr. Edward Downing, Transfer Station Operator, as follows:

Jackson County Transfer Station
651 County Road 51A
Walden, Colorado 80480
(970)619-9189 (mobile)

2.12 Vector Control Plan [Section 10.8.9 (A) (4)]

Rodent and insect harborage will be controlled through routine cleanup and inspection by facility personnel. Tires may require spraying periodically with insecticide to control mosquitoes, in accordance with the Pesticide Applicators Act, § 35-10-101, Colorado Revised Statutes. Dust and odors are not anticipated to be a problem at the tire storage facility. A water truck is available to wet the roads, if necessary, for dust control. The site speed limit will be posted as 15 mph on the TCF access roads. Additionally, there will be no burial of waste or earth-moving at the TCF.

Noise from tire collection operations will be controlled primarily through being isolated from neighboring properties and being located within the Transfer Station. Nuisance conditions attributable to the operation of the TCF will be corrected within three days of receipt of complaint in writing from Jackson County or CDPHE.

2.13 Fire Prevention [Section 10.8.9 (3)]

The Fire Safety Plan is presented in Appendix A of this amendment and specifies fire lane locations and widths:

- Jackson County persomiel will maintain the TCF so that fire lanes and access roads
- are accessible
- Jackson County personnel will be on site during normal operating hours and will
- monitor the tire storage area for signs of fire
- Jackson County has access to a water truck on an as-needed basis
- Appendix A Fire Safety Plan outlines fire prevention and firefighting methods
- The Jackson County TCF Operator, Edward Downing, is designated as the
- Facility Emergency Coordinator. His contact information is as follows:

Jackson County Facility Operator
651 County Road 51A
Walden, Colorado 80480
(970)619-9189 (mobile)

The Fire Safety Plan has been reviewed and approved by the local fire control authority. A copy of the approval letter is included in Appendix C.

2.14 Buffer Zones [Section 10.8.2]

The TCF Buffer Zone will always include:

- A "no vegetation" zone within 40 feet of the tire piles.
- A 50-foot minimum distance from all property lines.
- In accordance with IFC 2015 this area shall be maintained free of brush and trees for a minimum distance of 100 feet from stored tires.

2.15 Emergency Reporting [Section 10.8.2 (G)]

In the event of a fire or other emergency, CDPHE will be notified by telephone within 24 hours of the incident. The telephone number for CDPHE will be posted in the facility office.
Within two weeks of notification of an emergency, the Facility will submit a report on the incident to CDPHE. The report will describe the origins of the emergency, the actions that were taken, actions that are being taken or are planned, results or anticipated results of these actions, and an approximate date of resolution of the problems generated by the emergency.

2.16 Personnel and Equipment [Sections 10.8.2 (F) and 10.8.9 (A) (1) (b)]

The unloading of waste tires at the TCF will be visible by personnel located in the facility office. A 1997 John Deere 310D Loader-Backhoe with Rylind quick-connect coupler, 7-foot bucket, 60 inch forks and a 9-foot hydraulic angle snow plow and a 2003 SI85 diesel Bobcat Skid Steer is located on site to assist with fire suppression and road maintenance. Additionally, the facility operator can quickly call and request motor graders, crawler dozers and water trucks from Jackson County Road and Bridge for firefighting and road maintenance.

FIGURES

GENERAL LOCATION MAP
JACKSON COUNTY TIRE COLLECTION FACILITY

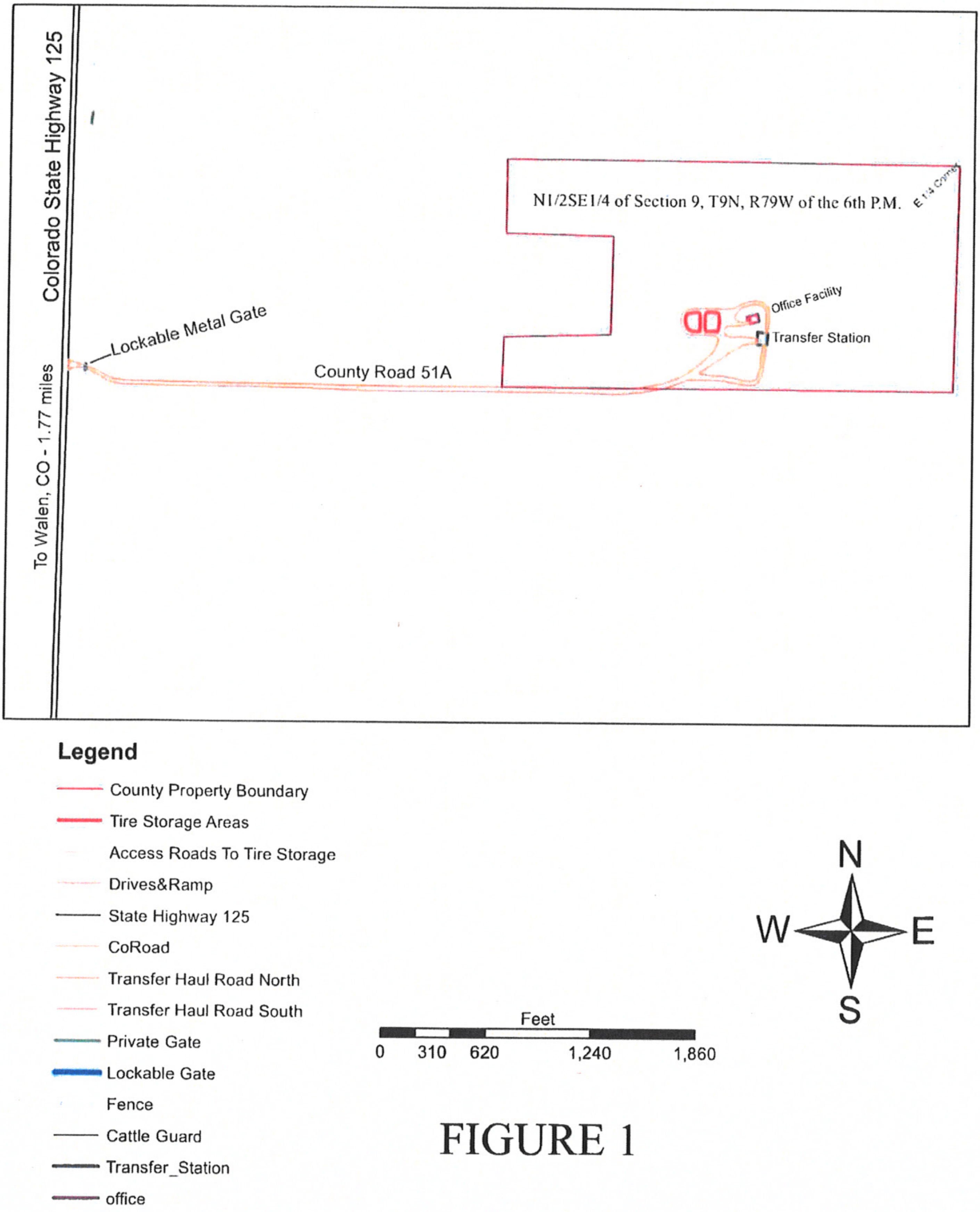


FIGURE 1

SITE MAP SHOWING OFFICE FACILITY, TRANSFER STATION AND TIRE STORATE AREAS

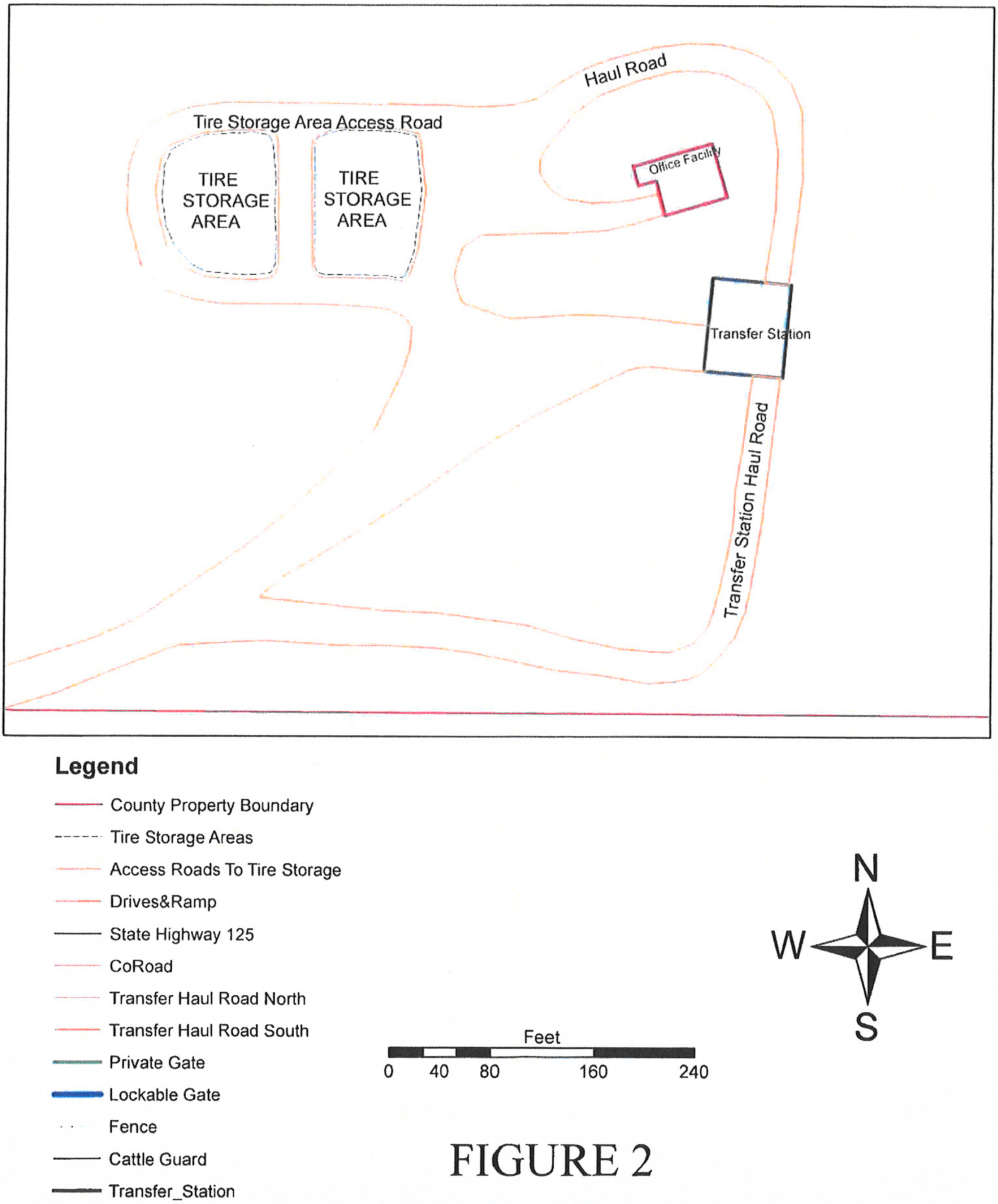


FIGURE 2

APPENDIX A

FIRE SAFETY PLAN

A.1 Fire Safety Plan [Section 10.8.9 (A)(3)]

The Fire Safety Plan for the Waste Tire Collection Facility (TCF) is consistent with the 2015 International Fire Code (IFC). A copy of the Plan will be kept at the Facility office.

Certain activities and actions shall be prohibited at the TCF site, including the following:

- Open burning within 250 feet of the tire stockpile
- Cutting/welding or heating devices
- Smoking of cigarettes, cigars, pipes, or other smoking materials ("No smoking" sign(s) will be prominently posted)
- The TCF will not be located beneath overhead power lines having a voltage exceeding 750 volts, or that supply power to fire emergency systems.

Access to the TCF area is shown on Figures 1 and 2. Access to the facility will include fire vehicle access roads to the facility and fire lanes around the tire collection facility. The Fire Safety Plan will be retained at the Facility office.

The telephone number of the North Park Fire Rescue Authority ("NPFRA") (970-723-8256), Emergency 911, and the location of the nearest telephone, will be posted at the TCF office facility. See Appendix B for a list of emergency contacts.

A.2 Pile Sizes, Buffers, and Volumes [CDPHE 10.2 and IFC 2015]

The tire storage shall be maintained per the restrictions of IFC as follows:

- Tires shall be stored outdoors on the surface of the Waste Tire Storage Facility, which will be relatively flat and graded to encourage drainage away from the TCF
- Individual piles of tires shall not exceed 5,000 square feet of continuous area. The dimensions of the piles will be periodically confirmed by site personnel
- The height of each individual pile will not exceed 10 feet and shall not exceed 50,000 cubic feet in volume. The height of each pile will be confirmed periodically by site personnel
- Individual tire piles shall be separated from each other by a minimum of 40 feet from the pile edges
- Other stored products will be kept clear from the Tire Storage Facility by minimum of 40 feet
- Tire piles are to be maintained more than 50 feet from lot lines and buildings
- Tire piles will be maintained free and clear of combustible ground vegetation for a distance of 40 feet from the stored tires to grass and weeds, and for a distance of 100 feet from the stored tires to brush and trees
- The total bulk volume of stored tires will not exceed 150,000 cubic feet. The total number of tires proposed to be handled by the Landfill each year is anticipated to be less than 7,500 tires

- The location of the TCF will never be under a bridge, elevated trestle, elevated roadway, or elevated railroad.

A.3 Fire Department Access [CDPHE Section 10.8.9 (A) (3) (a) and IFC 2015]

The TCF shall meet fire department access requirements as follows:

- The access road will lead directly from existing access roads, which are maintained by Jackson County
- The access road will be a minimum of 20 feet wide
- The access road shall be all-weather and maintained
- The access road will be marked with fire lane signage
- Fire equipment access roads shall be a minimum of 20 feet from the edge of the tire piles
- The access roads shall be maintained clear of obstructions and be fully operational at all times.

The TCF is located on property owned by Jackson County, Colorado. A lockable hinged gate, at least 20 feet in width controls entry onto the access road (CR 51A) to the site. The NPFRA has been given a key to the gate.

A.4 Fire Protection [CDPHE Section 10.8.9 (A) (3) (b) and IFC 2015]

Equipment located on site for extinguishing fires at the Tire Storage Facility include a 1997 John Deere 310D Loader-Backhoe with Rylind quick-connect coupler, 7 foot bucket, 60 inch forks and a 9 foot hydraulic angle snow plow and a 2003 S185 diesel Bobcat Skid Steer is located on site to assist with fire suppression and road maintenance. Additionally, the facility operator can quickly call and request motor graders, crawler dozers and water trucks from Jackson County Road and Bridge for firefighting and road maintenance. Equipment from the Road and Bridge Department including water trucks can be mobilized to the TCF on short notice.

Each piece of heavy equipment on site is equipped with an A:B:C-rated portable fire extinguisher. Jackson County personnel on site at the Facility have been trained in fire extinguisher use, the recognition of fire and notification procedures for emergency response.

North Park Fire Rescue Authority (NPFRA) has excellent firefighting equipment housed in Walden, Colorado that can be dispatched to the TCF. NPFRA will have a short response time to the TCF from the fire station in Walden.

APPENDIX B

EMERGENCY RESPONSE PLAN

Emergency Contacts

IN CASE OF EMERGENCY DIAL 9-1-1

FIRE DEPARTMENT
North Park Fire Rescue Authority
970-819-8732

EMERGENCY MANAGEMENT
Jackson County Sheriff Dispatch
970-723-4242

SITE EMERGENCY COORDINATOR
Ed Downing, Facility Operator
Jackson County, Colorado
651 CR 51A
Walden, Colorado 80480
jacksoncounty.co@gmail.com
970-619-9189 (mobile)

STATE OF COLORADO
Colorado Department of Public Health and Environment (CDPHE)
Hazardous Materials and Waste Management Division
4300 Cherry Creek Drive South
Denver, Colorado 80246
Attention: Cindy Smith
303-692-3409

EMERGENCY EQUIPMENT AVAILABLE ON-SITE:
Equipment located on site for extinguishing fires at the Tire Storage Facility include a 1997 John Deere 310D Loader-Backhoe with Rylind quick-connect coupler, 7 foot bucket, 60 inch forks and a 9 foot hydraulic angle snow plow and a 2003 S185 diesel Bobcat Skid Steer is located on site to assist with fire suppression and road maintenance. Additionally, the facility operator can quickly call and request motor graders, crawler dozers and water trucks from Jackson County Road and Bridge for firefighting and road maintenance. Equipment from the Road and Bridge Department including water trucks can be mobilized to the TCF on short notice.

Each piece of heavy equipment on site is equipped with an A:B:C-rated portable fire extinguisher.

EMERGENCY RESPONSE PROCEDURE:

- In the event of an emergency, dial 9-1-1.
- In the case of fire, as appropriate, mobilize on-site equipment to isolate burning materials, as required, and begin using portable fire extinguishers and/or water truck and available on-site water.
- Notify the CDPHE of the emergency situation as soon as possible.

FACILITY OWNERS

Jackson County, Colorado
396 Lafever Street
Walden, CO 80480
Telephone: 970-723-4660

FACILITY OPERATOR

Ed Downing, Facility Operator
Jackson County, Colorado
651 County Road 51A
Walden, Colorado 80480
jacksoncounty.co@gmail.com
970-619-9189 (mobile)

APPENDIX C

LETTER FROM LOCAL FIRE CONTROL AUTHORITY

NORTH PARK FIRE RESCUE AUTHORITY
P.O. BOX 708
513 HARRISON ST.
WALDEN, CO 80480

Date: June 18, 2019

From: Jeff Benson, Chief
(970) 819-8732 Mobile

To: Randall R. Miller, P.E.
North Park Engineering & Consulting, Inc.

Re: Jackson County Waste Tire Collection Facility EDOP

I have reviewed and approve the EDOP for the Jackson County Waste Tire Collection Facility that was presented to me. This Plan addresses the requirements of the International Fire Code, 2015 Edition, First Printing: May 2014 (Copyright 2014 by the International Code Council, Inc. Washington, D.C.), pertaining to outdoor storage of tires. The IFC 2015 Standard is the current set of regulations used by Colorado DFPC for Waste Tire Facilities. If there are any questions, feel free to give me a call.

Sincerely,

Jeff Beson

Jeff Benson, Fire Chief

APPENDIX D

CLOSURE AND RECLAMATION BIDS

Glenn E. Sessions & Sons, Inc.
33492 Highway 125
P.O. Box 1076
Walden, CO. 80480

"Serving Colorado and surrounding areas since 1949 in the oil and gas, general construction, and trucking industries."

Glenn E. Sessions and Sons submits the following estimate to reclaim approximately .4 acres of property located on the County's solid waste property. This scope of this work includes mobilization, regrading of the site, and seeding with a mix design that is approved by the local NRCS representative. No tire cleanup, tire hauling, or facility disassembly is included in this price.

$3,450 – Turnkey Proposal for Site Reclamation

Please feel free to contact us with any questions regarding this estimate.

Thank you,

Joe Sessions

President

Overton Recycling
PO Box 92
Meeker, CO 81641 US
(970) 878-7150
overtonrecycling@gmail.com

Estimate

ADDRESS
Jackson County
PO Box 1019
Walden, CO 81641

ESTIMATE # 1023
DATE 08/16/2019

ACTIVITY	QTY	RATE	AMOUNT
Tire Pick Up Fee:Small Tire Removal of 7500 tires of various sizes	1	30,000.00	30,000.00

TOTAL **$30,000.00**

Accepted By

Accepted Date

North Park Engineering &
Consulting, Inc.
P.O. Box 395
Walden, CO 80480
(970) 723-3725 fax: (970) 723-3725

September 5, 2019

Daniel E. Manville
Jackson County Commissioner

Re: Waste Tire Collection Facility (Proposed)
Environmental Assessment and Sampling Proposal

Dear Mr. Manville:

North Park Engineering & Consulting, Inc. is pleased to provide the following Cost Estimate and Proposal to conduct a visual assessment and sampling of potential stained soil for a proposed 7500 Waste Tire location Facility located on Jackson County Property.

Scope of Work and Cost Estimate

Soil Sampling	$500
Laboratory Analysis (10 samples)	$1100
Total	**$1,600**

Respectfully Submitted,

Randall R. Miller

Randall R. Miller, Colorado PE # 32004
President, North Park Engineering & Consulting, Inc.

APPENDIX F

Alternative Cover Demonstration/Design

CALCULATIONS

DATE July 2020
DOCUMENT NO. 19124320-6-R-0
SITE NAME Jackson County Landfill

PREPARED BY MEM
CHECKED BY ALB
REVIEWED BY JAR

JACKSON COUNTY LANDFILL EVAPOTRANSPIRATION CAP DESIGN

1.0 OBJECTIVE

Estimate the required thickness of an evapotranspiration (ET) cap for closure of the Jackson County Landfill (JCL) based on wilting point and field capacity soil parameters as well as average precipitation (P) and potential evapotranspiration (PET) data using the method described by Albright, Benson, and Waugh (2010).

2.0 METHOD

The available storage (S_A) was obtained from literature for a loamy sand. The material proposed for the ET cap is a prevalent loamy sand at the site, represented by sample F3. This sample plots as a loamy sand on the United States Department of Agriculture (USDA) soil texture triangle. A soil–water characteristic curve is being prepared based on laboratory testing in Golder's laboratory, and this calculation will be updated once that data is available. For this preliminary analysis, prior to getting the characteristic curve results, an Sa value of 1.1 inch/foot from the literature (University of Nebraska 2019) is being used.

Monthly average total precipitation for Walden, Colorado, was obtained from the Western Regional Climate Center (WRCC) for the last 30 years. The wettest year since 1990 (1995) and the average precipitation in the last 30 years were used to evaluate the required ET cap thickness. PET data was obtained from Dry Lake RAWS station (as there was no data for Walden) and while not that close to Walden, it is at elevation 8,320 feet verses 8,056 feet to Walden and at similar temperature. Penman PET were calculated from 2000 to present, and the average monthly Penman were used for that period as listed below:

Month	Penman PET (inches)	Month	Penman PET (inches)	Month	Penman PET (inches)
1	1.19	5	3.10	9	3.51
2	1.19	6	4.28	10	2.40
3	1.97	7	4.68	11	1.56
4	2.37	8	4.24	12	1.08

Average: 31.58 inches

The total annual PET value from the historical PET data of 31.58 inches corresponds well other values of PET from other similar areas in the Rocky Mountain west.

Next, P/PET was calculated for each month and compared to an empirical P/PET threshold (0.51 in fall–winter and 0.32 in spring–summer) for sites where snow and frozen ground may be present (Albright et al. 2010). In months when monthly P/PET exceed the P/PET threshold, it is assumed that water will accumulate in the landfill cover; when monthly P/PET is less than the P/PET threshold, water will be removed from the cover through evaporation and transpiration.

For months in which the P/PET exceeded the threshold, the monthly accumulation of soil water storage (ΔS) was calculated using the water balance equation $\Delta S = P - \beta \text{ PET} - \Lambda$, where β PET is an approximation of ET based on a percentage (β) of PET and Λ is the combination of monthly runoff and monthly percolation. Assumed values of β and Λ were provided by Albright et al. (2010). For months in which the P/PET did not exceed the assumed threshold or if ΔS was calculated to be negative, ΔS was assumed to be zero. The required storage (S_R) for a design year is computed as the summation of the monthly ΔS terms (Albright et al. 2010). Calculation spreadsheets are presented in Attachment F-1.

Once available storage (S_A, inches/ft) and required storage (S_R, inches) were computed, the minimum required thickness (L) was determined using the following equation:

$$L \geq \frac{S_R}{S_A}$$

3.0 ASSUMPTIONS – AVAILABLE STORAGE (S_A)

- Used literature data from University of Nebraska for initial analysis (S_A = 1.1 inches/ft).
- A soil-water characteristic curve is being developed in Golder's lab for sample F3 and will be used to update this analysis when available.

4.0 ASSUMPTIONS – REQUIRED STORAGE (S_R)

- The JCL is in an environment that experiences snow and frozen ground.
- Fall–winter months are assumed to be September, October, November, December, January, and February.
- Spring–summer months are assumed to be March, April, May, June, July, and August.
- P/PET thresholds are assumed to be 0.51 in fall–winter and 0.32 in spring–summer.
- ΔS values are only calculated if the monthly P/PET exceeds the thresholds; otherwise $\Delta S = 0$.
- ΔS terms less than zero are not to be included in the computation of S_R.
- β is assumed to be 0.37 in winter–fall and 1.00 in spring–summer.
- Λ is assumed to be -8.9 mm in winter–fall and 167.8 mm in spring–summer.

5.0 CONCLUSIONS/RESULTS

Estimates of minimum ET cover thicknesses are as follows:

$$L \geq \frac{S_R}{S_A}$$

- For wettest year (1995): L ≥ 3.09 inches/1.1 inches/ft) ≥ 2.8 feet

As a practical matter, it is recommended that the ET cover thickness be increased from the minimum of 2.8 feet to 3 to 3.5 feet to allow adequate root growth depth and to provide additional protection against erosion, particularly until vegetation is established. These results will be updated with the results from the soil–water characteristic curve being developed for sample F3 when available.

6.0 ATTACHMENTS

Attachment F-1: ET Cover Thickness Calculations

7.0 REFERENCES

Albright, W.H., C.H. Benson, and W.J. Waugh. 2010. Water Balance Covers for Waste Containment: Principles and Practice. Reston, VA: American Society of Civil Engineers.

Fetter, C.W. 2001. Applied Hydrogeology. 4th Edition. Prentice Hall.

National Oceanic and Atmospheric Administration (NOAA). 2020. Home page. Available online: http://www.NOAA.gov (accessed July 23, 2020)

University of Nebraska. 2019. Soil Water Content and Soil Matric Potential-Based Irrigation Trigger Values for Different Soil Types. Institute of Agriculture and Natural Resources.

Western Region Climate Center (WRCC). 2020. Home page. http://www.wrcc.dri.edu (accessed July 23, 2020)

ATTACHMENT F-1

ET Cover Thickness Calculation

Attachment F-1: Jackson County Water Storage Capacity Verses Storage Requirements

Required Storage Capacity - (MAX Year Precipitation 1995)

Made by:	MEM
Checked by:	ALB
Reviewed by:	JAR

Precipitation Data from LOCATION 058756 Station. PET were filled from Dry Lake RAWS station.

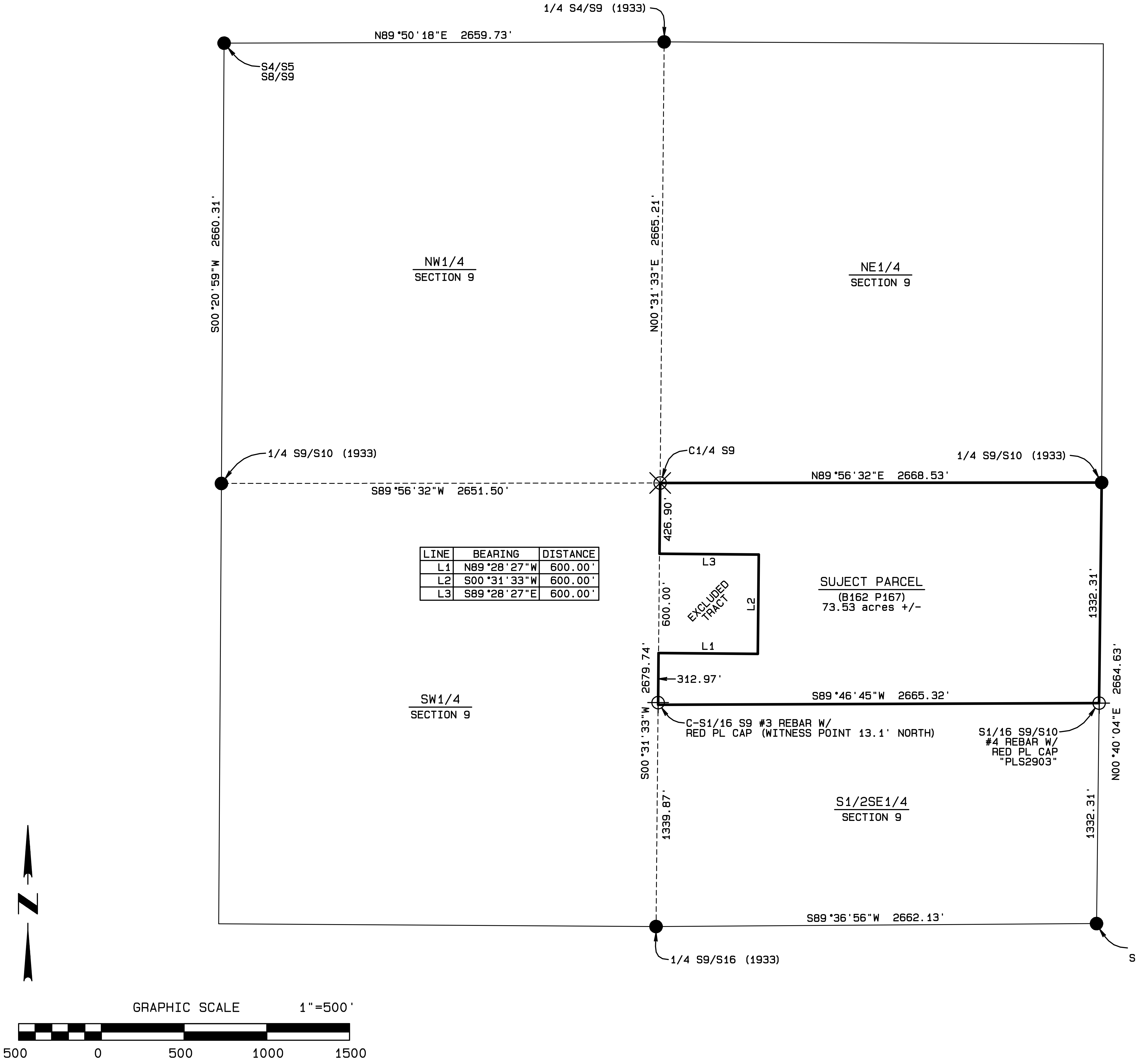
Month	**PET (in)**	**PET (mm)**	**P (in)**	**P (mm)**	**P/PET (mm)**	**Threshold**	**Exceed Threshold?**	**Beta (β)**	**Lambda (Λ)**	**ΔS Calculated mm**	**ΔS Effective mm**
January-95	1.19	30.23	0.48	12.2	0.40	0.51	0	0.37	-8.90	0.00	0.0
February-95	1.19	30.23	0.65	16.5	0.55	0.51	1	0.37	-8.90	14.23	14.2
March-95	1.97	50.04	0.56	14.2	0.28	0.51	0	0.37	-8.90	0.00	0.0
April-95	2.37	60.20	1.25	31.8	0.53	0.32	1	1.00	167.80	-196.25	0.0
May-95	3.10	78.74	5.46	138.7	1.76	0.32	1	1.00	167.80	-107.86	0.0
June-95	4.28	108.71	2.00	50.8	0.47	0.32	1	1.00	167.80	-225.71	0.0
July-95	4.68	118.87	0.78	19.8	0.17	0.32	0	1.00	167.80	0.00	0.0
August-95	4.24	107.70	0.86	21.8	0.20	0.32	0	1.00	167.80	0.00	0.0
September-95	3.51	89.15	2.78	70.6	0.79	0.32	1	1.00	167.80	-186.34	0.0
October-95	2.40	60.96	1.46	37.1	0.61	0.51	1	0.37	-8.90	23.43	23.4
November-95	1.56	39.62	1.23	31.2	0.79	0.51	1	0.37	-8.90	25.48	25.5
December-95	1.08	27.43	0.65	16.5	0.60	0.51	1	0.37	-8.90	15.26	15.3
TOTAL	**31.6**	**801.9**	**18.16**	**461.3**					**Total Required Storage**		**78.4**

APPENDIX G

Boundary Survey

PROPERTY BOUNDARY SURVEY

Portion of the N1/2 of the SE1/4 of Section 9,
T. 9 N., R. 79 W., 6th PM, Jackson County, Colorado



LINE	BEARING	DISTANCE
L1	N89°28'27"W	600.00'
L2	S00°31'33"W	600.00'
L3	S89°28'27"E	600.00'

BASIS OF BEARINGS: ASTRONOMIC USING STATIC AND KINEMATIC GPS WITH THE BEARING MEASURED BETWEEN FOUND MONUMENTS FOR THE EASTERLY LINE OF THE SE1/4 OF SECTION 9 AT N00°40'04"E.

NOTICE: According to Colorado law you must commence any legal action based upon any defect in this survey within three years after you first discover such defect. In no event may any action based on any defect in this survey be commenced more than ten years from the date of the certification shown hereon.

LEGEND

● FOUND GLO BRASS CAP

☒ FOUND #6 REBAR W/ ALUM CAP "PLS24303"

⊕ FOUND MONUMENT AS SHOWN

LEGAL DESCRIPTION

A portion of the N1/2 of the SE1/4 of Section 9, T. 9 N., R. 79 W., 6th PM, Jackson County, Colorado, more particularly described as follows:

Commencing at the Point of Beginning a found GLO brass cap stamped 1933 at the true point for the 1/4 between Sections 9 and 10; thence along the line between Sections 9 and 10 South 00°40'04" West, a distance of 1332.31 feet to a found rebar with red plastic cap stamped "PLS2903" at the true point for the S 1/16 between Sections 9 and 10; thence along the northerly line of the S1/2 of the SE1/4 of Section 9 South 89°46'45" West, a distance of 2665.32 feet to a point witnessed by a found rebar with red plastic cap found 13.1' northerly on the north-south mid-section line of Section 9; thence on the north-south mid-section line of Section 9 North 00°31'33" East, a distance of 312.97 feet;
thence South 89°28'27" East, a distance of 600.00 feet;
thence North 00°31'33" East, a distance of 600.00 feet;
thence North 89°28'27" West, a distance of 600.00 feet;
thence on the north-south mid-section line of Section 9 North 00°31'33" East, a distance of 426.90 feet to a found rebar with aluminum cap stamped "PLS24303" at the true point for the C1/4 of Section 9; thence along the northerly line of the N1/2 of the SE1/4 of Section 9 North 89°56'32" East, a distance of 2668.53 feet to the Point of Beginning.

Containing 73.53 Acres, more or less.

BASIS OF BEARINGS MEASURED BETWEEN FOUND MONUMENTS FOR THE EASTERLY LINE OF THE SE1/4 OF SECTION 9 AT N00°40'04"E.

LAND SURVEYOR'S CERTIFICATE

I, Randall R. Miller, being a Registered Professional Land Surveyor in the State of Colorado, do hereby certify that this plat was made by me and/or under my direct supervision and that it is accurate to the best of my knowledge.

Dated this 19 day of May, 2020.

Randall R. Miller, Colorado PLS #38084

38084

NOTES:

1. This survey does not constitute a title search by this surveyor or by North Park Engineering & Consulting, Inc.
2. At the request of the client, easement data was not obtained nor shown on this plat.
3. The positions of corners used herein were obtained using a combination of static and RTK GPS techniques. The positional accuracies meet BLM standards as well as applicable minimum standards of the State of Colorado.
4. Documents prepared by the surveyor and without a signature and wet stamp are to be viewed as preliminary and all information shown thereon is subject to change.

Jackson County - Landfill Property

NORTH PARK ENGINEERING & CONSULTING, INC.

P.O. Box 395, 492 Lafever
Walden, CO 80480
970-723-3725

Surveyed by: C. Utley
Drawn by: T. Hilliard
Checked by: R. Miller

Scale: 1"=500'
Date Completed: May 19, 2020
Sheet 1 of 1
Job #20-015

APPENDIX H

Geotechnical Investigation

GOLDER

TECHNICAL MEMORANDUM

DATE July 31, 2020 **Reference No.** 19124320-4-TM-1

TO Daniel E. Manville, Chairman
Board of County Commissioners, Jackson County

FROM Alex Brown, Amin Ghorbanpour **EMAIL alebrown@golder.com**

RESULTS OF SUBSURFACE FIELD INVESTIGATION FOR JACKSON COUNTY TRANSFER STATION PROPOSED LANDFILL CELL SITE; WALDEN, COLORADO

As requested by the Jackson County Colorado Board of Commissioners (the County), Golder Associates Inc. (Golder) has completed a geotechnical site investigation at the County's proposed landfill site (the Site) in addition to a proposed borrow area approximately nine miles north of the Site along Highway CO-125. The primary purpose of the geotechnical investigation at the Site and the borrow area was to establish the geologic stratigraphy, subsurface conditions, and properties of the soils expected to be used in construction of the proposed landfill.

This technical memorandum presents the results of a geotechnical subsurface investigation and includes the following:

- The boring and test pit locations plan and the borehole and test pit logs
- Geotechnical laboratory testing results
- Descriptions and characterization of the subsurface conditions encountered
- Discussion of the suitability of the soils encountered for use in future constructions

1.0 SUBSURFACE GEOTECHNICAL INVESTIGATION

Work was performed in general accordance with the Work Plan for Subsurface Field Investigation (Work Plan) submitted to the County and Colorado Department of Public Health and Environment (CDPHE) on October 29, 2019 (Reference Number 19124320-0006-3-WP-0). In cases where there were differences between the actual investigation and the Work Plan, the reasoning for these differences are provided.

Subsurface conditions were explored by drilling one soil boring and six test pits (four test pits at the Site and two test pits at the off-site borrow area) at the approximate locations shown in Figure 1 – Boring and Test Pit Location Map – Landfill Cell Site and Figure 2 – Test Pit Location Map-Borrow Site. The subsurface exploration was conducted November 4 and 5, 2019. The test pits were excavated using a backhoe. Photos taken during the test pitting are provided in Attachment 1 – Test Pit Photo Logs. The soil boring was advanced using a CME-55 drill rig. Conventional continuous flight, 4.25-inch-inside-diameter (ID) hollow-stem augers were used to advance the borings. The boring was advanced to a depth of 45 feet below ground surface (ft bgs). Split-barrel sampling techniques were used to obtain samples in general accordance with ASTM Procedure D1586. A two-inch-ID split-barrel sampler was used in this investigation (versus the standard 1.5-inch-ID sampler) to collect more material at each interval. Split-barrel samples were 18 inches long and were driven using an automated drop hammer. Generally, the sampling interval was every 2.5 feet in the upper 15 feet, then every 5 feet below that depth. Golder recorded the following sample descriptions:

- Descriptive Unified Soil Classification System (USCS) classification in accordance with ASTM D2488
- Consistency of cohesive materials or density of non-cohesive materials
- Drive sample intervals and associated blow counts and recovery
- Moisture content assessment
- Color based on the Munsell color chart
- Other descriptive features (weathered state, organic materials, macrostructure of fine-grained soils)

After completion of the boring operation, a groundwater monitoring well was installed. This monitoring well was not developed following completion, but will be if the design and construction of an on-site landfill is proposed to the CDPHE. Test pits were backfilled with the excavated materials. Table 1 summarizes the drilling completed. GPS coordinates were taken using a Trimble Geo 7X Handheld GNSS Systems. Accuracy of the recorded locations fell within 11 feet after processing, according to the software used for processing (GPS Pathfinder Office, version 5.9-65535). The groundwater monitoring well will be surveyed by a professional land surveyor during the existing condition survey if the design and construction of an on-site landfill is proposed to the CDPHE.

Table 1: Subsurface Drilling and Test Pitting Summary

Location	**Boring**	**Boring/Test Pit Depth (ft)** [1]	**Northing** [2]	**Easting** [2]	**Elevation** [3] **(ft AMSL)** [1]
Proposed Landfill Cell Site	MW-1	45	1522617	2786215	8,123
	TP-1	15	1522669	2786369	8,118
	TP-2	15	1522710	2786564	8,124
	TP-3	15	1522538	2786363	8,123
	TP-4	15	1522541	2786572	8,123
Proposed Off-site Borrow Area	TP-OS-01	15	1561551	2776031	7,914
	TP-OS-02	15	1561635	2775936	7,916

Notes:
1) Abbreviations: ft = feet, ft AMSL = feet above mean sea level
2) The coordinate system is NAD83 State Plane Colorado North Coordinates
3) The vertical datum is NAVD88

During sampling, standard penetration testing (SPT) was performed at regular intervals to measure the penetration resistance of the soil. The SPT N-value is defined as the number of blows required to advance a 2-inch-outside-diameter (OD) split-barrel sampler 1 foot into the soil using a 140-pound hammer free falling 30 inches. The blows are recorded in 6-inch increments, and for the 18-inch-long split-barrel samplers used for this project, the initial 0- to 6-inch interval is disregarded (as a “seating” interval and typically the least representative due to disturbance, hole cave-ins, etc.), and the subsequent two 6-inch intervals are added together to form the N-value. These N-values provide a measure of the compactness of granular soil deposits and provide a basis for estimating the relative strength and stiffness of the soil profile components. The results of the SPT tests are included in the Soil Boring and Test Pit Logs in Attachment 2.

If encountered during drilling or test-pitting, groundwater depths were recorded in the boring and test pit logs. It should be noted that the groundwater depths provided in the boring and test pit logs were the approximate depths at the time of drilling. Groundwater conditions can vary significantly over time due to seasonal fluctuations and other factors.

2.0 LABORATORY TESTING

Laboratory testing was performed on select representative soil samples to provide geotechnical and hydrologic laboratory data for the proposed landfill cell design and to evaluate the suitability of the subsurface materials to be used as construction materials. The completed tests were performed in general accordance with ASTM standards and consisted of the following tests:

- Mechanical sieve analyses with hydrometer (ASTM D422)
- Atterberg limits (ASTM D4318)
- Moisture content (ASTM D2216)
- Standard Proctor (ASTM D698)
- Direct shear (ASTM D3080)
- Remolded permeability (ASTM D5084)
- Organic content (ASTM D2974)
- pH (ASTM D4972)
- Calcium carbonate content (ASTM D4373)
- Nutrient analysis (nitrogen, sodium, potassium, and phosphorus content)

The geotechnical laboratory testing program was completed in Golder’s geotechnical soils laboratory located in Lakewood, Colorado, except for the nutrient analysis testing, which was completed by Pace Analytical in Sheridan, Wyoming. A summary of the laboratory test results and individual laboratory test data sheets are provided in Attachment 3 – Laboratory Test Results.

Soil samples obtained from this investigation are stored at Golder’s laboratory in Denver, Colorado. The soil samples will be retained for 120 days after the final issuance of this report. After that date, the soil samples will be discarded unless Golder is otherwise instructed.

3.0 SUBSURFACE CONDITIONS

The types of subsurface materials observed at the test pit and test boring locations have been visually classified by a Golder field representative and are described in the attached Soil Boring and Test Pit Logs. Results of the SPT and water level observations are also presented in the boring and test pit logs. It should be recognized that the soil descriptions presented in the logs represent Golder’s interpretation of subsurface conditions at specific locations. Variations may occur between locations and between sampling intervals. In addition, the stratigraphic lines shown in the logs represent the approximate boundary between soil types. The actual transition from one soil type to another may be gradational.

3.1 On-Site Subsurface Conditions

In general, the ground surface at the boring and test pit locations is covered with vegetation and a topsoil layer that extends several inches below the ground surface. Below the topsoil layer, the following soil and groundwater conditions were observed.

3.1.1 Sand Stratum

Beneath the topsoil, a brown sand stratum with varying amounts of gravel was encountered to a depth of 27 (ft bgs) (or to the termination depth of 15 ft bgs in test pits). This stratum is compact to very dense as N-values range from 23 to over 50 blows per foot (bpf). The results of the standard proctor test on screened sand sample through sieve #10 indicated 15.1% optimum moisture content (OMC) and 114.1 pounds per cubic foot (pcf) maximum dry density.

3.1.2 Highly Weathered Siltstones and Shales

Beneath the sand stratum, highly weathered brown siltstone and shale were encountered to the borehole termination depth of 45 ft bgs.

3.1.3 Groundwater Conditions

Groundwater was encountered in the monitoring well (MW-01) at 20 ft bgs. No groundwater was encountered in any test pits. Variations in groundwater levels and the occurrence of perched water (i.e., a water-bearing zone perched above the regional water-bearing zone) should be anticipated as a result of seasonal variations in precipitation, groundwater recharge, and the presence of low-permeability material just beneath this measured water level.

3.2 Off-Site Borrow Site Subsurface Conditions

In general, the ground surface at the test pit locations is covered with vegetation and a layer of topsoil that extends several inches below the ground surface. Below the topsoil stratum, the following soil and groundwater conditions were encountered.

3.2.1 Highly Weathered Shale/Fat Clay

Beneath the topsoil, highly weathered brown shale was encountered to an approximate depth of 5 ft bgs. An accurate estimation of the depth of highly weathered shale could not be established because of limitations associated with test pitting (subsurface conditions were logged based on soil cuttings since the field engineer was not able to see the ground profile inside the pit due to safety concerns). The results of the standard Proctor test on the clay sample indicated 27.6% OMC and 91.1 pcf maximum dry density. A direct shear test was performed on a remolded clay sample compacted to 95% maximum dry density of the standard Proctor test.

3.2.2 Highly to Moderately Weathered Shale

Beneath the highly weathered shale, highly to moderately weathered brown shales were encountered to the test pit termination depth of 15 ft bgs. Generally, the degree of weathering was observed to decrease with depth.

3.2.3 Groundwater Conditions

No groundwater was encountered in either test pit.

4.0 PRELIMINARY ASSESSMENT OF SOILS SUITABILITY

The permeability and index tests completed on the off-site borrow soils suggests the off-site clayey soils (highly weathered shale) will be suitable to build natural low-permeability soil barriers. A summary of permeability test results for the clay samples compacted to 95% maximum dry density of the standard Proctor test is presented in Table 2. While the permeability tests conducted do not achieve a permeability of 1.0E-07 centimeters per second (cm/sec), the testing of the samples does indicate that material can be moisture conditioned and compacted to meet a permeability of 1.0E-06, and Golder's experience is that these materials can meet a permeability of 1.0 to 5.0E-07 cm/sec once the samples are compacted to a slightly higher density and moisture content that would more closely correspond to a "line of optimums" between the standard Proctor and modified Proctor. Permeability values in this range will be sufficient for a composite liner design that will be protective. Additional testing will be conducted during final design to finalize the permeability values to be used in the composite liner system. The on-site sandy soils will be appropriate for use as daily cover, general fill, and structural fill materials.

Table 2: Summary of Permeability Test Results

Sample ID	Sample Depth (feet)	Hydraulic Conductivity (centimeter/second)
TP-OS-01, BS1	0–5	2.4E-06
TP-OS-02, BS1	0–5	7.4E-07
TP-OS-02, BS1-Retest	0–5	4.9E-07
TP-OS-02, BS1 (-#10 material)	0–5	1.3E-06

The off-site clayey soils should not be used as fill materials when placed within the frost zone (within approximately 36 inches of finished grade) or in direct contact with a load-bearing foundation or retaining element.

5.0 GENERAL CONDITIONS AND LIMITATIONS

This geotechnical investigation has been conducted in a manner consistent with the level of care ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. The findings, recommendations, and opinions contained herein have been formulated in accordance with generally accepted practice in the fields of foundation engineering, soil mechanics, and engineering geology. No other representations or warranties, expressed or implied, are included or intended by the dissemination of this report.

The scope or purpose of this geotechnical evaluation did not specifically or by implication provide an environmental assessment of the proposed site.

6.0 CLOSING

Golder appreciates this opportunity to provide geotechnical engineering services. If any questions arise regarding the information in this letter, please contact Golder Associates Inc.

Sincerely,

Golder Associates Inc.

Alex L. Brown, PE
Senior Project Engineer

Amin Ghorbanpour
Project Engineer

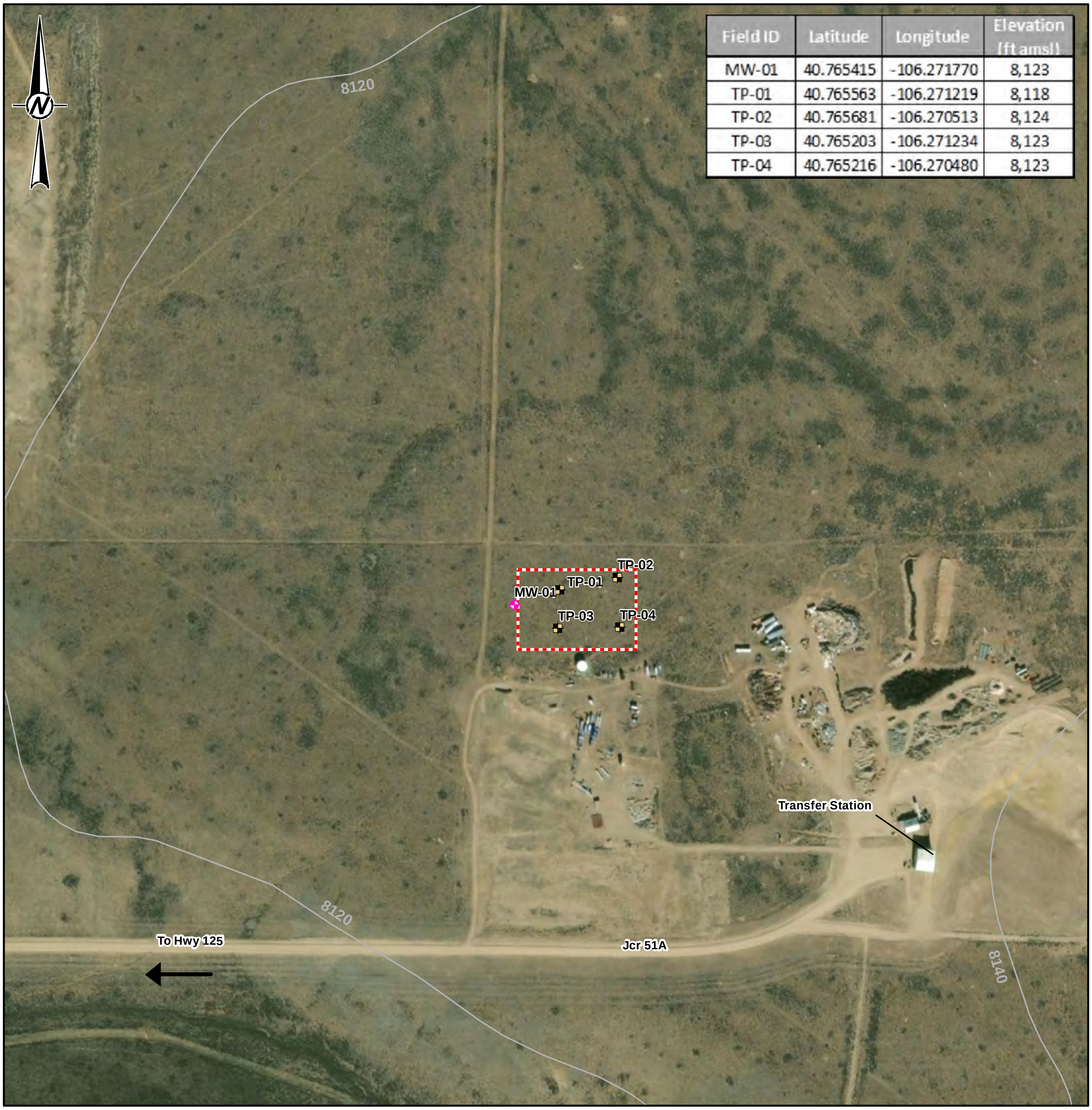
Mark McClain, PE
Principal

ALB/AG/MM/af

Attachments: Figures
Attachment 1: Test Pit Photo Logs
Attachment 2: Soil Boring and Test Pit Logs
Attachment 3: Laboratory Test Results
Attachment 4: Geotech Investigation Addendum

https://golderassociates.sharepoint.com/sites/110066/project files/6 deliverables/techmemos/4-tm-jacksoncolf_geotechinvestigation/4-tm-1/19124320-4-tm-1_jacksoncolf_geotechinvestigation_31jul20.docx

Figures



Field ID	Latitude	Longitude	Elevation (ft amsl)
MW-01	40.765415	-106.271770	8,123
TP-01	40.765563	-106.271219	8,118
TP-02	40.765681	-106.270513	8,124
TP-03	40.765203	-106.271234	8,123
TP-04	40.765216	-106.270480	8,123

LEGEND

⊕ MONITORING WELL
▨ TEST PIT
⬚ PROPOSED LANDFILL BOUNDARY
— ELEVATION CONTOUR

Feet
0 250 500 1,000

NOTE(S)

1. TEST PIT AND MONITORING WELL LOCATIONS WERE SURVEYED USING A HAND-HELD GPS UNIT WITH SUB-DECIMETER ACCURACY.
2. PROPOSED LANDFILL FOOTPRINT IS APPROXIMATE AND INCLUDES, AT MINIMUM, A 75' OFFSET FROM THE APPROXIMATE COUNTY OF JACKSON PROPERTY BOUNDARY. THE ACTUAL LANDFILL FOOTPRINT MAY CHANGE FOLLOWING THE PROFESSIONAL LAND SURVEY.

REFERENCE(S)

1. AERIAL IMAGERY: ESRI BASEMAP SERVICES, DIGITAL GLOBE CAPTURED ON 10/29/2018.
2. ELEVATION DATASET: USGS NATIONAL ELEVATION DATASET 1 ARC-SECOND

CLIENT
BOARD OF COUNTY COMMISSIONERS,
JACKSON COUNTY, CO

PROJECT
SUBSURFACE FIELD INVESTIGATION
OF JACKSON COUNTY TRANSFER STATION
PROPOSED LANDFILL CELL SITE

TITLE
BORING AND TEST PIT
LOCATION MAP - LANDFILL CELL SITE

CONSULTANT
GOLDER

YYYY-MM-DD	2020-02-03
DESIGNED	RHG
PREPARED	RHG
REVIEWED	ABG
APPROVED	ALB

PROJECT NO.
19124320

FIGURE
01

PATH: M:\JacksonCountyLandfill\Mapping\8 5x11 19124320 JacksonCountyLF Fig1.mxd PRINTED ON: 2020-02-03 AT: 3:22:26 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
1 inch
0

Field ID	Latitude	Longitude	Elevation (ft amsl)
TP-OS-01	40.872025	-106.309819	7,914
TP-OS-02	40.872252	-106.310162	7,916

LEGEND

▚ TEST PIT

NOTE(S)

1. TEST PIT AND MONITORING WELL LOCATIONS WERE SURVEYED USING A HAND-HELD GPS UNIT WITH SUB-DECIMETER ACCURACY.

REFERENCE(S)

1. AERIAL IMAGERY: ESRI BASEMAP SERVICES, DIGITAL GLOBE CAPTURED ON 10/29/2018.
2. ELEVATION DATASET: USGS NATIONAL ELEVATION DATASET 1 ARC-SECOND

CLIENT

BOARD OF COUNTY COMMISSIONERS,
JACKSON COUNTY, CO

PROJECT

SUBSURFACE FIELD INVESTIGATION
OF JACKSON COUNTY TRANSFER STATION
PROPOSED LANDFILL CELL SITE

TITLE

TEST PIT
LOCATION MAP - BORROW SITE

CONSULTANT

GOLDER

YYYY-MM-DD	2020-02-03
DESIGNED	RHG
PREPARED	RHG
REVIEWED	ABG
APPROVED	ALB

PROJECT NO.
19124320

FIGURE
02

PATH: M:\JacksonCountyLandfill\Mapping\8 5x11 19124320 JacksonCountyLF Fig2.mxd PRINTED ON: 2020-02-03 AT: 3:21:13 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

1 inch

0

ATTACHMENT 1

Test Pit Photo Logs

CJ/TS Clean-up Eval

PHOTO 1

TP-OS-01

Depth: 0-4’

CJ/TS Clean-up Eval

PHOTO 2 TP-OS-01	

CJ/TS Clean-up Eval

PHOTO 3 TP-OS-02 Depth: 0-4’	

CJ/TS Clean-up Eval

PHOTO 4 TP-OS-02 Depth: 0-5’	

PHOTO 5

TP-OS-02

Depth: 5’-10’

PHOTO 6 TP-OS-02 Depth: 10’-15’	

CJ/TS Clean-up Eval

PHOTO 7 TP-1 Depth: 0-5’	

CJ/TS Clean-up Eval

PHOTO 8 TP-1 Depth: 5’-10’	

PHOTO 9 TP-1 Depth: 10’-15’	

PHOTO 40

TP-2

Depth: 0-5’

PHOTO 11

TP-2

Depth: 5’-10’

PHOTO 12 TP-2 Depth: 10'-15'	

PHOTO 53

TP-3

Depth: 0-5’

PHOTO 14

TP-3

Depth: 5’-10’

CJ/TS Clean-up Eval

PHOTO 15

TP-3

Depth: 10’-15’

CJ/TS Clean-up Eval

PHOTO 66 TP-4 Depth: 0-5’	

CJ/TS Clean-up Eval

PHOTO 17

TP-4

Depth: 5’-10’

CJ/TS Clean-up Eval

PHOTO 18

TP-4

Depth: 10’-15’

ATTACHMENT 2

Soil Boring and Test Pit Logs

PROJECT: CJ/TS Clean-Up Eval
PROJECT NUMBER: 19124320 - 0007
LOCATION: Jackson County, CO
CLIENT: Board of Commissioners, Jackson County

RECORD OF BOREHOLE MW-1

SHEET 1 of 2

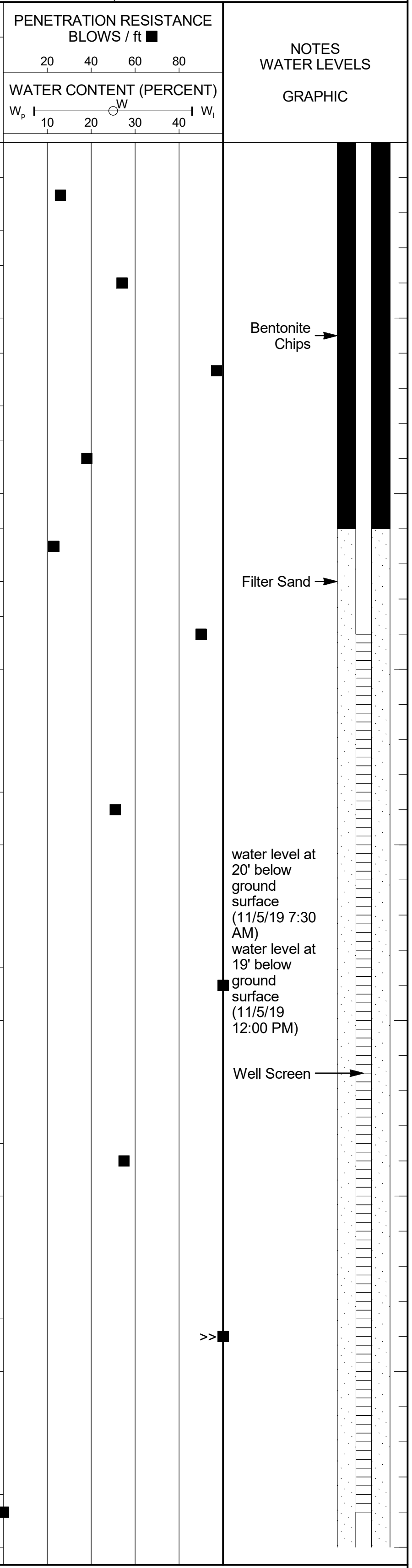
DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE: 11-4-2019, 11-5-2019
DRILL RIG: CME 55

DATUM: NAVD88
AZIMUTH: n/a
COORDS: N 1522616.5, E 2786215.4

GS ELEVATION (ft):8123
TOC ELEVATION: -

SOIL PROFILE				SAMPLES				
DESCRIPTION VEGETATION:	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in lb hammer 30 inch drop	N	REC / ATT
0.0 - 27.0 (SP) SAND, fine to medium, poorly graded, some to non plastic fines; yellowish-brown to orange-brown; moist, compact to very dense..	SP							
				1	SS	11-15-11	26	18.0 / 18.0
				2	SS	8-20-34	>50	18.0 / 18.0
				3	SS	14-55-42	>50	18.0 / 18.0
				4	SS	6-22-16	38	18.0 / 18.0
				5	SS	3-9-14	23	18.0 / 18.0
				6	SS	16-40-50	>50	18.0 / 18.0
				7	SS	8-21-30	>50	18.0 / 18.0
				8	SS	60-100-0	>50	7.0 / 18.0
27.0 - 45.0 SHALE and SILTSTONE, highly weathered..			8096.0 27.0					
				9	SS	13-22-33	>50	18.0 / 18.0
				10	SS	21-38-80	>50	18.0 / 18.0
				11	SS	100-0-0	0	5.0 / 18.0

Log continued on next page



water level at 20' below ground surface (11/5/19 7:30 AM)
water level at 19' below ground surface (11/5/19 12:00 PM)

GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: Site Services
DRILLER: N/A

LOGGED: A. Ghorbanpour
CHECKED: ABG
DATE: 12/12/2019

Figure 1

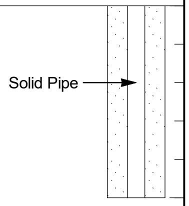
PROJECT: CJ/TS Clean-Up Eval
PROJECT NUMBER: 19124320 - 0007
LOCATION: Jackson County, CO
CLIENT: Board of Commissioners, Jackson County

RECORD OF BOREHOLE MW-1

DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE: 11-4-2019, 11-5-2019
DRILL RIG: CME 55

DATUM: NAVD88
AZIMUTH: n/a
COORDS: N 1522616.5, E 2786215.4

SHEET 2 of 2
GS ELEVATION (ft):8123
TOC ELEVATION: -

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION VEGETATION:	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in lb hammer 30 inch drop	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ 20 40 60 80 WATER CONTENT (PERCENT) Wp ⊢ W ○ ⊣ Wl 10 20 30 40	NOTES WATER LEVELS GRAPHIC
40		27.0 - 45.0 SHALE and SILTSTONE, highly weathered.. *(Continued)*										
					8078.0	12	SS	37-100-0	>50	18.0 18.0	■	
45		Boring completed at 45.0 ft.										
50												
55												
60												
65												
70												
75												
80												

GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: Site Services
DRILLER: N/A

LOGGED: A. Ghorbanpour
CHECKED: ABG
DATE: 12/12/2019

Figure 1

GOLDER

LOG OF TEST TRENCH

Sheet Number 1 of 1

Test Pit Number TP-1
Total Depth 15 feet
Date Begin 11-5-2019
Date End 11-5-2019

Project CJ/TS Clean-Up Eval and Recomm/CO
Project Number 19124320 - 0007

Station / Location 1522669.1N, 2786368.5E
Datum NAVD88
Elevation Reference Ground Surface
Equipment Type Deere 410E Backhoe
Weather Sunny, 30 Degrees
Golder Staff A. Ghorbanpour
Field Crew N/A

Ground Water Data

Depth in (m.)	N/A	
Time		
Date		
Symbol		

Method	Depth in (Feet)		Sample Data: Method	Sample Data: Number		Loc. Sampled	Water Level	Soil Graph	SUBSURFACE MATERIAL
	0								
	1								0.0 - 15.0 gravelly SAND, well graded, trace cobbles; dark yellowish brown; non-cohesive, moist.
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13		BS1						
	14								
	15							BOH 15 ft.	
	16								
	17								Notes: BS = Bulk Sample Bag bulk sample from 10'-15'
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								
	26								
	27								
	28								
	29								
	30								
	31								
	32								
	33								
	34								
	35								

CHECKED: ABG
DATE: 12/12/2019

LOG OF TEST TRENCH

Sheet Number 1 of 1

GOLDER

Test Pit Number TP-2
Total Depth 15 feet
Date Begin 11-5-2019
Date End 11-5-2019
Project CJ/TS Clean-Up Eval and Recomm/CO
Project Number 19124320 - 0007
Station / Location 1522710.4N, 2786564.4E
Datum NAVD88
Elevation Reference Ground Surface
Equipment Type Deere 410E Backhoe
Weather Sunny, 30 Degrees
Golder Staff A. Ghorbanpour
Field Crew N/A

Ground Water Data		
Depth in (m.)	N/A	
Time		
Date		
Symbol		

Method	Depth in (Feet)		Sample Data: Method	Number		Loc. Sampled	Water Level	Soil Graph	SUBSURFACE MATERIAL	
	0									0
	1								0.0 - 15.0 gravelly SAND, poorly graded, trace cobbles, non-cohesive, moist.	1
	2									2
	3									3
	4									4
	5									5
	6									6
	7									7
	8		BS1							8
	9									9
	10									10
	11									11
	12									12
	13									13
	14									14
	15									15
	16							BOH 15 ft.		16
	17								Notes: BS = Bulk Sample Bag bulk sample from 5'-10'	17
	18									18
	19									19
	20									20
	21									21
	22									22
	23									23
	24									24
	25									25
	26									26
	27									27
	28									28
	29									29
	30									30
	31									31
	32									32
	33									33
	34									34
	35									35

CHECKED: ABG DATE: 12/12/2019

GOLDER

LOG OF TEST TRENCH

Sheet Number 1 of 1

Test Pit Number TP-3
Total Depth 15 feet
Date Begin 11-5-2019
Date End 11-5-2019

Project CJ/TS Clean-Up Eval and Recomm/CO
Project Number 19124320 - 0007

Station / Location 1522538N, 2786363.2E
Datum NAVD88
Elevation Reference Ground Surface
Equipment Type Deere 410E Backhoe
Weather Sunny, 30 Degrees
Golder Staff A. Ghorbanpour
Field Crew N/A

Ground Water Data

Depth in (m.)	N/A	
Time		
Date		
Symbol		

Method	Depth in (Feet)		Sample Data: Method	Number		Loc. Sampled	Water Level	Soil Graph	SUBSURFACE MATERIAL
	0 - 15								0.0 - 15.0 gravelly SAND, fine to coarse, poorly graded, trace cobbles; brown; non-coheisve, moist.
	15							BOH 15 ft.	

Notes:
N/A

CHECKED: ABG DATE: 12/12/2019

LOG OF TEST PIT WALDEN_LF_TP.GPJ DUL.GOLDER.GDT 2/4/20

GOLDER

LOG OF TEST TRENCH

Sheet Number 1 of 1

Test Pit Number TP-4
Total Depth 15 feet
Date Begin 11-5-2019
Date End 11-5-2019

Project CJ/TS Clean-Up Eval and Recomm/CO
Project Number 19124320 - 0007

Station / Location 1522540.9N, 2786572.1E
Datum NAVD88
Elevation Reference Ground Surface
Equipment Type Deere 410E Backhoe
Weather Sunny, 30 Degrees
Golder Staff A. Ghorbanpour
Field Crew N/A

Ground Water Data

Depth in (m.)	N/A	
Time		
Date		
Symbol		

Method	Depth in (Feet)		Sample Data: Method	Sample Data: Number		Loc. Sampled	Water Level	Soil Graph	SUBSURFACE MATERIAL
	0.0 - 15.0		BS1						0.0 - 15.0 SILTY SAND and GRAVEL, well graded, trace cobbles; gray to light olive brown; non-cohesive, moist.
	15							BOH 15 ft.	

Notes:
BS = Bulk Sample
Bulk sample (bucket) from 10'-15'

CHECKED: ABG
DATE: 12/12/2019

LOG OF TEST TRENCH

Sheet Number 1 of 1

Test Pit Number TP-OS-1
Total Depth 15 feet
Date Begin 11-5-2019
Date End 11-5-2019
Project CJ/TS Clean-Up Eval and Recomm/CO
Project Number 19124320 - 0007
Station / Location 1561551.2N, 2776030.6E
Datum NAVD88
Elevation Reference Ground Surface
Equipment Type Deere 410E Backhoe
Weather Sunny, 30 Degrees
Golder Staff A. Ghorbanpour
Field Crew N/A

Ground Water Data		
Depth in (m.)	N/A	
Time		
Date		
Symbol		

Method	Depth in (Feet)		Sample Data Method	Sample Data Number		Loc. Sampled	Water Level	Soil Graph	SUBSURFACE MATERIAL
	0 - 5		BS1					▨	0.0 - 5.0 SHALE, highly weathered, dark gray, moist.
	5 - 15		BS2						5.0 - 15.0 SHALE, highly to moderately weathered.
	15							BOH 15 ft.	

Notes:
BS = Bulk Sample
Bulk sample from 0'-5'
Bulk sample from 10'-15'

CHECKED: ABG DATE: 12/12/2019

LOG OF TEST TRENCH

Sheet Number 1 of 1

Test Pit Number TP-OS-2
Project CJ/TS Clean-Up Eval and Recomm/CO
Total Depth 15 feet
Project Number 19124320 - 0007
Date Begin 11-5-2019
Date End 11-5-2019
Station / Location 1561634.7N, 2775936.5E
Datum NAVD88
Elevation Reference Ground Surface
Equipment Type Deere 410E Backhoe
Weather Sunny, 30 Degrees
Golder Staff A. Ghorbanpour
Field Crew N/A

Ground Water Data

Depth in (m.)	N/A	
Time		
Date		
Symbol		

Method	Depth in (Feet)		Sample Data: Method	Number		Loc. Sampled	Water Level	Soil Graph	SUBSURFACE MATERIAL
	0		BS1					▨	0.0 - 5.0 SHALE, highly weathered, very dark grayish brown, moist.
	5		GS					▤	5.0 - 15.0 SHALE, highly to moderately weathered. (Large pieces cannot be broken with hand)
	15							BOH 15 ft.	

Notes:
BS = Bulk Sample
Bulk sample from 0'-5'
Bag bulk sample from 5'-10'
Hard drilling noticed from 10'-15'

CHECKED: ABG
DATE: 12/12/2019

LOG OF TEST PIT WALDEN_LF_TP.GPJ DUL.GOLDER.GDT 2/4/20

ATTACHMENT 3

Laboratory Test Results

TABLE 1
CJ/TS CLEAN UP EVAL AND RECOMM/CO
SUMMARY OF SOIL DATA

Sample Type	**Sample Identification**	**Sample Depth (ft.)**	**USCS Soil Classification**	**Delivered Moisture (%)**	**Atterberg Limits**			**Grain Size Distribution**			**Specific Gravity**	**Moisture/Density Relationship Standard Proctor**		**Additional Tests Comments (See Notes)**
					LL	**PL**	**PI**	**% Finer 3/4"**	**% Finer #4**	**% Finer #200**		**Dry Density (pcf)**	**Moisture (%)**	
Bag	MW-1, SS-5	11.0 - 12.5	SC	--	46	27	19	100	100	40	--	--	--	
Bag	MW-9, SS-9	28.5 - 30	MH	--	53	31	22	100	100	55	--	--	--	
Pail	TP-OS-1, BS1	0 - 5	CH	24.4	75	34	41	100	100	97	2.75	91.1	27.6	DS, PERM
Pail	TP-OS-2, BS1	0 - 5	CH	25.8	79	32	47	100	100	94	--	--	--	PERM
Pail	TP-4, BS1	10 - 15	--	11.5	--	--	--	87	62	13	--	114.1	15.1	
Bag	TP-1, BS1	10 - 15	--	11.1	--	--	--	93	70	16	--	--	--	
Bag	TP-2, BS1	5 - 10	--	--	--	--	--	--	--	--	--	--	--	A*
Bag	MW-1, SS-2	3.5 - 5.0	--	--	--	--	--	--	--	--	--	--	--	A*

NOTES:

LL= LIQUID LIMIT
PL= PLASTIC LIMIT
PI= PLASTIC INDEX
SL= SHRINKAGE LIMIT
UW= UNIT WEIGHT

T = TRIAXIAL TEST
U = UNCONFINED COMPRESSION TEST
C = CONSOLIDATION TEST
DS = DIRECT SHEAR TEST
PERM = PERMEABILITY
A = AGRONOMIC TESTING

*Agronomic testing includes pH level determination, organic content determination, calcium carbonate content determination, and the nutrient analysis.

TABLE 2
CJ/TS CLEAN UP EVAL AND RECOMM/CO
SUMMARY OF ORGANIC MATERIAL DATA

Sample Type	Sample Number	Sample Depth (ft)	Organic Content			Additional Tests Comments (See Notes)
			Moisture (%)	Ash (%)	Organics (%)	
Bag	MW-1, SS-2	3.5 - 5.0	3.7	98.6	1.4	
Bag	TP-2, BS1	5 - 10	2.8	99.5	0.5	

NOTE: Moisture Contents Determined at 110º C

TABLE 3
CJ/TS CLEAN UP EVAL AND RECOMM/CO
SUMMARY OF SOIL pH

Sample Type	**Sample Identification**	**Sample Depth (ft.)**	**pH of Soil**		**Comments**
			Water	**Calcium Chloride**	
Bag	MW-1, SS-2	3.5 - 5.0	8.65	7.20	
Bag	TP-2, BS-1	5 - 10	8.12	6.23	

TABLE 4
CJ/TS CLEAN UP EVAL AND RECOMM/CO
SUMMARY OF FLEXIBLE-WALL HYDRAULIC CONDUCTIVITY TEST RESULTS

Sample Identification	Sample Depth (ft.)	Sample Length[1] (cm)	Sample Diameter[1] (cm)	Sample Initial Dry Density (lbf/ft^3)	Maximum Dry Density (lbf/ft^3)	Achieved Compaction (%)	Initial Moisture (%)	Requested Moisture (%)	Effective Stress (kPa)	Back Pressure (kPa)	Gradient	Average Hydraulic Conductivity (cm/s)
TP-OS-01, BS1	0 - 5	9.690	7.527	86.0	91.1	94.4	28.8	27.6	34	410	13	2.4E-06
TP-OS-02, BS1	0 - 5	9.908	7.641	86.1	91.1	94.5	26.7	27.6	34	410	8	7.4E-07
TP-OS-02, BS1-Retest	0 - 5	9.800	7.523	85.8	91.1	94.2	29.4	27.6	34	410	13	4.9E-07
TP-OS-02, BS1 (-#10 material)	0 - 5	9.727	7.527	85.9	91.1	94.3	29.4	27.6	34	480	9	1.3E-06

NOTES: (1) Dimensions are from final measurements

P or Red = indicates pending test results

FLOW PUMP #2

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MEDIA USING A FLEXIBLE WALL PERMEAMETER
ASTM D5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT NAME	CJ/TS Clean Up Eval and Recomm/CO
PROJECT NUMBER	19124320
SAMPLE ID	TP-OS-02, BS1 @ 0 - 5 ft. -RETEST
SAMPLE TYPE	Remold

BOARD #	2
CELL #	AA
Flow Pump Speed	7
Technician	BC

COMMENTS
1. Specific gravity is assumed.
2. Specimen was remolded to 94.2% of the Maximum Dry Density and +1.8% of optimum moisture content (per ASTM D698)

Sample Data

	Initial	Final
Specific Gravity	2.70	
Height, cm	9.384	9.800
Diameter, cm	7.313	7.523
Area, m²	0.004201	0.004445
Volume, m^3	0.0003942	0.0004356
Mass, g	700.60	758.93
Moisture Content	29.4%	38.9%
Dry Unit Weight, kN/m^3	13.48	12.30
Dry Unit Weight, lbf/ft^3	85.8	78.3
Saturation, %	82.2%	91.2%

Permeant	Water
Back Pressure, kPa	410
Effective Consolidation Stress, kPa	34
Length During Permeation, cm	9.800
Area During Permeation, m²	0.004445

USCS Description (ASTM D 2487):
Fat clay, very dark grayish brown, moist

DATE/TIME		TEMP (^oC)	Δh (cm)	Flow (m^3)	Gradient	Uncorrected Hydraulic Conductivity (cm/s)
15-Jan-20	15:15	20.7	125	--	--	--
15-Jan-20	15:25	20.7	125	1.7E-07	12.76	4.94E-07
15-Jan-20	15:35	20.7	124	1.7E-07	12.70	4.96E-07
15-Jan-20	15:45	20.7	124	1.7E-07	12.65	4.98E-07
15-Jan-20	15:50	20.7	124	8.4E-08	12.65	4.98E-07

Average Corrected Hydraulic Conductivity (cm/s) 4.9E-07

DATE 20-Jan-2020
REVIEW MB

GOLDER

FLOW PUMP #2

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MEDIA USING A FLEXIBLE WALL PERMEAMETER
ASTM D5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT NAME	CJ/TS Clean Up Eval and Recomm/CO
PROJECT NUMBER	19124320
SAMPLE ID	TP-OS-01, BS1 @ 0 - 5 ft.
SAMPLE TYPE	Remold

BOARD #	3
CELL #	AA
Flow Pump Speed	5
Technician	BC

COMMENTS
1. Specific gravity is assumed.
2. Specimen was remolded to 94.4% of the Maximum Dry Density and +1.2% of optimum moisture content (per ASTM D698)

Sample Data

	Initial	Final
Specific Gravity	2.70	
Height, cm	9.354	9.690
Diameter, cm	7.319	7.527
Area, m^2	0.004208	0.004450
Volume, m^3	0.0003936	0.0004312
Mass, g	697.81	755.90
Moisture Content	28.8%	38.9%
Dry Unit Weight, kN/m^3	13.51	12.38
Dry Unit Weight, lbf/ft^3	86.0	78.8
Saturation, %	80.8%	92.2%

Permeant	Water
Back Pressure, kPa	410
Effective Consolidation Stress, kPa	34
Length During Permeation, cm	9.690
Area During Permeation, m^2	0.004450

USCS Description (ASTM D 2487):

Fat clay, dark gray, moist

DATE/TIME		TEMP (°C)	Δh (cm)	Flow (m^3)	Gradient	Uncorrected Hydraulic Conductivity (cm/s)
16-Dec-19	7:45	20.7	126	--	--	--
16-Dec-19	7:50	20.7	127	4.2E-07	13.05	2.41E-06
16-Dec-19	7:55	20.7	127	4.2E-07	13.11	2.40E-06
16-Dec-19	8:00	20.7	128	4.2E-07	13.16	2.39E-06
16-Dec-19	8:05	20.7	128	4.2E-07	13.21	2.38E-06

Average Corrected Hydraulic Conductivity (cm/s) 2.4E-06

DATE	18-Dec-2019
REVIEW	MB

FLOW PUMP #2

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MEDIA USING A FLEXIBLE WALL PERMEAMETER

ASTM D5084

METHOD D, CONSTANT RATE OF FLOW

PROJECT NAME	CJ/TS Clean Up Eval and Recomm/CO
PROJECT NUMBER	19124320
SAMPLE ID	TP-OS-02, BS1 @ 0 - 5 ft.
SAMPLE TYPE	Remold

BOARD #	1
CELL #	#5
Flow Pump Speed	7
Technician	BC

COMMENTS
1. Specific gravity is assumed.
2. Specimen was remolded to 94.5% of the Maximum Dry Density and -0.9% of optimum moisture content (per ASTM D698)

Sample Data

	Initial	Final
Specific Gravity	2.70	
Height, cm	9.328	9.908
Diameter, cm	7.319	7.641
Area, m²	0.004208	0.004585
Volume, m^3	0.0003925	0.0004543
Mass, g	685.63	765.49
Moisture Content	26.7%	42.2%
Dry Unit Weight, kN/m^3	13.52	11.62
Dry Unit Weight, lbf/ft^3	86.1	74.0
Saturation, %	75.2%	89.1%

Permeant	Water
Back Pressure, kPa	410
Effective Consolidation Stress, kPa	34
Length During Permeation, cm	9.908
Area During Permeation, m²	0.004585

Visual Description (Golder Procedure):

CLAY, dark grayish brown, moist

DATE/TIME		TEMP (^oC)	Δh (cm)	Flow (m^3)	Gradient	Uncorrected Hydraulic Conductivity (cm/s)
3-Jan-20	12:55	20.7	80	--	--	--
3-Jan-20	13:05	20.7	81	1.7E-07	8.12	7.52E-07
3-Jan-20	13:15	20.7	80	1.7E-07	8.12	7.52E-07
3-Jan-20	13:25	20.7	80	1.7E-07	8.07	7.56E-07
3-Jan-20	13:35	20.7	80	1.7E-07	8.07	7.56E-07

Average Corrected Hydraulic Conductivity (cm/s) 7.4E-07

DATE	7-Jan-2020
REVIEW	MB

FLOW PUMP #1

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MEDIA USING A FLEXIBLE WALL PERMEAMETER

ASTM D5084

METHOD D, CONSTANT RATE OF FLOW

PROJECT NAME	CJ/TS Clean Up Eval and Recomm/CO
PROJECT NUMBER	19124320
SAMPLE ID	TP-OS-02, BS1 (-#10 material) @ 0 - 5 ft.
SAMPLE TYPE	Remold

BOARD #	7
CELL #	AA
Flow Pump Speed	6
Technician	BC

COMMENTS
1. Specific gravity is assumed.
2. Specimen was remolded to 94.3% of the Maximum Dry Density and +1.8% of optimum moisture content (per ASTM D698)

Sample Data

	Initial	Final
Specific Gravity	2.70	
Height, cm	9.343	9.727
Diameter, cm	7.317	7.527
Area, m²	0.004205	0.004450
Volume, m^3	0.0003928	0.0004328
Mass, g	698.78	762.12
Moisture Content	29.4%	40.2%
Dry Unit Weight, kN/m^3	13.49	12.32
Dry Unit Weight, lbf/ft^3	85.9	78.5
Saturation, %	82.3%	94.4%

Permeant	Water
Back Pressure, kPa	480
Effective Consolidation Stress, kPa	34
Length During Permeation, cm	9.727
Area During Permeation, m²	0.004450

USCS Description (ASTM D 2487):

Fat clay, very dark grayish brown, moist

DATE/TIME		TEMP (^{o}C)	Δh (cm)	Flow (m^3)	Gradient	Uncorrected Hydraulic Conductivity (cm/s)
27-Jan-20	7:30	20.7	91	--	--	--
27-Jan-20	7:45	20.7	92	5.0E-07	9.41	1.31E-06
27-Jan-20	8:00	20.7	91	4.9E-07	9.41	1.31E-06
27-Jan-20	8:15	20.7	91	5.0E-07	9.36	1.32E-06
27-Jan-20	8:30	20.7	92	5.0E-07	9.41	1.31E-06

Average Corrected Hydraulic Conductivity (cm/s) 1.3E-06

DATE 28-Jan-2020

REVIEW MB

Carbonate Content of Soils
ASTM D 4373

Project Name:	**CJ/TS Clean up Eval and Recomm/CO**	**Reviewed:**	MB
Project Number:	**19124320**	**Date:**	18-Dec-2019

Sample ID	Depth	Mass (g)	Carbonate Content (Percent Calcite Equivalent)	Tech	Date	Notes
MW-1, SS-2	3.5-5.0	1.01	5%	DS	3-Dec-2019	
TP-2, BS-1	5.0-10.0	9.99	1%	DS	4-Dec-2019	

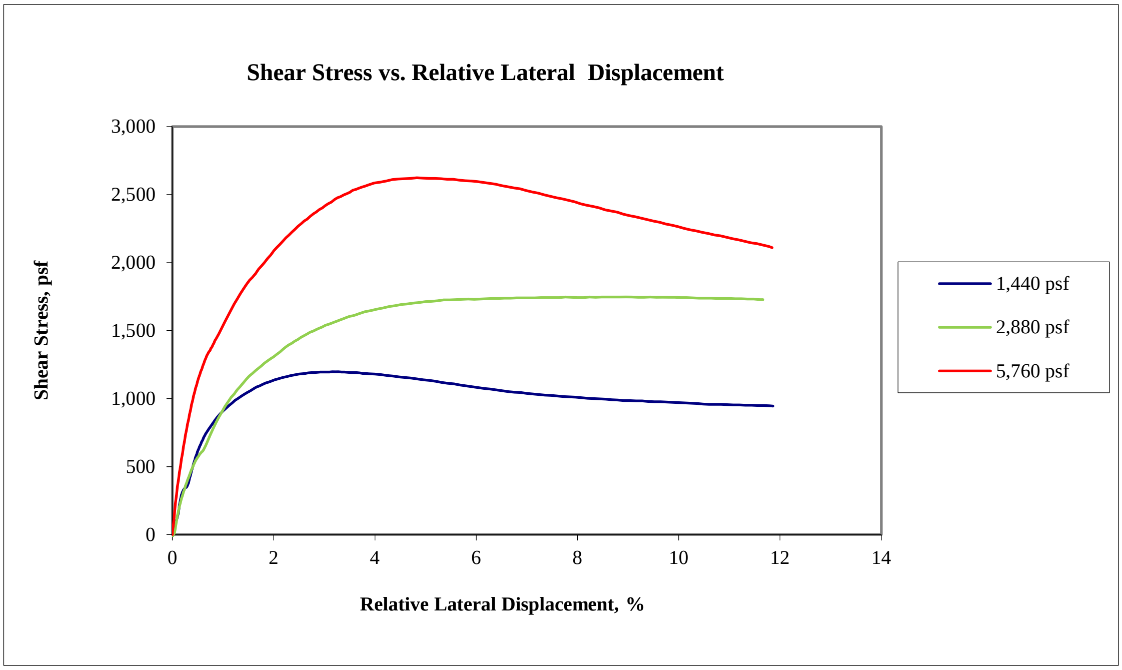
Notes:
Carbonate Content measured after 10 minutes unless otherwise noted

Boring or Test Pit:	TP-OS-01		Boring or Test Pit:	TP-OS-01		Boring or Test Pit:	TP-OS-01	
Sample:	BS-1		Sample:	BS-1		Sample:	BS-1	
Depth:	0-5	ft.	Depth:	0-5	ft.	Depth:	0-5	ft.
Point No.:	1		Point No.:	2		Point No.:	3	
	Initial			**Initial**			**Initial**	
Thickness =	1.196	in	Thickness =	1.193	in	Thickness =	1.195	in
Diameter =	2.50	in	Diameter =	2.50	in	Diameter =	2.50	in
Wet Mass =	0.377	lb	Wet Mass =	0.378	lb	Wet Mass =	0.378	lb
Area =	4.91	in^2	Area =	4.91	in^2	Area =	4.91	in^2
Volume =	5.87	in^3	Volume =	5.86	in^3	Volume =	5.87	in^3
Specific Gravity =	2.75	(ASTM D854)	Specific Gravity =	2.75	(ASTM D854)	Specific Gravity =	2.75	(ASTM D854)
Dry Mass of Solids =	0.294	lb	Dry Mass of Solids =	0.295	lb	Dry Mass of Solids =	0.294	lb
Moisture Content =	28.3%		Moisture Content =	27.8%		Moisture Content =	28.7%	
Wet Unit Weight =	110.9	pcf	Wet Unit Weight =	111.4	pcf	Wet Unit Weight =	111.5	pcf
Dry Unit Weight =	86.4	pcf	Dry Unit Weight =	87.2	pcf	Dry Unit Weight =	86.6	pcf
Void Ratio =	0.98		Void Ratio =	0.97		Void Ratio =	0.98	
Percent Saturation =	79%		Percent Saturation =	79%		Percent Saturation =	81%	
	Pre-Shear			**Pre-Shear**			**Pre-Shear**	
Thickness =	1.226	in	Thickness =	1.203	in	Thickness =	1.162	in
Diameter =	2.50	in	Diameter =	2.50	in	Diameter =	2.50	in
Area =	4.91	in^2	Area =	4.91	in^2	Area =	4.91	in^2
Volume =	6.02	in^3	Volume =	5.91	in^3	Volume =	5.71	in^3
Moisture Content =	35.4%		Moisture Content =	34.3%		Moisture Content =	32.0%	
Wet Unit Weight =	114.1	pcf	Wet Unit Weight =	116.1	pcf	Wet Unit Weight =	117.5	pcf
Dry Unit Weight =	84.3	pcf	Dry Unit Weight =	86.4	pcf	Dry Unit Weight =	89.0	pcf
Void Ratio =	1.03		Void Ratio =	0.98		Void Ratio =	0.92	
Percent Saturation =	94%		Percent Saturation =	96%		Percent Saturation =	95%	
Shear Rate =	0.0004	in/min	Shear Rate =	0.0004	in/min	Shear Rate =	0.0004	in/min
Normal Stress =	1,440	psf	Normal Stress =	2,880	psf	Normal Stress =	5,760	psf

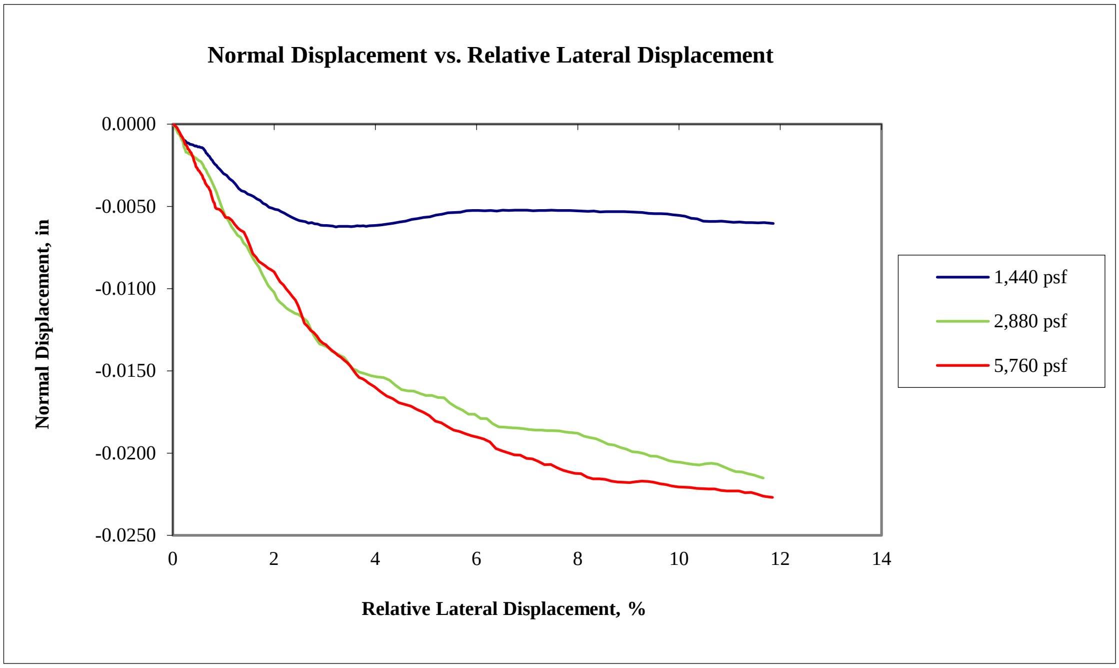
Notes:

USCS description (ASTM D2487): Fat clay, dark gray, moist
Atterberg limits: LL = 75 PL = 34 PI = 41 (ASTM D4318)
Percent finer: 3/4 in. = 100% No. 4 = 100% No. 200 = 97% (ASTM D422, refer to separate report)
Specimen type: ☐ Intact ☒ Reconstituted Remold targets: 86.5 pcf (dry) at 27.6% ± 1.0% moisture
Inundation: At Seating
Apparatus: 2.5 -inch nominal diameter box, GeoTac automated test system, GeoJac loading system

Project Name: **CJ/TS Clean Up Eval and Recomm/CO**	**ASTM D3080** **CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT** **SAMPLE AND TEST DATA**			
Project Number: **19124320**				
Sample ID: **TP-OS-01, BS1 @ 0 - 5 ft.**	**Technician:** **PRH**	**Checked:** **PRH**	**Reviewed:** **CPA**	**Date:** **4-Jan-2020**
				Figure: **1**



Shear Stress vs. Relative Lateral Displacement



Normal Displacement vs. Relative Lateral Displacement

Project Name:
CJ/TS Clean Up Eval and Recomm/CO

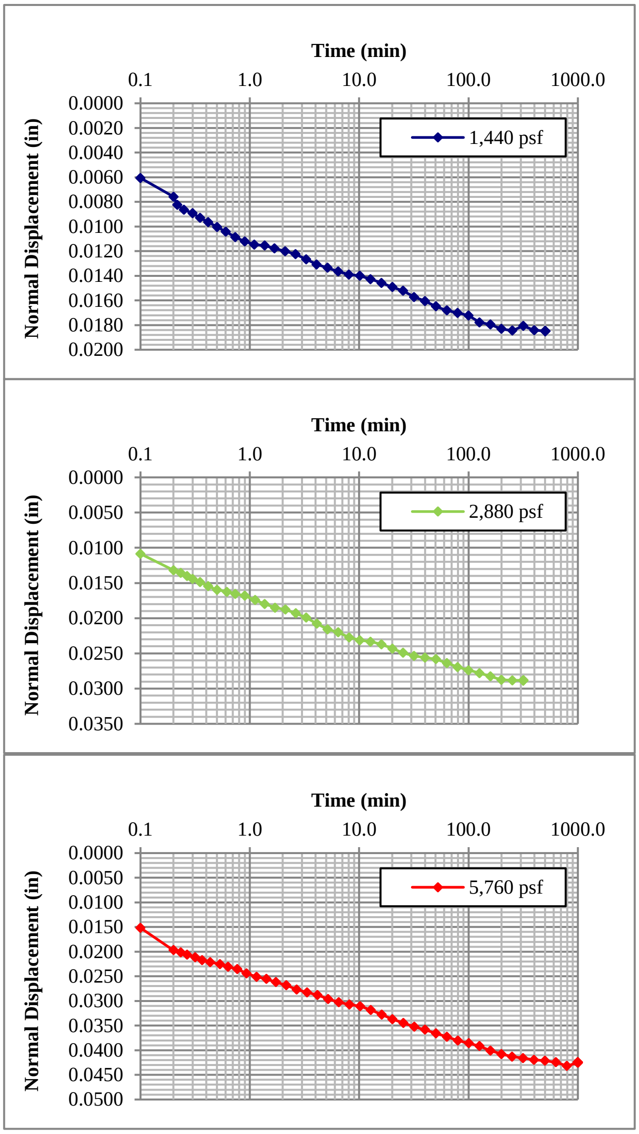
Project Number:
19124320

ASTM D3080
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT
SHEAR STRESS AND NORMAL DISPLACEMENT PLOTS

Sample ID:
TP-OS-01, BS1 @ 0 - 5 ft.

Technician:	**Checked:**	**Reviewed:**	**Date:**	**Figure:**
PRH	PRH	CPA	4-Jan-2020	2

Consolidation Data Used to Determine Shear Rate



Normal Stress, psf	Normal Displacement, in	Load Duration, min
	Point No. 1	
180	-0.0601	720
720	0.0116	255
1,440	0.0185	501
	Point No. 2	
100	-0.0728	1,036
720	0.0162	91
1,440	0.0175	139
2,880	0.0288	316
	Point No. 3	
99	-0.0664	1,280
720	0.0146	216
1,440	0.0142	98
2,880	0.0276	240
5,760	0.0425	999

Project Name:
CJ/TS Clean Up Eval and Recomm/CO

Project Number:
19124320

ASTM D3080
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT CONSOLIDATION DATA

Sample ID:
TP-OS-01, BS1 @ 0 - 5 ft.

Technician:	Checked:	Reviewed:	Date:	Figure:
PRH	PRH	CPA	4-Jan-2020	3

Point No.: 1
Normal Stress = 1,440 psf
Shear Rate = 0.0004 in/min

Shear Stress psf	Relative Lateral Displacement %	Normal Displacement in
108	0.1	-0.0003
292	0.2	-0.0008
349	0.3	-0.0011
467	0.4	-0.0012
591	0.5	-0.0014
681	0.6	-0.0014
754	0.7	-0.0018
809	0.8	-0.0022
861	0.9	-0.0026
888	0.9	-0.0028
1,044	1.5	-0.0042
1,130	2.0	-0.0051
1,176	2.4	-0.0058
1,195	3.0	-0.0062
1,194	3.5	-0.0062
1,180	4.0	-0.0062
1,160	4.5	-0.0060
1,138	5.0	-0.0057
1,113	5.4	-0.0054
1,087	5.9	-0.0053
1,063	6.4	-0.0053
1,038	7.0	-0.0052
1,022	7.5	-0.0052
1,010	8.0	-0.0053
998	8.4	-0.0053
985	8.9	-0.0053
980	9.4	-0.0054
970	10.0	-0.0056

Point No.: 2
Normal Stress = 2,880 psf
Shear Rate = 0.0004 in/min

Shear Stress psf	Relative Lateral Displacement %	Normal Displacement in
100	0.1	-0.0004
263	0.2	-0.0010
380	0.3	-0.0017
478	0.4	-0.0019
556	0.5	-0.0022
608	0.6	-0.0024
672	0.7	-0.0030
728	0.7	-0.0033
823	0.9	-0.0041
905	1.0	-0.0052
1,142	1.5	-0.0074
1,294	1.9	-0.0100
1,436	2.5	-0.0116
1,526	3.0	-0.0134
1,606	3.5	-0.0147
1,648	3.9	-0.0153
1,683	4.4	-0.0159
1,712	5.0	-0.0165
1,726	5.5	-0.0170
1,731	6.0	-0.0176
1,736	6.4	-0.0184
1,740	6.9	-0.0185
1,742	7.4	-0.0186
1,743	8.0	-0.0188
1,746	8.5	-0.0193
1,747	9.0	-0.0198
1,746	9.4	-0.0202
1,744	9.9	-0.0205

Point No.: 3
Normal Stress = 5,760 psf
Shear Rate = 0.0004 in/min

Shear Stress psf	Relative Lateral Displacement %	Normal Displacement in
291	0.1	-0.0002
554	0.2	-0.0008
772	0.3	-0.0014
954	0.4	-0.0019
1,103	0.5	-0.0027
1,219	0.6	-0.0031
1,316	0.7	-0.0038
1,379	0.8	-0.0045
1,439	0.9	-0.0051
1,524	1.0	-0.0054
1,839	1.5	-0.0069
2,058	1.9	-0.0089
2,267	2.5	-0.0111
2,403	3.0	-0.0133
2,508	3.4	-0.0145
2,584	4.0	-0.0160
2,615	4.5	-0.0169
2,621	4.9	-0.0175
2,612	5.4	-0.0184
2,599	5.9	-0.0189
2,576	6.4	-0.0197
2,529	7.0	-0.0203
2,488	7.5	-0.0207
2,448	7.9	-0.0212
2,403	8.4	-0.0216
2,356	8.9	-0.0218
2,316	9.4	-0.0217
2,264	10.0	-0.0221

Project Name: CJ/TS Clean Up Eval and Recomm/CO

Project Number: 19124320

ASTM D3080
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT
SHEAR DATA

Sample ID:	Technician:	Checked:	Reviewed:	Date:	Figure:
TP-OS-01, BS1 @ 0 - 5 ft.	PRH	PRH	CPA	4-Jan-2020	4

Project Name: CJ/TS Clean Up Eval and Recomm/CO	ASTM D3080 CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT SPECIMEN PHOTOGRAPH - 1,440 psf			
Project Number: 19124320				
Sample ID: TP-OS-01, BS1 @ 0 - 5 ft.	**Technician:** PRH	**Checked:** PRH	**Reviewed:** CPA	**Date:** 4-Jan-2020

Figure:
5

GOLDER

Project Name: CJ/TS Clean Up Eval and Recomm/CO	**ASTM D3080** **CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT** **SPECIMEN PHOTOGRAPH - 2,880 psf**				
Project Number: 19124320					
Sample ID: TP-OS-01, BS1 @ 0 - 5 ft.	**Technician:** PRH	**Checked:** PRH	**Reviewed:** CPA	**Date:** 4-Jan-2020	**Figure:** 6

Project Name: CJ/TS Clean Up Eval and Recomm/CO	**ASTM D3080** **CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT** **SPECIMEN PHOTOGRAPH - 5,760 psf**
Project Number: 19124320	

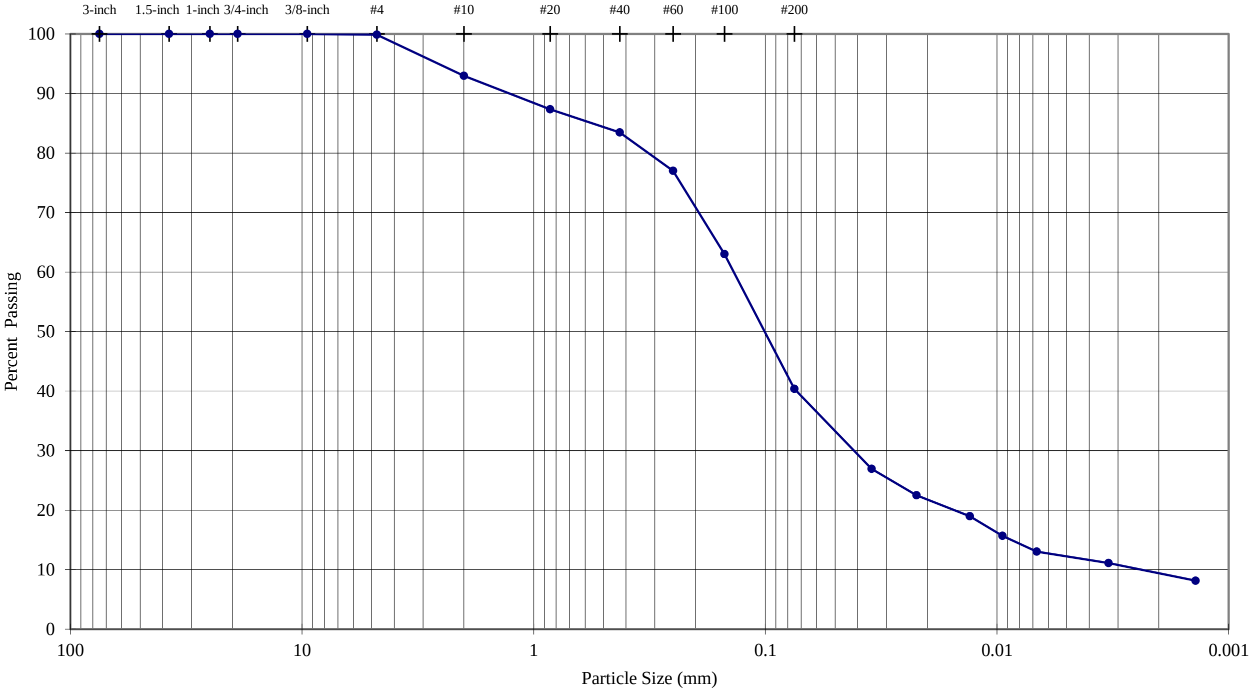
Sample ID: TP-OS-01, BS1 @ 0 - 5 ft.	**Technician:** PRH	**Checked:** PRH	**Reviewed:** CPA	**Date:** 4-Jan-2020	**Figure:** 7

November-19 **19124320**

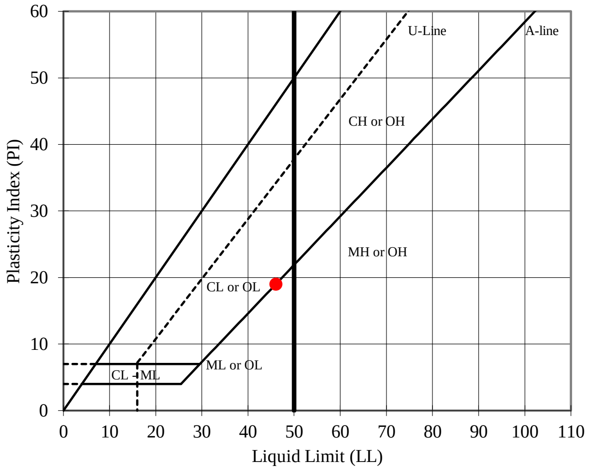
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **CJ/TS Clean Up Eval and Recomm/CO**
SAMPLE ID: **MW-1, SS-5** DEPTH (ft): **11.0 - 12.5**
TYPE: **Bag**



	Sieve	Particle Size (mm)	% Passing	Description	Percentage
Sieve Analysis (Initial Separation on No. 4 Sieve)	3-inch	75.0	**100.0**		
	1.5-inch	37.5	**100.0**	Coarse Gravel	**0.00**
	1-inch	25.0	**100.0**		
	3/4-inch	19.0	**100.0**		
	3/8-inch	9.5	**100.0**	Fine Gravel	**0.11**
	#4	4.75	**99.9**		
	#10	2.0	**93.0**	Coarse Sand	**6.93**
	#20	0.850	**87.3**	Medium Sand	**9.53**
	#40	0.425	**83.4**		
	#60	0.250	**77.0**	Fine Sand	**43.06**
	#100	0.150	**63.0**		
	#200	0.075	**40.4**		
Hydrometer Analysis		0.035	**26.9**	Silt or Clay Fines	**40.37**
		0.022	**22.5**		
		0.013	**19.0**		
		0.009	**15.7**		
		0.007	**13.0**		
		0.003	**11.1**		
		0.001	**8.1**		



USCS Description (ASTM D 2487):

Clayey sand, yellowish brown, moist

LL	PL	PI	SpG
46	**27**	**19**	**--**

As-Received Moisture Content (%): --

USCS Group Symbol: SC

Notes: 0 g of particles up to 9.5 mm maximum size were removed from particle size analysis sample prior to testing
Particle size analysis sample mechanically dispersed using Stirring Apparatus A for about 1 minute
Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device

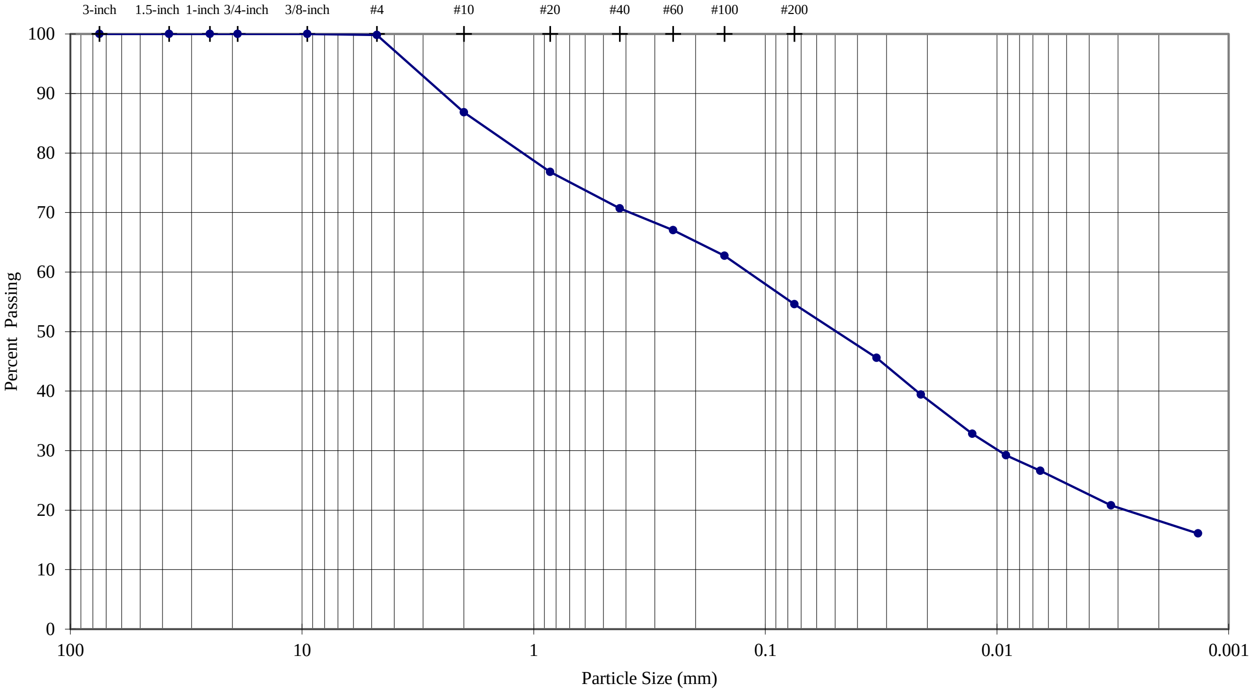
TECH	TDF/MGC
DATE	15-Nov-2019
REVIEW	MB

November-19 **19124320**

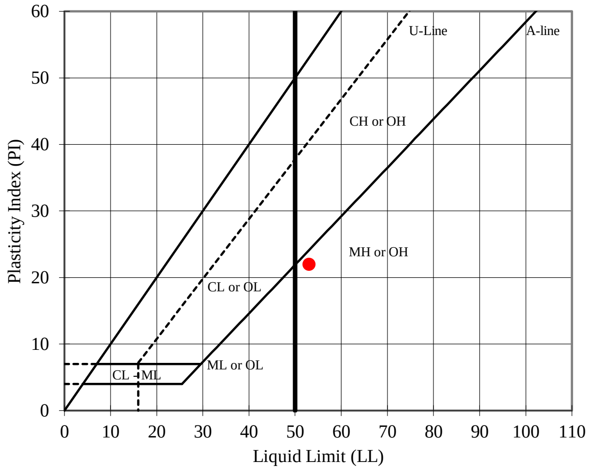
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **CJ/TS Clean Up Eval and Recomm/CO**
SAMPLE ID: **MW-9, SS-9** DEPTH (ft): **28.5-30.0**
TYPE: **Bag**



	Sieve	Particle Size (mm)	% Passing	Description	Percentage
Sieve Analysis (Initial Separation on No. 4 Sieve)	3-inch	75.0	**100.0**		
	1.5-inch	37.5	**100.0**	Coarse Gravel	**0.00**
	1-inch	25.0	**100.0**		
	3/4-inch	19.0	**100.0**		
	3/8-inch	9.5	**100.0**	Fine Gravel	**0.19**
	#4	4.75	**99.8**		
	#10	2.0	**86.8**	Coarse Sand	**12.96**
	#20	0.850	**76.8**	Medium Sand	**16.13**
	#40	0.425	**70.7**		
	#60	0.250	**67.0**	Fine Sand	**16.13**
	#100	0.150	**62.8**		
	#200	0.075	**54.6**		
Hydrometer Analysis		0.033	**45.6**	Silt or Clay Fines	**54.58**
		0.021	**39.4**		
		0.013	**32.8**		
		0.009	**29.2**		
		0.007	**26.6**		
		0.003	**20.8**		
		0.001	**16.1**		



USCS Description (ASTM D 2487):

Sandy elastic silt, olive brown, moist

LL	PL	PI	SpG
53	**31**	**22**	**--**

As-Received Moisture Content (%): --

USCS Group Symbol: MH

Notes: 0 g of particles up to 9.5 mm maximum size were removed from particle size analysis sample prior to testing
Particle size analysis sample mechanically dispersed using Stirring Apparatus A for about 1 minute
Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device

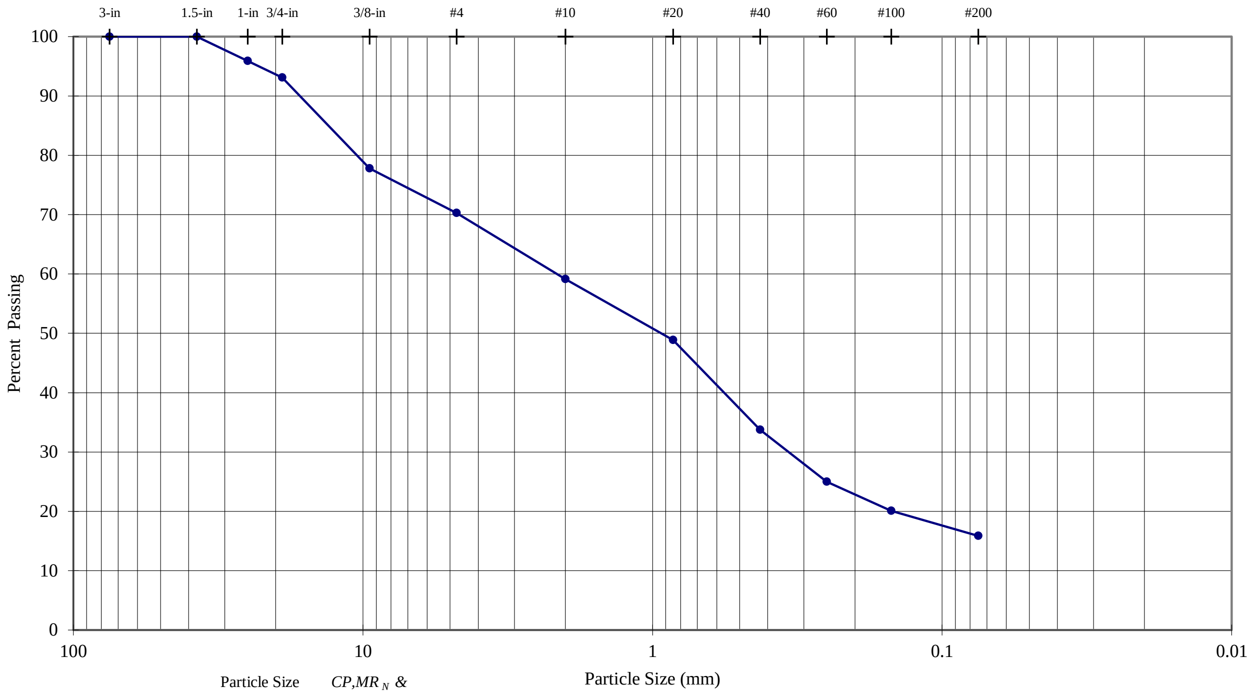
TECH	DS/MGC
DATE	18-Nov-2019
REVIEW	MGC

November-19 **19124320**

PARTICLE-SIZE DISTRIBUTION & ATTERBERG LIMITS

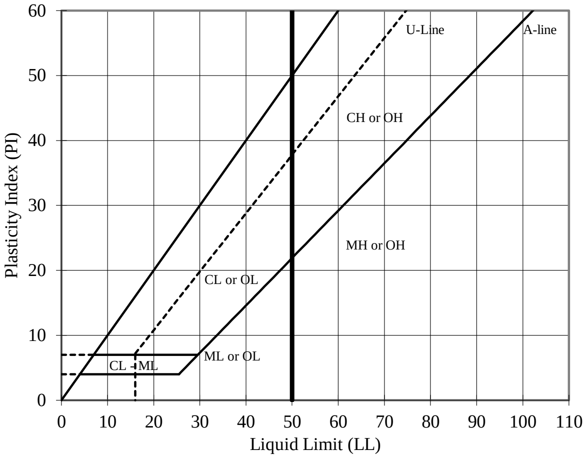
ASTM D421, D6913 (Method A), D4318

PROJECT NAME: **CJ/TS Clean Up Eval and Recomm/CO**
SAMPLE ID: **TP-1, BS1** DEPTH (ft.) **10-15**
TYPE: **Bag**



Sieve Analysis
Composite sieving, No. 4 (4.75-mm) separating sieve.

Sieve	Particle Size (mm)	*CP,MR $_N$ & SubS,MR $_N$*	% Passing
3-in	75	0.0	**100**
1.5-in	37.5	0.0	**100**
1-in	25.0	97.9	**96**
3/4-in	19.0	66.4	**93**
3/8-in	9.5	365.5	**78**
#4	4.75	179.9	**70.3**
#10	2.00	35.60	**59**
#20	0.850	32.92	**49**
#40	0.425	48.45	**34**
#60	0.250	28.01	**25**
#100	0.150	15.77	**20**
#200	0.075	13.53	**16**



Visual Description (Estimated ASTM D 2487):
sandy, CLAYEY GRAVEL, dark yellowish brown, moist

USCS Group Symbol --

S,M $_d$	2387.2
SubS,FCPR $_{first}$	0.0%

LL	--
PL	--
PI	--

As-Received Moisture Content (%)
11.1%

Notes: Specimens obtained from sample following air-dried procedures.
0 g of particles up to 37.5 maximum size were removed from sample prior to sieve analysis testing.
Particle size analysis sample was not dispersed using an ultrasonic bath or shaking apparatus}.
Prior testing performed on specimen: none.
Dry mass of finer fraction and finer fraction subspecimen calculated using an auxilliary water content sample.
Sieve analysis mass values are directly mesaured or calculated individual masses. Mass measurements for water content and material loss calculations, total mass of coarse and fine portions, and finer portion subspecimen cumulative mass retained omitted for brevity and are available upon request.
Sample prepared for Atterberg Limits testing by the dry method.
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving.
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device.

TECH	DS
DATE	19-Nov-2019
REVIEW	MB

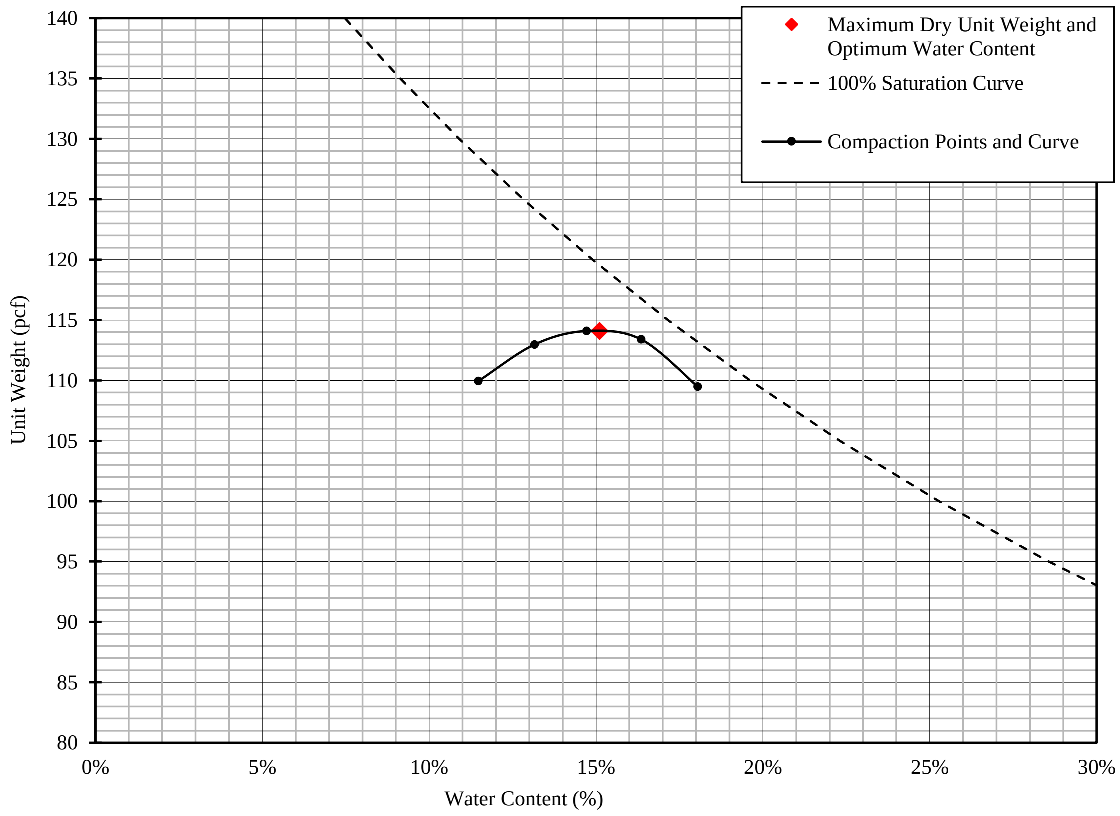
November-19 0

LABORATORY COMPACTION CHARACTERISTICS OF SOIL

ASTM D698 - Method A

Manual Rammer	**Dry Preparation**

PROJECT NAME: **CJ/TS Clean Up Eval and Recomm/CO**
SAMPLE ID: **TP-4, BS-1** DEPTH (ft): **10-15**
TYPE: **Pail**



% Test Fraction Passing #4 Sieve	**#VALUE!**
As-Received Moisture Content	**11.5%**
Specific Gravity (estimated)	**2.70**

Maximum Dry Unit Weight (pcf)	**114.1**
Optimum Water Content (%)	**15.1**

USCS Description (ASTM D 2487): SILTY SAND and GRAVEL, light olive brown, moist

USCS --

Notes: Proctor test performed on mateiral passing the #10 sieve

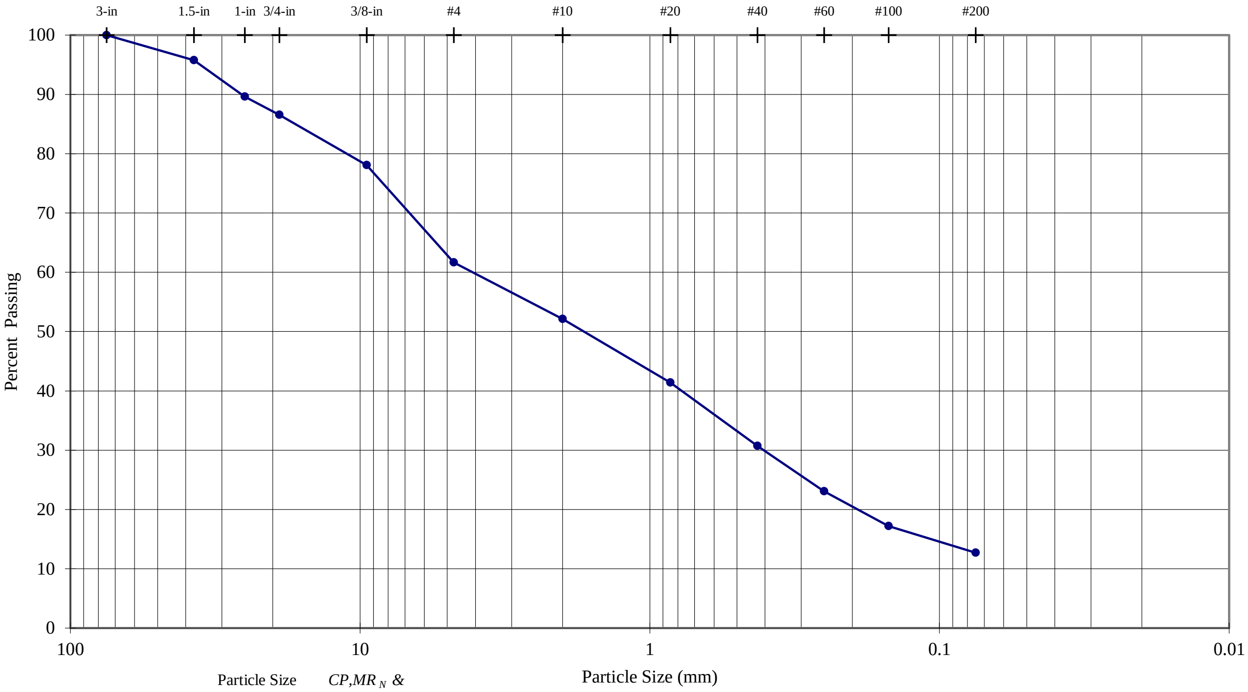
TECH	EH
DATE	12/17
REVIEW	MGC

November-19 **19124320**

PARTICLE-SIZE DISTRIBUTION & ATTERBERG LIMITS

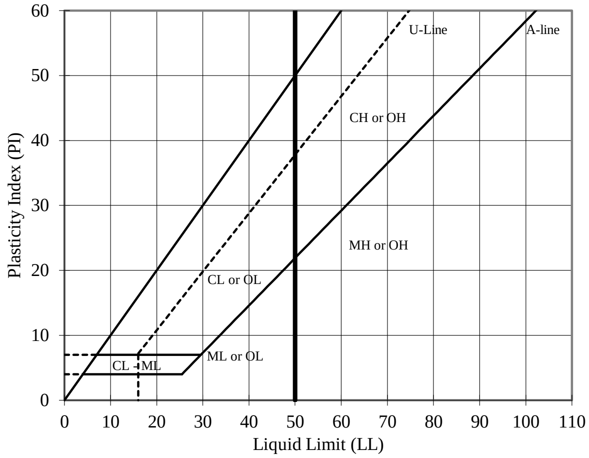
ASTM D421, D6913 (Method A), D4318

PROJECT NAME: **CJ/TS Clean Up Eval and Recomm/CO**
SAMPLE ID: **TP-4, BS-1** DEPTH (ft.) **10-15**
TYPE: **Pail**



Composite sieving, No. 4 (4.75-mm) separating sieve.
Sieve Analysis

Sieve	Particle Size (mm)	*CP,MR $_N$ & SubS,MR $_N$*	% Passing
3-in	75	0.0	**100**
1.5-in	37.5	1129.7	**96**
1-in	25.0	1651.7	**90**
3/4-in	19.0	818.1	**87**
3/8-in	9.5	2279.4	**78**
#4	4.75	4387.6	**62**
#10	2.00	36.72	**52**
#20	0.850	41.38	**41**
#40	0.425	41.06	**31**
#60	0.250	29.55	**23**
#100	0.150	22.49	**17**
#200	0.075	17.34	**13**



Visual Description (Golder Procedure):

SILTY SAND and GRAVEL, light olive brown, moist

USCS Group Symbol --

S,M $_d$	26784.5
SubS,FCPR $_{first}$	0.0%

LL	--
PL	--
PI	--

As-Received Moisture Content (%)
11.5%

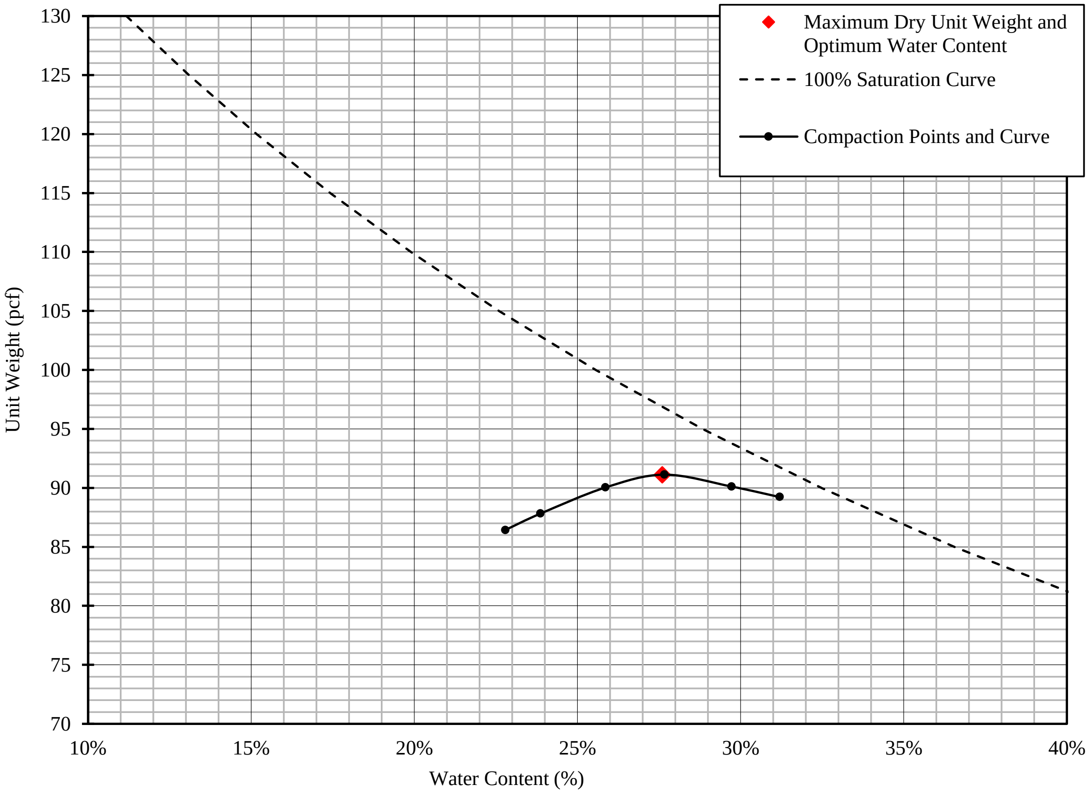
Notes: Specimens obtained from sample following air-dried procedures.
0 g of particles up to 75.0 maximum size were removed from sample prior to sieve analysis testing.
Particle size analysis sample was not dispersed using an ultrasonic bath or shaking apparatus.
Prior testing performed on specimen: none.
Dry mass of finer fraction and finer fraction subspecimen calculated using an auxilliary water content sample.
Sieve analysis mass values are directly mesaured or calculated individual masses. Mass measurements for water content and material loss calculations, total mass of coarse and fine portions, and finer portion subspecimen cumulative mass retained omitted for brevity and are available upon request.
Sample prepared for Atterberg Limits testing by the dry method.
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving.
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device.

TECH	DS
DATE	19-Nov-2019
REVIEW	MB

LABORATORY COMPACTION CHARACTERISTICS OF SOIL
ASTM D698 - Method A

Manual Rammer	Dry Preparation

PROJECT NAME: **CJ/TS Clean Up Eval and Recomm/CO**
SAMPLE ID: **TP-OS-01, BS1** DEPTH (ft): **0-5**
TYPE: **Bag**



% Test Fraction Passing #4 Sieve	**100%**
As-Received Moisture Content	**24%**
Specific Gravity (estimated)	**2.72**

Maximum Dry Unit Weight (pcf)	**91.1**
Optimum Water Content (%)	**27.6**

USCS Description (ASTM D 2487): Fat clay, dark gray, moist

USCS CH

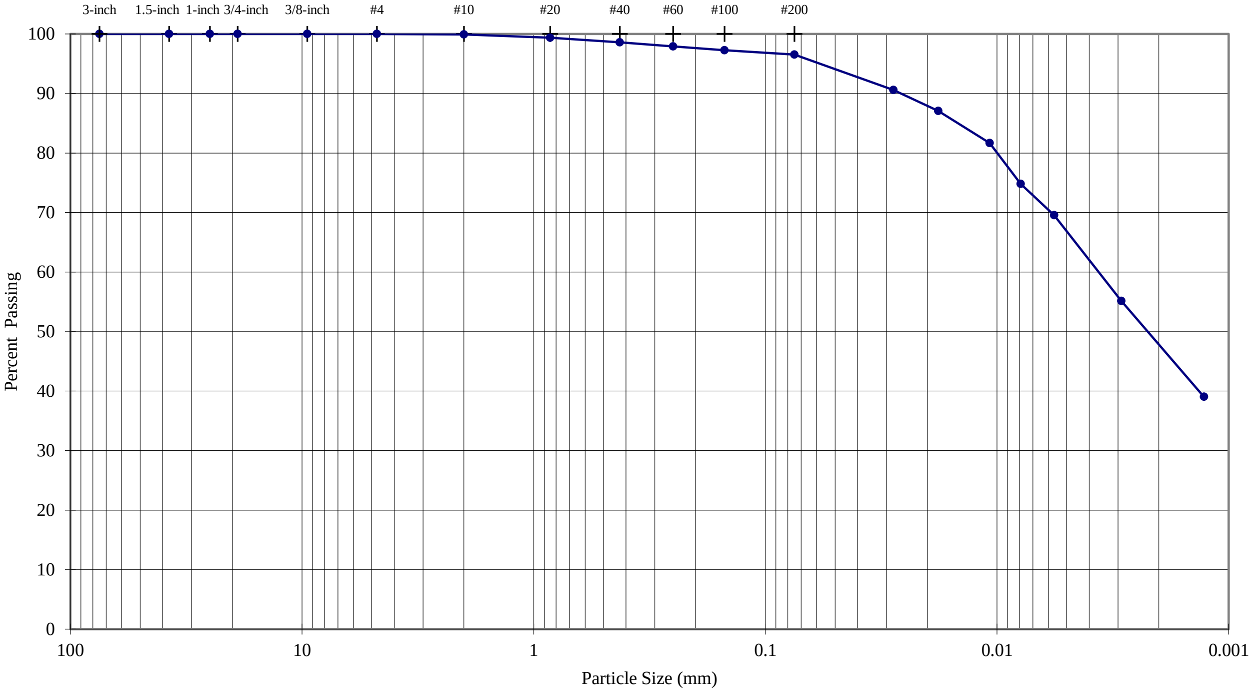
TECH	DS
DATE	18-Nov-2019
REVIEW	MB

November-19 **19124320**

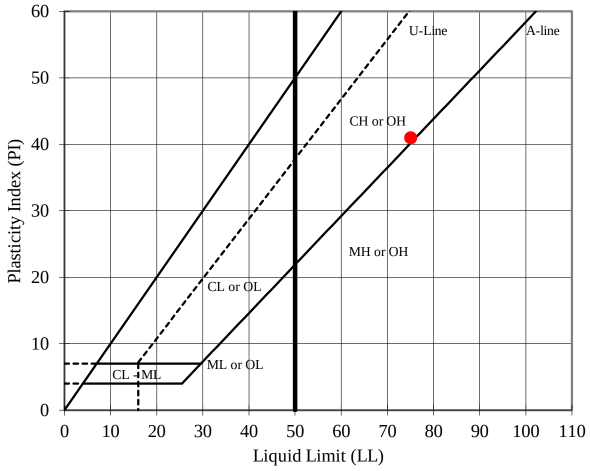
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **CJ/TS Clean Up Eval and Recomm/CO**
SAMPLE ID: **TP-OS-01, BS1** DEPTH (ft): **0-5**
TYPE: **Bag**



	Sieve	Particle Size (mm)	% Passing	Description	Percentage
Sieve Analysis (Initial Separation on No. 4 Sieve)	3-inch	75.0	**100.0**		
	1.5-inch	37.5	**100.0**	Coarse Gravel	**0.00**
	1-inch	25.0	**100.0**		
	3/4-inch	19.0	**100.0**		
	3/8-inch	9.5	**100.0**	Fine Gravel	**0.00**
	#4	4.75	**100.0**		
	#10	2.0	**99.9**	Coarse Sand	**0.07**
	#20	0.850	**99.4**	Medium Sand	**1.32**
	#40	0.425	**98.6**		
	#60	0.250	**97.9**	Fine Sand	**2.09**
	#100	0.150	**97.3**		
	#200	0.075	**96.5**		
Hydrometer Analysis		0.028	**90.6**	Silt or Clay Fines	**96.52**
		0.018	**87.1**		
		0.011	**81.7**		
		0.008	**74.8**		
		0.006	**69.6**		
		0.003	**55.1**		
		0.001	**39.0**		



USCS Description (ASTM D 2487):

Fat clay, dark gray, moist

LL	PL	PI	SpG
75	**34**	**41**	**--**

As-Received Moisture Content (%): **24.4**

USCS Group Symbol: CH

Notes: 0 g of particles up to 4.75 mm maximum size were removed from particle size analysis sample prior to testing
Particle size analysis sample mechanically dispersed using Stirring Apparatus A for about 1 minute
Sample prepared for Atterberg Limits testing by the wet/dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A/B Liquid Limit test performed using mechanical device

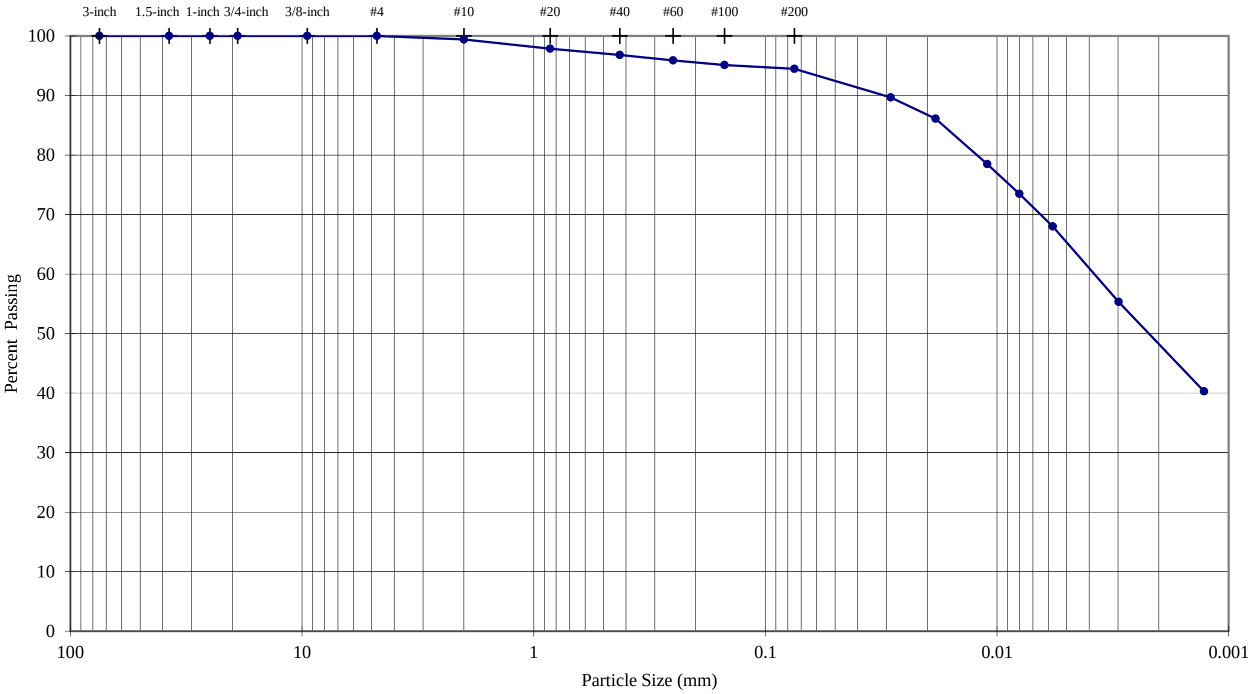
TECH	DS/MGC
DATE	18-Nov-2019
REVIEW	MGC

November-19 **19124320**

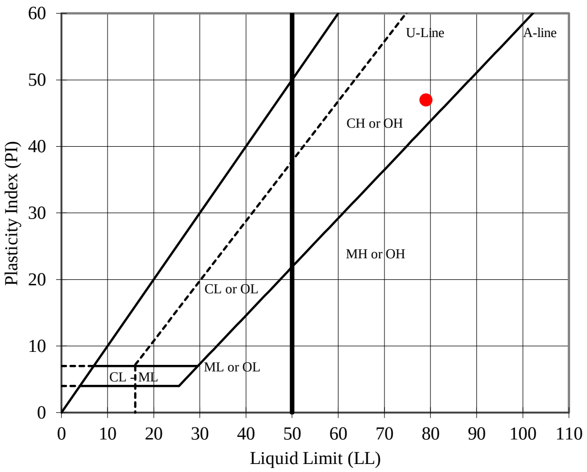
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **CJ/TS Clean Up Eval and Recomm/CO**
SAMPLE ID: **TP-OS-2, BS1** DEPTH (ft): **0 - 5**
TYPE: **Pail**



	Sieve	Particle Size (mm)	% Passing	Description	Percentage
Sieve Analysis (Initial Separation on No. 4 Sieve)	3-inch	75.0	**100.0**		
	1.5-inch	37.5	**100.0**	Coarse Gravel	**0.00**
	1-inch	25.0	**100.0**		
	3/4-inch	19.0	**100.0**		
	3/8-inch	9.5	**100.0**	Fine Gravel	**0.00**
	#4	4.75	**100.0**		
	#10	2.0	**99.4**	Coarse Sand	**0.60**
	#20	0.850	**97.9**	Medium Sand	**2.60**
	#40	0.425	**96.8**		
	#60	0.250	**95.9**	Fine Sand	**2.33**
	#100	0.150	**95.1**		
	#200	0.075	**94.5**		
Hydrometer Analysis		0.029	**89.7**	Silt or Clay Fines	**94.47**
		0.018	**86.1**		
		0.011	**78.5**		
		0.008	**73.5**		
		0.006	**68.0**		
		0.003	**55.3**		
		0.001	**40.3**		



USCS Description (ASTM D 2487):

Fat clay, very dark grayish brown, moist

LL	PL	PI	SpG
79	**32**	**47**	**--**

As-Received Moisture Content (%): **25.8**

USCS Group Symbol: CH

Notes: 0 g of particles up to 4.75 mm maximum size were removed from particle size analysis sample prior to testing
Particle size analysis sample mechanically dispersed using Stirring Apparatus A for about 1 minute
Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device

TECH	DS/MGC
DATE	15-Nov-2019
REVIEW	MGC

Date: 12/20/2019

CLIENT: Golder Associates, Inc
Project: 19124320 Jackson Co. Landfill
Lab Order: S1911230

CASE NARRATIVE

Report ID: S1911230001

Samples MW-1 SS2 and TP-2 BS1 were received on November 14, 2019.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Pace Analytical (Formerly Inter-Mountain Laboratories) except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Pace Analytical® Formerly Inter-Mountain Laboratories
1673 Terra Avenue Sheridan, WY 82801 ph: (307) 672-8945

Soil Analysis Report

Golder Associates, Inc
44 Union Blvd, Ste 300
Lakewood, CO 80228

Report ID: S1911230001

Project: 19124320 Jackson Co. Landfill
Date Received: 11/14/2019

Date Reported: 12/20/2019
Work Order: S1911230

		Depths	Available Potassium	Phosphorus	Nitrate(as N)
Lab ID	**Sample ID**	Feet	ppm	ppm	ppm
S1911230-001	TP-2 BS1	5-10	40	2	<0.1
S1911230-002	MW-1 SS2	3.5-5	38	4	<0.1

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, TOC=Total Organic Carbon

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

ANALYTICAL QC SUMMARY REPORT

CLIENT: Golder Associates, Inc
Work Order: S1911230
Project: 19124320 Jackson Co. Landfill

Date: 12/20/2019
Report ID: S1911230001

Available Metals - ppm Sample Type **MBLK** Units: ppm

AVA BLK (12/13/19 20:28) RunNo: 174617

Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Available Potassium	ND	1					

Available Metals - ppm Sample Type **LCS** Units: ppm

AVA QC (12/13/19 20:26) RunNo: 174617

Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Available Potassium	254	1	231		110	75 - 125	

Nitrogen - Nitrate - Calcium Chloride Extraction Sample Type **MBLK** Units: ppm

BLANK (12/20/19 08:36) RunNo: 174836

Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Nitrogen-Nitrate	ND	0.1					

Nitrogen - Nitrate - Calcium Chloride Extraction Sample Type **LCS** Units: ppm

QC (12/20/19 08:39) RunNo: 174836

Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Nitrogen-Nitrate	11.6	0.1	10.3		113	80 - 120	

Sodium Bicarbonate Phosphorus Sample Type **MBLK** Units: ppm

P BLK (12/13/19 18:46) RunNo: 174616

Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Phosphorus	ND	1					

Sodium Bicarbonate Phosphorus Sample Type **LCS** Units: ppm

P QC (12/13/19 18:44) RunNo: 174616

Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Phosphorus	6	1	6.1		102	80 - 120	

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range
G	Analyzed at IML Gillette laboratory	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	L	Analyzed by another laboratory
ND	Not Detected at the Reporting Limit	O	Outside the Range of Dilutions
R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits
X	Matrix Effect		

ATTACHMENT 4

Geotech Investigation Addendum

July 31, 2020 Reference No. 19124320-4-TM-1

Geotech Investigation Addendum

RESULTS OF MONITORING WELL INSTALLATION AND SUBSURFACE INVESTIGATION FOR JACKSON COUNTY TRANSFER STATION PROPOSED LANDFILL CELL SITE; WALDEN, COLORADO

1.0 INTRODUCTION

As requested by Jackson County (the County), Golder has completed the installation of two additional monitoring wells (MW-2 and MW-3) at the Jackson County Landfill (JCL or Site) and seven additional surface samples at the Site and potential borrow areas identified by the County. The monitoring well locations (installed on June 30 and July 2, 2020) were located to provide more comprehensive data regarding the subsurface conditions at the Site, while the surface samples (collected May 19, 2020) were collected to perform additional laboratory testing for determining the suitability of the soils for low-permeability soil liner and alternative final cover (AFC).

Potential liner material was sampled from the proposed borrow area approximately nine miles north of the Site along Highway CO-125 (Sample ID CB). Potential engineered fill material was sampled from proposed borrow areas located 600 feet southeast of the Site and 0.5 miles north of the Site (Sample ID BS-1 and BS-2, respectively) as well as within the proposed landfill footprint (Sample ID F-1, F-2, and F-3).

Sampling and logging performed on the two monitoring wells were done in accordance with the procedures outlined in the previously performed geotechnical subsurface field investigation to which this addendum is attached. The locations of the monitoring wells are shown in the Drawings and the Water Table Map (Figure 4) of the Engineering, Design, and Operations Plan (EDOP) main text. A summary of the monitoring well and sample locations is presented in Table 1.

Table 1: Monitoring Well and Sample Locations

Location	Boring/Sample	Boring/Sample Depth (ft)	Northing[1] (ft)	Easting[1] (ft)
Proposed landfill cell site	MW-2	30	1522754	2787235
	MW-3	45	1522356	2787751
	F-1	Surface	1522639	2787414
	F-2	Surface	1522557	2787018
	F-3	Surface	1522676	2786843
Proposed off-site Liner Borrow Area	CB	Surface	1561638	2775930
Proposed off-site Engineered Fill Borrow Area 1	BS-1	Surface	1521980	2787979
Proposed off-site Engineered Fill Borrow Area 2	BS-2	Surface	1525227	2786229

Notes:
1) The coordinate system is NAD83 State Plane Colorado North Coordinates.

2.0 LABORATORY TESTING

Laboratory testing was performed on select representative soil samples to provide geotechnical and hydrologic laboratory data for the proposed landfill cell design and to evaluate the suitability of the subsurface materials to be used as construction materials. Testing is outlined in Table 2.

Table 2: Laboratory Testing

Location	Boring/ Sample	Laboratory Test(s) Performed
Proposed landfill cell site	F-3	■ Mechanical sieve analyses with hydrometer (ASTM D422) ■ Standard Proctor (ASTM D698) ■ Remolded Permeability (ASTM D5084) ■ Soil Water Characteristic Curve (ASTM D6836, *Pending*)
Proposed off-site Liner Borrow Area	CB	■ Mechanical sieve analyses with hydrometer (ASTM D422) ■ Atterberg limits (ASTM D4318) ■ Standard Proctor (ASTM D698) ■ Remolded Permeability (ASTM D5084)
Proposed off-site Engineered Fill Borrow Area 1	BS-1	■ Mechanical sieve analyses with hydrometer (ASTM D422)
Proposed off-site Engineered Fill Borrow Area 2	BS-2	■ Mechanical sieve analyses with hydrometer (ASTM D422)

Results of the laboratory testing are presented in Attachment 4-1.

3.0 SUBSURFACE CONDITIONS

The results of the borings performed during installation of MW-2 and MW-3 support the conclusions made in the previous investigation report. The results of the remolded permeability test on the clay borrow sample (CB) were 4.2E-08, which supports the design specifications of 1.0E-07 as a minimum. The boring and monitoring well logs in Attachment 4-2 have been updated to reflect all three wells installed on the Site.

Attachments: Attachment 4-1: Laboratory Test Data
Attachment 4-2: Borehole Logs

https://golderassociates.sharepoint.com/:f:/r/sites/110066/Project%20Files/6%20Deliverables/TechMemos/4-TM-JacksonCoLF_GeotechInvestigation/4-TM-1/Att4?csf=1&web=1&e=vEfmMT

ATTACHMENT 4-1

Laboratory Test Data

Table 1: Summary of Soil Data

Sample Type	Sample Identification	Sample Depth (ft)	USCS Soil Classification	Delivered Moisture (%)	Atterberg Limits			Grain Size Distribution			Specific Gravity	Moisture–Density Relationship Standard Proctor		Additional Tests/Comments (See Notes)
					LL	PL	PI	% Finer 3/4"	% Finer #4	% Finer #200		Dry Density (pcf)	Moisture (%)	
Pail	BS-1 Bucket 2	--	--	--	--	--	--	100	99	9	--	--	--	
Pail	F-3	--	--	--	--	--	--	99	96	20	--	--	--	
Pail	F-3	--	--	--	--	--	--	99	96	22	--	118.4	12.0	PERM
Pail	BS-2 Bucket 2	--	--	--	--	--	--	99	99	80	--	--	--	
Pail	CB	--	CH	--	57	22	35	100	99	80	--	90.4	29.6	PERM

Notes:

LL = liquid limit
PL = plastic limit
PI = plastic index
SL = shrinkage limit
UW = unit weight
P or red indicates pending test result(s)
*Over size corrected value per ASTM D4718

T = triaxial test
U = unconfined compression test
C = consolidation test
DS = direct shear test
PERM = permeability
CP = compression permeability

ATTERBERG LIMITS

AS RECEIVED WATER CONTENT

Mass Wet Soil & Tare (gm)	0
Mass Dry Soil & Tare (gm)	0
Mass of Tare (gm)	0
Mass of Water (gm)	0
Mass of Dry Soil (gm)	0
Moisture Content (%)	#DIV/0!

MONTH AND YEAR: July-20
PROJECT NAME: CJ/TS Clean Up Eval and Recomm/CO
PROJECT NUMBER: 19124320.0009
SAMPLE ID: CB Depth (ft) --
TYPE: Pail

USCS Description (ASTM D 2487): Fat clay with sand, dark brown, moist

USCS	CH
LL	57
PL	22
PI	35

Multi POINT ATTERBERG

	PLASTIC LIMIT DETERMINATION			LIQUID LIMIT DETERMINATION			
Number of Drops				33	27	20	
Mass of Wet Soil & Tare (gm)	21.27	21.37		28.04	28.42	27.56	
Mass of Dry Soil & Tare (gm)	19.90	20.00		23.09	23.31	22.47	
Mass of Tare (gm)	13.61	13.67		14.14	14.21	13.79	
Mass of Water (gm)	1.37	1.37		4.95	5.11	5.09	0.00
Mass of Dry Soil (gm)	6.29	6.33		8.95	9.10	8.68	0.00
Water Content %	21.78	21.64	OK	55.31	56.15	58.64	#DIV/0!

PLASTIC LIMIT (PL) 22

LIQUID LIMIT (LL) 57

PLASTICITY INDEX (PI) 35

Drops	Water Content %	Log(Drops)
33	55.31	1.52
27	56.15	1.43
20	58.64	1.30
0	#N/A	#N/A

LL Interpolation
57.00

CHECKED BY

ONE POINT ATTERBERG

	PLASTIC LIMITS			LIQUID LIMITS	
Number of Drops					
Mass of Wet Soil & Tare (gm)					
Mass of Dry Soil & Tare (gm)					
Mass of Tare (gm)					
Mass of Water (gm)	0.00	0.00		0.00	0.00
Mass of Dry Soil (gm)	0.00	0.00		0.00	0.00
Water Content %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
Drops:		
LL Value		

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

CHECKED BY

NON-PLASTIC

	PLASTIC LIMITS		LIQUID LIMITS	
Number of Drops				
Mass of Wet Soil & Tare (gm)				
Mass of Dry Soil & Tare (gm)				
Mass of Tare (gm)				
Mass of Water (gm)	0.00	0.00	0.00	0.00
Mass of Dry Soil (gm)	0.00	0.00	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

PLASTIC LIMIT (PL) **NP**

LIQUID LIMIT (LL) **NP**

PLASTICITY INDEX (PI) **NP**

LIQUIDITY INDEX (LI) **NP**

CHECKED BY

Golder Associates Inc.

SPLIT SIEVE DATA ENTRY SHEET

MONTH AND YEAR: July-20
PROJECT NAME: CJ/TS Clean Up Eval and Recomm/CO
PROJECT NUMBER: 19124320.0009
SAMPLE ID: CB Depth (ft) --
TYPE Pail

USCS Description (ASTM D 2487): Fat clay with sand, dark brown, moist

USCS	CH
LL	57
PL	22
PI	35

AS RECEIVED WATER CONTENT

Mass Wet Soil & Tare (gm)	
Mass Dry Soil & Tare (gm)	
Mass of Tare (gm)	
Mass of Water (gm)	0.00
Mass of Dry Soil (gm)	0.00
Moisture Content (%)	--

HYGROSCOPIC MOISTURE FOR MINUS #4 SIEVE SAMPLE

Mass Soil & Tare (gm)	71.45
Mass Dry Soil & Tare (gm)	62.71
Tare Mass (gm)	20.55
Moisture Content (%)	20.7

Total Mass of Sample Used For Analysis, with Finer Split Fraction Corrected for Hygroscopic Moisture

Mass of Sample (gm) 17189.3

PLUS #4 MATERIAL SIEVE

Test Method for 100% finer than 3" only!

Tare Mass		Individual (Mass + Tare)	Cumulative Mass Retained	% Passing
	3-inch		0.0	100
	1.5-inch		0.0	100
	1-inch	32.6	32.6	100
	3/4-inch	0.0	32.6	100
	3/8-inch	59.5	92.1	99
	#4	35.1	127.3	99
	Total Passing #4	20599.1	<--(Uncorrected for Hygroscopic Moisture)	

coarse gravel	0.19	
fine gravel	0.55	0.74
coarse sand	3.01	
medium sand	7.02	
fine sand	8.78	18.80
fines	80.46	
Total	100.00	

BACK SIEVE Tare Mass		Cumulative Mass Retained	Cumulative Mass Retained	% Passing
	#10	1.26	1.3	96.3
	#20	2.80	2.8	92.6
	#40	4.20	4.2	89.2
	#60	5.67	5.7	85.7
	#100	7.00	7.0	82.6
	#200	7.88	7.9	80.5

HYDROMETER ANALYSIS

AIR-DRY MASS OF SAMPLE USED FOR HYDROMETER TEST

Mass of Sample (gm) 50.22

Specific Gravity (ass'd)	2.70
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute
Zero Corr (Cc)	6.00
Meniscus Corr.	1.00

DATE	TIME	READING R	TEMP T	Temp Corr	(mm)	%Finer
8-Jul-2020	8:59					
8-Jul-2020	9:01	38.00	22.2	-0.48	0.030	79.00
8-Jul-2020	9:04	37.00	21.8	-0.39	0.019	76.43
8-Jul-2020	9:14	35.00	20.7	-0.15	0.011	71.14
8-Jul-2020	9:29	33.25	20.0	0.00	0.008	66.66
8-Jul-2020	9:59	31.50	19.4	0.12	0.006	62.25
8-Jul-2020	13:09	27.00	19.2	0.16	0.003	51.53
9-Jul-2020	8:59	21.00	18.9	0.22	0.001	37.24

TEST BY	JP/MGC
DATE SET UP	7-Jul-2020
CHECKED BY	MB
REVIEW BY	MB

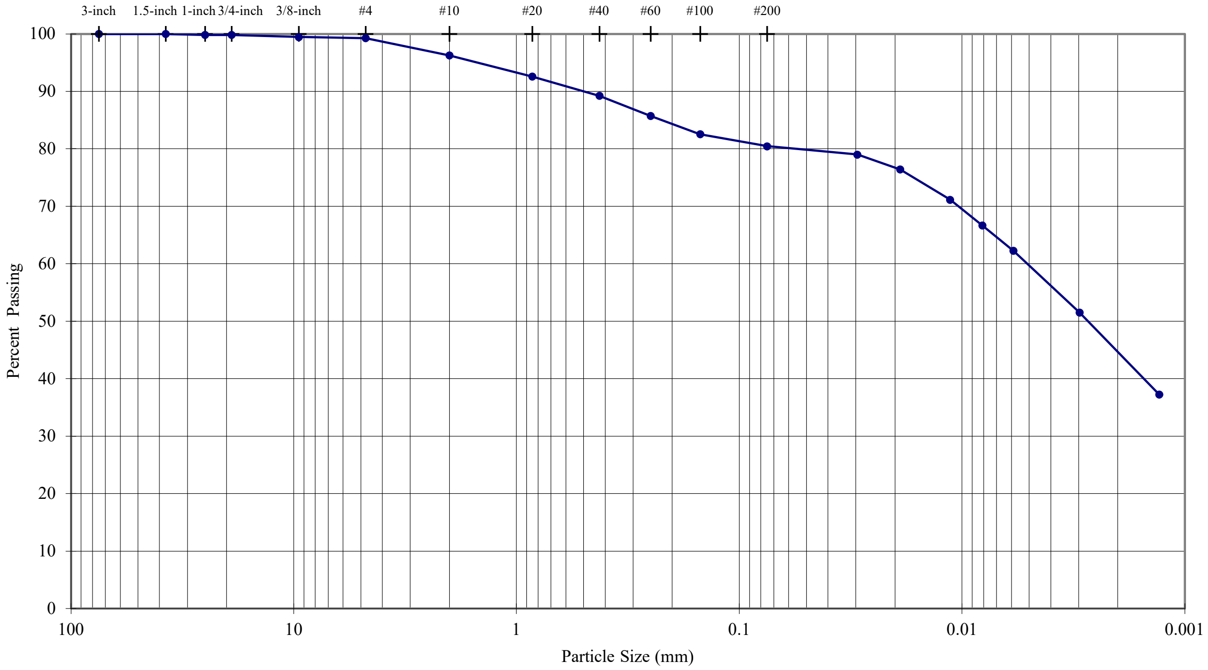
July-20 **19124320.0009**

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

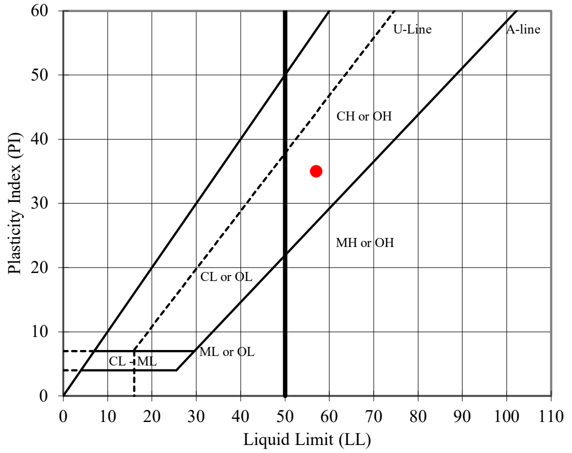
ASTM D421, D422, D4318

PROJECT NAME:	**CJ/TS Clean Up Eval and Recomm/CO**
SAMPLE ID:	**CB**
TYPE:	**Pail**

DEPTH (ft): --



	Sieve	Particle Size (mm)	% Passing	Description	Percentage
Sieve Analysis (Initial Separation on No. 4 Sieve)	3-inch	75.0	**100.0**		
	1.5-inch	37.5	**100.0**	Coarse Gravel	**0.19**
	1-inch	25.0	**99.8**		
	3/4-inch	19.0	**99.8**		
	3/8-inch	9.5	**99.5**	Fine Gravel	**0.55**
	#4	4.75	**99.3**		
	#10	2.0	**96.3**	Coarse Sand	**3.01**
	#20	0.850	**92.6**	Medium Sand	**7.02**
	#40	0.425	**89.2**		
	#60	0.250	**85.7**	Fine Sand	**8.78**
	#100	0.150	**82.6**		
	#200	0.075	**80.5**		
Hydrometer Analysis		0.030	**79.0**	Silt or Clay Fines	**80.46**
		0.019	**76.4**		
		0.011	**71.1**		
		0.008	**66.7**		
		0.006	**62.2**		
		0.003	**51.5**		
		0.001	**37.2**		



USCS Description (ASTM D 2487):

Fat clay with sand, dark brown, moist

LL	PL	PI
57	**22**	**35**

As-Received Moisture Content (%): --

USCS Group Symbol: CH

Notes: 0 g of particles up to 37.5 mm maximum size were removed from particle size analysis sample prior to testing
Particle size analysis sample mechanically dispersed using Stirring Apparatus A for about 1 minute
Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device

TECH	JP/MGC
DATE	7-Jul-2020
REVIEW	MB

ASTM D 698 & 1557

PROJECT NAME	CJ/TS Clean Up Eval and Recomm/CO	**TEST TYPE**	**ASTM D698 - Method A**
PROJECT NUMBER	19124320.0009		
SAMPLE IDENTITY	CB --		
SAMPLE TYPE	Pail		

		TYPE COMPACTOR	**PREPARATION**	**Oversize Correction (Y/N)**
Mold Number	AH-7	Manual	Dry	N
Mold Mass (gm)	2347.50	Mechanical or Manual	Moist or Dry	Y or N
Avg Diameter (in.)		**TYPE PROCTOR**	**Method**	**As Received Water Content**
Avg Height (in.)		Standard	A	NA
Mold Volume (cc)		Standard or Modified	A, B, or C	nearest 1%
Direct Entry Volume (cc)	930.45	**5.5 -lbf. Rammer with 12 inch drop**		

Direct Entry Volume takes precedence in calcs. Leave blank if using linear method.

WATER CONTENT		**OVERSIZE FRACTION**	**TEST FRACTION**
Mass Tare & Soil (Wet)	**(W1)**		140.41
Mass Tare & Soil (Dry)	**(W2)**		121.10
Mass Tare	**(W3)**		21.99
Mass Moisture	**(W4=W1-W2)**	0.00	19.31
Mass Dry Soil	**(W5=W2-W3)**	0.00	99.11
Water Content (dec)	**(wc=W4/W5)**	0.0000	0.1948
Water Content (%)	**(W4/W5)*100**	0.0%	19%

Moist Mass of Test Fraction (no oversize), g	17062.0
Dry Mass of Test Fraction	14280
Cumulative Mass retained on #4 sieve (dry)	127
Cumulative Mass retained on 3/8" sieve (dry)	--
Cumulative Mass retained on 3/4" sieve (dry)	--
Percent Oversize #4 sieve	0.9%
Percent Oversize 3/8" sieve	--
Percent Oversize 3/4" sieve	--
Percent Test Fraction	99%

POINT RESULTS		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Mass. Soil & Mold	**(W1)**	3912.4	3961.1	4006.4	4046.9	4091.4	4094.9	4075.9
Mass of Mold	**(W2)**	2347.50	2347.50	2347.50	2347.50	2347.50	2347.50	2347.50
Mass of Wet Soil	**(W3=W1-W2)**	1564.90	1613.60	1658.90	1699.40	1743.90	1747.40	1728.40
Wet Density, g/cc		1.682	1.734	1.783	1.826	1.874	1.878	1.858
Wet Unit Weight, pcf		105.0	108.3	111.3	114.0	117.0	117.2	116.0
WATER CONTENTS								
Mass Tare & Soil (Wet)	**(W4)**	236.28	282.58	292.26	340.82	268.82	320.82	286.08
Mass Tare & Soil (Dry)	**(W5)**	217.43	249.65	255.58	295.40	240.47	279.31	247.68
Mass Tare	**(W6)**	131.22	112.97	112.95	129.49	144.14	144.14	131.23
Mass Moisture	**(W7=W4-W5)**	18.85	32.93	36.68	45.42	28.35	41.51	38.4
Mass Dry Soil	**(W8=W5-W6)**	86.21	136.68	142.63	165.91	96.33	135.17	116.45
Water Content (%)	**(W7/W8)*100**	21.9%	24.1%	25.7%	27.4%	29.4%	30.7%	33.0%
Dry Density, g/cc		1.380	1.398	1.418	1.434	1.448	1.437	1.397
Dry Unit Weight, pcf		86.2	87.2	88.5	89.5	90.4	89.7	87.2

Maximum Dry Unit Weight (pcf)	90.4
Optimum Water Content (%)	29.6%
Corrected Maximum Dry Unit Weight (pcf)	--
Corrected Optimum Water Content (%)	--

USCS Description (ASTM D 2487):	Fat clay with sand, dark brown, moist
USCS	CH
Specific Gravity	2.70
Specific Gravity Type	

=ASTM Std if measured (e.g. D854), 0 if assumed

Oversize Correction - For Total Sample - ASTM D4718 - 4.1

Percent Finer Fraction (%)	99.1	
Percent Oversize Fraction (%)	0.9	
Corrected Water Content	--	(Corrected Optimum Moisture Content)
Corrected Dry Unit Weight	--	(Corrected Maximum Dry Unit Weight for Oven Dry Oversize)

Bulk Specific Gravity of Oversize Fraction by ASTM C127

Mass Tare (g)				
Mass of Saturated Surface-Dry Sample + Tare (g)				
Apparent Mass of SSD Sample in 23° C H2O (g)		(Note No Tare)		
Oven Dry Mass of Sample + Tare (g)				
Mass of Saturated Surface-Dry Sample (g)	0.00			
Oven Dry Mass of Sample (g)	0.00		**Absorption (%)**	#DIV/0!
Oven Dry Specific Gravity	#DIV/0!		**Oven Dry Density (pcf)**	#DIV/0!
SSD Specific Gravity	#DIV/0!		**SSD Density (pcf)**	#DIV/0!
Apparent Specific Gravity	#DIV/0!		**Apparent Density (pcf)**	#DIV/0!

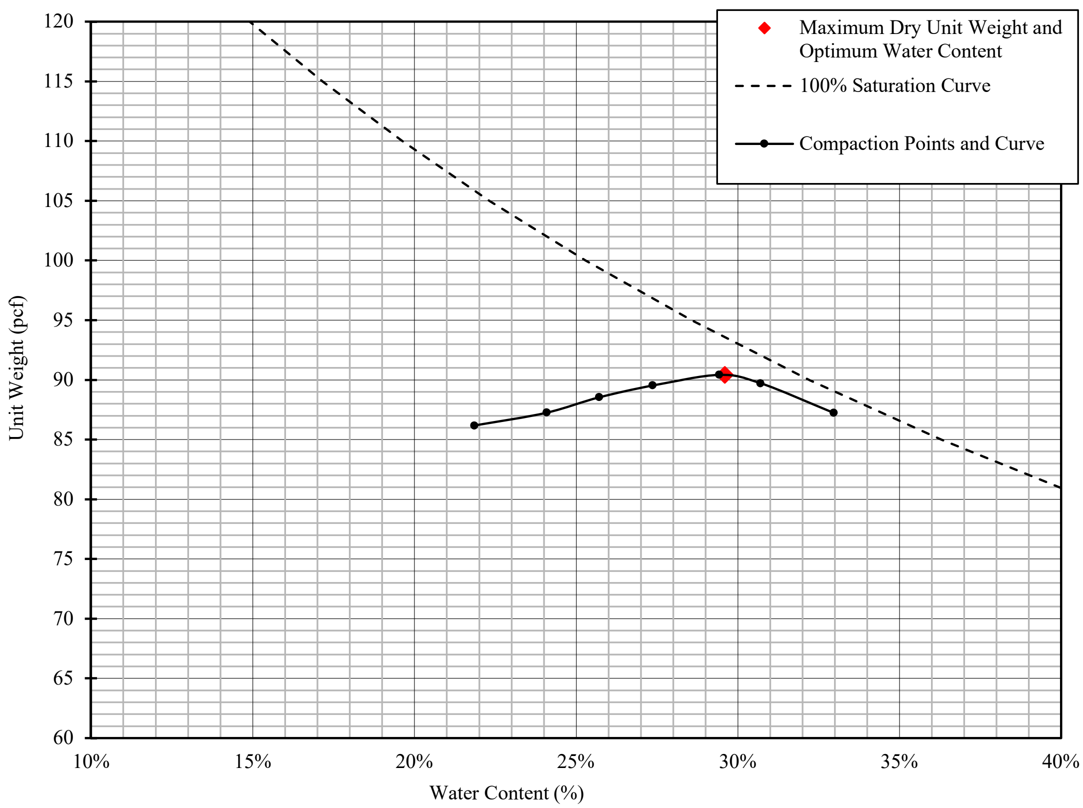
TECH	JP
DATE	6-Jul-2020
REVIEW	MB

July-20 **19124320.0009**

LABORATORY COMPACTION CHARACTERISTICS OF SOIL
ASTM D698 - Method A

Manual Rammer	**Dry Preparation**

PROJECT NAME: **CJ/TS Clean Up Eval and Recomm/CO**
SAMPLE ID: **CB** DEPTH (ft): --
TYPE: **Pail**



% Test Fraction Passing #4 Sieve	**99%**
As-Received Moisture Content	**NA**
Specific Gravity (estimated)	**2.70**

Maximum Dry Unit Weight (pcf)	**90.4**
Optimum Water Content (%)	**29.6**

USCS Description (ASTM D 2487): Fat clay with sand, dark brown, moist

USCS CH

TECH	JP
DATE	6-Jul-2020
REVIEW	MB

FLOW PUMP #1

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MEDIA USING A FLEXIBLE WALL PERMEAMETER
ASTM D5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT NAME	CJ/TS Clean Up Eval and Recomm/CO
PROJECT NUMBER	19124320.0009
SAMPLE ID	CB
SAMPLE TYPE	Remold

BOARD #	5
CELL #	AA
Flow Pump Speed	10
Technician	BC

COMMENTS
1. Specific gravity is assumed.
2. Specimen was remolded to 97.2% of the Maximum Dry Density and +1.3% of optimum moisture content (per ASTM D698)

Sample Data

	Initial	Final
Specific Gravity	2.70	
Height, cm	9.370	9.530
Diameter, cm	7.325	7.390
Area, m²	0.004214	0.004289
Volume, m^3	0.0003948	0.0004087
Mass, g	727.10	750.71
Moisture Content	30.9%	35.3%
Dry Unit Weight, kN/m^3	13.80	13.32
Dry Unit Weight, lbf/ft^3	87.9	84.8
Saturation, %	90.8%	96.4%

Permeant	Water
Back Pressure, kPa	410
Effective Consolidation Stress, kPa	34
Length During Permeation, cm	9.530
Area During Permeation, m²	0.004289

USCS Description (ASTM D 2487):
Fat clay with sand, dark brown, moist

DATE/TIME		TEMP (^oC)	Δh (cm)	Flow (m^3)	Gradient	Uncorrected Hydraulic Conductivity (cm/s)
27-Jul-20	10:15	20.7	146	--	--	--
27-Jul-20	10:30	20.7	144	2.5E-08	15.22	4.29E-08
27-Jul-20	10:45	20.7	144	2.5E-08	15.11	4.32E-08
27-Jul-20	11:00	20.7	144	2.5E-08	15.11	4.32E-08
27-Jul-20	11:15	20.7	143	2.5E-08	15.06	4.34E-08

Average Corrected Hydraulic Conductivity (cm/s) 4.2E-08

DATE	28-Jul-2020
REVIEW	MB

GOLDER

FLOW PUMP #1

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MEDIA USING A FLEXIBLE WALL PERMEAMETER

ASTM D5084

METHOD D, CONSTANT RATE OF FLOW

PROJECT NAME	CJ/TS Clean Up Eval and Recomm/CO
PROJECT NUMBER	19124320.0009
SAMPLE ID	F-3
SAMPLE TYPE	Remold

BOARD #	7
CELL #	#5
Flow Pump Speed	1
Technician	BC

COMMENTS
1. Specific gravity is assumed.
2. Specimen was remolded to 87.0% of the Maximum Dry Density and -1.9% of optimum moisture content (per ASTM D698)

Sample Data

	Initial	Final
Specific Gravity	2.70	
Height, cm	9.349	9.034
Diameter, cm	7.317	7.437
Area, m²	0.004205	0.004344
Volume, m^3	0.0003932	0.0003925
Mass, g	713.56	773.59
Moisture Content	10.1%	19.6%
Dry Unit Weight, kN/m^3	16.18	16.17
Dry Unit Weight, lbf/ft^3	103.0	103.0
Saturation, %	42.6%	82.8%

Permeant	Water
Back Pressure, kPa	690
Effective Consolidation Stress, kPa	34
Length During Permeation, cm	9.034
Area During Permeation, m²	0.004344

Visual Description (Golder Procedure):
SILTY SAND, brown, moist

DATE/TIME		TEMP (^oC)	Δh (cm)	Flow (m^3)	Gradient	Uncorrected Hydraulic Conductivity (cm/s)
13-Jul-20	7:30:00	20.7	14	--	--	--
13-Jul-20	7:30:30	20.7	14	8.4E-07	1.55	4.16E-04
13-Jul-20	7:31:00	20.7	12	8.4E-07	1.44	4.48E-04
13-Jul-20	7:31:30	20.7	14	8.4E-07	1.44	4.48E-04
13-Jul-20	7:32:00	20.7	13	8.4E-07	1.49	4.31E-04

Average Corrected Hydraulic Conductivity (cm/s) 4.3E-04

DATE	14-Jul-2020
REVIEW	MB

ATTERBERG LIMITS

AS RECEIVED WATER CONTENT

Mass Wet Soil & Tare (gm)	0
Mass Dry Soil & Tare (gm)	0
Mass of Tare (gm)	0
Mass of Water (gm)	0
Mass of Dry Soil (gm)	0
Moisture Content (%)	#DIV/0!

MONTH AND YEAR: July-20
PROJECT NAME: CJ/TS Clean Up Eval and Recomm/CO
PROJECT NUMBER: 19124320.0009
SAMPLE ID: F-3 Depth (ft) --
TYPE: Pail

Visual Description (Golder Procedure): SILTY SAND, brown, moist

USCS	--
LL	--
PL	--
PI	--

Multi POINT ATTERBERG

	PLASTIC LIMIT DETERMINATION			LIQUID LIMIT DETERMINATION			
Number of Drops							
Mass of Wet Soil & Tare (gm)							
Mass of Dry Soil & Tare (gm)							
Mass of Tare (gm)							
Mass of Water (gm)	0.00	0.00		0.00	0.00	0.00	0.00
Mass of Dry Soil (gm)	0.00	0.00		0.00	0.00	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

PLASTIC LIMIT (PL) #DIV/0!

LIQUID LIMIT (LL) #######

PLASTICITY INDEX (PI) #######

Drops	Water Content %	Log(Drops)
0	#DIV/0!	#NUM!
0	#DIV/0!	#NUM!
0	#DIV/0!	#NUM!
0	#N/A	#N/A

LL Interpolation
#######

CHECKED BY

ONE POINT ATTERBERG

	PLASTIC LIMITS			LIQUID LIMITS	
Number of Drops					
Mass of Wet Soil & Tare (gm)					
Mass of Dry Soil & Tare (gm)					
Mass of Tare (gm)					
Mass of Water (gm)	0.00	0.00		0.00	0.00
Mass of Dry Soil (gm)	0.00	0.00		0.00	0.00
Water Content %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
Drops:		
LL Value		

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

CHECKED BY

NON-PLASTIC

	PLASTIC LIMITS		LIQUID LIMITS	
Number of Drops				
Mass of Wet Soil & Tare (gm)				
Mass of Dry Soil & Tare (gm)				
Mass of Tare (gm)				
Mass of Water (gm)	0.00	0.00	0.00	0.00
Mass of Dry Soil (gm)	0.00	0.00	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

PLASTIC LIMIT (PL) **NP**

LIQUID LIMIT (LL) **NP**

PLASTICITY INDEX (PI) **NP**

LIQUIDITY INDEX (LI) **NP**

CHECKED BY

Golder Associates Inc.

SPLIT SIEVE DATA ENTRY SHEET

MONTH AND YEAR: July-20
PROJECT NAME: CJ/TS Clean Up Eval and Recomm/CO
PROJECT NUMBER: 19124320.0009
SAMPLE ID: F-3 Depth (ft) --
TYPE Pail

AS RECEIVED WATER CONTENT

Mass Wet Soil & Tare (gm)	
Mass Dry Soil & Tare (gm)	
Mass of Tare (gm)	
Mass of Water (gm)	0.00
Mass of Dry Soil (gm)	0.00
Moisture Content (%)	--

Visual Description (Golder Procedure): SILTY SAND, brown, moist

USCS --

LL	--
PL	--
PI	--

HYGROSCOPIC MOISTURE FOR MINUS #4 SIEVE SAMPLE

Mass Soil & Tare (gm)	118.80
Mass Dry Soil & Tare (gm)	112.39
Tare Mass (gm)	21.66
Moisture Content (%)	7.1

Total Mass of Sample Used For Analysis, with Finer Split Fraction Corrected for Hygroscopic Moisture

Mass of Sample (gm) 17870.6

PLUS #4 MATERIAL SIEVE Test Method for 100% finer than 3" only!

Tare Mass		Individual (Mass + Tare)	Cumulative Mass Retained	% Passing
	3-inch		0.0	100
	1.5-inch		0.0	100
	1-inch	109.0	109.0	99
	3/4-inch	88.6	197.6	99
	3/8-inch	249.6	447.2	97
	#4	234.2	681.4	96
	Total Passing #4	18403.6	<--(Uncorrected for Hygroscopic Moisture)	

coarse gravel	1.11	
fine gravel	2.71	3.81
coarse sand	1.55	
medium sand	14.17	
fine sand	58.71	74.43
fines	21.76	
Total	100.00	

BACK SIEVE Tare Mass		Cumulative Mass Retained	Cumulative Mass Retained	% Passing
	#10	0.85	0.9	94.6
	#20	2.19	2.2	92.2
	#40	8.63	8.6	80.5
	#60	19.78	19.8	60.2
	#100	30.76	30.8	40.2
	#200	40.87	40.9	21.8

HYDROMETER ANALYSIS

AIR-DRY MASS OF SAMPLE USED FOR HYDROMETER TEST

Mass of Sample (gm)	56.55
Specific Gravity (ass'd)	2.70
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute
Zero Corr (Cc)	6.00
Meniscus Corr.	0.75

DATE	TIME	READING R	TEMP T	Temp Corr
25-Jun-2020	8:44			
25-Jun-2020	8:46	13.50	21.5	-0.32
25-Jun-2020	8:49	13.00	21.0	-0.21
25-Jun-2020	8:59	12.25	20.0	0.00
25-Jun-2020	9:14	11.75	19.8	0.04
25-Jun-2020	9:44	11.00	19.3	0.14
25-Jun-2020	12:54	10.00	19.2	0.16
26-Jun-2020	8:44	9.00	19.2	0.16

(mm)	%Finer
0.035	15.43
0.022	14.34
0.013	12.61
0.009	11.63
0.007	10.10
0.003	8.26
0.001	6.46

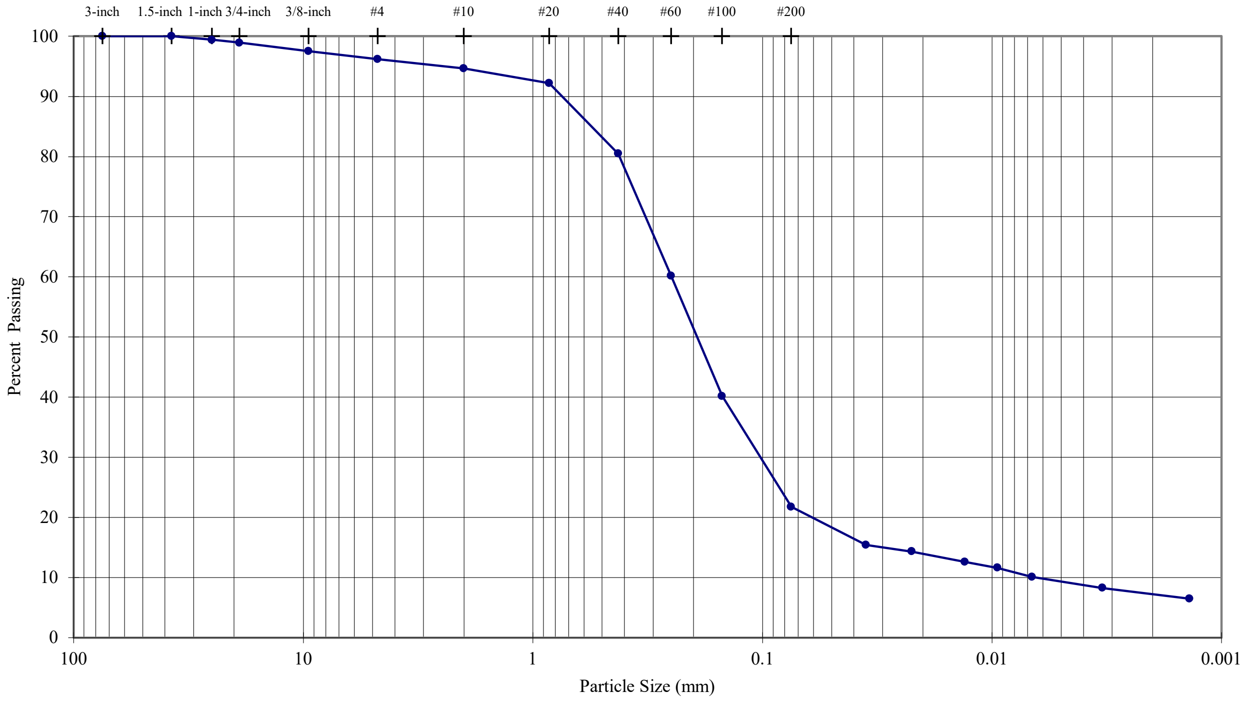
TEST BY	MGC/PRH
DATE SET UP	24-Jun-2020
CHECKED BY	MB
REVIEW BY	MB

July-20 **19124320.0009**

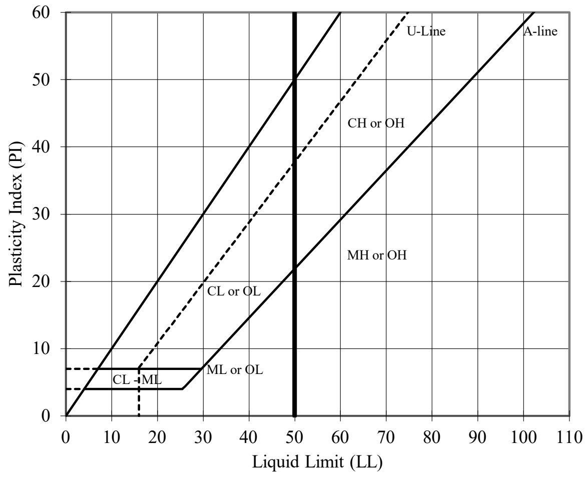
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **CJ/TS Clean Up Eval and Recomm/CO**
SAMPLE ID: **F-3** DEPTH (ft): **--**
TYPE: **Pail**



	Sieve	Particle Size (mm)	% Passing	Description	Percentage
Sieve Analysis (Initial Separation on No. 4 Sieve)	3-inch	75.0	**100.0**		
	1.5-inch	37.5	**100.0**	Coarse Gravel	**1.11**
	1-inch	25.0	**99.4**		
	3/4-inch	19.0	**98.9**		
	3/8-inch	9.5	**97.5**	Fine Gravel	**2.71**
	#4	4.75	**96.2**		
	#10	2.0	**94.6**	Coarse Sand	**1.55**
	#20	0.850	**92.2**	Medium Sand	**14.17**
	#40	0.425	**80.5**		
	#60	0.250	**60.2**	Fine Sand	**58.71**
	#100	0.150	**40.2**		
	#200	0.075	**21.8**		
Hydrometer Analysis		0.035	**15.4**	Silt or Clay Fines	**21.76**
		0.022	**14.3**		
		0.013	**12.6**		
		0.009	**11.6**		
		0.007	**10.1**		
		0.003	**8.3**		
		0.001	**6.5**		



Visual Description (Golder Procedure):

SILTY SAND, brown, moist

LL	PL	PI	SpG
--	--	--	**0.00**

As-Received Moisture Content (%)	USCS Group Symbol
--	--

Notes: 0 g of particles up to37.5 mm maximum size were removed from particle size analysis sample prior to testing
Particle size analysis sample mechanically dispersed using Stirring Apparatus A for about 1 minute

TECH	MGC/PRH
DATE	24-Jun-2020
REVIEW	MB

ASTM D 698 & 1557

PROJECT NAME	CJ/TS Clean Up Eval and Recomm/CO		**TEST TYPE**	**ASTM D698 - Method A**
PROJECT NUMBER	19124320.0009			
SAMPLE IDENTITY	F-3	--		
SAMPLE TYPE	Pail			

		TYPE COMPACTOR	**PREPARATION**	**Oversize Correction (Y/N)**
Mold Number	AH7	Manual	Dry	N
Mold Mass (gm)	2346.7	Mechanical or Manual	Moist or Dry	Y or N
Avg Diameter (in.)		**TYPE PROCTOR**	**Method**	**As Received Water Content**
Avg Height (in.)		Standard	A	NA
Mold Volume (cc)		Standard or Modified	A, B, or C	nearest 1%
Direct Entry Volume (cc)	931.62	**5.5 -lbf. Rammer with 12 inch drop**		

Direct Entry Volume takes precedence in calcs. Leave blank if using linear method.

WATER CONTENT		**OVERSIZE FRACTION**	**TEST FRACTION**
Mass Tare & Soil (Wet)	**(W1)**		278.81
Mass Tare & Soil (Dry)	**(W2)**		273.37
Mass Tare	**(W3)**		126.22
Mass Moisture	**(W4=W1-W2)**	0.00	5.44
Mass Dry Soil	**(W5=W2-W3)**	0.00	147.15
Water Content (dec)	**(wc=W4/W5)**	0.0000	0.0370
Water Content (%)	**(W4/W5)*100**	0.0%	4%

Moist Mass of Test Fraction (no oversize), g	18403.6
Dry Mass of Test Fraction	17747
Cumulative Mass retained on #4 sieve (dry)	681
Cumulative Mass retained on 3/8" sieve (dry)	NA
Cumulative Mass retained on 3/4" sieve (dry)	NA
Percent Oversize #4 sieve	3.7%
Percent Oversize 3/8" sieve	NA
Percent Oversize 3/4" sieve	NA
Percent Test Fraction	96%

POINT RESULTS		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Mass. Soil & Mold	**(W1)**	4219.6	4288.9	4328.9	4313.7	4262.4		
Mass of Mold	**(W2)**	2346.70	2346.70	2346.70	2346.70	2346.70		
Mass of Wet Soil	**(W3=W1-W2)**	1872.90	1942.20	1982.20	1967.00	1915.70		
Wet Density, g/cc		2.010	2.085	2.128	2.111	2.056		
Wet Unit Weight, pcf		125.5	130.1	132.8	131.8	128.4		
WATER CONTENTS								
Mass Tare & Soil (Wet)	**(W4)**	613.91	689.16	653.98	672.30	600.97		
Mass Tare & Soil (Dry)	**(W5)**	574.55	635.58	595.97	606.42	540.67		
Mass Tare	**(W6)**	128.08	130.39	124.72	126.91	143.98		
Mass Moisture	**(W7=W4-W5)**	39.36	53.58	58.01	65.877	60.3		
Mass Dry Soil	**(W8=W5-W6)**	446.47	505.19	471.25	479.513	396.69		
Water Content (%)	**(W7/W8)*100**	8.8%	10.6%	12.3%	13.7%	15.2%		
Dry Density, g/cc		1.847	1.885	1.894	1.856	1.785		
Dry Unit Weight, pcf		115.3	117.7	118.3	115.9	111.4		

Maximum Dry Unit Weight (pcf)	118.4
Optimum Water Content (%)	12.0%
Corrected Maximum Dry Unit Weight (pcf)	--
Corrected Optimum Water Content (%)	--

Visual Description (Golder Procedure):	SILTY SAND, brown, moist
USCS	--
Specific Gravity	2.70
Specific Gravity Type	

=ASTM Std if measured (e.g. D854), 0 if assumed

Oversize Correction - For Total Sample - ASTM D4718 - 4.1

Percent Finer Fraction (%)	96.3	
Percent Oversize Fraction (%)	3.7	
Corrected Water Content	--	(Corrected Optimum Moisture Content)
Corrected Dry Unit Weight	--	(Corrected Maximum Dry Unit Weight for SSD Oversize)

Bulk Specific Gravity of Oversize Fraction by ASTM C127

Mass Tare (g)		
Mass of Saturated Surface-Dry Sample + Tare (g)		
Apparent Mass of SSD Sample in 23° C H2O (g)		(Note No Tare)
Oven Dry Mass of Sample + Tare (g)		
Mass of Saturated Surface-Dry Sample (g)	0.00	
Oven Dry Mass of Sample (g)	0.00	
Oven Dry Specific Gravity	#DIV/0!	
SSD Specific Gravity	#DIV/0!	
Apparent Specific Gravity	#DIV/0!	

Absorption (%)	#DIV/0!
Oven Dry Density (pcf)	#DIV/0!
SSD Density (pcf)	#DIV/0!
Apparent Density (pcf)	#DIV/0!

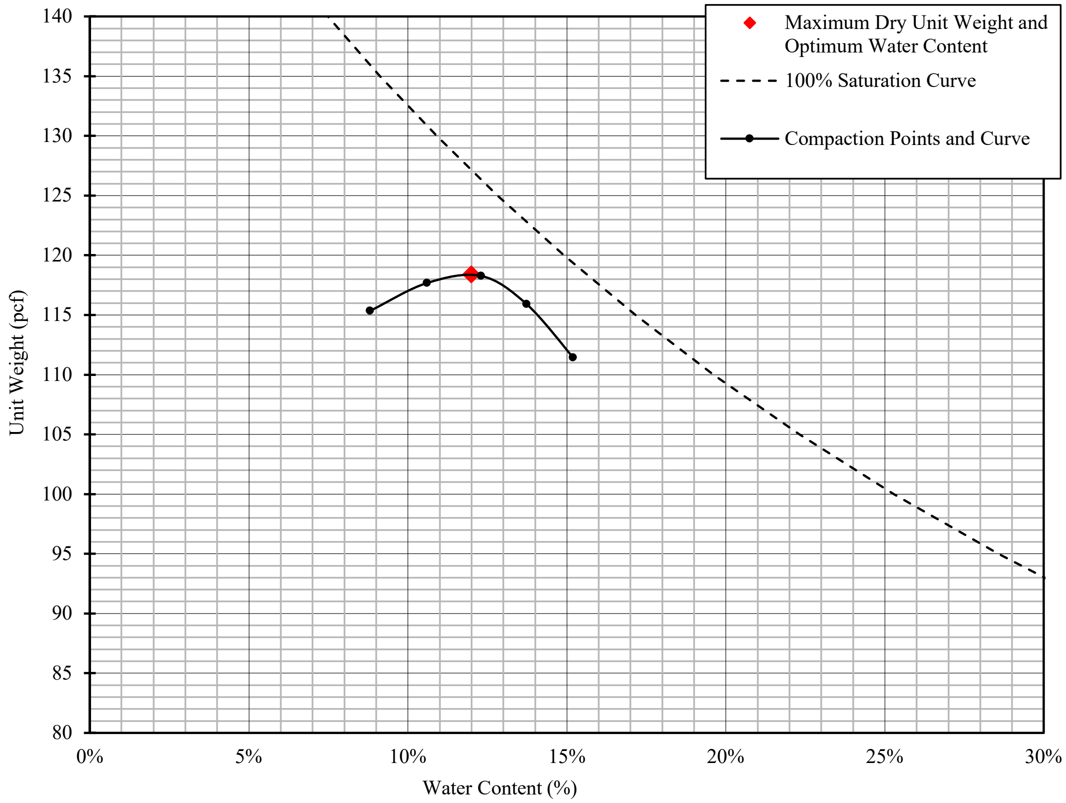
TECH	JP
DATE	2-Jul-2020
REVIEW	MB

July-20 **19124320.0009**

LABORATORY COMPACTION CHARACTERISTICS OF SOIL
ASTM D698 - Method A

Manual Rammer	Dry Preparation

PROJECT NAME: **CJ/TS Clean Up Eval and Recomm/CO**
SAMPLE ID: **F-3** DEPTH (ft): --
TYPE: **Pail**



% Test Fraction Passing #4 Sieve	**96%**
As-Received Moisture Content	**NA**
Specific Gravity (estimated)	**2.70**

Maximum Dry Unit Weight (pcf)	**118.4**
Optimum Water Content (%)	**12.0**

Visual Description (Golder Procedure): SILTY SAND, brown, moist

USCS --

TECH	JP
DATE	2-Jul-2020
REVIEW	MB

Summary of Flexible Wall Hydraulic Conductivity Test Results

Sample Identification	Sample Depth (ft.)	Sample Length[1] (cm)	Sample Diameter[1] (cm)	Sample Initial Dry Density (lbf/ft^3)	Maximum Dry Density (lbf/ft^3)	Achieved Compaction (%)	Initial Moisture (%)	Requested Moisture (%)	Effective Stress (kPa)	Back Pressure (kPa)	Gradient	Average Hydraulic Conductivity (cm/s)
TP-OS-01, BS1	0 - 5	9.690	7.527	86.0	91.1	94.4	28.8	27.6	34	410	13	2.4E-06
TP-OS-02, BS1	0 - 5	9.908	7.641	86.1	91.1	94.5	26.7	27.6	34	410	8	7.4E-07
TP-OS-02, BS1-Retest	0 - 5	9.800	7.523	85.8	91.1	94.2	29.4	27.6	34	410	13	4.9E-07
TP-OS-02, BS1 (-#10 material)	0 - 5	9.727	7.527	85.9	91.1	94.3	29.4	27.6	34	480	9	1.3E-06
F3	--	9.034	7.437	103.0	118.4	87.0	10.1	10.0	34	690	2	4.3E-04
						#DIV/0!						

Notes:

1. Dimensions are from final measurements.

P or Red = pending test results

ATTACHMENT 4-2

Borehole Logs

RECORD OF BOREHOLE MW-1

SHEET 1 of 2

PROJECT: CJ/TS Clean-Up Eval
PROJECT NUMBER: 19124320 - 0007
LOCATION: Jackson County, CO
CLIENT: Board of Commissioners, Jackson County

DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE: 11-4-2019, 11-5-2019
DRILL RIG: CME 55

DATUM:
AZIMUTH: n/a
COORDS: N: 1,522,617 E: 2,786,215

GS ELEVATION (ft): 8123
INCLINATION: -90

VEGETATION:

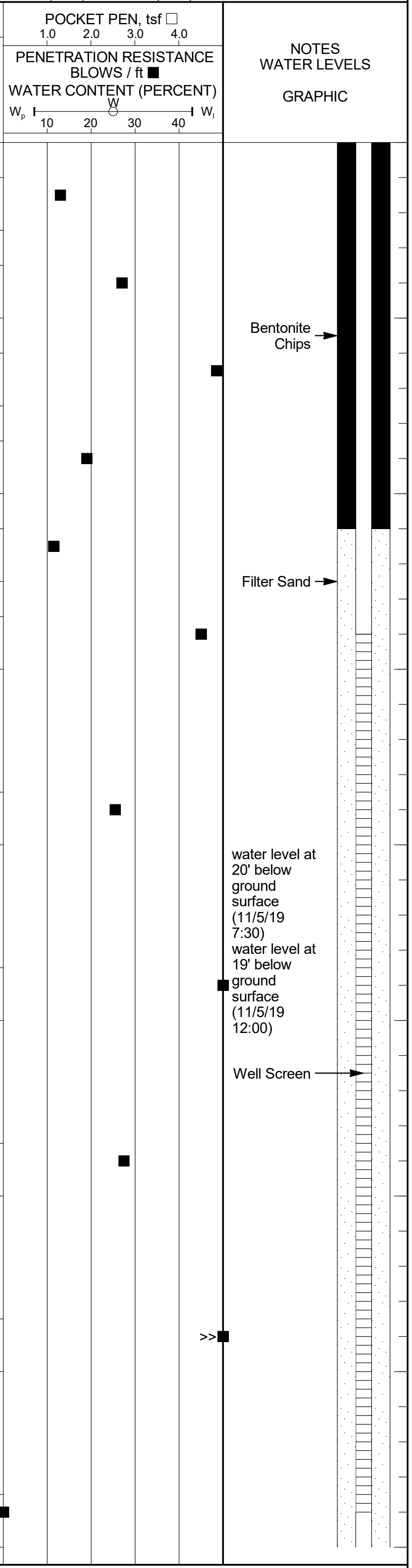
SOIL PROFILE

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
0.0 - 27.0 (SP) SAND, fine to medium, poorly graded, some non plastic fines; yellowish-brown to orange-brown; moist, compact to very dense..	SP	8096.0 27.0
27.0 - 45.0 SHALE and SILTSTONE, highly weathered..		

Log continued on next page

SAMPLES

NUMBER	TYPE	BLOWS per 6 in (lb hammer 30 inch drop)	N	REC / ATT
1	SS	11-15-11	26	18.0 / 18.0
2	SS	8-20-34	>50	18.0 / 18.0
3	SS	14-55-42	>50	18.0 / 18.0
4	SS	6-22-16	38	18.0 / 18.0
5	SS	3-9-14	23	18.0 / 18.0
6	SS	16-40-50	>50	18.0 / 18.0
7	SS	8-21-30	>50	18.0 / 18.0
8	SS	60-100-0	>50	7.0 / 18.0
9	SS	13-22-33	>50	18.0 / 18.0
10	SS	21-38-80	>50	18.0 / 18.0
11	SS	100-0-0	0	5.0 / 18.0



water level at 20' below ground surface (11/5/19 7:30)
water level at 19' below ground surface (11/5/19 12:00)

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: Site Services
DRILLER: N/A

LOGGED: A. Ghorbanpour
CHECKED: ABG
DATE: 12/12/2019

Figure 1

PROJECT: CJ/TS Clean-Up Eval
PROJECT NUMBER: 19124320 - 0007
LOCATION: Jackson County, CO
CLIENT: Board of Commissioners, Jackson County

RECORD OF BOREHOLE MW-1

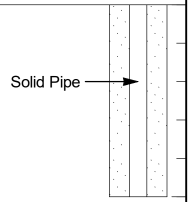
SHEET 2 of 2

DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE: 11-4-2019, 11-5-2019
DRILL RIG: CME 55

DATUM:
AZIMUTH: n/a
COORDS: N: 1,522,617 E: 2,786,215

GS ELEVATION (ft): 8123
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION VEGETATION:	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in lb hammer 30 inch drop	N	REC / ATT	POCKET PEN, tsf ☐ 1.0 2.0 3.0 4.0 PENETRATION RESISTANCE BLOWS / ft ■ WATER CONTENT (PERCENT) W_p W W_l 10 20 30 40	NOTES WATER LEVELS GRAPHIC
40		27.0 - 45.0 SHALE and SILTSTONE, highly weathered.. *(Continued)*										Solid Pipe
						12	SS	37-100-0	>50	18.0 18.0	■	
45					8078.0							
		Boring completed at 45.0 ft.										
50												
55												
60												
65												
70												
75												
80												



GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: Site Services
DRILLER: N/A

LOGGED: A. Ghorbanpour
CHECKED: ABG
DATE: 12/12/2019

Figure 1

RECORD OF BOREHOLE MW-2

SHEET 1 of 1

PROJECT: CJ/TS Clean-Up Eval
PROJECT NUMBER: 19124320 - 0007
LOCATION: Jackson County, CO
CLIENT: Board of Commissioners, Jackson County

DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE:
DRILL RIG: CME 55

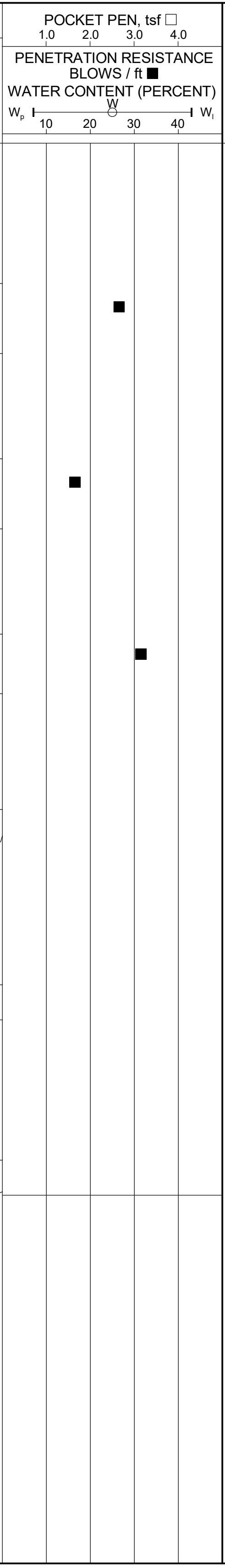
DATUM:
AZIMUTH: n/a
COORDS: n/a

GS ELEVATION (ft):
INCLINATION: -90

VEGETATION:

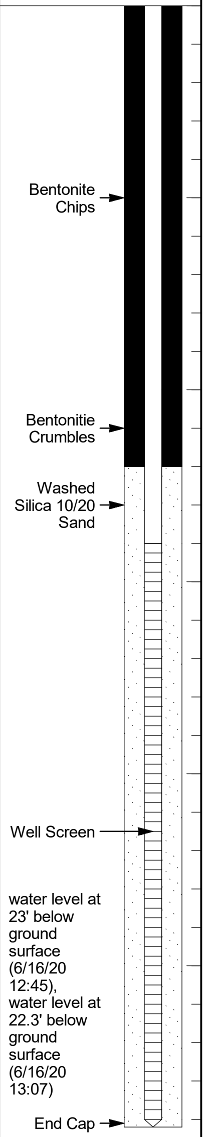
DESCRIPTION	USCS	ELEV. / DEPTH (ft)
0.0 - 5.5 (SP) SAND, fine to medium grained, poorly graded, some silt, trace medium grained white sand; light brown and orange brown; dry, compact to very dense.	SP	
5.5 - 10.5 (SP) gravelly SAND, fine to course sand, fine to medium gravel, white/gray/red quartz gravel; light gray to light brown, trace iron staining; dry, dense to very dense.	SP	5.5
10.5 - 12.5 (ML) CLAYEY SILT, some fine sand; orange and medium brown; w~PL, very stiff, highly weathered siltstone.	ML	10.5
12.5 - 17.5 (SP) SAND, fine to medium grained, some silt; orange-brown and medium to dark brown, some iron staining; moist, very dense, weathered sandstone.	SP	12.5
17.5 - 22.5 (SM) SILTY SAND, fine to medium grained; light to medium brown, some iron staining; moist, very dense, weathered siltstone/sandstone.	SM	17.5
22.5 - 29.9 (SM) SILTY SAND, fine to medium grained; light to medium brown, some iron staining; wet, very dense, weathered siltstone/sandstone.	SM	22.5
Boring completed at 30.0 ft.		29.9

DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (lb hammer 30 inch drop)	N	REC / ATT
5	1	SS	13-18-35-41	>50	19.0 / 24.0
10	2	SS	10-21-12-17	33	19.0 / 24.0
15	3	SS	10-27-36-50/2"	>50	20.0 / 20.0
19.5	4	SS	29-50	50	8.5 / 9.0
24.5	5	SS	27-50	50	11.5 / 12.0
29.5	6	SS	38-50	50	11.0 / 11.0



NOTES
WATER LEVELS

GRAPHIC



water level at 23' below ground surface (6/16/20 12:45), water level at 22.3' below ground surface (6/16/20 13:07)

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: Site Services
DRILLER:

LOGGED:
CHECKED:
DATE:

GOLDER

Figure 2

RECORD OF BOREHOLE MW-3

SHEET 1 of 2

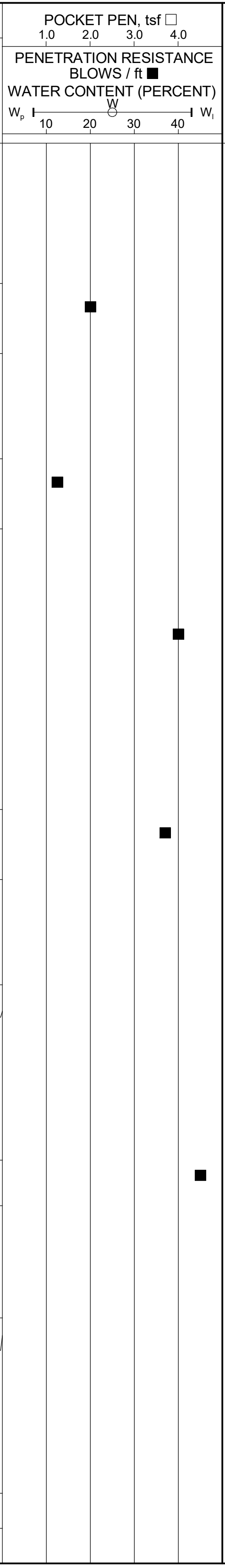
PROJECT: CJ/TS Clean-Up Eval
PROJECT NUMBER: 19124320 - 0007
LOCATION: Jackson County, CO
CLIENT: Board of Commissioners, Jackson County

DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE:
DRILL RIG: CME 55

DATUM:
AZIMUTH: n/a
COORDS: n/a

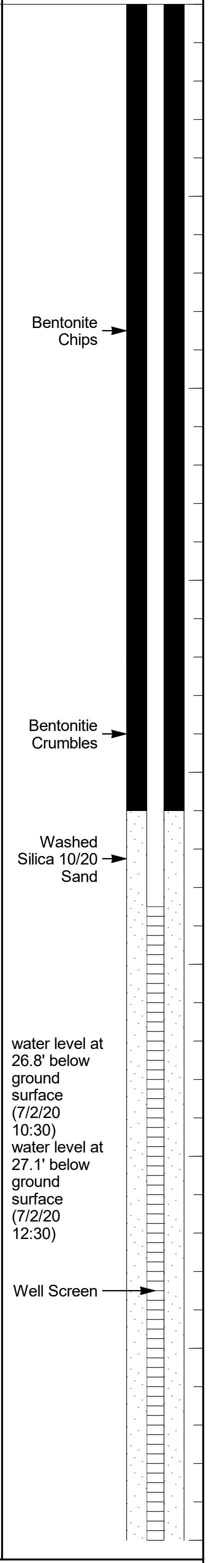
GS ELEVATION (ft):
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION VEGETATION:	USCS	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in lb hammer 30 inch drop	N	REC / ATT
0		0.0 - 5.5 (SP) SAND, fine to medium grained, poorly graded, some silt, trace to some fine rounded gravel; orange-brown and medium brown; dry to moist, compact to very dense.	SP						
5					1	SS	7-14-26-50	40	24.0 / 24.0
		5.5 - 7.5 (SP) gravelly SAND, fine to course sand, fine to medium angular gravel; light gray to light brown, white/gray/pink quartz gravel; dry to moist, dense to very dense.	SP	5.5					
		7.5 - 10.8 (SW) SAND, fine to medium grained, some angular quartz gravel, trace fines; light brown; moist to dry, compact.	SW	7.5					
10					2	SS	8-18-7-10	25	16.0 / 24.0
		10.8 - 22.5 (ML) CLAYEY SILT, some fine to medium sand; orange brown, medium brown, medium gray; w~PL, stiff to very stiff.	ML	10.8					
					3	SS	12-36-44-50	>50	
15									
20					4	SS	3-27-47-44	>50	24.0 / 24.0
		22.5 - 36.0 (SM) SILTY SAND, fine to medium grained; light to medium brown, some iron staining; wet, very dense, extremely weathered siltstone/sandstone.	SM	22.5					
					5	SS	45-50	50	9.0 / 9.0
25									
30					6	SS	18-40-50	>50	16.0 / 16.0
					7	SS	50	50	6.0 / 6.0
35									
		36.0 - 44.3 (CL) sandy SILTY CLAY, medium plasticity, fine sand; blue-gray, iron staining; w<PL, hard, weathered shale/siltstone.	CL	36.0					
					8	SS	31-50	50	12.0 / 12.0
40		Log continued on next page							



NOTES
WATER LEVELS

GRAPHIC



water level at 26.8' below ground surface (7/2/20 10:30)
water level at 27.1' below ground surface (7/2/20 12:30)

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: Site Services
DRILLER:

LOGGED:
CHECKED:
DATE:

Figure 3

GOLDER

PROJECT: CJ/TS Clean-Up Eval
PROJECT NUMBER: 19124320 - 0007
LOCATION: Jackson County, CO
CLIENT: Board of Commissioners, Jackson County

RECORD OF BOREHOLE MW-3

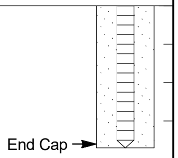
SHEET 2 of 2

DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE:
DRILL RIG: CME 55

DATUM:
AZIMUTH: n/a
COORDS: n/a

GS ELEVATION (ft):
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION VEGETATION:	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in lb hammer 30 inch drop	N	REC / ATT	POCKET PEN, tsf ☐ 1.0 2.0 3.0 4.0 PENETRATION RESISTANCE BLOWS / ft ■ WATER CONTENT (PERCENT) W_p W W_l 10 20 30 40	NOTES WATER LEVELS GRAPHIC
40		36.0 - 44.3 (CL) sandy SILTY CLAY, medium plasticity, fine sand; blue-gray, iron staining; w<PL, hard, weathered shale/siltstone. *(Continued)*	CL	▨								
						9	SS	38-50	50	10.0 10.0		End Cap
					44.3							
45		Boring completed at 45.0 ft.										
50												
55												
60												
65												
70												
75												
80												



GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: Site Services
DRILLER:

LOGGED:
CHECKED:
DATE:

Figure
3

APPENDIX I

Calculations

APPENDIX I-1

HELP Model

GOLDER

CALCULATIONS

DATE	July 24, 2020	**PREPARED BY**	JAF
DOCUMENT NO.	19124320-6-R-0	**CHECKED BY**	ALB
SITE NAME	Jackson County Landfill	**REVIEWED BY**	MEM

HELP MODEL ANALYSIS

1.0 OBJECTIVE

Perform hydrologic modeling of the proposed Jackson County Landfill (JCL) to model leachate generation and corresponding hydrologic performance of the composite liner system. Estimate maximum leachate head buildup on the composite liner system. Confirm that the proposed drainage layer will always result in less than 12 inches of head on the composite liner system.

2.0 METHOD

Use the Hydrologic Evaluation of Landfill Performance (HELP) Model, version 3.07 (USACE 1997), to model the hydrologic performance of the composite liner system and leachate collection system within the proposed landfill. Model various waste depth and cover configurations assumed to represent the most critical typical operational scenarios anticipated to occur throughout the life of the landfill from a leachate generation standpoint.

3.0 INPUT PARAMETERS

3.1 Operational Scenarios

The following waste depths and cover configurations were initially modeled to identify the most critical operational scenarios from a leachate-generation standpoint:

- Scenario 1: 6 feet of municipal solid waste (MSW) with daily cover (1 year of weather generation);
- Scenario 2: 25 feet of MSW with daily cover (1 year of weather generation);
- Scenario 3: 25 feet of MSW with intermediate cover (10 years of weather generation);
- Scenario 4: 45 feet of MSW with final cover (30 years of weather generation representative of post-closure period); and
- Scenario 5: 25 feet of construction and demolition (C&D) waste with intermediate cover (10 years of weather generation).

3.2 Meteorological Data

Meteorological data for the JCL was synthetically generated using the synthetic weather generator (WGEN) developed by the United States Department of Agriculture (USDA) Agricultural Research Service (ARS) and built into the HELP model. Statistical characteristics for synthetic weather data generation were adopted from Cheyenne, Wyoming, the nearest city to the site with published values in the program's default database.

Average monthly precipitation and temperature data for Walden, Colorado, per National Oceanic and Atmospheric Administration (NOAA) 1981–2010 Climate Normals (NCEI 2010), was user inputted for the synthetic generation of daily data. Daily solar radiation and evapotranspiration data were synthetically generated based on the latitude for Walden, Colorado (40.73° N).

3.3 Composite Liner System

3.3.1 General Design Inputs

The following is a list of the general input parameters used in the HELP analysis:

- The length and slope of the MSW cells floor was modeled at 181 feet and 2.0%, based on the maximum leachate flow path length within the leachate collection drainage layer to the leachate collection and removal system (LCRS);
- The length and slope of the C&D cell floor was modeled at 167 feet and 2.0%, based on the maximum leachate flow path length within the leachate collection drainage layer to the LCRS;
- The flexible membrane liner (FML) component of the MSW composite liner system consists of a 60-mil double-sided textured HDPE geomembrane;
- The compacted cohesive soil liner consists of 12 inches of on-site low-permeability soil for Scenarios 1 through 4, and 36 inches for Scenario 5;
- The leachate collection drainage layer consists of 12 inches of silty sand;
- Daily, intermediate, and final cover soils consist of on-site material (silty sandy loam) encountered within the proposed excavation depth for the development of the landfill;
- Zero percent of the waste area was modeled to have runoff under Scenarios 1 and 2, 50% of the waste area was allowed for Scenarios 3 and 5, and 100% was allowed for Scenario 4;
- Waste areas where runoff was allowed (under daily or intermediate cover conditions) were modeled using an SCS runoff curve number (CN) of 85;
- The waste surface was assumed to be bare ground (i.e., Leaf Area Index of 0);
- The final cover area was modeled using an SCS runoff CN of 69;
- The final cover surface was assumed to have a fair to good stand of grass and modeled with a Leaf Area Index of 2.5; and
- The evaporative zone depth was 12 inches unless limited to the thickness of the cover material modeled.

3.3.2 HELP Material Layers

Material properties were referenced from site-specific geotechnical data from investigations completed by Golder and correlated to default HELP model soil textures, with user defined properties input to reflect specific material requirements, where appropriate:

- The 60-mil HDPE geomembrane (All Scenarios) was modeled as HELP Default Liner Type 35 (HDPE), with a hydraulic conductivity of 2.0 x 10^{-13} cm/sec;
- The compacted cohesive soil liner of varying thickness (All Scenarios) was modeled as a barrier soil liner, HELP Default Soil Type 16, with a hydraulic conductivity of 1 x 10^{-7} centimeters per second (cm/sec);
- The 12-inch-thick protective leachate collection drainage layer (all scenarios) was modeled as a lateral drainage layer, HELP Default Soil Type 5 (SM in USCS, LFS in USDA), with a user defined hydraulic conductivity of 1 x 10^{-2} cm/sec;
- The MSW mass (Scenarios 1 through 4) was modeled as a vertical percolation layer, HELP default soil type 18 (municipal waste), with a hydraulic conductivity of 1 x 10^{-3} cm/sec;
- The C&D mass (Scenario 5) was modeled as a vertical percolation layer, HELP default soil type 19 (municipal waste channeling and dead zones), with a hydraulic conductivity of 1 x 10^{-3} cm/sec. Soil type 19 has 65% less water drainage and storage capacity than soil type 18, which simulates the effects of larger impermeable debris contained within typical C&D wastes;
- Daily covers (Scenarios 1 and 2) were modeled as a vertical percolation layer, HELP Default Soil Type 6 (SM in USCS, SL in USDA), with a hydraulic conductivity of 7.2 x 10^{-4} cm/sec;
- Intermediate covers (Scenarios 3 and 5) were modeled as a vertical percolation layer, HELP Default Soil Type 7 (SM in USCS, FSL in USDA), with a user defined hydraulic conductivity of 4.3 x 10^{-4} cm/sec established from site-specific laboratory data.; and
- The 42-inch-thick water balance final cover (Scenario 4) was modeled as a vertical percolation layer, HELP Default Soil Type 7 (SM in USCS, FSL in USDA), with a user defined hydraulic conductivity of 4.3 x 10^{-4} cm/sec established from site-specific laboratory data.

4.0 CONCLUSION

The results of the initial HELP Model analysis are summarized in Table 1.

Table 1: Leachate Generation Analysis HELP Model Results

Scenario	Waste and Cover Configuration	Model Duration (years)	Peak Daily Head (inches)
1	6 Feet of MSW with Daily Cover	1	4.0
2	25 Feet of MSW with Daily Cover	1	4.1
3	25 Feet of MSW with Intermediate Cover	10	3.6
4	49 Feet of MSW with Final Cover	30	2.8
5	25 Feet of C&D Waste with Intermediate Cover	10	2.6

The results of the initial analysis indicate that the peak daily head on the liner system is estimated to be greatest during daily cover conditions for the MSW cells. This is to be expected as the daily cover conditions allow no runoff and soil thickness is considerably less than intermediate and final cover conditions. For each operational scenario and duration modelled, the calculated peak daily head on the composite liner system is expected to be less than 12 inches throughout all open/daily cover, intermediate cover, and closed conditions of the landfill.

5.0 REFERENCES

National Center for Environmental Information (NCEI). 2010. 1981–2010 Normals. National Oceanic and Atmospheric Administration (NOAA). Washington D.C.: NOAA

United States Army Corps of Engineers (USACE). 1997. Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3.07. Waterways Experiment Station for ESEPA Risk Reduction Engineering Laboratory.

ATTACHMENT I-1-1

Scenario 1 HELP Model:
Six Feet of Waste, Daily Cover
(1-Year Weather Generation)

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\JCL_DC.D4
TEMPERATURE DATA FILE:      C:\JCL_DC.D7
SOLAR RADIATION DATA FILE:  C:\JCL_DC.D13
EVAPOTRANSPIRATION DATA:    C:\JCL_DC.D11
SOIL AND DESIGN DATA FILE:  C:\JCL_6DC.D10
OUTPUT DATA FILE:           C:\JCL_6DC.OUT



TIME:  35:36     DATE:   7/21/2020



******************************************************************************

     TITLE:  JACKSON CO. LF SCENARIO 1: 6' WASTE WITH DAILY COVER

******************************************************************************



     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                   =      6.00   INCHES
           POROSITY                    =      0.4530 VOL/VOL
           FIELD CAPACITY              =      0.1900 VOL/VOL
           WILTING POINT               =      0.0850 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.1750 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.720000011000E-03 CM/SEC
         NOTE:  100.00 PERCENT OF THE DRAINAGE COLLECTED FROM LAYER # 3
                  IS RECIRCULATED INTO THIS LAYER.



                                   LAYER  2
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  18
           THICKNESS                   =     72.00   INCHES
           POROSITY                    =      0.6710 VOL/VOL
           FIELD CAPACITY              =      0.2920 VOL/VOL
```

```
   WILTING POINT                =      0.0770 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.2920 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC




                         LAYER  3
                         --------

             TYPE 2 - LATERAL DRAINAGE LAYER
               MATERIAL TEXTURE NUMBER   0
   THICKNESS                    =     12.00   INCHES
   POROSITY                     =      0.4570 VOL/VOL
   FIELD CAPACITY               =      0.1310 VOL/VOL
   WILTING POINT                =      0.0580 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.1476 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.999999978000E-02 CM/SEC
   SLOPE                        =      2.00   PERCENT
   DRAINAGE LENGTH              =    181.0    FEET
 NOTE:  100.00 PERCENT OF THE DRAINAGE COLLECTED FROM THIS
          LAYER IS RECIRCULATED INTO LAYER #  1.




                         LAYER  4
                         --------

             TYPE 4 - FLEXIBLE MEMBRANE LINER
               MATERIAL TEXTURE NUMBER  35
   THICKNESS                    =      0.06   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          =      1.00   HOLES/ACRE
   FML INSTALLATION DEFECTS     =      2.00   HOLES/ACRE
   FML PLACEMENT QUALITY        =  2 - EXCELLENT




                         LAYER  5
                         --------

               TYPE 3 - BARRIER SOIL LINER
               MATERIAL TEXTURE NUMBER  16
   THICKNESS                    =     12.00   INCHES
   POROSITY                     =      0.4270 VOL/VOL
   FIELD CAPACITY               =      0.4180 VOL/VOL
   WILTING POINT                =      0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC




           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER            =     85.00
FRACTION OF AREA ALLOWING RUNOFF   =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =      6.0    INCHES
```

```
        INITIAL WATER IN EVAPORATIVE ZONE   =      1.050  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE  =      2.718  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.510  INCHES
        INITIAL SNOW WATER                  =      0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS    =     28.969  INCHES
        TOTAL INITIAL WATER                 =     28.969  INCHES
        TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR



                    EVAPOTRANSPIRATION AND WEATHER DATA
                    -----------------------------------

         NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                  CHEYENNE              WYOMING

             STATION LATITUDE                       =  40.73 DEGREES
             MAXIMUM LEAF AREA INDEX                =   0.00
             START OF GROWING SEASON (JULIAN DATE)  =    138
             END OF GROWING SEASON (JULIAN DATE)    =    273
             EVAPORATIVE ZONE DEPTH                 =   6.0  INCHES
             AVERAGE ANNUAL WIND SPEED              =  12.90 MPH
             AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  52.00 %
             AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  54.00 %
             AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  50.00 %
             AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  51.00 %



         NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    CHEYENNE            WYOMING

                  NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       0.55        0.64        0.79        1.17        1.43        1.31
       1.41        1.20        1.36        0.99        0.90        0.64


         NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    CHEYENNE            WYOMING

             NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
      16.00       18.40       26.80       34.90       43.90       52.70
      58.50       56.70       48.60       38.30       25.50       16.90


         NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    CHEYENNE            WYOMING
                    AND STATION LATITUDE  =  40.73 DEGREES




*******************************************************************************

                  MONTHLY TOTALS (IN INCHES) FOR YEAR    1
-------------------------------------------------------------------------------

                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
```

```
                                ------- ------- ------- ------- ------- -------

PRECIPITATION                    0.10    0.12    0.93    0.44    1.18    0.62
                                 1.85    0.83    2.19    1.36    0.69    0.18

RUNOFF                           0.000   0.000   0.000   0.000   0.000   0.000
                                 0.000   0.000   0.000   0.000   0.000   0.000

EVAPOTRANSPIRATION               0.100   0.160   0.819   0.549   1.090   0.685
                                 1.443   0.801   2.496   0.722   1.309   0.170

LATERAL DRAINAGE RECIRCULATED    0.0893  0.0540  0.0427  0.0621  0.0857  0.2706
  INTO LAYER  1                  0.2653  0.2889  0.3558  0.3652  0.3107  0.2084

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  3                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

LATERAL DRAINAGE RECIRCULATED    0.0893  0.0540  0.0427  0.0621  0.0857  0.2706
  FROM LAYER  3                  0.2653  0.2889  0.3558  0.3652  0.3107  0.2084

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  LAYER  5                       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000


-------------------------------------------------------------------------------
                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


AVERAGE DAILY HEAD ON            0.460   0.308   0.220   0.330   0.441   1.441
  TOP OF LAYER  4                1.367   1.488   1.894   1.882   1.654   1.074

STD. DEVIATION OF DAILY          0.080   0.027   0.035   0.049   0.050   0.329
  HEAD ON TOP OF LAYER  4        0.270   0.068   0.283   0.328   0.166   0.184

*******************************************************************************


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR    1
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           10.49          38078.703    100.00

  RUNOFF                                   0.000             0.000      0.00

  EVAPOTRANSPIRATION                      10.343         37546.391     98.60

  RECIRCULATION INTO LAYER  1              2.398714       8707.330     22.87

  DRAINAGE COLLECTED FROM LAYER  3         0.0000            0.000      0.00

  RECIRCULATION FROM LAYER  3              2.398714       8707.330     22.87

  PERC./LEAKAGE THROUGH LAYER  5           0.000125          0.454      0.00

  AVG. HEAD ON TOP OF LAYER  4             1.0465

  CHANGE IN WATER STORAGE                  0.145           527.819      1.39

  SOIL WATER AT START OF YEAR             28.969        105156.578

  SOIL WATER AT END OF YEAR               29.114        105684.398

  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             0.0011           4.039      0.01

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******************************************************************************

         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH    1
------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 0.10     0.12     0.93     0.44     1.18     0.62
                           1.85     0.83     2.19     1.36     0.69     0.18

    STD. DEVIATIONS        0.00     0.00     0.00     0.00     0.00     0.00
                           0.00     0.00     0.00     0.00     0.00     0.00

  RUNOFF
  ------
    TOTALS                 0.000    0.000    0.000    0.000    0.000    0.000
                           0.000    0.000    0.000    0.000    0.000    0.000

    STD. DEVIATIONS        0.000    0.000    0.000    0.000    0.000    0.000
                           0.000    0.000    0.000    0.000    0.000    0.000

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.100    0.160    0.819    0.549    1.090    0.685
                           1.443    0.801    2.496    0.722    1.309    0.170

    STD. DEVIATIONS        0.000    0.000    0.000    0.000    0.000    0.000
                           0.000    0.000    0.000    0.000    0.000    0.000

  LATERAL DRAINAGE RECIRCULATED INTO LAYER  1
  ------------------------------------------
    TOTALS                 0.0893   0.0540   0.0427   0.0621   0.0857   0.2706
                           0.2653   0.2889   0.3558   0.3652   0.3107   0.2084

    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

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ---------------------------------------
    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

  LATERAL DRAINAGE RECIRCULATED FROM LAYER  3
  ------------------------------------------
    TOTALS                 0.0893   0.0540   0.0427   0.0621   0.0857   0.2706
                           0.2653   0.2889   0.3558   0.3652   0.3107   0.2084

    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

  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               0.4599   0.3078   0.2201   0.3304   0.4413   1.4406
                           1.3669   1.4884   1.8938   1.8815   1.6539   1.0737

    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

*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH    1
-------------------------------------------------------------------------------
                                     INCHES            CU. FEET       PERCENT
                               -------------------   -------------   ---------
 PRECIPITATION                  10.49    (   0.000)      38078.7     100.00

 RUNOFF                          0.000   (  0.0000)          0.00      0.000

 EVAPOTRANSPIRATION             10.343   (  0.0000)      37546.39     98.602

 DRAINAGE RECIRCULATED           2.39871 (  0.00000)      8707.330   22.86667
   INTO LAYER  1

 LATERAL DRAINAGE COLLECTED      0.00000 (  0.00000)         0.000    0.00000
   FROM LAYER  3

 DRAINAGE RECIRCULATED           2.39871 (  0.00000)      8707.330   22.86667
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH     0.00013 (  0.00000)         0.454     0.00119
   LAYER  5

 AVERAGE HEAD ON TOP             1.047 (    0.000)
   OF LAYER  4

 CHANGE IN WATER STORAGE         0.145   (  0.0000)        527.82      1.386

*******************************************************************************


🡅
******************************************************************************

                PEAK DAILY VALUES FOR YEARS    1 THROUGH    1
   ------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                              0.82          2976.600

      RUNOFF                                     0.000            0.0000

      DRAINAGE RECIRCULATED INTO LAYER  1        0.01550         56.25103
```

```
      DRAINAGE COLLECTED FROM LAYER  3           0.00000          0.00000

      DRAINAGE RECIRCULATED FROM LAYER  3        0.01550         56.25103

      PERCOLATION/LEAKAGE THROUGH LAYER  5       0.000001         0.00295

      AVERAGE HEAD ON TOP OF LAYER  4            2.475

      MAXIMUM HEAD ON TOP OF LAYER  4            4.070

      LOCATION OF MAXIMUM HEAD IN LAYER  3
            (DISTANCE FROM DRAIN)               32.1 FEET

      SNOW WATER                                 0.35          1270.5000


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.2727

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.0868

       ***  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    1
    ----------------------------------------------------------------------
                    LAYER        (INCHES)       (VOL/VOL)
                    -----        --------       ---------
                      1            1.1383         0.1897

                      2           21.0239         0.2920

                      3            1.8279         0.1523

                      4            0.0000         0.0000

                      5            5.1240         0.4270

                  SNOW WATER       0.000

******************************************************************************
******************************************************************************
```

ATTACHMENT I-1-2

Scenario 2 HELP Model:
25 Feet of Waste, Daily Cover
(1-Year Weather Generation)

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\JCL_DC.D4
TEMPERATURE DATA FILE:      C:\JCL_DC.D7
SOLAR RADIATION DATA FILE:  C:\JCL_DC.D13
EVAPOTRANSPIRATION DATA:    C:\JCL_DC.D11
SOIL AND DESIGN DATA FILE:  C:\JCL25DC.D10
OUTPUT DATA FILE:           C:\JCL25DC.OUT


TIME:  16:19     DATE:   7/21/2020



******************************************************************************

     TITLE:  JACKSON CO. LF SCENARIO 2: 25' WASTE WITH DAILY COVER

******************************************************************************


     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                   =      6.00   INCHES
           POROSITY                    =      0.4530 VOL/VOL
           FIELD CAPACITY              =      0.1900 VOL/VOL
           WILTING POINT               =      0.0850 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.1751 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.720000011000E-03 CM/SEC
         NOTE:  100.00 PERCENT OF THE DRAINAGE COLLECTED FROM LAYER # 3
                  IS RECIRCULATED INTO THIS LAYER.



                                   LAYER  2
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  18
           THICKNESS                   =    300.00   INCHES
           POROSITY                    =      0.6710 VOL/VOL
           FIELD CAPACITY              =      0.2920 VOL/VOL
```

```
   WILTING POINT               =      0.0770 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.2920 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC




                           LAYER  3
                           --------

               TYPE 2 - LATERAL DRAINAGE LAYER
                 MATERIAL TEXTURE NUMBER   0
   THICKNESS                   =     12.00   INCHES
   POROSITY                    =      0.4570 VOL/VOL
   FIELD CAPACITY              =      0.1310 VOL/VOL
   WILTING POINT               =      0.0580 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.1476 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.999999978000E-02 CM/SEC
   SLOPE                       =      2.00   PERCENT
   DRAINAGE LENGTH             =    181.0    FEET
 NOTE:  100.00 PERCENT OF THE DRAINAGE COLLECTED FROM THIS
          LAYER IS RECIRCULATED INTO LAYER #  1.




                           LAYER  4
                           --------

               TYPE 4 - FLEXIBLE MEMBRANE LINER
                 MATERIAL TEXTURE NUMBER  35
   THICKNESS                   =      0.06   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         =      1.00   HOLES/ACRE
   FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
   FML PLACEMENT QUALITY       =  2 - EXCELLENT




                           LAYER  5
                           --------

                 TYPE 3 - BARRIER SOIL LINER
                 MATERIAL TEXTURE NUMBER  16
   THICKNESS                   =     12.00   INCHES
   POROSITY                    =      0.4270 VOL/VOL
   FIELD CAPACITY              =      0.4180 VOL/VOL
   WILTING POINT               =      0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC




           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER            =     85.00
FRACTION OF AREA ALLOWING RUNOFF   =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =      6.0    INCHES
```

```
        INITIAL WATER IN EVAPORATIVE ZONE   =      1.051  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE  =      2.718  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.510  INCHES
        INITIAL SNOW WATER                  =      0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS    =     95.546  INCHES
        TOTAL INITIAL WATER                 =     95.546  INCHES
        TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR




                    EVAPOTRANSPIRATION AND WEATHER DATA
                    -----------------------------------

         NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                  CHEYENNE              WYOMING

             STATION LATITUDE                       =  40.73 DEGREES
             MAXIMUM LEAF AREA INDEX                =   0.00
             START OF GROWING SEASON (JULIAN DATE)  =    138
             END OF GROWING SEASON (JULIAN DATE)    =    273
             EVAPORATIVE ZONE DEPTH                 =   6.0  INCHES
             AVERAGE ANNUAL WIND SPEED              =  12.90 MPH
             AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  52.00 %
             AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  54.00 %
             AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  50.00 %
             AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  51.00 %



         NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    CHEYENNE            WYOMING

                  NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       0.55        0.64        0.79        1.17        1.43        1.31
       1.41        1.20        1.36        0.99        0.90        0.64



         NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    CHEYENNE            WYOMING

             NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
      16.00       18.40       26.80       34.90       43.90       52.70
      58.50       56.70       48.60       38.30       25.50       16.90



         NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    CHEYENNE            WYOMING
                    AND STATION LATITUDE  =  40.73 DEGREES





*******************************************************************************

                  MONTHLY TOTALS (IN INCHES) FOR YEAR    1
-------------------------------------------------------------------------------

                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
```

```
                                ------- ------- ------- ------- ------- -------

PRECIPITATION                    0.10    0.12    0.93    0.44    1.18    0.62
                                 1.85    0.83    2.19    1.36    0.69    0.18

RUNOFF                           0.000   0.000   0.000   0.000   0.000   0.000
                                 0.000   0.000   0.000   0.000   0.000   0.000

EVAPOTRANSPIRATION               0.100   0.160   0.819   0.549   1.090   0.678
                                 1.443   0.800   2.496   0.722   1.309   0.170

LATERAL DRAINAGE RECIRCULATED    0.0894  0.0541  0.0428  0.0623  0.0849  0.2673
  INTO LAYER  1                  0.2689  0.2929  0.3555  0.3687  0.3134  0.2106

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  3                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

LATERAL DRAINAGE RECIRCULATED    0.0894  0.0541  0.0428  0.0623  0.0849  0.2673
  FROM LAYER  3                  0.2689  0.2929  0.3555  0.3687  0.3134  0.2106

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  LAYER  5                       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000


-------------------------------------------------------------------------------
                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


AVERAGE DAILY HEAD ON            0.461   0.308   0.221   0.331   0.437   1.423
  TOP OF LAYER  4                1.385   1.509   1.892   1.900   1.668   1.085

STD. DEVIATION OF DAILY          0.080   0.027   0.036   0.049   0.044   0.354
  HEAD ON TOP OF LAYER  4        0.271   0.069   0.280   0.332   0.167   0.185

*******************************************************************************


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR    1
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           10.49          38078.703    100.00

  RUNOFF                                   0.000             0.000      0.00

  EVAPOTRANSPIRATION                      10.337         37524.949     98.55

  RECIRCULATION INTO LAYER  1              2.410729       8750.947     22.98

  DRAINAGE COLLECTED FROM LAYER  3         0.0000            0.000      0.00

  RECIRCULATION FROM LAYER  3              2.410729       8750.947     22.98

  PERC./LEAKAGE THROUGH LAYER  5           0.000126          0.456      0.00

  AVG. HEAD ON TOP OF LAYER  4             1.0517

  CHANGE IN WATER STORAGE                  0.151           549.075      1.44

  SOIL WATER AT START OF YEAR             95.546        346830.375

  SOIL WATER AT END OF YEAR               95.697        347379.437

  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              0.0012           4.221      0.01

*******************************************************************************




*******************************************************************************

         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH    1
-------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 0.10     0.12     0.93     0.44     1.18     0.62
                           1.85     0.83     2.19     1.36     0.69     0.18

    STD. DEVIATIONS        0.00     0.00     0.00     0.00     0.00     0.00
                           0.00     0.00     0.00     0.00     0.00     0.00

  RUNOFF
  ------
    TOTALS                 0.000    0.000    0.000    0.000    0.000    0.000
                           0.000    0.000    0.000    0.000    0.000    0.000

    STD. DEVIATIONS        0.000    0.000    0.000    0.000    0.000    0.000
                           0.000    0.000    0.000    0.000    0.000    0.000

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.100    0.160    0.819    0.549    1.090    0.678
                           1.443    0.800    2.496    0.722    1.309    0.170

    STD. DEVIATIONS        0.000    0.000    0.000    0.000    0.000    0.000
                           0.000    0.000    0.000    0.000    0.000    0.000

  LATERAL DRAINAGE RECIRCULATED INTO LAYER  1
  -------------------------------------------
    TOTALS                 0.0894   0.0541   0.0428   0.0623   0.0849   0.2673
                           0.2689   0.2929   0.3555   0.3687   0.3134   0.2106

    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

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    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

  LATERAL DRAINAGE RECIRCULATED FROM LAYER  3
  -------------------------------------------
    TOTALS                 0.0894   0.0541   0.0428   0.0623   0.0849   0.2673
                           0.2689   0.2929   0.3555   0.3687   0.3134   0.2106

    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

  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               0.4606   0.3084   0.2206   0.3314   0.4374   1.4227
                           1.3850   1.5087   1.8923   1.8996   1.6685   1.0851

    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

*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH    1
-------------------------------------------------------------------------------
                                     INCHES            CU. FEET       PERCENT
                               -------------------   -------------   ---------
 PRECIPITATION                  10.49    (   0.000)      38078.7     100.00

 RUNOFF                          0.000   (  0.0000)          0.00      0.000

 EVAPOTRANSPIRATION             10.337   (  0.0000)      37524.95     98.546

 DRAINAGE RECIRCULATED           2.41073 (  0.00000)      8750.947   22.98121
   INTO LAYER  1

 LATERAL DRAINAGE COLLECTED      0.00000 (  0.00000)         0.000    0.00000
   FROM LAYER  3

 DRAINAGE RECIRCULATED           2.41073 (  0.00000)      8750.947   22.98121
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH     0.00013 (  0.00000)         0.456     0.00120
   LAYER  5

 AVERAGE HEAD ON TOP             1.052 (    0.000)
   OF LAYER  4

 CHANGE IN WATER STORAGE         0.151   (  0.0000)        549.08      1.442

*******************************************************************************


↑
******************************************************************************

                PEAK DAILY VALUES FOR YEARS    1 THROUGH    1
   ------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                              0.82          2976.600

      RUNOFF                                     0.000            0.0000

      DRAINAGE RECIRCULATED INTO LAYER  1        0.01564         56.78994
```

```
      DRAINAGE COLLECTED FROM LAYER  3           0.00000          0.00000

      DRAINAGE RECIRCULATED FROM LAYER  3        0.01564         56.78994

      PERCOLATION/LEAKAGE THROUGH LAYER  5       0.000001         0.00298

      AVERAGE HEAD ON TOP OF LAYER  4            2.498

      MAXIMUM HEAD ON TOP OF LAYER  4            4.105

      LOCATION OF MAXIMUM HEAD IN LAYER  3
            (DISTANCE FROM DRAIN)               32.3 FEET

      SNOW WATER                                 0.35          1270.5000


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.2728

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.0868


       ***  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    1
    ----------------------------------------------------------------------
                    LAYER        (INCHES)       (VOL/VOL)
                    -----        --------       ---------
                      1            1.1423         0.1904

                      2           87.5999         0.2920

                      3            1.8306         0.1526

                      4            0.0000         0.0000

                      5            5.1240         0.4270

                  SNOW WATER       0.000

******************************************************************************
******************************************************************************
```

ATTACHMENT I-1-3

Scenario 3 HELP Model:
25 Feet of Waste, Intermediate Cover
(10-Year Weather Generation)

```
****************************************************************************
****************************************************************************
**                                                                        **
**                                                                        **
**              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:\JCL_IC.D4
TEMPERATURE DATA FILE:      C:\JCL_IC.D7
SOLAR RADIATION DATA FILE:  C:\JCL_IC.D13
EVAPOTRANSPIRATION DATA:    C:\JCL_IC.D11
SOIL AND DESIGN DATA FILE:  C:\JCL25IC.D10
OUTPUT DATA FILE:           C:\JCL25IC.OUT



TIME:  16:27     DATE:   7/21/2020




****************************************************************************

     TITLE:  JACKSON CO. LF SCENARIO 3: 25' WASTE WITH INTERMEDIATE COVER

****************************************************************************



     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   0
           THICKNESS                   =     12.00   INCHES
           POROSITY                    =      0.4730 VOL/VOL
           FIELD CAPACITY              =      0.2220 VOL/VOL
           WILTING POINT               =      0.1040 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.1673 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.429999985000E-03 CM/SEC
         NOTE:  100.00 PERCENT OF THE DRAINAGE COLLECTED FROM LAYER # 3
                    IS RECIRCULATED INTO THIS LAYER.




                                   LAYER  2
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  18
           THICKNESS                   =    300.00   INCHES
           POROSITY                    =      0.6710 VOL/VOL
           FIELD CAPACITY              =      0.2920 VOL/VOL
```

```
   WILTING POINT              =      0.0770 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.2920 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC



                            LAYER  3
                            --------

               TYPE 2 - LATERAL DRAINAGE LAYER
                 MATERIAL TEXTURE NUMBER   0
   THICKNESS                  =     12.00   INCHES
   POROSITY                   =      0.4570 VOL/VOL
   FIELD CAPACITY             =      0.1310 VOL/VOL
   WILTING POINT              =      0.0580 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.1310 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.999999978000E-02 CM/SEC
   SLOPE                      =      2.00   PERCENT
   DRAINAGE LENGTH            =    181.0    FEET
 NOTE:  100.00 PERCENT OF THE DRAINAGE COLLECTED FROM THIS
          LAYER IS RECIRCULATED INTO LAYER #  1.



                            LAYER  4
                            --------

               TYPE 4 - FLEXIBLE MEMBRANE LINER
                 MATERIAL TEXTURE NUMBER  35
   THICKNESS                  =      0.06   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        =      1.00   HOLES/ACRE
   FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
   FML PLACEMENT QUALITY      =  2 - EXCELLENT



                            LAYER  5
                            --------

                 TYPE 3 - BARRIER SOIL LINER
                 MATERIAL TEXTURE NUMBER  16
   THICKNESS                  =     12.00   INCHES
   POROSITY                   =      0.4270 VOL/VOL
   FIELD CAPACITY             =      0.4180 VOL/VOL
   WILTING POINT              =      0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC




           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER             =     85.00
FRACTION OF AREA ALLOWING RUNOFF    =     50.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =     12.0    INCHES
```

```
        INITIAL WATER IN EVAPORATIVE ZONE   =      2.007  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE  =      5.676  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE  =      1.248  INCHES
        INITIAL SNOW WATER                  =      0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS    =     96.303  INCHES
        TOTAL INITIAL WATER                 =     96.303  INCHES
        TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR



                    EVAPOTRANSPIRATION AND WEATHER DATA
                    -----------------------------------

         NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                  CHEYENNE              WYOMING

             STATION LATITUDE                        =  40.73 DEGREES
             MAXIMUM LEAF AREA INDEX                 =   0.00
             START OF GROWING SEASON (JULIAN DATE)   =    138
             END OF GROWING SEASON (JULIAN DATE)     =    273
             EVAPORATIVE ZONE DEPTH                  =  12.0  INCHES
             AVERAGE ANNUAL WIND SPEED               =  12.90 MPH
             AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  52.00 %
             AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  54.00 %
             AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  50.00 %
             AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  51.00 %



         NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    CHEYENNE            WYOMING

                  NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       0.55        0.64        0.79        1.17        1.43        1.31
       1.41        1.20        1.36        0.99        0.90        0.64



         NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    CHEYENNE            WYOMING

             NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
      16.00       18.40       26.80       34.90       43.90       52.70
      58.50       56.70       48.60       38.30       25.50       16.90



         NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    CHEYENNE            WYOMING
                    AND STATION LATITUDE  =  40.73 DEGREES



*******************************************************************************

                          ANNUAL TOTALS FOR YEAR    1
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           10.49          38078.703    100.00
```

```
  RUNOFF                                   0.035           126.980      0.33

  EVAPOTRANSPIRATION                      10.051         36484.207     95.81

  RECIRCULATION INTO LAYER  1              0.006316         22.927      0.06

  DRAINAGE COLLECTED FROM LAYER  3         0.0000            0.000      0.00

  RECIRCULATION FROM LAYER  3              0.006316         22.927      0.06

  PERC./LEAKAGE THROUGH LAYER  5           0.000003          0.010      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0028

  CHANGE IN WATER STORAGE                  0.404          1467.515      3.85

  SOIL WATER AT START OF YEAR             96.303        349581.000

  SOIL WATER AT END OF YEAR               96.708        351048.531

  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           -0.010      0.00

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                          ANNUAL TOTALS FOR YEAR    2
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           14.83          53832.910    100.00

  RUNOFF                                   0.026            94.504      0.18

  EVAPOTRANSPIRATION                      14.804         53737.410     99.82

  RECIRCULATION INTO LAYER  1              0.025984         94.321      0.18

  DRAINAGE COLLECTED FROM LAYER  3         0.0000            0.000      0.00

  RECIRCULATION FROM LAYER  3              0.025984         94.321      0.18

  PERC./LEAKAGE THROUGH LAYER  5           0.000003          0.012      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0113

  CHANGE IN WATER STORAGE                  0.000             0.901      0.00

  SOIL WATER AT START OF YEAR             96.708        351048.531

  SOIL WATER AT END OF YEAR               96.014        348529.937

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.694          2519.485      4.68

  ANNUAL WATER BUDGET BALANCE              0.0000            0.084      0.00

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                          ANNUAL TOTALS FOR YEAR    3
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           12.48          45302.398    100.00

  RUNOFF                                   0.334          1214.122      2.68

  EVAPOTRANSPIRATION                      11.733         42589.059     94.01

  RECIRCULATION INTO LAYER  1              0.081879        297.222      0.66

  DRAINAGE COLLECTED FROM LAYER  3         0.0000            0.000      0.00

  RECIRCULATION FROM LAYER  3              0.081879        297.222      0.66

  PERC./LEAKAGE THROUGH LAYER  5           0.000006          0.021      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0357

  CHANGE IN WATER STORAGE                  0.413          1498.498      3.31

  SOIL WATER AT START OF YEAR             96.014        348529.937

  SOIL WATER AT END OF YEAR               96.864        351617.031

  SNOW WATER AT START OF YEAR              0.694          2519.485      5.56

  SNOW WATER AT END OF YEAR                0.256           930.883      2.05

  ANNUAL WATER BUDGET BALANCE              0.0002            0.698      0.00

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                          ANNUAL TOTALS FOR YEAR    4
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           12.05          43741.508    100.00

  RUNOFF                                   0.039           142.254      0.33

  EVAPOTRANSPIRATION                      12.257         44491.687    101.72

  RECIRCULATION INTO LAYER  1              0.014616         53.055      0.12

  DRAINAGE COLLECTED FROM LAYER  3         0.0000            0.000      0.00

  RECIRCULATION FROM LAYER  3              0.014616         53.055      0.12

  PERC./LEAKAGE THROUGH LAYER  5           0.000003          0.011      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0064

  CHANGE IN WATER STORAGE                 -0.246          -891.693     -2.04

  SOIL WATER AT START OF YEAR             96.864        351617.031

  SOIL WATER AT END OF YEAR               96.729        351126.687

  SNOW WATER AT START OF YEAR              0.256           930.883      2.13
```

```
  SNOW WATER AT END OF YEAR                0.146          529.525      1.21

  ANNUAL WATER BUDGET BALANCE             -0.0002          -0.752      0.00

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                          ANNUAL TOTALS FOR YEAR    5
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           13.26          48133.809    100.00

  RUNOFF                                   0.245           888.899      1.85

  EVAPOTRANSPIRATION                      13.570         49260.598    102.34

  RECIRCULATION INTO LAYER  1              0.470334       1707.312      3.55

  DRAINAGE COLLECTED FROM LAYER  3         0.0000            0.000      0.00

  RECIRCULATION FROM LAYER  3              0.470334       1707.312      3.55

  PERC./LEAKAGE THROUGH LAYER  5           0.000026          0.094      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.2044

  CHANGE IN WATER STORAGE                 -0.560         -2031.824     -4.22

  SOIL WATER AT START OF YEAR             96.729        351126.687

  SOIL WATER AT END OF YEAR               96.315        349624.406

  SNOW WATER AT START OF YEAR              0.146           529.525      1.10

  SNOW WATER AT END OF YEAR                0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0044           16.040      0.03

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                          ANNUAL TOTALS FOR YEAR    6
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           13.82          50166.609    100.00

  RUNOFF                                   0.127           461.744      0.92

  EVAPOTRANSPIRATION                      13.417         48703.340     97.08

  RECIRCULATION INTO LAYER  1              1.427874       5183.183     10.33

  DRAINAGE COLLECTED FROM LAYER  3         0.0000            0.000      0.00

  RECIRCULATION FROM LAYER  3              1.427874       5183.183     10.33

  PERC./LEAKAGE THROUGH LAYER  5           0.000074          0.269      0.00
```

```
  AVG. HEAD ON TOP OF LAYER  4             0.6234

  CHANGE IN WATER STORAGE                  0.278          1010.166      2.01

  SOIL WATER AT START OF YEAR             96.315        349624.406

  SOIL WATER AT END OF YEAR               96.327        349665.844

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.267           968.735      1.93

  ANNUAL WATER BUDGET BALANCE             -0.0025           -8.910     -0.02

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                          ANNUAL TOTALS FOR YEAR    7
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           12.34          44794.207    100.00

  RUNOFF                                   0.185           671.712      1.50

  EVAPOTRANSPIRATION                      12.094         43901.098     98.01

  RECIRCULATION INTO LAYER  1              0.330156       1198.465      2.68

  DRAINAGE COLLECTED FROM LAYER  3         0.0000            0.000      0.00

  RECIRCULATION FROM LAYER  3              0.330156       1198.465      2.68

  PERC./LEAKAGE THROUGH LAYER  5           0.000017          0.063      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.1442

  CHANGE IN WATER STORAGE                  0.063           228.119      0.51

  SOIL WATER AT START OF YEAR             96.327        349665.844

  SOIL WATER AT END OF YEAR               96.656        350862.687

  SNOW WATER AT START OF YEAR              0.267           968.735      2.16

  SNOW WATER AT END OF YEAR                0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE             -0.0019           -6.786     -0.02

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                          ANNUAL TOTALS FOR YEAR    8
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           11.36          41236.801    100.00

  RUNOFF                                   0.493          1788.795      4.34

  EVAPOTRANSPIRATION                      11.116         40351.262     97.85
```

```
  RECIRCULATION INTO LAYER  1             0.376778       1367.702      3.32

  DRAINAGE COLLECTED FROM LAYER  3        0.0000            0.000      0.00

  RECIRCULATION FROM LAYER  3             0.376778       1367.702      3.32

  PERC./LEAKAGE THROUGH LAYER  5          0.000020          0.074      0.00

  AVG. HEAD ON TOP OF LAYER  4            0.1639

  CHANGE IN WATER STORAGE                -0.249          -903.678     -2.19

  SOIL WATER AT START OF YEAR            96.656        350862.687

  SOIL WATER AT END OF YEAR              96.407        349959.000

  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             0.0001            0.351      0.00

******************************************************************************



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                          ANNUAL TOTALS FOR YEAR    9
------------------------------------------------------------------------------
                                       INCHES         CU. FEET     PERCENT
                                      --------       ----------    -------
  PRECIPITATION                        10.06         36517.805    100.00

  RUNOFF                                0.244          884.758      2.42

  EVAPOTRANSPIRATION                    9.871        35830.406     98.12

  RECIRCULATION INTO LAYER  1           0.264741       961.010      2.63

  DRAINAGE COLLECTED FROM LAYER  3      0.0000           0.000      0.00

  RECIRCULATION FROM LAYER  3           0.264741       961.010      2.63

  PERC./LEAKAGE THROUGH LAYER  5        0.000015         0.055      0.00

  AVG. HEAD ON TOP OF LAYER  4          0.1153

  CHANGE IN WATER STORAGE              -0.055         -199.762     -0.55

  SOIL WATER AT START OF YEAR          96.407       349959.000

  SOIL WATER AT END OF YEAR            96.352       349759.250

  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           0.0006           2.349      0.01

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```
                          ANNUAL TOTALS FOR YEAR   10
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           14.15          51364.508    100.00

  RUNOFF                                   0.121           438.975      0.85

  EVAPOTRANSPIRATION                      13.137         47688.555     92.84

  RECIRCULATION INTO LAYER  1              0.436488       1584.450      3.08

  DRAINAGE COLLECTED FROM LAYER  3         0.0000            0.000      0.00

  RECIRCULATION FROM LAYER  3              0.436488       1584.450      3.08

  PERC./LEAKAGE THROUGH LAYER  5           0.000023          0.084      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.1898

  CHANGE IN WATER STORAGE                  0.892          3236.355      6.30

  SOIL WATER AT START OF YEAR             96.352        349759.250

  SOIL WATER AT END OF YEAR               96.463        350159.687

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.781          2835.917      5.52

  ANNUAL WATER BUDGET BALANCE              0.0001            0.542      0.00

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         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH   10
-------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 0.62     0.63     0.85     1.36     1.29     1.31
                           1.32     1.09     1.71     1.04     0.62     0.64

    STD. DEVIATIONS        0.51     0.45     0.43     0.70     0.98     0.76
                           0.47     0.51     0.86     0.61     0.59     0.45

  RUNOFF
  ------
    TOTALS                 0.025    0.003    0.030    0.091    0.011    0.000
                           0.000    0.000    0.005    0.000    0.020    0.000

    STD. DEVIATIONS        0.073    0.006    0.065    0.106    0.025    0.000
                           0.000    0.000    0.013    0.000    0.046    0.000

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.589    0.591    0.705    1.392    1.454    1.427
                           1.070    1.008    1.780    1.092    0.593    0.503

    STD. DEVIATIONS        0.357    0.301    0.260    0.481    0.981    0.821
                           0.672    0.423    0.636    0.508    0.444    0.341
```

```
  LATERAL DRAINAGE RECIRCULATED INTO LAYER  1
  -------------------------------------------
    TOTALS                   0.0178   0.0091   0.0062   0.0099   0.0356   0.0346
                             0.0238   0.0219   0.0441   0.0657   0.0391   0.0357

    STD. DEVIATIONS          0.0329   0.0168   0.0110   0.0154   0.0612   0.0622
                             0.0365   0.0293   0.0597   0.0863   0.0480   0.0567

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    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

  LATERAL DRAINAGE RECIRCULATED FROM LAYER  3
  -------------------------------------------
    TOTALS                   0.0178   0.0091   0.0062   0.0099   0.0356   0.0346
                             0.0238   0.0219   0.0441   0.0657   0.0391   0.0357

    STD. DEVIATIONS          0.0329   0.0168   0.0110   0.0154   0.0612   0.0622
                             0.0365   0.0293   0.0597   0.0863   0.0480   0.0567

  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                 0.0919   0.0519   0.0321   0.0527   0.1836   0.1844
                             0.1224   0.1126   0.2346   0.3384   0.2080   0.1839

    STD. DEVIATIONS          0.1693   0.0957   0.0567   0.0822   0.3151   0.3311
                             0.1882   0.1511   0.3179   0.4447   0.2557   0.2919

*******************************************************************************


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     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   10
-------------------------------------------------------------------------------
                                         INCHES           CU. FEET      PERCENT
                                   -------------------  -------------  ---------
 PRECIPITATION                      12.48    (   1.563)      45316.9     100.00

 RUNOFF                              0.185   (  0.1493)        671.27      1.481

 EVAPOTRANSPIRATION                 12.205   (  1.5801)      44303.76     97.764

 DRAINAGE RECIRCULATED               0.34352 (  0.42153)      1246.965    2.75165
   INTO LAYER  1

 LATERAL DRAINAGE COLLECTED          0.00000 (  0.00000)         0.000    0.00000
   FROM LAYER  3
```

```
 DRAINAGE RECIRCULATED           0.34352 (  0.42153)      1246.965    2.75165
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH     0.00002 (  0.00002)         0.069     0.00015
   LAYER  5

 AVERAGE HEAD ON TOP             0.150 (    0.184)
   OF LAYER  4

 CHANGE IN WATER STORAGE         0.094   (  0.4164)        341.46      0.753

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                PEAK DAILY VALUES FOR YEARS    1 THROUGH   10
   ------------------------------------------------------------------------
                                               (INCHES)      (CU. FT.)
                                              ----------   -------------
      PRECIPITATION                             1.17          4247.100

      RUNOFF                                    0.233          847.4340

      DRAINAGE RECIRCULATED INTO LAYER  1       0.01334         48.43282

      DRAINAGE COLLECTED FROM LAYER  3          0.00000          0.00000

      DRAINAGE RECIRCULATED FROM LAYER  3       0.01334         48.43282

      PERCOLATION/LEAKAGE THROUGH LAYER  5      0.000001         0.00254

      AVERAGE HEAD ON TOP OF LAYER  4           2.131

      MAXIMUM HEAD ON TOP OF LAYER  4           3.565

      LOCATION OF MAXIMUM HEAD IN LAYER  3
            (DISTANCE FROM DRAIN)              29.5 FEET

      SNOW WATER                                1.13          4103.0435


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                 0.3229

      MINIMUM VEG. SOIL WATER (VOL/VOL)                 0.1207

       ***  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   10
    ----------------------------------------------------------------------
                    LAYER       (INCHES)       (VOL/VOL)
                    -----       --------       ---------
```

```
                      1            2.1174         0.1764

                      2           87.5999         0.2920

                      3            1.6214         0.1351

                      4            0.0000         0.0000

                      5            5.1240         0.4270

                  SNOW WATER       0.781

******************************************************************************
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```

ATTACHMENT I-1-4

Scenario 4 HELP Model:
49 Feet of Waste, Final Cover
(30-Year Weather Generation

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\JCL_CAP.D4
TEMPERATURE DATA FILE:      C:\JCL_CAP.D7
SOLAR RADIATION DATA FILE:  C:\JCL_CAP.D13
EVAPOTRANSPIRATION DATA:    C:\JCL_CAP.D11
SOIL AND DESIGN DATA FILE:  C:\JCL_FC.D10
OUTPUT DATA FILE:           C:\JCL_FC.OUT



TIME:  16:50     DATE:   7/21/2020



******************************************************************************

   TITLE:  JACKSON CO. LF SCENARIO 4: FINAL COVER 45' WASTE

******************************************************************************


     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   0
           THICKNESS                   =     42.00   INCHES
           POROSITY                    =      0.4730 VOL/VOL
           FIELD CAPACITY              =      0.2220 VOL/VOL
           WILTING POINT               =      0.1040 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.1985 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.429999985000E-03 CM/SEC



                                   LAYER  2
                                   --------

                         TYPE 1 - VERTICAL PERCOLATION LAYER
                             MATERIAL TEXTURE NUMBER   0
           THICKNESS                   =     12.00   INCHES
           POROSITY                    =      0.4730 VOL/VOL
           FIELD CAPACITY              =      0.2220 VOL/VOL
           WILTING POINT               =      0.1040 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.2220 VOL/VOL
```

```
EFFECTIVE SAT. HYD. COND.   =  0.429999985000E-03 CM/SEC



                        LAYER  3
                        --------

          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  =      0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC



                        LAYER  4
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
THICKNESS                   =    300.00   INCHES
POROSITY                    =      0.6710 VOL/VOL
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC



                        LAYER  5
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =     12.00   INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1310 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.999999978000E-02 CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    181.0    FEET



                        LAYER  6
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   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         =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  2 - EXCELLENT
```

```
                              LAYER  7
                              --------

                    TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  16
      THICKNESS                   =     12.00   INCHES
      POROSITY                    =      0.4270 VOL/VOL
      FIELD CAPACITY              =      0.4180 VOL/VOL
      WILTING POINT               =      0.3670 VOL/VOL
      INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
      EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC




              GENERAL DESIGN AND EVAPORATIVE ZONE DATA
              ----------------------------------------

    NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

   SCS RUNOFF CURVE NUMBER             =     69.00
   FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
   EVAPORATIVE ZONE DEPTH              =     12.0    INCHES
   INITIAL WATER IN EVAPORATIVE ZONE   =      1.678  INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE  =      5.676  INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE  =      1.248  INCHES
   INITIAL SNOW WATER                  =      0.000  INCHES
   INITIAL WATER IN LAYER MATERIALS    =    175.378  INCHES
   TOTAL INITIAL WATER                 =    175.378  INCHES
   TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR




               EVAPOTRANSPIRATION AND WEATHER DATA
               -----------------------------------

    NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
             CHEYENNE              WYOMING

        STATION LATITUDE                       =  40.73 DEGREES
        MAXIMUM LEAF AREA INDEX                =   2.50
        START OF GROWING SEASON (JULIAN DATE)  =    138
        END OF GROWING SEASON (JULIAN DATE)    =    273
        EVAPORATIVE ZONE DEPTH                 =  12.0  INCHES
        AVERAGE ANNUAL WIND SPEED              =  12.90 MPH
        AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  52.00 %
        AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  54.00 %
        AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  50.00 %
        AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  51.00 %



    NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
             COEFFICIENTS FOR    CHEYENNE            WYOMING

             NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
-------     -------     -------     -------     -------     -------
  0.55        0.64        0.79        1.17        1.43        1.31
  1.41        1.20        1.36        0.99        0.90        0.64



    NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
```

```
                  COEFFICIENTS FOR    CHEYENNE            WYOMING

             NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
      16.00       18.40       26.80       34.90       43.90       52.70
      58.50       56.70       48.60       38.30       25.50       16.90


         NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    CHEYENNE            WYOMING
                    AND STATION LATITUDE  =  40.73 DEGREES



*******************************************************************************

                          ANNUAL TOTALS FOR YEAR    1
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           10.49          38078.703    100.00

  RUNOFF                                   0.000             0.004      0.00

  EVAPOTRANSPIRATION                      10.457         37957.500     99.68

  DRAINAGE COLLECTED FROM LAYER  5         0.0025            9.022      0.02

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0011

  CHANGE IN WATER STORAGE                  0.031           112.164      0.29

  SOIL WATER AT START OF YEAR            175.378        636622.375

  SOIL WATER AT END OF YEAR              175.409        636734.562

  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            0.004      0.00

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                          ANNUAL TOTALS FOR YEAR    2
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           14.83          53832.910    100.00

  RUNOFF                                   0.000             0.000      0.00

  EVAPOTRANSPIRATION                      14.514         52686.531     97.87

  DRAINAGE COLLECTED FROM LAYER  5         0.0011            3.957      0.01

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.009      0.00
```

```
  AVG. HEAD ON TOP OF LAYER  6             0.0005

  CHANGE IN WATER STORAGE                  0.315          1142.394      2.12

  SOIL WATER AT START OF YEAR            175.409        636734.562

  SOIL WATER AT END OF YEAR              175.030        635357.437

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.694          2519.485      4.68

  ANNUAL WATER BUDGET BALANCE              0.0000            0.017      0.00

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                          ANNUAL TOTALS FOR YEAR    3
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           12.48          45302.398    100.00

  RUNOFF                                   0.150           545.446      1.20

  EVAPOTRANSPIRATION                      11.893         43170.426     95.29

  DRAINAGE COLLECTED FROM LAYER  5         0.0089           32.381      0.07

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.010      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0039

  CHANGE IN WATER STORAGE                  0.428          1554.137      3.43

  SOIL WATER AT START OF YEAR            175.030        635357.437

  SOIL WATER AT END OF YEAR              175.895        638500.187

  SNOW WATER AT START OF YEAR              0.694          2519.485      5.56

  SNOW WATER AT END OF YEAR                0.256           930.883      2.05

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.001      0.00

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                          ANNUAL TOTALS FOR YEAR    4
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           12.05          43741.508    100.00

  RUNOFF                                   0.000             0.007      0.00

  EVAPOTRANSPIRATION                      12.380         44937.871    102.74

  DRAINAGE COLLECTED FROM LAYER  5         0.0025            9.118      0.02

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.009      0.00
```

```
  AVG. HEAD ON TOP OF LAYER  6            0.0011

  CHANGE IN WATER STORAGE                -0.332        -1205.501     -2.76

  SOIL WATER AT START OF YEAR           175.895       638500.187

  SOIL WATER AT END OF YEAR             175.674       637696.062

  SNOW WATER AT START OF YEAR             0.256          930.883      2.13

  SNOW WATER AT END OF YEAR               0.146          529.525      1.21

  ANNUAL WATER BUDGET BALANCE             0.0000           0.004      0.00

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                          ANNUAL TOTALS FOR YEAR    5
------------------------------------------------------------------------------
                                        INCHES         CU. FEET     PERCENT
                                       --------       ----------    -------
  PRECIPITATION                          13.26         48133.809    100.00

  RUNOFF                                  0.109          394.709      0.82

  EVAPOTRANSPIRATION                     12.987        47142.988     97.94

  DRAINAGE COLLECTED FROM LAYER  5        0.0020           7.195      0.01

  PERC./LEAKAGE THROUGH LAYER  7          0.000003         0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6            0.0009

  CHANGE IN WATER STORAGE                 0.162          588.898      1.22

  SOIL WATER AT START OF YEAR           175.674       637696.062

  SOIL WATER AT END OF YEAR             175.982       638814.500

  SNOW WATER AT START OF YEAR             0.146          529.525      1.10

  SNOW WATER AT END OF YEAR               0.000            0.000      0.00

  ANNUAL WATER BUDGET BALANCE             0.0000           0.008      0.00

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                          ANNUAL TOTALS FOR YEAR    6
------------------------------------------------------------------------------
                                        INCHES         CU. FEET     PERCENT
                                       --------       ----------    -------
  PRECIPITATION                          13.82         50166.609    100.00

  RUNOFF                                  0.003            9.607      0.02

  EVAPOTRANSPIRATION                     14.217        51608.570    102.87

  DRAINAGE COLLECTED FROM LAYER  5        0.3185        1156.058      2.30
```

```
  PERC./LEAKAGE THROUGH LAYER  7          0.000017          0.062      0.00

  AVG. HEAD ON TOP OF LAYER  6            0.1395

  CHANGE IN WATER STORAGE                -0.718         -2607.704     -5.20

  SOIL WATER AT START OF YEAR           175.982        638814.500

  SOIL WATER AT END OF YEAR             174.997        635238.062

  SNOW WATER AT START OF YEAR             0.000             0.000      0.00

  SNOW WATER AT END OF YEAR               0.267           968.735      1.93

  ANNUAL WATER BUDGET BALANCE             0.0000            0.018      0.00

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                          ANNUAL TOTALS FOR YEAR    7
-------------------------------------------------------------------------------
                                        INCHES          CU. FEET     PERCENT
                                       --------        ----------    -------
  PRECIPITATION                          12.34          44794.207    100.00

  RUNOFF                                  0.066           239.021      0.53

  EVAPOTRANSPIRATION                     11.603         42119.293     94.03

  DRAINAGE COLLECTED FROM LAYER  5        0.0037           13.574      0.03

  PERC./LEAKAGE THROUGH LAYER  7          0.000003          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6            0.0016

  CHANGE IN WATER STORAGE                 0.667          2422.315      5.41

  SOIL WATER AT START OF YEAR           174.997        635238.062

  SOIL WATER AT END OF YEAR             175.931        638629.062

  SNOW WATER AT START OF YEAR             0.267           968.735      2.16

  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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                          ANNUAL TOTALS FOR YEAR    8
-------------------------------------------------------------------------------
                                        INCHES          CU. FEET     PERCENT
                                       --------        ----------    -------
  PRECIPITATION                          11.36          41236.801    100.00

  RUNOFF                                  0.422          1533.350      3.72

  EVAPOTRANSPIRATION                     10.851         39390.641     95.52

  DRAINAGE COLLECTED FROM LAYER  5        0.3308         1200.739      2.91
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  PERC./LEAKAGE THROUGH LAYER  7           0.000018          0.066      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.1437

  CHANGE IN WATER STORAGE                 -0.245          -887.948     -2.15

  SOIL WATER AT START OF YEAR            175.931        638629.062

  SOIL WATER AT END OF YEAR              175.686        637741.125

  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           -0.044      0.00

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                          ANNUAL TOTALS FOR YEAR    9
------------------------------------------------------------------------------
                                        INCHES          CU. FEET     PERCENT
                                       --------        ----------    -------
  PRECIPITATION                          10.06          36517.805    100.00

  RUNOFF                                  0.215           779.700      2.14

  EVAPOTRANSPIRATION                     10.437         37885.297    103.74

  DRAINAGE COLLECTED FROM LAYER  5         0.0188           68.361      0.19

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.011      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0083

  CHANGE IN WATER STORAGE                 -0.610         -2215.576     -6.07

  SOIL WATER AT START OF YEAR            175.686        637741.125

  SOIL WATER AT END OF YEAR              175.076        635525.562

  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            0.012      0.00

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                          ANNUAL TOTALS FOR YEAR   10
------------------------------------------------------------------------------
                                        INCHES          CU. FEET     PERCENT
                                       --------        ----------    -------
  PRECIPITATION                          14.15          51364.508    100.00

  RUNOFF                                  0.017            60.798      0.12

  EVAPOTRANSPIRATION                     13.012         47232.918     91.96
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  DRAINAGE COLLECTED FROM LAYER  5         0.0012            4.474      0.01

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0005

  CHANGE IN WATER STORAGE                  1.120          4066.338      7.92

  SOIL WATER AT START OF YEAR            175.076        635525.562

  SOIL WATER AT END OF YEAR              175.415        636756.000

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.781          2835.917      5.52

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.025      0.00

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                          ANNUAL TOTALS FOR YEAR   11
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           11.86          43051.805    100.00

  RUNOFF                                   0.000             0.000      0.00

  EVAPOTRANSPIRATION                      11.676         42385.559     98.45

  DRAINAGE COLLECTED FROM LAYER  5         0.0003            1.106      0.00

  PERC./LEAKAGE THROUGH LAYER  7           0.000002          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0001

  CHANGE IN WATER STORAGE                  0.183           665.141      1.54

  SOIL WATER AT START OF YEAR            175.415        636756.000

  SOIL WATER AT END OF YEAR              175.709        637824.875

  SNOW WATER AT START OF YEAR              0.781          2835.917      6.59

  SNOW WATER AT END OF YEAR                0.670          2432.154      5.65

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.008      0.00

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                          ANNUAL TOTALS FOR YEAR   12
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           11.35          41200.508    100.00

  RUNOFF                                   0.144           524.287      1.27

  EVAPOTRANSPIRATION                      11.714         42522.602    103.21
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  DRAINAGE COLLECTED FROM LAYER  5         0.0001            0.483      0.00

  PERC./LEAKAGE THROUGH LAYER  7           0.000002          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0001

  CHANGE IN WATER STORAGE                 -0.509         -1846.922     -4.48

  SOIL WATER AT START OF YEAR            175.709        637824.875

  SOIL WATER AT END OF YEAR              175.476        636979.375

  SNOW WATER AT START OF YEAR              0.670          2432.154      5.90

  SNOW WATER AT END OF YEAR                0.394          1430.751      3.47

  ANNUAL WATER BUDGET BALANCE              0.0000            0.050      0.00

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                          ANNUAL TOTALS FOR YEAR   13
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                            9.61          34884.301    100.00

  RUNOFF                                   0.000             0.000      0.00

  EVAPOTRANSPIRATION                      10.504         38130.461    109.31

  DRAINAGE COLLECTED FROM LAYER  5         0.0008            2.888      0.01

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0003

  CHANGE IN WATER STORAGE                 -0.895         -3249.020     -9.31

  SOIL WATER AT START OF YEAR            175.476        636979.375

  SOIL WATER AT END OF YEAR              174.976        635161.125

  SNOW WATER AT START OF YEAR              0.394          1430.751      4.10

  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   14
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           11.70          42471.008    100.00

  RUNOFF                                   0.000             0.000      0.00
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  EVAPOTRANSPIRATION                      11.041         40078.844     94.37

  DRAINAGE COLLECTED FROM LAYER  5         0.0006            2.157      0.01

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0003

  CHANGE IN WATER STORAGE                  0.658          2389.997      5.63

  SOIL WATER AT START OF YEAR            174.976        635161.125

  SOIL WATER AT END OF YEAR              175.634        637551.125

  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            0.001      0.00

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                          ANNUAL TOTALS FOR YEAR   15
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           10.34          37534.203    100.00

  RUNOFF                                   0.001             2.054      0.01

  EVAPOTRANSPIRATION                      10.097         36653.090     97.65

  DRAINAGE COLLECTED FROM LAYER  5         0.0023            8.498      0.02

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0010

  CHANGE IN WATER STORAGE                  0.240           870.522      2.32

  SOIL WATER AT START OF YEAR            175.634        637551.125

  SOIL WATER AT END OF YEAR              175.599        637422.875

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.275           998.749      2.66

  ANNUAL WATER BUDGET BALANCE              0.0000            0.030      0.00

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                          ANNUAL TOTALS FOR YEAR   16
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           11.06          40147.797    100.00

  RUNOFF                                   0.000             0.000      0.00
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  EVAPOTRANSPIRATION                      11.301         41023.516    102.18

  DRAINAGE COLLECTED FROM LAYER  5         0.0006            2.233      0.01

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0003

  CHANGE IN WATER STORAGE                 -0.242          -877.945     -2.19

  SOIL WATER AT START OF YEAR            175.599        637422.875

  SOIL WATER AT END OF YEAR              175.632        637543.687

  SNOW WATER AT START OF YEAR              0.275           998.749      2.49

  SNOW WATER AT END OF YEAR                0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.014      0.00

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                          ANNUAL TOTALS FOR YEAR   17
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           14.37          52163.098    100.00

  RUNOFF                                   0.004            13.387      0.03

  EVAPOTRANSPIRATION                      14.430         52380.410    100.42

  DRAINAGE COLLECTED FROM LAYER  5         0.0106           38.323      0.07

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.010      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0046

  CHANGE IN WATER STORAGE                 -0.074          -269.045     -0.52

  SOIL WATER AT START OF YEAR            175.632        637543.687

  SOIL WATER AT END OF YEAR              175.234        636101.062

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.323          1173.573      2.25

  ANNUAL WATER BUDGET BALANCE              0.0000            0.014      0.00

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                          ANNUAL TOTALS FOR YEAR   18
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                            8.46          30709.803    100.00
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  RUNOFF                                   0.142           513.824      1.67

  EVAPOTRANSPIRATION                       8.604         31231.676    101.70

  DRAINAGE COLLECTED FROM LAYER  5         0.0016            5.763      0.02

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0007

  CHANGE IN WATER STORAGE                 -0.287         -1041.469     -3.39

  SOIL WATER AT START OF YEAR            175.234        636101.062

  SOIL WATER AT END OF YEAR              175.271        636233.187

  SNOW WATER AT START OF YEAR              0.323          1173.573      3.82

  SNOW WATER AT END OF YEAR                0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000            0.000      0.00

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                          ANNUAL TOTALS FOR YEAR   19
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                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           15.14          54958.219    100.00

  RUNOFF                                   0.005            19.612      0.04

  EVAPOTRANSPIRATION                      14.411         52311.488     95.18

  DRAINAGE COLLECTED FROM LAYER  5         0.0048           17.478      0.03

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.010      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0021

  CHANGE IN WATER STORAGE                  0.719          2609.642      4.75

  SOIL WATER AT START OF YEAR            175.271        636233.187

  SOIL WATER AT END OF YEAR              175.397        636691.562

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.593          2151.240      3.91

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.011      0.00

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                          ANNUAL TOTALS FOR YEAR   20
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                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           12.81          46500.309    100.00
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  RUNOFF                                   0.091           329.095     0.71

  EVAPOTRANSPIRATION                      13.271         48173.836   103.60

  DRAINAGE COLLECTED FROM LAYER  5         0.0024            8.847     0.02

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.009     0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0011

  CHANGE IN WATER STORAGE                 -0.554         -2011.492    -4.33

  SOIL WATER AT START OF YEAR            175.397        636691.562

  SOIL WATER AT END OF YEAR              175.436        636831.312

  SNOW WATER AT START OF YEAR              0.593          2151.240     4.63

  SNOW WATER AT END OF YEAR                0.000             0.000     0.00

  ANNUAL WATER BUDGET BALANCE              0.0000            0.011     0.00

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                          ANNUAL TOTALS FOR YEAR   21
------------------------------------------------------------------------------
                                         INCHES          CU. FEET    PERCENT
                                        --------        ----------   -------
  PRECIPITATION                           10.81          39240.309   100.00

  RUNOFF                                   0.000             1.076     0.00

  EVAPOTRANSPIRATION                      10.754         39038.668    99.49

  DRAINAGE COLLECTED FROM LAYER  5         0.0004            1.520     0.00

  PERC./LEAKAGE THROUGH LAYER  7           0.000002          0.009     0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0002

  CHANGE IN WATER STORAGE                  0.055           198.989     0.51

  SOIL WATER AT START OF YEAR            175.436        636831.312

  SOIL WATER AT END OF YEAR              175.484        637006.375

  SNOW WATER AT START OF YEAR              0.000             0.000     0.00

  SNOW WATER AT END OF YEAR                0.007            23.903     0.06

  ANNUAL WATER BUDGET BALANCE              0.0000            0.047     0.00

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                          ANNUAL TOTALS FOR YEAR   22
------------------------------------------------------------------------------
                                         INCHES          CU. FEET    PERCENT
                                        --------        ----------   -------
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  PRECIPITATION                           14.67          53252.109    100.00

  RUNOFF                                   0.008            30.353      0.06

  EVAPOTRANSPIRATION                      14.463         52499.316     98.59

  DRAINAGE COLLECTED FROM LAYER  5         0.0196           71.119      0.13

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.011      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0085

  CHANGE IN WATER STORAGE                  0.179           651.284      1.22

  SOIL WATER AT START OF YEAR            175.484        637006.375

  SOIL WATER AT END OF YEAR              175.369        636590.812

  SNOW WATER AT START OF YEAR              0.007            23.903      0.04

  SNOW WATER AT END OF YEAR                0.300          1090.774      2.05

  ANNUAL WATER BUDGET BALANCE              0.0000            0.026      0.00

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                          ANNUAL TOTALS FOR YEAR   23
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           12.65          45919.508    100.00

  RUNOFF                                   0.042           153.830      0.33

  EVAPOTRANSPIRATION                      12.332         44765.715     97.49

  DRAINAGE COLLECTED FROM LAYER  5         0.0009            3.409      0.01

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0004

  CHANGE IN WATER STORAGE                  0.275           996.555      2.17

  SOIL WATER AT START OF YEAR            175.369        636590.812

  SOIL WATER AT END OF YEAR              175.843        638311.625

  SNOW WATER AT START OF YEAR              0.300          1090.774      2.38

  SNOW WATER AT END OF YEAR                0.101           366.492      0.80

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.011      0.00

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                          ANNUAL TOTALS FOR YEAR   24
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
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                                        --------        ----------    -------
  PRECIPITATION                           13.82          50166.602    100.00

  RUNOFF                                   0.291          1055.490      2.10

  EVAPOTRANSPIRATION                      13.820         50165.469    100.00

  DRAINAGE COLLECTED FROM LAYER  5         0.0035           12.641      0.03

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0015

  CHANGE IN WATER STORAGE                 -0.294         -1067.021     -2.13

  SOIL WATER AT START OF YEAR            175.843        638311.625

  SOIL WATER AT END OF YEAR              175.541        637214.375

  SNOW WATER AT START OF YEAR              0.101           366.492      0.73

  SNOW WATER AT END OF YEAR                0.109           396.735      0.79

  ANNUAL WATER BUDGET BALANCE              0.0000            0.016      0.00

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                          ANNUAL TOTALS FOR YEAR   25
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           10.08          36590.398    100.00

  RUNOFF                                   0.067           243.622      0.67

  EVAPOTRANSPIRATION                       9.496         34471.535     94.21

  DRAINAGE COLLECTED FROM LAYER  5         0.0007            2.421      0.01

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0003

  CHANGE IN WATER STORAGE                  0.516          1872.901      5.12

  SOIL WATER AT START OF YEAR            175.541        637214.375

  SOIL WATER AT END OF YEAR              176.166        639484.000

  SNOW WATER AT START OF YEAR              0.109           396.735      1.08

  SNOW WATER AT END OF YEAR                0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.090      0.00

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                          ANNUAL TOTALS FOR YEAR   26
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                                        INCHES          CU. FEET     PERCENT
                                       --------       ----------    -------
  PRECIPITATION                          12.12          43995.609    100.00

  RUNOFF                                  0.040           146.963      0.33

  EVAPOTRANSPIRATION                     12.774         46368.199    105.39

  DRAINAGE COLLECTED FROM LAYER  5        0.0188           68.307      0.16

  PERC./LEAKAGE THROUGH LAYER  7          0.000003          0.011      0.00

  AVG. HEAD ON TOP OF LAYER  6            0.0082

  CHANGE IN WATER STORAGE                -0.713         -2587.904     -5.88

  SOIL WATER AT START OF YEAR           176.166        639484.000

  SOIL WATER AT END OF YEAR             175.453        636896.125

  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            0.035      0.00

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                         ANNUAL TOTALS FOR YEAR   27
-------------------------------------------------------------------------------
                                        INCHES          CU. FEET     PERCENT
                                       --------       ----------    -------
  PRECIPITATION                          14.68          53288.410    100.00

  RUNOFF                                  0.545          1979.834      3.72

  EVAPOTRANSPIRATION                     11.182         40589.500     76.17

  DRAINAGE COLLECTED FROM LAYER  5        0.0704          255.372      0.48

  PERC./LEAKAGE THROUGH LAYER  7          0.000006          0.021      0.00

  AVG. HEAD ON TOP OF LAYER  6            0.0303

  CHANGE IN WATER STORAGE                 2.883         10463.610     19.64

  SOIL WATER AT START OF YEAR           175.453        636896.125

  SOIL WATER AT END OF YEAR             178.313        647276.437

  SNOW WATER AT START OF YEAR             0.000             0.000      0.00

  SNOW WATER AT END OF YEAR               0.023            83.304      0.16

  ANNUAL WATER BUDGET BALANCE             0.0000            0.073      0.00

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                         ANNUAL TOTALS FOR YEAR   28
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-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           11.26         40873.801    100.00

  RUNOFF                                   0.362         1315.114      3.22

  EVAPOTRANSPIRATION                      10.869        39456.133     96.53

  DRAINAGE COLLECTED FROM LAYER  5         2.4447        8874.338     21.71

  PERC./LEAKAGE THROUGH LAYER  7           0.000127         0.462      0.00

  AVG. HEAD ON TOP OF LAYER  6             1.0685

  CHANGE IN WATER STORAGE                 -2.417        -8772.254    -21.46

  SOIL WATER AT START OF YEAR            178.313       647276.437

  SOIL WATER AT END OF YEAR              175.711       637830.500

  SNOW WATER AT START OF YEAR              0.023           83.304      0.20

  SNOW WATER AT END OF YEAR                0.209          756.994      1.85

  ANNUAL WATER BUDGET BALANCE              0.0000           0.007      0.00

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                          ANNUAL TOTALS FOR YEAR   29
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                            9.92         36009.605    100.00

  RUNOFF                                   0.000            0.000      0.00

  EVAPOTRANSPIRATION                      10.452        37939.270    105.36

  DRAINAGE COLLECTED FROM LAYER  5         0.0742         269.305      0.75

  PERC./LEAKAGE THROUGH LAYER  7           0.000005         0.020      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0327

  CHANGE IN WATER STORAGE                 -0.606        -2198.946     -6.11

  SOIL WATER AT START OF YEAR            175.711       637830.500

  SOIL WATER AT END OF YEAR              175.314       636388.500

  SNOW WATER AT START OF YEAR              0.209          756.994      2.10

  SNOW WATER AT END OF YEAR                0.000            0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000          -0.045      0.00

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                          ANNUAL TOTALS FOR YEAR   30
-------------------------------------------------------------------------------
                                         INCHES           CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           14.68          53288.406    100.00

  RUNOFF                                   0.001             5.055      0.01

  EVAPOTRANSPIRATION                      14.542         52788.066     99.06

  DRAINAGE COLLECTED FROM LAYER  5         0.0040           14.687      0.03

  PERC./LEAKAGE THROUGH LAYER  7           0.000003          0.010      0.00

  AVG. HEAD ON TOP OF LAYER  6             0.0018

  CHANGE IN WATER STORAGE                  0.132           480.558      0.90

  SOIL WATER AT START OF YEAR            175.314        636388.500

  SOIL WATER AT END OF YEAR              175.446        636869.062

  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            0.033      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                 0.56     0.59     0.76     1.24     1.34     1.34
                           1.24     1.09     1.43     1.04     0.92     0.66

    STD. DEVIATIONS        0.40     0.49     0.32     0.57     0.67     0.67
                           0.53     0.56     0.81     0.71     0.61     0.41

  RUNOFF
  ------
    TOTALS                 0.007    0.001    0.012    0.044    0.000    0.000
                           0.000    0.000    0.000    0.000    0.021    0.005

    STD. DEVIATIONS        0.039    0.004    0.040    0.088    0.002    0.000
                           0.000    0.000    0.000    0.000    0.074    0.027

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.599    0.557    0.712    1.219    1.438    1.591
                           1.534    0.998    1.219    0.876    0.660    0.600

    STD. DEVIATIONS        0.275    0.276    0.263    0.527    0.640    0.659
                           0.679    0.508    0.622    0.483    0.313    0.338

  LATERAL DRAINAGE COLLECTED FROM LAYER  5
  ----------------------------------------
    TOTALS                 0.0093   0.0112   0.0136   0.0118   0.0088   0.0059
```

```
                           0.0091   0.0126   0.0113   0.0085   0.0049   0.0048

    STD. DEVIATIONS        0.0412   0.0526   0.0576   0.0500   0.0360   0.0223
                           0.0360   0.0489   0.0460   0.0358   0.0196   0.0156

  PERCOLATION/LEAKAGE THROUGH LAYER  7
  ------------------------------------
    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  6
  -------------------------------------
    AVERAGES               0.0479   0.0617   0.0698   0.0630   0.0451   0.0314
                           0.0468   0.0647   0.0603   0.0440   0.0261   0.0247

    STD. DEVIATIONS        0.2122   0.2899   0.2968   0.2659   0.1853   0.1186
                           0.1855   0.2518   0.2448   0.1844   0.1041   0.0802

*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                     INCHES           CU. FEET       PERCENT
                               -------------------   -------------   ---------
 PRECIPITATION                  12.21    (   1.827)      44313.8     100.00

 RUNOFF                          0.091   (  0.1422)        329.87      0.744

 EVAPOTRANSPIRATION             12.003   (  1.6684)      43570.18     98.322

 LATERAL DRAINAGE COLLECTED      0.11172 (  0.44817)       405.526    0.91512
   FROM LAYER  5

 PERCOLATION/LEAKAGE THROUGH     0.00001 (  0.00002)         0.029     0.00007
   LAYER  7

 AVERAGE HEAD ON TOP             0.049 (    0.196)
   OF LAYER  6

 CHANGE IN WATER STORAGE         0.002   (  0.8536)          8.22      0.019

*******************************************************************************



******************************************************************************

                PEAK DAILY VALUES FOR YEARS    1 THROUGH   30
   ------------------------------------------------------------------------
                                               (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                              1.49          5408.700

      RUNOFF                                     0.397         1440.7190
```

```
      DRAINAGE COLLECTED FROM LAYER  5           0.01034         37.52281

      PERCOLATION/LEAKAGE THROUGH LAYER  7       0.000001         0.00196

      AVERAGE HEAD ON TOP OF LAYER  6            1.651

      MAXIMUM HEAD ON TOP OF LAYER  6            2.835

      LOCATION OF MAXIMUM HEAD IN LAYER  5
            (DISTANCE FROM DRAIN)               25.5 FEET

      SNOW WATER                                 1.22          4418.5054


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.3322

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1040


       ***  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   30
    ----------------------------------------------------------------------
                    LAYER        (INCHES)       (VOL/VOL)
                    -----        --------       ---------
                      1            8.4059         0.2001

                      2            2.6640         0.2220

                      3           70.0800         0.2920

                      4           87.6000         0.2920

                      5            1.5722         0.1310

                      6            0.0000         0.0000

                      7            5.1240         0.4270

                  SNOW WATER       0.000

******************************************************************************
******************************************************************************
```

ATTACHMENT I-1-5

Scenario 5 HELP Model: 25 Feet of Construction and Demolition (C&D) Waste, Intermediate Cover (10-Year Weather Generation)

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\JCL_IC.D4
TEMPERATURE DATA FILE:      C:\JCL_IC.D7
SOLAR RADIATION DATA FILE:  C:\JCL_IC.D13
EVAPOTRANSPIRATION DATA:    C:\JCL_IC.D11
SOIL AND DESIGN DATA FILE:  C:\JCLCDIC.D10
OUTPUT DATA FILE:           C:\JCLCDIC.OUT



TIME:  16:46     DATE:   7/21/2020




******************************************************************************

     TITLE:  JACKSON CO. LF SCENARIO 5: INTERMEDIATE COVER 25' C&D WASTE

******************************************************************************




     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   0
           THICKNESS                   =     12.00   INCHES
           POROSITY                    =      0.4730 VOL/VOL
           FIELD CAPACITY              =      0.2220 VOL/VOL
           WILTING POINT               =      0.1040 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.1666 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.429999985000E-03 CM/SEC




                                   LAYER  2
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  19
           THICKNESS                   =    300.00   INCHES
           POROSITY                    =      0.1680 VOL/VOL
           FIELD CAPACITY              =      0.0730 VOL/VOL
           WILTING POINT               =      0.0190 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.0730 VOL/VOL
```

```
    EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC



                            LAYER  3
                            --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER   0
    THICKNESS                   =     12.00   INCHES
    POROSITY                    =      0.4570 VOL/VOL
    FIELD CAPACITY              =      0.1310 VOL/VOL
    WILTING POINT               =      0.0580 VOL/VOL
    INITIAL SOIL WATER CONTENT  =      0.1310 VOL/VOL
    EFFECTIVE SAT. HYD. COND.   =  0.999999978000E-02 CM/SEC
    SLOPE                       =      2.00   PERCENT
    DRAINAGE LENGTH             =    167.0    FEET



                            LAYER  4
                            --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                  MATERIAL TEXTURE NUMBER  35
    THICKNESS                   =      0.06   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         =      1.00   HOLES/ACRE
    FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
    FML PLACEMENT QUALITY       =  2 - EXCELLENT



                            LAYER  5
                            --------

                  TYPE 3 - BARRIER SOIL LINER
                  MATERIAL TEXTURE NUMBER  16
    THICKNESS                   =     36.00   INCHES
    POROSITY                    =      0.4270 VOL/VOL
    FIELD CAPACITY              =      0.4180 VOL/VOL
    WILTING POINT               =      0.3670 VOL/VOL
    INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
    EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC




            GENERAL DESIGN AND EVAPORATIVE ZONE DATA
            ----------------------------------------

  NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

 SCS RUNOFF CURVE NUMBER             =     85.00
 FRACTION OF AREA ALLOWING RUNOFF    =     50.0    PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
 EVAPORATIVE ZONE DEPTH              =     12.0    INCHES
 INITIAL WATER IN EVAPORATIVE ZONE   =      1.999  INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE  =      5.676  INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE  =      1.248  INCHES
 INITIAL SNOW WATER                  =      0.000  INCHES
```

```
        INITIAL WATER IN LAYER MATERIALS    =     40.843  INCHES
        TOTAL INITIAL WATER                 =     40.843  INCHES
        TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR




                    EVAPOTRANSPIRATION AND WEATHER DATA
                    -----------------------------------

         NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                  CHEYENNE             WYOMING

             STATION LATITUDE                     =  40.73 DEGREES
             MAXIMUM LEAF AREA INDEX              =   0.00
             START OF GROWING SEASON (JULIAN DATE)  =    138
             END OF GROWING SEASON (JULIAN DATE)    =    273
             EVAPORATIVE ZONE DEPTH               =  12.0  INCHES
             AVERAGE ANNUAL WIND SPEED            =  12.90 MPH
             AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  52.00 %
             AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  54.00 %
             AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  50.00 %
             AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  51.00 %



         NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    CHEYENNE            WYOMING

                  NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       0.55        0.64        0.79        1.17        1.43        1.31
       1.41        1.20        1.36        0.99        0.90        0.64


         NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    CHEYENNE            WYOMING

             NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
      16.00       18.40       26.80       34.90       43.90       52.70
      58.50       56.70       48.60       38.30       25.50       16.90


         NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    CHEYENNE            WYOMING
                    AND STATION LATITUDE  =  40.73 DEGREES



*******************************************************************************

                          ANNUAL TOTALS FOR YEAR    1
-------------------------------------------------------------------------------
                                          INCHES          CU. FEET     PERCENT
                                         --------        ----------    -------
  PRECIPITATION                            10.49          38078.703    100.00

  RUNOFF                                    0.035           126.884      0.33

  EVAPOTRANSPIRATION                       10.050         36481.125     95.80
```

```
  DRAINAGE COLLECTED FROM LAYER  3         0.0044           15.889      0.04

  PERC./LEAKAGE THROUGH LAYER  5           0.000003          0.010      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0018

  CHANGE IN WATER STORAGE                  0.401          1454.789      3.82

  SOIL WATER AT START OF YEAR             40.843        148260.797

  SOIL WATER AT END OF YEAR               41.244        149715.594

  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            0.008      0.00

*******************************************************************************


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR    2
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           14.83          53832.910    100.00

  RUNOFF                                   0.026            94.239      0.18

  EVAPOTRANSPIRATION                      14.804         53738.875     99.83

  DRAINAGE COLLECTED FROM LAYER  3         0.0124           45.138      0.08

  PERC./LEAKAGE THROUGH LAYER  5           0.000003          0.010      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0050

  CHANGE IN WATER STORAGE                 -0.013           -45.376     -0.08

  SOIL WATER AT START OF YEAR             41.244        149715.594

  SOIL WATER AT END OF YEAR               40.537        147150.734

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.694          2519.485      4.68

  ANNUAL WATER BUDGET BALANCE              0.0000            0.023      0.00

*******************************************************************************


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR    3
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           12.48          45302.398    100.00

  RUNOFF                                   0.333          1207.658      2.67

  EVAPOTRANSPIRATION                      11.732         42588.090     94.01
```

```
  DRAINAGE COLLECTED FROM LAYER  3         0.0586          212.654      0.47

  PERC./LEAKAGE THROUGH LAYER  5           0.000005          0.017      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0236

  CHANGE IN WATER STORAGE                  0.356          1293.973      2.86

  SOIL WATER AT START OF YEAR             40.537        147150.734

  SOIL WATER AT END OF YEAR               41.331        150033.312

  SNOW WATER AT START OF YEAR              0.694          2519.485      5.56

  SNOW WATER AT END OF YEAR                0.256           930.883      2.05

  ANNUAL WATER BUDGET BALANCE              0.0000            0.008      0.00

*******************************************************************************


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR    4
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           12.05          43741.508    100.00

  RUNOFF                                   0.038           136.279      0.31

  EVAPOTRANSPIRATION                      12.258         44495.789    101.72

  DRAINAGE COLLECTED FROM LAYER  3         0.0114           41.280      0.09

  PERC./LEAKAGE THROUGH LAYER  5           0.000003          0.010      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0046

  CHANGE IN WATER STORAGE                 -0.257          -931.850     -2.13

  SOIL WATER AT START OF YEAR             41.331        150033.312

  SOIL WATER AT END OF YEAR               41.185        149502.812

  SNOW WATER AT START OF YEAR              0.256           930.883      2.13

  SNOW WATER AT END OF YEAR                0.146           529.525      1.21

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.001      0.00

*******************************************************************************


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR    5
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           13.26          48133.809    100.00

  RUNOFF                                   0.238           863.943      1.79
```

```
  EVAPOTRANSPIRATION                      13.529         49108.559    102.03

  DRAINAGE COLLECTED FROM LAYER  3         0.2438          884.975      1.84

  PERC./LEAKAGE THROUGH LAYER  5           0.000013          0.048      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0980

  CHANGE IN WATER STORAGE                 -0.750         -2723.721     -5.66

  SOIL WATER AT START OF YEAR             41.185        149502.812

  SOIL WATER AT END OF YEAR               40.581        147308.625

  SNOW WATER AT START OF YEAR              0.146           529.525      1.10

  SNOW WATER AT END OF YEAR                0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000            0.006      0.00

*******************************************************************************


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR    6
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           13.82          50166.609    100.00

  RUNOFF                                   0.122           442.901      0.88

  EVAPOTRANSPIRATION                      13.003         47202.172     94.09

  DRAINAGE COLLECTED FROM LAYER  3         0.8072         2930.023      5.84

  PERC./LEAKAGE THROUGH LAYER  5           0.000039          0.141      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.3254

  CHANGE IN WATER STORAGE                 -0.113          -408.633     -0.81

  SOIL WATER AT START OF YEAR             40.581        147308.625

  SOIL WATER AT END OF YEAR               40.201        145931.250

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.267           968.735      1.93

  ANNUAL WATER BUDGET BALANCE              0.0000            0.006      0.00

*******************************************************************************


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR    7
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           12.34          44794.207    100.00

  RUNOFF                                   0.164           595.175      1.33
```

```
  EVAPOTRANSPIRATION                      11.713         42516.836     94.92

  DRAINAGE COLLECTED FROM LAYER  3         0.0564          204.579      0.46

  PERC./LEAKAGE THROUGH LAYER  5           0.000004          0.016      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0229

  CHANGE IN WATER STORAGE                  0.407          1477.566      3.30

  SOIL WATER AT START OF YEAR             40.201        145931.250

  SOIL WATER AT END OF YEAR               40.875        148377.547

  SNOW WATER AT START OF YEAR              0.267           968.735      2.16

  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    8
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           11.36          41236.801    100.00

  RUNOFF                                   0.495          1795.985      4.36

  EVAPOTRANSPIRATION                      10.473         38018.539     92.20

  DRAINAGE COLLECTED FROM LAYER  3         0.2108          765.129      1.86

  PERC./LEAKAGE THROUGH LAYER  5           0.000011          0.040      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0848

  CHANGE IN WATER STORAGE                  0.181           657.112      1.59

  SOIL WATER AT START OF YEAR             40.875        148377.547

  SOIL WATER AT END OF YEAR               41.056        149034.656

  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           -0.003      0.00

*******************************************************************************



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                          ANNUAL TOTALS FOR YEAR    9
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           10.06          36517.805    100.00
```

```
  RUNOFF                                   0.268           974.491      2.67

  EVAPOTRANSPIRATION                      10.301         37391.465    102.39

  DRAINAGE COLLECTED FROM LAYER  3         0.0263           95.488      0.26

  PERC./LEAKAGE THROUGH LAYER  5           0.000003          0.012      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0106

  CHANGE IN WATER STORAGE                 -0.535         -1943.670     -5.32

  SOIL WATER AT START OF YEAR             41.056        149034.656

  SOIL WATER AT END OF YEAR               40.521        147091.000

  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            0.018      0.00

*******************************************************************************


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR   10
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           14.15          51364.508    100.00

  RUNOFF                                   0.114           414.211      0.81

  EVAPOTRANSPIRATION                      13.050         47370.820     92.22

  DRAINAGE COLLECTED FROM LAYER  3         0.0044           16.033      0.03

  PERC./LEAKAGE THROUGH LAYER  5           0.000003          0.010      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0018

  CHANGE IN WATER STORAGE                  0.982          3563.416      6.94

  SOIL WATER AT START OF YEAR             40.521        147091.000

  SOIL WATER AT END OF YEAR               40.721        147818.500

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.781          2835.917      5.52

  ANNUAL WATER BUDGET BALANCE              0.0000            0.017      0.00

*******************************************************************************


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         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH   10
-------------------------------------------------------------------------------
```

```
                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 0.62     0.63     0.85     1.36     1.29     1.31
                           1.32     1.09     1.71     1.04     0.62     0.64

    STD. DEVIATIONS        0.51     0.45     0.43     0.70     0.98     0.76
                           0.47     0.51     0.86     0.61     0.59     0.45

  RUNOFF
  ------
    TOTALS                 0.025    0.002    0.031    0.089    0.011    0.000
                           0.000    0.000    0.005    0.000    0.019    0.000

    STD. DEVIATIONS        0.073    0.005    0.069    0.104    0.025    0.000
                           0.000    0.001    0.013    0.000    0.044    0.000

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.589    0.591    0.699    1.490    1.386    1.350
                           1.095    0.933    1.870    1.011    0.577    0.500

    STD. DEVIATIONS        0.357    0.301    0.259    0.514    0.996    0.700
                           0.663    0.412    0.528    0.537    0.463    0.342

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS                 0.0066   0.0032   0.0019   0.0014   0.0115   0.0107
                           0.0064   0.0037   0.0350   0.0336   0.0173   0.0123

    STD. DEVIATIONS        0.0111   0.0054   0.0032   0.0017   0.0255   0.0254
                           0.0137   0.0071   0.0651   0.0575   0.0294   0.0206

  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               0.0313   0.0168   0.0091   0.0067   0.0548   0.0527
                           0.0302   0.0174   0.1720   0.1597   0.0850   0.0584

    STD. DEVIATIONS        0.0528   0.0284   0.0154   0.0083   0.1213   0.1246
                           0.0651   0.0335   0.3198   0.2733   0.1446   0.0981

*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   10
-------------------------------------------------------------------------------
                                     INCHES           CU. FEET       PERCENT
                               -------------------   -------------   ---------
 PRECIPITATION                  12.48    (   1.563)      45316.9     100.00

 RUNOFF                          0.183   (  0.1515)        665.18      1.468
```

```
 EVAPOTRANSPIRATION             12.091   (  1.5444)      43891.23     96.854

 LATERAL DRAINAGE COLLECTED      0.14356 (  0.24876)       521.119    1.14994
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH     0.00001 (  0.00001)         0.031     0.00007
   LAYER  5

 AVERAGE HEAD ON TOP             0.058 (    0.100)
   OF LAYER  4

 CHANGE IN WATER STORAGE         0.066   (  0.5093)        239.36      0.528

*******************************************************************************


⬆
******************************************************************************

                PEAK DAILY VALUES FOR YEARS    1 THROUGH   10
   ------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                              1.17         4247.100

      RUNOFF                                     0.232         842.3121

      DRAINAGE COLLECTED FROM LAYER  3           0.01017        36.90978

      PERCOLATION/LEAKAGE THROUGH LAYER  5       0.000000        0.00176

      AVERAGE HEAD ON TOP OF LAYER  4            1.498

      MAXIMUM HEAD ON TOP OF LAYER  4            2.577

      LOCATION OF MAXIMUM HEAD IN LAYER  3
            (DISTANCE FROM DRAIN)               23.3 FEET

      SNOW WATER                                 1.13         4103.0435


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.3095

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1049

       ***  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   10
    ----------------------------------------------------------------------
                    LAYER        (INCHES)       (VOL/VOL)
                    -----        --------       ---------
                      1            1.8771         0.1564
```

```
                      2           21.9000         0.0730

                      3            1.5723         0.1310

                      4            0.0000         0.0000

                      5           15.3720         0.4270

                  SNOW WATER       0.781

******************************************************************************
******************************************************************************
```

APPENDIX I-2

Stability

GOLDER

CALCULATIONS

DATE	July 24, 2020	**PREPARED BY**	CAJ
DOCUMENT NO.	19124320-6-R-0	**CHECKED BY**	ALB
SITE NAME	Jackson County Landfill	**REVIEWED BY**	MEM

SLOPE STABILITY ANALYSIS

1.0 OBJECTIVE

Evaluate the slope stability of the alternative final cover system and perimeter berm at the Jackson County Landfill (JCL) during final closure conditions as well as the slope stability of the internal side slope after cell construction, prior to waste placement. Final closure conditions are modeled at the final design slopes of 4H:1V side slope and a 10% crown slope.

2.0 METHOD

One cross section representative of the most conservative final closure conditions, and after cell construction prior to waste placement, of the JCL was evaluated for global slope stability analysis as shown in Figure I-1. This section corresponds to both the maximum waste grades and the minimum perimeter berm height, thus modelling both the maximum driving force and the minimum resisting force. As the perimeter berm maintains a relatively consistent height above existing ground, this section also serves to analyze the conditions following cell construction before waste placement.

General limit equilibrium (GLE) slope stability analyses were performed using the Spencer method in Slide 8.0 (RocScience 2018), a slope stability modeling software platform commonly considered as the standard of practice for slope stability analyses of earthen structures such as landfills. It is common geotechnical practice to analyze the stability of embankment slopes using limit equilibrium methods.

The CJL is located in a seismic impact zone, defined in the Colorado Department of Public Health and Environment (CDPHE) Regulations Pertaining to Solid Waste Sites and Facilities, 6 CCR 1007-2, Part 1 (Regulations) as an area with a 10% or greater probability that the maximum horizontal acceleration in lithified earth material, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10g in 250 years. The mapped peak horizontal ground acceleration (PGA) with a 2% probability of exceedance in 50 years (approximately equivalent to 10% in 250 years or a 2,475-year return period) for the site is 0.17g. Therefore, slope stability analyses were run for both static and seismic (pseudo-static) loading conditions. Given the relatively homogenous structure of the landfill and perimeter berm, circular failure surfaces were analyzed, with the exception of the block failure analyzed for the liner system prior to waste placement.

2.1 Assumptions

Slope stability analyses were based on the following assumptions:

- Factors of safety were computed using the Spencer Method of Slices.

- Circular failure analyses were modeled for the final cover. Circular analysis slip surfaces were drawn using a random search routine to locate the critical failure surface (the failure surface yielding the lowest factor of safety).
- Block failure analyses were modeled for post cell construction, prior to waste placement. The block analysis slip surface with the lowest factor of safety was identified to occur at the interface between the protective cover and underlying textured 60-mil high-density polyethylene (HDPE) geomembrane. The interface between the textured geomembrane and the underlying low-permeability soil liner is supported by the anchor trench at the slope crest and is not considered critical.
- Unit weight for the native material was estimated at 112 pounds per cubic foot (pcf) based on N_{60} values (Bowles 1988).
- Friction angle for the native material was estimated at 33.6 degrees based on N_{60} values (Bowles 1988).
- Material properties for engineered fill used in the perimeter berms, protective cover, and final cover are assumed to be the same. The unit weight of these materials was based on standard Proctor test results for Sample F-3 at maximum dry density. Shear strength properties of these materials were based on published data for engineering properties of compacted soils for specific United Soil Classification System (USCS) soil types (USDI 1987). On-site soils were generally classified as silty sand (SM) as shown in the 2019 Geotechnical Investigation (Appendix H of the Engineering Design and Operations Plan [EDOP]). Shear strength values were obtained from average published values for silty sand (SM).
- Shear strength properties for municipal solid waste (MSW) were developed from the average of conservative values referenced from published data (Kavazanjian et al. 1995). The unit weight of MSW was referenced from published data (NAVFAC 1983) assuming an average between good and best compaction methods.
- Soil liner material properties were based on direct shear test (ASTM D3080) report of on-site soils as shown in the 2019 Geotechnical Investigation (EDOP, Appendix H);
- 60-mil HDPE geomembrane unit weight taken from Agru America Inc. product specification sheet. Shear strength properties for the interface between a textured geomembrane and clay material is based on published data (Koutsourais et al. 1991). Shear strength properties for the interface between a textured geomembrane and sand material is derived from empirical data collected by Golder.
- Shear strength of site soils for seismic loading scenarios were adjusted based on approach presented in Rationalizing the Seismic Coefficient Method (Hynes-Griffin and Franklin 1984).
- Minimum allowable factors of safety for long-term conditions (final closure) is 1.50 for static scenarios and 1.0 for seismic loading scenarios.

2.2 Material Properties

Mohr-Coulomb drained shear strength parameters were used for all materials (except for characterizing the interface between a textured geomembrane and sand material) as summarized in Table 1.

Table 1: Shear Strength Parameters

Material	Total Unit Weight (pcf)	Static Loading Analysis		Seismic Loading Analysis	
		Friction Angle (°)	Cohesion (psf)	Friction Angle (°)	Cohesion (psf)
Subgrade	112	35	0	29.3	0
Soil Liner	86.7	18	717	14.6	573.6
60-mil HDPE Geomembrane Interface with Soil Liner	60	11	252	8.8	201.6
60-mil HDPE Geomembrane Interface with Protective Cover	60	32	0	-	-
Engineered Fill, Protective Cover, and Final Cover	118	33.6	0	28	0
Waste	65	21	210	17.1	168

3.0 RESULTS AND CONCLUSIONS

Results of the slope stability analyses are summarized in Table 2. The results are also illustrated graphically in the attached Slide Output Models, provided in Attachment I-2-1. The figures depict the most critical slip surfaces and computed minimum factors of safety for the cross sections evaluated.

Table 2: Summary of Analyses and Computed Minimum Factors of Safety

Operational Condition	Cross Section	Analysis Type	Seismic or Static	Factor of Safety
Final closure	North–south	Circular	Static	2.05
	North–south	Circular	Seismic	1.27
	North–south (within limits of waste)	Circular	Static	2.66
	North–south (within limits of waste)	Circular	Seismic	1.56
Prior to waste placement	North–south	Block	Static	1.96

The minimum factors of safety calculated against both static and seismic stability failure were found to be above the targeted factors of safety for both cross sections and are therefore considered stable for the operational conditions evaluated.

4.0 REFERENCES

Bowles, J.E. 1988. Foundation Analysis and Design. 4th Edition, McGraw-Hill, New York.

Kavazanjian, E. Jr., N. Matasovic, R. Bonaparte, and G.R. Schmertmann. 1995. Evaluation of MSW properties for Seismic Analysis. Geoenvironment 2000, ASCE Geotechnical Special Publication No. 46, 2, ASCE, Reston, Va., pp. 1126-1141.

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M. M. Koutsourais, C.J. Sprague, R.C. Pucetas. 1991. Interfacial friction study of cap and liner components for landfill design.

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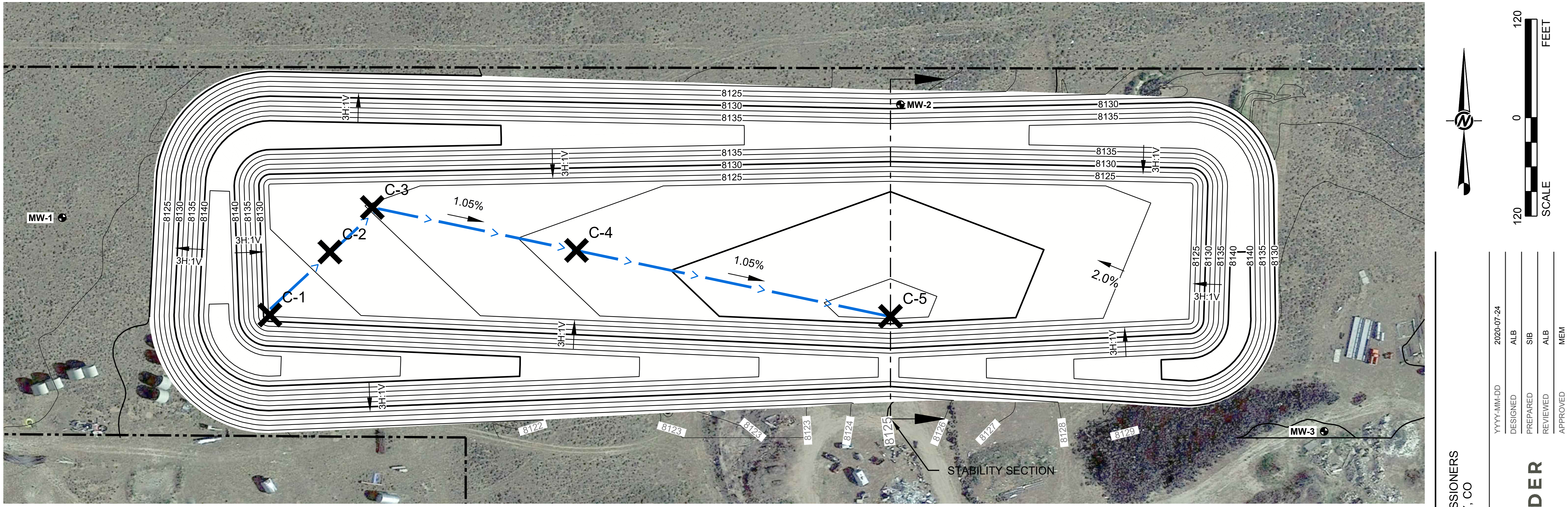
FIGURE I-1

Engineering Calculations Figure



LEGEND

5280	EXISTING TOPOGRAPHY (SEE NOTE 1)
5280	PROPOSED GRADE
— - - —	PROPERTY BOUNDARY
— < —	CRITICAL LEACHATE FLOW PATH
● MW-2	MONITORING WELL (SEE NOTE 2)

NOTES

1. EXISTING TOPOGRAPHY IS A COMPOSITE OF GROUND SURVEY PROVIDED TO GOLDER BY JACKSON COUNTY ON MARCH 27, 2020 PERFORMED BY NORTH PARK ENGINEERING & CONSULTING, INC. MARCH 2020 AND USGS CONTOURS.
2. MONITORING WELL LOCATIONS ARE APPROXIMATE.
3. AERIAL IMAGERY: ESRI BASEMAP SERVICES, DIGITAL GLOBE CAPTURED ON 10/29/2018.
4. ELEVATION DATA SET: USGS NATIONAL ELEVATION DATA SET 1 ARC-SECOND

CLIENT
BOARD OF COMMISSIONERS
JACKSON COUNTY, CO

CONSULTANT
GOLDER

YYYY-MM-DD	2020-07-24
DESIGNED	ALB
PREPARED	SIB
REVIEWED	ALB
APPROVED	MEM

PROJECT
JACKSON COUNTY TRANSFER STATION
MSW LANDFILL CELL
WALDEN, CO

TITLE
ENGINEERING CALCULATIONS FIGURE

PROJECT NO.
19-124320

REV.
0

FIGURE
I-1

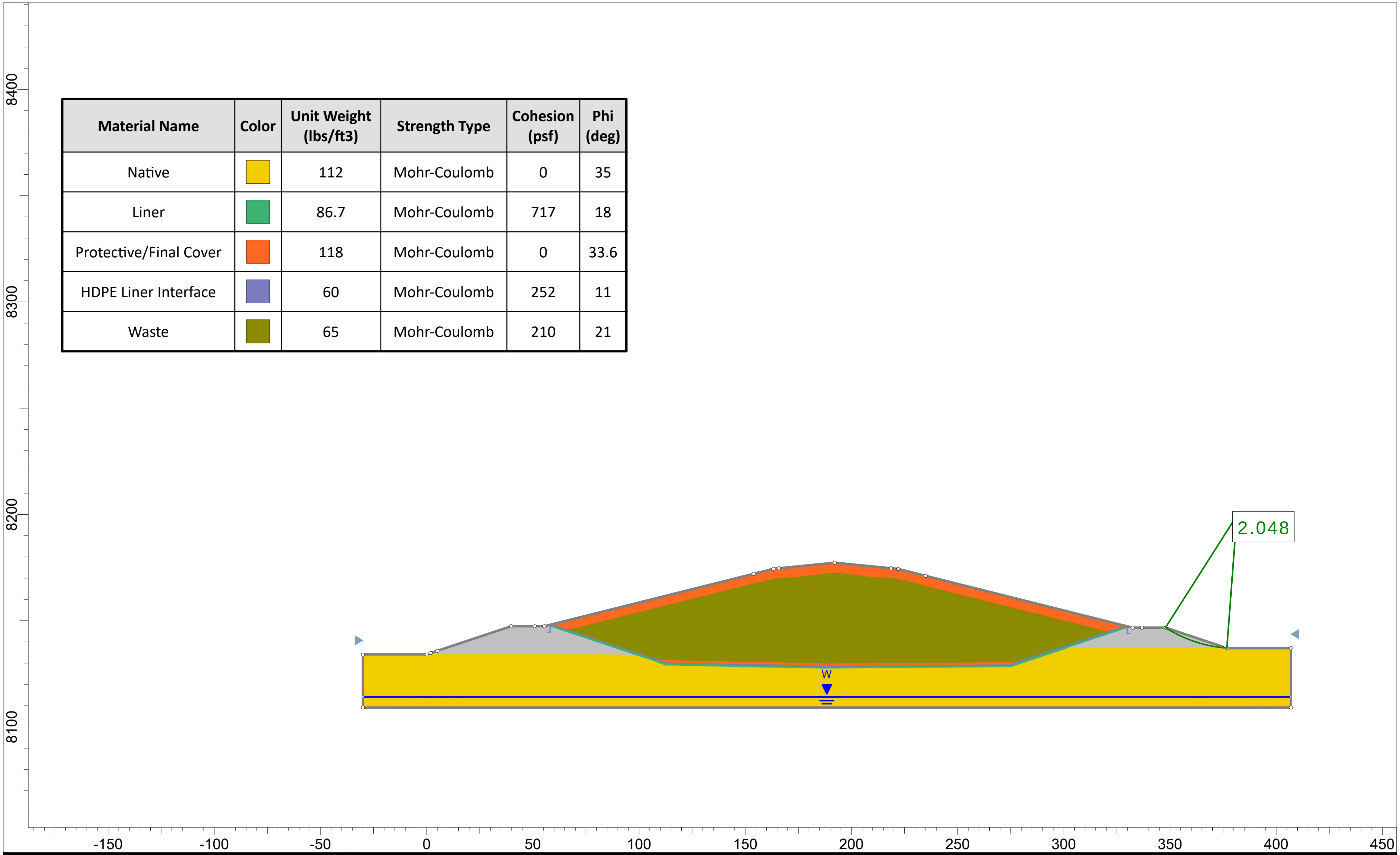
1 in IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Path: G:\Plan Production Data Files\Drawing Data Files\19-124320\CIVIL 3D\Design 04142020.dwg

ATTACHMENT I-1-2

Slide Output Models

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Native	🟨	112	Mohr-Coulomb	0	35
Liner	🟩	86.7	Mohr-Coulomb	717	18
Protective/Final Cover	🟧	118	Mohr-Coulomb	0	33.6
HDPE Liner Interface	🟪	60	Mohr-Coulomb	252	11
Waste	🟫	65	Mohr-Coulomb	210	21



Project
SLIDE - An Interactive Slope Stability Program

Analysis Description
Final Cover: Circular - Static

Drawn By CAJ

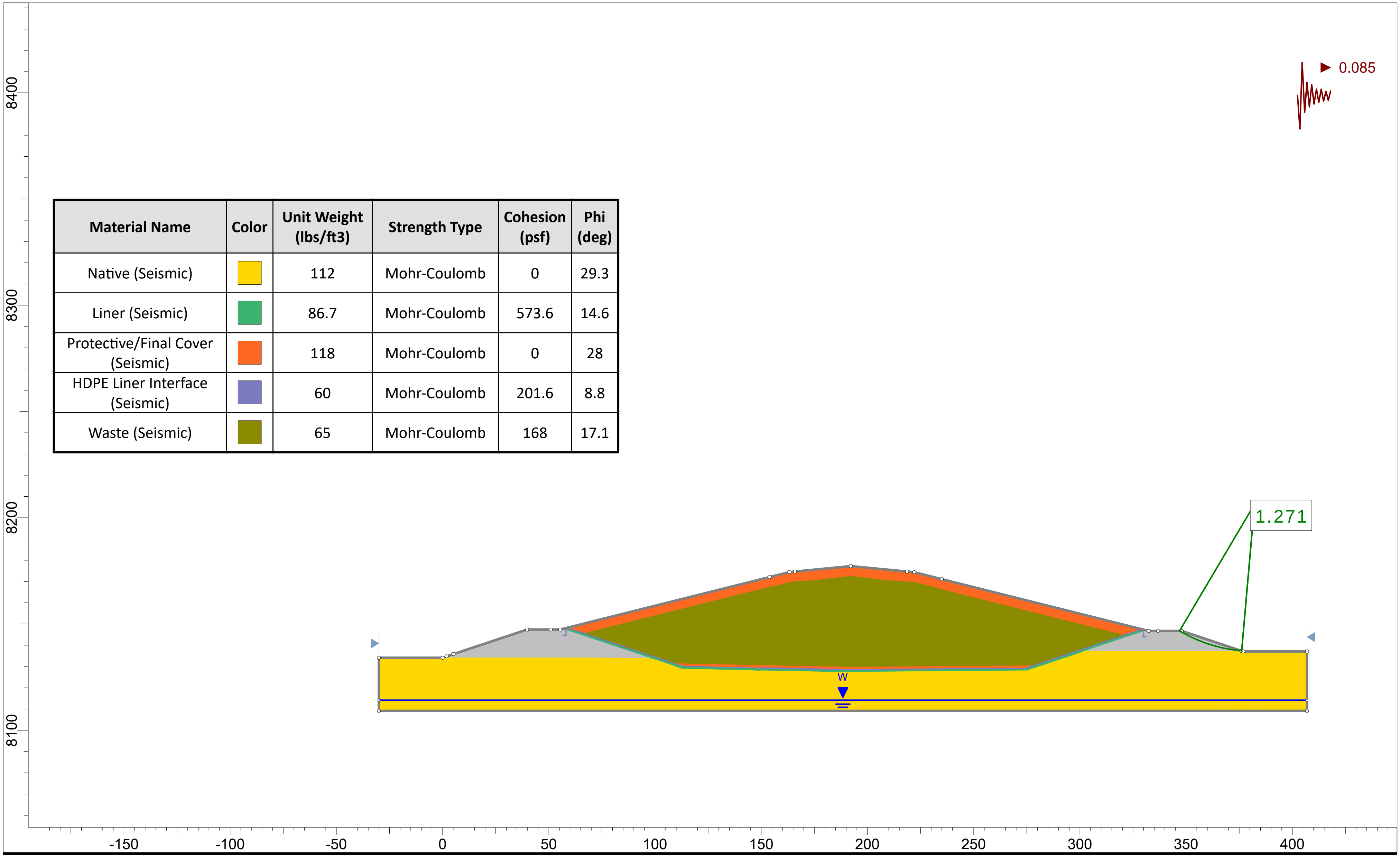
Scale 1:750

Company Golder

Date 7/13/2020, 12:12:00 PM

File Name 19124320 - FC North to South.slmd

SLIDEINTERPRET 8.032

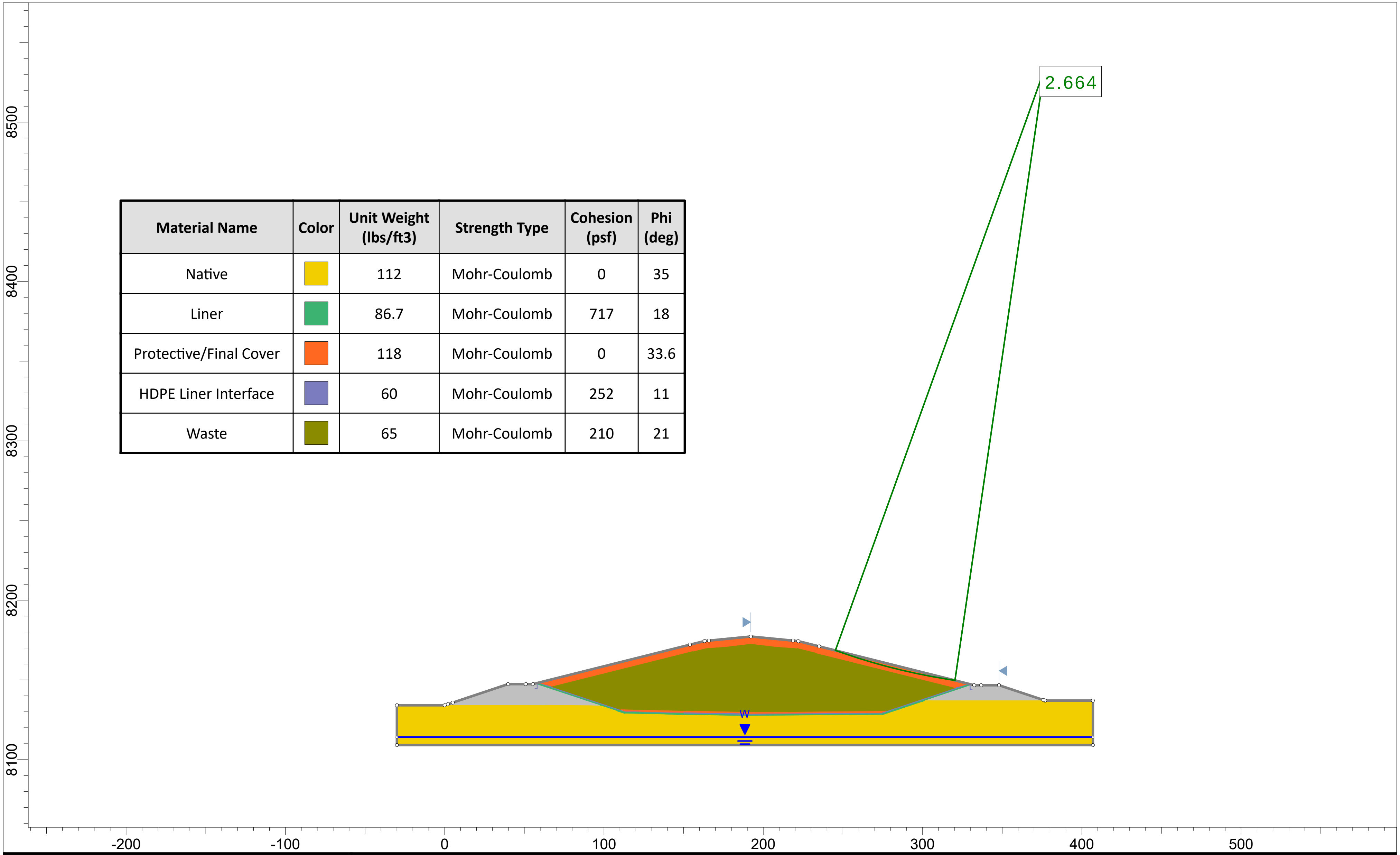


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Native (Seismic)	🟨	112	Mohr-Coulomb	0	29.3
Liner (Seismic)	🟩	86.7	Mohr-Coulomb	573.6	14.6
Protective/Final Cover (Seismic)	🟧	118	Mohr-Coulomb	0	28
HDPE Liner Interface (Seismic)	🟪	60	Mohr-Coulomb	201.6	8.8
Waste (Seismic)	🟫	65	Mohr-Coulomb	168	17.1

rocscience

SLIDEINTERPRET 8.032

Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	Final Cover: Circular - Seismic
Drawn By	CAJ
Scale	1:750
Company	Golder
Date	7/13/2020, 12:12:00 PM
File Name	19124320 - FC North to South.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Native	🟨	112	Mohr-Coulomb	0	35
Liner	🟩	86.7	Mohr-Coulomb	717	18
Protective/Final Cover	🟧	118	Mohr-Coulomb	0	33.6
HDPE Liner Interface	🟪	60	Mohr-Coulomb	252	11
Waste	🟫	65	Mohr-Coulomb	210	21

rocscience

SLIDEINTERPRET 8.032

Project SLIDE - An Interactive Slope Stability Program

Analysis Description Final Cover: Circular (Limits of Waste) - Static

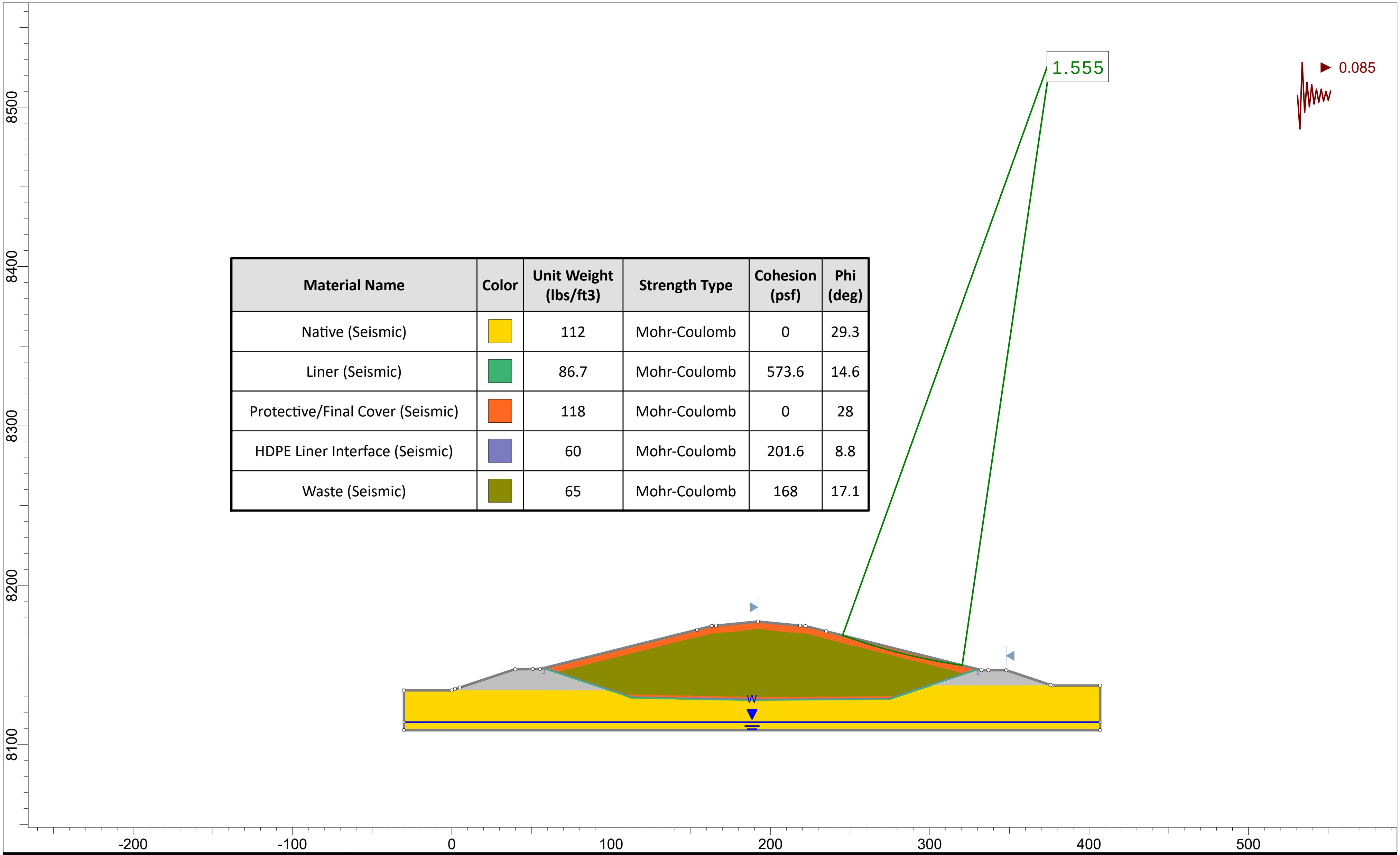
Drawn By CAJ

Scale 1:1000

Company Golder

Date 7/13/2020, 12:12:00 PM

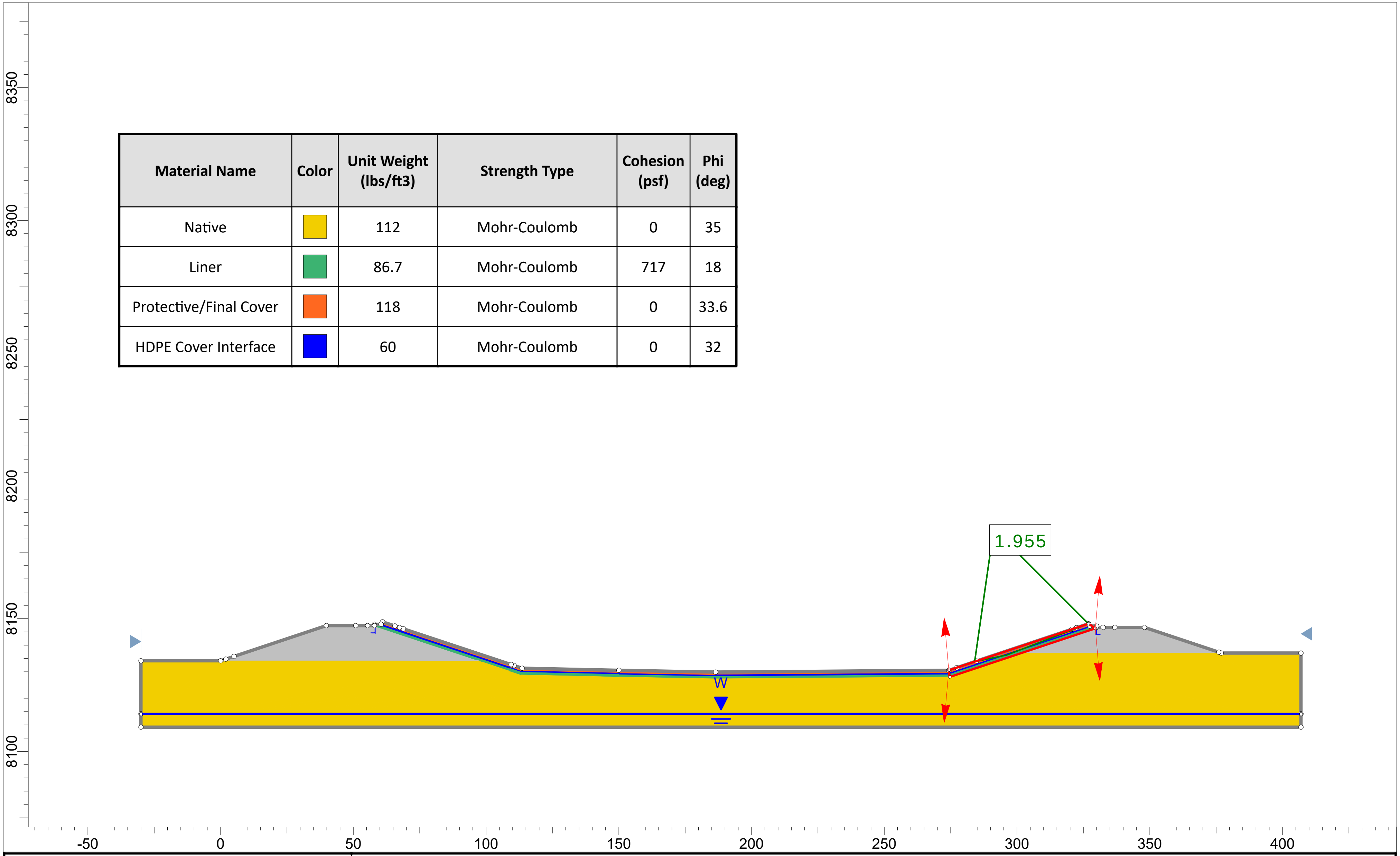
File Name 19124320 - FC North to South.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Native (Seismic)	🟨	112	Mohr-Coulomb	0	29.3
Liner (Seismic)	🟩	86.7	Mohr-Coulomb	573.6	14.6
Protective/Final Cover (Seismic)	🟧	118	Mohr-Coulomb	0	28
HDPE Liner Interface (Seismic)	🟪	60	Mohr-Coulomb	201.6	8.8
Waste (Seismic)	🟫	65	Mohr-Coulomb	168	17.1

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Final Cover: Circular (Limits of Waste) - Seismic		
Drawn By	CAJ	*Scale*	1:1000
Company	Golder		
Date	7/13/2020, 12:12:00 PM	*File Name*	19124320 - FC North to South.slmd

SLIDEINTERPRET 8.032



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Native	🟨	112	Mohr-Coulomb	0	35
Liner	🟩	86.7	Mohr-Coulomb	717	18
Protective/Final Cover	🟧	118	Mohr-Coulomb	0	33.6
HDPE Cover Interface	🟦	60	Mohr-Coulomb	0	32

rocscience

SLIDEINTERPRET 8.032

Project SLIDE - An Interactive Slope Stability Program

Analysis Description Prior to Waste Placement: Planar - Static

Drawn By CAJ

Scale 1:600

Company Golder

Date 7/13/2020, 12:12:00 PM

File Name 19124320 - FC North to South.slmd

APPENDIX I-3

Settlement

CALCULATIONS

DATE	July 24, 2020	**PREPARED BY**	ALB
DOCUMENT NO.	19124320-6-R-0	**CHECKED BY**	JAR
SITE NAME	Jackson County Landfill	**REVIEWED BY**	MEM

ELASTIC FOUNDATION SETTLEMENT CALCULATION

1.0 OBJECTIVE

Calculate the potential elastic settlement (total and differential) of the foundation soils below the proposed municipal solid waste (MSW) landfill assuming maximum waste elevations and final cover conditions. Estimate the maximum change in the slope of the landfill liner floor grades and in the leachate collection header trench resulting from differential foundation settlement.

2.0 METHOD

Apply the modified Schmertmann method to estimate total and differential settlements of foundation soils. Settlement of foundation soils is considered from the bottom of the liner to the top of bedrock beneath the landfill. Settlement is calculated at five points along the leachate collection header trench alignment and the landfill liner floor under varying overburden pressures from overlying waste and final cover. The locations of the settlement points are shown in Figure I-1. The change in the liner floor grade slope is calculated using differential settlements between each point.

3.0 ASSUMPTIONS

Settlement calculations were based on the following assumptions and input parameters:

- Elastic settlement of granular foundation soils beneath the landfill footprint follows the model outlined by Schmertmann (Schmertmann 1970) for shallow foundations of bridges.
- The stratigraphy of the foundation soils was assumed to be uniform across the landfill footprint from existing ground surface to the depth of bedrock. This assumption was based on borehole logs from the site (Golder 2020, Appendix H of the Engineering Design and Operation Plan [EDOP]).
- Site subsurface data, including standard penetration test (SPT) blow counts (N), depth to bedrock, and groundwater elevation were referenced from Golder's geotechnical investigation of the site and monitoring well installation (Golder 2020). Blow counts were adjusted to account for the energy imparted by the hammer to produce the N_{60} value. The site average N_{60} value is 54.
- The elastic modulus (Es) for the sandy silt present on site is estimated using the Bowles correlation (Bowles 1988) from SPT N_{60} values.
- The influence factor outlined in the Schmertmann method is equal to 1 for large landfill footprints overlying relatively shallow bedrock.

- Settlement does not occur in the highly weathered bedrock noted on the borehole logs, included in Appendix H.
- Elastic settlement is calculated considering creep over a 30-year time period.
- The following material properties were used in the settlement analysis:
  - Landfill waste unit weight: 65 pounds per cubic foot (pcf)
  - Liner unit weight: 91 pcf (Golder 2020)
  - Alternative final cover (AFC), intermediate cover, structural fill, and leachate collection layer unit weights: 114 pcf (Golder 2020)
  - In situ subsurface soil unit weight: 112 pcf (Bowles 1988), calculated using an N-value correlation
  - Modulus of elasticity (Es) of subsurface soil: 520 kips per square foot (ksf) (Bowles 1988), calculated using an N-value correlation
    - Es for the material was based on the average N_{60} value correlation minus one standard deviation.

4.0 ANALYSIS

The immediate elastic settlement of the landfill is estimated by the modified Schmertmann method using the following equation:

$$S_i = C_1 C_2 \Delta p \sum_{i=1}^{n} \left(H_i \left(\frac{I_z}{E_{s_i}} \right) \right)$$

where:

$$C_1 = 1 - 0.5 \left(\frac{p_0}{\Delta p} \right) \geq 0.5$$

and:

$$C_2 = 1 + 0.2 \log_{10} \left(\frac{t(yrs)}{0.1} \right)$$

S_i is the elastic settlement, C_1 is a correction factor accounting for the embedment of a shallow foundation, C_2 is a correction factor accounting for creep in settlement with time (*t*), p_0 is the vertical overburden stress at the midpoint f each subsurface layer, Δp is the change in vertical overburden stress imparted by the landfill at the midpoint of each subsurface layer, H_i is the thickness of each subsurface soil layer, I_z is an influence factor based on the depth of each subsurface layer, and E_s is the modulus of elasticity for each layer. For this calculation, the C_1 correction factor is neglected (i.e., assumed to be 1) because there is no strain relief in subsurface soils for typical foundation construction.

The five settlement points were selected along the longest leachate flow path to determine how settlement affects the liner floor slope and subsequent leachate travel time. The locations of the settlement points are shown in Figure I-1. Table 1 outlines the input data for the calculations.

Table 1: Input data for Settlement Analysis

	C-1	**C-2**	**C-3**	**C-4**	**C-5**
Existing ground elevation (ft)	8,120.8	8,120.6	8,120.4	8,121.3	8,124.1
Proposed subgrade elevation (ft)	8,127.5	8,125.4	8,123.9	8,121.2	8,117.1
Proposed top of waste elevation (ft)	8,152.6	8,167.5	8,158.3	8,165.5	8,144.8
Bedrock elevation (ft)	8,093.4	8,094.9	8,095.9	8,098.1	8,101.5
Initial vertical overburden pressure (P_0) (psf)	1,533.8	1,441.0	1,375.4	1,298.7	1,266.0
Net surcharge Δp (psf)	2,987.3	3,877.2	3,217.3	3,458.8	1,602.6
Layer thickness, H (ft)	34.1	30.5	28.0	23.1	15.6
Embedment depth correction factor (C_1)	1.0	1.0	1.0	1.0	1.0
Creep correction factor (C_2)	1.5	1.5	1.5	1.5	1.5
Strain (Δp/Es) (ft/ft)	0.006	0.007	0.006	0.007	0.003

5.0 RESULTS

Calculations at the settlement points yield total settlement ranging from 0.07 feet near the perimeter of the landfill to 0.34 feet near the maximum anticipated waste height. As a result, floor grades are expected to decrease by as much as 0.8% and the slope of the leachate header by as much as approximately 0.2%. Results are presented in Table 2.

Table 2: Results of Settlement Analysis

<table>
<tr><th></th><th colspan="2">C-1</th><th colspan="2">C-2</th><th colspan="2">C-3</th><th colspan="2">C-4</th><th colspan="2">C-5</th></tr>
<tr><td>Total Elastic Settlement (ft)</td><td colspan="2">0.29</td><td colspan="2">0.34</td><td colspan="2">0.26</td><td colspan="2">0.23</td><td colspan="2">0.07</td></tr>
<tr><td>Pre-consolidation slope</td><td colspan="3">2.00%</td><td colspan="2">2.00%</td><td colspan="2">1.05%</td><td colspan="3">1.05%</td></tr>
<tr><td>Post-consolidation slope</td><td colspan="3">1.40%</td><td colspan="2">1.20%</td><td colspan="2">0.86%</td><td colspan="3">0.97%</td></tr>
</table>

6.0 CONCLUSION

These changes in slope are considered acceptable for the successful function of the landfill.

7.0 REFERENCES

Bowles, J.E. 1988. Foundation Analysis and Design. 4th Edition, McGraw-Hill, New York.

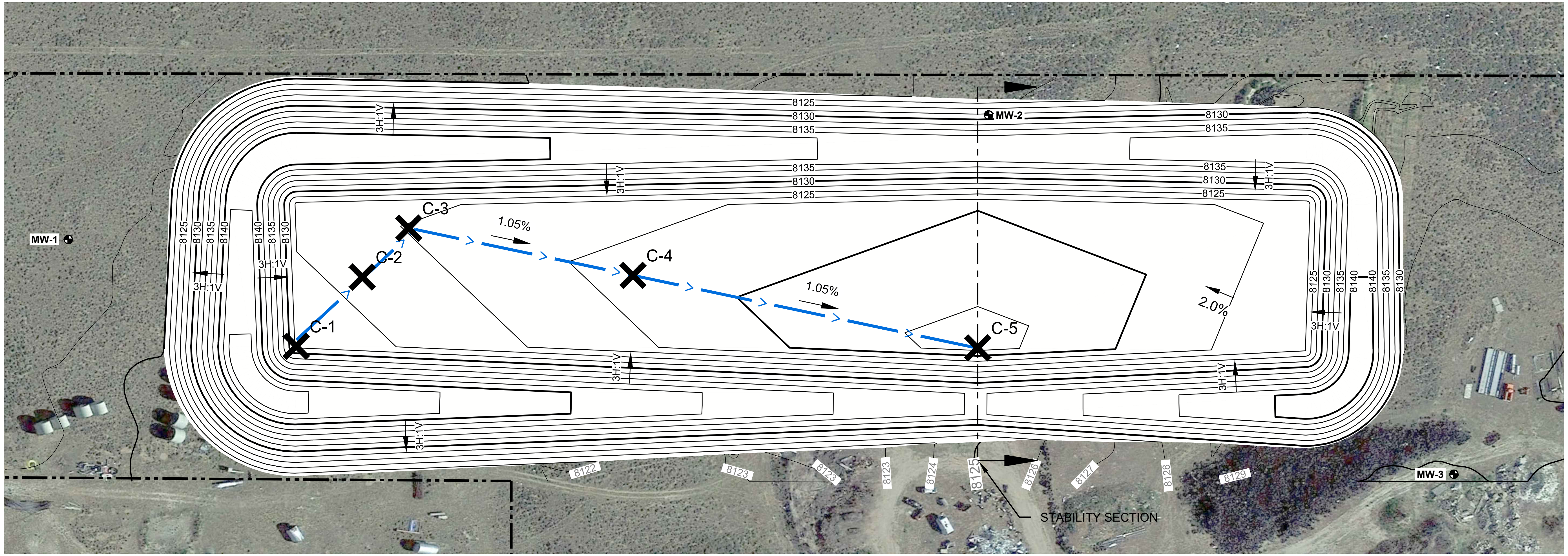
Golder Associates Inc. (Golder). 2020. Results of Subsurface Filed Investigation for Jackson County Transfer Station Proposed Landfill Cell Site; Walden, Colorado. February 7, 2020. Draft

Schmertmann, J.H. 1970. Static Cone to Compute Static Settlement Over Sand. Journal of Soil Mechanics & Foundations Division, 96(3), 1,011–1,043.

Schmertmann, J.H., J.P. Hartman, and P.R. Brown. 1978. Improved Strain Influence Factor Diagrams. Journal of the Geotechnical Engineering Division, 104(GT8), 1,131–1,135.

FIGURE I-1

Engineering Calculations Figure



LEGEND

5280	EXISTING TOPOGRAPHY (SEE NOTE 1)
5280	PROPOSED GRADE
— - - —	PROPERTY BOUNDARY
— < —	CRITICAL LEACHATE FLOW PATH
◐ MW-2	MONITORING WELL (SEE NOTE 2)

NOTES

1. EXISTING TOPOGRAPHY IS A COMPOSITE OF GROUND SURVEY PROVIDED TO GOLDER BY JACKSON COUNTY ON MARCH 27, 2020 PERFORMED BY NORTH PARK ENGINEERING & CONSULTING, INC. MARCH 2020 AND USGS CONTOURS.
2. MONITORING WELL LOCATIONS ARE APPROXIMATE.
3. AERIAL IMAGERY: ESRI BASEMAP SERVICES, DIGITAL GLOBE CAPTURED ON 10/29/2018.
4. ELEVATION DATA SET: USGS NATIONAL ELEVATION DATA SET 1 ARC-SECOND

CLIENT
BOARD OF COMMISSIONERS
JACKSON COUNTY, CO

CONSULTANT
GOLDER

YYYY-MM-DD	2020-07-24
DESIGNED	ALB
PREPARED	SIB
REVIEWED	ALB
APPROVED	MEM

PROJECT
JACKSON COUNTY TRANSFER STATION
MSW LANDFILL CELL
WALDEN, CO

TITLE
ENGINEERING CALCULATIONS FIGURE

PROJECT NO.
19-124320

REV.
0

FIGURE
I-1

0
1 in
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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APPENDIX I-4

Leachate Travel

CALCULATIONS

DATE	July 24, 2020	**PREPARED BY**	JAF
DOCUMENT NO.	19124320-6-R-0	**CHECKED BY**	ALB
SITE NAME	Jackson County Landfill	**REVIEWED BY**	MEM

LEACHATE TRAVEL TIME

1.0 OBJECTIVE

Estimate the maximum travel time for leachate to report to a permanent leachate collection sump using the longest hydraulic leachate flow path within the leachate collection drainage layer and leachate drain lines for the proposed Jackson County Landfill (JCL). Verify that the travel times through the longest flow paths are less than 365 days.

2.0 METHOD

Use Darcy's Law to calculate travel time through the leachate collection drainage layer and drain lines:

$$Q = k \times i \times A$$

where:
Q = Discharge
k = Hydraulic Conductivity
A = Area
i = Gradient

$$q = \frac{Q}{A} = k \times i$$

where:
q = Specific discharge

$$V_s = \frac{q}{n} = \frac{k \times i}{n}$$

where:
V_s = Average linear leachate velocity
n = Porosity

$$T = \frac{d}{V_s} = \frac{d \times n}{k \times i}$$

where:
T = Leachate travel time
d = Maximum leachate travel distance

3.0 ASSUMPTIONS AND DESIGN PARAMETERS

Leachate travel time calculations were based on the following assumptions and design parameters:

- It was assumed that leachate flow through the leachate collection drainage layer and the drain lines follows Darcy's Law.
- It was assumed that the hydraulic gradient of the leachate is equivalent to the slope of the landfill floor.
- Leachate travel times were calculated for the following design slopes and conservative estimates of post-consolidation slopes:
  - Landfill floor slopes:
    - Design slope: 2.00%
    - Post-consolidation slope: 1.40%/1.20%
  - Drain line slopes:
    - Design slope: 1.05%
    - Post-consolidation slope: 0.86%/0.97%
- Material properties of the leachate collection drainage layer material and gravel drain line material are conservatively modelled as follows:
  - Drainage layer:
    - Hydraulic conductivity (k): 0.01 cm/sec (Engineering Design and Operations Plan [EDOP] minimum requirement)
    - Porosity: 0.45
  - Drain line gravel:
    - Hydraulic conductivity (k) – 0.30 cm/sec
    - Porosity: 0.40

4.0 CALCULATIONS

Maximum leachate travel times were calculated for the longest hydraulic leachate flow paths within the proposed facility as shown in Figure I-1. Calculations are summarized in Table 1 and Table 2.

Table 1: Leachate Travel Time – Design Slopes

Drainage Layer				Drain Line				Total Travel Time (days)
Slope (%)	Flow Length (ft)	Velocity (ft/sec)	Travel Time (days)	Slope (%)	Flow Length (ft)	Velocity (ft/sec)	Travel Time (days)	
2.0	181	0.000015	143.5	1.05	645	0.00026	28.7	172.2

Table 2: Leachate Travel Time – Post-Consolidation Slopes

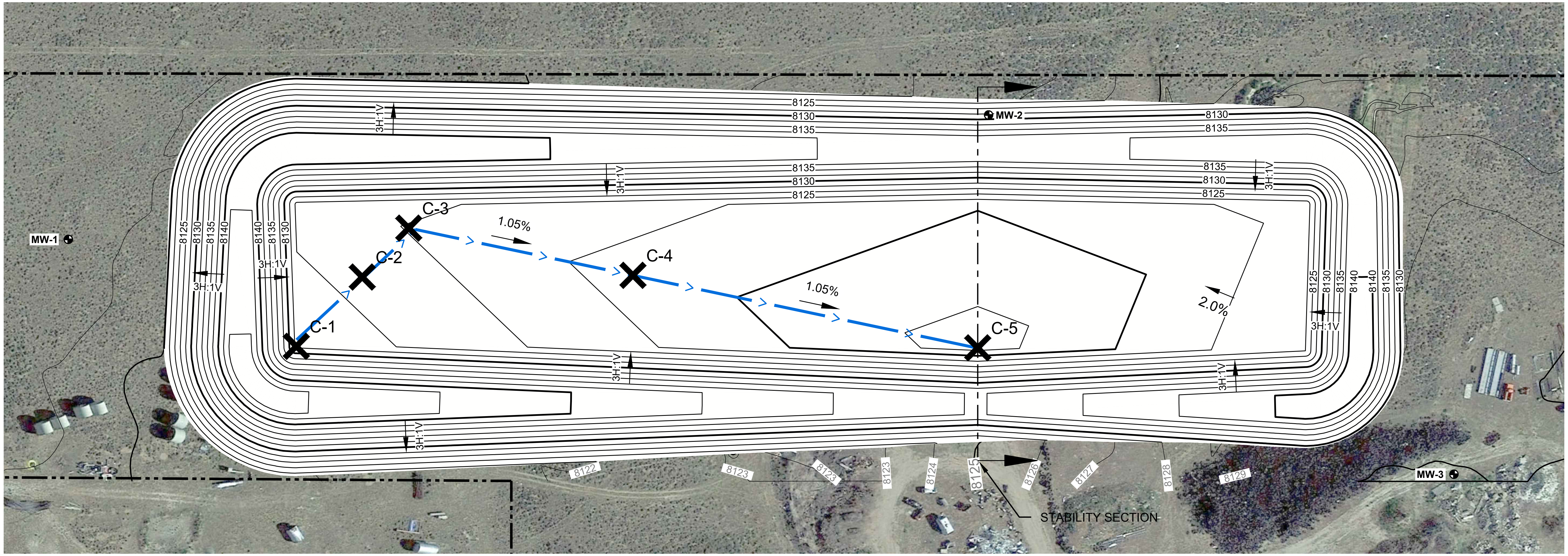
Drainage Layer				Drain Line				Total Travel Time (days)
Slope (%)	Flow Length (ft)	Velocity (ft/sec)	Travel Time (days)	Slope (%)	Flow Length (ft)	Velocity (ft/sec)	Travel Time (days)	
1.3	181	0.000095	219.2	0.92	645	0.00023	32.8	252.0

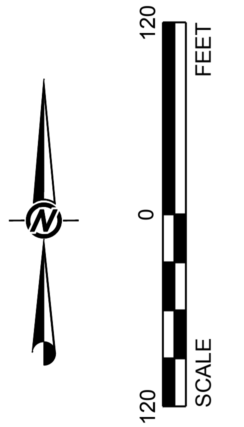
5.0 CONCLUSIONS

The maximum leachate travel times calculated were approximately 172 days for design slopes and approximately 252 days for post-consolidation slopes. All calculated travel times were less than the required 365-day limit for design and post-consolidation conditions.

FIGURE I-1

Engineering Calculations Figure





LEGEND

—5280—	EXISTING TOPOGRAPHY (SEE NOTE 1)
═5280═	PROPOSED GRADE
— · · —	PROPERTY BOUNDARY
— < —	CRITICAL LEACHATE FLOW PATH
● MW-2	MONITORING WELL (SEE NOTE 2)

NOTES

1. EXISTING TOPOGRAPHY IS A COMPOSITE OF GROUND SURVEY PROVIDED TO GOLDER BY JACKSON COUNTY ON MARCH 27, 2020 PERFORMED BY NORTH PARK ENGINEERING & CONSULTING, INC. MARCH 2020 AND USGS CONTOURS.
2. MONITORING WELL LOCATIONS ARE APPROXIMATE.
3. AERIAL IMAGERY: ESRI BASEMAP SERVICES, DIGITAL GLOBE CAPTURED ON 10/29/2018.
4. ELEVATION DATA SET: USGS NATIONAL ELEVATION DATA SET 1 ARC-SECOND

CLIENT
BOARD OF COMMISSIONERS
JACKSON COUNTY, CO

CONSULTANT

GOLDER

YYYY-MM-DD	2020-07-24
DESIGNED	ALB
PREPARED	SIB
REVIEWED	ALB
APPROVED	MEM

PROJECT
JACKSON COUNTY TRANSFER STATION
MSW LANDFILL CELL
WALDEN, CO

TITLE
ENGINEERING CALCULATIONS FIGURE

PROJECT NO.
19-124320

REV.
0

FIGURE
I-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in

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Path: G:\Plan Production Data Files\Drawing Data Files\19-124320\CIVIL 3D\Design 04142020.dwg

APPENDIX I-5

Surface Water

CALCULATIONS

DATE	July 24, 2020	**PREPARED BY**	JAF
DOCUMENT NO.	19124320-6-R-0	**CHECKED BY**	ALB
SITE NAME	Jackson County Landfill	**REVIEWED BY**	MEM

SURFACE WATER

1.0 OBJECTIVE

The purpose of these calculations is to determine the minimum channel depth and slope required to convey surface water runoff around the proposed Jackson County Landfill (JCL). The channels must convey the design storm event with a freeboard of approximately one foot.

2.0 METHOD

Drainage basins for the proposed surface water control system were delineated based on planned and existing topography, shown in Figure I-2.

Times of concentration were calculated using the methodology described in TR-55 (NRCS 1986) for sheet and shallow concentrated flow and Manning's equation for channel flow. Surface water runoff from the final cover system slopes were routed into diversion channels based on proposed landfill grading.

The graphical peak discharge method, also as described in TR-55, was used to determine peak inflows that will occur into perimeter surface water diversion channels.

$$q_p = q_u \times A_m \times Q \times F_p$$

where:

q_p = peak discharge (cubic feet per second [cfs])
q_u = unit peak discharge (cfs/square mile/runoff inch [csm/in])
A_m = drainage area (square miles [mi^2])
Q = runoff (inches)
F_p = percent pond and swamp adjustment

Peak flows were then used to size channels, assuming normal depths.

3.0 ASSUMPTIONS AND DESIGN PARAMETERS

- A design storm event of 2.20 inches was used in this analysis. This event is the 24-hour duration, 100-year frequency storm event from the Rainfall Frequency Atlas of the United States (HDSC 2020)
- The 24-hour duration, 2-year frequency storm depth, which is used in the TR-55 time of concentration method, is 0.94 inches (HDSC 2020).
- The design storms are distributed in time as an SCS Type II synthetic distribution.

- Lag time is equal to 60% of the time of concentration.
- The minimum lag time is 3.0 minutes (a time of concentration of 5 minutes per TR-55).
- The maximum length of sheet flow is 100 feet.
- Subbasins were modeled with a curve number (CN) of 69, representing final landfill cover with a fair stand of grass and Hydrologic Soil Group (HSG) B soil.
- Subbasins contain no pond and swamp area, thus an adjustment factor of 1.0.
- The following Manning's roughness coefficients were used in hydraulic calculations:

Channel Lining	**Manning's n for Stability**	**Manning's n for Capacity**
Grass	0.030	0.035

- Given the low precipitations and subsequently low flow depths (less than 1 foot), a target one foot of freeboard was used for the channels

4.0 CALCULATIONS

Channel reach locations and drainage basin delineations are identified in Figure I-2. Hydrologic parameters for the basins (Tables 1 and 2) and reaches were used to calculate a peak discharge using TR-55 Graphical Peak Discharge Method (Table 3). Channels were sized to accommodate peak flow from the 24-hour, 100-year storm event (Table 4).

5.0 REFERENCES

Natural Resources Conservation Service (NRCS). 1986. Urban Hydrology for Small Watersheds. Washington D.C.: United States Department of Agriculture

Hydrometeorological Design Studies Center (HDSC). 2013. Precipitation Frequency Data Server. National Ocean and Atmospheric Administration (NOAA). Washington D.C.: NOAA

Tables

TABLE 1
SUBBASIN SUMMARY TABLE

Client

Project Description: Jackson County EDOP

Project Number: 19124320

Date:	7/24/20
By:	JAF
Chkd:	ALB
Apprvd:	MEM

Design Storm **100 -Year Reccurence Interval**

Storm Duration (hours)	2-Year Depth (inches)	100 -Year Depth (inches)	Storm Distribution
24	0.9	2.2	II

				CN = 69								
Subbasin ID	Subbasin Area (ft^2)	Subbasin Area (acres)	Subbasin Area (sq mile)	Final Cover (Grass Cover 50-75%; HSG B)				Composite SCS Curve No.	S = $\frac{1000}{CN}$ - 10	Unit Runoff Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
DA 1	103,902	2.39	0.0037	2.39				CN = 69	4.49	0.29	0.06	2,531
DA 2	17,381	0.40	0.0006	0.40				CN = 69	4.49	0.29	0.01	423
DA 3	103,104	2.37	0.0037	2.37				CN = 69	4.49	0.29	0.06	2,512
DA 4	46,347	1.06	0.0017	1.06				CN = 69	4.49	0.29	0.03	1,129
DA 5	18,460	0.42	0.0007	0.42				CN = 69	4.49	0.29	0.01	450
DA 6	47,747	1.10	0.0017	1.10				CN = 69	4.49	0.29	0.03	1,163
		0.00	0.0000									
		0.00	0.0000									
		0.00	0.0000									
		0.00	0.0000									
		0.00	0.0000									
		0.00	0.0000									
		0.00	0.0000									
		0.00	0.0000									
		0.00	0.0000									
Total:	336,941	7.74	0.01								0.19	8,208

GOLDER

TABLE 2
BASIN TIME OF CONCENTRATION CALCULATIONS

Client
Project Description: Jackson County EDOP
Project Number: 19124320

Date:	7/24/20
By:	JAF
Chkd:	ALB
Apprvd:	MEM

					Flow Segment 1							Flow Segment 2						
Subbasin ID	Subbasin Area (sq mile)	Composite Curve Number	Total Lag (0.6*Tc) (min)	Total Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition(1)		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition(1)		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
DA 1	0.0037	69	4.4	7.3	Sheet	100.0	0.200	E	Short Grass		7.2	Shallow	40.9	0.259	U	Unpaved		0.1
DA 2	0.0006	69	4.3	7.1	Sheet	100.0	0.211	E	Short Grass		7.0	Shallow	30.3	0.259	U	Unpaved		0.1
DA 3	0.0037	69	4.4	7.3	Sheet	100.0	0.200	E	Short Grass		7.2	Shallow	29.4	0.259	U	Unpaved		0.1
DA 4	0.0017	69	4.3	7.2	Sheet	100.0	0.200	E	Short Grass		7.2	Shallow	27.8	0.259	U	Unpaved		0.1
DA 5	0.0007	69	4.3	7.1	Sheet	100.0	0.211	E	Short Grass		7.0	Shallow	30.9	0.259	U	Unpaved		0.1
DA 6	0.0017	69	4.4	7.3	Sheet	100.0	0.200	E	Short Grass		7.2	Shallow	41.7	0.259	U	Unpaved		0.1

Notes:
(1) Refer to Attachment A for Roughness Condition descriptions and Tc Coeffiecients.

GOLDER

TABLE 3
FLOW RESULTS FROM HEC-HMS

Client
Project Description: Jackson County EDOP
Project Number: 19124320

Date:	7/24/20
By:	JAF
Chkd:	ALB
Apprvd:	MEM

TR-55 Peak Discharge	Jackson Co LF
Design Storm	100-YR, 24-HR

Hydrologic Element	Drainage Area (mi^2)	Runoff Volume (ac-ft)	Peak Discharge TR-55 (cfs)
DA-1	0.004	0.058	0.858
DA-2	0.001	0.010	0.140
DA-3	0.004	0.058	0.858
DA-4	0.002	0.026	0.3944
DA-5	0.001	0.010	0.1624
DA-6	0.002	0.027	0.3944

Table 4
Channel Hydraulic Calculations

Client
Project Description: Jackson County EDOP
PROJECT NO.: **19124320**

Date:	7/24/20
By:	JAF
Chkd:	ALB
Apprvd:	MEM

			Channel Design Geometry						**Channel Roughness Parameters**			
Reach Designation	**Q100 from TR-55 Graphical Peak Discharge**	**HEC HMS Element ID for Q**	**Approximate Channel Length (ft)**	**Bed Slope (ft/ft)**	**Left Side Slope (H:1V)**	**Right Side Slope (H:1V)**	**Bottom Width (ft)**	**Minimum Channel Depth (ft)**	**Design Channel Lining**		**Mannings 'n' for Capacity (Depth Calculation)**	**Mannings 'n' for Stability (Velocity Calculation)**
Reach DA 1	0.9	DA 1 R	805	0.014	2.0	2.0	0	1.5	G	G	0.035	0.030
Reach DA 2	0.1	DA 2-3 R	247	0.015	2.0	2.0	0	1.5	G	G	0.035	0.030
Reach DA 3	0.9	DA 3 R	777	0.007	2.0	2.0	0	1.5	G	G	0.035	0.030
Reach DA 4	0.4	DA 4 R	387	0.007	2.0	2.0	0	1.5	G	G	0.035	0.030
Reach DA 5	0.2	DA 5	270	0.005	2.0	2.0	0	1.5	G	G	0.035	0.030
Reach DA 6	0.4	DA 6 R	380	0.016	2.0	2.0	0	1.5	G	G	0.035	0.030

GOLDER

Table 4
Channel Hydraulic Calculations

Client
Project Descripti
PROJECT NO.:

Date:	7/24/20
By:	JAF
Chkd:	ALB
Apprvd:	MEM

		Hydraulic Calculations							**Channel Evaluations**	
Reach Designation	**Q100 from TR-55 Graphical Peak Discharge**	**Maximum Velocity (ft/sec)**	**Maximum Normal Flow Depth (ft)**	**Froude Number**	**Normal Depth Shear Stress (lb/ft^2)**	**Stream Power (W/m^2)**	**Top Width of Flow (ft)**	**Top Width of Channel (ft)**	**Available Freeboard (ft)**	
Reach DA 1	0.9	2.0	0.49	0.75	0.42	12.36	1.9	6.0	1.0	
Reach DA 2	0.1	1.3	0.24	0.70	0.23	4.53	1.0	6.0	1.3	
Reach DA 3	0.9	1.6	0.55	0.54	0.24	5.52	2.2	6.0	0.9	**< 1.0 ft**
Reach DA 4	0.4	1.3	0.41	0.52	0.18	3.40	1.7	6.0	1.1	
Reach DA 5	0.2	0.9	0.32	0.42	0.10	1.31	1.3	6.0	1.2	
Reach DA 6	0.4	1.8	0.35	0.76	0.35	9.1	1.4	6.0	1.1	

(1) Note: Comments and Warnings:

< 1.0 ft indicates freeboard is less than 1 foot.

< 1/2 Vel. Head indicates that the remaining freeboard is less than 1/2 the velocity head ($V^2/2g$)
suggesting water may splash out.

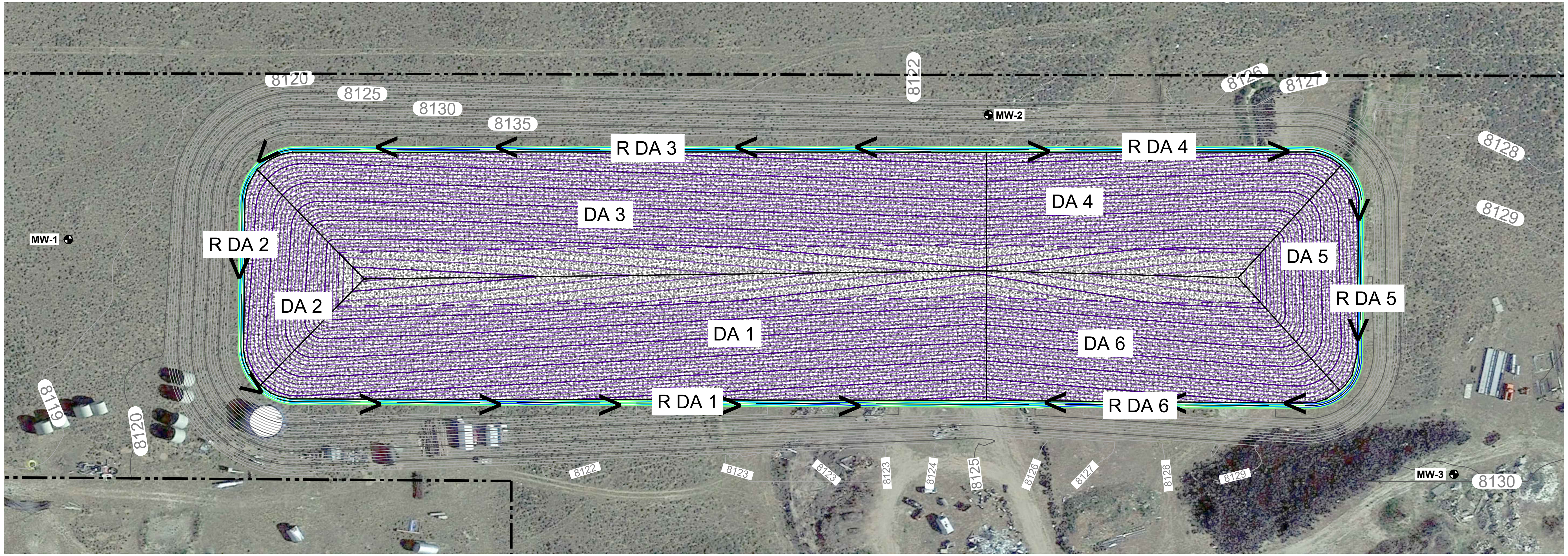
Warning: VxD>9 indicates that the velocity times the depth is greater than 9 ft^2/sec, which is undesirable and may be ur

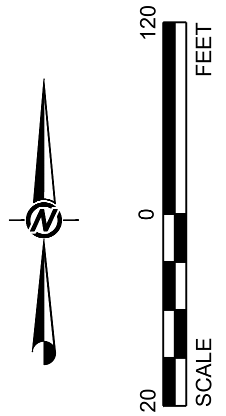
Unstable V indicates that calculated velocity exceeds the recommended maximum for the lining material.

Unstable T indicates that calculated shear stress exceeds the recommended maximum for the lining material.

FIGURE I-2

Delineation Map





LEGEND

▨	EXISTING GROUND (SEE NOTE 1)
☐	PROPOSED FINAL COVER GRADES
● MW-1	MONITORING WELLS (SEE NOTE 2)
— · · —	PROPERTY BOUNDARY
▤	PERIMETER CHANNEL

NOTE(S)

1. EXISTING TOPOGRAPHY IS A COMPOSITE OF GROUND SURVEY PROVIDED TO GOLDER BY JACKSON COUNTY ON MARCH 27, 2020 PERFORMED BY NORTH PARK ENGINEERING & CONSULTING, INC. MARCH 2020 AND USGS CONTOURS.
2. MONITORING WELL LOCATIONS ARE APPROXIMATE.
3. AERIAL IMAGERY: ESRI BASEMAP SERVICES, DIGITAL GLOBE CAPTURED ON 10/29/2018.
4. ELEVATION DATA SET: USGS NATIONAL ELEVATION DATA SET 1 ARC-SECOND

CLIENT
BOARD OF COMMISSIONERS
JACKSON COUNTY, CO

CONSULTANT

GOLDER

YYYY-MM-DD	2020-07-24
DESIGNED	ALB
PREPARED	SIB
REVIEWED	ALB
APPROVED	MEM

PROJECT
JACKSON COUNTY TRANSFER STATION
MSW LANDFILL CELL
WALDEN, CO

TITLE
DELINEATION MAP

PROJECT NO.
19-124320

REV.
0

FIGURE
I-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
1 in
0

Path: G:\Plan Production Data Files\Drawing Data Files\19-124320\CIVIL 3D\delineation map.dwg

APPENDIX J

Construction Quality Assurance Plan

REPORT

Construction Quality Assurance (CQA) Plan

Appendix J

Submitted to:

Jackson County
PO Box 1019
Walden, Colorado 80480

Submitted by:

Golder Associates Inc.
7245 W Alaska Drive, Suite 200, Lakewood, Colorado, USA 80226

+1 303 980-0540

19124320-6-R-2

January 2021

Table of Contents

TABLES

FIGURES

1.0 INTRODUCTION

1.1 Project Background

The Jackson County Landfill (JCL) is located in Jackson County, Colorado, and will be owned and operated by Jackson County. This Construction Quality Assurance (CQA) Plan outlines the monitoring, testing, and documentation requirements for liner and final cover construction at JCL. CQA personnel shall use this CQA Plan as the guidance document to implement the CQA program for all liner and final cover construction work at JCL and is intended to eliminate the need for preparation of separate CQA plans for each construction project.

This CQA Plan addresses quality assurance, not quality control (QC). This CQA Plan provides the plan for independent third-party CQA verification and testing. Construction quality control (CQC) is independently provided by manufacturers and contractors and refers only to those actions taken by them to ensure that materials and workmanship meet the requirements of the design.

1.2 Scope

Construction activities associated with liner construction at JCL may include:

- Excavation and stockpiling of soil from within the project area;
- Excavation and grading for appropriate drainage control and stormwater control features;
- Installation of a three-foot-thick compacted low-permeability soil liner for the construction and demolition (C&D) cell and one-foot-thick for the municipal solid waste (MSW) cells;
- Installation of a high-density polyethylene (HDPE) geomembrane liner for the MSW cells;
- Installation of a drainage layer over the liner systems, leachate collection system, and a six-inch-thick protective layer over the liner side slopes;
- Installation of a leachate collection system consisting of gravel drain lines;
- Construction of temporary and/or permanent leachate collection sumps; and
- Installation of inter-phase and/or inter-module separation berms over the liner system.

Construction activities associated with final cover construction at JCL may include:

- Installation of a 42-inch- (3.5-foot)-thick water balance alternative final cover (AFC); and
- Seeding of the AFC cover.

1.3 Construction Schedules

Construction schedules shall be prepared prior to each construction project and updated as necessary during construction.

1.4 Document Format

This CQA Plan is organized as follows:

- Section 1.0 provides this introduction and defines the scope of the document
- Section 2.0 defines personnel and organizations that will be involved with CQA and their roles

- Section 3.0 provides information regarding various CQA-related meetings
- Section 4.0 defines general CQA documentation procedures, including items such as project reporting, data collection, record keeping, and site surveying requirements
- Section 5.0 defines CQA procedures for earthwork construction
- Section 6.0 defines CQA procedures for leachate collection system construction
- Section 7.0 defines CQA procedures for geomembrane manufacturing and installation
- Section 8.0 defines requirements for the Construction Documentation Report

2.0 PROJECT PERSONNEL AND CONTACTS

2.1 Jackson County Landfill Personnel

Key JCL personnel for construction projects will include the County commissioners and the facility manager.

2.2 Design Engineer

The design engineer is the individual or firm that is responsible for the design as it exists at the time construction begins and the preparation of the construction drawings for the project. Construction drawings are defined as the part of the contract documents that graphically show the scope, extent, character, and details of the work to be performed.

The design engineer for the JCL is Golder Associates Inc. (Golder). Contact information for the design engineer shall be provided to appropriate parties prior to the construction.

2.3 Certifying Engineer (CQA Engineer)

The certifying engineer (CQA engineer) is the individual or firm that, on behalf of JCL, is responsible for monitoring construction activities on site and certifying that the work is constructed in accordance with the contract documents, including this CQA Plan. A certifying engineer shall be chosen by JCL prior to each construction project.

2.4 CQA Laboratory

A CQA soils laboratory shall be selected by the certifying engineer prior to each construction project to perform quality assurance (QA) testing on soil samples to verify that the work is constructed in accordance with the contract documents, including this CQA Plan.

2.5 Site Surveyor

A site surveyor shall be chosen by JCL or subcontracted by the contractor for each construction project to certify that as-built conditions conform to the design specified in the contract documents.

2.6 Construction Contractor

A general construction contractor shall be chosen by JCL for each construction project and shall be contracted directly by JCL. Work conducted by the contractor shall be overseen and certified by the certifying engineer.

2.7 Geomembrane Liner Contractor

A liner contractor shall be selected to install the geomembrane liner. The liner contractor may be the general contractor, a subcontractor to the contractor, or independently contracted by JCL. Work conducted by the liner contractor shall be overseen by the certifying engineer.

2.8 Colorado Department of Health and Environment

Construction documentation reports certifying that the construction work was constructed in accordance with the contract documents, including this CQA Plan, shall be submitted to the Colorado Department of Health and Environment (CDPHE) Hazardous Materials and Waste Management Division, Solid Waste Unit at the following address:

Colorado Department of Public Health & Environment
Hazardous Materials & Waste Management Division
Solid Waste Unit
4300 Cherry Creek Drive South
Denver, Colorado 80246

2.9 Jackson County

Construction documentation reports shall also be submitted to Jackson County at the following address:

Jackson County
P.O. Box 1019
Walden, Colorado 80480

3.0 CONSTRUCTION MEETINGS

3.1 Preconstruction Meeting

Prior to the start of construction, a preconstruction meeting shall be held involving the general contractor, liner contractor (if applicable), district manager, project manager, site surveyor, and certifying CQA engineer. The preconstruction meeting agenda shall identify party responsibilities, construction documents, lines of communication, design and CQA Plan requirements, construction schedule requirements and/or limitations, and Health and Safety Environment Plan (HaSEP) requirements. The purpose of the meeting shall be to:

- Present a proposed construction progress schedule and submittal log as required by the contract documents
- Discuss procedures for handling submittals
- Discuss the rules for project correspondence and roles and responsibilities
- Establish reporting and documentation procedures for each party
- Schedule weekly progress meetings
- Present a summary of the laboratory testing and field testing required to meet CQC and CQA requirements
- Discuss procedures for field orders, work change directives, and change orders
- Discuss the JCL site rules
- Review the contract documents
- Review the CQA Plan
- Review work area security, safety procedures, and related issues
- Provide all parties with relevant contract documents

- Review testing equipment and procedures
- Establish testing protocols and procedures for correcting and documenting non-conforming work or materials
- Conduct a site inspection to discuss the work area, stockpile areas, lay-down areas, material storage areas, access roads, haul roads, and related items

The minutes from the meeting shall be included as an appendix to the Construction Documentation Report.

3.2 Project Progress Meetings

Generally, project progress meetings shall be conducted on a weekly basis with the contractor, liner contractor (if applicable), certifying CQA engineer, district manager, project manager, and site surveyor (as necessary). These meetings shall include the following:

- Discussion of health and safety issues relevant to scheduled work
- Work in progress and key activities scheduled for the upcoming week
- Updates to the overall construction schedule
- Review of relevant CQA test data
- Discussion of any necessary decisions or project requirements regarding the construction activities
- Resolution of outstanding issues or disputes

If necessary, a brief daily meeting with the above parties shall be conducted to address any critical construction matters and determine an acceptable course of action. The certifying engineer shall maintain a file containing notes from such meetings and a copy of the notes shall be provided to the project manager.

4.0 DOCUMENTATION

The success of the CQA program requires thorough performance of the specified monitoring and testing activities, documentation of completed monitoring and testing activities, and frequent senior review of CQA documentation. Therefore, the certifying engineer must help verify that all CQA procedures have been implemented, results of the program are reviewed frequently, and corrections are implemented as needed.

4.1 Standard Reporting Procedures

The CQA engineer shall issue a daily report of construction activities. These reports shall contain, at a minimum and as applicable, the following information:

1) Date, project name, location, weather, and other information as appropriate
2) Description and locations of ongoing construction
3) Equipment used
4) Description of areas tested and sampled
5) Description of areas requiring reconditioning, retesting, and procedures followed

6) Summary of compacted low-permeability soil liner lift thickness and cohesive soil moisture–density at time of placement, as applicable

7) Summary of leachate collection system and sump construction, as applicable

8) Surveys performed for lift thickness control and any record surveys performed

9) Description of any variations from the contract documents and justification for the variance

4.2 Applicable Forms

The forms to be used in documenting the daily activities shall generally consist of the following:

1) Daily Field Report

2) Request for Information

3) Field Density Test Forms

4) Soil Sample Test Request Forms

5) Soil Testing Tracking Log

6) Geomembrane Testing, Deployment, Seaming, Defect, and Repair Logs

Prior to the preconstruction meeting, the certifying engineer shall provide the project manager with samples of these forms for review and approval.

All completed daily recordkeeping forms shall be checked, reviewed, signed, and dated by the certifying engineering on a weekly basis. Completed daily field report forms shall be bound separate from the Construction Documentation Report and copies shall be kept at the JCL. Applicable field data sheets and recordkeeping forms shall also be included as appendices to the Construction Documentation Report as further described in Section 8.0 of this CQA Plan.

4.3 Agency Notification

All contact with the CDPHE and Jackson County shall be the responsibility of and conducted by the project manager or a project manager-designated representative.

4.4 Issue Identification and Corrective Action

The certifying engineer shall inform the contractor and/or liner contractor in a timely manner of any difference between the contractor’s and/or liner contractor’s interpretation of the contract documents and the certifying engineer’s interpretation. In addition, any actual or suspected work deficiencies shall be promptly brought to the attention of the project manager.

If a difference in interpretation cannot readily be resolved between the contractor and certifying engineer, a meeting shall be held involving the district manager, project manager, contractor, and certifying engineer. The objective of the meeting shall be to define and discuss the issue, review alternative solutions, and implement an action plan to resolve the issue to the satisfaction of all parties. If the issue involves a possible design modification, the design engineer shall be contacted for approval.

If a field modification is required that affects the Engineering Design and Operations Plan (EDOP) or regulatory requirement, the CDPHE shall be contacted for approval and to identify the documentation that is required. Applicable documentation shall be included as an appendix to the Construction Documentation Report.

4.5 Photographic Documentation

Photographs (indicating date) shall be taken to document observations and as-built conditions of elements of construction. These photos shall be labeled to identify, at a minimum, date, location where photo was taken, direction of photo, and a brief description of the photo. The photographs shall be compiled in chronological order and captioned by the certifying engineer in a photograph log. Copies of the photograph log shall be kept at JCL.

4.6 Site Survey Requirements

4.6.1 Record Surveys

Site survey requirements shall include performing record surveys. At a minimum, record surveys shall be performed on the subgrade, compacted low-permeability soil liner, geomembrane paneling, leachate collection drain line and drainage layer, and bottom and top elevations of sumps. Record surveys shall confirm that the work was constructed in accordance with the contract documents. Record surveys to be performed by the site surveyor shall include the following, as applicable to the construction project:

1) Subgrade record survey:
    a) Subgrade on a 50-foot x 50-foot grid, inclusive of sumps.
    b) All subgrade breaklines on 50-foot centers, inclusive of the leachate collection drain line alignment.
    c) Edge of the subgrade/existing compacted low-permeability soil liner interface for tie-ins to existing liner (where applicable) on 50-foot centers.
2) Top of compacted low-permeability soil liner:
    a) 50-foot x 50-foot grid, inclusive of sumps. The certification grid shall be the same grid used for the certification of the subgrade on the floor.
    b) All breaklines, as appropriate, and edges on 50-foot centers.
    c) Top of edge where liners are tied together on 50-foot centers.
    d) Geomembrane liner anchor trench on 50-foot centers.
3) Geomembrane panel layout:
    a) Orientation and size of each geomembrane panel (textured and smooth).
    b) Roll numbers associated with each panel.
    c) Assigned panel numbers.
    d) Assigned seam numbers.
    e) Destructive test locations.
    f) Repair locations.

4) Leachate collection drain line and permanent/temporary sumps:
   a) Subgrade at 50-foot intervals along the leachate collection drain line.
   b) Top of compacted low-permeability soil liner along the leachate collection drain line at 50-foot intervals.
   c) Survey stationing shall be at the same horizontal locations as the 50-foot grid used for certification of subgrade and top of compacted low-permeability soil liner. Each survey point along the 50-foot stationing shall have three associated elevations: subgrade, top of compacted low-permeability soil liner, and top of gravel drain line.
   d) Top of leachate collection drain line at tie-in points and end of line.
   e) Grade breaks and corners for subgrade and top of compacted low-permeability soil liner in sumps.

5) Finished grades:
   a) Top of drainage layer on 50-foot x 50-foot grid. The grid shall be the same grid used for certification of subgrade and top of compacted low-permeability soil liner on the floor. Thickness may be verified using a calibrated probe or by survey.
   b) All breaklines and mid-slope points of protective layer on 50-foot centers.
   c) Thicknesses shall be summarized in a plan view figure identifying grid points and in a table presenting thickness measurements to be included in the Construction Documentation Report.

All survey data shall be reduced at the end of each working day, or other frequency appropriate for the survey work performed, and given to the Certifying engineer in the form of a report. Record surveys and record grade tables shall be included in an appendix to the Construction Documentation Report to document that the work was performed in accordance with the construction documents.

4.6.2 Survey Tolerances

Construction tolerances for excavation and fill shall consist of the following.

Table J-1: Construction Tolerances

Layer	Tolerances
Top of subgrade	Line: ±0.5 foot Grade: -0.2 to 0.0 feet
Compacted low-permeability soil liner	Line: ±0.5 feet Grade: 0.0 to +0.1 feet of top of liner design grade Thickness: 1.0 feet (minimum MSW), 3.0 feet (minimum C&D)
Granular drainage layer	Line: ±0.5 feet Grade: 0.0 to +0.2 feet of top of drainage layer design grade
Protective cover	Line: ±0.5 feet Grade: 0.0 to +0.2 feet of top of protective cover design grade

Layer	Tolerances
Gravel drain lines	Line: ±0.5 foot Grade: -0.0 to +0.1 foot Thickness: 1.0 foot (minimum)
Sumps	Line: ±0.5 foot Subgrade: -0.2 to +0.1 feet
Final cover	The final cover line and grade may vary due to landfill settlement. Construction documentation will demonstrate conformance with the minimum cover thickness and minimum/maximum final design slopes.

4.7 Calibrating Testing Equipment

Before on-site testing equipment is placed into service, the accuracy of each piece of equipment shall be verified by calibration. Types of on-site equipment requiring calibration include nuclear gauges (calibration and daily standardization using a reference standard block within acceptable manufacturer count limits), tensiometers, scales, and field ovens. The calibration procedures and frequencies shall be completed per the equipment manufacturer's instructions and American Society for Testing and Materials (ASTM) standards as applicable. Copies of current calibration certificates for equipment shall be maintained by the CQA engineer and dates of last calibration for all field and laboratory testing equipment shall be provided in the Construction Documentation Report. Whenever a piece of equipment is suspected of producing questionable results, it shall be removed from service and recalibrated.

4.8 Complying with Test Standards

The CQA laboratory and CQA engineer must perform various field and laboratory tests in accordance with applicable standards as specified in this CQA Plan. In most instances, the applicable test procedure is an ASTM standard. Only the most recent version of each test standard identified in this CQA Plan shall be used.

5.0 LANDFILL CQA – EARTHWORK

5.1 Subgrade Preparation

5.1.1 Construction Requirements

The liner subgrade shall be established by excavating overburden soils to the design grades as shown in the construction drawings. In some areas, engineered fill may be required to develop the design grades.

Upon attainment of subgrade grades by excavation and compaction, the CQA engineer shall observe the subgrade conditions and document any unexpected conditions, such as wet or unstable areas, permeable lenses, or other condition not suitable for liner foundation as determined by the CQA engineer. Any unstable area, permeable lens, or other unsuitable condition shall be excavated at least one foot in depth and replaced with engineered fill material. Engineered fill shall be placed in compacted lifts not exceeding 12 inches. Engineered fill shall be compacted to a minimum density of 95% of the standard Proctor maximum dry density (ASTM D698).

5.1.2 CQA Testing

Subgrade material and construction shall conform to the following specifications:

- Grade control: as described in Sections 4.6.1 and 4.6.2 of this CQA Plan
- Compaction (ASTM D698) greater than or equal to 95% of standard Proctor
- (Engineered fill only) maximum dry density (ASTM D698)

In situ density testing (ASTM D6938) of engineered fill shall be performed on an approximate grid pattern randomly defined by the CQA engineer for each 12-inch lift placed.

5.1.3 CQA Sampling

Representative samples of the native subgrade and engineered fill materials shall be obtained prior to and during subgrade preparation for the following laboratory testing:

- Grain size (no hydrometer) (ASTM D6913)
- Moisture content (ASTM D2216 or ASTM D4643)
- Standard Proctor (five points per curve) (ASTM D698)

In the event that the engineered fill material changes, additional samples shall be collected and tested for each material type to define standard Proctor maximum dry density and optimum moisture content. Sampling and testing frequencies for subgrade preparation and engineered fill placement are provided in Table J-2 of this CQA Plan. All field and laboratory testing results shall be provided as an appendix to the Construction Documentation Report. The certifying engineer shall reference all test and sample points and reconstructed areas by measuring from reference points established for the on-site coordinate system.

5.1.4 Leachate Collection Drain Line CQA

While constructing the subgrade, the chevron pattern shall be graded to form the leachate collection drain line alignment. As discussed in Section 4.6.1 of this CQA Plan, the site surveyor shall perform record survey documentation of the subgrade, top of liner, and top of gravel drain line along the leachate collection drain line alignment.

Field density testing of the subgrade along the leachate collection drain line shall be in accordance with the requirements of Section 5.1.2 of this CQA Plan.

5.2 Anchor Trench

The anchor trench shall be excavated to the lines, grades, and widths shown in the construction drawings prior to geomembrane deployment and left open until seaming is completed. The CQA engineer shall verify that the anchor trench has been constructed according to the construction drawings. Expansion and contraction of the geomembrane shall be accounted for in its placement. Geomembrane shall be extended into the anchor trench as shown in the construction drawings. The geomembrane shall be seamed along the entire length of the anchor trench. The anchor trench shall be backfilled in 9- to 12-inch-thick loose lifts and compacted by wheel rolling with light, rubber-tired compaction equipment or other compaction equipment approved by the CQA engineer. Anchor trench backfill material shall be moisture conditioned and compacted in accordance with the requirements for engineered fill material and to the satisfaction of the CQA engineer. Backfilling shall take place in cooler parts of the day to reduce potential bridging of the geomembrane.

Care shall be taken when backfilling the anchor trench to prevent damage to the geomembrane. At no time shall construction equipment come into direct contact with the geomembrane. Any damage that occurs will be repaired by the contractor prior to the completion of backfilling

5.3 Compacted Low-Permeability Soil Liner

5.3.1 Construction Requirements

The compacted low-permeability soil liner shall be constructed in accordance with design criteria presented in the JCL EDOP (briefly summarized as follows) and as described in the contract documents:

- Base grades will be consistent with approved design grades.
- The minimum thickness of the compacted low-permeability soil liner at all locations shall be 1.0 feet (MSW cell) and 3.0 feet (C&D cell) measured perpendicular to the liner surface.
- The compacted low-permeability soil liner shall be constructed in lift heights no greater than six inches after compaction (eight inches loose) and no greater than the depth of the teeth of the compaction equipment used.
- Typical side slopes shall not exceed three horizontal to one vertical (3H:1V), unless otherwise shown in the construction drawings.

The compacted low-permeability soil liner material shall have a maximum allowable clod and rock size of three inches (with a clod defined as a soil aggregation that does not break down by hand). A pull-type disc (or similarly effective equipment as approved by the CQA engineer) shall be used to break up clods, expose stones in the cohesive soil to allow for removal, and assist in establishing the required moisture content (above the line of optimums drawn between the standard Proctor moisture–density test [ASTM D698], optimum moisture content, and the modified Proctor [ASTM D1557] optimum moisture content). The specification for acceptable moisture content range is described in more detail in Section 5.3.2 of this CQA Plan.

Compaction shall be performed using a tamping foot compactor with fully penetrating feet extending the full depth of the loose lift of soil (Caterpillar 815, 825, or CQA engineer-approved alternative equipment). Compaction may be supplemented by running wheeled tracks of construction equipment across fill areas; however, the use of supplementary vehicular tracking shall not be used in place of mechanical compaction with the tamping foot compactor. The number of tamping foot compactor passes required to achieve the required compaction shall be determined during the first lift of compacted low-permeability soil liner placement and monitored throughout subsequent lifts. Compaction shall be performed to form a stable non-yielding base. Frozen materials, organics, roots, and large rocks (greater than three inches in any dimension based on visual observation) shall be removed prior to compaction.

Prior to placing compacted low-permeability soil liner on side slopes, the subgrade shall be scarified (if lifts are placed horizontally) or proof-rolled with a tamping foot compactor (if lifts are placed parallel to the slope).

The surface of previous lifts shall be watered as necessary until subsequent lifts or cover materials are placed to prevent desiccation. The contractor shall not be allowed to place cohesive soil at temperatures below freezing unless it can be demonstrated that freezing of the compacted low-permeability soil liner will not occur. Previously placed soils shall be protected from freezing by the contractor by methods such as placing additional soil over the completed compacted low-permeability soil liner until protective cover is placed. Any placed liner material that is found to be frozen shall be removed or thawed and reworked, as necessary.

Tie-in to compacted low-permeability soil liner of previously constructed cells (where applicable) shall be performed by constructing “steps” in the formerly placed liner. The “steps” shall be approximately six inches in depth and at least six inches wide, shall be cut with an excavator or other appropriate equipment, and shall extend the full depth of the previously placed compacted low-permeability soil liner. After the “steps” are cut, placement of the new compacted low-permeability soil liner shall begin by placing in lifts that correspond to the thickness of the “steps.” Each lift shall be compacted through the step area so that there are no vertical seams in the former “step” area. Once this is complete, the next lift shall be placed and the procedure repeated until the entire thickness of compacted low-permeability soil liner has been placed through the tie-in area.

5.3.2 CQA Testing

Compacted low-permeability soil liner material and construction shall conform to the following specifications:

- Grade control: As described in Sections 4.6.1 and 4.6.2 of this CQA Plan.
- Classification (ASTM D2487): CL (low-plasticity clay) or CH (high-plasticity clay) under the Unified Soil Classification System (USCS).
- Hydraulic conductivity (ASTM D5084): less than or equal to 1 x 10^{-7} centimeters per second (cm/sec).
- Dry density and moisture content field measurements (ASTM D6938 and ASTM D2216): 90% of tests exceeding 95% of dry density per ASTM D698 and plotting above and to the right of the line drawn between the standard Proctor (ASTM D698) optimum moisture content and the modified Proctor (ASTM D1557) (herein referred to as the “line of optimums”) on the dry density versus moisture content plot for each soil type. Tests that plot below the line of optimums must have a moisture content within 2% of the line of optimums moisture content.
- Liquid limit (ASTM D4318): greater than 25%.
- Plasticity index (ASTM D4318): greater than 10%.
- Grain size (ASTM D6913): 200-nanometer particle (P_{200}) content of 50% or greater by weight.

In-place moisture content and density testing (ASTM D6938) of the compacted low-permeability soil liner shall be performed randomly but on a density equivalent to an approximate 150-foot grid pattern for each 6-inch compacted lift placed to ensure that the testing locations and samples collected for hydraulic conductivity are evenly distributed with a comparable number of tests for each lift. The testing grid pattern shall be offset on subsequent lifts. For side slopes, minimum testing requirements shall be determined based on the surface area of the slopes.

Additional moisture and density tests shall be obtained in confined areas where equipment movement is hindered or hand compaction is necessary. The number of density tests in these areas shall be specified by the CQA engineer based on the size of the confined area. If areas are encountered that do not meet the specified compaction, moisture content, or percent saturation, the area shall be reworked, moisture conditioned, and/or recompacted as necessary. Retests shall be performed following rework activities.

At least 90% of all field moisture and density tests (and within two-acre subareas) shall plot above and to the right of the line of optimums between the standard Proctor and modified Proctor and exceed 95% dry density per ASTM D698. Moisture–density tests that do not plot above the line of optimums shall be within 1% of the standard Proctor optimum moisture content (ASTM D698). Tests that plot below the line of optimums must have a moisture content within 2% of the line of optimums moisture content. Plan view figures identifying the locations of field density measurements and the two-acre subareas for each lift shall be prepared and included in the Construction Documentation Report.

Subareas with less than 90% passing tests (i.e., with compaction of less than 95% of the standard Proctor maximum dry density and/or that do not plot above and to the right of the line of optimums) shall be reworked to provide additional moisture conditioning and/or additional compactive effort. Tests that plot below the line of optimums must have a moisture content within 2% of the line of optimums moisture content. Retests shall be performed following the reworking activities.

Each penetration made into the compacted low-permeability soil liner for density testing purposes shall be repaired after testing. The test hole shall be repaired by backfilling with bentonite and hydrated or other material(s) approved by the CQA engineer.

All moisture–density content tests shall be reported on the field density forms. Test locations shall be presented on a plan view figure. Completed field density forms shall be included as an appendix to the Construction Documentation Report. Prior to the preconstruction meeting, the CQA engineer shall provide the project manager with a sample of the field density form for review and approval.

5.3.3 CQA Sampling

Representative samples of compacted low-permeability soil liner material shall be obtained prior to and during liner construction for the following laboratory testing:

1) Soil classification (ASTM D2487)
2) Grain size (no hydrometer) (ASTM D6913)
3) Atterberg limits (ASTM D4318)
4) Moisture content (ASTM D2216)
5) Standard Proctor (five points per curve) (ASTM D698)
6) Modified Proctor (ASTM D1557)
7) Hydraulic conductivity (ASTM D5084)
8) One-point Proctors (conducted in the field) (AASHTO T272)

Sampling and testing frequencies for the compacted low-permeability soil liner are provided in Table J-2 of this CQA Plan. One-point Proctors shall be performed at the specified frequency to assist the CQA engineer in the selection of the appropriate standard Proctor for the purposes of evaluating passing moisture content and density conditions. A soil sample inventory log shall be maintained as samples are acquired. The certifying engineer shall reference all test and sample points and reconstructed areas by measuring from reference points established for the on-site coordinate system. All completed inventory logs and field and laboratory testing results shall be provided as an appendix to the Construction Documentation Report.

5.4 Inter-phase and Inter-module Separation Berms

Compacted engineered fill material shall be used to construct inter-phase and inter-module berms. Moisture conditioning shall be performed as necessary and/or as directed by the CQA engineer.

5.5 Protective Layer

A one-foot-thick soil protective layer shall be placed over the compacted low-permeability soil liner (C&D) and composite liner (MSW) side slopes. The protective layer material shall consist of earthen fill material as defined in the contract documents. The protective layer shall be placed and lightly compacted in a single lift with a focus on minimizing potential damage to the geomembrane liner. The CQA engineer shall observe and report on appropriate CQA test results and placement operations to verify uniform lift thickness and adequate placement.

5.6 Alternative Final Cover

A water balance AFC system shall be constructed over all waste placed at JCL as final grades are developed. The AFC was designed pursuant to the streamlined guidance provided in the CDPHE Final Guidance Document, Water Balance Covers in Colorado (CDPHE 2013), hereinafter referred to as CDPHE Guidance. The location of the JCL lies within Ecozone 2 as defined in the CDPHE Guidance. The water balance analysis conducted in Appendix F indicates that the alternative final cover should be for a 3.5-foot-thick water balance cover.

The water balance AFC system for JCL shall consist of the following soil layers, listed from bottom of cover to finished grade:

- Foundation layer (1-foot minimum thickness, may consist of daily soil cover or interim cover already in place) underlying
- Water storage layer (3.5 feet thick).

A key component to the effectiveness of the water balance AFC will be the capacity for vegetation growth throughout the entirety of the cover. This will be ensured by pre-screening the soils from the borrow area for pH and $CaCO_3$ content, amending the water storage layer materials as appropriate, and preparing a firm but not overly compacted seed bed in accordance with Sections 5.6.1 and 5.6.2 of this CQA Plan. A USDA triangle showing the acceptance zone for the 3.5-foot-thick AFC in Ecozone 3 is included in Figure 1.

5.6.1 Construction Requirements

The water balance AFC soil shall be placed without active compaction so as to obtain a density of between 80% and 90% of the standard Proctor (ASTM D698) maximum dry density and dry of the optimum moisture content. The water storage layer shall be constructed in 18-inch minimum lifts to minimize over-compaction from equipment loads. It is anticipated that the water storage layer will be installed in a single lift.

In locations of drainage structures (e.g., bench channels, downchutes) and below the landfill access road, final cover material shall be compacted to 95% of the standard Proctor maximum dry density to ensure a stable base for the overlying features. Final cover material in these locations shall be installed in two compacted lifts.

After placement, the AFC shall be fertilized if necessary and planted with erosion-controlling grasses native to the region, such as the seed mix provided in Table J-4 of this CQA Plan. Soil amendment, seed bed preparation and seeding, and mulching recommendations are also provided in Table J-4.

5.6.2 CQA Testing

AFC material and construction shall conform to the following specifications:

- Grade control: verification of foundation grades and slopes prior to AFC construction. Thickness of AFC layers on 100-foot x 100-foot grid, by grade stakes or survey.
- Grain size (ASTM D6913): gravel content 15% or less by weight, maximum particle size less than two inches, maximum clod size less than four inches in longest dimension, and grain size distribution plots within the Acceptance Zone for JCL as shown in Appendix F.
- Moisture content (ASTM D6938 and ASTM D2216 or D4643): dry of the optimum moisture content.
- Moisture–density (ASTM D6938 and D698): between 80% and 90% of standard Proctor maximum dry density.
- pH (SW-846 SW 9045C): 6.0–8.4.
- Calcium carbonate ($CaCO_3$) (USDA Handbook Number 60): less than 15% by weight.

In addition to these tests, the CQA engineer shall perform additional agronomic testing of AFC soil materials, as outlined in Table J-5 of this CQA Plan, to evaluate the suitability of soils prior to AFC construction.

In-place moisture content and density testing (ASTM D6938) of the AFC shall be performed at a frequency of 1 test per 6,500 cubic yards of final cover placed. In-place density and moisture content of the water storage layer shall be verified following topsoil placement on a maximum 250-foot grid pattern to ensure that over-compaction did not occur during construction. Corrective action for over compaction and/or excessive moisture shall consist of ripping material that is too dense and/or drying material that exceeds the optimum moisture content until field testing confirms that the specifications are met.

5.6.3 CQA Sampling

Representative samples of AFC material shall be obtained during final cover construction for the following laboratory testing:

1) Grain size (ASTM D422)
2) Hydrometer (ASTM D7928)
3) Moisture content (ASTM D2216 or D4346)
4) Standard Proctor (five points per curve) (ASTM D698)
5) pH (SW-846 SW 9045C)
6) $CaCO_3$ (United States Department of Agriculture [USDA] Handbook Number 60)

Sampling and testing frequencies for final cover are provided in Table J-2 of this CQA Plan consistent with the CDPHE Guidance. The certifying engineer shall reference all test and sample points and reconstructed areas by measuring from reference points established for the on-site coordinate system. All field and laboratory testing results shall be provided as an appendix to the Construction Documentation Report.

5.6.4 Revegetation Monitoring and Evaluation

Monitoring and evaluation of revegetation will be conducted as recommended in the CDPHE Guidance. Revegetation monitoring will occur annually for the first five years following AFC construction. The Transect Liner Intercept Method will be used to assess the revegetation. The monitoring and criteria for vegetation evaluation in Year 1 and Years 2 through 5 shall be as follows:

- Year 1: The revegetated area will be assessed by counting the number of seedlings of desirable species per unit area. Generally, unless unusual conditions occur (e.g., extreme drought), two to four seedlings per square foot will be considered sufficient vegetation cover, with the lower end of this range representing a vegetation stand that will develop more slowly. One to two seedlings per square foot will be monitored and may require some reseeding at a later date. Areas with less than one seedling per square foot are likely to be unsatisfactory in the long run and the situation will be evaluated to determine why the response was so sparse and what the potential remedies are.
- Years 2–5: The plant cover will be evaluated annually in Years 2 through 5 and compared to the performance standards described below:
- Total live vegetation cover of perennial species in the seed mix or other appropriate live perennial vegetative species (excluding noxious weeds/vegetation) in any year starting two years after initial seeding shall be greater than 25%;
- Two-year running average for percent cover starting two years after initial seeding shall be greater than 50%; and
- Three-year running average for percent cover starting two years after initial seeding shall be greater than 67%.

“Percent cover” is defined as the percent live vegetation of perennial species in seed mix plus the percent appropriate live perennial vegetation by species not in seed mix.

A single live perennial species in the seed mix or other appropriate live perennial species shall not comprise more than 60% of the vegetative growth of live perennial species. Areas having insufficient vegetation success two years after initial seeding will be repaired and reseeded as necessary as per procedures to be provided in annual reports documenting the revegetation success. If revegetation does not meet the performance standards outlined above by Year 5, potential remedial measures will be discussed with the CDPHE.

6.0 CQA – LEACHATE COLLECTION SYSTEM

Leachate collection system construction shall follow completion of the geomembrane liner. Construction shall consist of geotextile fabric, leachate drain and sump gravel, and granular drainage layer material as discussed in this section.

6.1 Geotextile Fabric

Geotextile fabric used to wrap the leachate collection trenches shall be non-woven, 12-ounce per square yard (oz/sq. yd.) geotextile. Placement shall conform to the following requirements:

1) Fabric shall be placed as smooth and wrinkle-free as possible without stretching.
2) The gravel drain lines shall be wrapped in geotextile fabric as shown in the construction drawings.
3) Geotextile fabric shall overlap at all seams by a minimum of 24 inches.

CQA requirements for the geotextile fabric consist of the following:

1) Geotextile fabric shall be free of tears, holes, other visible damage, and significant folds or wrinkles.
2) Geotextile fabric QC certificates shall be included as an appendix to the Construction Documentation Report.

6.2 Leachate Drain and Sump Gravel

The leachate drain and sump gravel shall consist of rounded or subrounded clean gravel or other permeable material that meets the following requirements:

- Grade control:
    - As described in Sections 4.6.1 and 4.6.2 of this CQA Plan.
- Classification (ASTM D2487):
    - Earthen material classified by the Unified Soil Classification System (USCS) as GP (poorly-graded gravel).
- Grain size (ASTM C136):
    - A minimum of 99% passing the three-inch sieve by weight.
    - d_{50} of less than 1.5 inches. (The material gradation may vary provided that testing confirms the material meets the permeability requirement).
- Hydraulic conductivity (ASTM D5084): greater than or equal to 1 cm/sec.
- Thickness: A minimum of 12 inches of aggregate material shall be placed within each geotextile-wrapped gravel drain measured perpendicular to the slope. The aggregate height shall be documented with a field survey or hand measurements.

Representative samples of drainage gravel material shall be obtained prior to and during leachate collection system construction for the following laboratory testing:

1) Grain size (no hydrometer) (ASTM C136)
2) Hydraulic conductivity (ASTM D2434)

Sampling and testing frequencies for drainage gravel are provided in Table J-2 of this CQA Plan. Laboratory testing results shall be provided as an appendix to the Construction Documentation Report.

6.3 Granular Drainage Layer

The granular drainage layer shall consist of a minimum of six inches of sand or an equivalent thickness of tire shreds placed over the liner. Tire shreds are only allowed over soil liner in the C&D cell. The drainage layer requirements are as follows:

- Grade control: as described in Sections 4.6.1 and 4.6.2 of this CQA Plan.
- Grain size sand (ASTM C136): a minimum of 95% passing the ½-inch sieve and between 0 and 5% passing the #200 sieve by weight. Specific grain size requirement will be developed for tire shreds in conjunction with the CDPHE.

- Hydraulic conductivity (ASTM D2434): greater than or equal to 1 x 10^{-2} cm/sec.

Representative samples of granular drainage layer/tire shreds material shall be obtained prior to and during cell construction for the following laboratory testing:

1) Grain size (no hydrometer) (ASTM C136)

2) Hydraulic conductivity (ASTM D2434)

Sampling and testing frequencies for granular drainage layer material are provided in Table J-2 of this CQA Plan. Laboratory testing results shall be provided as an appendix to the Construction Documentation Report.

6.4 Leachate Collection Sumps (Permanent and Temporary)

Permanent leachate collection sumps shall be constructed as shown in the drawings. Temporary leachate collection sumps shall be installed at the low point of each module within disposal phases.

Gravel material, as described in Section 6.2 of this CQA Plan, shall be used to backfill leachate collection sumps. The same sampling and testing frequencies for drainage gravel as discussed in Section 6.2 and provided in Table J-2 of this CQA Plan shall apply to the leachate collection sumps. Laboratory testing results shall be provided as an appendix to the Construction Documentation Report. In addition, survey control of the sumps shall be documented as discussed in Sections 4.6.1 and 4.6.2 of this CQA Plan.

7.0 CQA – GEOMEMBRANE LINER

7.1 Geomembrane Specifications

Geomembrane used for the project shall conform to the minimum specifications provided in Table J-3 of this CQA Plan. Geomembrane shall be manufactured of first-quality resin and shall be compounded and manufactured specifically for containment applications.

The geomembrane material shall be free of holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Any such defect shall be repaired in accordance with the manufacturer's recommendations.

7.2 CQA Functions

The objectives of the geomembrane CQA program are to:

- Verify that the geomembrane manufactured for the project meet quality standards defined in the technical specifications
- Verify that construction techniques and procedures used during deployment of geomembrane are in compliance with the construction documents and the manufacturer’s installation manual
- Identify and define issues that may occur during construction and then verify that these issues are prevented or corrected before construction is complete

To help ensure compliance, the CQA program will include a review of the manufacturer’s quality control (MQC) testing, performance of material conformance testing, visual observation of geomembrane installation, and field CQA testing and documentation. MQC and conformance testing shall take place before installation of geomembrane to verify material quality. CQA testing includes activities that are performed during installation of geomembrane to verify installation quality.

7.3 Pre-construction Submittal Review

Prior to scheduled delivery of the geomembrane, the liner contractor shall submit the following items to the CQA engineer for review:

- The geosynthetic manufacturer’s description (cut sheet) for the proposed resin and geomembrane documenting that it will meet or exceed the requirements provided in Table J-3 of this CQA Plan.
- Shop drawings showing the proposed layout of the panels, field seams, and any other details that are needed to describe the proposed installation.

Prior to installation of the geomembrane, the CQA engineer shall review and approve submittals and shop drawings for conformance with the contract documents. If the properties outlined in Table J-3 differ from those listed in the geomembrane manufacturer’s submittals, the geomembrane manufacturer shall provide a written statement certifying that the properties in the specifications will be met or provide an alternative material.

The CQA engineer shall also complete geomembrane conformance testing in accordance with Section 7.4 of this CQA Plan and record the sampled roll numbers prior to installation of the geomembrane.

7.4 Conformance Testing

One sample of geomembrane shall be obtained for every 100,000 square feet of material supplied (textured and smooth) and at least one for each resin batch or lot represented by the geomembrane manufacturer. The material shall be sampled at the site by the CQA engineer or at the manufacturing plant by the geomembrane manufacturer. Samples shall be forwarded to an independent testing laboratory for conformance testing as outlined in Table J-3. The CQA engineer shall review all conformance test results prior to the start of deployment.

7.5 Delivery, Handling, and Storage

Upon delivery of geomembrane, the CQA engineer shall:

- Inspect geomembrane rolls for damage that potentially occurred during shipping and/or handling, then document the damaged materials and verify that damaged materials are set aside and not installed.
- Verify that geomembrane is stored on a level, prepared surface (not wooden pallets) in accordance with the technical specifications and the geosynthetics manufacturer’s recommendations, and is protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, direct sunlight, and other potential causes of damage.
- Verify that each roll is marked or tagged with the geosynthetics manufacturer’s name, project identification, lot number, roll number, and roll dimensions, and that this information is documented.
- Verify that all MQC and submittal documentation required by the technical specifications has been received, reviewed, and filed.

Damaged geomembrane will be rejected. The CQA engineer shall verify that rejected material is removed from the site or stored at a separate location away from accepted geomembrane. Geomembrane that is not accompanied by the proper documentation from the geosynthetics manufacturer will also be stored at a separate location until all such documentation has been received and approved.

At all times, geomembrane material shall be handled in a manner that:

- Prevents damage by such activities as handling, traffic, smoking, and use of equipment and tools;
- Prevents scratching or crimping of panels during unrolling;
- Prevents damage of the underlying liner components;
- Prevents uplifting of in-place panels by wind; and
- Minimizes the wrinkles (e.g., distribute across cell, avoid wrinkles at seams) and compensates for those that cannot be prevented.

7.6 Panel Layout Shop Drawings

Prior to placement of the geomembrane, the liner contractor and the CQA engineer shall review the panel layout shop drawing. The shop drawings shall show the proposed layout of the panels, field seams, and any other details that are needed to describe the proposed installation. Any subsequent changes of the panel layout initiated by the liner contractor shall require approval by the CQA engineer.

7.7 Deployment

7.7.1 Subsurface Preparation

Before geomembrane installation, the CQA engineer shall:

- Verify that all lines and grades have been met by the contractor
- Verify that the subsurface has been prepared in accordance with the technical specifications

7.7.2 Subgrade Acceptance

Prior to geomembrane deployment, the soil on which the geomembrane will be installed shall be prepared in accordance with the technical specifications. Before geomembrane installation, the CQA engineer and the liner contractor shall inspect the surface. The CQA engineer shall verify the following:

- The compacted low-permeability soil liner and/or subgrade soil has been prepared in accordance with the technical specifications and this CQA Plan.
- No sharp objects or other materials that could puncture the geomembrane are present on the surface.
- The underlying compacted low-permeability soil liner shall be smooth-rolled and shall not contain protrusions of stones, clods, rocks, or debris greater than ⅜ inch.
- The surface of the underlying compacted low-permeability soil liner shall have no sudden sharp or abrupt changes in grade.
- The anchor trench dimensions have been checked, and the trenches are free of sharp objects and stones.
- There are no excessively soft areas.

- The liner contractor has certified in writing on a subgrade acceptance form acceptable to the CQA engineer that the surface on which the geomembrane will be installed is acceptable.
- The contractor has signed the subgrade acceptance form.
- The subgrade acceptance form is prepared on a daily basis whenever geomembrane is being installed.

The contractor shall protect the surface underlying the geomembrane from desiccation, flooding, and freezing until such time that placement of geomembrane begins. Geomembrane deployment shall be performed as soon as practical after completion of the compacted low-permeability soil liner. Long-term exposure situations shall require placement of additional protective soil over the compacted low-permeability soil liner.

Underlying compacted low-permeability soil liner surfaces found to have significant desiccation cracking or that exhibit swelling, heaving, or other similar conditions, shall be replaced or reworked by the contractor to repair the defects.

7.7.3 Weather Conditions

Generally, geomembrane deployment shall not occur during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of standing water, or during high winds (in excess of 30 miles per hour). The liner contractor shall have the final responsibility to determine if conditions are suitable for liner placement. Placement and welding of the geomembrane shall not be undertaken during periods when the air temperature six inches above the surface of the geomembrane is colder than 32ºF or warmer than 105ºF, unless pre-construction site weld tests for the seaming reveal adequate results at temperatures outside this range.

7.7.4 Method of Deployment

The method deployment of the geomembrane shall meet the following requirements:

- The method and equipment used to deploy the panels shall not damage the geomembrane or the supporting surface. If the geomembrane is dragged across a surface that could damage the geomembrane, the geomembrane shall be inspected for scratches and repaired or rejected if necessary
- No personnel working on the geomembrane shall smoke or wear shoes that may damage the geomembrane liner or engage in actions that could result in damage to the liner.
- Adequate temporary anchoring (e.g., sandbags, tires, or other approved anchorage) that will not damage the geomembrane shall be placed to prevent uplift of the geomembrane by wind.
- The geomembrane shall be deployed in a manner to minimize wrinkles.
- Installed panels shall be anchored and ballast placed by the liner contractor to limit movement by the wind.
- Any area of a panel observed and noted as damaged (torn, twisted, punctured, or crimped) shall be marked and repaired or replaced. Any repaired panels shall be approved by the CQA engineer.
- Bridging or stressed conditions in the geomembrane shall be minimized. Proper slack allowance for shrinkage shall be provided during installation and before the placement of overlying components.
- Panels shall have a minimum four-inch finished overlap. Seams shall be oriented parallel to the line of maximum slope (i.e., horizontal seams shall not be allowed). In corners and odd shaped geometric locations, the number of field seams shall be minimized. No base T seam shall be closer than five feet to the toe of the slope.
- Objects such as pipes, gas vents, manholes, sumps, and other objects that may penetrate the liner shall be connected to the liner material in such a way that prevents leakage and unnecessary stresses.

The CQA engineer shall inform the liner contractor if panel placement requirements are not being met. The CQA engineer shall mark the location of observed damage to geomembrane and determine whether the material can be repaired. If it can be repaired, the repair must be performed in accordance with this CQA Plan and the technical specifications. All repairs shall be documented. Material that cannot be repaired will be rejected, removed from the installation area, and moved away from the construction area so that it is not reinstalled.

7.7.5 General Seaming/Welding Procedures

The method of general seaming and welding shall meet the following requirements:

- Seaming shall extend to the outside edge of panels to be placed in the anchor trench.
- While welding a seam, the proper overlap shall be monitored and maintained.
- Seams shall be inspected to ensure that the area is clean and free of moisture, dust, dirt, and debris of any kind.
- Welding technicians shall periodically check machine operating temperature and speed and shall mark this information on the geomembrane.
- Wrinkles shall be aligned at the seam overlap to allow welding through the wrinkle.
- “Fishmouths” or wrinkles at seam overlaps that cannot be welded through shall be cut along the ridge in order to achieve a flat overlap. The cut fishmouth or wrinkle shall be heat-tacked flat and extruded or patched with an oval or round patch of the same geomembrane extending a minimum of three inches beyond the cut in all directions.
- Prior to welding cross/butt seams, the top and bottom overlaps of intersecting fusion welded seams shall be trimmed six inches. Intersecting extrusion fillet-welded seams shall be ground to flatten the extrusion bead prior to welding butt seams.
- All “T” joints produced as a result of cross/butt seams shall be extrusion fillet welded. The overlap on each “leg” of the “T” joint shall be trimmed back six inches. A minimum of three inches on each of the three legs of the “T” shall be ground, and all of the area prepared by grinding shall be extrusion welded.
- The seam area shall be cleaned prior to seaming to provide an area that is clean and free of moisture, dust, dirt, and debris of any kind. No grinding is required for fusion welding.

7.7.6 Extrusion Fillet Welding

The method of extrusion fillet welding shall meet the following requirements:

- Whenever possible, extrusion-welded seams shall be pre-beveled prior to heat tacking into place.
- Geomembrane shall be overlapped a minimum of four inches.
- Using a hot air source, temporarily bond the panels of geomembrane to be welded, taking care not to damage the geomembrane.
- Clean the seam area prior to seaming to provide an area that is clean and free of moisture, dust, dirt, and debris of any kind.

- Prior to welding but within an hour of the welding operation, grind seam overlap in a manner that does not damage the geomembrane. Grind marks should be covered with extrudate whenever possible. In all cases, grinding should not extend more than ¼ inch past the edge of the area covered by the extrudate during welding.

7.8 Panel Layout As-Built

During installation, the CQA engineer will maintain an up-to-date panel layout drawing that shows the following as-built information:

- Orientation and size of each geomembrane panel
- Roll numbers associated with each panel
- Assigned panel numbers
- Assigned seam numbers
- Destructive test locations
- Repair locations

In addition, information relating to panel placement including date, time, panel number, and panel dimensions shall be maintained on a panel placement form by the liner contractor.

7.9 Trial Welds

Before the start of geomembrane production welding and during welding operations, each welder and welding apparatus shall be tested in accordance with the technical specifications to verify that they are functioning properly. One trial weld shall be performed before the start of work and one at mid-shift each day. Additional trial welds will be required if a machine is not in operation for a period longer than one hour.

All trial welds shall be performed under the same conditions encountered during actual seaming. Once qualified by a passing trial weld, welding technicians shall not change parameters (e.g., temperature and speed) without performing another trial weld.

1) Trial weld samples shall be at least 48 inches long and 12 inches wide, with the seam centered lengthwise on the geomembrane sample.

2) Each required trial seam test shall consist of five peel adhesion and five shear strength tests using a calibrated tensiometer capable of quantitatively measuring shear and peel strengths in accordance with ASTM D6392. Required seam tests and specifications are provided in Table J-3.

3) For a trial weld to be considered acceptable, all five specimens must meet the following criteria:

    a. Failure must be ductile or a film tearing bond (FTB).

    b. They must meet or exceed the minimum peel and shear strength values provided in Table J-3. If any specimen should fail, the entire procedure shall be repeated.

    c. In the case of double-track fusion-welded seams, both welds must pass to be considered acceptable.

d. If repeat tests using reasonable sets of welding parameters also fail, the seaming apparatus shall not be accepted and shall not be used for seaming until the deficiencies are corrected and a passing test seam is achieved.

e. Trial weld documentation: The CQA engineer or designated representative shall be present during peel and shear testing. The liner contractor shall record the date, time, operator, machine number, ambient and operating temperatures, speed setting, peel values, shear values, and pass/fail designation. A log of recorded test values shall be maintained and shall become part of the record documents for the installation.

f. In the event that non-complying seam test strips are encountered, the welding machine shall be taken out of service until a passing trial weld is obtained, and additional peel specimens shall be taken to localize the flaw.

g. All acceptable seams shall be bounded by two locations from which passing tests have been taken.

7.10 Seaming Documentation and Testing

7.10.1 Documentation

Seaming information including panel number, seam number, welder ID, machine number, temperature setting, and weather conditions shall be documented. Welding technicians shall mark the following information on the liner with permanent markers at the start of all seaming operations:

- Date
- Time of weld
- Welding technician ID
- Welding machine number
- Machine operating temperature
- Machine operating speed

All personnel performing seaming operations shall be trained and certified in the operation of the specific seaming equipment being used. The liner contractor shall provide direct supervision of the seaming operations.

7.10.2 Testing

7.10.2.1 Non-destructive Seam Testing

The purpose of non-destructive geomembrane seam testing is to detect discontinuities or holes in the seams. Non-destructive geomembrane tests include vacuum and air pressure testing. Non-destructive testing shall be performed over the full (100%) length of all field-welded seams.

It is the liner contractor’s responsibility to perform all non-destructive testing as part of the CQC program, then record and report the results to the CQA engineer. The CQA engineer’s responsibility is to observe and independently document that the liner contractor’s CQC testing is in compliance with the technical specifications and independently document seam defects and panel defects that the liner contractor detects. The non-destructive testing procedures are described in this section.

Air pressure testing shall be used to test the double wedge fusion-welded seams that have an enclosed air space (channel) between the wedge welds. Procedures outlined in ASTM D5820 shall be used for this test procedure. Both ends of the air channel are sealed. A pressure feed device, usually a needle equipped with a pressure gauge, is inserted into one end of the channel. Air pressure is then increased in the channel to a minimum specified pressure according to the technical specifications. A five-minute relaxation period is allowed for the pressure to stabilize. The air chamber shall sustain the pressure as specified in the technical specifications. Following a passed pressure test, and while the air pressure is sustained, the end of the air channel opposite the needle and gauge is punctured to release air in the channel. The pressure gauge should return to zero. If it does not, a blockage is likely present in the seam channel. When a blockage is detected, it shall be located and the seam retested on both sides of the blockage. The penetration holes must be repaired after testing.

For extrusion welds tested by vacuum method, the weld is placed under suction using 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. Procedures outlined in ASTM D5641 shall be used to perform the testing. The vacuum box is placed over a seam section that has been thoroughly wetted with a soapy water solution. 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. A vacuum pump is energized and a vacuum of approximately five pounds per square inch (psi) is applied to the segment of the geomembrane seam that is covered by the vacuum box. Pinholes or seam defects are indicated by the appearance of soap bubbles in the vicinity of the defect. Dwell time for the applied vacuum shall not be less than 10 seconds.

During non-destructive testing, the CQA engineer shall:

- Review the technical specifications and associated standards regarding test procedures and verify that all testing is completed in accordance with the technical specifications and standards.
- Verify that the equipment operators are fully trained and qualified to perform their work.
- Verify that the test equipment meets the requirements indicted in the technical specifications and test standards.
- Verify that the entire length of each seam is tested.
- Observe all testing and independently record the test results.
- Identify failed areas detected by the liner contractor by marking the area with a waterproof marker, verify that the liner contractor is aware of the required repair, and document the completion of the repair.

7.10.2.2 Destructive Seam Testing

The purpose of destructive seam sampling and testing is to demonstrate seam quality during construction.

Destructive seam testing shall be conducted once per 500 feet of seam length along the completed seam length for each welding apparatus. Additional specimens may be taken at any time if the CQA engineer suspects that a seam does not meet the requirements. Reasons for taking additional samples may include, but are not limited to:

- Wrinkling in the seam area
- Crystallinity in the seam area

- Suspect seaming equipment or techniques
- Weld contamination
- Insufficient overlap
- Adverse weather conditions
- Failing tests

Samples shall be removed from the completed seam by the liner contractor at locations selected by the CQA engineer. Samples measuring 48 inches by 12 inches will be cut into thirds. One piece will be used for CQC testing by the liner contractor, one piece will be used for CQA testing by the CQA engineer, and one sample will be archived for additional testing if required. CQC samples will be cut into 10 one-inch-wide specimens. Five specimens will be tested for peel and five specimens will be tested for shear. For double wedge welding, both sides of the air channel shall be tested for peel strength. The liner contractor shall test seam specimens at the project site using a calibrated tensiometer capable of quantitatively measuring shear and peel strengths in accordance with ASTM D6392. The results shall meet the requirements of Table J-3 and the technical specifications. Four of the five tests for peel are required to pass and four of the five tests for shear are required to pass. If one of the five tests for peel or shear fail, the strength must meet or exceed 80% of the requirements in Table J-3.

During destructive sampling, the CQA engineer shall:

- Observe sample cutting
- Mark each specimen with an identifying number and record the seam number, welder, weld date, and weld time corresponding to the specimen number
- Record the specimen locations in the panel layout drawing
- Record the liner contractor's test results

If any of the specimens fail to meet the specified seam quality, the liner contractor can, at their discretion, reconstruct the entire seam or take two additional test samples at least 10 feet in each direction from the point of the failed specimen. At that point, the liner contractor can repeat the peel and shear tests. If subsequent specimens fail to meet the specified seam quality, this procedure shall be repeated until the length of poor-quality seaming is established. Repeated failures indicate that the seaming equipment or operator is not performing adequately, and appropriate corrective action will be taken immediately.

All holes in the geomembrane resulting from destructive seam sampling shall be repaired and tested in accordance with Section 7.11 of this CQA Plan.

7.10.2.3 CQA Destructive Seam Testing

The purpose of CQA destructive seam testing is to verify the findings of CQC destructive seam sampling and field testing. Additional CQA tests may be taken if the CQA engineer suspects that a seam does not meet the requirements of the technical specifications.

CQA testing will be performed on 100% of all CQC destructive test samples. CQA samples will be cut into 10 one-inch-wide specimens. CQA destructive seam test specimens will be tested for peel and shear by the CQA engineer using the procedures in ASTM D6392 and outlined (above) for CQC testing. This testing can be performed on site in an environment that complies with ASTM D6392 and using equipment that complies with ASTM D6392 or off site in a qualified laboratory.

Four of the five CQA tests for peel are required to pass and four of the five CQA tests for shear are required to pass. If one of the five tests for peel or shear fail, the strength must meet or exceed 80% of the requirements in Table J-3. If any of the CQA test specimens fail to meet the specified seam quality, the liner contractor can, at their discretion, reconstruct the entire seam or take two additional test samples at least 10 feet in each direction from the point of the failed specimen. At that point, the CQA engineer can repeat the testing. If subsequent specimens fail to meet the specified seam quality, this procedure shall be repeated until the length of poor-quality seaming is established. Repeated failures indicate that the seaming equipment or operator is not performing adequately, and appropriate corrective action shall be taken immediately.

7.11 Repairs

Repairs are required where geomembrane panels or seams contain a flaw, where a destructive test sample has been taken, and where a “T” intersection exists at corners of welded panels. All of these repairs shall be made in accordance with the technical specifications. The CQA engineer shall locate the required repairs and document the completion of repair work. Acceptable repair techniques include the following:

- Patching: used to repair large holes, tears, panel defects, undispersed raw materials, welds, contamination by foreign matter, destructive sample locations, and “T” locations in panel welds
- Extrusion: used to repair small defects, generally those measuring less than ½ inch in the largest dimension, in panels and seams
- Capping: used to repair failed welds or to cover seams where welds cannot be non-destructively tested
- Removal (followed by patching or capping): used to replace areas with large defects when the preceding methods are not appropriate or to remove excess material (e.g., wrinkles, fishmouths, and intersections) from the installed geomembrane

7.12 Wrinkles

During placement of soil materials over geomembrane, temperature changes may cause wrinkles to develop in the geomembrane. Wrinkles that can fold over shall be repaired either by cutting out excess material or, if possible, by allowing the geomembrane to contract by temperature reduction. In no event shall material be placed over the geomembrane where the weight could result in the geomembrane folding. The CQA engineer shall observe geomembrane surfaces for wrinkles and notify the liner contractor if wrinkles are being covered by soil. The CQA engineer shall then be responsible for documenting the corrective action to remove the wrinkles on the daily report.

8.0 FINAL CONSTRUCTION DOCUMENTATION REPORT

After completion of each liner or final cover construction project, a Construction Documentation Report shall be prepared and submitted to the CDPHE. The report shall consist of a detailed narrative describing construction of the area in chronological fashion. It shall describe all major aspects of construction including (as applicable): excavation, subgrade preparation, compacted low-permeability soil liner placement, leachate collection system construction, granular drainage layer placement, geomembrane liner placement, and/or final cover construction. In addition, the report shall include a discussion of all changes or variances from the contract documents that were made during construction. All forms and reports relating to the installation of the geomembrane liner shall be included as appendices to the Construction Documentation Report, as referenced throughout this CQA Plan and the EDOP.

An analysis and discussion of all field and laboratory testing work performed shall be included, including identification of any non-conforming items. For any non-conforming item, the certifying engineer shall specifically discuss whether the item is acceptable as-is, or whether further testing or additional evaluation is required for approval.

A cover letter shall be included under the seal of a registered professional engineer (PE) licensed in the state of Colorado, rendering an opinion as to whether the facility has been constructed in substantial conformance to the contract documents. A registered land surveyor in the state of Colorado shall certify all survey data and documentation that shall be included in the report. A complete set of record drawings shall also be submitted along with the report.

Signature Page

Golder Associates Inc.

https://golderassociates.sharepoint.com/sites/110066/project files/6 deliverables/reports/6-r-edop/6-r-2/appj/appj-cqa_plan.docx

Tables

TABLE J-2
JACKSON COUNTY LANDFILL
SOIL CONSTRUCTION QUALITY ASSURANCE TESTING AND FREQUENCY

ENGINEERED FILL TESTING AND FREQUENCY

Test	ASTM Designation	Specification	Minimum Construction Frequency	Minimum Preconstruction Frequency
Field density	D6938	Greater than or equal to 95% of standard Proctor maximum dry density	1 per 370 cy	--
Field moisture	D6938	Within 3% of optimum moisture content	1 per 370 cy	--
Field test and sample locations	D6938	N/A	Selected randomly by CQA Engineer within an approximate predetermined grid	--
Grain size (no hydrometer)	D6913	At CQA Engineer's discretion	At CQA Engineer's discretion	1 per source and material type
Moisture content	D2216 or D4643	At CQA Engineer's discretion	At CQA Engineer's discretion	1 per source and material type
Standard Proctor	D698	N/A	At CQA Engineer's discretion	1 per source and material type

TABLE J-2
JACKSON COUNTY LANDFILL
SOIL CONSTRUCTION QUALITY ASSURANCE TESTING AND FREQUENCY

COMPACTED COHESIVE SOIL LINER TESTING AND FREQUENCY

Test	ASTM Designation	Specification	Minimum Construction Frequency	Minimum Preconstruction Frequency
Field Density and field moisture	D6938	90% of tests exceeding the line of optimums and dry density greater than or equal to 95% of standard Proctor maximum dry density. Tests that plot below the line of optimums shall have a moisture content within 2% of the line of optimums moisture content.	1 per 370 cy	--
Field test and sample locations	--	N/A	Selected randomly by the CQA Engineer within an approximate predetermined 150 ft x 150 ft grid pattern for every 6 inches of thickness. Grid shall be offset for subsequent lifts	--
Soil classification	D2487	CL or CH under the Unified Soil Classification System	1 per 5,000 cy and change in material type with a minimum of 2 tests per construction event	1 per 20,000 cy
Grain size (no hydrometer)	D6913	P200 content of 50% or greater by weight	1 per 5,000 cy and change in material type and minimum of two tests per construction event	1 per 20,000 cy
Atterberg limits	D4318	LL greater than 25% PI greater than 10%	1 per 5,000 cy and change in material type and minimum of two tests per construction event	1 per 20,000 cy
Moisture content	D2216 or D4643	90% of tests exceeding the moisture content corresponding to the line of optimums. Tests below the line of optimums must be within 2% of the line of optimums.	1 per 5,000 cy and minimum of two tests per construction event	1 per 20,000 cy
Standard Proctor	D698	N/A	1 per 10,000 cy and change in material type and minimum of two tests per construction event	1 per 20,000 cy

TABLE J-2
JACKSON COUNTY LANDFILL
SOIL CONSTRUCTION QUALITY ASSURANCE TESTING AND FREQUENCY

Modified Proctor	D1557	N/A	1 per 10,000 cy and change in material type and minimum of two tests per construction event	1 per 20,000 cy
Hydraulic conductivity	D5084	Less than or equal to 1 x 10^{-7} cm/sec	1 per 10,000 cy and change in material type and minimum of two tests per construction event	1 per 20,000 cy
One-point Proctor	AASHTO T272	N/A	1 per change in material type and per each day of clay liner placement	--

LEACHATE DRAIN AND SUMP GRAVEL TESTING AND FREQUENCY

Test	ASTM Designation	Specification	Minimum Construction Frequency	Minimum Preconstruction Frequency
Grain size	C136	▪ A minimum of 99% passing the three-inch sieve by weight; ▪ Between 0 and 5% passing the 3/8-inch sieve by weight; and ▪ d50 of less than 1.5 inch. (The material gradation may vary provided that testing confirms the material meets the permeability requirement)	1 per 1,000 LF or minimum of 2 samples	1 per source
Hydraulic conductivity	D5084	Greater than or equal to 1 cm/sec	1 per 10,000 cy	1 per source

TABLE J-2
JACKSON COUNTY LANDFILL
SOIL CONSTRUCTION QUALITY ASSURANCE TESTING AND FREQUENCY

GRANULAR DRAINAGE LAYER TESTING AND FREQUENCY

Test	ASTM Designation	Specification	Minimum Construction Frequency	Minimum Preconstruction Frequency
Hydraulic conductivity*	D5084	Greater than or equal to 1 x 10^{-2} cm/sec	1 per 10,000 cy	1 per source
Grain size	C136	▪ A minimum of 95% passing the 1/2-inch sieve by weight; and ▪ Between 0 and 5% passing the #200 sieve by weight.	1 per 10,000 cy	1 per source

* Preconstruction hydraulic conductivity tests for glass cullet to be conducted under loaded and unloaded effective stress conditions, construction tests to be conducted under unloaded effective stress conditions.

TABLE J-2
JACKSON COUNTY LANDFILL
SOIL CONSTRUCTION QUALITY ASSURANCE TESTING AND FREQUENCY

WATER BALANCE FINAL COVER TESTING AND FREQUENCY

Test	ASTM Designation	Specification	Minimum Construction Frequency	Minimum Preconstruction Frequency
Field density	D6938	Between 80% and 90% of standard Proctor maximum dry density	3 per acre per lift	--
Field moisture	D6938	Dry of optimum moisture content	3 per acre per lift	--
Field test locations	--	N/A	Selected randomly by the certifying CQA Engineer	--
Grain size	D6913	▪ Gravel content 15% or less by weight; and ▪ Maximum particle size less than two inches	1 per 1,500 cy with a minimum of two tests per construction event and minimum of two tests per construction event	1 per source and material type
Hydrometer	D7928	Within 3.0 ft Acceptance Zone for Ecozone 3 (CDPHE Guidance)	1 per 1,500 cy with a minimum of two tests per construction event and minimum of two tests per construction event	1 per source and material type
Moisture content	D2216 or D4643	Dry of optimum moisture content	1 per 1,500 cy with a minimum of two tests per construction event and minimum of two tests per construction event	1 per source and material type
Standard Proctor	D698	N/A	1 per 3,000 cy with a minimum of two tests per construction event and at one standard proctor per material type and minimum of two tests per construction event	1 per source and material type
One-point Proctor	D698	N/A	1 per day or 1 per source material, whichever is more frequent	N/A
pH	SW-846 SW 9045C	6.0 – 8.4	1 per 6,500 cy with a minimum of two tests per construction event	1 per source and material type
$CaCO_3$	USDA Handbook Number 60	Less than 15% by weight	1 per 6,500 cy with a minimum of two tests per construction event	1 per source and material type

Table J-3: Geomembrane Construction Quality Control and Assurance Testing and Frequencies

Item	Parameter	Specification	Test Method	Manufacturer QC Frequency Requirement	Conformance Testing Frequency	Construction Testing Frequency
HDPE Resin	Specific Gravity	≥ to 0.932 g/cm3	ASTM D792 Method A or ASTM D1505	One per batch	N/A	N/A
	Melt Index	≤ 1.0g per 10 minutes	ASTM D1238 Condition E			
	Oxidative Induction Time	≥ 100 minutes (average) or	ASTM D3895 (Standard) or	One per formulation		
		≥ 400 minutes (average)	ASTM D5885 (High Pressure)			
Extrudate Rod or Bead	Specific Gravity	≥ to 0.94 g/cm3	ASTM D792 Method B or ASTM D1505	One per resin lot of batch	N/A	N/A
	Carbon Black Content	2-3%	ASTM D1603			
	Melt Index	≤ 1.0g per 10 minutes	ASTM D1238 Condition E			
60-mil HDPE Double-Sided Textured Geomembrane	Thickness	57-mils (minimum average) from 10 tests 54-mils (minimum) from 8 of 10 tests 51-mils (minimum) from 10 tests	ASTM D5994	Each roll	One per lot or 100,000 sf	N/A
	Asperity Height	16-mils (minimum average)	ASTM D7466	Every second roll		
	Compound Density	≥ 0.94 g/cm3	ASTM D792 or ASTM D1505	One per 200,000 lbs		
	Tensile Properties		ASTM D6693 Type IV	One per 20,000 lbs		
	Yield Strength	≥ 126 lbs/in from 5 tests				
	Break Strength	≥ 90 lbs/in from 5 tests				
	Yield Elongation	≥ 12% from 5 tests				
	Break Elongation	≥ 100% from 5 tests				
	Tear Resistance	≥ 42 lbs	ASTM D1004	One per 45,000 lbs		
	Puncture Resistance	≥ 90 lbs	ASTM D4833	One per 45,000 lbs		
	Stress Crack Resistance (on smooth edges or smooth sheets)	500 hrs	ASTM D5397 (app.)	per GRI GM10		
	Carbon Black Content	2-3%	ASTM D4218	One per 20,000 lbs		
	Carbon Black Dispersion	9 of 10 views Category 1 or 2 No more than 1 view Category 3 (for near spherical agglomerates)	ASTM D5596	One per 45,000 lbs		
	Stress Crack Resistance (on smooth edges or smooth sheets)	500 hrs	ASTM D5397 (app.)	per GRI GM10	N/A	
	Oxidative Induction Time	≥ 100 minutes (average) or	ASTM D3895 (Standard) or	One per 200,000 lbs		
		≥ 400 minutes (average)	ASTM D5885 (High Pressure)			
	Oven Aging at 85° C	≥ 55% retained after 90 days	ASTM D3895	One per formulation		
		≥ 80% retained after 90 days	ASTM D5885			
	UV Resistance (20-hr UV cycle at 75°C followed by 4 hr condensation period at 60° C	≥ 50% retained after 1600 hrs	ASTM D5885	One per formulation		

Table J-3: Geomembrane Construction Quality Control and Assurance Testing and Frequencies

Item	Parameter	Specification	Test Method	Manufacturer QC Frequency Requirement	Conformance Testing Frequency	Construction Testing Frequency
60-mil HDPE Smooth Geomembrane	Thickness	57-mils (average) from 10 tests 54-mils (minimum) from 10 tests	ASTM D5994	Each roll	One per lot or 100,000 sf	N/A
	Compound Density	≥ 0.94 g/cm3	ASTM D792 or ASTM D1505	One per 200,000 lbs		
	Tensile Properties		ASTM D6693 Type IV	One per 20,000 lbs		
	Yield Strength	≥ 126 lbs/in from 5 tests				
	Break Strength	≥ 228 lbs/in from 5 tests				
	Yield Elongation	≥ 12% from 5 tests				
	Break Elongation	≥ 700% from 5 tests				
	Tear Resistance	≥ 42 lbs	ASTM D1004	One per 45,000 lbs		
	Puncture Resistance	≥ 108 lbs	ASTM D4833	One per 45,000 lbs		
	Stress Crack Resistance (on smooth edges or smooth sheets)	500 hrs	ASTM D5397 (app.)	per GRI GM10		
	Carbon Black Content	2-3%	ASTM D4218	One per 20,000 lbs		
	Carbon Black Dispersion	9 of 10 views Category 1 or 2 No more than 1 view Category 3 (for near spherical agglomerates)	ASTM D5596	One per 45,000 lbs		
	Stress Crack Resistance (on smooth edges or smooth sheets)	500 hrs	ASTM D5397 (app.)	per GRI GM10	N/A	
	Oxidative Induction Time	≥ 100 minutes (average) or	ASTM D3895 (Standard) or	One per 200,000 lbs		
		≥ 400 minutes (average)	ASTM D5885 (High Pressure)			
	Oven Aging at 85° C	≥ 55% retained after 90 days	ASTM D3895	One per formulation		
		≥ 80% retained after 90 days	ASTM D5885			
	UV Resistance (20-hr UV cycle at 75°C followed by 4 hr condensation period at 60° C	≥ 50% retained after 1600 hrs	ASTM D5885	One per formulation		
Destructive Seam Testing	Peel and Shear Strength		ASTM D6392	N/A	Pre-weld testing required at beginning of each shift per weld machine	1 per 500 feet of seam length; Observation of each destructive sample
	Fusion Weld	Peel ≥ 91 lbs Peel Separation ≤ 25% Shear ≥ 120 lbs Shear Elongation ≥ % 50% at break				
	Extrusion Weld	Peel ≥ 78 lbs Peel Separation ≤ 25% Shear ≥ 120 lbs Shear Elongation ≥ % 50% at break				
Non-destructive Seam Testing	Fusion Weld Continuity by Air-Pressure Testing	27 to 35 psi for 5 minutes; Permissible drop of 3 psi	ASTM D5820	N/A	N/A	Each Seam
	Extrusion Weld Continuity by Vacuum-Box Testing	Induce pressure of 5 psi; Hold for 10 seconds	ASTM D5641			Each Seam

Table J-4: Seed Mix and Soil Amendments, Grass Species

Common Name	Variety	Lbs PLS/Acre
Buffalo grass	Texoka	2.8
Blue grama	Hachita	0.8
Switchgrass	Dakotah	1.2
Side-oats grama	Vaughn	1.6
Sand dropseed	Native	0.02
Western wheatgrass	Arriba	4.4
Slender wheatgrass	Primar or Revenue	3.8
Thickspike wheatgrass	Critana	1
Little bluestem	Cimmaron	2.2
Total		**17.82**

Notes:

A. The CQA Engineer shall inspect seed labels/certifications upon delivery of seed to worksite to ensure that they contain correct seed mix. Native seed varieties shall be from appropriate climatic region. All legume species shall be inoculated by the seed supplier with the appropriate rhizobium species. Sources for native seed variety shall be subject to inspection and concurrence by the CQA Engineer before subcontractor is authorized to proceed with seeding.

B. Perform seeding operations only during periods when successful results can be obtained (i.e., not during drought or excessive precipitation periods). Do not conduct seeding operations when soil is frozen or when snow is present. Do not conduct seedbed preparation, seeding, or mulch application when wind conditions cause the seed/mulch to blow from the intended target area.

C. Seedbed preparation shall be conducted to maintain existing drainage patterns or as indicated on the project-specific drawings. Re-till areas compacted by construction. Protect finished graded areas from damage by vehicular or pedestrian traffic and erosion. Prior to seeding, rework any previously prepared seedbed areas compacted or damaged by rain, traffic, or other cause to restore the seedbed to previous condition.

D. Seeding times shall be: fall seeding: September 1 until freezing conditions; spring seeding: March 1 through May 15. Perform seeding within 10 days of completion of seedbed preparation.

E. Plant by drill seeding or by evenly broadcasting and incorporating the seed into the soil surface by harrowing. Drill seeding will be accomplished with a rangeland type drill equipped with double coulter furrow openers and depth bands followed by packer wheels. Use a drill capable of evenly seeding the native seed mixes over the entire site. Do not exceed 6 inches between drill rows. Plant seed to an average depth of 0.25 inch but not deeper than 0.50 inch.

F. If broadcast seeding is used, seeding rate shall be increased by 50%. Broadcast seed shall be distributed uniformly. Rake seed into the soil to an average depth of 0.25 inch but not deeper than 0.50 inch by a harrow device.

G. Fertilization and seeding mix shall be finalized after agricultural analysis of topsoil.

H. Spread and anchor grass straw mulch on areas that have been seeded with fall-seeded mixes within 24 hours after seeding. Apply straw mulch in a continuous cover of uniform thickness at a rate of 2 tons per acre. Anchor straw mulch to the soil by crimping straw into the soil. Start mulching on the windward side of relatively flat areas or on the upper part of steep slopes and continue uniformly until the area is covered. Immediately after seeding, protect seeded areas against traffic or other use by erecting barricades and providing signage. Re-till, seed, and mulch any areas impacted by traffic as directed by the contractor.

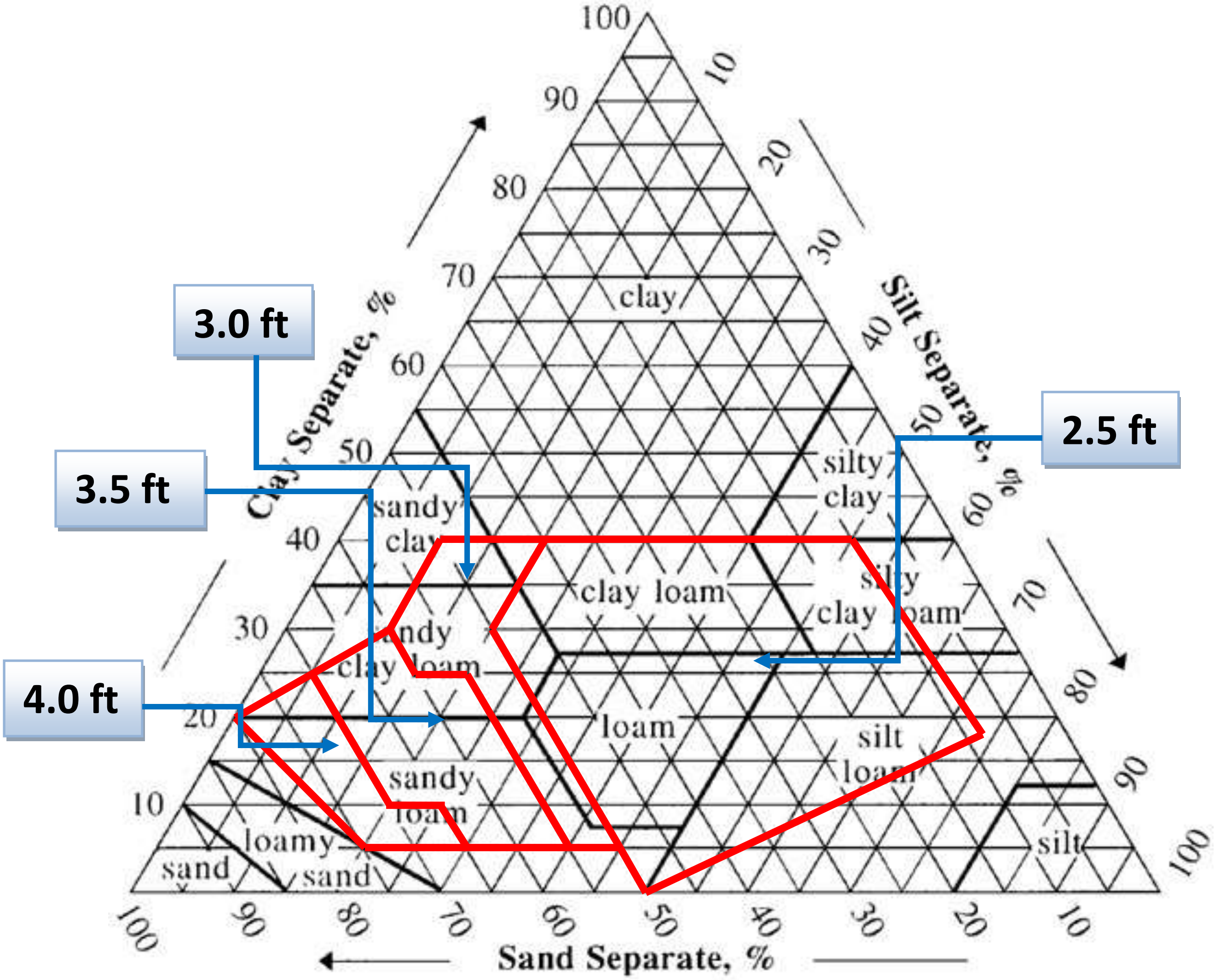
I. Repair: Reseed and mulch eroded, damaged, or barren areas that occur prior to completion of the seeding operation as determined by the Contractor. Repair or replace mulch as required.

Table J-5: Vegetative Properties prior to Seeding

Parameter	Test Method	Recommendations
Salinity	USDA Handbook Number 60	Salt content < 2%
Nitrogen	EPA 351.2	5 to 30 parts per million
Potassium	ICP 200.7	~120 parts per million
Phosphorous	EPA M365.1	3 to 7 parts per million
Organic Matter	USDA Handbook Number 60	1.5 to 2.0% when accompanied by proper nitrogen/phosphorous levels
Conductivity	Soil Survey Standard Test Method	< 4 millisiemens per centimeter

Figures

Figure 2.2.1-4
Water Storage Layer Thicknesses for
Ecozone 3



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